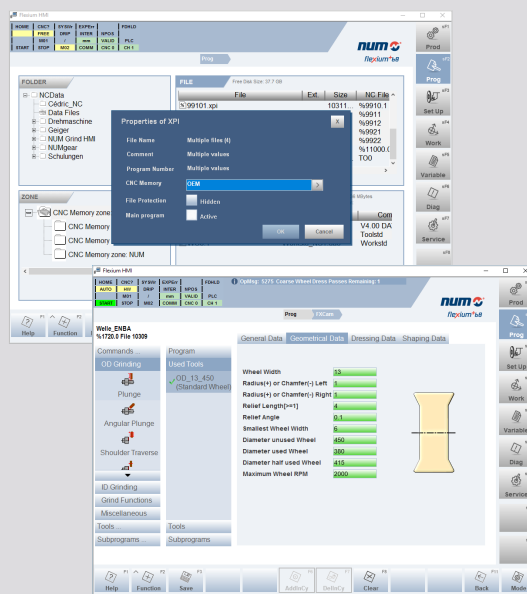


# Installation and Commissioning manual

M00064EN-01

Edition 10.2021



flexium+

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The programming examples described in this manual are intended for guidance only. They must be specially adapted before they can be used in programs with an industrial application, according to the automated system used and the safety levels required.

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# 1 Foreword

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## 1.1 Introduction

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Technology packages for Total solutions (as NUMgear, NUMmill, NUMgrind etc.) are combined as a set of HMI files that represent the user interface (Technology HMI), program files, a configuration file to define the data, as well as NC programs. Not every Total solution needs all listed files.

Installation is very simple and done using the tools NUM provides.

You'll need to use the Flexium HMI as well as the Flexium Tools.

All it requires is the installation of the technology HMI - that will run within the NUM Flexium HMI and includes the technology configuration file and the part programs that will run within the NUM CNC and connect to the technology HMI programs using Flexium Tools.

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## **1.2 Use of the manual**

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This manual is for use by qualified personnel only.

To reduce the risk due to an improper use of the product, do not perform any servicing other than that contained in this manual unless you are qualified to do so.

To ensure proper use of these products, please always read this User's manual carefully and retain for future reference. Should the unit require maintenance, please contact a NUM authorized service center only.

## 1.3 How to read the manual

This manual provides information about the NUMmill - NUMgear - NUMgrind - HMI.

| Chapter  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1</b> | <b>Foreword</b><br><br>This chapter introduces: <ul style="list-style-type: none"> <li>- Use of the manual.</li> <li>- How to read the manual</li> <li>- Document revisions</li> <li>- NUM Agencies</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                |
| <b>2</b> | <b>Setup Technology HMI</b><br><br>This chapter introduces: <ul style="list-style-type: none"> <li>- Installation of a Technology Package.</li> <li>- Uninstallation of a Technology Package</li> <li>- Select HMI Page.</li> <li>- Flexium CAM Settings.</li> <li>- User data</li> </ul>                                                                                                                                                                                                                                                                                                     |
| <b>3</b> | <b>NUMmill and NUMgear</b><br><br>This chapter introduces: <ul style="list-style-type: none"> <li>- Installation of a Technology Package</li> <li>- Uninstallation of a Technology Package .</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>4</b> | <b>NUMmill and NUMgear</b><br><br>This chapter introduces: <ul style="list-style-type: none"> <li>- NUMmill.</li> <li>- NUMgear.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>5</b> | <b>NUMgrind</b><br><br>This chapter introduces: <ul style="list-style-type: none"> <li>- Schematic Illustration of a Grinding Machine.</li> <li>- Wheelhead Configurations</li> <li>- Wheel Dressing Tools</li> <li>- Setting Origins and Shifts</li> <li>- Setup an Flexium Tools Application for NUMgrind</li> <li>- Language Files for NUMgrind</li> <li>- CNC Files for NUMgrind</li> <li>- Customer NC programs</li> <li>- Tool table</li> <li>- Load data file in the NC memory</li> <li>- Wheel Speed Limitations</li> <li>- CNC/PLC Link.</li> <li>- PLC Code for NUMgrind</li> </ul> |

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## 1.4 Document revisions

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| Date      | Index | Reason for revision                     | See chapter       |
|-----------|-------|-----------------------------------------|-------------------|
| 11 - 2019 | 00    | Document creation                       | -                 |
| 10 - 2021 | 01    | Update image - Fx Office                | 2.1               |
|           |       | Flexium Tools Settings                  | 2.4.2             |
|           |       | User data                               | 2.5               |
|           |       | Setup Technology HMI for Flexium Office | 3                 |
|           |       | Z-Flagging Device Data                  | 5.7.3.3           |
|           |       | Non-Circular Grinding Data              | 5.7.3.4           |
|           |       | Wheel Setup and Dresser Data            | 5.7.3.5           |
|           |       | Tables update                           | 5.12.4<br>5.12.10 |
|           |       | M-Functions table                       | 5.12.11           |
|           |       | PLC Code for NUMgrind                   | 5.13              |

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## 1.5 NUM Agencies

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The list of NUM agencies is given click here <http://www.num.com>

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## 2 Setup Technology HMI in Flexium HMI

You can install and uninstall technology HMI as necessary.

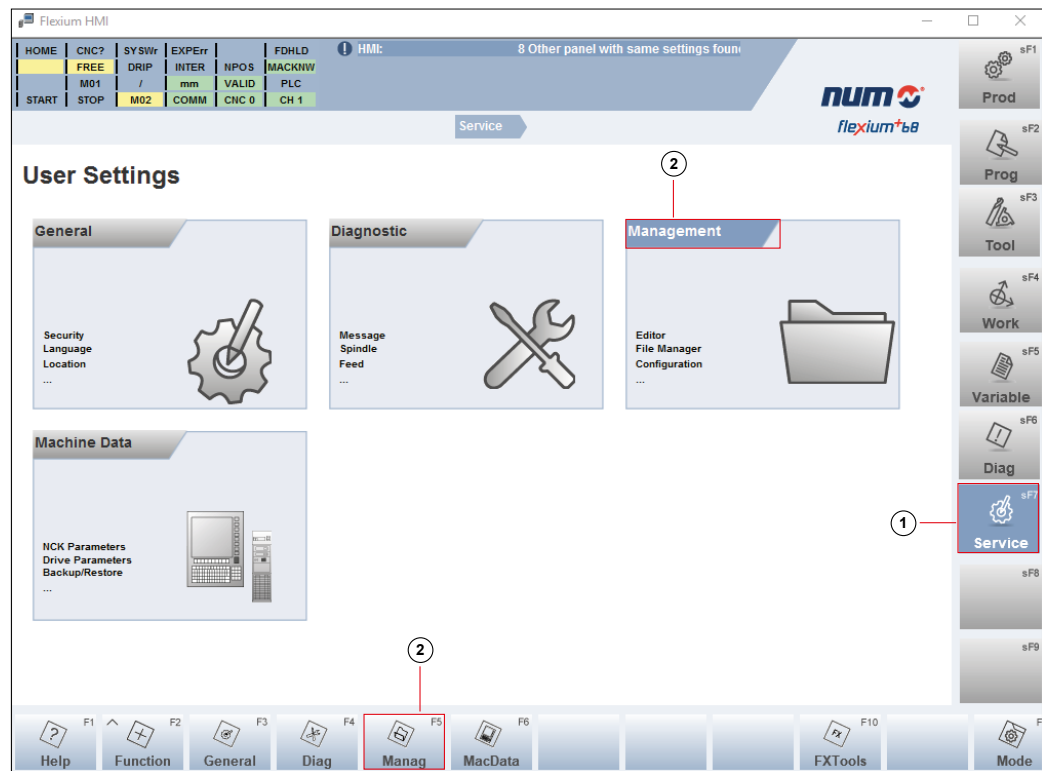
Installing several technology packages on a dedicated machine does not really make sense.

But this feature might be very useful on a PC connected to several different machines of different types of technologies. Having installed a set of different technologies you can connect to each individual machine and run the technology installed on that machine.

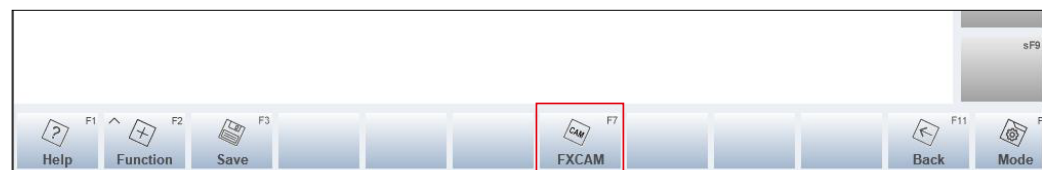
If you open a project that was created with a version lower than the one you install, the project will be updated automatically once you selected it for editing in the technology HMI.

### 2.1 Installation of a Technology Package

- Copy the ".car" file in a local folder on your drive system.
- In the *NUM Flexium+ HMI*, go to the context *Service* (1) and then to the sub context *Management* (2).



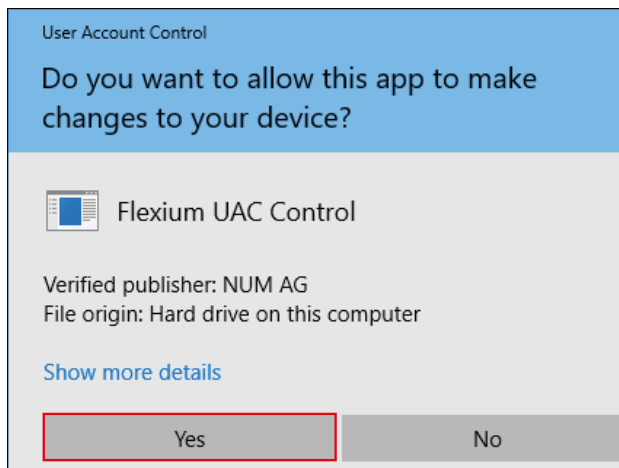
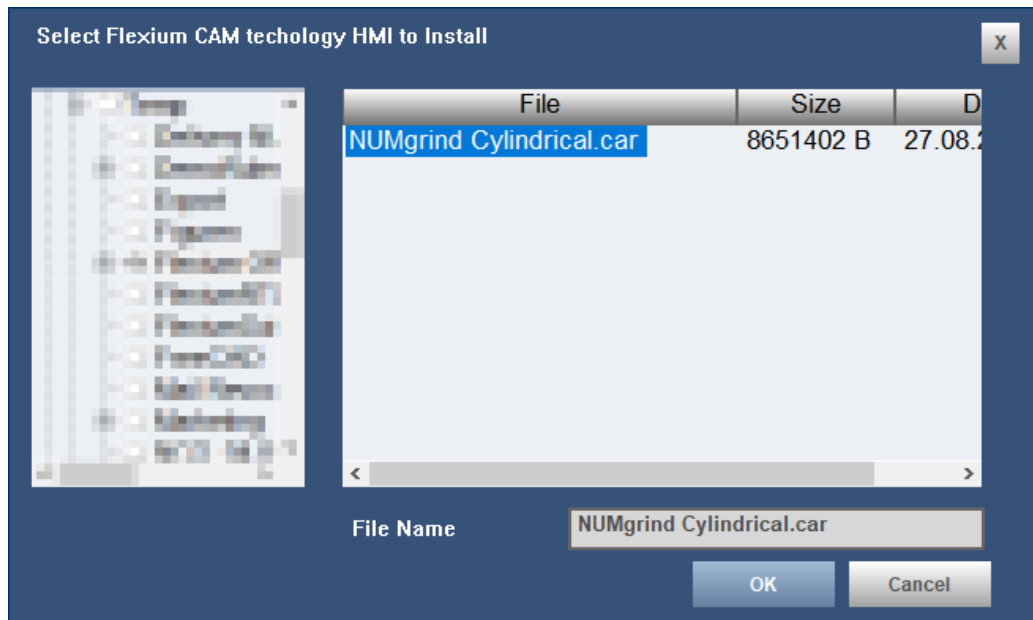
- Select *FXCAM*.



- Here, select *InstCfg*

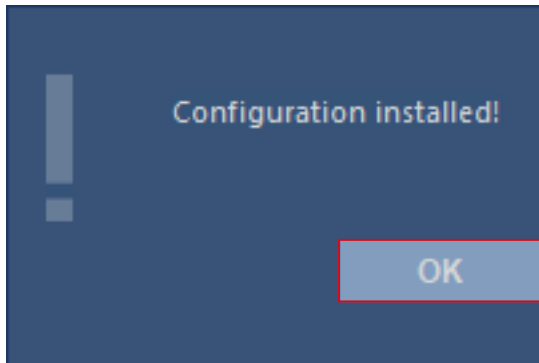


- Select your ".car" file on your local folder and confirm with **OK**.  
Files from network drives cannot be opened!



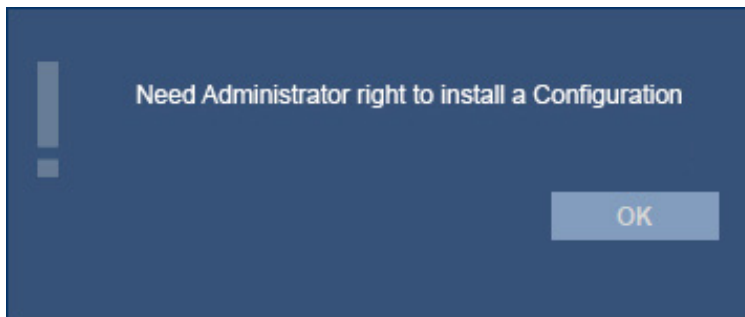
- Allow to install the package and confirm with **YES**.

- The following message should now appear. Confirm with **OK**.



Now you can use the technology HMI to create new projects as well as to edit projects you have created with an earlier version.

If you get the following message, your user/account has not the permission to install a technology package.



Get in contact with your IT specialist.

1

2

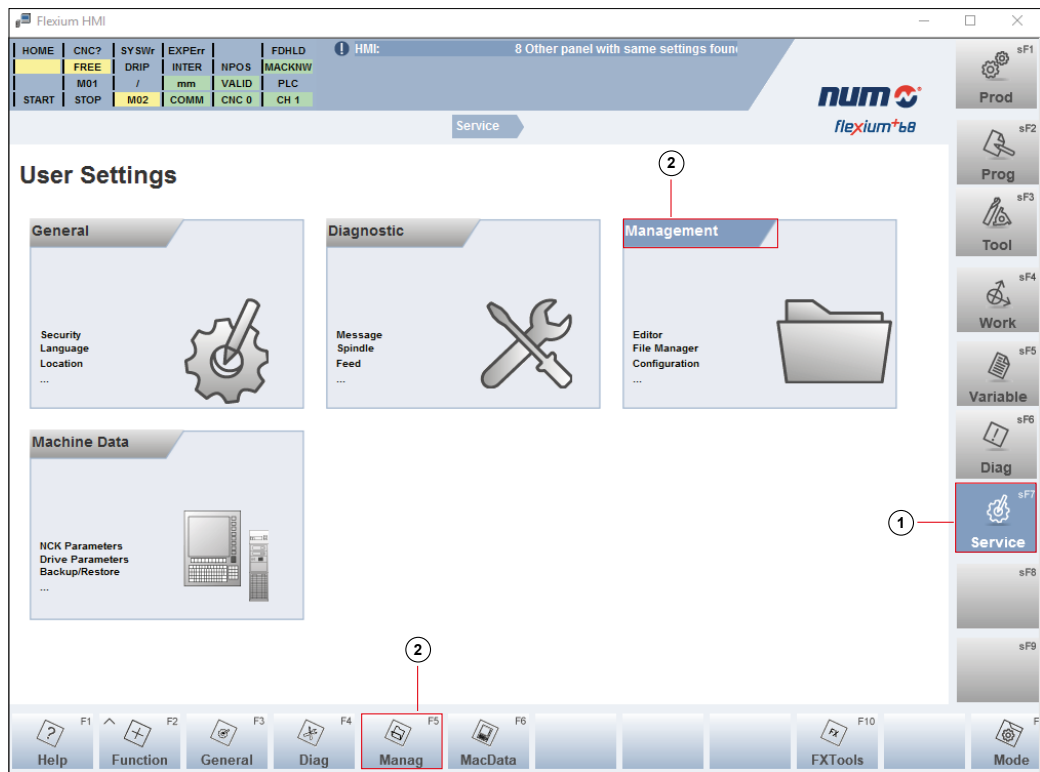
3

4

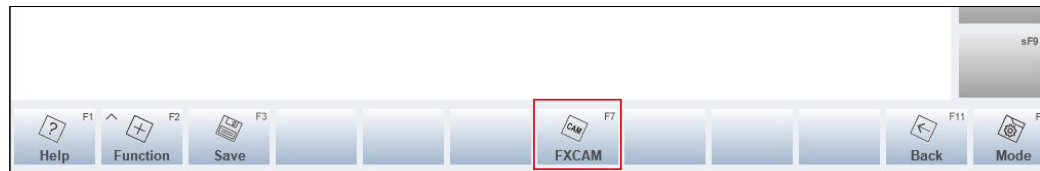
5

## 2.2 Uninstallation of a Technology Package

- In the *NUM Flexium+ HMI*, go to the *context Service* (1) and then to the *sub context Management* (2).



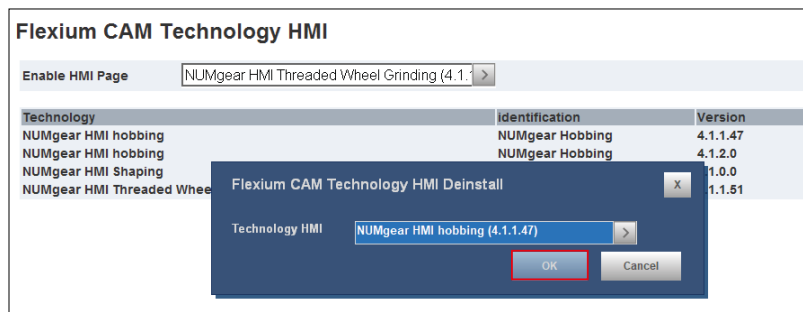
- Select *FXCAM*



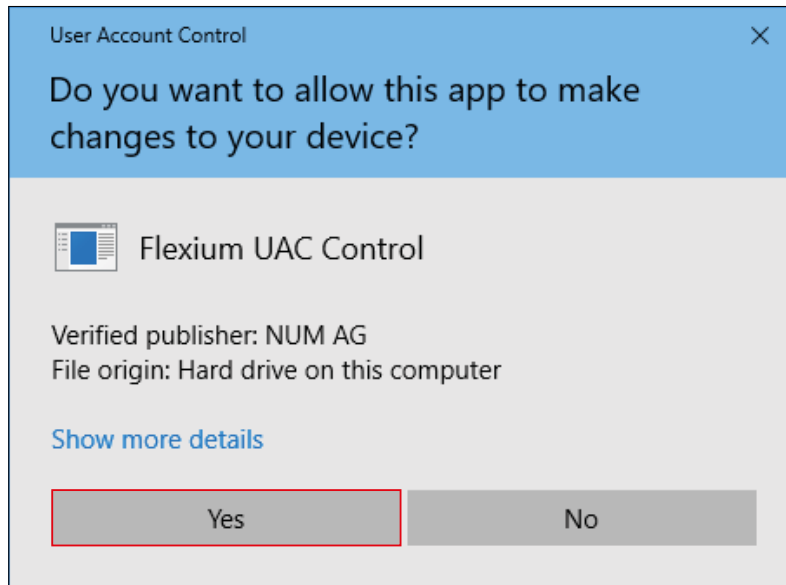
- Here, select *DelCfg*



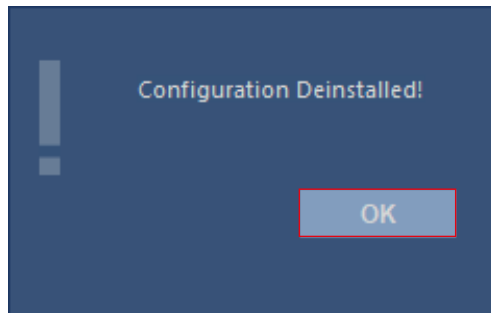
- Select your *technology package*, which should be uninstalled. Confirm with *OK*.



- Allow to uninstall the package and confirm with YES.



- The following message should now appear. Confirm with OK.

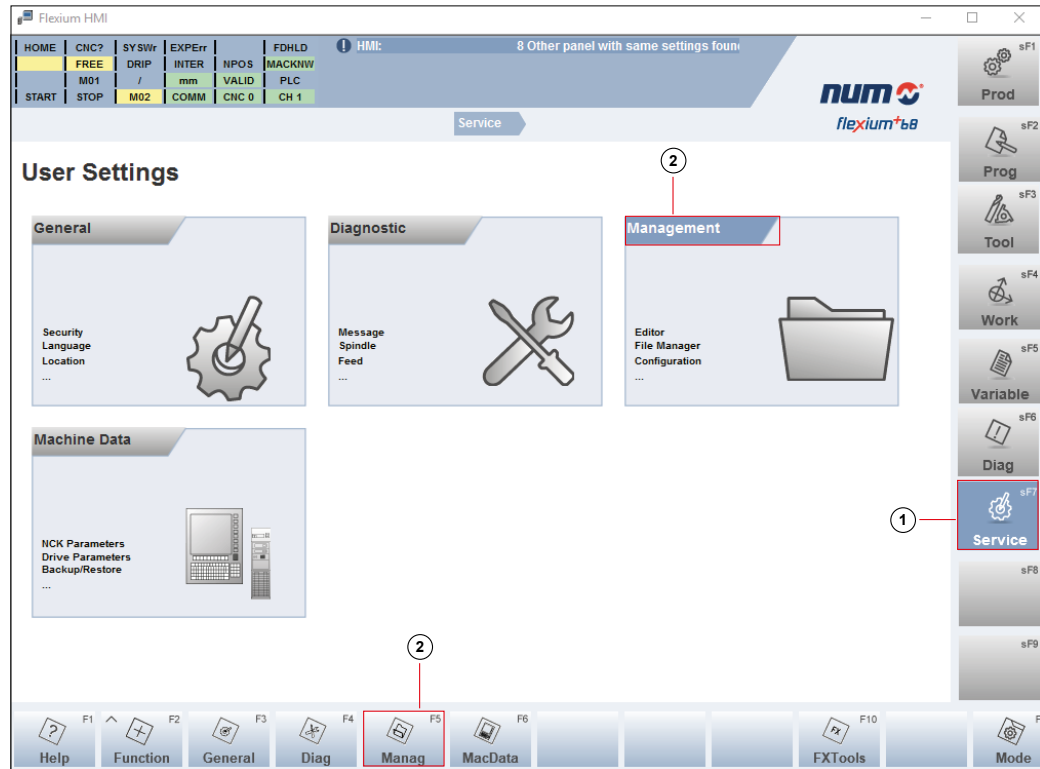


Projects created will not be deleted when you uninstall.

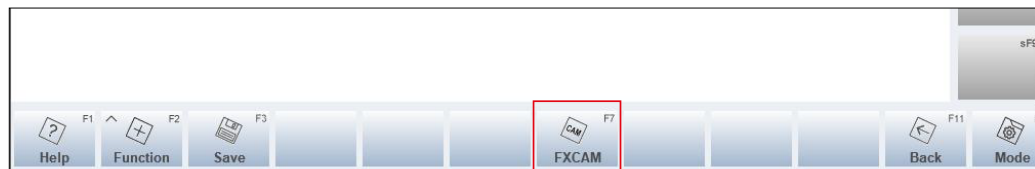
## 2.3 Select HMI Page

Most of the Total Solutions include special contexts or sub contexts. They need to be activated. Their activation is described below.

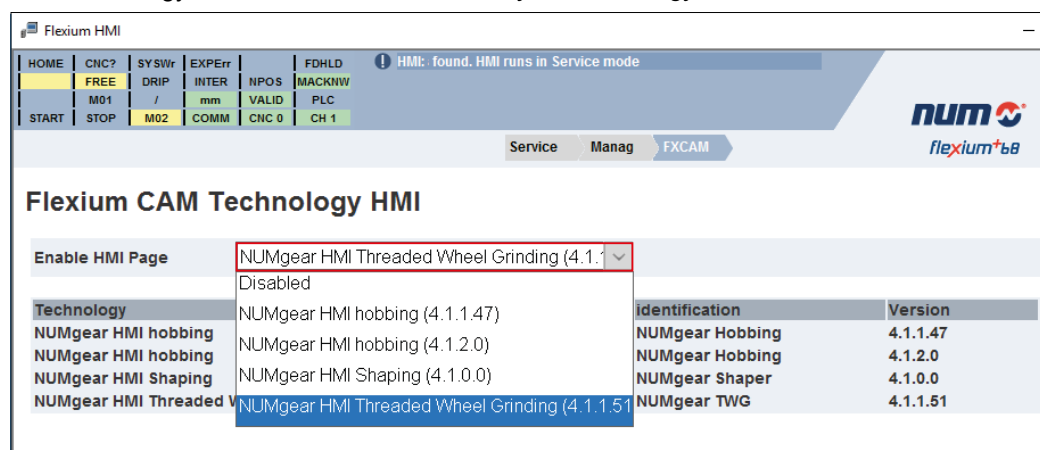
- In the *NUM Flexium+ HMI*, go to the *context Service* (1) and then to the *sub context Management* (2).



- Select *FXCAM*.



- To switch between different technologies even between different versions of the same technology use the combo box to *select your technology*.



- The activation of a technology or the change between the technologies requires a restart of the HMI.

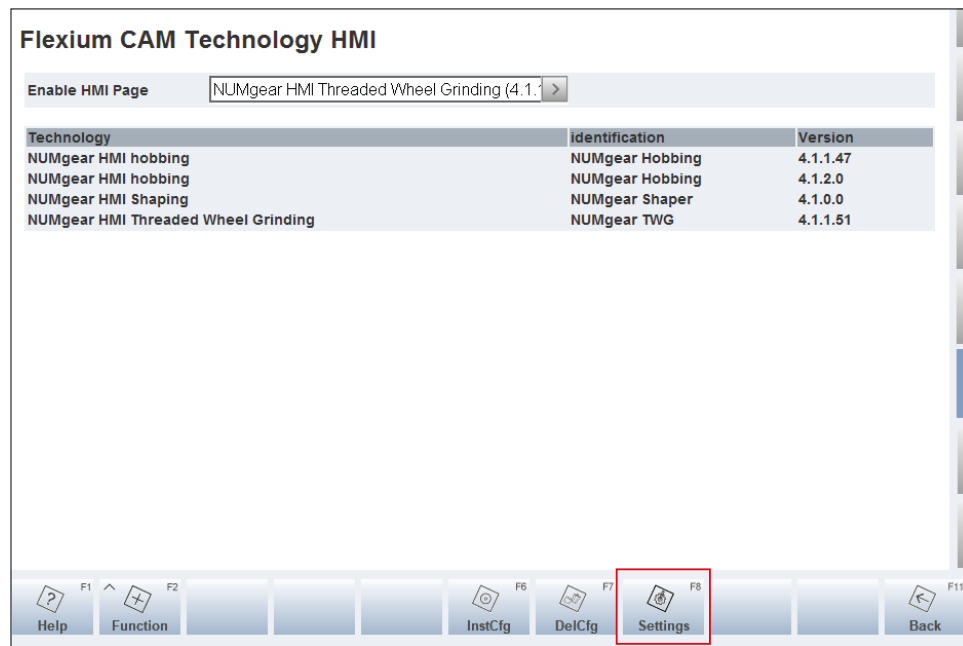
## 2.4 Flexium CAM Settings

### 2.4.1 Pre-setting of Part Program Number

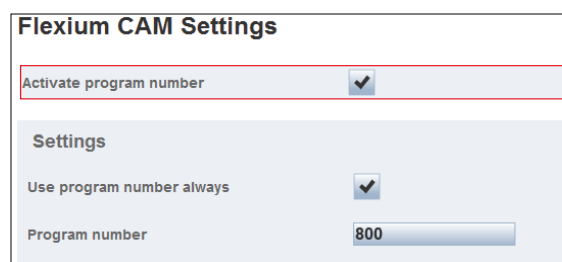
Usually, the operator sets the number of the part programs. But, it is possible to preset it or give them always the same program number.

If you want the part-program number to be fixed, proceed as follows:

- In the *NUM Flexium+ HMI*, go to the context *Service* and then to the sub context *Management*.
- Select *FXCAM*.
- Select *Settings*.

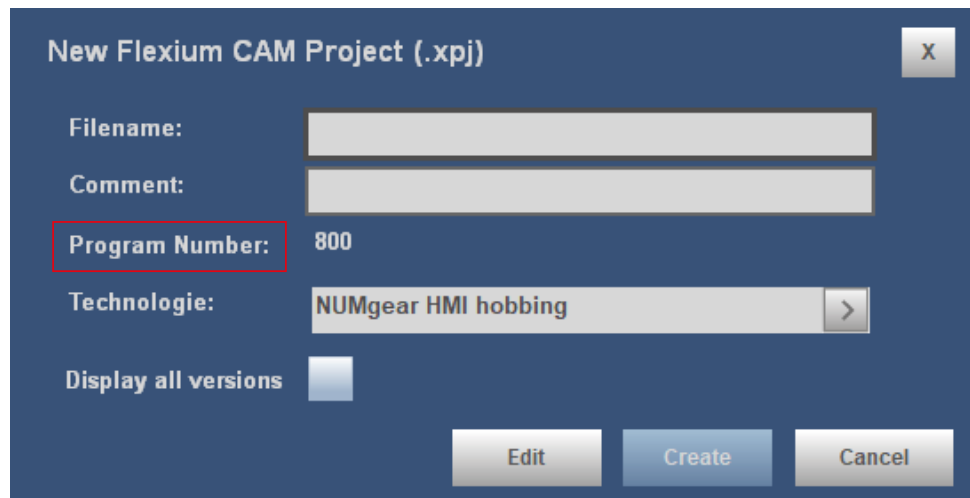


- Check 'Activate program number'.



- Set a value in the field '*Program number*'. This will be the default number for the main part program, the technology HMI will generate.

If '*Use program number always*' is checked then the part program number cannot be changed when creating a new Flexium CAM project.



New Flexium CAM Project (.xpj)

Filename:

Comment:

Program Number: 800

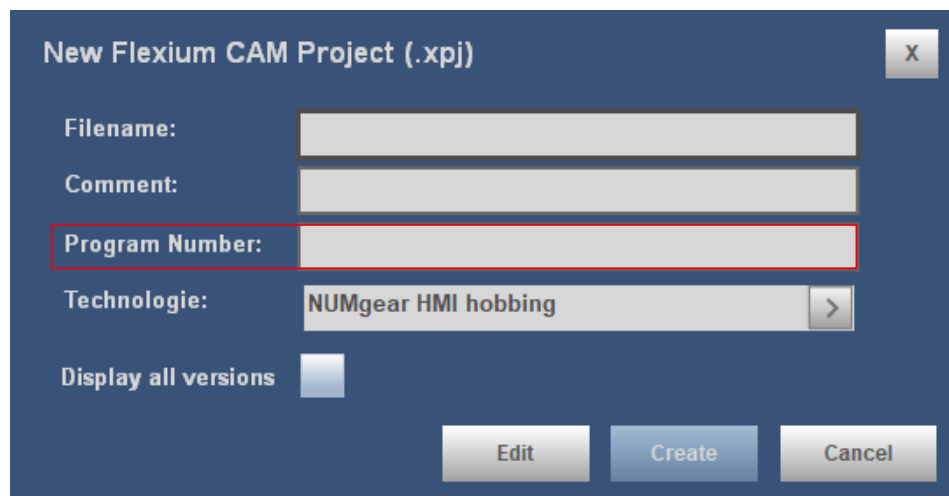
Technologie: NUMgear HMI hobbing >

Display all versions ☐

Edit Create Cancel

If it is not checked, the operator can change the default part program number.

If you leave '*Activate program number*' unchecked, the dialog to create a new project will prompt you for a main program number.



New Flexium CAM Project (.xpj)

Filename:

Comment:

Program Number:

Technologie: NUMgear HMI hobbing >

Display all versions ☐

Edit Create Cancel



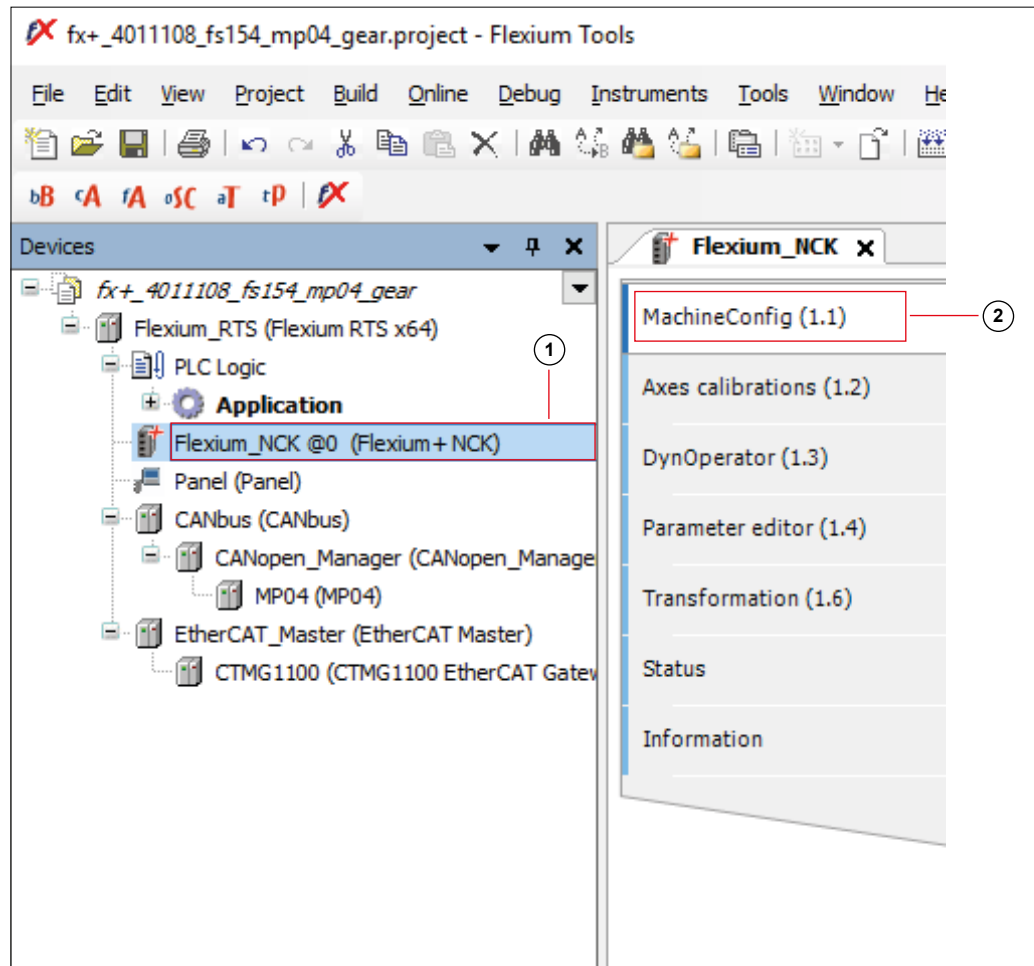
## 2.4.2 Flexium Tools Settings

### 2.4.2.1 XM3 File / Zone 3 File

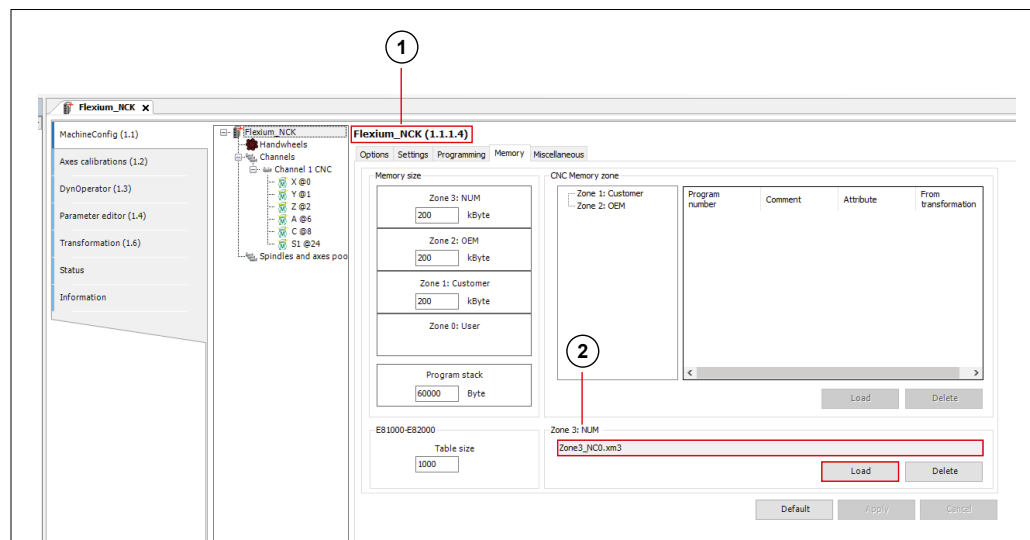
Part programs delivered as part of the technology package are in a Zone 3 file.

They are encrypted and will be loaded into the NC system by means of Flexium Tools.

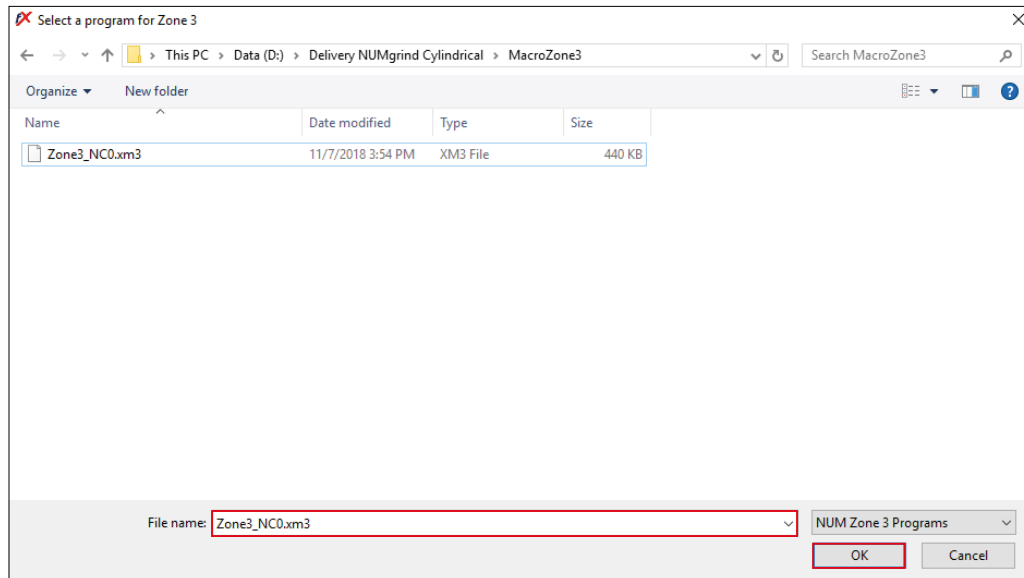
- Double click on *Flexium\_NCK @x (Flexium+ NCK)* (1) and go to the tabbed page and select *Machine Configuration (1.1)* see (2).



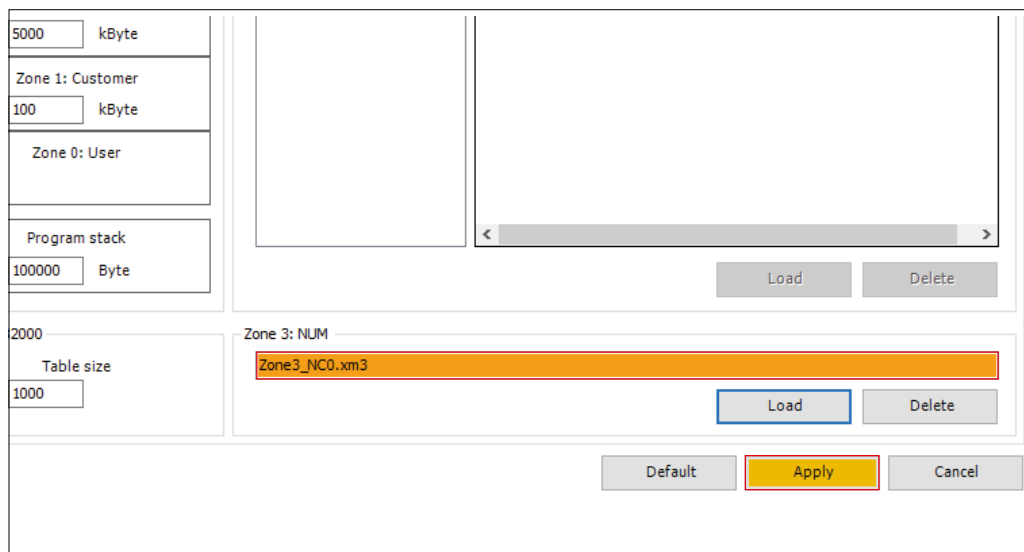
- Go to the *Memory tab*. (1) There you will find in the right bottom corner the following area: *Zone 3: NUM* (2).



- Click on *Load*.
- Select the *Zone 3\_NC0.xm3* file from your file system and confirm with *OK*.  
The file can be found in the unzipped delivery folder (for example for NUMgrind):  
..\\Delivery NUMgrind Cylindrical\\ MacroZone3\\ .



- Confirm the change with by *Apply*.



### 2.4.2.2 Set Memory Size

Sufficient disk space must be allocated to Zone 3 to accommodate all files. Set the according field in the *NCK / MachineConfig / Memory* to 500 (1) or higher and confirm the changes by clicking *Apply* (2).

| Parameter  | Word | Value | Description          |
|------------|------|-------|----------------------|
| <b>P95</b> | N2   | 500   | Size of zone 3 : NUM |

| P95N2 (Size of zone 3 : NUM) |       |                      |
|------------------------------|-------|----------------------|
| Value                        | Unit  | Description          |
| 500                          | kByte | Size of zone 3 : NUM |

---

## 2.5 User Data

---

All links are related to a normal standard installation.

### 2.5.1 Tool Data

The XML file contains all tools, from all technologies. So, for example, the file can contain tools from NUMgear as well as tools from NUMgrind.

|                     |                                                    |
|---------------------|----------------------------------------------------|
| Path Flexium HMI    | C:\ProgramData\NUM\Flexium HMI\FXBrowser\Config\   |
| Path Flexium Office | C:\ProgramData\NUM\Flexium Office\FXOffice\Config\ |
| File                | ToolsDb.xml                                        |

### 2.5.2 FX CAM Config

The configuration file contains setting options for general Flexium CAM purpose.

|                     |                                                    |
|---------------------|----------------------------------------------------|
| Path Flexium HMI    | C:\ProgramData\NUM\Flexium HMI\FXBrowser\Config\   |
| Path Flexium Office | C:\ProgramData\NUM\Flexium Office\FXOffice\Config\ |
| File                | FXCAM.cfg                                          |

#### 2.5.2.1 [Settings]

| Parameters              | Description                                                                    | Values                                                                                                                                                                                                         |
|-------------------------|--------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DefPrgNr                | Default Part Program Number                                                    | Positive Integer Number                                                                                                                                                                                        |
| EnableDefPrgNr          | Enable Default Part Program Number                                             | 0: Disabled<br>1: Enabled                                                                                                                                                                                      |
| EnableUseAlwaysDefPrgNr | Enable Use Always Default Part Program Number                                  | 0: Disabled<br>1: Enabled                                                                                                                                                                                      |
| CreateProjectPath       | File path for new xpj projects. Relevant for Flexium Office.                   | Folder Path. Example:<br>C:\Users\Public\Documents                                                                                                                                                             |
| DebugErrorQueue         | Display additional information in the HMI to debug errors on FX CAM HMI pages. | 0: Disabled<br>1: DisplayUiVariableText (Shows the name of the input field that has the error.)<br>2: DisplayVariableBehindText (Show the CAM variable name that has the error.)<br>3: Combination of 1 and 2. |

The settings can be made very easily via the Settings page of FXCAM. See the manual chapter "Flexium CAM Settings".

## 2.5.2.2 Combinations of the Default Part Program Number

### 1. Combination

| DefPrgNr | EnableDefPrgNr | EnableUseAlwaysDefPrgNr |
|----------|----------------|-------------------------|
| 77       | 0              | 1                       |

**New Flexium CAM Project (.xpj)**

Filename: test.xpj

Folder: C:\\$NCData

Comment:

**Program Number: 77**

Technologie: NUMgear HMI hobbing

Display all versions ☐

Edit Create Cancel

### 2. Combination

| DefPrgNr | EnableDefPrgNr | EnableUseAlwaysDefPrgNr |
|----------|----------------|-------------------------|
| 77       | 1              | 0                       |

Possibility to overwrite the part program number. This number 77 is entered as a suggestion when creating a new project.

**New Flexium CAM Project (.xpj)**

Filename:

Folder: C:\Users\casas\Documents

Comment:

Program Number: 77

Technologie: NUMgear HMI hobbing

Display all versions ☐

Edit Create Cancel

### 3. Combination

| DefPrgNr | EnableDefPrgNr | EnableUseAlwaysDefPrgNr |
|----------|----------------|-------------------------|
| 77       | 0              | 0                       |

No part program number is displayed.

The screenshot shows a dialog box titled "New Flexium CAM Project (.xpj)". It contains several input fields: "Filename:" with the value "test2.xpj", "Folder:" with the value "C:\Users\casas\Documents", "Comment:" (empty), "Program Number:" (empty and highlighted with a red rectangle), "Technologie:" with the value "NUMgear HMI hobbing", and a "Display all versions" checkbox. At the bottom, there are three buttons: "Edit", "Create", and "Cancel".

### 2.5.3 NUMgrind Cylindrical Config

The configuration file contains setting options for the technology-related NUMgrind HMI pages.

|                     |                                                    |
|---------------------|----------------------------------------------------|
| Path Flexium HMI    | C:\ProgramData\NUM\Flexium HMI\FXBrowser\Config\   |
| Path Flexium Office | C:\ProgramData\NUM\Flexium Office\FXOffice\Config\ |
| File                | NUMgrind Cylindrical.cfg                           |

#### 2.5.3.1 [HOBTOOL]

Used on the sF3 page of NUMgrind. Saves whether the tool data is incremental or absolute. Has no influence on NUMgrind.

#### 2.5.3.2 [Focus]

Used on the sF3 page of NUMgrind. Saves the cell on which the focus was last when leaving the sF3 page.

| Parameters | Description                        | Values         |
|------------|------------------------------------|----------------|
| Row        | Saves the row of the last cell     | set by the HMI |
| Col        | Saves the column of the last cell. | set by the HMI |

**2.5.3.3 [General]**

| Parameters     | Description                                                                                                          | Values                                  |
|----------------|----------------------------------------------------------------------------------------------------------------------|-----------------------------------------|
| Vertical       | Not used anymore.                                                                                                    | -                                       |
| AllUnitsInch   | Pre set the input field about the units in the program. Used in «Start of Program» and «Wheel Selection»             | FALSE (mm)<br>TRUE (inch)               |
| Rq_NRq_Enabled | RqSetting used in case where some input fields may be set to required or non-required. Depending on the application. | TRUE (Required)<br>FALSE (Non-Required) |

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1

2

3

4

5

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### 3 Setup Technology HMI for Flexium Office

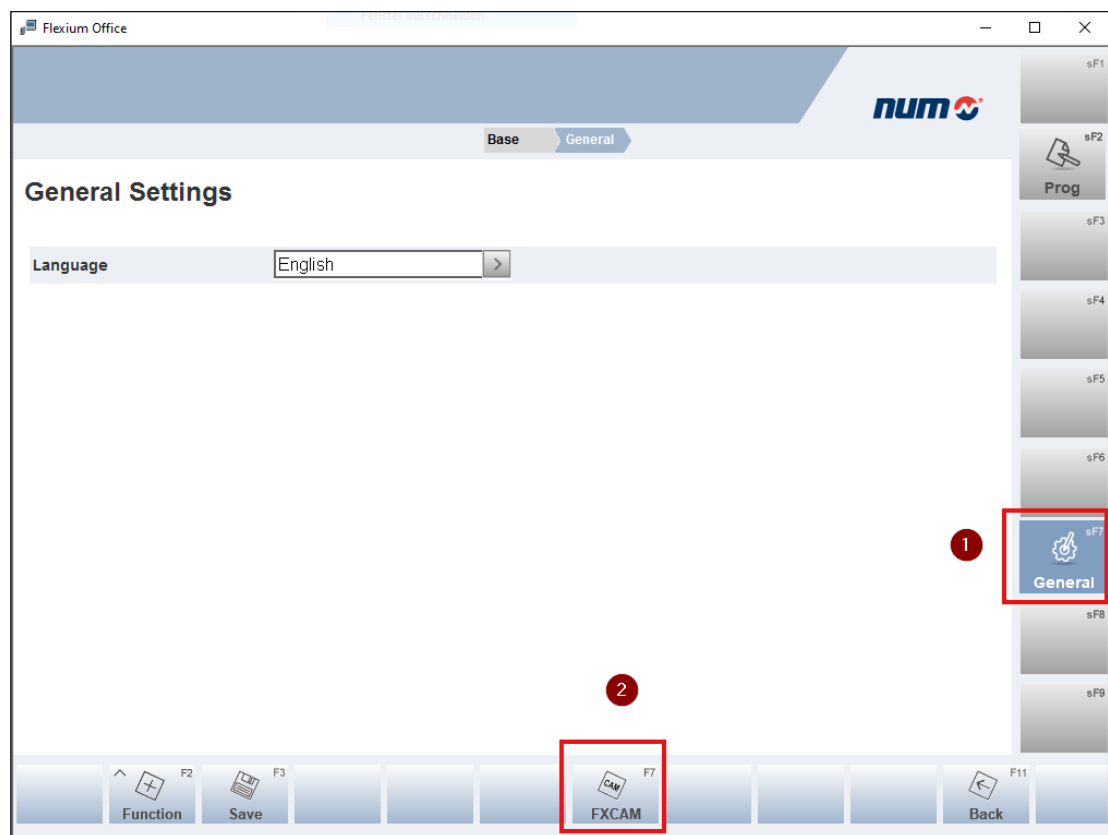
You can install and uninstall technology HMI as necessary.

This allows a user to prepare the necessary part programs for different types of machines with the help of the available technology HMIs.

If you open a project that was created with a version lower than the one you install, the project will be updated automatically once you selected it for editing in the technology HMI.

#### 3.1 Installation of a Technology Package

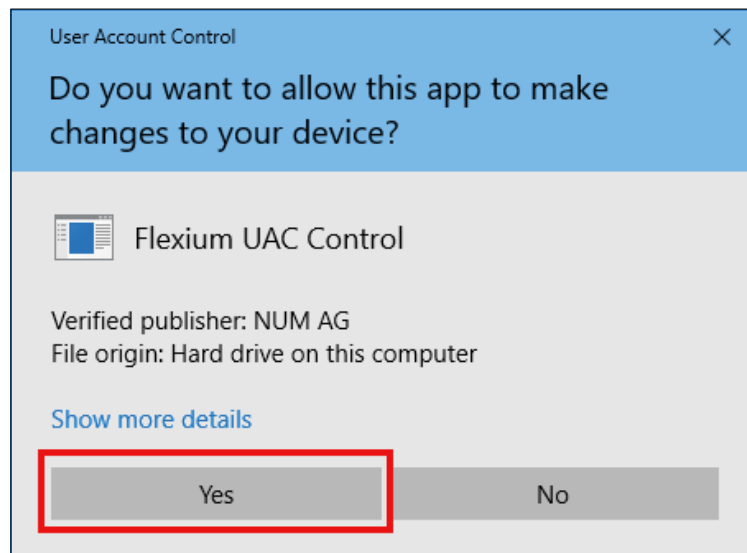
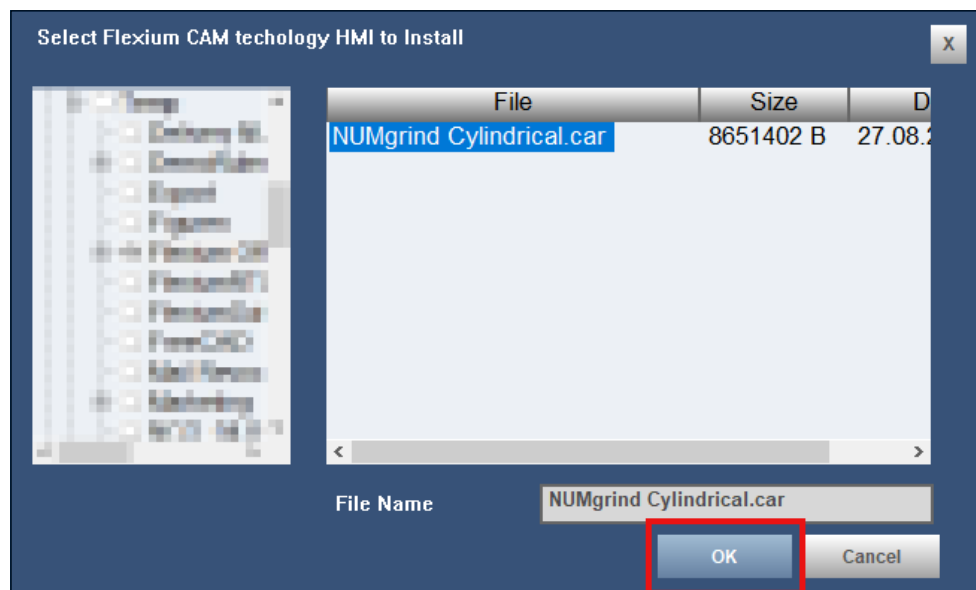
- Copy the “.car” file in a local folder on your drive system.
- In the *NUM Flexium+ Office*, go to the context *General* (1) and then to the sub context *FXCAM* (2).



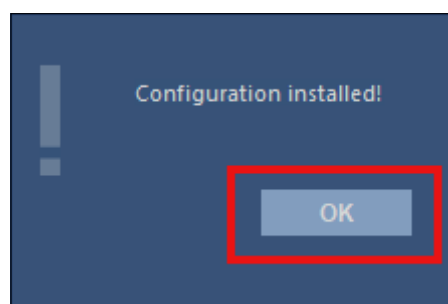
- Here, select *InstCfg*



- Select your “.car” file on your local folder and confirm with **OK**.  
Files from network drives cannot be opened!

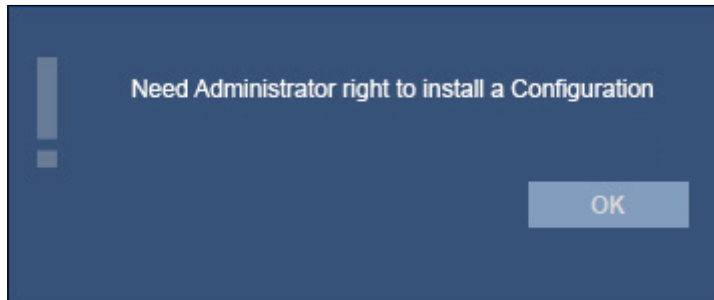


- Allow to install the package and confirm with **YES**.
- The following message should now appear. Confirm with **OK**.



Now you can use the technology HMI to create new projects as well as to edit projects you have created with an earlier version.

If you get the following message, your user/account has not the permission to install a technology package.



Get in contact with your IT specialist.

1

2

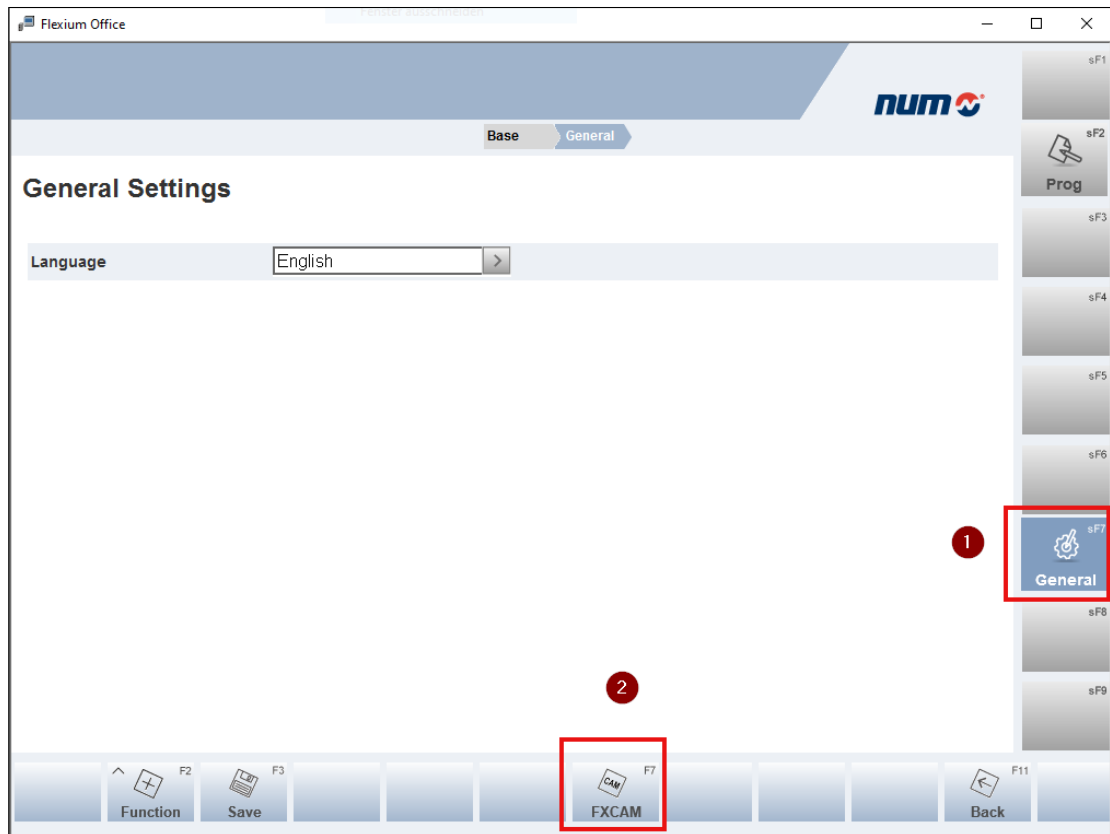
3

4

5

## 3.2 Uninstallation of a Technology Package

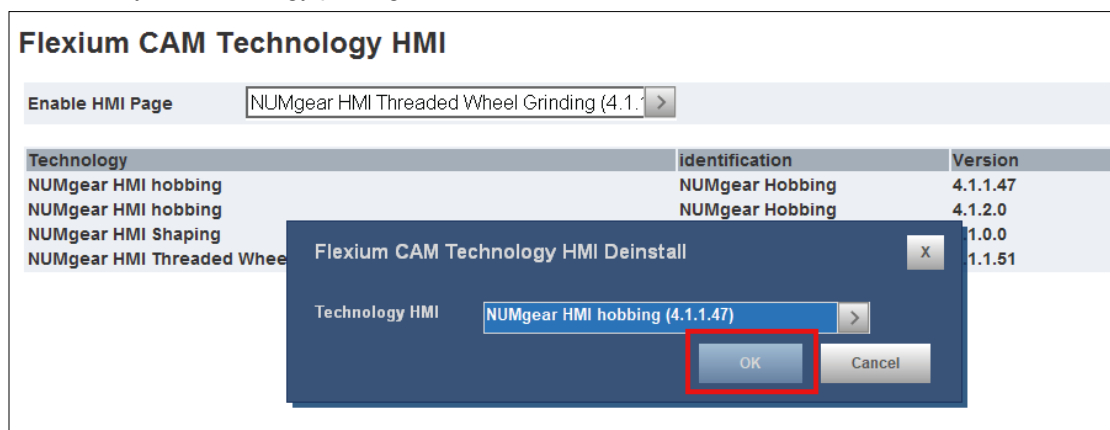
- In the *NUM Flexium<sup>+</sup> Office*, go to the context *General* (1) and then to the sub context *FXCAM* (2).



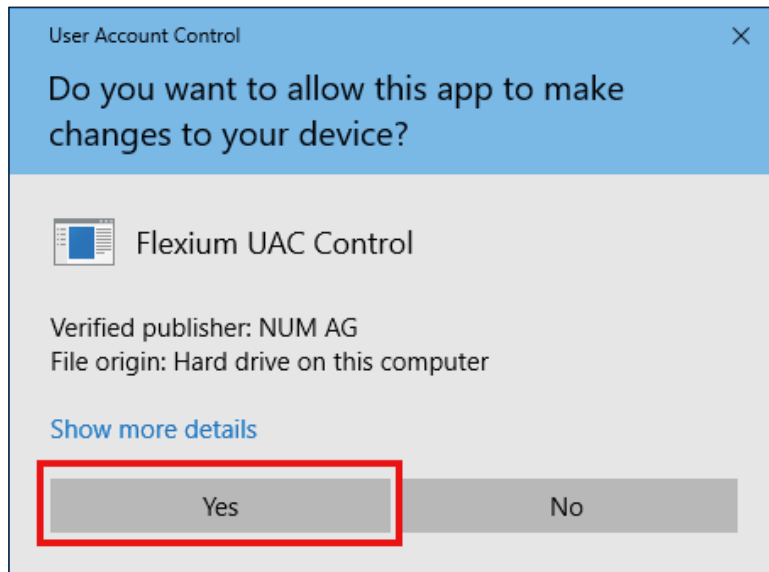
- Here, select *DeICfg*



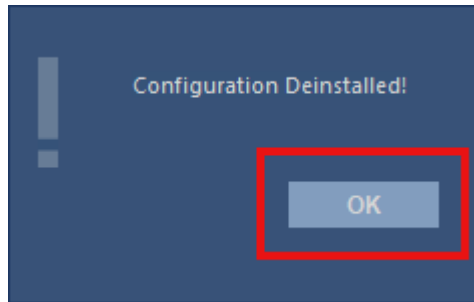
- Select your technology package, which should be uninstalled. Confirm with *OK*.



- Allow to uninstall the package and confirm with YES.



- The following message should now appear. Confirm with OK.



Projects created will not be deleted when you uninstall.

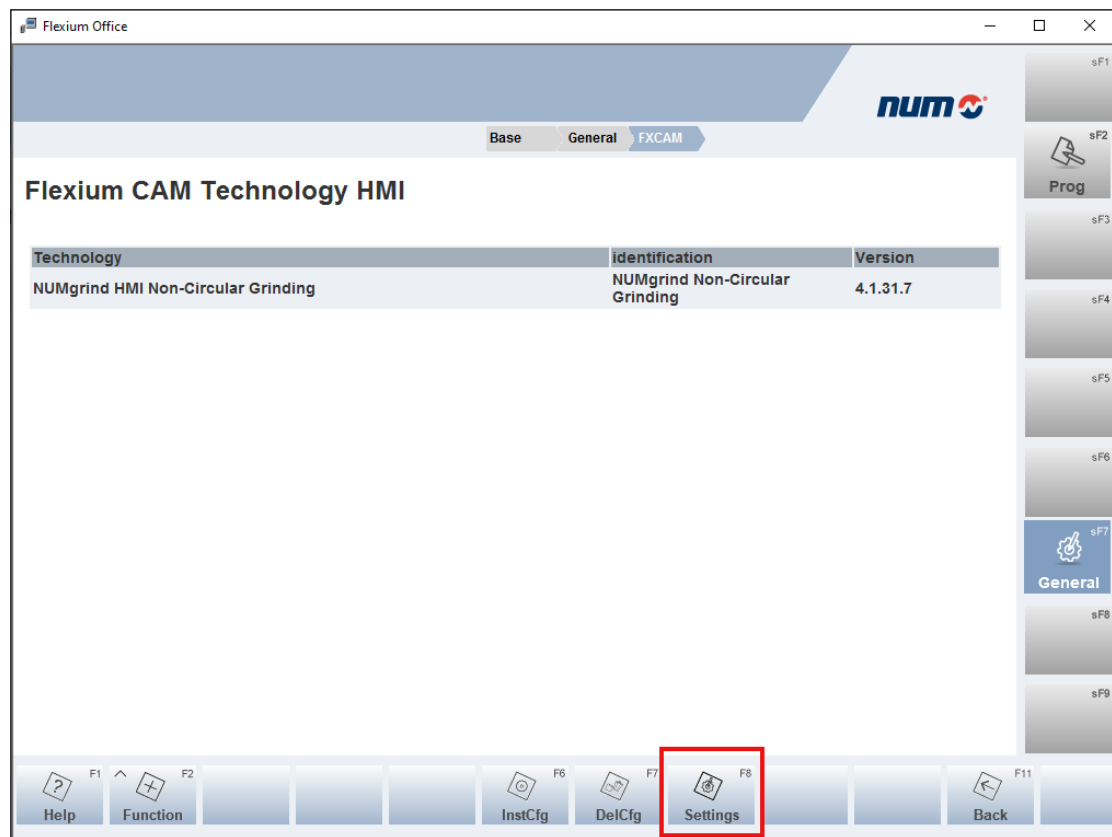
## 3.3 Flexium CAM Settings

### 3.3.1 Pre-setting of Part Program Number

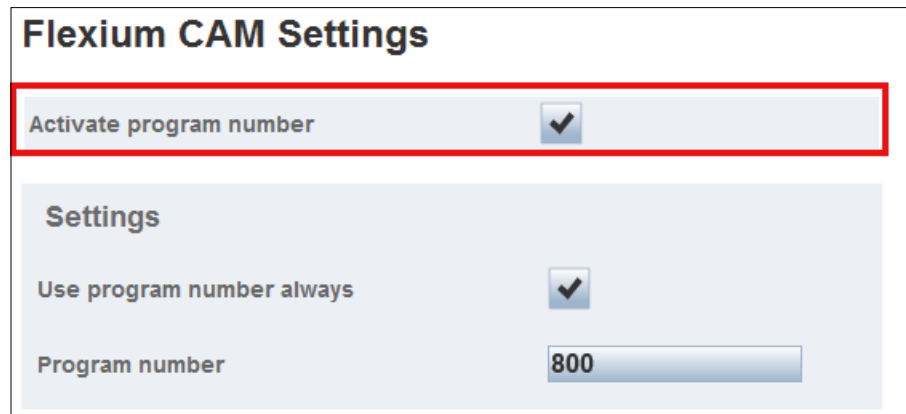
Usually, the operator sets the number of the part programs. But, it is possible to preset it or give them always the same program number.

If you want the part-program number to be fixed, proceed as follows:

- In the *NUM Flexium+ Office*, go to the context *General* and then to the sub context *FXCAM*.
- Select *Settings*.



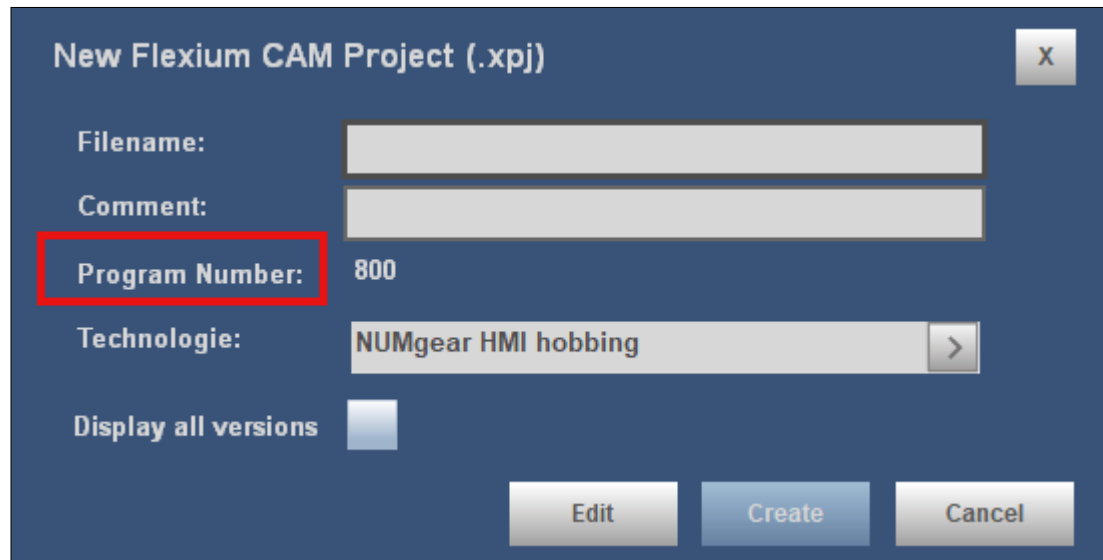
- Check '**Activate program number**'.





- Set a value in the field '**Program number**'. This will be the default number for the main part program, the technology HMI will generate.

If '**Use program number always**' is checked then the part program number cannot be changed when creating a new Flexium CAM project.



New Flexium CAM Project (.xpj)

Filename:

Comment:

**Program Number:** 800

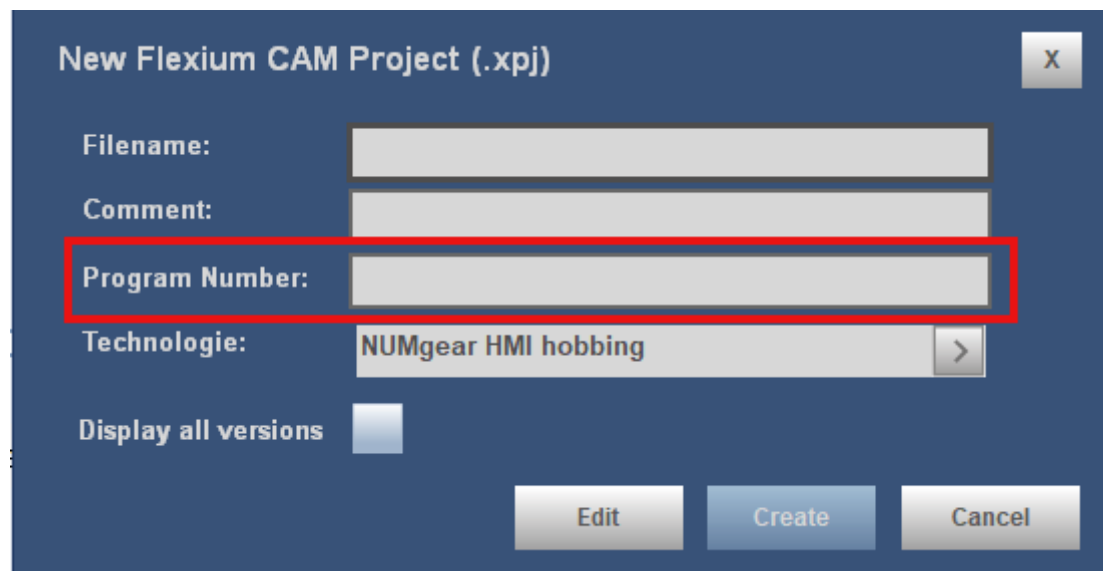
Technologie: NUMgear HMI hobbing >

Display all versions ☐

Edit Create Cancel

If it is not checked, the operator can change the default part program number.

If you leave '**Activate program number**' unchecked, the dialog to create a new project will prompt you for a main program number.



New Flexium CAM Project (.xpj)

Filename:

Comment:

**Program Number:**

Technologie: NUMgear HMI hobbing >

Display all versions ☐

Edit Create Cancel

---

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# Summary

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## 4 NUMmill and NUMgear

### 4.1 NUMmill

To install NUMmill, follow the instructions in Chapter 2.

The machine must have a coordinate system in accordance with standard ISO 841 (or NF Z68-020). The X, Y and Z axes, parallel to the machine slideways, form a right-handed rectangular Cartesian coordinate system.

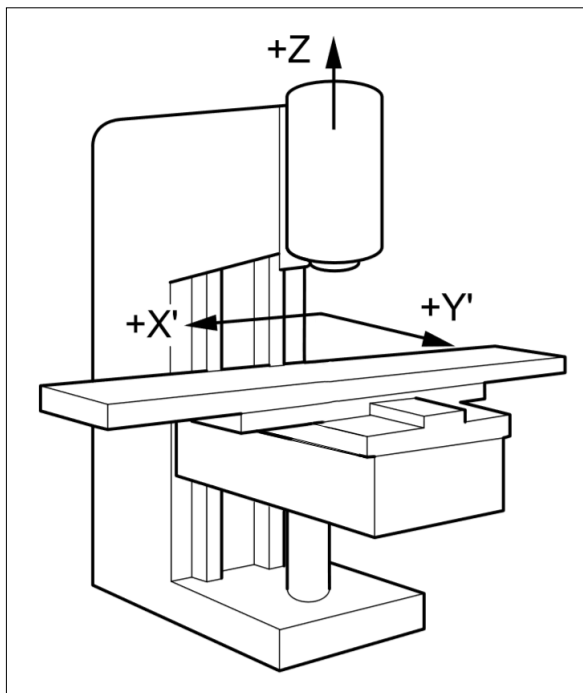
The coordinate system measures the tool movements relative to the part to be machined that is assumed to be fixed.

The direction of the axes of the milling machine must be:

|               |                                                                                                                                                                               |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Z axis</b> | This is the axis of the main spindle when this axis is parallel to one of the slideways. Positive movement along the Z axis increases the distance between the part and tool. |
| <b>X axis</b> | This is perpendicular to the Z axis and corresponds to the largest excursion.                                                                                                 |
| <b>Y axis</b> | This is perpendicular to the X and Z axes.                                                                                                                                    |

#### Example machine:

Cross table milling machine



NUMmill does not require space in the Zone 3.

## 4.2 NUMgear

To install a NUMgear technology, follow the instructions in Chapter 2.

The machine must have the following kinematics:

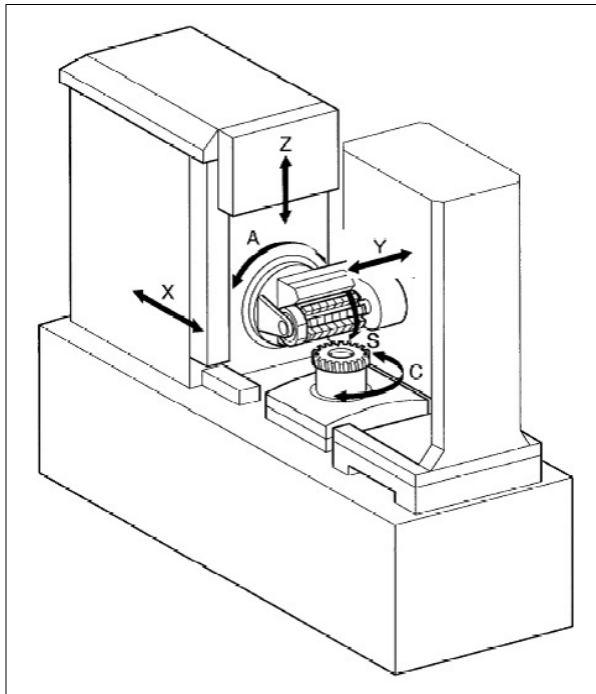
| Axis                  | Axis Designations:                                                                    |
|-----------------------|---------------------------------------------------------------------------------------|
| <b>X Axis</b>         | Radial in feed of tool to gear.                                                       |
| <b>Y Axis</b>         | Tangential shift of tool for tool wear management or diagonal hobbing/grinding cycle. |
| <b>Z Axis</b>         | Axial movement of tool thru the gear during machining cycle.                          |
| <b>A Axis</b>         | Tool head swivel for the adjustment of tool for the proper gear helix angle.          |
| <b>C Axis</b>         | Worktable or work piece rotation.                                                     |
| <b>S Spindle axis</b> | Hob/grinding spindle.                                                                 |

The axes directions are following the right hand rule.

| Axis      | Axis Directions:                                                      |
|-----------|-----------------------------------------------------------------------|
| <b>X+</b> | Moves hob/wheel away from gear.                                       |
| <b>X-</b> | Moves hob/wheel toward gear.                                          |
| <b>Y+</b> | Moves hob/wheel toward outboard bearing. (Conventional hobber)        |
| <b>Y-</b> | Moves hob/wheel away from outboard bearing. (Conventional hobber)     |
| <b>Z+</b> | Moves hob/wheel away from table.                                      |
| <b>Z-</b> | Moves hob/wheel toward table.                                         |
| <b>A+</b> | Moves hob/wheel head gear end toward the table. (Conventional Hobber) |
| <b>A-</b> | Moves hob/wheel head gear end away from table. (Conventional Hobber)  |

### Example machine:

Vertical Gear Hobbing machine



NUMgear requires space in Zone 3. The amount depends on the production technology.

The maximum is 250 kB.

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## Summary

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---

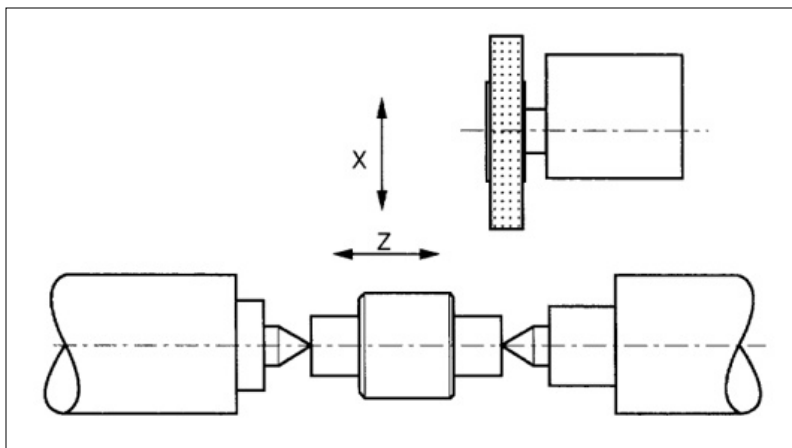
|           |                                                                       |     |
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## 5 NUMgrind

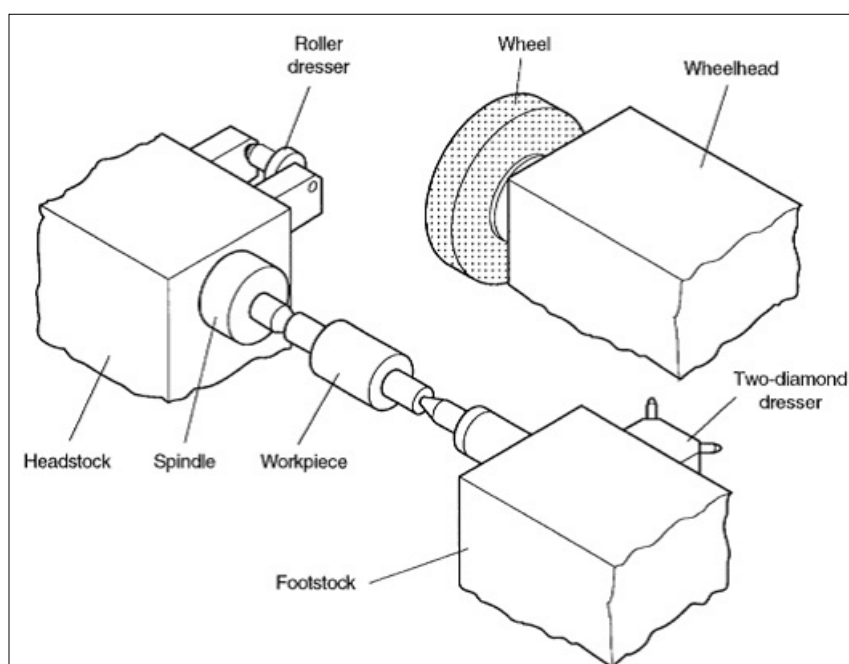
The grinding machine is configured like a turning machine. The axis and spindles are defined as follows:

- X axis: primary radial grinding axis.
- Z axis: primary axial grinding axis.
- One workpiece-holder spindle.
- One or more wheel spindles.
- May include a swiveling wheel head (B rotary axis) for grinding with wheel on inclined axis.
- May be equipped with a headstock and a footstock.
- May be used in the inclined X axis configuration.

There can be many grinding machine configurations, but the movement of the X and Z axis are generally defined using the convention shown in the diagram below.



### 5.1 Schematic Illustration of a Grinding Machine



---

## 5.2 Wheelhead Configurations

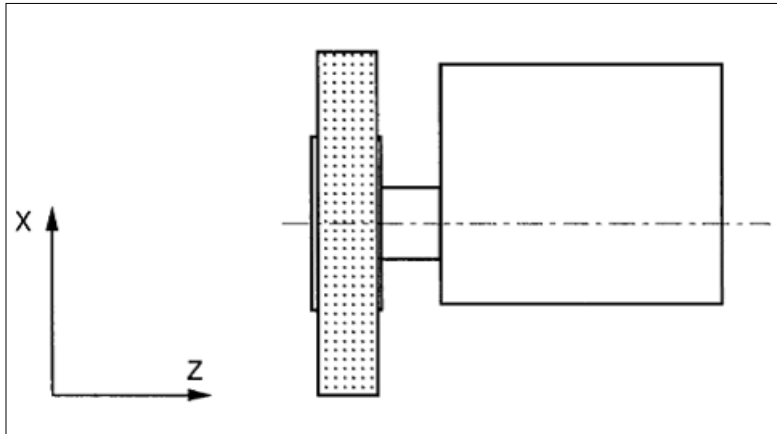
---

Depending on the type of grinding machine and the grinding technique used, the wheel head can be configured as follows:

- Straight.
- On inclined axis.

### Wheelhead (X axis) Straight

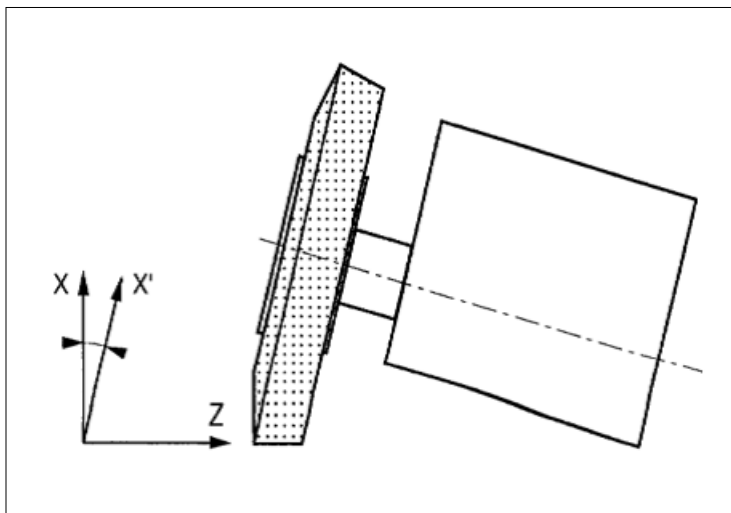
The wheel axis is parallel with the Z axis.



### Wheelhead (X axis) on Inclined Axis

The wheelhead X axis is titled at the angle specified in the machine parameter E69001.

In NUMgrind CAM this value can be specified as '*Wheel Angle*' in the geometrical section of the Angular wheel data page.



## 5.3 Wheel Dressing Tools

Two types of dresser are generally used on grinding wheels:

- fixed two-diamond dresser.
- roller dresser.

### 5.3.1 Fixed Two-Diamond Dresser

This type of dresser can be used to dress:

- the wheel left and right sides and its peripheral cutting face (with a radius or chamfer if necessary).
- a complex wheel shape with a special profile.

#### Limitations associated with the geometry of the fixed two-diamond dresser:

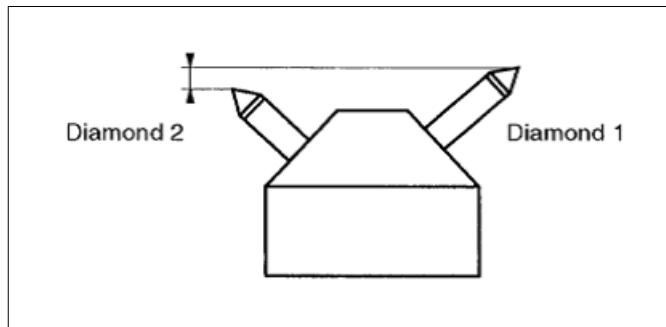
All the shaping and dressing cycles performed with the fixed two-diamond dresser are based on the following principle:

- Diamond 1 (right) is used for dressing the wheel peripheral face and its left side.
- Diamond 2 (left) is used for dressing the right side of the wheel.

#### Two-diamond dresser:

Since diamond 1 dresses the wheel peripheral face, diamond 2 must be lower than diamond 1.

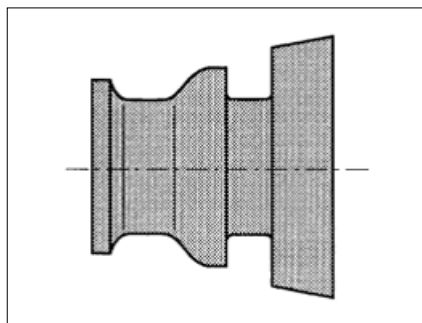
In this case the difference between the two diamonds is negative. Diamonds 1 and 2 are offset with respect to one another.



### 5.3.2 Roller Dresser

A roller dresser is a profiled tool used to dress a wheel to the complementary profile. The roller dresser is rotated by an auxiliary spindle.

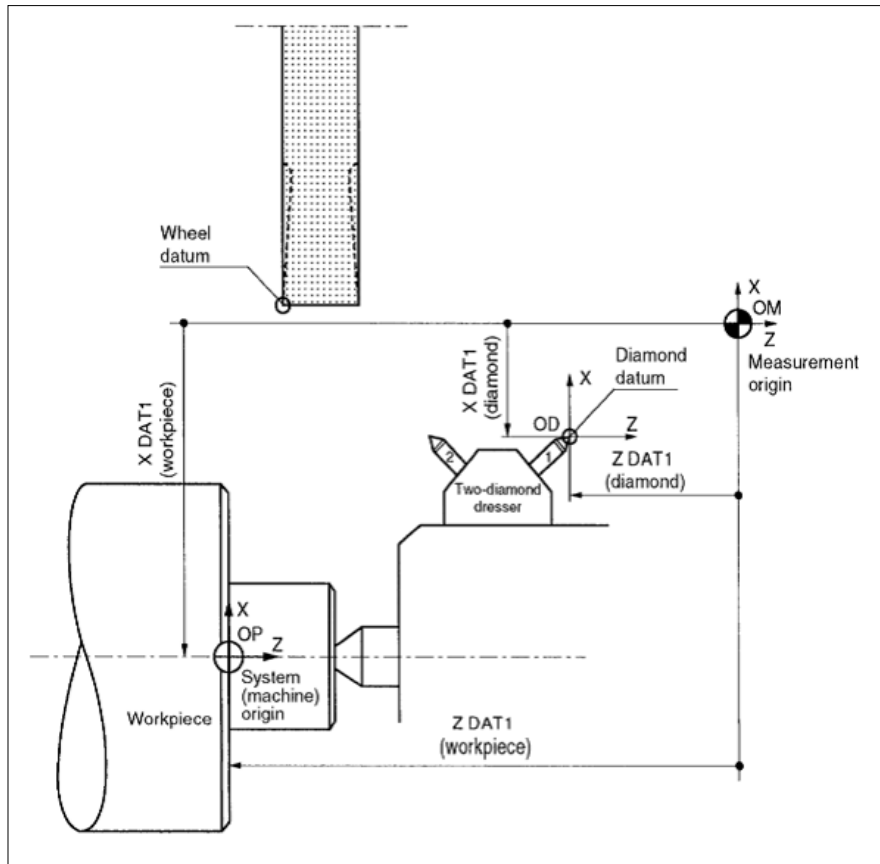
Example of roller dresser:



## 5.4 Setting Origins and Shifts

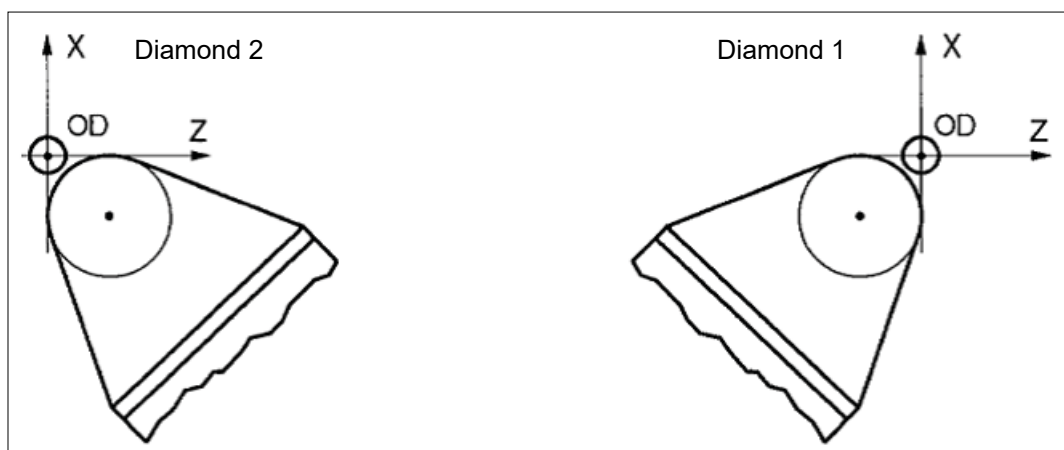
### 5.4.1 Machine Origins and Shifts

External grinding reference system.



### 5.4.2 Dresser Origins

Fixed Two-Diamond Dresser (Diamonds 1 and 2) Origins.



### 5.4.3 Roller Dresser Origin

The roller dresser origin can be position with respect to the reference side of the wheel (left or right side).

## 5.5 Setup an Flexium Tools Application for NUMgrind

- Unzip the ZIP-Folder Delivery NUMgrind Cylindrical.zip to a local folder.  
The unzipped folder will later be used by the HMI, so it is not allowed to move this folder later.  
Therefore, please choose the storage location wisely.
- Start Flexium Tools.
- Open a Flexium Tools Project.

### 5.5.1 Load Zone 3 File

See section 2.5.

NUMgrind requires 600kB in the Zone 3!

### 5.5.2 M Functions and Checkboxes

Various M functions must be assigned to the corresponding program numbers and some ticks must be set in checkboxes. To do this, switch to the Programming register.  
(*Flexium\_NCK / MachineConfig / Programming*).

#### 5.5.2.1 M Functions

The following M codes and NC program numbers must be entered.

| M-Code      | NC Program Call | Function                                                                                              |
|-------------|-----------------|-------------------------------------------------------------------------------------------------------|
| <b>M6</b>   | 9910            | Selecting the wheel and setting up the working environment (Wheel Setup Number Call, Example: M6 T1). |
| <b>M140</b> | 9940            | Dresser Setup Call.                                                                                   |
| <b>M145</b> | 9945            | Part Zero Setup Call.                                                                                 |
| <b>M160</b> | 9920            | Test Counter for Periodic Dress, programmed in Wheel Select Block.                                    |

Corresponding parameter: P35: Subroutine call by M function.

| Parameter  | Word | Value | Description       | Meaning                          |
|------------|------|-------|-------------------|----------------------------------|
| <b>P35</b> | N0   | 6     | M function number | Function M06.                    |
|            | N1   | 9910  | Subroutine number | Subroutine %9910 called by M06.  |
|            | N2   | 140   | M function number | Function M140.                   |
|            | N3   | 9940  | Subroutine number | Subroutine %9940 called by M140. |
|            | N4   | 145   | M function number | Function M145.                   |
|            | N5   | 9945  | Subroutine number | Subroutine %9945 called by M145. |
|            | N6   | 160   | M function number | Function M160.                   |
|            | N7   | 9920  | Subroutine number | Subroutine %9920called by M160.  |

### 5.5.2.2 Checkboxes

The following checkboxes must be selected:

- Forcing manual mode enabled.
- Inhibit HOMING via the keyboard.
- Sub-program %11000 call on RESET.

Corresponding parameter: P7: Miscellaneous Parameter

| Parameter | Word | Bit | Value | Description                        |
|-----------|------|-----|-------|------------------------------------|
| P7        | N1   | 1   | 1     | M12 activates manual intervention. |
|           | N1   | 2   | 1     | Inhibition HOMING via keyboard.    |
|           | N1   | 3   | 1     | %11000 subroutines call on RESET.  |

**P7N1 (Miscellaneous functions)**

| Bit | Value                               | Description                                                              |
|-----|-------------------------------------|--------------------------------------------------------------------------|
| 0   | <input type="checkbox"/>            | Feed rate initialisation in [0=(G94 = mm/min)] [1=(G95 = mm/rev)]        |
| 1   | <input checked="" type="checkbox"/> | M12 activates manual intervention                                        |
| 2   | <input checked="" type="checkbox"/> | Inhibition HOMING via keyboard                                           |
| 3   | <input checked="" type="checkbox"/> | %11000 subroutines call on RESET                                         |
| 4   | <input type="checkbox"/>            | FEED STOP inhibited during rigid tapping                                 |
| 5   | <input type="checkbox"/>            | Radius calculation on the trajectory (E32014) [0=Disabled] [1=Enabled]   |
| 6   | <input type="checkbox"/>            | G52 (Prog/OM) in inclined plane [0=Inhibited] [1=Authorised]             |
| 7   | <input type="checkbox"/>            | Detection of tool interference (Err 149) [0=Activated] [1=Not activated] |

### 5.5.2.3 Overview & Apply

Make the points selections as shown in the figure, then confirm all changes by clicking *Apply* (4).

**Flexium\_NCK (1.1.1.3)**

Options Settings **Programming** Memory Miscellaneous

**M Function**

| M Function | Program |
|------------|---------|
| 6          | 9910    |
| 140        | 9940    |
| 145        | 9945    |
| 160        | 9920    |

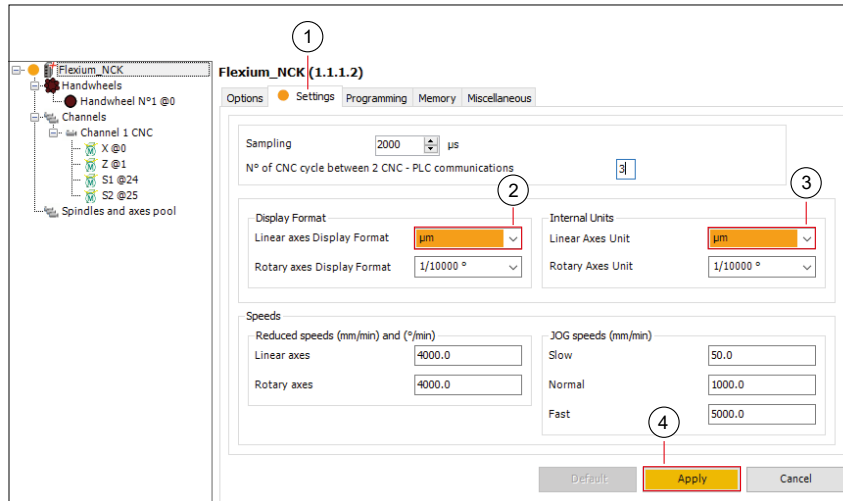
M-Function for workpiece change: 0

Buttons: Default Apply Cancel



### 5.5.3 Display Format & Internal Units

- Switch to the Settings register. (*Flexium\_NCK / MachineConfig / Settings*) (1).
- Select  $\mu\text{m}$  in dropdown menu for Linear axes Display Format (2).
- Select  $\mu\text{m}$  in dropdown menu for Linear Axes Unit (3).
- Confirm with *Apply* (4).



Corresponding parameter:

| Parameter | Word | Value | Description                                                               |
|-----------|------|-------|---------------------------------------------------------------------------|
| <b>P4</b> | N2   | 33h   | Internal measurement unit for linear axes / Dimension format for display. |

The internal measuring unit and the displayed resolution are set in Word N2. The value is composed as follows:

1st number/2nd number = displayed resolution / internal measuring unit.

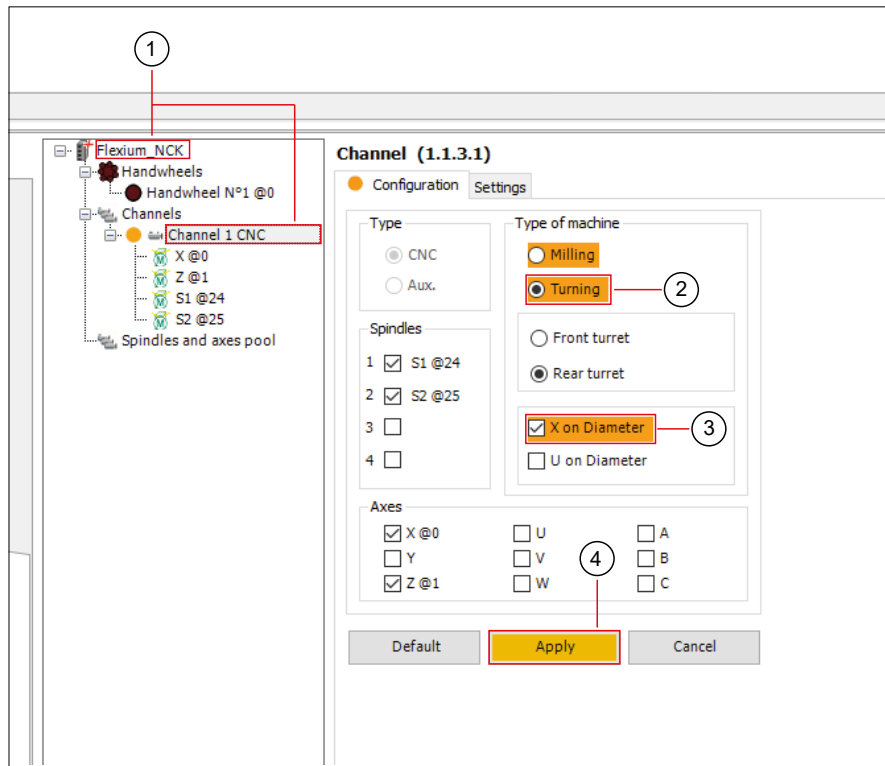
Example: 35 → Displayed resolution is at 1  $\mu\text{m}$ , internal measuring unit at 1/100  $\mu\text{m}$ .

| Digit | Resolution          |
|-------|---------------------|
| 1     | 1/10 mm             |
| 2     | 1/100 mm            |
| 3     | 1 $\mu\text{m}$     |
| 4     | 1/10 $\mu\text{m}$  |
| 5     | 1/100 $\mu\text{m}$ |
| 6     | 1 nm                |
| 7     | 1/10 nm             |
| 8     | 1/100 nm            |

| P4 (Axes programmable by diameter - Internal measurement - Dimension format for acquisition and display) |       |      |                                                                          |        |        |
|----------------------------------------------------------------------------------------------------------|-------|------|--------------------------------------------------------------------------|--------|--------|
| Name                                                                                                     | Value | Unit | Description                                                              | Min    | Max    |
| N0                                                                                                       | 1h    |      | X axis displayed and programmed by diameter for turning                  | 0h     | FFh    |
| N1                                                                                                       | 0h    |      | U axis displayed and programmed by diameter for turning                  | 0h     | FFh    |
| N2                                                                                                       | 33h   |      | Internal measurement unit for linear axes / Dimension format for display | 1h, 1h | 8h, 6h |
| N3                                                                                                       | 0h    |      | X and U axes controlled by diameter in incremental JOG and Handwheel     | 0h     | FFh    |
| N4                                                                                                       | 44h   |      | Internal measurement unit for rotary axes / Dimension format for display | 1h, 1h | 8h, 6h |

## 5.5.4 Channel / CNC Setup

- Switch to the Configuration register, which can be found in Channels → Channel 1 CNC. (*Flexium\_NCK / MachineConfig / Channels / Channel 1 CNC / Configuration*) (1).
- Change there the Type of machine from *Milling* to *Turning* (if not set anyway) (2).  
Corresponding parameter: P5N0B00 (set to 0).
- And set a tick at the checkbox from *X on Diameter* (3).  
Corresponding parameter: P4N0B00 (set to 1).
- Confirm all changes by clicking *Apply* (4).



### 5.5.4.1 Axis

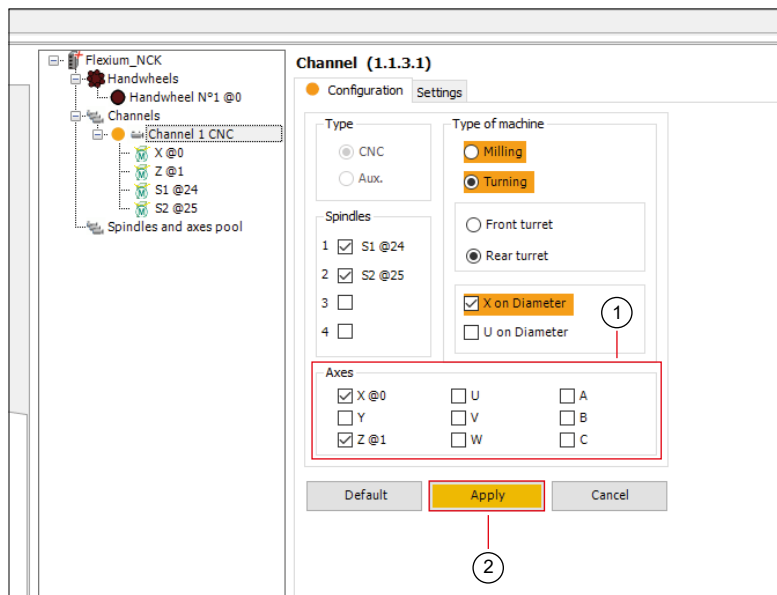
In the same folder as the settings for Channel / CNC were done, the axes must also be assigned. Each cylindrical grinding machine contains at least the X axis and the Z axis.

For more information on how to assign the motors to the axes, please refer to the Flexium<sup>+</sup> Commissioning manual M00044EN.

The following axes have to be defined:

| Axis                 | Description                                       |
|----------------------|---------------------------------------------------|
| <b>X / Z</b>         | Basic external/internal cylindrical grinder.      |
| <b>X / Z / U</b>     | External cylindrical grinder with roller dresser. |
| <b>X / Z / U / W</b> | Grinder with separate 2 axis dresser.             |

Set a *tick at the checkboxes* if necessary (1) and confirm all changes by clicking *Apply* (2).

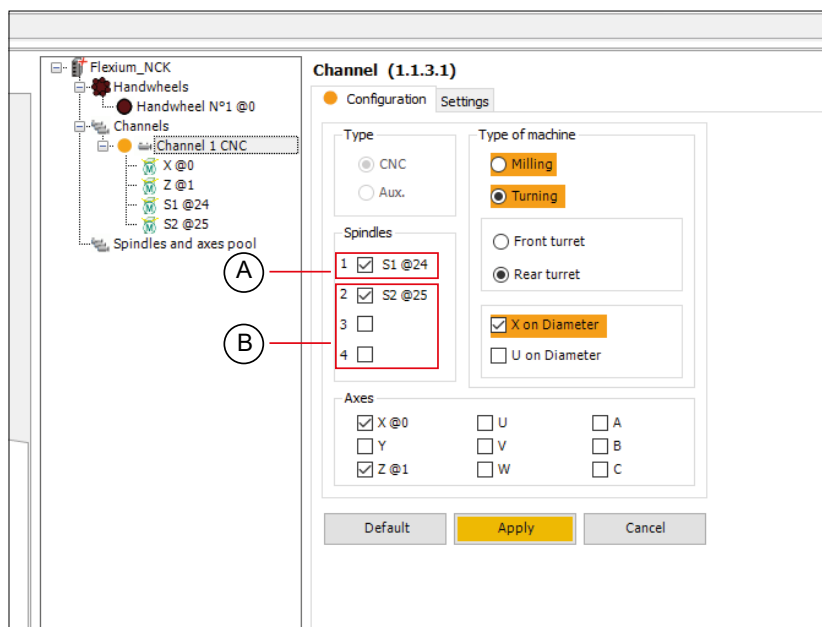


#### 5.5.4.2 Spindles



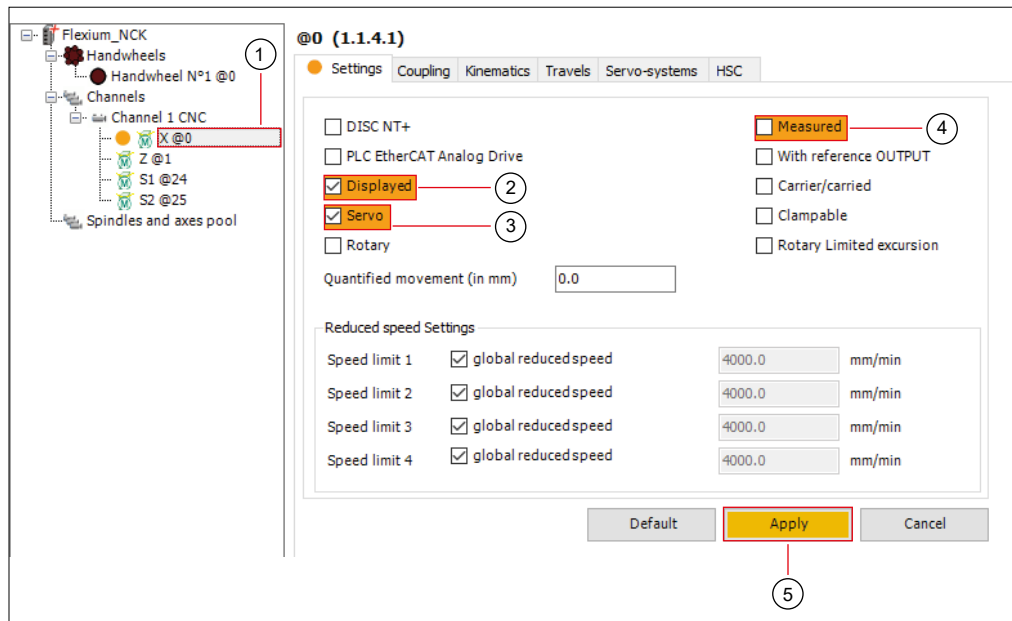
*Spindle number 1 is the main spindle! (A).*  
With NUMgrind, this is always the workpiece spindle!

*Spindle numbers 2 to 4 are auxiliary spindles (B);*  
Therefore the grinding wheel spindle is also an auxiliary spindle!



### 5.5.5 X Axis Parameter

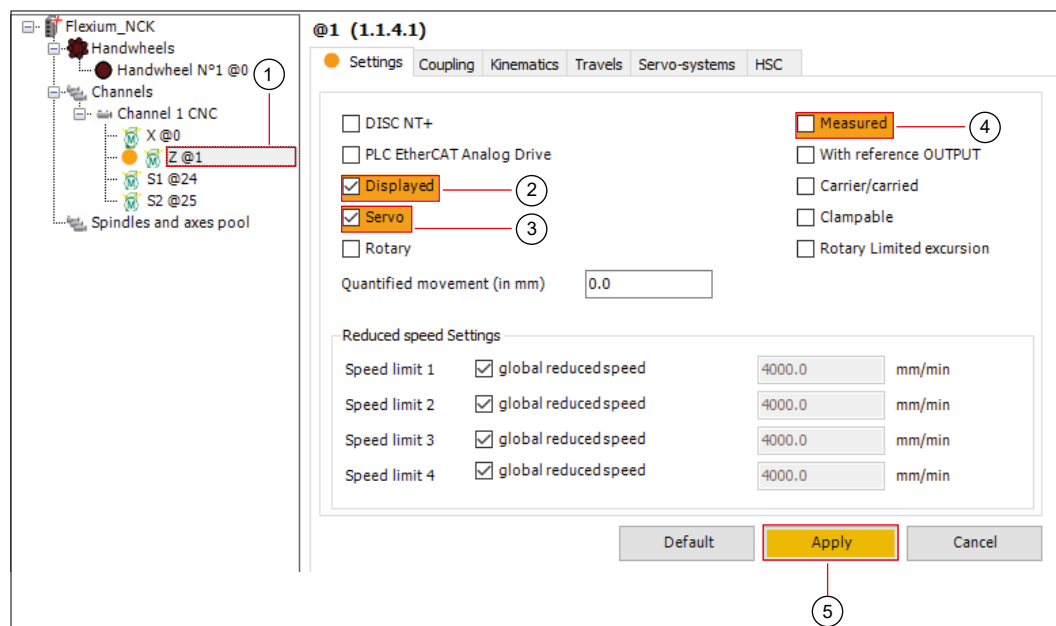
- Switch to the Settings register of the X - Axis, which can be found in Channels → *Channel 1 CNC* → *X@0* (1).
- Set a tick at the checkbox *Displayed* (2)  
Corresponding parameter: P0N0B00.
- Set a tick at the checkbox *Servo* (3)  
Corresponding parameter: P120N2B00.
- Set NO tick at the checkbox *Measured* (4)  
Corresponding parameter: P120N4B00.
- Confirm all changes by clicking *Apply* (5).



### 5.5.6 Z Axis Parameter

Do the same for the Z axis as you did for the X axis.

- Switch to the Settings register of the Z –Axis , which can be found in Channels → *Channel 1 CNC* → *Z@1*. (1).
- Set a tick at the checkboxe Displayed (2)  
Corresponding parameter: P0N0B01.
- Set a tick at the checkboxe Servo (3)  
Corresponding parameter: P120N2B01.
- Set NO tick at the checkboxe Measured (4)  
Corresponding parameter: P120N4B01.
- Confirm all changes by clicking Apply (5).



### 5.5.7 Overview Parameter

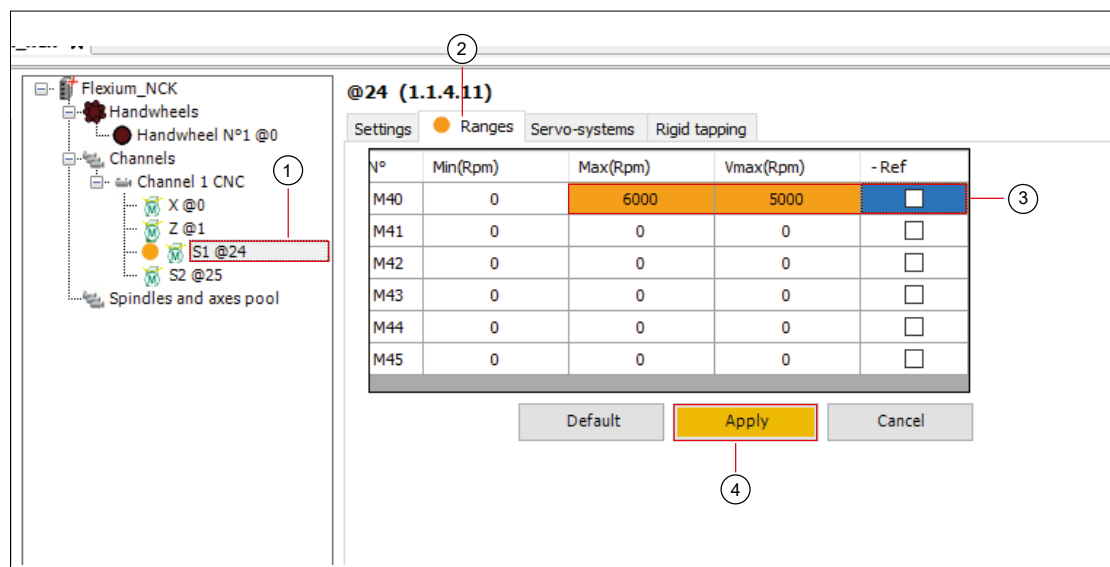
If P9 is set as shown then:

| Parameter   | Word | Bit | Value | Description          | Meaning                                             |
|-------------|------|-----|-------|----------------------|-----------------------------------------------------|
| <b>P0</b>   | N0   | 0   | 1     | Axis @0              | Display X axis.                                     |
|             |      | 1   | 1     | Axis @1              | Display Z axis.                                     |
| <b>P9</b>   | N0   |     | 0h    | Symbolic axis number | X axis belongs to channel 1.                        |
|             |      |     | 1h    | Channel number       |                                                     |
|             | N1   |     | 2h    | Symbolic axis number | Z axis belongs to channel 1.                        |
|             |      |     | 1h    | Channel number       |                                                     |
| <b>P120</b> | N2   | 0   | 1     | Axis @0              | X axis is a servo controlled and interpolated axis  |
|             |      | 1   | 1     | Axis @1              | Z axis is a servo controlled and interpolated axis. |
|             | N4   | 0   | 1     | Axis @0              | X axis is an axis without measure INPUT.            |
|             |      | 1   | 1     | Axis @1              | Z axis is an axis without measure INPUT.            |

### 5.5.8 Spindles Parameters

If you have a spindle which, for example, is controlled by a star-delta circuit and the spindle only knows the On/Off modes, you can skip this chapter. As soon as the spindle runs via a motor controller and the motor controller is connected to the NCK, the spindle must be listed here in the project.

- Switch to your *spindle* (1).
- Select the tab *Ranges* (2).
- Enter values in the following fields depending on your spindle motor (3):
  - Min (Rpm): Minimum speed in range *M40* for spindle.
  - Max (Rpm): Maximum range *M40* for spindle (This is the theoretical spindle speed when the motor is running at its maximum rpm).
  - Vmax (Rpm): Limit speed in range *M40* for spindle (If set to 0 the limit speed is the max speed of the range).
- Confirm all changes by clicking Apply (4).



If Vmax is greater than Max, the NCK will discard an error once the project has been downloaded to the NCK.

Error 81 Ext 2 Wrong spindle configuration.

---

**Example:**

If the ranges would go from 0-10 V DC, then 6000 rpm would be 100% and thus 10V DC.

The 5000 rpm is like a limit which can be set as OEM. If the spindle is requested by a part program to rotate faster than 5000 rpm, an exception is thrown.

| 0 rpm | 6000 rpm | 5000 rpm |
|-------|----------|----------|
| 0 V   | 10 V     | 8.33 V   |

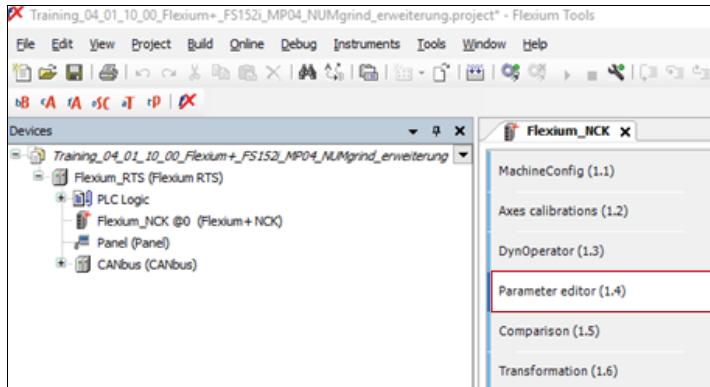
For more information about these parameters refer to the Flexium<sup>+</sup> Parameters manual M00041EN and depending on your spindle channel to one of the following sections:

| Address of spindle | Parameter | Section                              |
|--------------------|-----------|--------------------------------------|
| @0 ... @7          | P46       | Speed range for spindles @0 ... @7   |
| @8 ... @15         | P47       | Speed range for spindles @8 ... @15  |
| @16 ... @23        | P48       | Speed range for spindles @16 ... @23 |
| @24 ... @31        | P49       | Speed range for spindles @24 ... @31 |



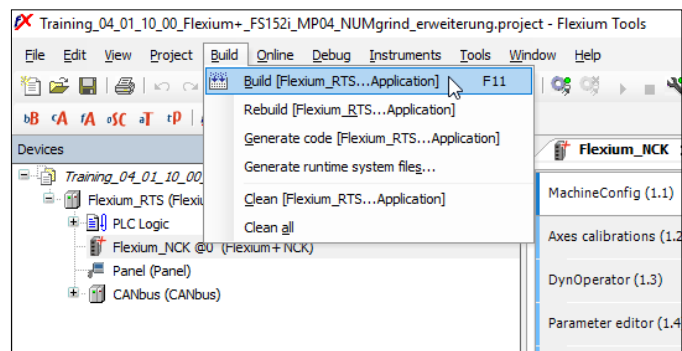
### 5.5.9 Parameter Setting

Go to the tabbed page and select *Parameter editor* (1.4). Various parameters must be checked or set there.

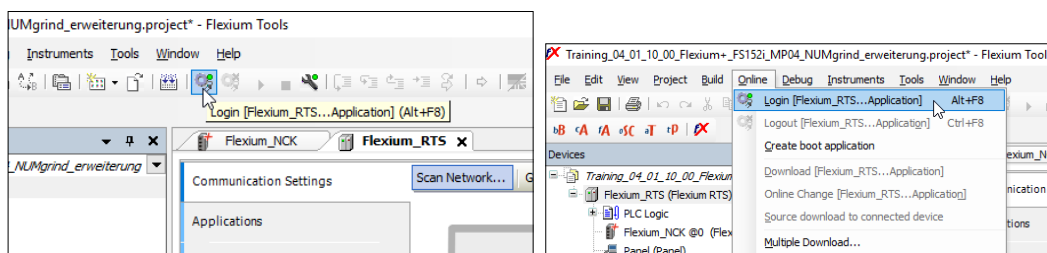


### 5.5.10 Build & Load Application to RTS

Build the source code for the transfer to the RTS and NCK by clicking the key F11 on the Keyboard or via the menu *Build* → *Build [Flexium\_RTS...Application]*.



Login to your RTS via the key combination Alt+F8, the icon in the toolbar or via the menu *Online* → *Login [Flexium\_RTS...Application]*



If you can't get online, more information can be found in the Flexium+ Commissioning manual M00044EN.

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## 5.6 Language Files for NUMgrind

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This section explains how to add the NUMgrind specific operator and error messages to the *Language.ini* file.

- Go to your unzipped delivery folder:
  - a. Go to the following subfolder: *..\Delivery NUMgrind Cylindrical\HMI\Language*.
  - b. Go into that subfolder, which represent your language.

| Shortcut | Language   | Section in the Language.ini-file |
|----------|------------|----------------------------------|
| cn       | Chinese    | 5                                |
| cs       | Czech      | 8                                |
| da       | Danish     | 15                               |
| de       | German     | 2                                |
| en       | English    | 1                                |
| es       | Spanish    | 7                                |
| fr       | French     | 3                                |
| hu       | Hungarian  | 12                               |
| it       | Italian    | 4                                |
| pl       | Polish     | 9                                |
| pt       | Portuguese | 6                                |
| ro       | Romanian   | 13                               |
| ru       | Russian    | 10                               |
| tr       | Turkish    | 11                               |
| tw       | Taiwanese  | 14                               |

- c. There you will find two files (yy is a placeholder)

*CN\_NUMgrind Cylindrical\_Error\_yy.txt*

*CN\_NUMgrind Cylindrical\_OperatorMessage\_yy.txt*

- Go to the following folder: *c:\Program Files (x86)\NUM\Flexium HMI\FXBrowser\Bin\*
- Open with a text editor program (for example Notepad++ or standard Notepad) the *Language.ini* file with administrator rights.
- Add the path of the needed files at the right section.
  - a. Go to your section.
  - b. Search the next free spot of *CncPlusErrorFilex* (x is a placeholder).
  - c. Add the path of your error-file.

**Example:**

*D:\Delivery NUMgrind Cylindrical\HMI\Language\de\CN\_NUMgrind Cylindrical\_Error\_de.txt*

```

181 Cnc14ErrorFile=
182 Cnc15ErrorFile=
183 CncPlusErrorFile0=C:\Program Files (x86)\NUM\Flexium HMI\FXBrowser\Language\de\CN_Errors_de.txt
184 CncPlusErrorFile1=C:\Program Files (x86)\NUM\Flexium HMI\FXBrowser\Language\de\CN_Macros_Error_de.txt
185 CncPlusErrorFile2=D:\Delivery NUMgrind Cylindrical\HMI\Language\de\CN_NUMgrind Cylindrical_Error_de.txt
186 CncPlusErrorFile3=
187 CncPlusErrorFile4=
188 CncPlusErrorFile5=

```

- d. Search the next free spot of *CncPlusOperatorMsgFile*x (x is a placeholder).

```

233 CncPlus14WarningFile=
234 CncPlus15WarningFile=
235 CncPlusOperatorMsgFile0=C:\Program Files (x86)\NUM\Flexium HMI\FXBrowser\Language\de\CN_OperatorMessage_de.txt
236 CncPlusOperatorMsgFile1=D:\Delivery NUMgrind Cylindrical\HMI\Language\de\CN_NUMgrind Cylindrical_OperatorMessage_de.txt
237 CncPlusOperatorMsgFile2=
238 CncPlusOperatorMsgFile3=

```

- e. Add the path of your error-file.  
 f. If you want, you can add multiple paths to the *Language.ini-File*.  
 g. When you are done, save the *Language.ini* file and close it.



As soon as you move the unzipped delivery folder, Flexium HMI will discard an error at startup!

Therefore either do not move the unzipped delivery folder anymore or change the paths in the *Language.ini* file if the unzipped delivery folder has been moved.

---

## 5.7 CNC Files for NUMgrind

---

The following two sections deal with the reset file and the machine data file.

Both files can be edited. This can be done before the transfer to the machine on a PC or laptop (for example with the program Notepad++) or also after loading the files into the zone directly on the HMI editor.

### 5.7.1 G Cycles

All G cycles can be looked up in the following manual: Flexium+ Cylindrical Grinding Programming manual M00049EN.

### 5.7.2 Reset File

The file %11000.0 is called the reset routine. The program is executed each time on a reset.

The file can be found in the unzipped delivery folder: `..\Delivery NUMgrind Cylindrical\Part Programs\110000.xpi`

Check the following values and adapt them to your specifications.

More information about the reset routine can be found in the following manuals:

Flexium+ Programming manual M00040EN Chapter: Subroutine call on Reset %11000.

#### 5.7.2.1 Universal Inch / Metric variable

If the NUMgrind NC programs including the NUMgrind HMI are used, the E-parameter E80002 is automatically set via the templates of *Wheel Selection* and *Start of Program*.

Therefore the E80002 is NOT required in the reset file!

If the NUMgrind cycles are used alone (without NUMgrind HMI), the reset file must be supplemented with the E80002!

| Parameter | Value       | Description             |
|-----------|-------------|-------------------------|
| E80002    | 1           | Units in Inch.          |
|           | 2 (default) | Units in Metric.        |
|           | 3           | Units in Inch / Metric. |

### 5.7.2.2 MAX Wheel RPM or Calculated RPM

| Parameter     | Value          | Description                                  |
|---------------|----------------|----------------------------------------------|
| <b>E30000</b> | --             | Calculated wheel RPM for machine setups 1-8. |
| <b>E30001</b> | 2000 (default) | Max. Wheel RPM Tool 1 (T1).                  |
| <b>E30002</b> | 2000 (default) | Max. Wheel RPM Tool 2 (T2).                  |
| <b>E30003</b> | 2000 (default) | Max. Wheel RPM Tool 3 (T3).                  |
| <b>E30004</b> | 2000 (default) | Max. Wheel RPM Tool 4 (T4).                  |
| <b>E30005</b> | 2000 (default) | Max. Wheel RPM Tool 5 (T5).                  |
| <b>E30006</b> | 2000 (default) | Max. Wheel RPM Tool 6 (T6).                  |
| <b>E30007</b> | 2000 (default) | Max. Wheel RPM Tool 7 (T7).                  |
| <b>E30008</b> | 2000 (default) | Max. Wheel RPM Tool 8 (T8).                  |

Parameter E30000 is calculated and used in NC program %10230 (contained in Zone 3).

Parameters E30001-E30008 can be used by the PLC and compared with the E30000. In case of too high value the PLC can throw a message. The E30001-E30008 are not used in any NUMgrind cycles.

For example, the PLC could be used to program that an error message is discarded if the value of E30000 is exceeded in comparison to the values of E30001-E30008.

### 5.7.2.3 Part Speed

| Parameter     | Value         | Description                                                       |
|---------------|---------------|-------------------------------------------------------------------|
| <b>E80003</b> | 200 (default) | Work RPM part setup / the RPM of the workpiece during part setup. |

#### 5.7.2.4 Flagging Parameter & BCD Flagging Probe Resolution

The parameters E80005 and E80008 are for possible measurements of parts in Z direction (Part flagging for Z shift).

Not to be confused with the measuring possibilities in X direction on the parts! These are two different measurements.

| Parameter | Value       | Description                                 | Flagging Type<br>(set in HMI NUMgrind) |
|-----------|-------------|---------------------------------------------|----------------------------------------|
| E80005    | 0           | No Flagging                                 | -                                      |
|           | 1 (default) | Single Interrupt Input Flag                 | Automatic.                             |
|           | 2           | Multi Input BCD <sup>2</sup> Gauge Probe    | Automatic.                             |
|           | 3           | Manually Teach Z                            | Cond. Manual.                          |
|           | E40096      | Value 0-3 set by PLC. <sup>1</sup>          | Automatic or Cond. Manual.             |
| E80008    | 10          | BCD Probe Resolution is 1 µm (1 micron)     | -                                      |
|           | 1 (default) | BCD Probe Resolution is 0.1 µm (0.1 micron) | -                                      |

1. The PLC must send a command for the reset routine (%11000) to the NC as soon as the value of E40096 has been changed by the PLC.

2. BCD: Binary Coded Decimal

#### 5.7.2.5 Wheel Data in Inch/Metric

| Parameter | Value       | Description                           |
|-----------|-------------|---------------------------------------|
| E80006    | 0           | Wheel Data in Inch → Inch Mode (G70). |
|           | 1 (default) | Wheel Data in mm → Metric Mode (G71). |

The variable E80006 does not convert the wheel data field from inch to metric or vice-versa in the cycles!

#### 5.7.2.6 Wheel / Spindle Speed

| Parameter | Value       | Description                                                              |
|-----------|-------------|--------------------------------------------------------------------------|
| E80007    | 0           | Wheel / Spindle On/Off, no speed control (example star-delta switching). |
|           | 1 (default) | Variable Wheel / Spindle Speed (example servo controlled).               |

When Dress Wheel or Shape Wheel push buttons are pressed and E80007 = 1 the program asks the operator to enter the wheel speed in ft/min or M/s.

Message: "\$0 Wheel Speed in Ft/min or M/s:"

If E80007 = 0 these message is skipped and the Wheel runs at one specific speed (max speed of the spindle).

### 5.7.2.7 Backoff Amount Part Setup

| Parameter     | Value            | Description                                                               |
|---------------|------------------|---------------------------------------------------------------------------|
| <b>E80009</b> | 508000 (default) | Value in internal / system measurement units.                             |
| <b>E80018</b> | 0                | Move wheel to calculated backoff position (Current X Position + UE80009). |
|               | 1 (default)      | Move wheel to X safe OM during part setup instead of incr. move.          |

This value is used when the diameter of a part in X is touched during part setup.

After the wheel touches the surface of the part, the wheel will backoff to a position (Backoff position = Current X Position + UE80009) in the positive X direction.

Depending on the value set in P4N2, the value in parameter E80009 is converted differently.

#### Example:

In P4N2 the value 33h and in E80009 the value 508000 are set. The 508000 now corresponds to 508 mm. If the value 34h were set in P4N2, then the value 508000 would correspond to 50.8 mm.

| E80009        | P4N2 | Factor  | Effective lengths |
|---------------|------|---------|-------------------|
| <b>508000</b> | 33h  | 1 µm    | 508 mm            |
| <b>508000</b> | 34h  | 1/10 µm | 50.8 mm           |

The numerical values of P4N2 are broken down in section "*P4: Axes programmable by diameter - Internal measurement – Dimension format for acquisition and display*".

If the parameter E80018 is set to 1, then the parameter E80009 has no influence how big the backoff distance is.

The backoff distance is then determined by the value set in the NUMgrind CAM under "*Safe X Machine Position*" in the wheel file.

### 5.7.2.8 Roller Dresser

| Parameter     | Value       | Description                                       |
|---------------|-------------|---------------------------------------------------|
| <b>E80010</b> | 0 (default) | Standard servo.                                   |
|               | 1           | Hydraulic roller or Special Roller Dresser cycle. |

### 5.7.2.9 Axis setup

| Parameter     | Value       | Description                       |
|---------------|-------------|-----------------------------------|
| <b>E80011</b> | 0 (default) | XZ axis for Dressing and Shaping. |
|               | 1           | UW axis for Dressing and Shaping. |

### 5.7.2.10 Default Setup Number

| Parameter | Value         | Description                                                                                                |
|-----------|---------------|------------------------------------------------------------------------------------------------------------|
| E80012    | 1             | Setup number (1-8) is fix set in the reset routine and the operator is not prompted to enter setup number. |
|           | 2             |                                                                                                            |
|           | 3             |                                                                                                            |
|           | 4             |                                                                                                            |
|           | 5             |                                                                                                            |
|           | 6             |                                                                                                            |
|           | 7             |                                                                                                            |
|           | 8             |                                                                                                            |
|           | 999 (default) | The operator is prompted to enter the setup number every time.                                             |

### 5.7.2.11 Default Wheel File Number

| Parameter | Value         | Description                                                                                                    |
|-----------|---------------|----------------------------------------------------------------------------------------------------------------|
| E80013    | 1             | Wheel file number is fix set in the reset routine and the operator is not prompted to enter wheel file number. |
|           | 2             |                                                                                                                |
|           | 3             |                                                                                                                |
|           | 4             |                                                                                                                |
|           | 5             |                                                                                                                |
|           | 6             |                                                                                                                |
|           | 7             |                                                                                                                |
|           | 8             |                                                                                                                |
|           | 999 (default) | The operator is prompted to enter the wheel file number every time.                                            |

### 5.7.2.12 Rough Setup Positions

| Parameter | Value       | Description                                                           |
|-----------|-------------|-----------------------------------------------------------------------|
| E10025    | 0 (default) | Rough Setup Positions switched off.                                   |
|           | 1           | Rough Setup Positions switched on (Used during dresser setup %99400). |

Rough Setup Positions allows the operator, during the dresser setup, to move the motionless / stationary grinding wheel in manual mode and under open safety doors very close to the diamond, but without touching the diamond.

The process is described in detail on Flexium Cylindrical Grinding Operator's manual M00057EN.



### 5.7.3 Machine Data File

The file %9910.1 is called the machine data file. The machine data file is used by the grinding and dressing canned cycles to define various default parameters.

The file can be found in the unzipped delivery folder:

..\Delivery NUMgrind Cylindrical\Part Programs\99101.xpi.

Some lines of the machine data file should be checked by the machine manufacturer and adapted if necessary. The machine data file is divided into 4 sections:

- General Data.
- Dressing and Shaping Data.
- Z-Flagging Device Data.
- Setup Data and Wheel Data.

Check only the settings from N10 to N23 and adapt them to your specifications. All other data does not need to be edited. These fields need to be manually entered.



If the machine data file has been modified and then loaded to the NCK, all saved wheel data is gone! Among other things, distances to dressing station, workpiece and between diamonds.

Therefore, the file %9910.1 should first be loaded from the NCK to the PC on which the HMI is running, modified and then downloaded again so that the values are retained.

How the data can be loaded from the NCK into the local memory is described in chapter Context "*Programming*" of the Flexium+ HMI Operator Manual - M00039EN.



The lines in the Machine Date File must have the following properties:

- 1 At least 22 spaces after the equal sign (=) for writing data into the file (see Flexium+ Programming manual M00040EN. Transfer of the *current values* of L Variables and E Parameters into the part program).
- 2 To read L-variables from the file, the number after the equal sign (=) may have a maximum of 22 digits incl. sign and decimal point!
- 3 1 line may have a maximum of 118 characters including comments and N notation (see Flexium+ Programming manual M00040EN in chapter General word format).
- 4 No double brackets (...(...)...), % characters and square brackets [ ] in the comments.

Examples (Spaces are marked with \*)

| Case | Example                                                                                                        | Good / Bad | Explanation                                                                              |
|------|----------------------------------------------------------------------------------------------------------------|------------|------------------------------------------------------------------------------------------|
| 1    | N200 L0 =+0.00*****(Comment)                                                                                   | Bad        | Has too few spaces after the equal sign (=).                                             |
|      | N200 L0 =+0.00***** (Comment)                                                                                  | Good       | Has enough spaces after the equal sign (=).                                              |
| 2    | N10 L0 =+1.2345678912345678912345***** (Comment)                                                               | Bad        | Too many characters in the number after the equal sign (=) incl. sign and decimal point. |
|      | N10 L0 =+1.23456789***** (Comment)                                                                             | Good       | Number incl. sign and decimal point has less than 22 characters.                         |
| 3    | N111 L11 =+1.23456789123456789***** (Comment<br>CommentCommentCommentCommentCommentCommentComment-<br>Comment) | Bad        | More than 118 characters.                                                                |
|      | N10 L0 =+1.23456789***** (Comment)                                                                             | Good       | Less than 118 characters.                                                                |
| 4    | N10 L0 =+1.234567***** (Comment A (Comment B)<br>Comment C)                                                    | Bad        | Double brackets (...(...)) in the comment.                                               |
|      | N10 L0 =+1.23456789***** (Comment A %9910.1 Comment B)                                                         | Bad        | % characters in the comment.                                                             |
|      | N10 L0 =+1.23456789***** (Comment A [WD1] Comment B)                                                           | Bad        | Square brackets [ ] in the comment.                                                      |
|      | N10 L0 =+1.23456789***** (Comment A WD1 Prog. 9910.1)                                                          | Good       | No double brackets (...(...)), % characters and square brackets [ ] in the comment.      |

### 5.7.3.1 General Data

|                   |                                                                                            |
|-------------------|--------------------------------------------------------------------------------------------|
| <b>N10 @X = X</b> | Name of axis 0. To be specified as per parameter P9.                                       |
| <b>N11 @Z = Z</b> | Name of axis 1. To be specified as per parameter P9.                                       |
| <b>N12 @U = U</b> | Name of axis 3. To be specified as per parameter P9 but only if roller dresser is present. |

#### Example:

If the axis of the roller dresser is called axis W by the machine builder, then the following should stand: @U =W. Within the system, the U-axis is the Roller Dresser axis.

For more information about the @-notation please refer to the Flexium<sup>+</sup> Programming manual M00040EN in chapter Address equivalences.

---

|                     |                                         |
|---------------------|-----------------------------------------|
| <b>N13 L0 = 0.2</b> | Safety amount under the final diameter. |
|---------------------|-----------------------------------------|

To be specified for grinding with measurement. When the gauging cycle is called from any of the OD, ID canned cycles, assuming that the program has just ended the finishing phase with 0 stock amount left to grind, the gauge measures the part and if it is found that the part is not at size then the gauging cycle will start grinding the part until a trip point (interrupt) is triggered.

Lacking an interrupt, grinding continues beyond the programmed dimension until reaching L0.

---

|                   |                                                                                                |
|-------------------|------------------------------------------------------------------------------------------------|
| <b>N14 L1 = 4</b> | Dummy gauge axis address (A kind of address of the "auxiliary" measuring axis). Range: 0 – 31. |
|-------------------|------------------------------------------------------------------------------------------------|

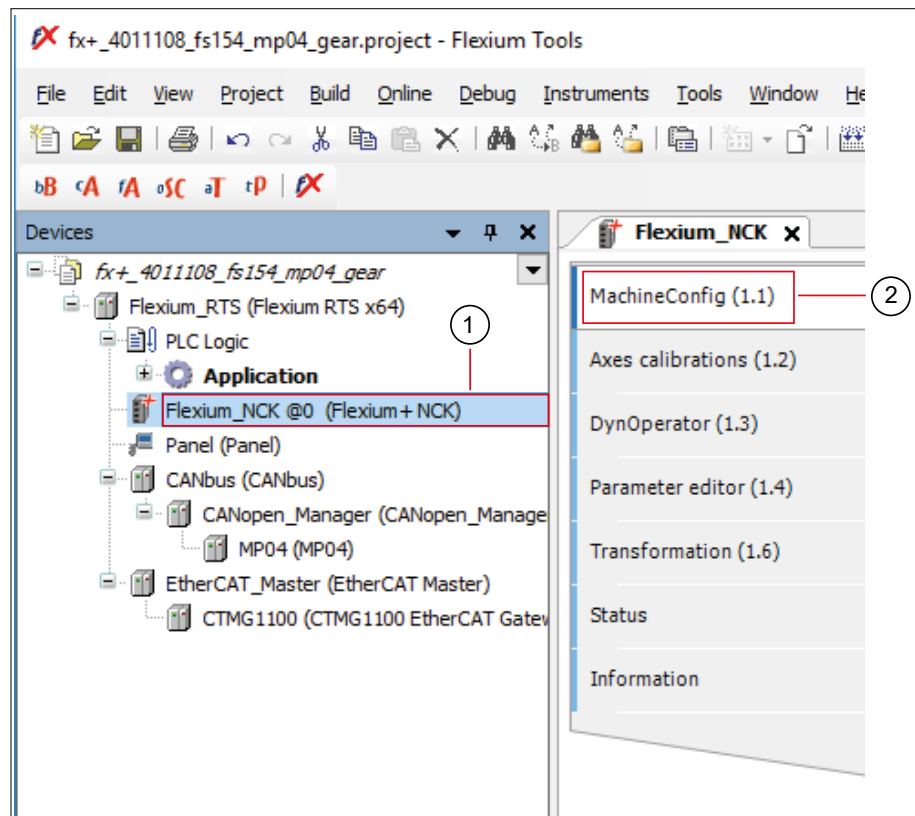
The value assigned to variable L1 is the address of the dummy variable used for measurement by interrupt. To be specified for gap elimination or grinding with measurement. This field specifies the dummy axis number used in flagging and gauging cycles (%10231.0).



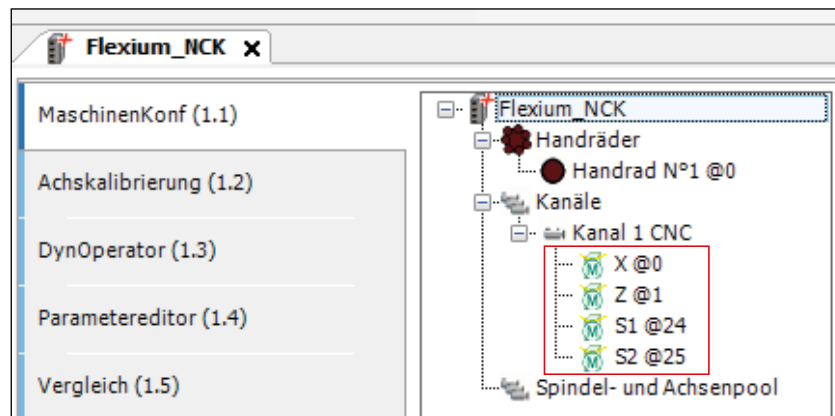
Any axis address that is not physically assigned to an axis may be entered. Never assign the address to a physically occupied axis! This can lead to unexpected movements of the machine.

The system checks whether the axis address does not match an address, a physical axis, (E7x005) whether the axis is not servo controlled (E9100x) or whether it is a measuring axis (E9310x).

To check which addresses are already occupied, open the machine project in Flexium Tools, double click on *Flexium\_NCK @x (Flexium+ NCK)* and go to the tabbed page and select *Machine Configuration (1.1)*.



In this example you can see that the axis addresses 0, 1, 24 and 25 are occupied.

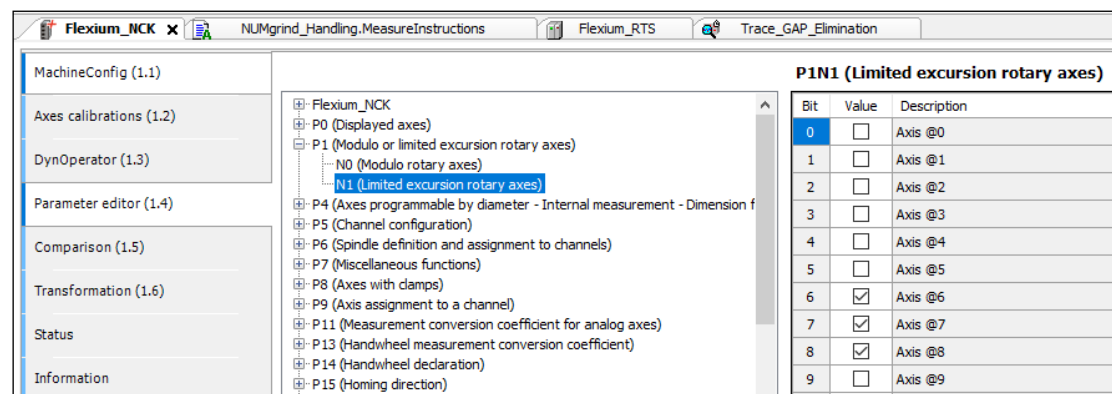
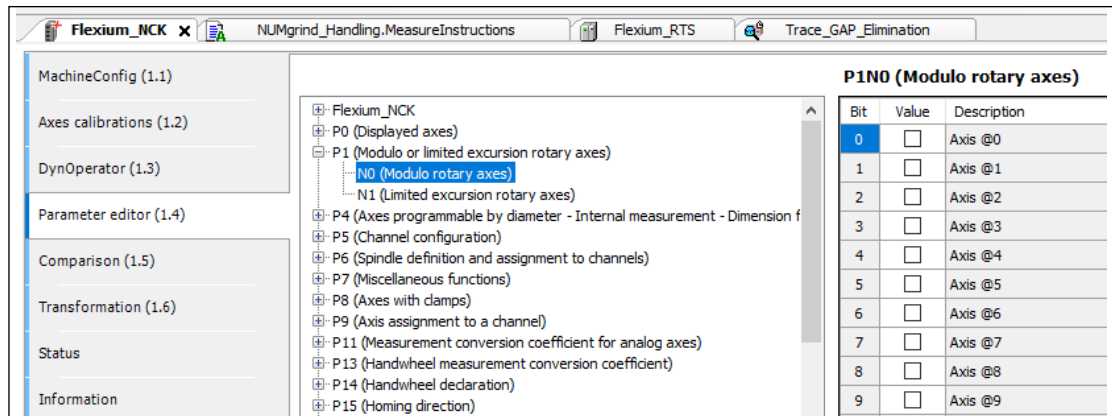


In addition, the following must be checked:

The corresponding bits must not be set in P1N0 and P1N1 for the axis which is transferred as value of variable L1! This can be checked in the tab Parameter editor (1.4) / sub register P1.

### Example:

L1 = 4 → P1N0B4 and P1N1B4 must not be set (no tick).



|                     |                                                                                                                                                                                                                   |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>N15 L2 = 0</b>   | Gauge Type: The value in this field should always be equal to 0.<br>Used to define measurement acquisition (gap elimination or grinding with measurement). Standard gauge or contact measurement (ON/OFF output). |
| <b>N16 L3 = 0</b>   | G10 dwell time in seconds: Dwell in seconds during which the block may be interrupted. Used in the program %10231.0. This field needs to be manually entered (default value = 0).                                 |
| <b>N17 L4 = 0.5</b> | G79 Time in seconds: Programming this function in a block of movements temporarily suspends preparation of the next block.                                                                                        |

### Example of G79

```
N..
N110 G00 X0 Y0
N120 G01 X100 G79+F4
N130 G79 E10000=1 N300
N...
```

Movement along X with four second delay before analysis of block N130

For more information about the G79 function please refer to the Flexium+ Programming manual M00040EN in chapter Temporary suspension of next block preparation.

|                   |                                                   |
|-------------------|---------------------------------------------------|
| <b>N18 L5 = 1</b> | Maximum time in seconds for 1 grinding increment. |
|-------------------|---------------------------------------------------|

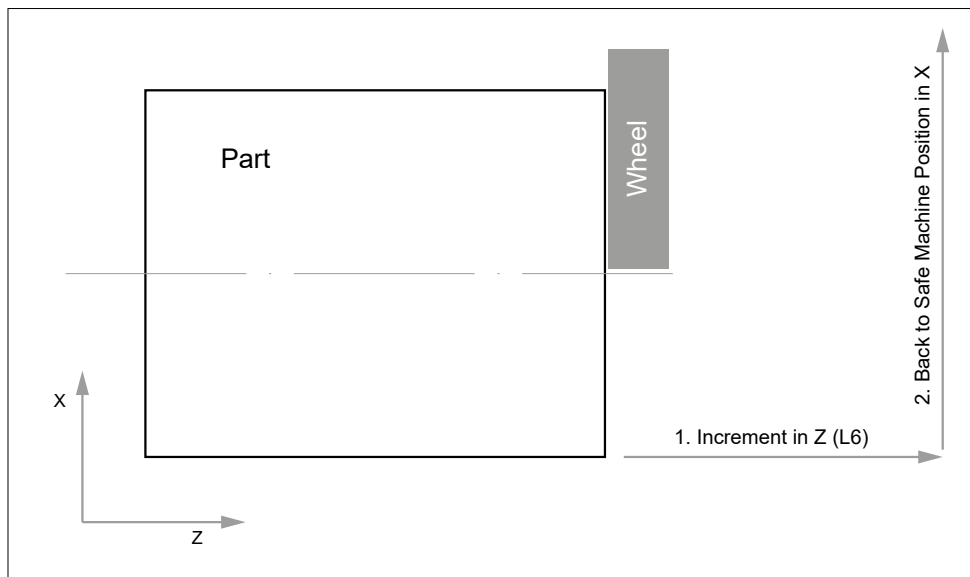
The value of this field is used in all the cylindrical grinding cycles except the profile grind cycle and shoulder with fillet cycle.

This field is used in calculating the number of infeeds required to reach the X diameter, defined by the field "*Stock remaining relative to Final X*" in the in-cycle block, from the Rapid stop point.

$$\text{Number of infeeds} = \frac{\text{Time of the infeed distance}}{\text{Maximum time for 1 grinding increment}}$$

The smaller the value, the more increments are executed. The larger the value, the less increment is made. At least one increment is always made.

|                      |                                                                                                                                                                                                    |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>N19 L6 = 2.00</b> | Increment in Z during part setup: After teaching the Z reference position, the Z axis moves in positive direction one increment before the wheel is pulled back in X to the safe machine position. |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

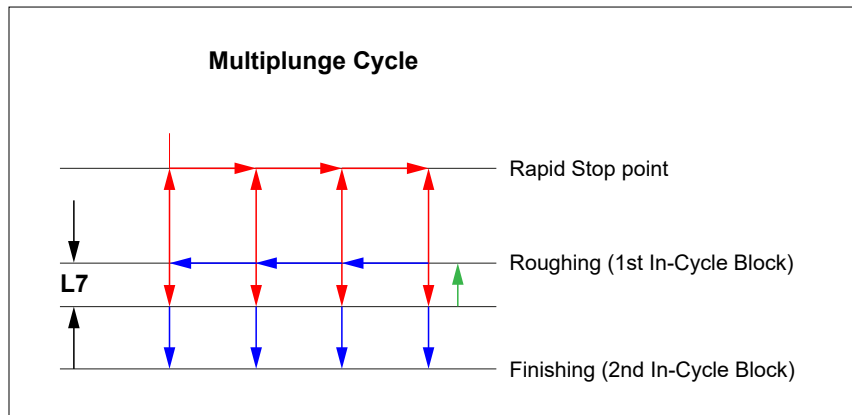


|                      |                                                                                                                                                                                                                                                                                                 |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>N20 L7 = 0.01</b> | <p>Defined as Clearance increment along X for multi-plunge.</p> <p>This field is used in multi-plunge cycles and oscillating multi-plunge cycles (G200, G201, G204, G205).</p> <p>To use this variable you must have a multi-plunge cycle programmed with a roughing and a finishing phase.</p> |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

- Plunge Cycle:
  - Pre-Cycle block.
  - In-Cycle block (Roughing Phase).
  - In-Cycle block (Finishing Phase).

After the 1st In-Cycle block (Roughing Phase) the X axis backs off to a distance specified in this field before the start of the 2nd In-Cycle block (Finishing Phase).

This field acts like a rapid stop point to the finishing phase.



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### 5.7.3.2 Dressing and Shaping Data

#### Note

- **Dresser type 1 (fixed dresser)**

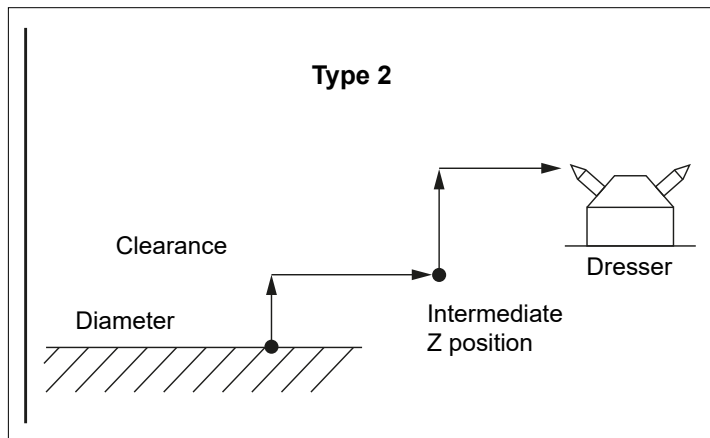
A fixed diamond set with an absolute X/Z position that is set during the "Dresser Setup".

- **Dresser type 2 (fixed dresser with @Z intermediate position)**

It is the same fixed diamond set as dresser type 1, except that a "@Z intermediate position" is approached.

This type is used when the diamond dresser is in a special place. In order for the wheel to get there without colliding with the machine or part, it must first move to this intermediate position before moving to the diamond.

After the dressing has been completed, the wheel returns to the intermediate Z position to return to the part. The operator can easily teach that intermediate position when he is performing the "Dresser Setup".



- **Dresser type 3 (roller dresser)**

This type is a profiled tool used to dress a wheel to the complementary profile and is rotated by an auxiliary spindle/axis (@U).

The machine only needs to make a radial movement to bring the wheel to the roller dresser to shape/dress the profile and then move back.

For more information about the dresser types please refer to the Flexium\* Cylindrical Grinding Programming manual M00049EN in chapter Wheel Dressing Tools.

|                     |                                                                        |
|---------------------|------------------------------------------------------------------------|
| <b>N21 L8 = 0.1</b> | X backoff distance face<br>Cases see below, depending on Dresser Type. |
|---------------------|------------------------------------------------------------------------|

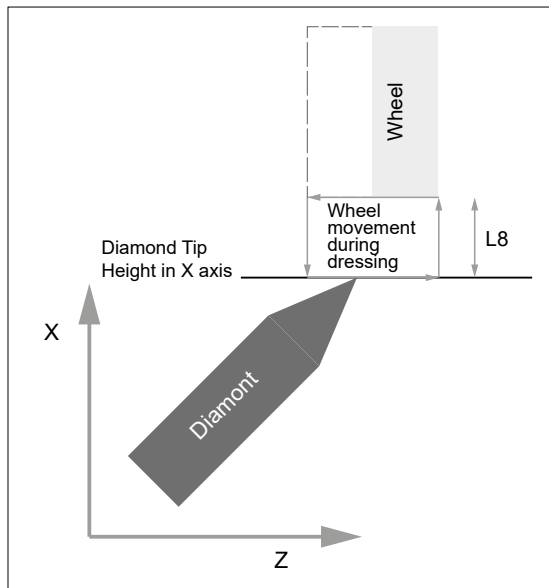


Since the machine is set for turning, the effective travel distance is only half the distance entered.



**Dresser Type = 1**

L8 is the backoff distance in X from the face of the wheel at the end of each dressing pass for diamond 1 and diamond 2.

**Dresser Type = 2**

In case of diamond 1, L8 is the approach point in X before making a first pass.

Attention: possible operation commands in the OEM file %9941 are only executed after reaching the Z intermediate position and the backoff distance in X (value of L8)!

L8 is also the backoff distance in X from the face of wheel at the end of each dressing pass for diamond 1 and 2. In all the cases below the X axis backs off to the value specified in this field.

| Case | Dress Wheel Face | Dress Wheel Side |
|------|------------------|------------------|
| 1    | Diam 1           | None.            |
| 2    | None.            | Left.            |
| 3    | Diam 1           | Left.            |
| 4    | Diam 1           | Left + Right.    |

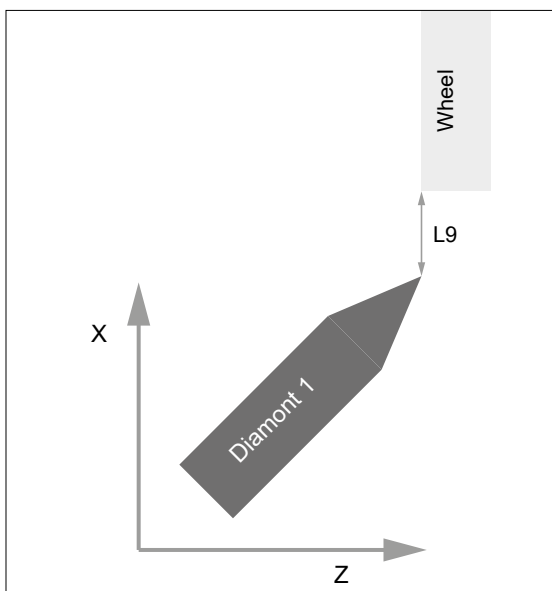
This field is valid for Standard Wheel / Angular Wheel. In the case of Special Wheel this field does not take effect.

|                       |                              |
|-----------------------|------------------------------|
| <b>N22 L9 = 0.015</b> | X start radial compensation. |
|-----------------------|------------------------------|

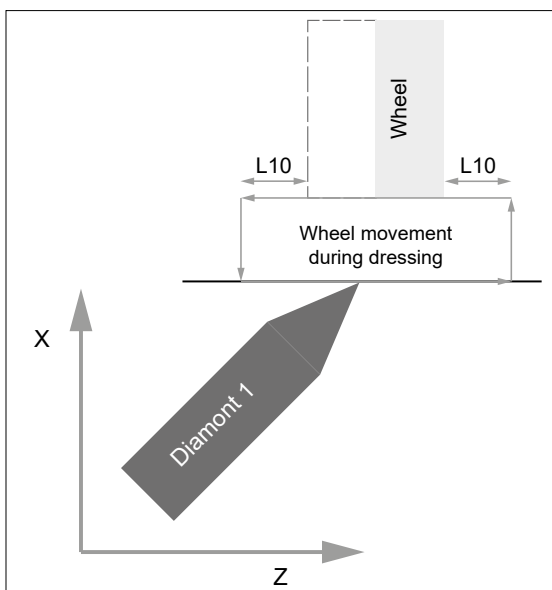
L9 is only used in the case of Standard wheel / Angular wheel when left side dressing and dresser type = 1 is selected.

The dressing side can be selected in the NUMgrind CAM Editorial / Standard Wheel or Angle Wheel / Dressing Data / Default Dress.

The G41 (left radius tool offset) is activated at a distance L9 away from the diamond 1 in X axis before dressing pass begins.



|                      |                                                                                                                                  |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------|
| <b>N23 L10 = 0.2</b> | In the case of diamond 1 L10 is the approach / overtravel distance in Z before and after the width of the wheel during dressing. |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------|



In case of diamond 2 the L10 is the approach distance before the dressing pass.

The overtravel distance past the wheel is calculated by subtracting the value of L10 from the value of distance between the two diamonds.

### 5.7.3.3 Z-Flagging Device Data

All values are automatically calculated and entered into the fields during the Part Setup.  
Positions are recorded in internal units.

|                      |                                                                                                       |
|----------------------|-------------------------------------------------------------------------------------------------------|
| <b>N24 L11= 0.00</b> | Wheel-flag distance:<br>L11 is the distance between the wheel and the flagging device start position. |
|----------------------|-------------------------------------------------------------------------------------------------------|

Can only be set if E80005 = 1 (Single Input Probe) in %11000 (Reset File).

|                      |                      |
|----------------------|----------------------|
| <b>N26 L15= 0.00</b> | X axis flag position |
|----------------------|----------------------|

Can only be set if E80005 = 1 (Single Input Probe) or E80005 = 3 (Manually teach Z) in %11000 (Reset File).

E80005 = 1 → Start Position for Measuring with Single Input Probe

E80005 = 3 → Safe Probe Position with manually teach Z

|                      |                      |
|----------------------|----------------------|
| <b>N27 L16= 0.00</b> | Z axis flag position |
|----------------------|----------------------|

Can only be set if E80005 = 1 (Single Input Probe) or E80005 = 3 (Manually teach Z) in %11000 (Reset File).

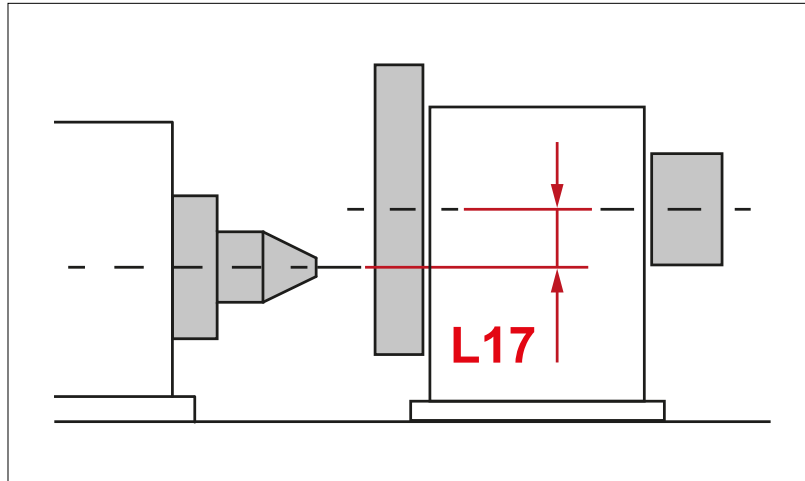
E80005 = 1 → Start Position for Measuring with Single Input Probe

E80005 = 3 → Safe Probe Position with manually teach Z

### 5.7.3.4 Non-Circular Grinding Data

These data refer to non-circular grinding functions.

|                       |                                                       |
|-----------------------|-------------------------------------------------------|
| <b>N28 L17 = 0.00</b> | Center height error between C-Axis and Grinding Wheel |
|-----------------------|-------------------------------------------------------|



|                       |                                                                                                                    |
|-----------------------|--------------------------------------------------------------------------------------------------------------------|
| <b>N29 L18 = 5.00</b> | Below this radius in mm is the tangential feedrate calculation disabled. The value is passed to the G92 R command. |
|-----------------------|--------------------------------------------------------------------------------------------------------------------|

For more information about the G92 R, please consult the Flexium<sup>+</sup> Programming manual M00040xx-yy.

|                       |                                                                                                                    |
|-----------------------|--------------------------------------------------------------------------------------------------------------------|
| <b>N30 L19 = 0.10</b> | Below this length in mm is the tangential feedrate calculation disabled. The value is passed to the G92 L command. |
|-----------------------|--------------------------------------------------------------------------------------------------------------------|

For more information about the G92 L, please consult the Flexium<sup>+</sup> Programming manual M00040xx-yy.

|                       |                                                                                                                                  |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------|
| <b>N31 L20 = 45.0</b> | Below this angle in degrees the connecting arcs are replaced with line segments. The value is passed to the C.OFF ANGLE command. |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------|

For more information about the C.OFF ANGLE command, please consult the Flexium<sup>+</sup> Extended Programming manual M00055xx-yy.

|                       |                                                                                                        |
|-----------------------|--------------------------------------------------------------------------------------------------------|
| <b>N32 L21 = 17.0</b> | CCPS Filter. Possible values are: 17, 13, 9, 5, 3, 0. The value is passed to the C.OFF CCPS_F command. |
|-----------------------|--------------------------------------------------------------------------------------------------------|

For more information about the C.OFF CCPS\_F command, please consult the Flexium<sup>+</sup> Extended Programming manual M00055xx-yy.

---

|                       |                                                                                                     |
|-----------------------|-----------------------------------------------------------------------------------------------------|
| <b>N33 L22 = 5000</b> | Maximum feedrate in mm/min in the XY plane with MLEGB. The value is passed to the parameter E79014. |
|-----------------------|-----------------------------------------------------------------------------------------------------|

---

|                      |                                                                                        |
|----------------------|----------------------------------------------------------------------------------------|
| <b>N34 L23 = 200</b> | Current MLEGB tolerance in mm for X axis. The value is passed to the parameter E70206. |
|----------------------|----------------------------------------------------------------------------------------|

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### 5.7.3.5 Wheel Setup and Dresser Data

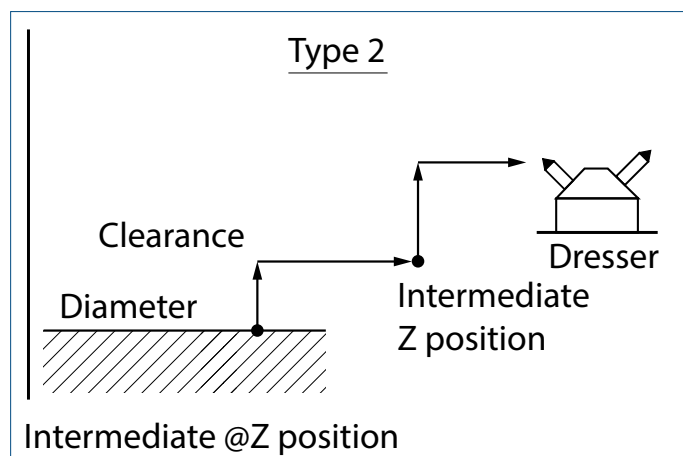
The placeholder x is the setup/tool number of the grinding wheel. X can be 1 - 8.

#### A. Setup Data

|                       |                                                                                                                                                                                                                                                           |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>NX00 L0 =+0</b>    | DAT offset X of the dresser reference system in Internal measurement unit. The value in this field is set when the operator finishes dresser setup.                                                                                                       |
| <b>NX01 L1 =+0</b>    | DAT offset Z of the dresser reference system in Internal measurement unit. The value in this field is set when the operator finishes dresser setup.                                                                                                       |
| <b>NX02 L2 =+0</b>    | DAT offset X of the part reference system in Internal measurement unit. The value in this field is set when the operator finishes part setup.                                                                                                             |
| <b>NX03 L3 =+0</b>    | DAT offset Z of the part reference system in Internal measurement unit. The value in this field is set when the operator finishes part setup.                                                                                                             |
| <b>NX04 L4 =+1</b>    | External Wheel = 1 (OD Grinding)<br>Internal Wheel = 0 (ID Grinding)                                                                                                                                                                                      |
| <b>NX05 L5 =+1</b>    | Dresser type 1: Fixed two-diamond dresser without intermediate position of axis 2 (Z axis).<br>Dresser type 2: Fixed two-diamond dresser with intermediate position of axis 2.<br>Dresser type 3: Roller Dresser moved by means of an auxiliary axis (@U) |
| <b>NX06 L6 =+2000</b> | This field sets the maximum wheel speed in rpm for scaling 10v output. Refer to the chapter "Wheel Speed Limitations" 4.11 for more information.                                                                                                          |

**B. Dresser Data**

|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>NX10 L7 =+0.02</b> | Diamond 1 radius: To generate proper wheel dress profile it is important that this radius be set equal to the actual diamond radius.                                                                                                                                                                                                                                                                                                                                                        |
| <b>NX11 L8 =+0</b>    | Distance between diamond 1 and 2 of the dresser type 1 or 2 in X axis (Internal measurement units).<br>This field is automatically updated during the dresser setup.                                                                                                                                                                                                                                                                                                                        |
| <b>NX12 L9 =+0</b>    | Distance between diamond 1 and 2 of the dresser type 1 or 2 in Z axis (Internal measurement units).<br>This field is automatically updated during the dresser setup.<br>During the dresser setup the diamond 2 origins are taught if and only if the wheel contains features on right side of the wheel.                                                                                                                                                                                    |
| <b>NX13 L10 =+0</b>   | Dresser intermediate Z Position: When the dresser type is set equal to 2 an intermediate safe Z position can be taught during the dresser setup. This field is automatically updated by the setup routine. The value stored is always in inches. When a dressing call is made from the part program the wheel goes to the intermediate Z position before it dresses the wheel. After the dressing is complete the wheel comes back to the intermediate Z position before going to the part. |



|                         |                                                                                                                                                                                                                                                                              |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>NX14 L11 ==+0</b>    | X Correction Diamond 1: The value gets added to the DAT1 X offset when dressing or shaping. Any correction to the dresser reference system with respect to diamond 1 can be made using this field. The value that should be entered should be in Internal measurement units. |
| <b>NX15 L12 ==+0</b>    | Z Correction Diamond 1: The value gets added to the DAT1 Z offset when dressing or shaping. Any correction to the dresser reference system with respect to diamond 1 can be made using this field. The value that should be entered should be in Internal measurement units. |
| <b>NX16 L13 ==+0</b>    | X Correction Diamond 2: The value gets added to the DAT1 X offset when dressing or shaping. Any correction to the dresser reference system with respect to diamond 2 can be made using this field. The value that should be entered should be in Internal measurement units. |
| <b>NX17 L14 ==+0</b>    | Z Correction Diamond 2: The value gets added to the DAT1 Z offset when dressing or shaping. Any correction to the dresser reference system with respect to diamond 2 can be made using this field. The value that should be entered should be in Internal measurement units. |
| <b>NX18 L15 ==+0.02</b> | Diamond 2 radius: To generate proper wheel dress profile it is important that this radius be set equal to the actual diamond radius.                                                                                                                                         |

#### 5.7.4 Init E-Parameter for Offline Simulation.

The file %9999.0 is relevant for offline simulation in Flexium 3D. It is not used by any cycle and therefore this file does not have to be loaded into zone 0 of the NCK.

It is used to initialize an E-parameter in the offline simulation and has been placed in the Zone 0 folder of the delivery package for easier retrieval.

| Parameter     | Value | Description                                                                                                                  |
|---------------|-------|------------------------------------------------------------------------------------------------------------------------------|
| <b>E41000</b> | -1    | Current CNC mode: Offline Simulation                                                                                         |
|               | > -1  | Current CNC mode: other.<br><br>For more information about E41000, please refer to the Flexium* Programming manual M00040EN. |



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## 5.8 Customer NC programs

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There are certain NC programs which the OEM may adapt. They have the following properties:

- Not protected.
- Changeable by customer or during commissioning.
- Included in Zone3\_NC0.xm3 file (by default).

The files can be found in the unzipped delivery folder:

*..\Delivery NUMgrind Cylindrical\OEM Settings\*

It is best to edit/modify the files on a PC or Laptop using a text editor such as Notepad++ or Notepad before loading them onto the NCK.

Only NC programs that have been modified should be loaded into zone 2. The rest should not be loaded, because all customization NC programs are also included in zone 3.

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## 5.8.1 Overview table of NC programs

In the following table all NC programs are listed on the left side (grey colored), which can be changed by the OEM. These are the customer NC programs.

On the right side of the table (in white) the NC programs are listed which call the customer NC programs.

| Function                    | Prog. Nr.: | Comment:                      | Call in: | Comment                            |
|-----------------------------|------------|-------------------------------|----------|------------------------------------|
| <b>Start \ Stop Spindle</b> | 9997       | Start\Stop Wheel\Part Spindle | 9950     | Dressing and Shaping Retract.      |
|                             |            |                               | 9931     | USER program Measurement Start.    |
|                             |            |                               | 9999     | Push button sub calls.             |
|                             |            |                               | 9945     | Part setup.                        |
| <b>Home Routine</b>         | 9990       | Call to home routine          |          |                                    |
| <b>Roller Dress</b>         | 9600       | Roller Special Dress          | 10240    | Dressing Cycle.                    |
|                             | 9951       | Roller Dressing Retract       | 9600     | Roller Special Dress.              |
|                             |            |                               | 10240    | Dressing Cycle.                    |
| <b>Shape</b>                | 9947       | Program called at Shape End   | 10245    | Shaping Cycle.                     |
|                             | 9946       | Program called at Shape Start | 10245    | Shaping Cycle.                     |
|                             | 9950       | Dressing and Shaping Retract  | 10245    | Shaping Cycle.                     |
|                             |            |                               | 10240    | Dressing Cycle.                    |
| <b>Dress</b>                | 9942       | Program called at Dress End   | 10240    | Dressing Cycle.                    |
|                             | 9941       | Program called at Dress Start | 10240    | Dressing Cycle.                    |
|                             | 9950       | Dressing and Shaping Retract  | 10245    | Shaping Cycle.                     |
|                             |            |                               | 10240    | Dressing Cycle.                    |
| <b>Measure Manuel</b>       | 9932       | USER prog. Measurement End    | 10232    | Manual Measure.                    |
|                             | 9931       | USER prog. Measurement Start  | 10232    | Manual Measure.                    |
| <b>Machine Limits</b>       | 9929       | Limit for Machine data input  | 9827     | Data Entry into Machine DATA file. |
|                             |            |                               | 9826     | Corrector Entry for Diamond 1/2.   |
| <b>Wheel Limits</b>         | 9928       | Wheel Limits, Limit Setup 8   | 9910     | Wheel definitions.                 |
|                             | 9927       | Wheel Limits, Limit Setup 7   | 9910     | Wheel definitions.                 |
|                             | 9926       | Wheel Limits, Limit Setup 6   | 9910     | Wheel definitions.                 |
|                             | 9925       | Wheel Limits, Limit Setup 5   | 9910     | Wheel definitions.                 |
|                             | 9924       | Wheel Limits, Limit Setup 4   | 9910     | Wheel definitions.                 |
|                             | 9923       | Wheel Limits, Limit Setup 3   | 9910     | Wheel definitions.                 |
|                             | 9922       | Wheel Limits, Limit Setup 2   | 9910     | Wheel definitions.                 |
|                             | 9921       | Wheel Limits, Limit Setup 1   | 9910     | Wheel definitions.                 |

|                          |      |                                         |      |              |
|--------------------------|------|-----------------------------------------|------|--------------|
| <b>Routine</b>           | 9912 | Program End Routine                     |      |              |
|                          | 9911 | Program Start Routine                   |      |              |
| <b>Gauge</b>             | 9824 | USER Program to Deactivate Gauge        |      |              |
|                          | 9823 | USER Program to Activate Gauge          |      |              |
| <b>Emergency Retract</b> | 9818 | Emergency Retract for Main part program | xxxx | G75 Retract. |
|                          | 9800 | Emergency Retract for G200              | 9978 | G75 Retract. |
|                          | 9801 | Emergency Retract for G201              | 9978 | G75 Retract. |
|                          | 9802 | Emergency Retract for G202              | 9978 | G75 Retract. |
|                          | 9803 | Emergency Retract for G203              | 9978 | G75 Retract. |
|                          | 9804 | Emergency Retract for G204              | 9978 | G75 Retract. |
|                          | 9805 | Emergency Retract for G205              | 9978 | G75 Retract. |
|                          | 9806 | Emergency Retract for G206              | 9978 | G75 Retract. |
|                          | 9807 | Emergency Retract for G207              | 9978 | G75 Retract. |
|                          | 9808 | Emergency Retract for G208              | 9978 | G75 Retract. |
|                          | 9809 | Emergency Retract for G209              | 9978 | G75 Retract. |
|                          | 9810 | Emergency Retract for G210              | 9978 | G75 Retract. |
|                          | 9811 | Emergency Retract for G211              | 9978 | G75 Retract. |
|                          | 9812 | Emergency Retract for G212              | 9978 | G75 Retract. |
|                          | 9813 | Emergency Retract for G213              | 9978 | G75 Retract. |
|                          | 9814 | Emergency Retract for G214              | 9978 | G75 Retract. |
|                          | 9815 | Emergency Retract for G215              | 9978 | G75 Retract. |
|                          | 9816 | Emergency Retract for G216              | 9978 | G75 Retract. |
|                          | 9817 | Emergency Retract for G217              | 9978 | G75 Retract. |

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### **5.8.2 Wheel Limit Files**

There are eight wheel limit files in the range of the customer NC programs, one for each wheel definition (%9921 - %9928).

Each time a tool change is performed using the M6 command, the wheel limit file matching to the setup/tool is run through and compared with the current wheel data (in the NC program %9910).

### **5.8.3 Machine Limit File**

In the machine limit file (%9929) the OEM can specify the maximum and minimum limits for various input values.

All are related to cylindrical grinding and cannot be set in Flexium Tools.

In Flexium Tools, general machine specific values can be entered which have a direct influence on the NCK and do not occur in any part program.

In part programs %9826 and %9827, the input values are compared with those of the machine limit file. If the input values are outside the range, an error message is displayed.

## 5.9 Tool table

There is an empty tool table (Toolstd\_NC1.jau) in the delivery folder. This should also be loaded on the NCK zone 0 so that the first 32 tool positions are all set to turning and not milling.

The file can be found in the unzipped delivery folder:

..\Delivery NUMgrind Cylindrical\EmptyToolTable\.

## 5.10 Load data file in the NC memory

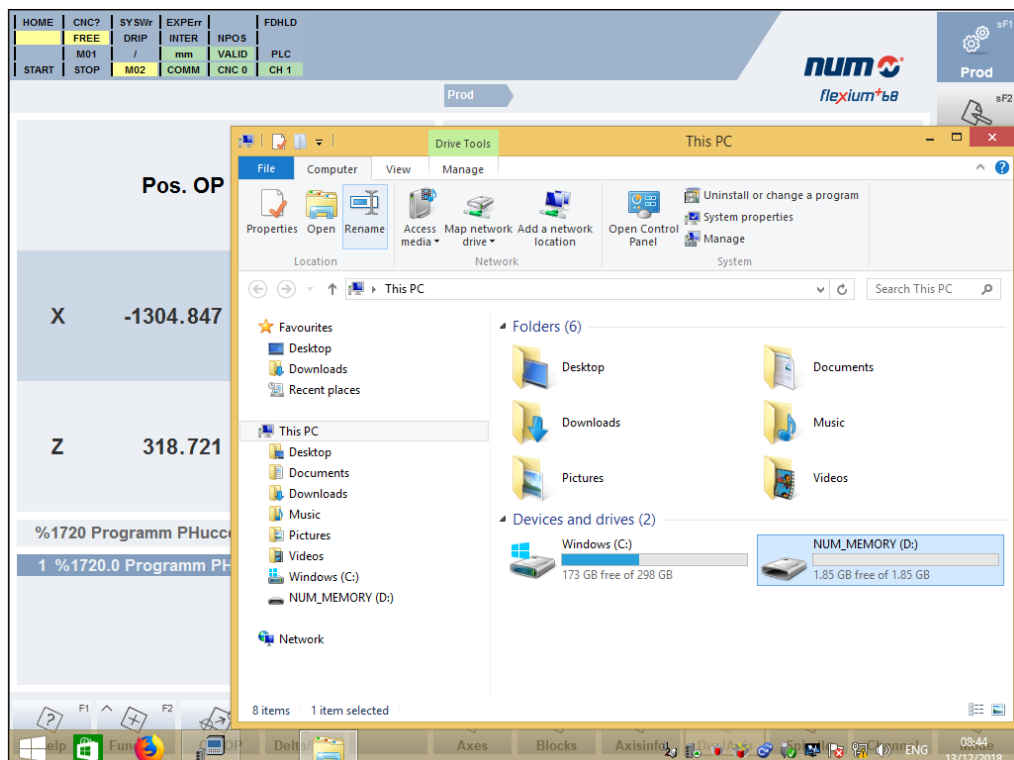
Now it is time to load the CNC files onto the NCK.

A keyboard and a mouse are required for the operation and transfer of the files. Flexium+ HMI, RTS and NCK must be started and ready for operation.

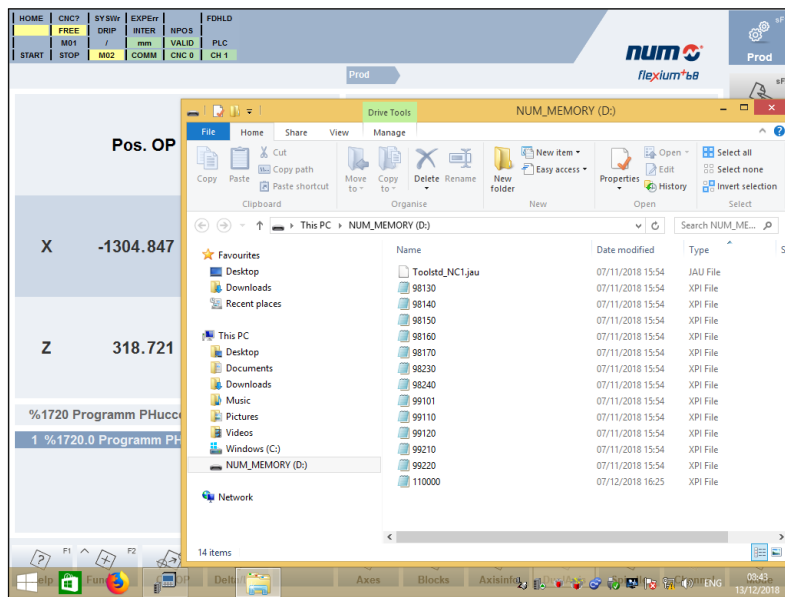
For more information about the Flexium+ HMI please refer to the Flexium+ HMI Operator's manual - M00039EN. There all functions and operating possibilities of the HMI are explained.

1. Load all files (*Machine Data File, Reset File, Tool Table and Customer NC programs*) onto a memory stick.
2. Connect the memory stick to the Operating Panel PC (hereinafter referred to as PC) on which the Flexium+ HMI and the RTS are running and the connection to the NCK is established.
3. As soon as the memory stick is connected to the PC, a folder window should open.  
If this does not happen, do the following:

- Press the *Windows+E* key combination on the PC.
- Folder opens.

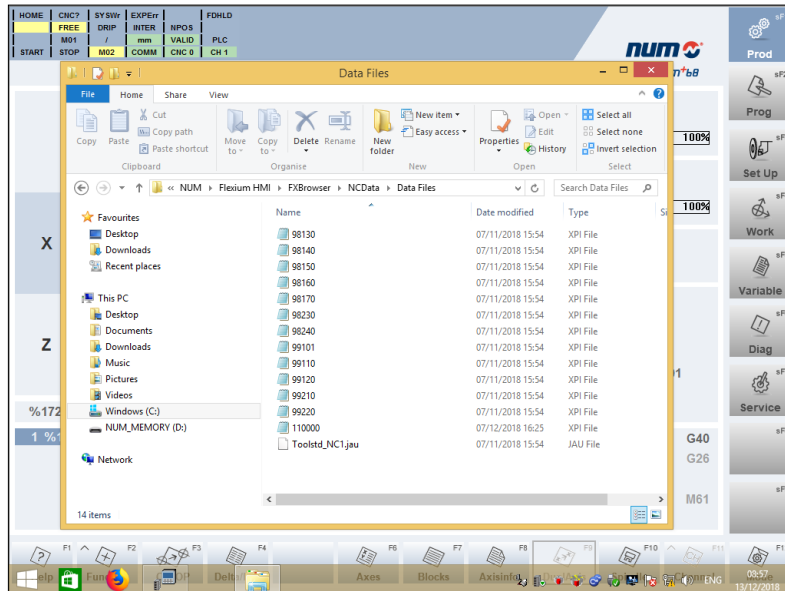


- Search and open the memory stick.

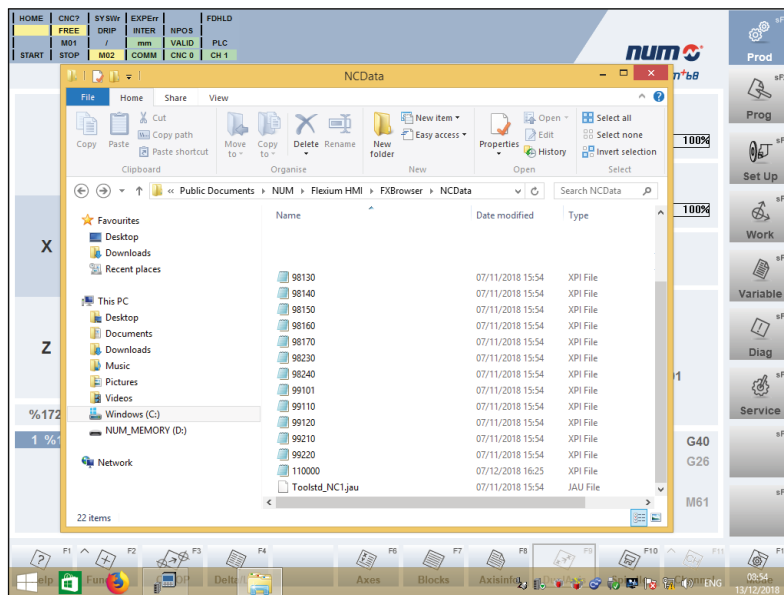


4. Copy all files (*key combination Ctrl+C*) or cut them (*key combination Ctrl+X*).
5. Open the following path: *C:\Users\Public\Documents\NUM\Flexium HMI\FXBrowser\NCData*.

If required, one or more new folders/subfolders can be created here (*key combination Ctrl+Shift+N*). In this example the subfolder is called "Data Files".

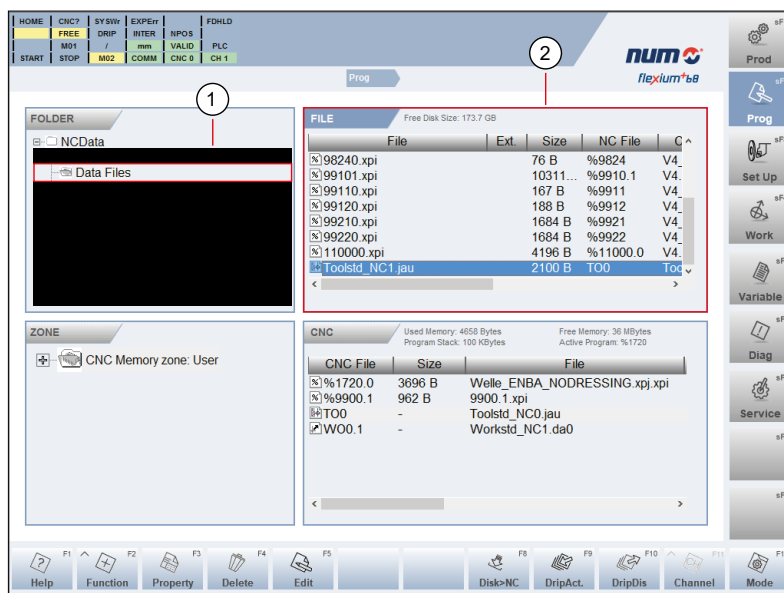


- Or save all files directly in the NCDATA folder.



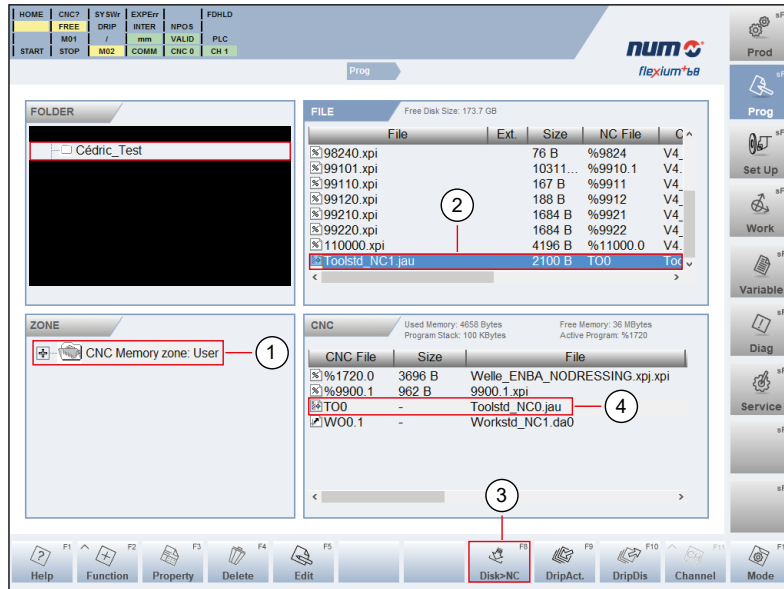
Switch from the folder to the Flexium<sup>+</sup> HMI program.  
Call *context Programming (Shift+F2)*.

Now the Directory and folder window (1) should contain the created folders / subfolders.  
By selecting the corresponding folder, the files are displayed in the File list window (2).



### 5.10.1 Tool table

- Select the zone *User in the CNC memory zone* select window (1).
- Select the file *Toolstd\_NC1.jau* (2).
- Press the button "Disk>NC" in the sub context menu to load the file into the zone 0 of the NCK (3).
- The file is now displayed in the CNC memory file list window (4).





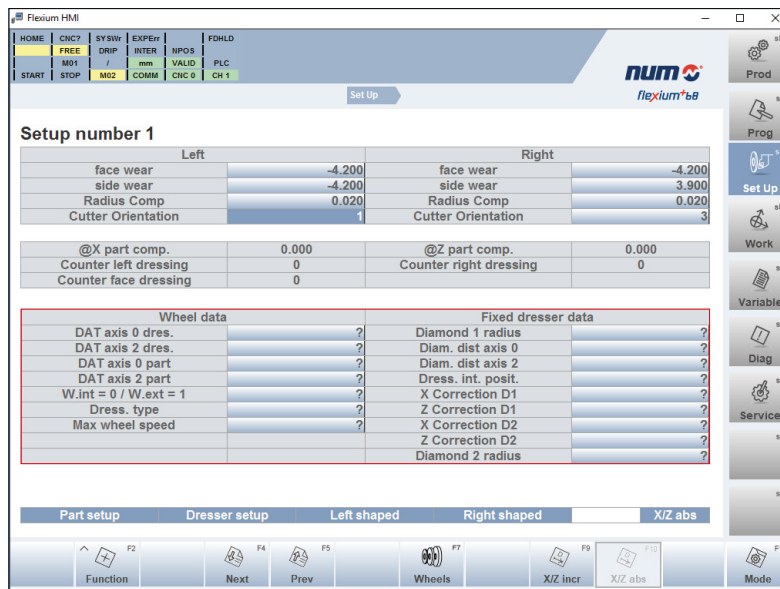
## 5.10.2 Reset & Machine Data File

The following combinations of zones are possible in which the two files can be stored.

However, as soon as the Machine Data File (%9910.1) is no longer in Zone 0 (User), the setup data can no longer be displayed in the HMI and can no longer be set accordingly!  
Therefore, the Machine Data File should always be left in Zone 0 (User).

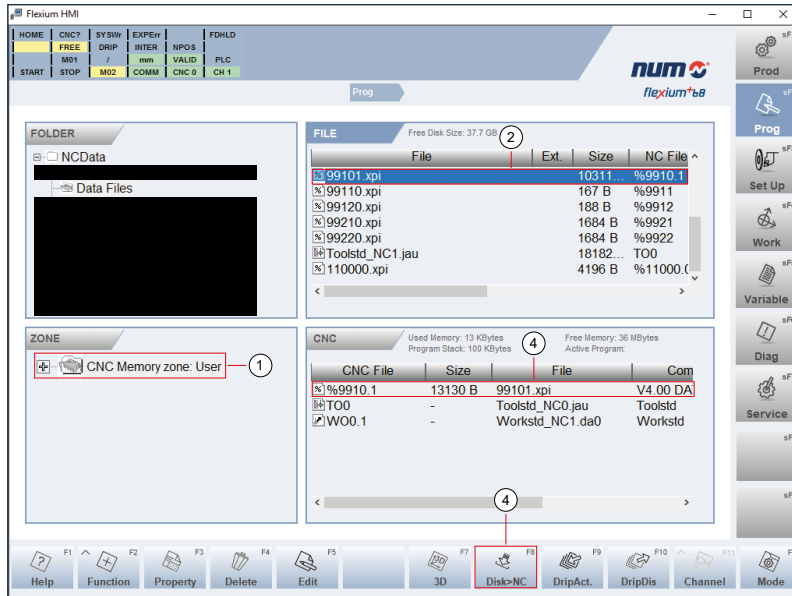
| 11000.0           | 9910.1            | Functioning              |
|-------------------|-------------------|--------------------------|
| Zone 0 (User)     | Zone 0 (User)     | Yes                      |
| Zone 0 (User)     | Zone 1 (Customer) | Yes (but no setup data). |
| Zone 0 (User)     | Zone 2 (OEM)      | Yes (but no setup data). |
| Zone 1 (Customer) | Zone 1 (Customer) | Yes (but no setup data). |
| Zone 1 (Customer) | Zone 2 (OEM)      | Yes (but no setup data). |
| Zone 2 (OEM)      | Zone 2 (OEM)      | Yes (but no setup data). |
| Zone 1 (Customer) | Zone 0 (User)     | Yes.                     |
| Zone 2 (OEM)      | Zone 0 (User)     | Yes.                     |
| Zone 2 (OEM)      | Zone 1 (Customer) | Yes (but no setup data). |

The following figure shows how the Set Up Page looks like when the Machine Data File (%9910.1) is no longer in Zone 0.



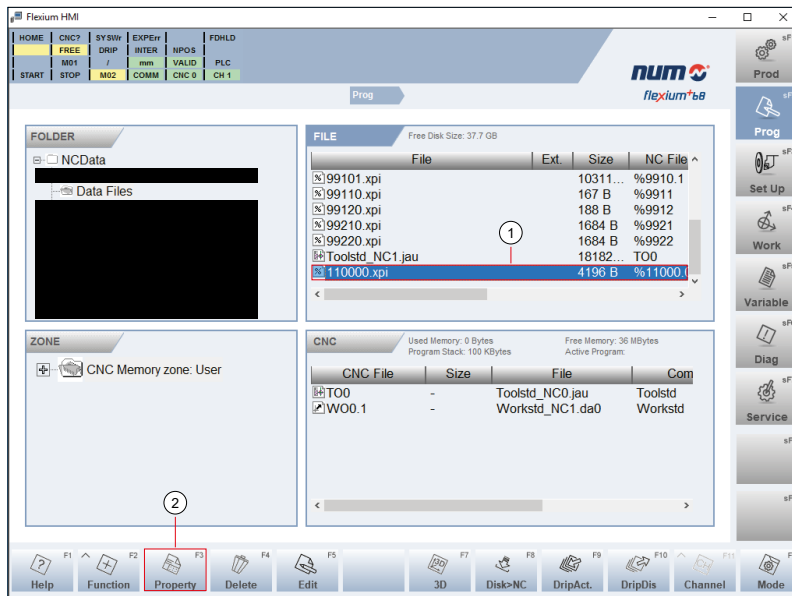
### 5.10.3 Machine Data File

- Select the zone *User in the CNC memory zone* select window (1).
- Select the file *99101.xpi* (2).
- Press the button "*Disk>NC*" in the sub context menu to load the file into the zone 0 of the NCK (3).
- The file is now displayed in the CNC memory file list window (4).



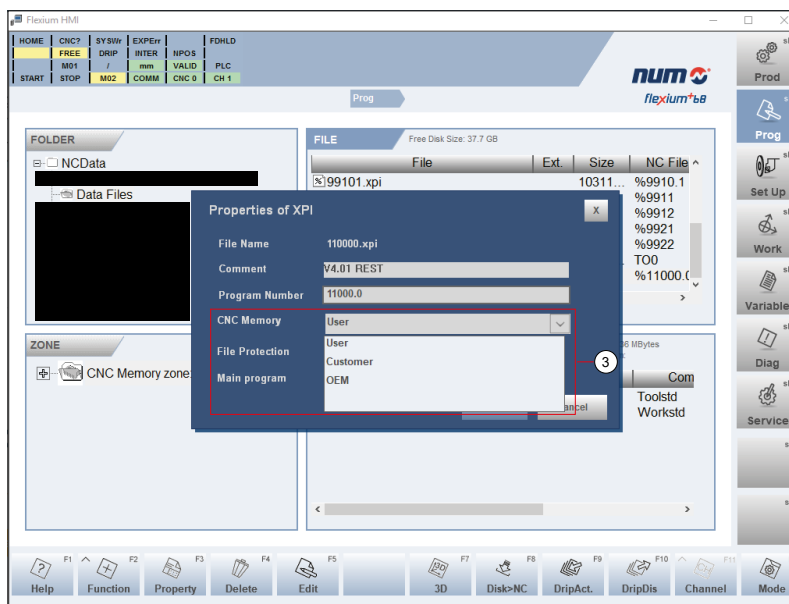
### 5.10.4 Reset File

- Select the file *110000.xpi* (1).
- Press the button "*Property*" in the sub context menu to open the file properties menu (2).

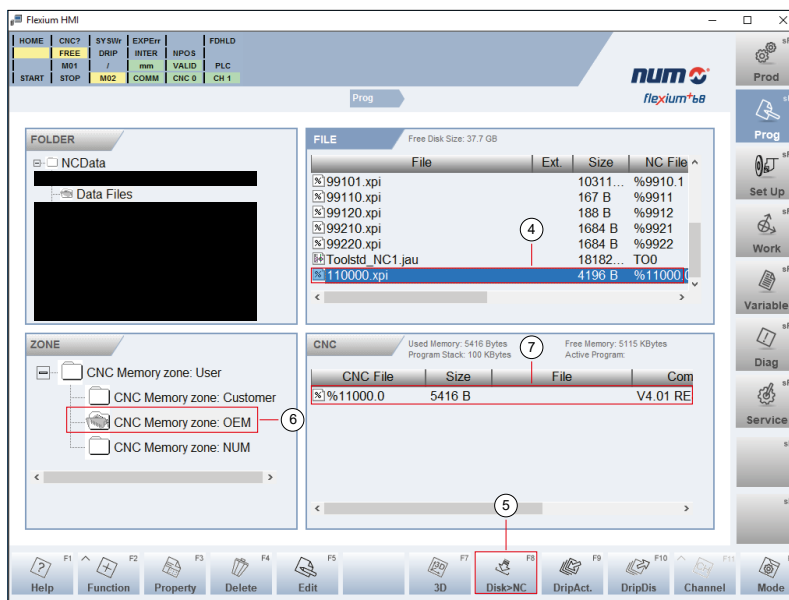


Never change the program number %11000.0!

- At the CNC Memory item, select *User*, *Customer* or *OEM*. Press *OK* to confirm (3).



- Select the file *110000.xpi* (4).
- Press the button "*Disk>NC*" in the sub context menu to load the file in this example into the zone 2 of the NCK (5).
- Select the *zone OEM in the CNC* memory zone select window (6).
- The file is now displayed in the CNC memory file list window (7).



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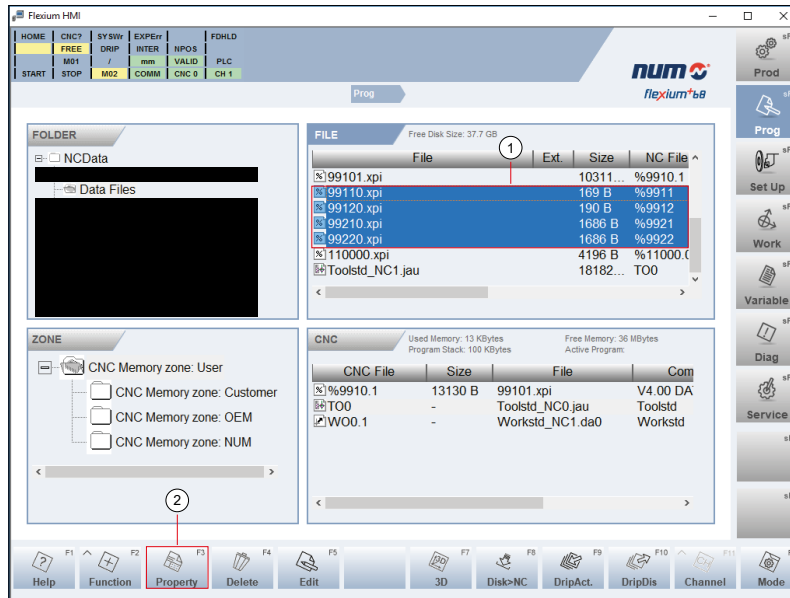
5

### 5.10.5 Customer NC programs

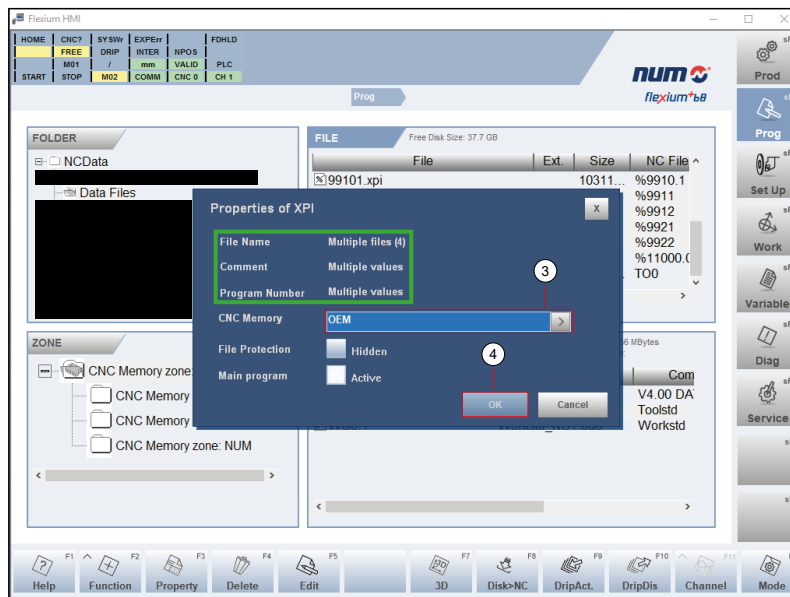
By default, the customer NC programs are loaded to zone 0 (user) of the NC memory. It is recommended to *copy the NC programs at OEM level (zone 2)*.

In the following example, four customer NC programs are stored in the OEM zone of the NCK.

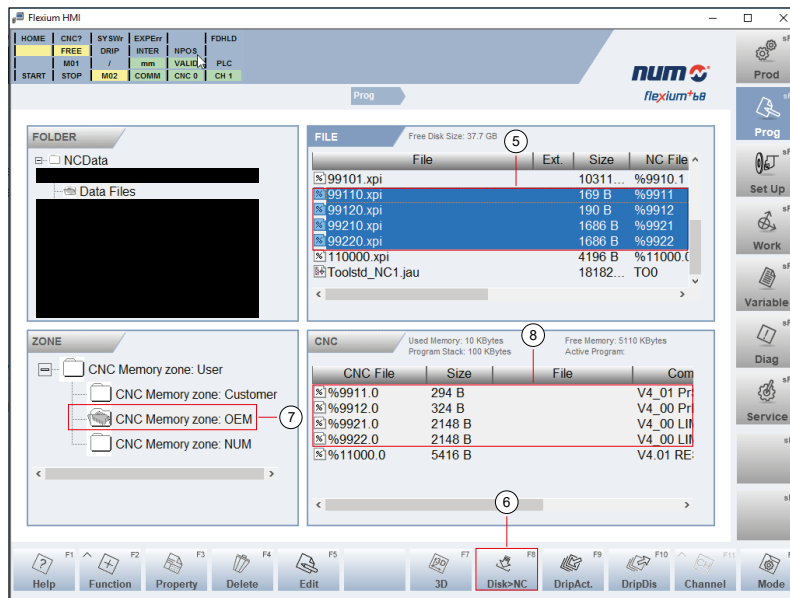
- Select all NC programs that are to be loaded into the OEM zone.  
In this example the files are 99110.xpi, 99120.xpi, 99210.xpi and 99220.xpi (1).
- Press the button "Property" in the sub context menu to open the file properties menu (2).



- At the CNC Memory item, select User, Customer or OEM (3).  
You can also see how many files have been selected at the same time and that they all have different comments and different program numbers (see green box below).
- Press OK to confirm (4).



- Select again *all NC programs* that are to be loaded into the OEM zone.  
In this example, the files are *still* 99110.xpi, 99120.xpi, 99210.xpi and 99220.xpi (5).
- Press the button "Disk>NC" in the sub context menu to load the files in this example into the zone 2 of the NCK (6).
- Select the zone *OEM* in the CNC memory zone select window (7).
- The files are now displayed in the CNC memory file list window (8).



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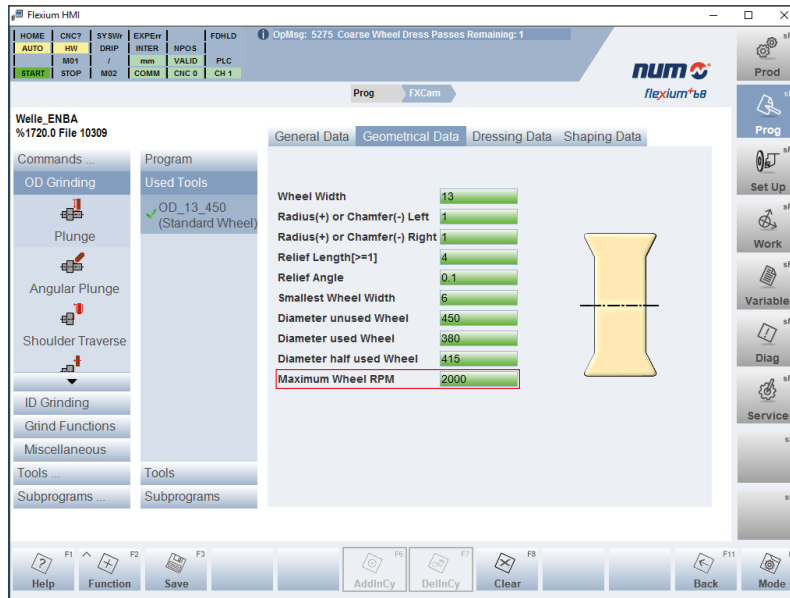
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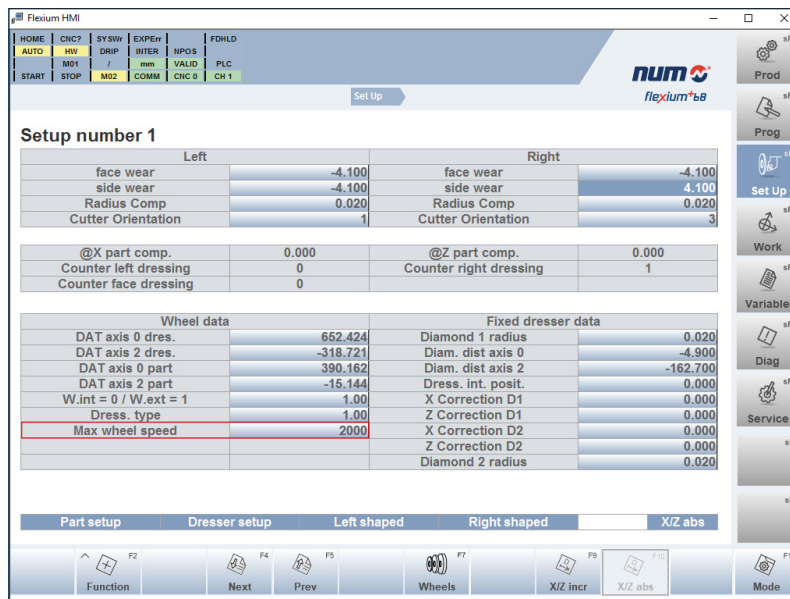
## 5.11 Wheel Speed Limitations

There are various sections in where different maximum wheel speed in RPM can be set.

- *NUMgrind CAM project / Tools / Wheel / Geometrical Data / Maximum Wheel RPM* → [WD(41)].



- *Set Up Page / Max wheel speed*. Refer to chapter 4.1.3 Red block from this manual → [WD(22)].



- In the reset routine %11000. Refer to chapter 5.1.2 MAX Wheel RPM or Calculated RPM from this manual.
- Limit for Machine data input 9929 → [MAXM(7)].
- Wheel Limit Files 992x → [MAXWD(41)].
- In a Flexium Tools Project. Refer to chapter 3.6 Spindles from this manual.

**5.11.1 M40**

The speed limits set in the Flexium Tools project only apply if the M40 is set in addition to the spindle commands.

Otherwise the set speed S cannot be assigned to a speed range (M40-M45) if it is too high.

**Examples**

| Command               | Values Flexium Tools / Spindle Min / Max / Vmax | Error    | Meaning of the error                                |
|-----------------------|-------------------------------------------------|----------|-----------------------------------------------------|
| <b>M4#1 S7000</b>     | 0 / 6000 / 0                                    | 29 Ext 5 | S does not belong to any range.                     |
| <b>M4#1 S6000</b>     | 0 / 6000 / 0                                    | No Error |                                                     |
| <b>M4#1 S6000</b>     | 0 / 7000 / 5000                                 | 29 Ext 5 | S does not belong to any range.                     |
| <b>M40 M4#1 S6000</b> | 0 / 7000 / 5000                                 | 29 Ext 3 | Spindle speed higher than the maximum of the range. |
| <b>M40 M4#1 S7500</b> | 0 / 7000 / 5000                                 | 29 Ext 3 | Spindle speed higher than the maximum of the range. |
| <b>M40 M4#1 S7500</b> | 0 / 7000 / 0                                    | 29 Ext 3 | Spindle speed higher than the maximum of the range. |

For more information about the Error Messages refer to the Flexium\* Programming Manual M00040EN in chapter Errors and error extensions summary table.

## 5.12 CNC/PLC Link

The following tables are listed for completeness and comprehensibility. These values/parameters do not require any changes. It should show the possibilities how the PLC can cooperate with the NCK and how data can be exchanged.

### 5.12.1 Wheel Rotation Speed

| Direction | Number | Value        | Description                                     |
|-----------|--------|--------------|-------------------------------------------------|
| CNC → PLC | E30000 | 0 to 32 bits | Calculated wheel speed                          |
| CNC → PLC | E30001 | 0 to 32 bits | Max wheel speed for tool/setup 1.               |
| CNC → PLC | E30002 | 0 to 32 bits | Max wheel speed for tool/setup 2.               |
| CNC → PLC | E30003 | 0 to 32 bits | Max wheel speed for tool/setup 3.               |
| CNC → PLC | E30004 | 0 to 32 bits | Max wheel speed for tool/setup 4.               |
| CNC → PLC | E30005 | 0 to 32 bits | Max wheel speed for tool/setup 5.               |
| CNC → PLC | E30006 | 0 to 32 bits | Max wheel speed for tool/setup 6.               |
| CNC → PLC | E30007 | 0 to 32 bits | Max wheel speed for tool/setup 7.               |
| CNC → PLC | E30008 | 0 to 32 bits | Max wheel speed for tool/setup 8.               |
| CNC → PLC | M177   |              | Message to PLC wheel speed has been calculated. |

### 5.12.2 Part Setup and Dresser Setup

| Direction | Number | Value | Description                   |
|-----------|--------|-------|-------------------------------|
| CNC → PLC | M140   |       | Call %9940 for dresser setup. |
| CNC → PLC | M145   |       | Call %9945 for part setup.    |

### 5.12.3 Register Update

| Direction | Number | Value | Description              |
|-----------|--------|-------|--------------------------|
| CNC ← PLC | E20028 | 1     | Flagging register reset. |
| CNC → PLC | M174   |       | Register reset executed. |



Function M174 defines acknowledgement of reset of the PLC flag register (E20028).

On a cylindrical grinding machine equipped with either manual or automatic wheel changer functionality, the CNC has to be notified by setting E20028 by the PLC if the wheel is unclamped at any point in time. Unclamping of the wheel may have changed the physical location of the wheel.

Before the operator runs the program %9910.1, routine checks for this bit (E20028) to make sure that the physical location of the wheel hasn't been changed.

If E20028=1 then E560xx is set to 0 which implies that part setup, dresser setup, left side wheel shaping and right side wheel shaping have not been executed on the machine (where xx = active T \* 4 -3).

If the grinding wheel has been changed, E20028 must be set to 1 by the PLC for the setup to be performed.



### 5.12.4 Dressing

| Direction | Number | Value | Description                                         |
|-----------|--------|-------|-----------------------------------------------------|
| CNC → PLC | M160   |       | Call %9920 for test counter for periodic dressings. |
| CNC → PLC | M175   |       | Wheel wear limit.                                   |
| CNC ← PLC | E20030 | 0     | Dressing not requested (inactive).                  |
|           |        | 1     | Dressing requested during grinding.                 |
| CNC → PLC | M178   |       | Dressing executed.                                  |
| CNC ← PLC | E40010 | 0     | Use Default Dressing Value from WD51                |
|           |        | 1     | Dressing Value is set by PLC                        |
| CNC ← PLC | E40011 | 0     | Use Default Dressing Value from WD51                |
|           |        | 0 - 8 | The Dressing Value from PLC                         |

### 5.12.5 Oscillations – Traversing

| Direction | Number           | Value    | Description                                                                        |
|-----------|------------------|----------|------------------------------------------------------------------------------------|
| CNC → PLC | E10031           | 1        | Oscillation axis in left/right window                                              |
| CNC ← PLC | E47000 to E47003 | 0 to 255 | Copy of the value of the feed rate override potentiometer.<br>0: Stop oscillation. |

### 5.12.6 Axial Correction (Flagging) Cycle

| Direction | Number | Value    | Description                                           |
|-----------|--------|----------|-------------------------------------------------------|
| CNC → PLC | M170   |          | Start of flagging cycle (head to measuring position). |
| CNC → PLC | M210   |          | Activation of measurement value. (Start measure)      |
| CNC → PLC | M171   |          | End of flagging cycle (head to home position).        |
| CNC ← PLC | E47124 | 0        | Axis 2 (Z) correction value.                          |
|           | E47125 | 0        | Not used.                                             |
|           | E47126 | 0 to 255 | Measured binary value MSB.                            |
|           | E47127 | 0 to 255 | Measured binary value LSB.                            |



Functions M170, M171 and M210 are generated by the flagging cycle. These functions must not be used in the user program.

### 5.12.7 Gap Elimination and Measuring Procedure (standard contact type)

| Direction | Number       | Value    | Description                                                                       |
|-----------|--------------|----------|-----------------------------------------------------------------------------------|
| CNC → PLC | M200         |          | Initialization of gauge.                                                          |
| CNC → PLC | M201         |          | Update of gap elimination (with EG1).                                             |
| CNC → PLC | M202 to M209 |          | Selection of measuring contact (with EG2 to EG9. Roughing, Semi-finishing, etc.). |
| CNC ← PLC | E47124       | 0 to 255 | Pseudo-value for contact measuring.                                               |
|           | E47125       | 0 to 255 |                                                                                   |
|           | E47126       | 0 to 255 |                                                                                   |
|           | E47127       | 0 to 255 |                                                                                   |



Functions M200 to M209 are generated by the grinding cycle using argument EG. These functions must not be used in the user programs.

### 5.12.8 Manual Measurement

| Direction | Number | Value | Description                                   |
|-----------|--------|-------|-----------------------------------------------|
| CNC → PLC | M179   |       | Manual measurement executed.                  |
| CNC ← PLC | E20031 | 0     | Manual measurement not requested.             |
|           |        | 1     | Manual measurement requested during grinding. |

### 5.12.9 Dwell time

| Direction | Number | Value        | Description                                                                                                                                                                   |
|-----------|--------|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CNC → PLC | E30010 | 0<X<300'000  | Dwelltime in ms. The PLC reacts as soon as a value greater than 0 is written into the E-parameter.<br><br>The value must be less than 300'000 (equivalent to 5min or 300sec). |
| CNC ← PLC | E40000 | 0<=X<300'000 | Current elapsed dwell time.                                                                                                                                                   |
| CNC ← PLC | E40001 | 0            | Dwell time not yet reached/timer not running.                                                                                                                                 |
|           |        | 1            | Dwell time reached.                                                                                                                                                           |
| CNC ← PLC | E20029 | 0 - 1        | E20029 must be set to 1 by the PLC in the event of an emergency retract so that any dwell times in the grinding cycles are interrupted.                                       |

**5.12.10 Function call by PLC**

| Direction        | Number | Value  | Description                                                   |
|------------------|--------|--------|---------------------------------------------------------------|
| <b>CNC ← PLC</b> | (1)*   |        | Call program %9999                                            |
| <b>CNC ← PLC</b> | E40032 | 1 to 8 | Setup Number set by PLC<br>(Used in %11000. E80012 = E40032). |
| <b>CNC ← PLC</b> | E40033 |        | Requested function.                                           |
|                  |        |        | 0: No Request.                                                |
|                  |        |        | 1: Dresser origin setting. (Dresser Setup)                    |
|                  |        |        | 2: Workpiece origin setting. (Part Setup)                     |
|                  |        |        | 3: Wheel shaping.                                             |
|                  |        |        | 4: Wheel dressing.                                            |
|                  |        |        | 5: Manual working.                                            |
|                  |        |        | 6: Axis to home position.                                     |
|                  |        |        | 7: Manual measurement.                                        |

(1)\* Command:

The call of the part program %9999 can be programmed via a PLC command in Flexium Tools.  
Programming command in ST: *Flexium\_NCK.WCNC.Channel[1].PlcCallSubroutine.*

## 5.12.11 M-Functions table

The exact functions depend on the respective PLC program!  
The table gives an overview of what the M functions are intended for.

| M Function | Description                                                                                           |
|------------|-------------------------------------------------------------------------------------------------------|
| M4         | Start Part Spindle or Grinding Wheel CCW. Used in %9997.                                              |
| M5         | Stop Part Spindle or Grinding Wheel CCW. Used in %9997.                                               |
| M6         | Call %9910 Selecting the wheel and setting up the working environment.                                |
| M7         | Coolant 2 on. Used in %9997.                                                                          |
| M8         | Coolant 1 on. Used in %9997.                                                                          |
| M9         | Coolant off. Used in %9997.                                                                           |
| M12        | Programmed feed stop □ The axis jogs or handwheel are made available.                                 |
| M13        | Grind Wheel On CCW (if no controlled spindle, only ON/OFF Mode). Used in %9997.                       |
| M14        | Grind Wheel On CW (if no controlled spindle, only ON/OFF Mode). Used in %9997.                        |
| M15        | Grind Wheel Stop (if no controlled spindle, only ON/OFF Mode). Used in %9997.                         |
| M100       | Causes a Reset by PLC.                                                                                |
| M120       | Part Counter (incremented E40252 by one every time it processed a M120 in the part program).          |
| M140       | Call %9940 for dresser setup.                                                                         |
| M145       | Call %9945 for part setup.                                                                            |
| M160       | Call %9920 for test counter for periodic dressings.                                                   |
| M170       | Start of flagging cycle (head to measuring/home position).                                            |
| M171       | Flagging device to home position.                                                                     |
| M173       | Diameter half used grinding wheel (info to PLC that grinding wheel is 50% consumed).                  |
| M174       | Reset feed register (Confirmation to PLC that E20028 was set to 1).                                   |
| M175       | Wheel wear limit reached (info to PLC that grinding wheel is used up).                                |
| M176       | Enable BCD Measurement (BCD: Binary Coded Decimal)                                                    |
| M177       | Wheel speed has been calculated (info to PLC RPM of grinding wheel has been calculated).              |
| M178       | Dressing executed (info to PLC that dressing cycle has been finished).                                |
| M179       | Manual measurement executed (info to PLC that manual measuring has been finished).                    |
| M190       | Start Manual Measurement.                                                                             |
| M200       | Initialize measurement value → PLC: set tripValue to 10001                                            |
| M201       | Gap elimination activated/enable (In-Cycle Argument: EG1) → PLC: set tripValue to 9005                |
| M202       | In-process measurement enabled (In-Cycle Argument: EG2   HMI: Measure 3) → PLC: set tripValue to 8005 |
| M203       | In-process measurement enabled (In-Cycle Argument: EG3   HMI: Measure 2) → PLC: set tripValue to 7005 |
| M204       | In-process measurement enabled (In-Cycle Argument: EG4   HMI: Measure 1) → PLC: set tripValue to 6005 |
| M205       | In-process measurement enabled (In-Cycle Argument: EG5   HMI: Measure 0) → PLC: set tripValue to 5005 |
| M206       | In-process measurement enabled (Not implemented in the HMI) → PLC: set tripValue to 4005              |
| M207       | In-process measurement enabled (Not implemented in the HMI) → PLC: set tripValue to 3005              |
| M208       | In-process measurement enabled (Not implemented in the HMI) → PLC: set tripValue to 2005              |
| M209       | In-process measurement enabled (Not implemented in the HMI) → PLC: set tripValue to 1005              |
| M210       | Activation of part Z position measurement* (used in G231)                                             |

### \*More Information to M210

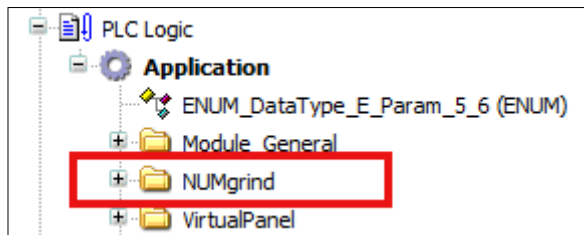
- If E80005 = 1 (Single Input Probe) → The M210 should trigger a PLC interrupt as soon as the sensor touches the workpiece.
- If E80005 = 2 (Binary Coded Decimal) → The M210 should write the measured value to the variable tripValue in the PLC. The value of tripValue is then stored in E47124 and written to the auxiliary measuring axis E900xx via a dynamic operator of the CNC and read out in cycle G231.
- E80005 is set in the Reste-File (110000.xpi).

## 5.13 PLC Code for NUMgrind

### 5.13.1 Introduction

This sample PLC program (NUMgrind\_Base\_Project\_04\_01\_xx.yy.project), contains all the necessary PLC code needed to communicate with the NUMgrind cycles. Additionally there is a mapping to a MP04 panel and an example of a virtual MP04 panel.

Relevant are only the PLC part, which is stored in the folder Application/NUMgrind. All other parts/modules can be replaced by application-specific, alternative, location-dependent solutions.



### 5.13.2 NUMgrind\_ButtonLED

Definition of all buttons and LEDs. Additionally the mapping to MP04 and the VP (virtual panel).

All buttons not mentioned in the following three sections are created by the respective application team, adapted to the local needs and customs in the realization of PLC projects.



If buttons, respectively functions, are not needed (because for example the sensor is not present in the machine), the mapping to the button should remain empty.

### 5.13.2.1 Mandatory buttons

These following buttons MUST be on every machine that wants to use NUMgrind to its fullest extent. The keys can be accessed via

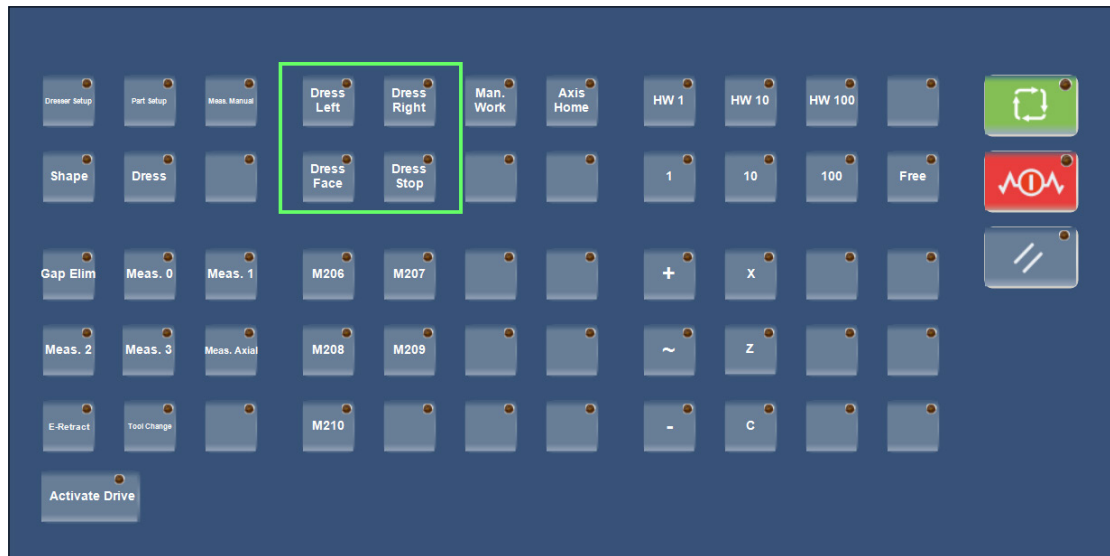
- A machine panel
  - A virtual panel
  - Physical buttons / switches on the machine
  - An HMI solution
- be solved.



- **Dresser Setup**  
Starts the process to set up the dresser.
- **Part Setup**  
Starts the process to set up the part.
- **Measurement Manual**  
Starts the process to measure the workpiece manually.
- **Shape**  
Starts the process to shape the grinding wheel.
- **Dress**  
Starts the process to dress the grinding wheel.
- **Manual Work**  
Starts the process to move the grinding wheel in JOG/handwheel mode.
- **Axis to Home Position**  
Starts the process to move the grinding wheel to the safe machine position.
- **Tool Change**  
Confirms to the PLC that the grinding wheel has been changed.

### 5.13.2.2 Additional buttons

The following keys do not have to be present. These are additional buttons that give the NUMgrind package more functionality.



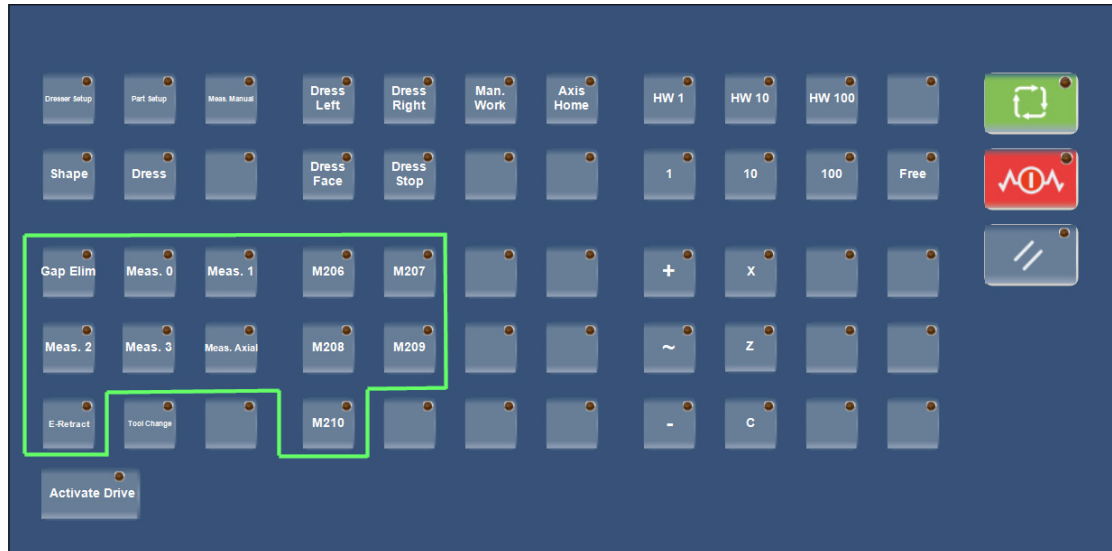
- **Dress Left**  
Starts the process to dress the left side of the grinding wheel.
- **Dress Right**  
Starts the process to dress the right side of the grinding wheel.
- **Dress Face**  
Starts the process to dress the circumference/face of the grinding wheel.
- **Dress Stop**  
Reset the set dress command. Including "Dress" from the mandatory buttons.

### 5.13.2.3 Sensors / logic buttons

These buttons represent sensors on the machine or logic in the PLC. They are listed/represented here as buttons for illustration and testing purposes.



In an application, these buttons should NEVER be directly available to the user on a panel.



- **Gap Elimination**  
Test button representing a gap elimination sensor.
- **Measure 0**  
Test button representing a measuring calliper.
- **Measure 1**  
Test button representing a measuring calliper.
- **Measure 2**  
Test button representing a measuring calliper.
- **Measure 3**  
Test button representing a measuring calliper.
- **Measure Axial**  
Test button representing a sensor for length measurement in Z.
- **Emergency Retract**  
Test button to trigger an emergency retract.
- **M206**  
Test button, which represents a sensor for triggering the measuring command M206.
- **M207**  
Test button, which represents a sensor for triggering the measuring command M207.
- **M208**  
Test button, which represents a sensor for triggering the measuring command M208.
- **M209**  
Test button, which represents a sensor for triggering the measuring command M209.
- **M210**  
Test button, which represents a sensor for triggering the measuring command M210.



### 5.13.3 NUMgrind\_Handling

This program module defines all the necessary PLC variables that are required for the action objects. The individual action objects are introduced and explained below. The order in this manual is alphabetical.

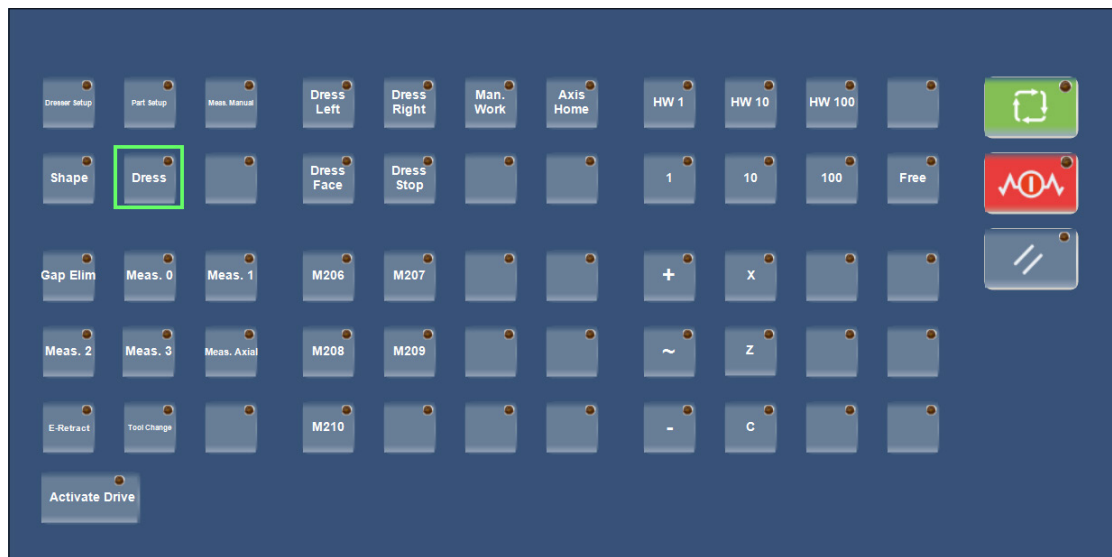
#### 5.13.3.1 AxialMeasuring

Currently contains all known PLC code for axial measurement of workpieces. Should be tested extensively before use.

#### 5.13.3.2 DressingMode

This module is called via GC\_Control. It contains a small state machine, which ensures that a made input cannot be overwritten by the keys again and again.

#### ■ Normal Dressing – Mandatory



```

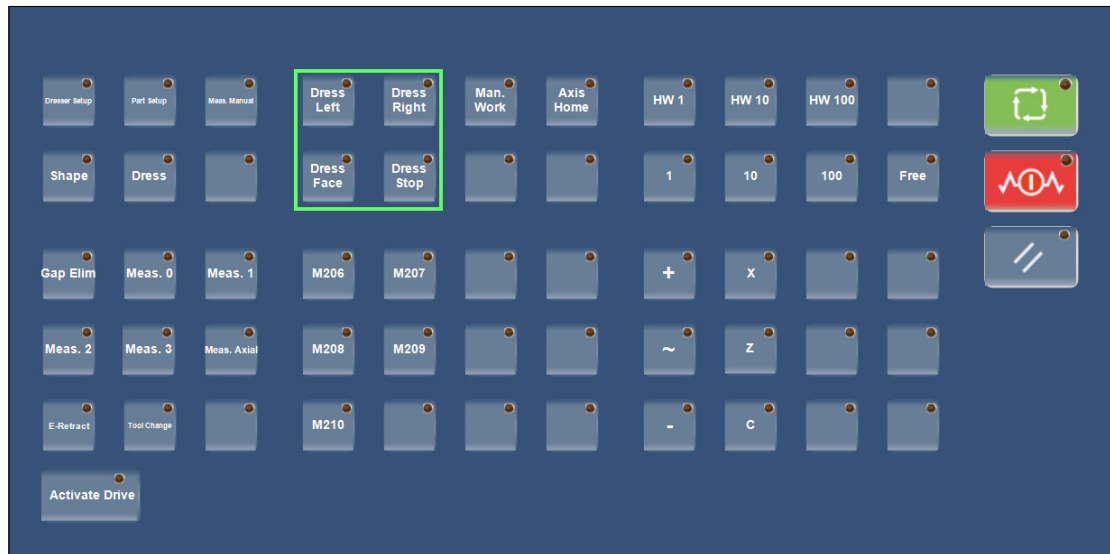
IF NUMgrind_ButtonLED.btnDress THEN // General Dressing Request
    SwitchAutoMode ();
    IF Flexium_NCK.RCNC.General.Start THEN
        Flexium_NCK.WCNC.E20000[30] := 1;
        // Request Dressing during grinding cylce.
        // E20030 is checked within the grinding cycles.
    ELSE
        Flexium_NCK.WCNC.E40000[33] := 4; // Request to Start Dressing Process
        Flexium_NCK.WCNC.Channel[1].PlcCallSubroutine := TRUE;
    END_IF
    Flexium_NCK.WCNC.E40000[10] := 0; // Use Default Dessing Value from WD51
    Flexium_NCK.WCNC.E40000[11] := 0; // Use Default Dessing Value from WD51
    NUMgrind_ButtonLED.ledDress := TRUE;
    state_Dressing := 10; // chance to dressing
END_IF

```

In this general part it is checked whether the machine is running or not. If the machine is already running, the value 1 is written to the E20033. This causes the grinding cycle to be interrupted at certain points and the grinding wheel to be dressed according to the standard dressing values.

If the machine is not started, the subprogram %9999 (zone 3) is to be called and the dressing process started from there. The standard dressing values are also used here for dressing.

## ■ Special Dressing – Additional



### // Special Dressing Buttons

**IF** NUMgrind\_ButtonLED.btnDressFace **OR** NUMgrind\_ButtonLED.btnDressLeft **OR** NUMgrind\_ButtonLED.btnDressRight **THEN**

SwitchAutoMode ();

**IF** NUMgrind\_ButtonLED.btnDressFace **THEN**

plc\_Dressing := 1; *// Dress Face / Diameter*

NUMgrind\_ButtonLED.ledDressFace := TRUE;

**END\_IF**

**IF** NUMgrind\_ButtonLED.btnDressLeft **THEN**

plc\_Dressing := 2; *// Dress Left Side*

NUMgrind\_ButtonLED.ledDressLeft := TRUE;

**END\_IF**

**IF** NUMgrind\_ButtonLED.btnDressRight **THEN**

plc\_Dressing := 4; *// Dress Right Side*

NUMgrind\_ButtonLED.ledDressRight := TRUE;

**END\_IF**

**IF** Flexium\_NCK.RCNC.General.Start **THEN**

Flexium\_NCK.WCNC.E20000[30] := 1;

*// Request Dressing during grinding cylce.*

*// E20030 is checked within the grinding cycles.*

**ELSE**

Flexium\_NCK.WCNC.E40000[33] := 4; *// Request to Start Dressing Process*

Flexium\_NCK.WCNC.Channel[1].PlcCallSubroutine := TRUE;

**END\_IF**

Flexium\_NCK.WCNC.E40000[10] := 1; *// Dressing Value is set by PLC*

Flexium\_NCK.WCNC.E40000[11] := plc\_Dressing; *// Dressing Value from PLC*

state\_Dressing := 10; *// chance to dressing*

**END\_IF**

With this special part, it can be made possible that the OEM/end user gets the possibility to tell directly the machine which grinding wheel side should be dressed. Of course the functionality can be extended and values between 0 and 8 can be written to the variable `plc_Dressing`.

The explanation of the values can be found in the manual "Flexium+ Cylindrical Grinding Programming manual M00049" in the chapter "Wheel dressing selection ED".

In this example the user can say if he wants to dress the left or right side of the grinding wheel or the circumference of the grinding wheel. This is independent of whether the machine is already running or at a standstill.

### 5.13.3.3 Dwelltime

This module controls the dwell time for the grinding cycles. Due to various points, the G4 cannot be used directly in the grinding cycles. Since, however, a dwell time is still required for cylindrical traverse grinding, for example, this can be done via this module.



The Dwelltime module must NOT be modified, otherwise the error-free function of the NUMgrind grinding cycles cannot be guaranteed.

1

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### 5.13.3.4 EmergencyRetract



```
IF NUMgrind_ButtonLED.btnEmRetract THEN // Emergency Retract Requested
```

```
Flexium_NCK.W_ALLCNC.EmergencyRetract := TRUE;
```

```
Flexium_NCK.WCNC.E20000[29] := 1; // If Grinding Cycle is within a dwell  
time, tell the cycle to stop dwell time
```

```
retractActive := TRUE;
```

```
ELSE
```

```
Flexium_NCK.W_ALLCNC.EmergencyRetract := FALSE;
```

```
END_IF
```

```
NUMgrind_ButtonLED.ledEmRetract := Flexium_NCK.RCNC.General.EmergencyRetract;
```

```
IF Flexium_NCK.W_ALLCNC.Reset AND NOT Flexium_NCK.W_ALLCNC.EmergencyRetract  
THEN
```

```
Flexium_NCK.WCNC.E20000[29] := 0;
```

```
retractActive := FALSE;
```

```
END_IF
```

The test button "E-Retract" must be replaced by a suitable application-related logic.



Important in this module, when the Emergency Retract is triggered on the CNC, it is mandatory to set the E20029 to 1, so that the dwell time is aborted within the grinding cycle.

### 5.13.3.5 GC\_Control

The GC\_Control is the main module that controls the handling of the following mandatory buttons:

- Dresser Setup
- Part Setup
- Shape
- Dress
- Manual Work
- Axis to Home Position
- Manual Measurement

This module can be adopted without any further changes. It is important that certainly no changes are made to the following section:

*// Call Subroutine for Button-Call*

```
IF (NUMgrind_ButtonLED.btnDressSetup OR NUMgrind_ButtonLED.btnShape OR
NUMgrind_ButtonLED.btnPartSetup OR NUMgrind_ButtonLED.btnManWork OR
NUMgrind_ButtonLED.btnAxisHome) AND NOT Flexium_NCK.RCNC.General.Start THEN
    Flexium_NCK.WCNC.Channel[1].PlcCallSubroutine := TRUE;
END_IF
```

*// Reset*

```
IF oMP04.xBtnReset OR (Flexium_NCK.WCNC.Channel[1].PlcCallSubroutine AND
M100_active) OR Flexium_NCK.RCNC.Channel[1].DecodeM.General.M02 THEN
    Flexium_NCK.WCNC.Channel[1].PlcCallSubroutine := FALSE;
    Flexium_NCK.W_ALLCNC.Reset := TRUE;
END_IF
```

```
IF Flexium_NCK.RCNC.General.Reset THEN
    Flexium_NCK.WCNC.E40000[10] := 0;
    Flexium_NCK.WCNC.E40000[11] := 0;
    Flexium_NCK.WCNC.E40000[33] := 0;
    Flexium_NCK.WCNC.E20000[30] := 0;
    Flexium_NCK.WCNC.E20000[31] := 0;
END_IF
```

If the logic for the LEDs needs a change, this may of course be done.

### 5.13.3.6 GC\_Errors

This module checks whether a grinding wheel is half worn (M173) or totally worn on the side and/or circumference (M175). This wear is then stored in the array for the current grinding wheel.

The two variables "wheelWearLimit" and "wheelHalfUsed" can be used for customer-specific functions.

This module does not necessarily have to be adopted.

---

### 5.13.3.7 GC\_MInstructions

This module controls the transfer of the signal from CNC to the local PLC variables for most of the M-commands of NUMgrind.

For error-free operation, it is recommended not to make any changes to this module.

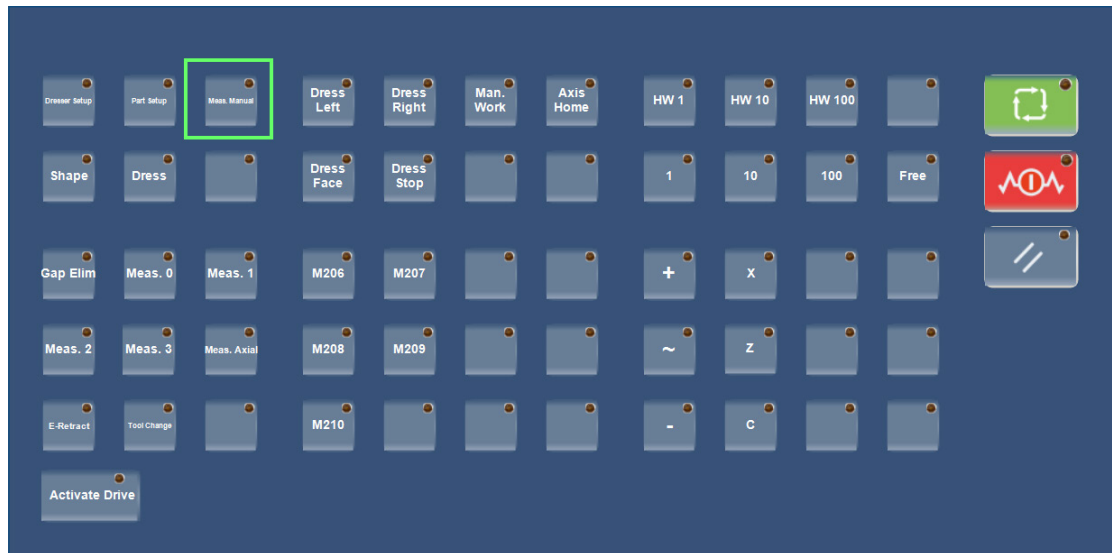
### 5.13.3.8 ManualMeasurement

---



Do not change this module!

If the operator wants to measure the workpiece himself, regardless of whether the machine is currently running or not, the call of the button "Meas. Manual" is controlled via this module.



### 5.13.3.9 MeasureInstructions

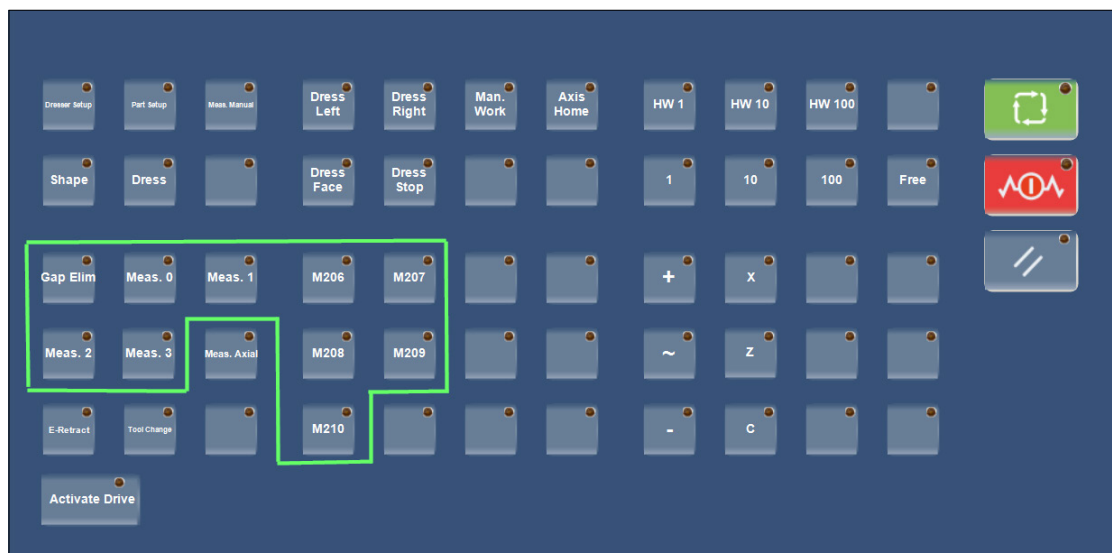
All diameter related measurements or gap elimination is controlled via this module.



Important that the part with setting and resetting the active M-commands is not changed!

The following buttons MUST be replaced by sensor signals or other PLC logic, or commented out completely!

NUMgrind\_ButtonLED.btnGapElim  
 NUMgrind\_ButtonLED.btnMeas3  
 NUMgrind\_ButtonLED.btnMeas2  
 NUMgrind\_ButtonLED.btnMeas1  
 NUMgrind\_ButtonLED.btnMeas0  
 NUMgrind\_ButtonLED.btnM206  
 NUMgrind\_ButtonLED.btnM207  
 NUMgrind\_ButtonLED.btnM208  
 NUMgrind\_ButtonLED.btnM209



The Gap Elimination and Measure 0 - 3 functions are integrated in the NUMgrind HMI and can be conveniently selected there. See the In-Cycles of the grinding cycles in the manual "NUMgrind HMI Cylindrical Grinding Operator's manual M00057yy-xx".

M206 to M209 are trigger functions, which can currently only be passed to the grinding cycles via the respective arguments. More information can be found in the "Flexium+ Cylindrical Grinding Programming manual M00049yy-xx" in chapter "Measurement selection ► EG".

### 5.13.3.10 NCG\_OperatorMessages



Do not change this module!

This module allows certain operator messages to be displayed in the HMI so that the user of the software is informed what the machine is doing. This module is necessary because \$-messages cannot be sent in the G41/G42 mode of the CNC.

---

### 5.13.3.11 OscillatingFeed

The following two E-parameters can be described with a feedrate value (0-255).

| Parameter | Oscillation  | Value |
|-----------|--------------|-------|
| E47000    | LINEAR/TAPER | 0-255 |
| E47003    | SINUS        | 0-255 |



In case of an emergency retract, both parameters must be set to 0!

#### ■ Explanation about the two E-parameters

There are two different types of oscillation in NUMgrind.

- 1) Sine
- 2) Linear & conical

Both oscillations are generated by dynamic operators. For the sine type a set of different operators is needed, among others the operator 6.

For the linear type only operator 21 is used.

For both oscillation types a separate value (e.g. from the feedrate potentiometer) can be written to the E-parameters E47000 and E47003 to control the oscillation speed (independent of the feedrate of the axis).



## – Sine Type - Operator 6

According to the manual M00055xx-yy, a bundle of 4 parameters is combined to one for each E47000 parameter.

This is because the E47000 parameters each represent only one byte and operator 6 passes a long as the result.

The following happens in operator 6:

The input, consisting of 4 bytes is added with a binary AND operation with the mask and the result is output as a long (4 bytes).

$$\text{Result} = \text{Input} \& \text{Mask}$$

*Input=4 Byte → E47000 bis E47003*

| Long   |        |        |        |
|--------|--------|--------|--------|
| 1 Byte | 1 Byte | 1 Byte | 1 Byte |
| E47000 | E47001 | E47002 | E47003 |

Calculation example

|           | Input     |           |           |           |
|-----------|-----------|-----------|-----------|-----------|
| Parameter | E47000    | E47001    | E47002    | E47003    |
| Hex       | FF        | 00        | 00        | FF        |
| Decimal   | 255       | 0         | 0         | 255       |
| Binär     | 1111 1111 | 0000 0000 | 0000 0000 | 1111 1111 |

|         | Maske     |           |           |           |
|---------|-----------|-----------|-----------|-----------|
| Hex     | 00        | 00        | 00        | FF        |
| Decimal | 0         | 0         | 0         | 255       |
| Binär   | 0000 0000 | 0000 0000 | 0000 0000 | 1111 1111 |

AND Operation

| Input          | 1111 1111 | 0000 0000 | 0000 0000 | 1111 1111 |
|----------------|-----------|-----------|-----------|-----------|
| Maske          | 0000 0000 | 0000 0000 | 0000 0000 | 1111 1111 |
| Resultat (bin) | 0000 0000 | 0000 0000 | 0000 0000 | 1111 1111 |
| Resultat (hex) | 00        | 00        | 00        | FF        |

Thus the result is always the value of the E47003, since the mask has constantly the value 255!

$$\text{Result} = \text{E47003}$$

The sine oscillation occurs in the following G cycles:

- G204
- G205
- G212
- G213

## — Linear Type – Operator 21

The linear oscillation mode is realized by the operator 21. There is also the possibility to specify an E-parameter for the speed of the oscillation, but no longer 4 bytes as with operator 6 but only 1 byte is needed with operator 21.

In case of NUMgrind, the E47000 is used to control the speed.

Since the E47000 corresponds to one byte, the following mapping is provided:

| Decimal | Hex | Speed in % |
|---------|-----|------------|
| 0       | 00  | 0          |
| 255     | FF  | 100        |

Linear oscillation occurs in the following G cycles:

- G206
- G207
- G210
- G211
- G214
- G215

### 5.13.3.12 SwitchAutoMode

Switches the CNC control to automatic mode.

### 5.13.3.13 ToolChangeControl

As soon as an M6 is recognized by the PLC, the variable "toolChangeActive" is set to 1. This module then checks whether the same grinding wheel is used as before or whether a different tool number has been changed.

If a new grinding wheel has been changed to a different setup number, this must be confirmed via the "Tool Change" button.



### 5.13.3.14 WheelRotationSpeed

If the G230 (calculation of grinding wheel speed) was called in the CNC, the M177 is called at the end of the calculation and thus signals to the PLC that the calculation is completed.

The calculated speed is contained in the E30000, respectively in the variable "calc\_GW\_Speed".  
With the speed of the E30000 then in the subprogram %9997 the grinding wheel is started with the following ISO command:

**M4#1 SE30000#1** (Start Wheel Spindle CCW) (first auxiliary spindle)

For the customer-specific PLC programming, the maximum grinding wheel speeds are available in the variables "maxSpeed\_GW1" to "maxSpeed\_GW8" for comparison with the value of "calc\_GW\_Speed". The E30001 to E30008 are set in the %110000 (Reset File).

### 5.13.4 fnE37xxxReader

Controls the reading of the E-parameters E37xxx from the CNC.



This is a function block and must not be changed!

### 5.13.5 ROUND

Rounds a number to a specified precision.



This is a function block and must not be changed!

---

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