# 6. PARAMETERS Operating Mode Input/Output of Parameters

**Selecting the operating mode**

Press operating mode key.

The operating mode menu is displayed.

Press the PARAMETER softkey.

| | | |
|---|---|---|
| NC-SWITCHES | SPS-SWITCHES | ZERO POINTS |
| D-TOOL OFFSETS | T-TOOL DIMENS | MATERIAL DATA > |
| MACHINE DIMENS | PARAMET. NUMBER NO. | EXTERNAL DATA TRANSMIS |

Press the continue key.

The following menu on the same level is displayed.

| | | |
|---|---|---|
| FEED | SPINDLE CHUCK GEARBOX | WORKING LEVEL |
| GENERAL OFFSETS | GRAPHIC DISPLAY | SERVICE LIFE > |
| TOOL DIAGNOS. VARIABLE | PARAMET. C/Y-AXES | GAUGING |

**Important note**
Parameters are numeric values for adapting the control system to the machine and for preparing the control system for operation. The parameters in this control system have been programmed by the manufacturer and should be altered by qualified persons only.

| | | |
|---|---|---|
| | TOOL REFER. LIST | |
| | | < |
| | DIAG-NOSTIC MODE | |

**Selecting the parameter range**
The parameter ranges given in the parameters menu are intended to help the user to find a certain parameter more quickly.

Press the NC-SWITCH softkey.

The corresponding section of the parameters list of the selected tool is displayed.

Proceed accordingly for the other parameter ranges.

**Select parameter directly**
"Browsing" through the entire parameter list is possible using this submenu.

| | | |
|---|---|---|
| | PARAMET. NUMBER BACKWARD | TOOL INPUT DIALOGUE |
| PARAMET. VALUE BACKWARD | PARAMET. NUMBER SEARCH | PARAMET. VALUE FORWARD |
| PARAMET. VALUE CHANGE | PARAMET. NUMBER FORWARD | |

Press the PARAMET. NO. FORWARD/PARAMET. NO. BACKWARD softkey.

The cursor jumps forward to next parameter number or backward to previous number.

Press the PARAMET. NUMBER SEARCH softkey.

Enter BLOCK NUMBER OF PARAMETER: N

Enter the desired block number of the parameter via the keypad.

Confirm.

Cursor jumps to the desired block.

Press the VALUE FORWARD/ VALUE BACKWARD softkey.

Cursor jumps before the desired address value within the parameters.

**Altering parameters**

Press the PARAMET. VALUE CHANGE softkey.

CHANGE VALUE OR CONFIRM:

Confirm

The existing address value is accepted.

Enter desired value using the numeric keypad.

Confirm.

Entered value is transferred to the control system.

**Diagnosis as side-line operating mode**

If, starting from the parameter mode, the diagnostic mode is to be selected as side-line operating mode, then proceed as follows:

Press the DIAGNOSTIC MODE softkey.

The main menu of the diagnosis operating mode is displayed (see also section 7.1 Diagnosis as side-line operating mode).

**Call tool type menu**
This menu enables the input of tool parameters under dialogue control

Press the TOOL INPUT DIALOGUE softkey.

The following submenu appears:

| | | |
|---|---|---|
| INTERNAL FINISH WT 7 | FURTHER TOOL POSITION | INPUT TOOLTYPE FINISHED |
| EXTERNAL THREAD. WT 4 | BUTTON TOOL EXT WT 5 | INTERNAL ROUGHING WT 6 > |
| EXTERAL ROUGHING WT 1 | EXTERNAL FINISH WT 2 | EXTERNAL GROOVING WT 3 |


Press the "continue" key.

The following menu appears.

| | | |
|---|---|---|
| MILLING FLATS WT 14 | FURTHER TOOL POSITION | INPUT TOOLTYPE FINISHED |
| TAPPING WT 11 | REAMING WT12 | MILLING KEYWAYS WT 13 > |
| INTERNAL GROOVING WT 8 | INTERNAL THREAD. WT 9 | INTERNAL BORING WT 10 |

If a tool group contains a number of tool types which diffe
r only in terms of the position of the tool, these tool types
can be activated as follows:

Press FURTHER TOOL POSITION softkey.

A switchover is executed to any other tool types.

Press this softkey again and it switches back to the initial tool type, if no other exists. The user has a total of 29 different tool types and a freely definable special tool at his disposal:

| | |
|---|---|
| WT 0 | Freely definable tool |
| WT 1 | Roughing, external left |
| WT 2 | Finishing, external left |
| WT 3 | Grooving, external radial |
| WT 4 | Thread, external radial |
| WT 5 | Button tool, external radial |
| WT 6 | Roughing, internal left |
| WT 7 | Finishing, internal left |
| WT 8 | Grooving, internal radial |
| WT 9 | Thread, internal radial |
| WT10 | Boring, axial |
| WT11 | Tapping, axial |
| WT12 | Reaming, axial |
| WT13 | Milling keyways, radial |
| WT14 | Milling flats, radial |
| WT15 | Roughing, external right |
| WT16 | Roughing, external transverse |
| WT17 | Finishing, external centre |
| WT18 | Finishing, external |
| WT19 | Finishing, external transverse |
| WT20 | Finishing, external transverse |
| WT21 | Grooving, external axial |
| WT22 | Thread, external axial |
| WT23 | Button tool, external |
| WT24 | Milling keyways, axial |
| WT25 | Boring, radial |
| WT26 | Tapping, radial |
| WT27 | Reaming, radial |
| WT28 | Countersinking, radial |
| WT29 | Countersinking, axial |

Press WT INPUT TERMINATED softkey.

The tool parameters required for the selected tool type are offered by the control system in the dialogue mode.

**Setting up a special tool**
A special tool which could otherwise not be related to one of the tool types WT1 - WT29 can be defined under the freely programmable tool type WT0.

The operator should bear in mind that here the cutting angles A and B are not monitored by the control system. If, however, address parameters I and K are programmed incorrectly, an error message will be displayed due to the calculations of the tool nose radius compensation (SRK).

In order to setup a special tool, proceed as follows:

Press the "continue" key.

Another follow-up menu will be displayed.

| SPECIAL TOOL AS WT0 | FURTHER TOOL POSITION | TOOL ENTRY FINISHED |
|---|---|---|
| | | < |
| COUNTER-SINKING WT29 | | |

Press the SPECIAL TOOL AS WT0 softkey

Tool type zero (special tool) is added to the selected tool file under address WT.

Press the TOOL ENTRY FINISHED softkey.

The required tool parameters can be entered in dialog mode.

**External input and output of parameters**
The parameters are stored on external data carriers, e.g. punched tapes.

Press the EXTERNAL DATA TRANSMISSION softkey.

The following submenu appears.

| | | |
|---|---|---|
| EXTERNAL PARAMET. INPUT | | |
| EXTERNAL PARAMET. OUTPUT | | |
| EXTERNAL DATA STOP | | |

Press the EXTERNAL PARAM. INPUT softkey.

The parameters stored on the external data carrier are read in.

Press the EXTERNAL PARAM. OUTPUT softkey.

INPUT PARAMETER START NUMBER: N

Confirm.

INPUT FINAL PARAMETER NUMBER: N

Confirm.

All parameter values of the selected slide are stored on an external data carrier (e.g. PUNCHER/PUNCHED TAPE).

If only **defined parameter ranges** are to be put out, then proceed as follows:

Confirm.

Output is only from parameter N1 to the indicated parameter, exclusively.

Enter digits.

Confirm.

Enter digits.

All parameters including the first and excluding the second indicated parameter are output.

Confirm.

Enter digits.

Confirm.

Enter digits.

All parameters starting from the indicated parameter are output.

Confirm.

Confirm.

Note: The parameter numbers given as limits must be in existance.

Press the EXTERNAL DATA STOP softkey.

External data transmission is terminated.

**Notes on parameter punched tape**
Parameter data are output on punched tape in a certain format.
The format of parameter words (parameter N1001 consists of 10 parameter words) corresponds to the screen format.

Leading text (e.g. actual value), index designation and index value (e.g. **T35** in the tool file) are not output.

Line feed is not carried out within a parameter.

**Line format**

1. Block number right adjust with block marking
   Examples:
   N 1
   N 1064
   N 22

2. One space character after the block number

3. Words with two space characters, word marking and correct format

   **Examples:**
   Single-digit format, word marking, two space characters or format in front of decimal point, three digits after decimal point, with sign, word marking X>, X>, Z>, Z>,
   X> -100.000 X< +200.000 Z> 0.000 Z< +100.000

4. The control characters CR and LF are output at the end of the line.
   First, the marking "Para1" is output.
   It is also possible to read in a parameter punched tape with the marking %00000000. The values will be stored correctly.

**Format check**
Format limits are checked when parameters are read in.
If a parameter exceeds the defined ranges

1. a message is displayed: Value too low.
2. the parameter check sum is set invalid.
3. the stored value is not changed.

If the message "value too high" is displayed, press softkey "PARAMETER NUMBER SEARCH" in order to find the parameters which were used to offset the check sum. Since only one check sum is formed for each parameter block the operator has to check if each word of the parameter is within the permissible range.
The parameters check sum is set when changing a word.

**Parameter punching format**
The parameter punched tape may include the following characters:

a) Header

1. Program marking %
2. Eight-digit programm number (alphanumeric)
3. 0DH, 0HA for CR, LF

b) Parameter prefix

1. Block marking N
2. 4-digit block number right-adjust with leading space characters
3. One space character (ASCII 20H)

c) Parameter words

1. Two space characters
2. Parameter word marking: two characters (either two space characters, or one space character and one character or two characters.
3. Contents of parameter word (corresponding to parameter format)
   c) 1.-3. is entered for each parameter word.

d) Parameter suffix

0DH, 0AH for CR, LF

e) Two space lines are output after each parameter block.

0DH, 0AH

f) Ending

64 zero characters (ASCII 00H)

**Parallel operation (reading from punched tape and editing)**
Editing operation is possible while data are read in from punched tape. If the control system displays an error message during the initialization procedure (e.g. error occurring in the PLC-unit), the editing operation will reset the edit switch. Parameters which are protected by the edit switch are no longer transferred to the memory and the message "Invalid input" will be displayed.
If parameter values are not within the permissible range (and thus neither the check sum), the values from the punched tape will be used.

## Parameters list

Inexpert handling when altering certain parameters may have serious consequences for the operating safety of the machine. Therefore the parameters are divided into 4 parameter groups according to the following criteria of protection.

1) Parameter is not protected and may be changed during all operating modes.

1a) Parameter cannot be changed in the AUTOMATIC operating mode.

2) Parameter is protected by means of a key switch and can not be changed in the AUTOMATIC operating mode.

3) Parameter is protected by means of password and key switch and cannot be changed in the AUTOMATIC operating mode.

| | Parameter | 1 | 1a | 2 | 3 |
|---|---|---|---|---|---|
| | **NC-switch and values** | | | | |
| N0001 | Inch/metric | | | X | |
| N0002 | Tool file switch | | | X | |
| N0003 | Reference position (with/without) | | | X | |
| N0004 | Orientation X-axis | | | | X |
| N0005 | Pictures (with/without) | X | | | |
| N0006 | ACTUAL display, lag error, residual path | X | | | |
| N0007 | DC-Code | X | | | |
| N0010 | Deletion level | | | X | |
| N0011 | Deletion step | | | X | |
| N0012 | Tool carrier offset | | | X | |
| N0013 | Wear factor | | | X | |
| N0015 | DNC | | | X | |
| N0016 | External waiting time | | | X | |
| N0018 | Print-out of variables output | | | X | |
| N0019 | Control char. for end of line during print-out | | | X | |
| N0022 | Reading baud rate | | | X | |
| N0023 | Writing baud rate | | | X | |

| | Parameter | 1 | 1a | 2 | 3 |
|---|---|---|---|---|---|
| | **C-axis** | | | | |
| N0121 | Range of adjustment 1 | | | | X |
| N0122 | Range of adjustment 2 | | | | X |
| N0123 | Range of adjustment 3 | | | | X |
| N0124 | Drift speed during coupling | | | | X |
| N0125 | Reference run | | | | X |
| N0126 | Rapid traverse | | | | X |
| N0127 | Zero point shift | | X | | |
| N0129 | Position monitoring (C-axis) | | | | X |
| N0130 | Control adaption (C-axis) | | | | X |
| | **Working level** | | | | |
| N0200 | Limit switch<br>-X-value, +X-value<br>-Z-value, +Z-value | | | | X |
| N0201 | Protective zone<br>-X-value, +X-value<br>-Z-value, +Z-value | | | X | |
| N0202 | Tool change point<br>X-value, Z-value | | | X | |
| N0203 | Reference dimension<br>X-value, Z-value | | | | X |
| | **Compensation** | | | | |
| N0298 | Number of position corrections | | | | X |
| N0299 | Start correction of position | | | | X |
| N0300 | Grating position | | | | X |
| N0301...0380 | Position | | | | X |
| N0401...0416 | Correct. position<br>X-value; Z-value | | | X | |

| | Parameter | 1 | 1a | 2 | 3 |
|---|---|---|---|---|---|
| | **Zero points** | | | | |
| N0050 | Zero points<br>X-value, Z-value | | | X | |
| N0053...56 | Allowance | | | X | |
| N0057 | Scratch value in X for boring bar | | | X | |
| | **Feed** | | | | |
| N0060 | Feed manual control mode | | | X | |
| N0061 | Rapid manual control mode | | | X | |
| N0062 | Rapid manual control mode<br>X-value, Z-value | | | X | |
| | **Display** | | | | |
| N0070 | Graphic limitation<br>-X-value, +X-value<br>-Z-value, +Z-value | X | | | |
| N0071 | Blank dimensions<br>-X-value, +X-value<br>-Z-value, +Z-value | X | | | |
| N0072 | Length of grip. area | X | | | |
| N0073 | Graphic representation | X | | | |
| N0077 | Gear switching time | X | | | |
| N0078 | Tool changing time | X | | | |
| | **SPS-switch** | | | | |
| N0101 | SPS-switch 1 | | | X | |
| N0102 | SPS-switch 2 | | | X | |
| N0103 | SPS-switch 3 | | | X | |
| N0104 | SPS-switch 4 | | | X | |
| N0105 | SPS-switch 5 | | | X | |
| N0106 | SPS-switch 6 | | | X | |
| N0107 | SPS-switch 7 | | | X | |
| N0108 | SPS-switch 8 | | | X | |
| N0111 | SPS-times | | | X | |

| Parameter | | 1 | 1a | 2 | 3 |
|---|---|---|---|---|---|
| **Spindles and gearbox** | | | | | |
| **N0501** | **Main spindle** (absolute maximum speed/ gear shift value/jog speed/jog direction) | | | X | |
| **N0502** | Maximum spindle speed in gear stage 1 - 4 | | | | X |
| **N0503 (AP186)** | Nominal speed of drive | | | | X |
| **N0504** | Torque division | | | | X |
| **N0505 (AP186)** | Tolerance value of torque | | | | X |
| **N0506** | Tolerance value of spindle speed | | | | X |
| **N0507 (AP186)** | Tolerance speed synchronous | | | | X |
| **N0508** | Tolerance value of position | | | | X |
| **N0509 (AP186)** | Tolerance value angle synchronous | | | | X |
| **N0510 (AP186)** | Start acceleration | | | | X |
| **N0511 (AP186)** | Braking deceleration | | | | X |
| **N0515 (AP186)** | Zero point shift | | | X | |
| **N0521** | Position control G1 | | | | X |
| **N0522** | Position control G2 | | | | X |
| **N0523** | Position control G3 | | | | X |
| **N0524** | Position control G4 | | | | X |
| **N0525 (AP186)** | Control adaption, position | | | | X |
| **N0526 (AP186)** | Break point | | | | X |
| **N0531 (AP186)** | Speed control G1 | | | | X |
| **N0532 (AP186)** | Speed control G2 | | | | X |
| **N0533 (AP186)** | Speed control G3 | | | | X |
| **N0534 (AP186)** | Speed control G4 | | | | X |
| **N0535 (AP186)** | Control adaption speed | | | | X |
| **N0536 (AP186)** | Control adaption speed | | | | X |
| **N0537 (AP186)** | Control adaption speed | | | | X |

**(AP186)** Only applies for spindle control via AP186

| Parameter | | 1 | 1a | 2 | 3 |
|---|---|---|---|---|---|
| **Spindles and gearbox** | | | | | |
| **N0541** | **Spindle 1** (absolute maximum speed/ gear shift value/jog speed/jog direction) | | | X | |
| **N0542** | Maximum spindle speed in gear stage 1 - 4 | | | | X |
| **N0543 (AP186)** | Nominal speed of drive | | | | X |
| **N0544** | Torque division | | | | X |
| **N0545 (AP186)** | Tolerance value of torque | | | | X |
| **N0546** | Tolerance value of spindle speed | | | | X |
| **N0547 (AP186)** | Tolerance speed synchronous | | | | X |
| **N0548** | Tolerance value of position | | | | X |
| **N0549 (AP186)** | Tolerance value angle synchronous | | | | X |
| **N0550 (AP186)** | Start acceleration | | | | X |
| **N0551 (AP186)** | Braking deceleration | | | | X |
| **N0555 (AP186)** | Zero point shift | | | X | |
| **N0561** | Position control G1 | | | | X |
| **N0562** | Position control G2 | | | | X |
| **N0563** | Position control G3 | | | | X |
| **N0564** | Position control G4 | | | | X |
| **N0565 (AP186)** | Control adaption, position | | | | X |
| **N0566 (AP186)** | Break point | | | | X |
| **N0571 (AP186)** | Speed control G1 | | | | X |
| **N0572 (AP186)** | Speed control G2 | | | | X |
| **N0573 (AP186)** | Speed control G3 | | | | X |
| **N0574 (AP186)** | Speed control G4 | | | | X |
| **N0575 (AP186)** | Control adaption speed | | | | X |
| **N0576 (AP186)** | Control adaption speed | | | | X |
| **N0577 (AP186)** | Control adaption speed | | | | X |

**(AP186)** Only applies for spindle control via **AP186**

| Parameter | | | 1 | 1a | 2 | 3 |
|---|---|---|---|---|---|---|
| **Spindles and gearbox** | | | | | | |
| N0581 | | Spindle 2 (absolute maximum speed/ gear shift value/jog speed/jog direction) | | | X | |
| N0582 | | Maximum spindle speed in gear stage 1 - 4 | | | | X |
| N0583 | (AP186) | Nominal speed of drive | | | | X |
| N0584 | | Torque division | | | | X |
| N0585 | (AP186) | Tolerance value of torque | | | | X |
| N0586 | | Tolerance value of spindle speed | | | | X |
| N0587 | (AP186) | Tolerance speed synchronous | | | | X |
| N0588 | | Tolerance value of position | | | | X |
| N0589 | (AP186) | Tolerance value angle synchronous | | | | X |
| N0590 | (AP186) | Start acceleration | | | | X |
| N0591 | (AP186) | Braking deceleration | | | | X |
| N0595 | (AP186) | Zero point shift | | | X | |
| N0601 | | Position control G1 | | | | X |
| N0602 | | Position control G2 | | | | X |
| N0603 | | Position control G3 | | | | X |
| N0604 | | Position control G4 | | | | X |
| N0565 | (AP186) | Control adaption, position | | | | X |
| N0566 | (AP186) | Break point | | | | X |
| N0611 | (AP186) | Speed control G1 | | | | X |
| N0612 | (AP186) | Speed control G2 | | | | X |
| N0613 | (AP186) | Speed control G3 | | | | X |
| N0614 | (AP186) | Speed control G4 | | | | X |
| N0615 | (AP186) | Control adaption speed | | | | X |
| N0616 | (AP186) | Control adaption speed | | | | X |
| N0617 | (AP186) | Control adaption speed | | | | X |

**(AP186)** Only applies for spindle control via AP186

| | Parameter | 1 | 1a | 2 | 3 |
|---|---|---|---|---|---|
| | **Measuring** | | | | |
| N0690 | No. of measuring circuit (in-process meas.) | | | X | |
| N0691 | Error evaluation (in-process measuring) | | | X | |
| N0692 | Special measuring feed (in-process measuring) | | | X | |
| N0693 | Type of measuring (measuring of tools) | | | X | |
| N0697 | Post-process measuring | | | X | |
| N0698 | Type of measuring device | | | X | |
| N0700 | Tool change | | | X | |
| N0701...716 | Tolerance limits for measuring points | | | X | |
| | **Machine dimensions** | | | | |
| N0751...759 | Machine dimensions | | | X | |
| | **Tool dimensions** | | | | |
| N1001...1064 | Tool type<br>Colour code<br>X-value, Z-value, I-value, K-value, A-value,<br>B-value, C-value, D-value, L-value | | | X | |
| | **Tool offsets** | | | | |
| N1101...1180 | D-tool offsets | X | | | |
| | **Tool inspection** | | | | |
| N1200 | Tool life switch | | | X | |
| N1201...1264 | Service life/batch size values | | X | | |

| | Parameter | 1 | 1a | 2 | 3 |
|---|---|---|---|---|---|
| | **Material data** | | | | |
| N1301...1324 | Cutting speed (roughing, finishing) | | | X | |
| | Feed (roughing, finishing) | | | X | |
| | Special feed | | | X | |
| | Adjusting range | | | X | |
| | Cutting speed (drilling) | | | X | |
| | Feed (drilling) | | | X | |
| | Cutting speed (threading, tapping) | | | X | |
| | Main value of specific cutting force | | | X | |
| | Inclination value of specific cutting force | | | X | |
| | **Tool diagnosis variables** | | | | |
| N1401...1464 | Tool diagnosis variables | | X | | |
| | **Measuring offset** | | | | |
| N1501...1564 | Measuring offset | | | X | |
| N1600 | Switch for input mode of tool number | | | X | |
| N1601...1664 | Tool reference list | | | X | |

## Description of parameters

### 1. NC-switches

N 1 MEASURING SYSTEM <METRIC/INCH> 0

0 = metric
1 = inch

Programming of this parameter determines whether input values to the control system are computed as metric values or in inches. The parameter values are converted and displayed accordingly. Programs are marked with the measuring system. The programs can only run under the measuring system in which they were entered (**stores are not erased**).

N 2 TOOL DIMENSIONS DIRECTORY <CLOSED/OPEN> 0

0 = closed
1 = open

Meaning:

| Programming | WZ- (tool) file | Effect |
|---|---|---|
| T | 0 | WZ-file data are used (N1001 - N1064) |
| T | 1 | WZ-file data are used (N1001 - N1064) |
| G92 T...W...Q...X...Z...I... K...A...B...C...E...L... | 0 | Programmed dimensions are used, but **not** transferred to tool file |
| G92 T...W...Q...X...Z...I... K...A...B...C...E...L... | 1 | Programmed W-, Q-, X-, Z-, I-, K-, A-, B-, C-, E- and L- values are used **and transferred to tool file (N1001 - N1064)** |

N 3 REFERENCE POSITION <WITH/WITHOUT> 0

0 = with
1 = without

When the switch is set to "**with reference position**", the reference point must always be engaged after switching on the control system. This establishes the workpiece zero point.

When the switch is set to "**without reference position**", the system of coordinates is set in MANUAL CONTROL and during setup by "**scratching**" the NC zero point.

**N 4 POSITIVE X-AXIS <TOP/BOTTOM> 0**

**0 = top**
**1 = bottom**

This parameter determines to which position of the positive X axis the vertical direction of the slide is related when the slide is traversed using the manual direction keys in the MANUAL CONTROL operating mode.

**Note:** When the positive X axis is directed downward, the actual vertical slide movement is opposite to the symbols on the manual direction keys.

**N 5 PICTURES <WITHOUT/WITH> 0**

**0 = without pictures**
**1 = with pictures**

This parameter is used to switch the graphic support facility on or off.

**N 6 ACTUAL DISPLAY < /S/D/I> 0**

**0 = workpiece measuring system**
**1 = S lag error display**
**2 = D distance display**
**3 = I internal counter reading ILG-counter**

This parameter is used to switch over the display mode of the actual values display.

If the value zero is written to this parameter, then the monitor displays the **actual value** of the cutting edge of the tool.
The display is active after the reference point run.
The X-value display relates to the diameter.

The **lag error display** shows the deviation, at any given moment, of the slide from the programmed contour in longitudinal and transversal direction. The display is active after selection.

The **distance display** indicates the remaining distance to the final destination of the traverse path in longitudinal and transversal direction at any given moment. The display is active after the reference point run. The X display relates to **diameter**.

The display of the internal **counter reading** refers to the distance from the reference point.
This display is active after the reference point run.

## N 7 DC-CODE (WITHOUT/CPU/LINE)

If data are to be transferred from the control system to an external device via an interface, the control system and the external device must be able to communicate with each other.
This is achieved in the software by the **DC code** (device control).

**The parameters have the following meaning:**

**WITHOUT (0)** **No DC codes**
Hardware-controlled communication between control system and external device. The control system neither transmits nor receives DC codes.

**CPU (1)** **CPU mode**

**Data transmission from the control system to an external device**
During output of an NC program the control system transmits the control character **DC2** to the external device.
After this the control system expects the external device to transmit the control character **DC1**.
Then data are transmitted from the control system to the external device. If the external device cannot handle the data fast enough, it transmits the control character **DC3** to the control system in order to interrupt further transmission of data. When the external device is again ready to handle further data, it transmits the control character **DC1**.

**Data transmission from the control system to an external device**
When an NC program is read into the control system, the control system transmits the control character **DC1** to the external device which in turn transmits the control character **DC2** and then starts data transmission. If the control system cannot handle the data fast enough, it transmits the control character **DC3**. When the control system is again ready to receive data, it transmits **DC1** and the external device continues data transmission.

**LINE (2)**

**Line mode**

**Data transmission from the control system to an external device**
Output of an NC program means data transmission from the control system. The external device cannot transmit back any control characterss. When the external device cannot handle data fast enough, they are lost.

**Data transmission from the control system to an external device**
During reading in of an NC program the control system transmits the control character **DC1**. The external device then transmits data. When the control system cannot handle the data fast enough, it transmits **DC3**. When the control system is again ready to receive data, it transmits **DC1** and the external device continues data transmission.

N 10 DELETION LEVEL <0...9> 0

It is possible to determine **one** deletion step for **one** deletion level.
This parameter is used to determine the level (0...9).

N 11 DELETION STEP <0...99> 0

This parameter is used to determine the deletion step (0...99).
The deletion step is only valid when the predetermined deletion level has been activated by selecting the deletion level under automatic operation.

0 = The block with the deletion step set under parameter N10 will never be executed.

1 = This block will be executed every time.

2-99 = The block will be executed every 2nd ... 99th time.

**Note:**
The deletion step and deletion level parameters must be taken into account when using deletion levels in the program sequence, as the program may otherwise not perform correctly.

N 12 TOOL DATA NO. FOR CARRIER <0 ... 63> 0

This parameter is used to enter a tool carrier offset for a set of tools. If, for example, offset **12** is programmed, then the compensation values of the tools clamped on tool carriers 1 to 12 correspond to the compensation values contained in the tool file under parameter numbers **N1013** to **N1024**.
The compensation of values **N1001** to **N1012** corresponds to offset **0** (possible only for 2-digit input of T number).

N 13 WEAR FACTOR 0.000

This parameter is used to enter a fixed value between 1 and 2 to indicate the maximum degree of wear of the tools.
The control system requires this input for calculating the power in the utilization graphic.
1 = TOOL unused 2 = TOOL unfit

N 15 DNC <WITHOUT/WITH> 0

Under this parameter is determined whether the DNC operation is activated or not.

0 = The DNC option is switched off. By switching off the DNC option, the DNC-SET is newly initialized. There is no data transmission to the supervisory computer via the interface.

1 = The DNC is switched on and the supervisory computer is informed by a message.

N 16 EXTERRNAL WAITING TIME 0

Under this parameter a waiting time in seconds can be programmed. Only after the expiry of this time will an error message be displayed in case data transmission between the control system and an external unit has been interrupted.

N 17 REACHING START POINT <WITHOUT WITH> 0

ATTENTION!
This parameter is optional and must be released by the manufacturer of the lathe.

0 = **Without reaching of the start point**
The program can be startet without a start point having been determined for each slide at the beginning of the NC program.

1 = **With reaching of the start point**
The program can only be startet when a start point has been defined for each existing slide (even those are switched off) at the beginning of the program. This is done using G15.

N 18 PRINT-OUT (WITHOUT/WITH) 0

By means of this parameter switch the reader/puncher interface can be activated to print out the variables outputs treated in the course of the program.

0 = **Print-out switched off**
Outputs of the variables (informational text or variables values) are displayed **only** in the dialogue line on the monitor

1 = **Print-out switched on**
Outputs of the variables (informational text or variables values) are displayed in the dialogue line on the monitor **and in addition** they are printed out on a connected printer via the reader/puncher interface

N 19 END OF LINE ( 0 = CRLF, 1 = LFCR, 2 = CR )

This parameter can be used to define the string of characters sent by the control system at the end of a variables output. This string triggers the carriage return, paper feed and start of a new line at the printer connected to the reader/puncher interface.
The following string sequences can be chosen, depending on the printer that is connected:

0 = Following the data transmission a CR (carriage return) and then an LF (line feed) is output in order to control the printer.

1 = Following the data transmission first an LF (line feed) and then a CR (carriage return) is output to control the printer.

2 = Only a CR is output at the end of the data transmission.

## N 22 READING BAUD RATE 00000

This parameter defines the baud rate for receiving data from an external unit via the reader/puncher interface or from the integrated reader.

**Important:** The only values it is permissible to input are **110, 300, 600, 1200, 2400, 4800, 9600** and **19200**. Other numerical values cannot be processed by the control system.

## N 23 WRITING BAUD RATE 00000

This parameter defines the baud rate for sending data to an external unit via the reader/puncher interfaces or to the integrated printer.

**Important:** The only values it is permissible to input are **110, 300, 600, 1200, 2400, 4800, 9600** and **19200**. Other numerical values cannot be processed by the control system.

**2. Zero points**

**N 50 NC-ZERO POINT X 0000.000 Z 0000.000**

This parameter is used to offset the workpiece zero point in relation to the machine zero point.
When the position programmed under this parameter is engaged, the actual values for X and Z will be displayed as zero (if parameter N6 is zero).

| | | |
|---|---|---|
| **N 53** | **ALLOWANCE 1** | **X 0000.000 Z 0000.000** |
| **N 54** | **ALLOWANCE 2** | **X 0000.000 Z 0000.000** |
| **N 55** | **ALLOWANCE 3** | **X 0000.000 Z 0000.000** |
| **N 56** | **ALLOWANCE 4** | **X 0000.000 Z 0000.000** |

Allowances 1 to 4 represent the incremental zero point shifts with respect to the NC zero point.

**N 57 DISTANCE XRN X 0000.000**

When this parameter is programmed accordingly, the scratching of the boring bar in X direction can be left out when setting up the tool file.
An X axis shift is entered under this parameter which is composed of the sum of the following values:

a) Distance from reference point to tool carrier reference point.

b) Distance from tool carrier reference point to tool reference point.

c) The position in X of the boring bar with respect to the tool reference point. If the boring bar is clamped exactly at the center with respect to tool reference point, this value is zero.

When setting up the boring bar, the value programmed under parameter **"distance XRN"** is compensated with the zero point shift entered under X and transferred to the tool shift of the boring bar. The boring bar must then be scratched in Z direction.

### 3. Feed

**N 60 FEED MANUAL CONTROL** **F00000**

Under address F in this parameter, feed is determined in mm/min for the manual direction keys with stationary spindle **MANUAL CONTROL** operating mode).

**N 61 RAPID TRAVERSE MANUAL CONTROL** **F00000**

This parameter is used to determine maximum feed in [mm/min] for traversing the slide using manual direction keys in rapid traverse.

**N 62 RAPID TRAVERSE AUTO** **FX 00000** **FZ 00000**

Under address FX, the maximum feed quota for transversal direction is entered in this parameter and under address FZ the maximum feed quota for longitudinal direction.

When both slides are traversed at the same time, the resulting rapid traverse is calculated in a way that no slide passes the value entered for its rapid traverse, but the highest possible rapid traverse is run.
Input under **FX** and **FZ** is in [mm/min].

## 4. Display

### N 70 GRAPHIC END X>-0000.000 X<+0000.000 Z>-0000.000 Z<+0000.000

This parameter determines the section limits of the graphics display:

X>-... lower limit (diameter)
X<+... upper limit (diameter)
Z>-... left limit
Z<+... right limit

Note: If the second X value is smaller than the first, then the positive X axis is directed downward in the graphic representation.

### N 71 BLANK DIMENS. -X-0000.000 +X+0000.000 -Z-0000.000 +Z+0000.000

This parameter is used to determine the blank dimensions for graphic representation so that the graphic representation has the same proportions as the drawing.

### N 72 LENGTH OF GRIP AREA 00.000

This parameter can be used to determine the extent to which the workpiece is to be clamped in the chuck in the graphic representation.

### N 73 GRAPHIC <0=WITHOUT, 1=BLANK, 3=WITH CHUCK, 7=WITH TAILST.>

**0 = Only traverse paths**
**1 = Contour, blank**
**2 = Contour, chucks**
**3 = Contour, blank, chucks**
**4 = Contour, tailstock**
**5 = Contour, blank, tailstock**
**6 = Contour, chucks, tailstock**
**7 = Contour, blank, chucks, tailstock**

This parameter determines the extent of graphic simulation (optional).

In order for the programmed parameters N70 to N74 to be transferred to the control system:

Press the graphic key.

Press the "continue" key, if necessary.

Press the ACCEPT NEW PARAMET. softkey.

**N77 GEAR SWITCHING TIME [SEC] 0.00**

This parameter is used to indicate the gear switching time in seconds..This value is required by the control system in order to calculate the cycle time (non-productive time).

**N78 TOOL CHANGING TIME [SEC] 0.00**

This parameter is used to indicate the gear switching time in seconds..This value is required by the control system in order to calculate the cycle time (non-productive time).

### 5. SPS-switches

Values for SPS switches must be entered as **binaries** so that each entered digit (bit) corresponds to one switch value.
Eight switch values are combined to form a byte.
There are eight bytes (S1 to S8), each consisting of eight bits.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| N 101 | S1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N 102 | S2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N 103 | S3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N 104 | S4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N 105 | S5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N 106 | S6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N 107 | S7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N 108 | S8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| N 111 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

This parameter can be used to determine eight different SPS-switches.

### Parameter 101: Operation

Range

X X X X X X X X

| | | | |
|---|---|---|---|
| | | Operating mode main spindle | 0-3 |
| 0 | 1 | No. 1 Internal chucking | |
| 1 | 0 | No. 2 External chucking | |
| 1 | 1 | No. 3 Disengagement stroke | |
| 1 | | Disengage hood at M30 | 0/1 |

### Parameter 102: PLC languages

X X X X X X X X

If the value is equal to "0", the PLC texts are displayed in the same language as the NC texts. If the value is not equal "0", the PLC texts are displayed in the language allocated to the number. If the required language is not implemented, no fault text is displayed.

| | | | | |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 = language as NC |
| 0 | 0 | 0 | 1 | 1 = D |
| 0 | 0 | 1 | 0 | 2 = GB |
| 0 | 0 | 1 | 1 | 3 = F |
| 0 | 1 | 0 | 0 | 4 = I |
| 0 | 1 | 0 | 1 | 5 = NL |
| 0 | 1 | 1 | 0 | 6 = S |
| 0 | 1 | 1 | 1 | 7 = DK |
| 1 | 0 | 0 | 0 | 8 = E |
| 1 | 0 | 0 | 1 | 9 = YU |
| 1 | 0 | 1 | 0 | 10 = SU |
| 1 | 0 | 1 | 1 | 11 = SF |

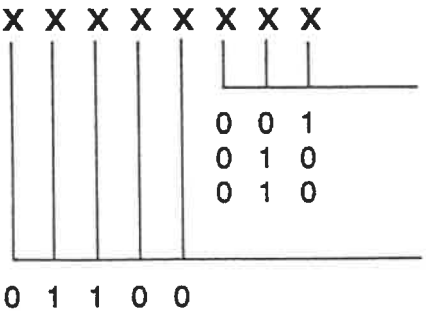
### Parameter 104: Machine equipment 3

Range

X X X X X X X X

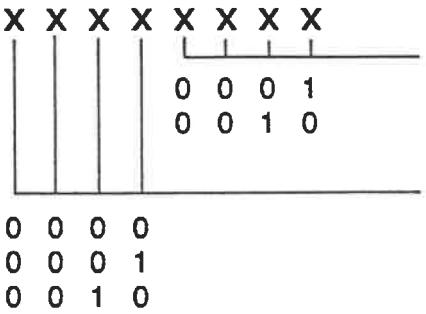
| | | | |
|---|---|---|---|
| | | Operating mode | 0-3 |
| 0 | 0 | No. 0 no handling fitted | |
| 0 | 1 | No. 1 HH = Promot portal | |
| | | Gearing main spindle drive | 0-3 |
| 0 | 0 | No. 0 No gearing | |
| 0 | 1 | No. 1 2 stage gearing ZF | |
| | | Synchronisation main spindle with spindle machining on rear, type | 0-3 |
| 0 | 0 | No. 0 no synchronisation | |
| 0 | 1 | No. 1 synchronisation via Baumüller drive | |
| | | Rear maching clamping type | 0-3 |
| 0 | 0 | No. 0 no rear machining clamp fitted | |
| 0 | 1 | No. 1 Hydraulic, return, clamping action | |

### Parameter 105: Tool holder



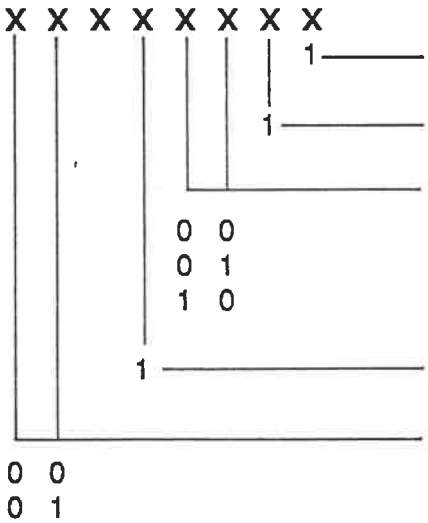

| | Range |
|---|---|
| Tool holder type | 0-7 |
| No. 1 Multifix | |
| No. 2 Sauter, cam roller contr. BR 200 | |
| No. 3 Sauter, cam roller contr. BR 500 | |
| No. of tool present (example = 12 tools) | 0-3 |

### Parameter 106: Chuck main spindle



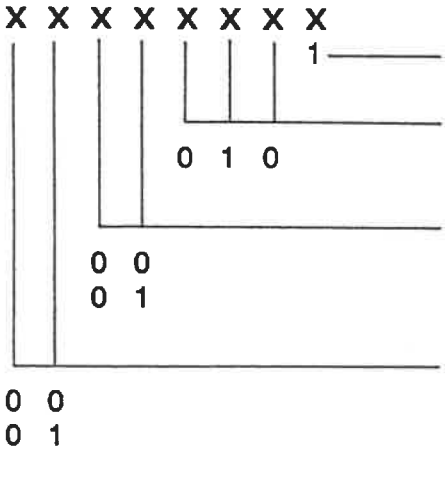

| | Range |
|---|---|
| Chuck type | 0-15 |
| No. 1 manually actuated | |
| No. 2 power actuated | |
| Clamping cylinder | 0-15 |
| No. 0 no clamping cylinder | |
| No. 1 return = close jaws | |
| No. 2 return = open jaws | |

### Parameter 107: Machine equipment 2




| | Range |
|---|---|
| AWZ fitted | 0/1 |
| Main spindle clamping fitted | 0/1 |
| Material supply type | 0-3 |
| No. 0 no material supply | |
| No. 1 bar loader | |
| No. 2 bar feed | |
| Main spindle C axis fitted | 0/1 |
| Pick off device type | 0-3 |
| No. 0 no pick-off device | |
| No. 1 pick-off device type 1 | |

**Parameter 108: machine equipment 1**




| | Range |
|---|---|
| Automatic hood fitted | 0/1 |
| Number of steady rests fitted (example = 2 steady rests) max. 4 | 0-7 |
| Centre sleeve type<br>No. 0 no centre sleeve fitted<br>No. 1 hydraulic centre sleeve | 0-3 |
| Tailstock type<br>No. 0 fixed tailstock<br>No. 1 hydraulically traversable tailstock 1 (traversable via cylinder) | 0-3 |

**Parameter 111: Other settings**

| | Range |
|---|---|
| 1 0 XX XX XX XX XX XX XX<br>Waiting time main spindle clamping<br>IMPORTANT: do not change this value !!! | 0-99 |

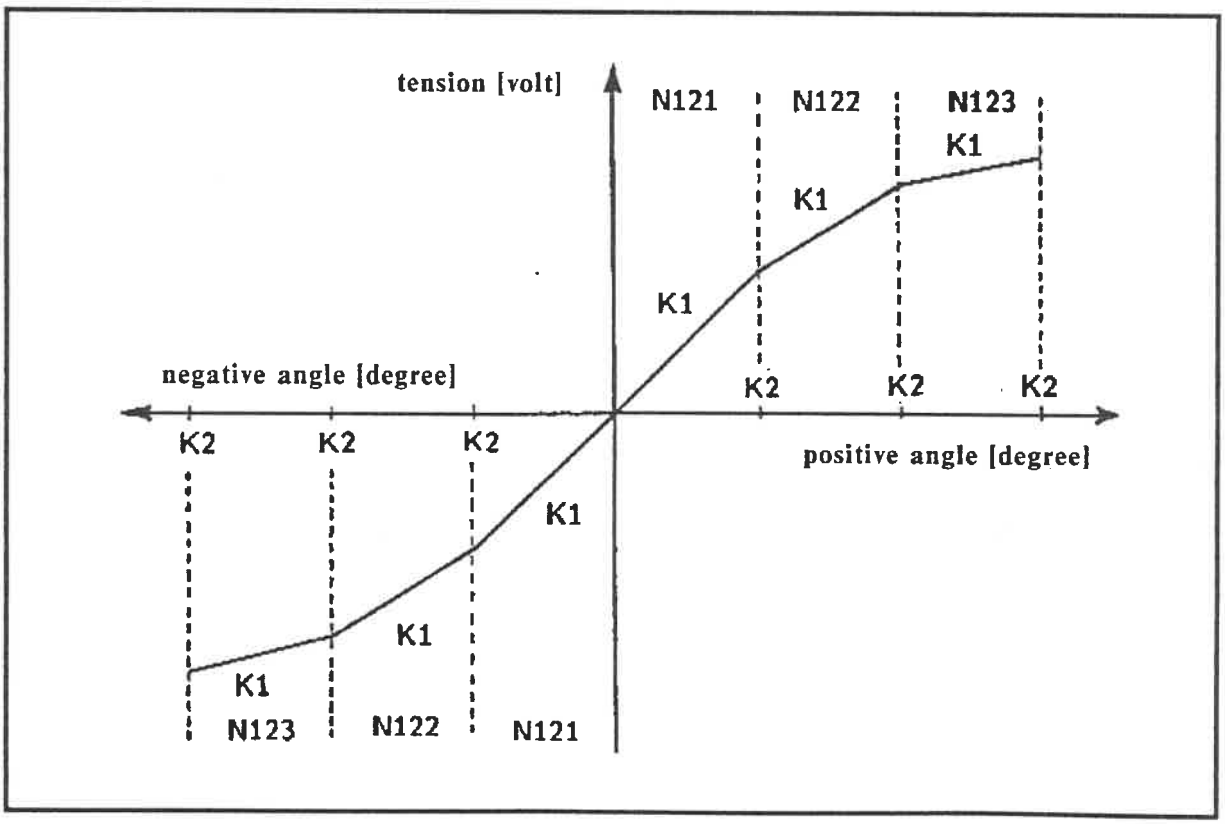
IMPORTANT: When changing the parameters 104, 107 and 108 subsequently switch the machine off and on again!

## 6. C-axis

The **ELTROPILOT L2** control system is capable of carrying out milling operations on the frontface and on the circumference of a workpiece. Parameters N121 to N126 have to be set in order to do this.

| | | | |
|---|---|---|---|
| N 121 | Range of adjustment 1 | K1 +0.000 | K2 +0.000 |
| N 122 | Range of adjustment 2 | K1 +0.000 | K2 +0.000 |
| N 123 | Range of adjustment 3 | K1 +0.000 | K2 +0.000 |

These parameters are used to determine the control characteristics for the C-axis 1. The correct amplification of the spindle control circuit is important for the functioning of the C-axis. If the amplification is too high, then harmful accelerations as well as overshoot and instability may be produced.
If the amplification is insufficient, then this may lead to a drifting in position and therefore to inaccurate machining.
Here, the control characteristics are described as a function of the voltage of the C-axis drive by the trailing distance.
Since the increase in voltage is to decrease with increasing trailing distance, the position control of the C-axis is approximated by a control characteristics divided into three different linear amplification ranges (straight lines).
These lines are determined by the parameters N121 to N123.



The first straight line in the figure above crosses the origin of the coordinates. The gradient of this line is determined in **(DA-converter increments/degree)*1000** under the address **K1** of the parameter **N121**. Under the address **K2** the trailing distance is determined (in degrees) up to which this straight line represents the characteristic. From this point the characteristic is continued by the second straigth line for which the gradient is determined under address **K1** and the end point under **K2**. The same applies to the third line.
The control behavior is to be the same for positive and negative angles, therefore the indications are valid for both directions of traverse.
Since the programming of these parameters depends on the machine, the following values are to be taken as rough approximation. They were determined by a 16 bit digital-to-analog converter. An analog value of 9V corresponds roughly to 1842 digital-to-analog converter increments.

e.g.:

**Parameter 121:** 6.000 (DA converter increments/degree)*1000 and 2.3 degrees
**Parameter 122:** 4.750 (DA converter increments/degree)*1000 and 3.7 degrees
**Parameter 123:** 1.875 (DA converter increments/degree)*1000 and 29.999 degrees

**Note:** The maximum numeric value for inputs under **K1** and **K2** to be executed by the control system is **32.767**

**N 124 DRIFTING (DEGREE/SEC) 0000**

During swivelling-in of the C-axis the gear wheels of the servo drive of the C-axis and the main spindle must be coupled together. In order to enable the meshing of the wheels, one wheel of the C-axis drive moves at a drift speed determined under parameter **N124** in degrees per second. A drift speed between 1 and 3 degrees/sec is recommended for selection.

**Note:** The maximum numeric value for inputs under parameter **N124** to be executed by the control system is **1536**

**N 125 REFERENCE POSITION (DEGREE/S) V 0000 A +0.000**

Under this parameter is determined the speed of rotation (in degrees per second) for turning the C-axis to reference position. A speed for 16 degree/s may be selected for the reference run. Under the address A an adjustment angle is determined, that is run additionally to the reference run (zero point of the C-axis) to simplify the transition between reference run and following positioning procedure in position regulation.

**Note:** The maximum numeric value for inputs under parameter **N125** to be executed by the control system is **1536** for **V** and **32.767** for **A**

**N 126 RAPID TRAVERSE (DEGREE/MIN) 0000**

Here the maximum angular velocity for positioning the spindle in rapid traverse of the C-axis is determined (in degrees per minute). The values programmed under the according parameter for turning (N62) are valid for the part of feed of the slide in X-direction (machining on the frontface) or Z-direction (machining on the circumference), respectively.

**Note:** The maximum numeric value to be executed by the control system is **1536.**

**N127 ZERO POINT SHIFT (DEGREE) 0.000**

Besides the zero point shift via G152, another zero point shift can be programmed for C-axis the input precision of which is 1/1000.

If, e.g., parameter N127 is set to 20° an actual value of "1C -20.000" will be displayed after the reference run. It can thus be seen from the display that a position offset of 20° is active in the parameter memory.

Angular values with an amount larger than 360° are transferred modulo 360°, that is, with angular values effecting more than a complete rotation of the spindle only that part of the value exceeding the complete rotation is transferred.

When function G152 is programmed in the parts program, the control system will take into account the sum of the zero point shift that can be programmed and of the zero point shift that can be expressed as parameter.

## N129 POSITION MONITOR P1 0.001 P2 0.001 T 0.001

The tolerance value for the target value for position during rapid traverse motions of the C-axis (G100 or G110) is specified in degrees under the address **P1** under this parameter. A "tolerance frame" is placed around the preset target for position by appropriately programming this parameter address. If the actual position of the C-axis after rapid traverse movements is within this tolerance frame for at least the period of time defined under the parameter address T, the control-internal message "Position reached" is sent and the subsequent machining operation is continued (indexing onward by record).
The tolerance value may be set between 0.001 and 9.999 degrees. A tolerance value of 0 degrees and a waiting time T of 0 seconds is not permitted and therefore cannot be programmed.
Keep this kept in mind, since the tolerance window preset here can also be reached by the control while positioning the C-axis during rapid traverse; controller parameters which are set too weak (N121 to N123) may create difficulties.
A more general tolerance frame is designed under parameter address P2; it makes it possible to permanently monitor the position of the C-axis. If the actual value for position is outside the tolerance frame defined by P2 while the C-axis is being machined, the control transmits a signal which is evaluated by the SPS.

**Note**
If the function Precision Stop (G9) is used during the C-axis machining, the tolerance frame defined under address P1 also refers to the functions G101, G102, G103, G111, G112 and G113.

## N130 CONTROL ADAPTION 1.000

To optimize the behaviour when positioning C-axis 1 with the handwheel, a reduction value for adapting the controller characteristic is defined under this parameter.
The operator has values from 1.000 to 32.767 at his disposal for this purpose.
While positioning the C-axis with the handwheel, which is performed with rapid traverse feed from parameter 126, the controller characteristic of the C-axis is reduced by the factor entered, ie. the Kv factor is divided by the value entered for control adaption.

## 7. Working space

For greater operating safety with the machine tool, the ELTROPILOT L control features not only the hardware limit switches but also collision protection for the slides (N200) and for the tool nose (N201).

It is also possible to define a tool exchange point (N202) which ensures a collision-free exchange of all tools. Apart from the direct numerical input of the parameter addresses under the associated parameters in the MANUAL CONTROL operating mode, the operator can also move manually to all these positions (except parameter N200) and then store them in the corresponding parameter (teach-in functions)

**N 200 LIMIT SWITCH -X-0000.000 +X+0000.000 -Z-0000.000 +Z+0000.000**

If one of the slides travels over the limit values set defined in the parameter limit switch, an error message is issued and the slide stops automatically (collision protection for the slide). Since these limits switches are software limit switches, the protective effect is not active until the slide position has been coordinated with the measuring system of the control by means of a reference run.
If the slide is moved in the MANUAL CONTROL operating mode without a prior reference run, only the machine's hardware switches are active.
The programmed values refer to the machine zero point. The addresses -X and +X are radius values.

**N 201 PROTECTIVE ZONES -X-0000.000 +X+0000.000 -Z-0000.000 +Z+0000.000**

If the tool nose traverses out of the range determined by the protective zones, an error message will be dieplayed and the slide is automatically stopped (protection from collision of tool).
This collision protection is not active until after the reference run. Exercise extreme care during traversing motions in the MANUAL CONTROL operating mode without any preceding reference run.

**N 202 TOOL CHANGE POINT** **X 0000.000 Z 0000.000**

This parameter determines the position to which the slide traverses during tool change in order to be able to change all tools without collision.
The entered value refers to machine zero.

**N 203 REFERENCE DIMENS.** **X 0000.000 Z 0000.000**

This parameter determines the position of the reference dimensions (reference point).
The reference dimension signifies the distance between the tool reference point (tool take-up on the turret disk) and the machine zero point.

**Important note**

As the reference point is a **crucial machine parameter**, the value preset by the manufacturer should **not** be changed.

## 8. Compensation

The **position correction** is used to compensate the tolerance and the reverse-play when changing the direction of the leading spindle.
These position errors (**difference** between **nominal** and **actual value**) are recorded once with a laser measuring device when the machine is set up and adjusted and then transferred to a series of measurements which is composed of several measured values (**positions**) according to the measuring step size (**grating position**).
The measuring values are recorded first in positive, then in negative traverse direction of the axes.
Then they are entered in the parameters N301 to N380, thus each measuring point (**position**) also contains the corresponding reverse-play and need not be entered as mean value for the entire spindle length.
The step size (**grating position**) of the measuring points and the start point of the position correction can be entered as parameters.

### N 298 NUMBER OF POSITION CORRECTIONS X 00

For this a number of 80 pairs of measuring values can be programmed per slide. The store is divided with respect to the number of measuring values for the X- and Z-axis under the parameter address X. The numeric value programmed here determines the number of measuring values for the X-axis, the remaining number is meant for the Z-axis.

**Example:** X = 25 Position 1 ... 25 for X-axis
Position 26 ... 80 for Z-axis

**N 299 START CORRECTION OF POSITION X 0.000 Z 0.000**

Under this parameter the start of the measuring series (where the message is started and continued in positive direction) is determined for the X and Z axis under the corresponding addresses.

**N 300 GRATING POSITION X 0.000 Z 0.000**

This parameter determines the step size (grating position) of the measuring series for the X and Z axes under the corresponding addresses. If the value entered for one or two axes is smaller than **5 mm** (e.g. 0.000 mm), then **no** spindle gradient compensation will be effected for one or both axes respectively, i.e. the compensation values will neither be checked nor compensated. Thus this parameter represents an additional switch with which the compensation can be switched on and off without having to change the individual compensation values N301 to N380.

**N 301 POSITION 1 K1 0.000 K2 0.000**
...
...
**N 380 POSITION 80 K1 0.000 K2 0.000**

Under this parameter, the compensation values for the positive and negative traverse directions can be entered under K1 and K2 respectively.

**Attention:** In order for the values entered under parameters N298 to N380 to be transferred to the control system, the reference point must be reached in the AUTOMATIC operating mode before continuing processing.

**All X parameter inputs must be radius dimensions.**

The control system interpolates linearily the compensation values as well as the reverse-play between the individual measuring points.

| | | | | |
|---|---|---|---|---|
| N 401 | POSITION CORRECTION | L1 | X 0.000 | Z 0.000 |
| N 402 | POSITION CORRECTION | L2 | X 0.000 | Z 0.000 |
| ... | | | | |
| ... | | | | |
| N 416 | POSITION CORRECTION | L16 | X 0.000 | Z 0.000 |

The position correction corresponds to an additional zero point shift which can be activated by the SPS. In order to consider, for example, only the presetter dimensions L and W of the tools when setting up the tool file, shifted positions of the internal and external hole circles and inaccuracies of the turret disc (due to manufacturing or thermal causes) are compensated by the position correction parameters. It is possible to compensate for each separate tool position.

The required dimensions of the individual tool positions (if present) are programmed under L1 to L16.

Example: L1 for turret position 1
L2 for turret position 2
L3 for turret position 3

...

L16 for turret position 16

### 10. Spindle, chuck, gearbox

With the help of the parameters N501 to N617 the data for the handling of maximum 3 main or auxiliary spindles can be determined. The values of this parameter group are predetermined by the machine manufacturer and must not to be changed.

**N501 SPINDLE M MD 0000 GS 0000 TD 0000 TR 0**

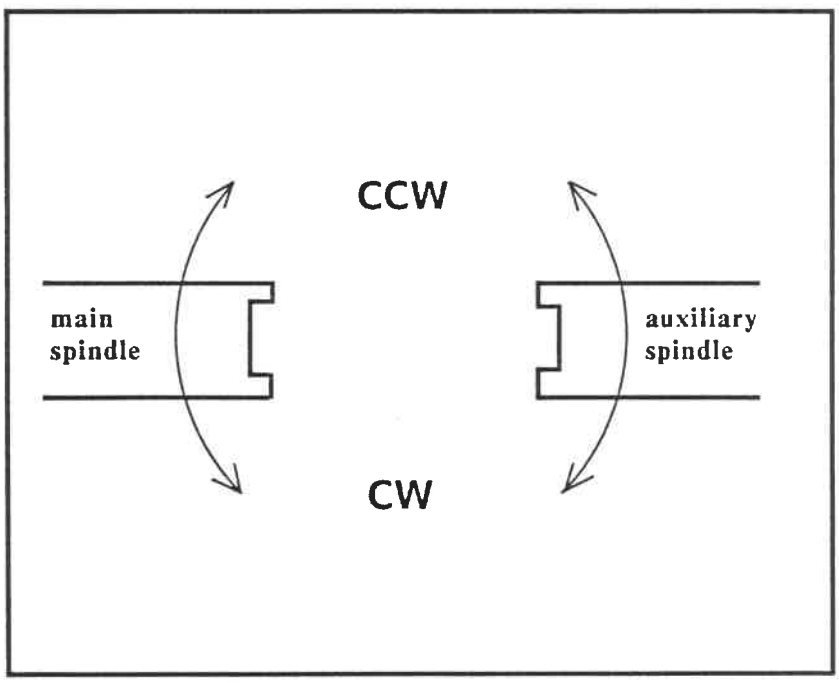
**MD** Under this address the maximum spindle speed [r.p.m.] of the main spindle (spindle M) is determined.

**GS** Under this address the gearbox shift value (spindle speed during gear shifting) is determined.

**TD** Under this address the speed of the main spindle [r.p.m.] is determined when the spindle is in jog control mode.

**TR** Under this address the turning direction of the main spindle is determined when the spindle is in jog control mode.

0 = Turning direction counter-clockwise (CCW)
1 = Turning direction clockwise (CW)



**N502 MAX. SPEED IN GST 1: 0000 2: 0000 3: 0000 4: 0000**

- If the main spindle is controlled via **AP186**, the maximum permissible speed in [r.pm.] of the spindle in the individual gear stages **GST1** to **GST4** is determined under this parameter. These speed values are selectable limits.

**N503 NOMINAL SPEED [R.P.M.] 0000**

The speed achieved by the main spindle at the selected gear transmission stage I at nominal motor speed must be programmed under this parameter.

**N504 TORQUE DIVISION [%]**

Parameter N504 is intended for synchronous run of two **speed-regulated** spindles. It determines the ratio in which torque is transmitted from the leading and from the led spindle to a workpiece clamped on both sides. At a torque division of 120% the 1.2-fold nominal torque of the leading spindle is transmitted to the regulator on drive of the led spindle. Note that the real actual torque on the workpiece depends, among other things, on the configuration of the regulator on drive. Parameter N504 is **not active** if one of the tspindles is **speed-controlled.**

**N505 TOLERANCE NOM. VALUE SPEED [Volt] 0.000**

Here, the tolerance is determined for a guided spindle in synchronous operation to alter its torque. This value must be such that in synchronous idling the spindle losses can be compensated at least.

**N506 TOLERANCE VAL. SPEED [R.P.M.] 0000**

Under this parameter the tolerance value for the spindle speed in [R.P.M.] is determined. By adequate programming of this parameter a tolerance area around the given speed target value is determined. If the limit of this tolerance area is reached, the message "spindle speed reached" will be output. If the value zero is programmed under this parameter, then the hardware signal $n_{actual} = n_{nominal}$ will be monitored.

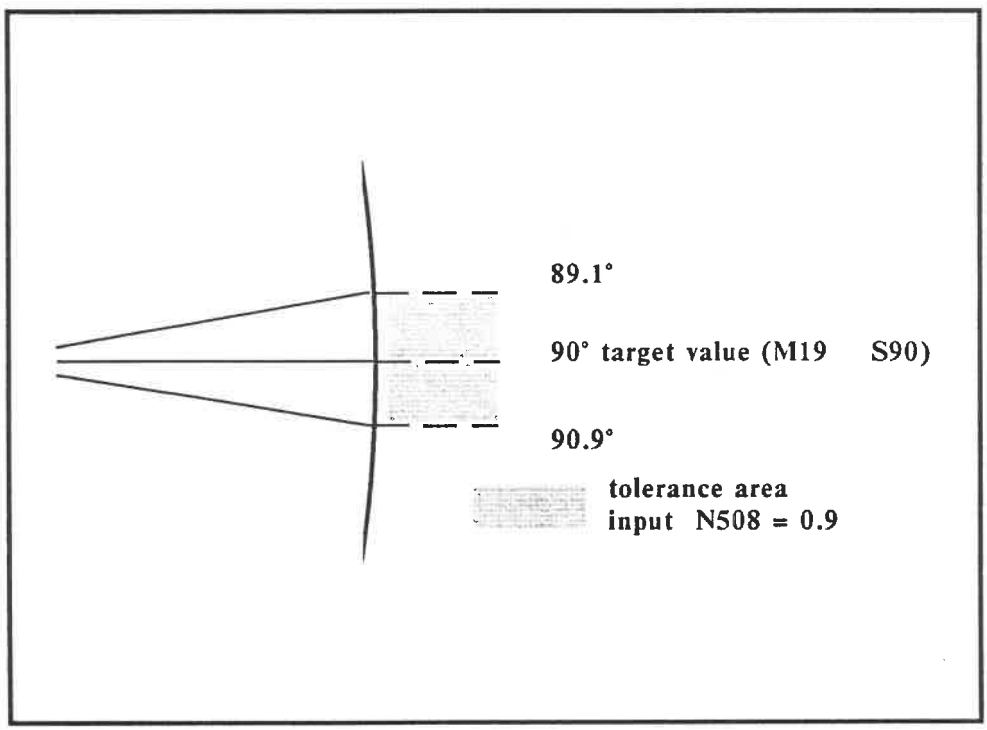
**N507 TOLERANCE SPEED SYNCHRONOUS [R.P.M.] 0000**

This parameter only takes effect when the spindle concerned is to be operated as led spindle while the synchronous running of speed or angle is switched on. If the difference between the **actual values of the speed of rotation** of the spindles to be synchronized lies within this tolerance, then the control system is informed that the "synchronous speed is reached" when the speeds of rotation are synchronous. At the same time the torque of the led spindle is limited (see also parameter N504, N505).
With synchronous running of angles parameter N509 must also be paid attention to.

Note: When this parameter is adjusted, the tolerances must not fall below those that can in fact be reached with the machine. The value programmed under this parameter must be larger than the sum of the maximum of deviations in ganging between the leading and the led spindle (experimental value of about 5 - 10 R.P.M.) The tolerances set in this place have no immediate influence on the precision that can be reached in the synchronous running of speed or angles.

**N508 TOLERANCE VALUE POSITION [DEGREE] 00.0**

The tolerance value for the position value of the main spindle is determined under this parameter. By adequate programming of this parameter a tolerance area is installed round the position target value. If the limit of the tolerance area is reached, the message "position reached" is output.



**N509 TOLERANCE VAL. ANGLE SYNCHR. [DEG.] 00.0**

This parameter takes effect only when the spindle concerned is to be operated as led spindle while the angle synchronization is switched on.
If the difference between the **actual position values** of the spindles to be synchronized lies within this tolerances and the conditions under parameter N507 are fulfilled, then the control is informed about "synchron. reached" once the speeds of rotation are synchronized.
At the same time the torque of the led spindle is limited (see also parameter N504, N505).

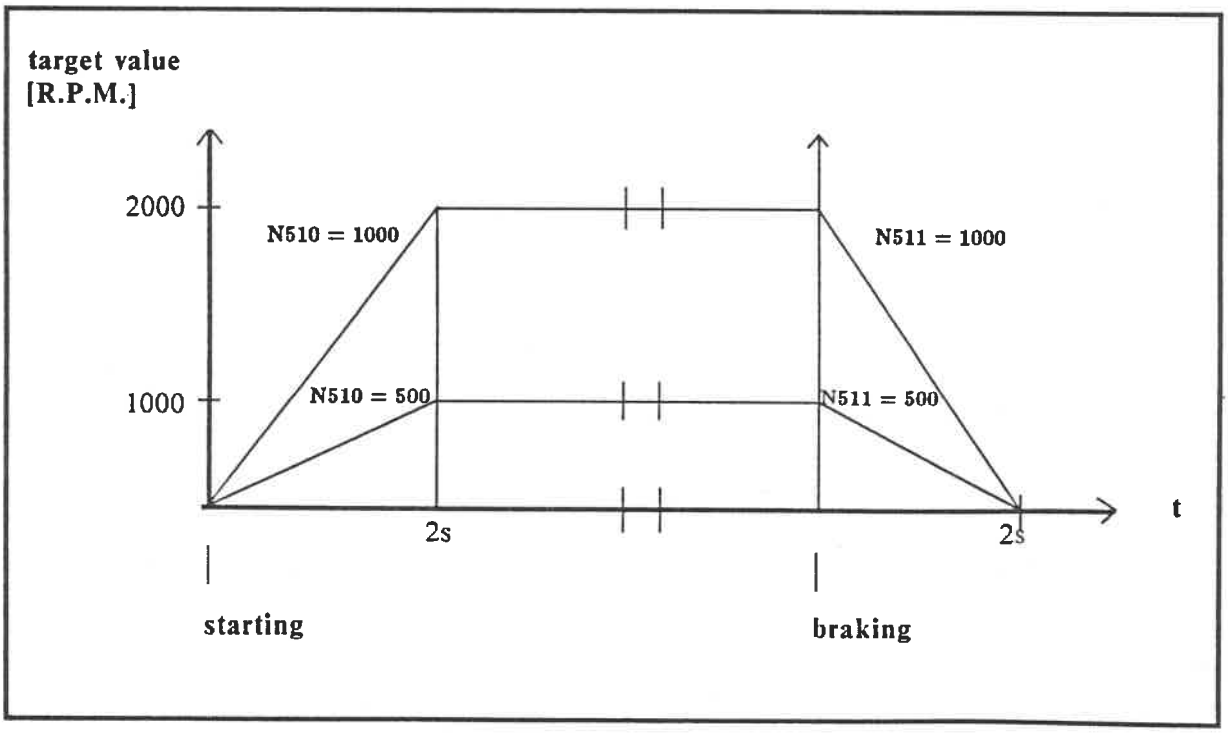
**Note:** When this parameter is set, the tolerances must not fall below those values that can in fact be reached with the machine. The value programmed in this case should be twice as large as the precision that can be reached when a point stop of the led spindle is effected (usually about 1 - 2 degrees).
The tolerances set in this parameter have no immediate influence on the precision that can in fact be obtained with the synchronization of speed or angles.

**N510 START ACCELERATION [(R.P.M.)/S] 0000**

This parameter determines the maximum changing speed of the spindle speed when starting the spindle.

**N511 BRAKING DECELERATION [(R.P.M.)/S] 0000**

This parameter corresponds to the parameter N510, but it is valid for the braking deceleration of the spindle.



**N515 ZERO POINT SHIFT [DEGREE] 000.0**

Under this parameter the position offset between the reference point of the main spindle and the reference point of the angle measuring system (angular pulse) is entered in degrees.

**N521 POS. CONTROL G1 P 00.000 I 0000 S> 00000 S< 00000**

This parameter contains the position regulator of the first gear stage.
The individual parameter addresses have the following meaning:

**P** Proportional part (used to be called KV-factor)

**I** Constant of integration period; ought to be zero for a position regulator

**S>** Lower limit of regulation value in [r.p.m.]

**S<** Upper limit of regulation value in [r.p.m.]

(The entered values limit the output value of the position regulator in both directions, thus determining the maximum speed of position regulation.)

**N522 POS. CONTROL G2 P 00.000 I 0000 S> 00000 S< 00000**

**N523 POS. CONTROL G3 P 00.000 I 0000 S> 00000 S< 00000**

**N524 POS. CONTROL G4 P 00.000 I 0000 S> 00000 S< 00000**

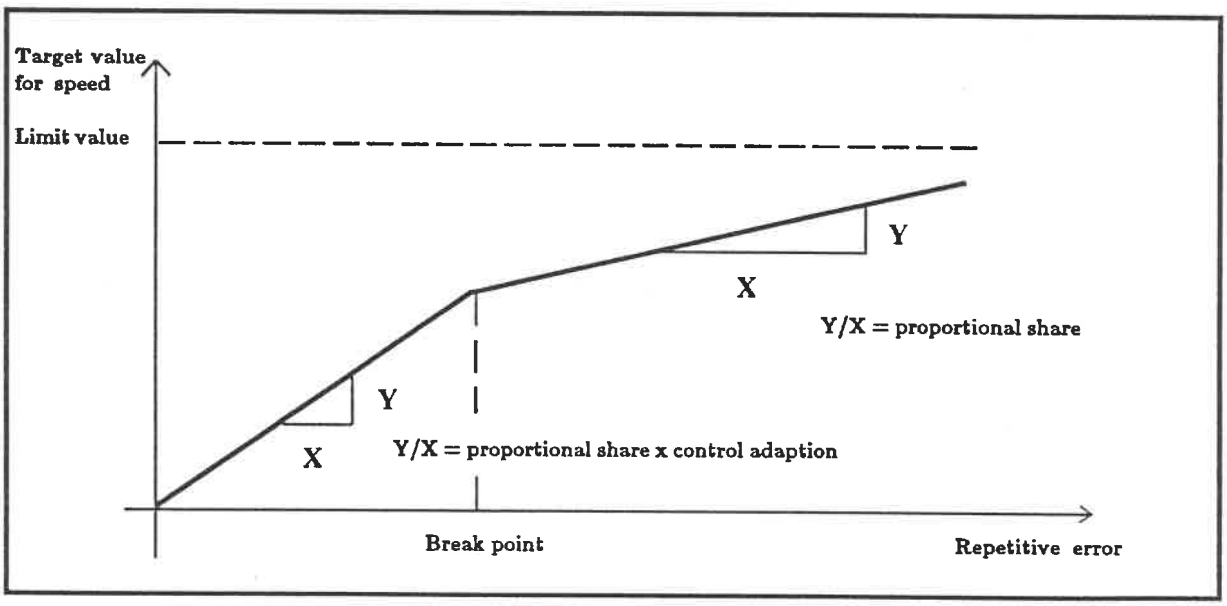
The parameters N522, N523 and N524 are the parameters for the position regulator of the second, third and fourth gear stage.

## N525 CONTROL ADAPTION, POSITION [-] 1

A factor to increase the proportional share (KV factor) of the position controller (position-controlled M19) is defined under this parameter.
In the case of repetitive errors in position which are smaller than the value of the break point (N526), the proportional share of the position controller is multiplied by this factor.

## N526 BREAK POINT [DEGREES] 0.0000

The limit of the swing-in range in degrees during position control (position-controlled M19) is defined under this position. In the event of repetitive deviations in position which are smaller than the programmed value of the break point, the proportional share (KV factor) of the position controller is multiplied by the factor defined under parameter N525.



**N531 SPEED CONTROL G1 P 00.000 I 0000 S> 0.000 S< 0.000**

This parameter represents the speed regulator for the first gear stage

- If spindle speed **REGULATION** is via AP186, the individual parameter addresses have the following meaning:

  **P** Proportional part

  **I** Constant of integration period in milliseconds

  **S>** Lower limit of regulation value in volts

  **S<** Upper limit of regulation value in volts

  (The entered values limit the output value of the position regulator in both directions; upper and lower limit. Thus the maximum voltage of the analog output and the maximum current or torque target value are determined).

- If spindle speed **CONTROL** is via AP186, the individual parameter addresses have the following meaning:

  **P** Standardization factor to set the actual spindle speed in the case of given speed target value. The factor is calculated via the following formula:

$$P = \frac{12000\ [\text{r.p.m.}] \cdot \text{max. voltage}}{10\text{V} \cdot \text{max. spindle speed}}$$

  This factor must be set such that in the case of max. spindle speed the actual value is slightly lower than the target value, observing the speed tolerance area.

  **I** Must be equal to zero

  **S>** Lower limit of regulation value in volts

  **S<** Upper limit of regulation value in volts

  (The entered values limit the maximum voltage of the analog output and also the maximum nominal spindle speed.)

| | | | | |
|---|---|---|---|---|
| N532 SPEED CONTROL G2 | P 00.000 | I 0000 | S> 0.000 | S< 0.000 |
| N533 SPEED CONTROL G3 | P 00.000 | I 0000 | S> 0.000 | S< 0.000 |
| N534 SPEED CONTROL G4 | P 00.000 | I 0000 | S> 0.000 | S< 0.000 |

The parameters N532, N533 and N534 are valid for the spindle speed regulator of the second, third and fourth gear stage.

| | | | | |
|---|---|---|---|---|
| N535 CONTROL ADAPTION SPEED | P | 00.000 | I | 0000 |
| N536 CONTROL ADAPTION SPEED | P | 00.000 | I | 0000 |
| N537 CONTROL ADAPTION SPEED | P | 00.000 | I | 0000 |

These parameters are valid for the adaption of the regulating parameters of the individual speed ranges above the **"RATED SPEED"**.

1: Speed range from rated speed to **double** rated speed

2: Speed range from **double** rated speed to **3-fold** rated speed

3: Speed range from **3-fold** rated speed to **more than 4-fold** rated speed

The values entered under the parameter addresses **I** and **P** are a measure for the weakening of the regulation parameters N521 to N537.

The parameters N541 to N577 and N581 to N617 have the same meaning as parameters N501 to N537 but refer to the regulation of the auxiliary spindles 1 and 2.
These parameters are also predetermined by the machine manufacturer; **the operator is not allowed to change the predetermined values.**

**10. In-process measuring**

N 690 IN-PROCESS MEASURING <OFF/NO OF MEAS. CIRCUIT> 0

By means of this parameter the in-process measurement is switched on

.

It applies:

**0 = in-process measuring is switched off**
**1 or 2 = in-process measuring is switched on**

N 691 ERROR EVALUATION <OFF/ON> 0

**0 = error evaluation is switched off**
If the control system recognizes an error during the measuring process, then the control independently generates the status **CYCLE STOP** and the corresponding error is displayed.

**1 = error evaluation is switched on**
If the control system recognizes an error during the measuring process, then this error is displayed and the number of the error is written into the variable V982. The status **CYCLE ON** is maintained, however, not in case of a collision.
Thus it is possible for the part program to react to measuring errors, e.g. by a repetition of the measurement.

N 692 MANUAL MEASURING FEED 000

A special measurement feedrate must be programmed in [mm/min] under this parameter for the starting-up of the measuring probe. However, this programmed feed is only active in the manual control operating mode.

N 693 TYPE OF MEASURING 0

This parameter is used to determine the desired type of measurement (measuring of tool lengths). The meaning of the values is as follows:

0 = This parameter must be set to zero when the NC zero point is determined by scratching with the basic tool and when the calculation of the follow-up tools is to refer to the basic tool.

1 = Determination of the absolute tool lengths by scratching to an input measure entered by the operator.

2 = Measuring with an optical system.

## 11. Post-process measuring

N 697 POST-PROCESS MEASURING <WITHOUT/WITH> 0

**0 = Postprocess measurement is switched off**

**1 = Postprocess measurement is switched on**
The measurement data is transmitted in accordance with the GILDEMEISTER PROTOCOL: Control (BFI card) and measuring device are synchronized, during which process the measuring device must initialize. To do so the measuring device has to be switched on.

**2 = Postprocess measurement is switched on**
The measurement data is transmitted in accordance with the 3964R protocol. No initialization is performed with the measuring device.

N 698 TYPE MEAS. DEVICE <SERIAL/PARALLEL> 0

**0 = post-process-measuring SERIAL**
The transfer of the measured values takes place in serial mode.

**1 = post-process measuring PARALLEL**
The transfer of the measured values to the SET takes place in parallel mode via the dual-port RAM.

N 699 MEAS. VALUE CHANGE OF SIGN <NO/YES> 0

**0 = no consequences for the measured values**

**1 = multiplication of the measured values by (-1)**
This is done to guarantuee that devices for tool measurements, which don't correspond to the standard of the control software as far as the sign of the output of the measured value is concerned, can be adapted to the control by means of the change of sign of the measured value.

N 700 TOOL CHANGE <1...9> 0

Under this parameter a number of 1 to 9 can be programmed which determines when a tool change takes place after the tolerance limit B (parameter N701 to N716) has been reached. In order to do this, the correction value of the corresponding measuring point (M1 to M16), which is written into the variables V941 to V956, is increased by 1. After interrogation of this variable in the part program (with G61) a tool change must be programmed.

1= When the tolerance limit B is reached, a tool change is demanded (increasing the correction value by 1).

2-9 The tool change is demanded only after the tolerance limit B was reached two to nine times in a row. If a measured value outside of tolerance limit B is followed by a measured value within the tolerance limit B, then the counting starts again.

| | | | | | | |
|---|---|---|---|---|---|---|
| N 701 | M1 AK0 | AI0 | A .000 | B .000 | C .000 TR0 | OF .000 > |
| - | NM 0.000 | | | | | |
| N 702 | M2 AK0 | AI0 | A .000 | B .000 | C .000 TR0 | OF.000 # |
| N 703 | M3 AK0 | AI0 | A .000 | B .000 | C .000 TR0 | OF.000 # |
| ... | | | | | | |
| ... | | | | | | |
| N 716 | M16 AK0 | AI0 | A .000 | B .000 | C .000 TR0 | OF.000 # |

Under this parameters the tolerance limits can be determined for the 16 measuring points M1 to M16, which serve as criteria for the evaluation of the measurement and which classify a workpiece into the categories

- **GOOD**
- **REFINISHING**
- **SCRAP**

depending on the determination of these criteria, or which cause a tool change to take place.

All tolerance limits **A, B** and **C** must be taken with reference to the nominal value and symmetrically both in the positive and negative direction.

The particular significance of these addresses is:

**AK** Under this address is determined whether a measuring point is to be activated or not.

**0 = point of measurement is deactivated**
**1 = point of measurement is active**

**AI** This parameter is used to determine whether the machining at the corresponding point of measurement is done on the outside or on the inside. The control system needs this indication to be able to decide whether a refinishing of the workpiece can take place, if this is necessary.

**0 = external machining**
**1 = internal machining**

**A** A value ranging from **0.000** to a maximum of **0.999 mm** can be determined under the **tolerance limit A** as deviation of the nominal value. If the measurement results in a value within the fixed tolerance, then the workpiece is classified as "good" at this measuring point and the measured value which the control system uses for the calculation of the correction value for this measuring point is zero.

**B** Under this **tolerance limit B** a value for A of up to a maximum of **0.999 mm** can be determined as deviation of the nominal dimension. If the measured value lies between the tolerance limits A and B, then the workpiece is classified as "good" at this measuring point. However, the measured value is used by the control system for the calculation of the correction value for this measuring point.

**C** Under this **tolerance limit C** a value for B of up to a maximum of **0.999 mm** can be determined as deviation of the nominal dimension. If the measured value lies within the tolerance limits B and C, then the workpiece is marked "SCRAP" and a tool change is effected, depending on the programming of parameter N700. The measured value is used by the control system for the calculation of the correction value for this measuring point.
When this tolerance limit C is exceeded, a refinishing work can be executed when machining was done externally. If the tolerance limit C is exceeded during internal machining, then the workpiece is marked "SCRAP".

**Fixed limit:** The control system is programmed with a fixed limit of one millimeter, symmetrically to the nominal dimension. When this fixed limit is surpassed, the measuring cycle is interrupted and an error message is transmitted to the NC.

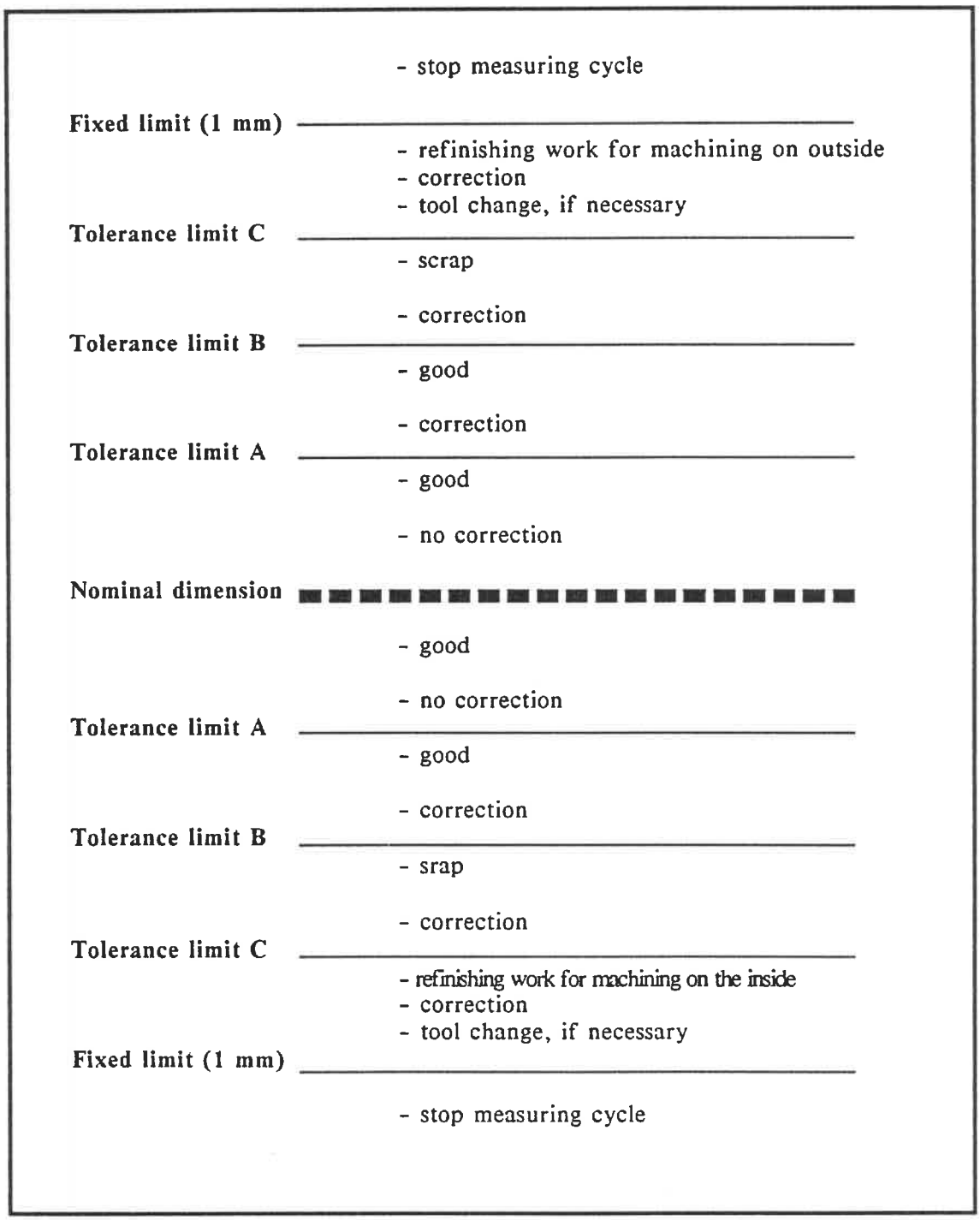
**TR** Under this address a **tendancy** can be determined, consisting of 1 to 5 measurements, of which the arithmetic mean (average value) is used for calculating the correction value.

**OF** Under this address values between **-0.999** and **+0.999** can be determined as **measuring offset**. If a value is indicated at this place, then an inaccuracy of measurement occurring constantly at this measuring point can be compensated.

The **nominal value** for the corresponding measurement point must be indicated under this address. Values from 0 to **9999.999** can be programmed.

**NM** Under this address values between zero and **9999.999** can be determined as the nominal measure for the relevant measuring point.

**Graphical representation of the tolerance limits**



**Evaluation of the measurement results**

If the addresses mentioned above are determined under the parameters N701 to N716, then the following formula is used for calculating the correction values of the particular points of measurement:

$$K = \frac{(MW1 + O) + (MW2 + O) + \ldots + (MWn + O)}{n} * R * A$$

The letters stand for:

| | | |
|---|---|---|
| K | = | correction value of the point of measurement (M1 to M16) |
| MW1 | = | last of the measured values to be calculated of the corresponding point of measurement (M1 to M16) |
| MW2 | = | last but one of the measured values to be calculated of the corresponding point of measurement |
| to | | |
| MWn | = | actual measured value of the corresponding point of measurement |
| O | = | offset |
| n | = | corresponds to the programmed tendancy (1 to 5) |
| R | = | change of sign of the measured value (±1) according to the programming in parameter N699 |
| A | = | change of sign according to the type of machining (external/internal) programmed under address AI. |

The correction values of all active points of measurement are always written together into the variables V941 (M1) to V956 (M16) after each cycle of measurement. If a tool change is executed via the part program, then a 1 is added to the correction value by the control system. After the tool change, this value must be reset. In addition, the variable V940 is set from 0 to 1 by the control system if new correction values and thus a new global result is available. After interrogation of the point of measurement M1 (V941) this value must be reset to zero via the part program. The global result of each measuring cycle is written into the variable V939.

Distinction is made between the following global results:

0 = workpiece is good
1 = workpiece can be refinished
2 = workpiece is scrap
3 = workpiece was not measured

**12. Machine dimensions**

```
N751      DIMENS. 1     -X 0.000   +X 0.000   -Z 0.000 +Z >
-         0.000
N752      DIMENS. 2     -X 0.000   +X 0.000   -Z 0.000 +Z #
N753      DIMENS. 3     -X 0.000   +X 0.000   -Z 0.000 +Z #
...
...
N759      DIMENS. 9     -X 0.000   +X 0.000   -Z 0.000 +Z #
```

In the parameters N751 to N759 four different dimensions in the machine space can be programmed each under the adresses -X, +X, -Z and +Z. All dimensions programmed here refer to the zero point of the machine. In one of these machine dimensions it is, for example, possible to program the switching points of the probe for measuring the tool for all directions of approach.
These dimensions are treated as nominal dimensions by the part program.

**Example:** If the +Z dimension indicated under parameter N751 is to be approached in Z-direction as nominal dimension, then the following block must be programmed in the part program:

```
N...
N... G0  Z (M1 |+Z|)
N...
```

(Zero point shifts are taken into consideration automatically.)

### 13. Tool dimensions

```
N1001  T1  WT00  FC0  X 0000.000  Z 0000.000  I 0.000  K 0.000 #
N1002  T2  WT00  FC0  X 0000.000  Z 0000.000  I 0.000  K 0.000 >
       A 000.0  B 000.0  C 000.0  D 000.0  L000
...
...
...
...
N1064  T64 WT00  FC0  X 0000.000  Z 0000.000  I 0.000  K 0.000 #
```

Data for 64 tools can be entered in these parameters (address T).
The user is guided by a menu with submenu for the tool types (WT) in dialog with the control system.
The tool number to be altered is selected by pressing the appropriate softkey. The second line containing the rest of the address parameters appears only for the selected tool number. After selecting the tool type from the tool menu, a picture of that tool is displayed, indicating the address parameters required for that tool type.
The color code (FC) with which this tool is to be represented in the graphic display is now determined.
The **address parameters** required for the tool in question are then requested.
The number of teeth C is only important for machining operations with the function G193.

(Input as described for MANUAL CONTROL operating mode)

### 14. Tool offset

```
N 1101     D1   X 0.000  Z 0.000  D 0.000
N 1102     D2   X 0.000  Z 0.000  D 0.000
...
...
...
N 1180     D80  X 0.000  Z 0.000  D 0.000
```

Tool offset values **D 1 ... D 80** are stored in these parameters.
The offset pairs are called by the corresponding number in the program under D.

**Note**
The parameter address **D** is only effective for milling tools (WT13 milling keyways, WT14 face milling, WT24 axial keyway milling and special tool WT0 defined as milling tool) and refers to the milling cutter diameter as the correction for wear.

## 15. Tool monitoring

N1200 TOOL LIFE SWITCH 0

**0 = Tool monitoring (service life/batch size) is switched off**

The type of monitoring has to be determined by programming the tool-dependent tool life parameters (N1201 to N1264) for each tool separately. The type of monitoring has to be identical for the original tool and the defined exchange tools. In case of batch size monitoring this parameter **has to be** 2, otherwise an error message will be displayed.
In case of tool life monitoring, programming this parameter will define whether the program run will be interrupted after the tool life has expired or whether the program is to be executed to the last block.

1 = Service life monitoring is activated. An error message is displayed and the machine is stopped (CYCLE STOP) when the service life of the tool to be taken as replacement has expired (also for all exchange tools defined for this purpose)
**(not possible with batch size monitoring)**

2 = Error is detected only at the end of the program.
During batch size monitoring an error message will be displayed when the original tool and all exchange tools have produced the programmed quantities.

```
N1201   T1  S 0 PZ  0 : 0 : 0   AZ  0 : 0 : 0   PS 0   AS 0 >
-       AT 0
N1202   T2  S 0 PZ  0 : 0 : 0   AZ  0 : 0 : 0   PS 0   AS 0 #
N1203   T3  S 0 PZ  0 : 0 : 0   AZ  0 : 0 : 0   PS 0   AS 0 #
...
N1264   T64 S 0 PZ  0 : 0 : 0   AZ  0 : 0 : 0   PS 0   AS 0 #
```

T **Number of the corresponding tool file**
T1 to T64 correspond to the tool files N1001 to N1064

S **Switch to enter the type of monitoring**

0 = tool life monitoring active

1 = batch size monitoring active

2 = tool is not being monitored
A certain tool is not being monitored (incl. possible exchange tools), although tool inspection has been activated via parameter N1200

**PZ** **programmed total service life in hours : minutes : seconds**
The relevant tool will not be used any more after the indicated period of time has expired.

**AZ** **current service life in hours : minutes : seconds**
Remaining service life of the relevant tool. When setting up a tool, this parameter must be programmed to be the same value as was indicated as total service life (PZ). When the tool is used in automatic mode of operation, this time period is automatically counted down by the control system, constantly displaying the actual AZ value.

**Note:**
If batch size monitoring has been selected under parameter S, **no inputs** must be made under the addresses **PZ** and **AZ.**

**PS** **programmed batch size**
The value programmed under this address defines the number of pieces which have to be produced before the tool is changed.

**AS** **current batch size**
This value indicates the number of pieces that can still be produced with the currently used tool. When setting up a tool, this parameter must be programmed to be the same value as was indicated as total batch size (PS). When the tool is used in automatic mode of operation, this figure is automatically counted down by the control system, constantly displaying the actual AS value.

**Note:**
If tool life monitoring has been selected under parameter S, **no inputs** must be made under the addresses **PS** and **AS.**

**AT** **exchange tool**
Furthermore, it is possible to allocate to an original tool any number of exchange tools which will then be taken as replacements instead of the original tool defined in the parts program. When the tool number of the exchange tool (data number = position number) is entered in two digits, the tool carrier offset is added when calculating the data number. This addition will not be done when data number and position number are entered separately. It is only after the service lives of all defined exchange tools have expired that the control system interrupts the program run with an error message.

**Tool inspection is active**
- if AUTOMATIC/SINGLE BLOCK mode of operation has been selected
- if tool life switch **N1200** is set at **1** or **2**

The following conditions must be fulfilled for counting the service life:

- switch S for the relevant tool = 0
- **AUTOMATIC/SINGLE BLOCK** operating mode
- no feed-stop, cycle-stop or single block-stop
- no movement in rapid traverse or feed in minutes
- current feed override > 75%

If one of these conditions is not fulfilled, the counting of service life will be interrupted.

The following conditions must be fulfilled in order to activate service life:

- Monitoring in parameter must be switched on (service life switch set to 1 or 2)
- Programmed service life > 0

If one of these conditions is not fulfilled, no monitoring of service life will take place.

The following conditions must be fulfilled in order to count the batch size:

- Switch S for the relevant tool = 1
- Programmed batch size > 0

**General notes on the monitoring procedure of the service life/batch size**

First the control system searches for used tools whose service life has not yet expired before considering service lives of new tools. Each tool which was in operation once is marked as "**used**" . The control system keeps the used tool in operation until its service life has expired. Only when the tool lives/batch sizes of all exchange tools have expired will an error message be displayed and the machine is stopped. In order to reset the tool life/batch size, first select MANUAL CONTROL operating mode, then TOOL SETTING mode and finally SERVICE LIFE. The control system requests the input of the relevant tool number, after which the selected group of parameters is displayed. Move the cursor to the next address, then press ACCEPT PROGR. TIME in order to reset service life/batch size to the programmed value (see chapter 2).

| | | |
|---|---|---|
| Example: | Original tool | T1 |
| | Exchange tool 1 | T3 |
| | Exchange tool 2 | T5 |

Service lives of T1 and T3 have expired. T5 has already been used before. T1 is provided with a new cutting edge and the value of the current expired service life is returned to the originally programmed value, i.e. the maximum service life for tool T1 is again available. However, tool T5 is used for machining until its service life has expired. After this the control system considers tool T1 again.

**16. Material data (optional)**

**N1301 W 1 ID VR VL FR FL E**
**N1302 W 2 ID VR VL FR FL E**
**ZR VB FB VG KC Z**
...
...
...
...
**N1324 W24 ID VR VL FR FL E**

To facilitate programming, standard values suggested by the control system can be used. These values can be either confirmed or altered and are then transferred to the corresponding NC program. This possibility is available for programming feed, cutting speed and cycles.
The control system bases its suggested values on the material file which is accessible via these parameters.
This file can contain values for up to 24 materials.
The address abbreviations in the parameters have the following meaning:

| | | |
|---|---|---|
| **W** | = | Material |
| **ID** | = | Identy number |
| **VR** | = | Cutting speed roughing |
| **VL** | = | Cutting speed finishing |
| **FR** | = | Feed roughing |
| **FL** | = | Feed finishing |
| **E** | = | Special feed for finishing of chamfers and roundances |
| **ZR** | = | Adjusting range for roughing cycles |
| **VB** | = | Cutting speed boring |
| **FB** | = | Feed for borer |
| **VD** | = | Cutting speed for thread cutting |
| **VG** | = | Cutting speed thread boring |
| **KC** | = | Main value of specific cutting force |
| **Z** | = | Inclination value of cutting force for identical cross section, but larger chip thickness |

## 17. Tool diagnosis variables

| BIT | | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| N1401 | T1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N1402 | T2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| N1403 | T3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ... | | | | | | | | | | | | | | | | | |
| ... | | | | | | | | | | | | | | | | | |
| N1464 | T64 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

These parameters are again contained in the diagnostic operating mode. There, the service life (N1201 to N1264) of each tool is displayed in addition, and a text explaining the significance of the bits 1 to 6 is displayed as well.
Basically, the parameters N1401 to N1464 can be changed by hand at this place. However, it is more convenient for the operator to change them in the diagnostic operating mode.
A detailed description of the tool diagnosis variables can also be found there together with an example of a part program.

## 18. Tool measuring offset

| | | | |
|---|---|---|---|
| N1501 | 1 | MX 0.000 | MZ 0.000 |
| N1502 | 2 | MX 0.000 | MZ 0.000 |
| N1503 | 3 | MX 0.000 | MZ 0.000 |
| ... | | | |
| ... | | | |
| N1564 | 64 | MX 0.000 | MZ 0.000 |

During setting-up of the tool file the tools are in general roughly pre-dimensioned and pre-set. The determined tool data are transferred to the tool file (N1001 to N1064). If the tools are later measured using a tool measuring device, the difference between the X and Z values from the tool file and the corresponding measured values can be written as a correction factor (measuring offset) under MX and MZ into the parameters N1501 to N1564 via the part program (see programming example in section 8.2).

Note:
It is also possible to compensate the difference calculated via the part program between the pre-setting and the exact measured value using the D-correction.

**19. Tool reference list**

| | | | |
|---|---|---|---|
| **N1600** | **TOOL IDENTIFIC. NO.** | **<WITHOUT/WITH>** | **0** |

**0 = Without tool identification number**
If a tool is called up in the parts program under the address T, only 2- or 4-digit tool numbers are allowed to be programmed.

**1 = With tool identification number**
The tool number T must be programmed as a 6-digit tool identification number. This identification number may contain zeroes (e.g. T000381), but it must contain 6 digits; otherwise an error message is displayed.
If the tool number T is programmed in this way, the control system uses the tool reference list; the programmed tool position (turret disc) and the tool measures from the corresponding tool file are calculated by the control system.

| | | | |
|---|---|---|---|
| **N1601** | **1** | **ID 000000** | **T 000** |
| **N1602** | **2** | **ID 000000** | **T 000** |
| **N1603** | **3** | **ID 000000** | **T 000** |
| ... | | | |
| ... | | | |
| **N1664** | **64** | **ID 000000** | **T 000** |

Under the address ID the user has to write the identification numbers being used in the program as tool numbers.

The corresponding tool position is written under the parameter address T. If now the user programs a 6-digit T-number, the control system chooses from the tool reference list the parameter under which the identification number is found.

The parameter address T programmed under this parameter is calculated as the tool position on the turret disc.
The tool measures are taken from the corresponding tool files N1001 to N1064. The last two digits of the parameter numbers N1601 to N1664 are identical with the last two digits of the parameter numbers N1001 to N1064 (see also chapter 3.4).