NUM 1060 G

CYLINDRICAL GRINDING COMMISSIONING MANUAL

en-938929/1

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The physical, technical and functional characteristics of the hardware and software products and the services described in this document are subject to modification and cannot under any circumstances be regarded as contractual.

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.

Table of Contents

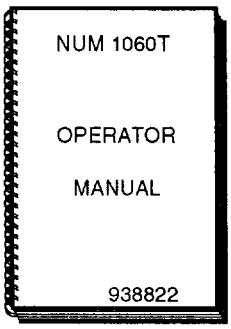
Record of Revisions

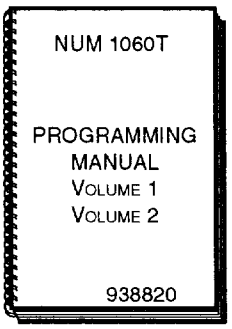
DOCUMENT REVISIONS		
Date	**Revision**	**Reason for Revision**
09-94	0	Creation of provisional document
12-95	1	Document rewrite

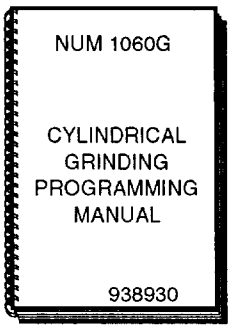
Structure of the NUM 1060 Product Documentation

User Documents

These documents describe operation of the CNC.

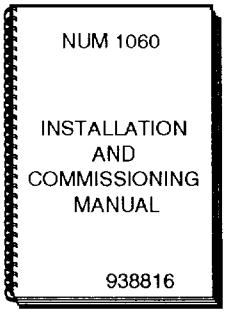


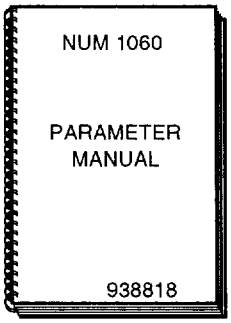


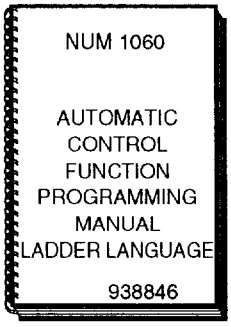


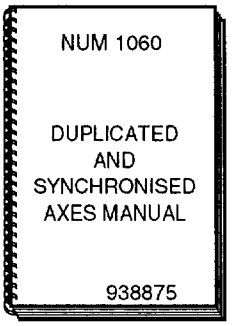
Integrator Documents

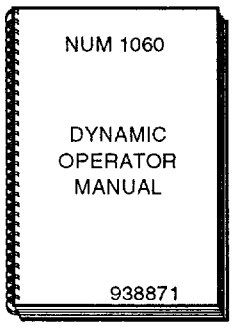
These documents describe setting up the CNC on a machine

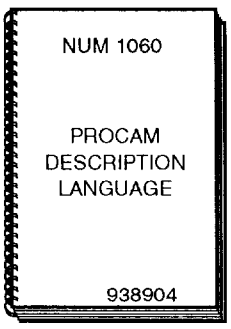


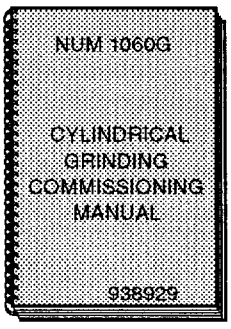






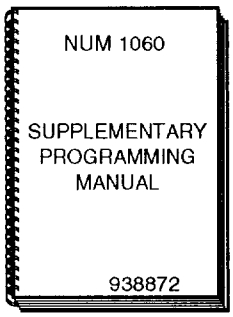


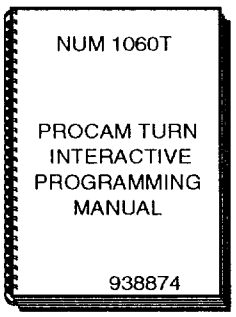


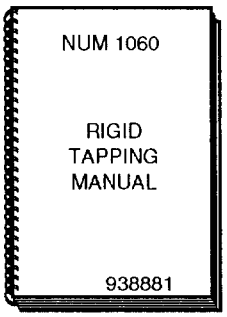


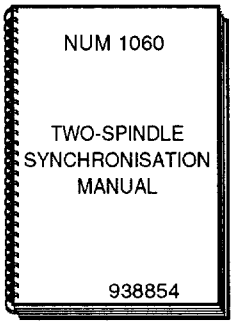
Special Programming Documents

These documents describe special CNC programming applications.

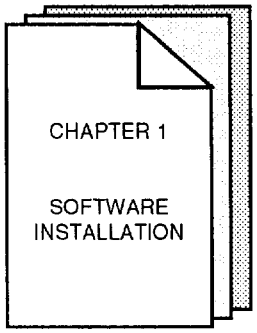




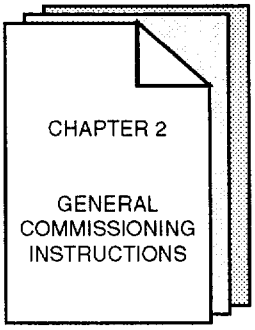




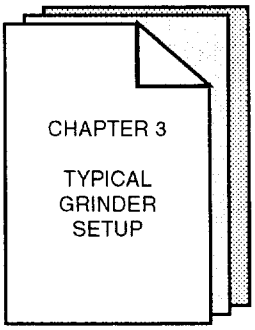
Commissioning Manual



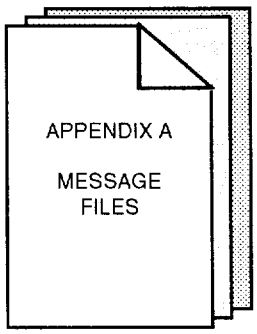
Description of loading the cylindrical grinding software into the CNC.



General description of the cylindrical grinding software operating instructions.



Description of typical grinder setup.



List of homing and grinding cycle error messages.

Agencies

The list of NUM agencies is given at the end of the volume.

Questionnaire

To help us improve the quality of our documentation, we kindly ask you to return the questionnaire at the end of this volume.

1 Software Installation

1.1 General

The cylindrical grinding software can be used for programming cycles in ISO or for interactive programming with PROCAM.

The software is provided on two diskettes:
- one called «Cylindrical Grinding Cycles»,
- one called «PROCAM Cylindrical Grinding».

REMARK *It is necessary to load the «Cylindrical Grinding Cycles» diskette to be able to program cylindrincal grinding cycles interactively with «PROCAM».*

1.2 Hardware Required for Loading the Software

A personal computer with:
- MS-DOS operating system,
- 3 1/2" HD drive,
- serial port,
- RS232 interface cable.

1.3 Software Language Codes

The software can be loaded in one of the following languages:
- French,
- English,
- German,
- Italian.

In the procedure below, replace «[language code]» with the abbreviation given in the table for the desired language.

Language	French	English	German	Italian
Code	Frch	Engl	Germ	Ital

1.4 Contents of the Diskettes

1.4.1 «Cylindrical Grinding Cycles» Diskette

The «Cylindrical Grinding Cycles» diskette contains:
- load file «minicom.exe»,
- the files to be loaded in the PLC,
- the files to be loaded in the CNC.

Load file minicom.exe

File «minicom.exe» on the diskette is used to load the other software files into the CNC and PLC.

REMARK *File «minicom.exe» is available only in French and English.*

Files to be loaded in the PLC

The files to be loaded in the PLC depend on the type of gauge used:
- all the files in directory «BCD» for a gauge with BCD outputs,
- all the files in directory «BIT» for a gauge with contact outputs.

REMARK *These example files supplied by NUM are to be loaded by the PLC-TOOL PLC ladder language programming tool.*

Files contained in directories «BCD» and «BIT»

Files in directory «BCD»:
- bcd_bin.xla
- command.xla
- init.xla
- mainbcd.xla

Files in directory «BIT»:
- bit_bin.xla
- command.xla
- init.xla
- mainbit.xla.

Files to be loaded in the CNC

The following files are to be loaded in the CNC:
- «cycles.bin» (ISO cycles),
- «mes_[language code].bin» (error messages for the cycles).

1.4.2 «PROCAM Cylindrical Grinding» Diskette

The «PROCAM Cylindrical Grinding» diskette contains:
- load file «minicom.exe»,
- the «PROCAM» files to be loaded in the CNC.

File minicom.exe

File «minicom.exe» on the diskette is used to load one of the three «PROCAM» files into the CNC.

«PROCAM» files to be loaded into the CNC

One of the following files is to be loaded, depending on the type of grinding machine:
- ext_[language code].bin for external cylindrical grinding,
- int_[language code].bin for internal cylindrical grinding,
- tot_[language code].bin for internal/external cylindrical grinding.

1.5 Installing the Software on the CNC

1.5.1 Loading the Files into the PLC

The files to be loaded are contained in one of the two following directories:
- «BCD»,
- «BIT».

Requirements

A serial port on the PC (COM1 or COM2) must be connected to a serial port configured for PLCTOOL (see PLCTOOL - Ladder Language Programming Tool) on the CNC by a connecting cable.

Actions

On the PC

Copy the files from the selected directory (BCD or BIT) into a machine directory of PLCTOOL.

Load the files from the PLCTOOL machine directory to the CNC.

For further information, refer to PLCTOOL - Ladder Language Programming Tool.

1.5.2 Loading the Files into the CNC

The following files are to be loaded into the CNC:
- «cycles.bin»,
- «mes_[language code].bin».

1.5.2.1 Loading File «cycles.bin»

Requirements

A serial port on the PC (COM1 or COM2) must be connected to a serial port configured for loading (see Operator Manual) on the CNC by a connecting cable.

The CNC must be on, with the «CURRENT POSITION» page and softkey bar displayed.

Actions

Select load mode. ☞ MODE MODE

Select the «LOAD MOD»E menu. ☞ LOAD

The «LOAD MODE» menu is displayed with item «0, PROGRAMME LOAD», selected.

Prepare the CNC for programme load. ☞ —

The CNC goes on wait for load and the «CYCLE» light is lit.

On the PC

Turn on the PC.

Prompt C:\> is displayed showing that drive c is selected.

Insert the «Cylindrical Grinding Cycles» diskette in the appropriate drive of the PC.

Enter DOS command «A: (or B:)» and press Enter.

Prompt A:\> (or B:\>) is displayed showing that the specified drive is selected.

Enter «minicom.exe» and press Enter.

The «MINICOM» menu is displayed:

```
1 —> PARAMETERS SETTING UP
2 —> SENDING AN ASCII OR OBJECT FILE
3 —> SENDING A BINARY FILE
```

The cursor is on «1 —> PARAMETERS SETTING UP».

Press Enter to confirm the selection.

The «PARAMETERS SETTING UP» page is displayed.

Set the parameters and confirm the settings by pressing Enter.

The default settings are listed below. They can be changed using the arrow keys or +/-:

Serial port:	COM1
Sending baudrate:	9600 bauds
Changing directory:	A:\
Language:	English

When all the parameters are correctly set, press Enter to return to the «MINICOM» menu.

The «MINICOM» menu is displayed.

Move the cursor to «3 —> SENDING A BINARY FILE» using the arrow keys.

The «SENDING A BINARY FILE» page is displayed.

Select file «cycles.bin» using the arrow keys.

File «cycles.bin» is highlighted.

Press Enter to start loading «cycles.bin».

On the CNC

The file is loaded into the CNC. The «CYCLE» light goes out when loading is completed.

1.5.2.2 Loading File «mes_[language code].bin»

Requirements

On the CNC

«LOAD MODE» menu displayed with «PROGRAMME LOAD» item selected.

Actions

On the CNC

Prepare the CNC for programme load (see the beginning of Sec. 1.5.2.1). ☞

The CNC goes on wait for load and the «CYCLE» light is lit.

On the PC

«SENDING A BINARY FILE» page displayed.

Select one of the «mes_[language code].bin» message files using the arrow keys.

Press Enter to load the message file in the language selected.

On the CNC

The file is loaded and the «CYCLE» light goes out when loading is completed.

On the PC

The «SENDING A BINARY FILE» page is displayed with the message «Time out press <Esc> to quit».

Press ESC to exit from the «SENDING A BINARY FILE» page.

The «MINICOM» menu is displayed.

Press «ALT+X» to exit from the «MINICOM» menu.

The prompt A:\ (or B:\) is displayed.

REMARK *Check for effective load of the files in the CNC memory (see Operator Manual).*

1.5.3 Loading the PROCAM software

The contents of the «PROCAM Cylindrical Grinding» diskette are loaded by load file «minicom.exe» in the same way as the «cycles.bin» file of the «Cylindrical Grinding Cycles» diskette (see Sec. 1.5.2.1).

Load the file corresponding to the type of machine in the language desired:
- «ext_[language code].bin»,
- «int_[language code].bin»,
- «tot_[language code].bin».

2 General Commissioning Instructions

2.1 General

This manual describes commissioning of the software for the following types of cylindrical grinding machines:
- internal,
- external,
- universal (internal/external).

The grinding machine is configured like a turning machine. The machine:
- must include the X and Z axes as a minimum,
- may include a swivelling wheel head (B axis) which may have one or more spindles (swivelling can be manual or motorised),
- may be equipped with a headstock and a footstock,
- may be used in the inclined X axis configuration.

Except for the dedicated grinding functions G1xx, G2xx, M1xx and M2xx described herein, the programming functions used in grinding comply with standard use for turning applications.

For any information not provided herein or in the internal or external grinding programming manual, refer to the following manuals:
- Installation and Commissioning Manual,
- Parameter Manual,
- Automatic Control Function Programming Manual,
- Turning Operator Manual,
- Turning Programming Manual,
- Supplementary Programming Manual,
- Dynamic Operator Manual.

2.2 Configuring the CNC

This paragraph describes how to configure the CNC for internal/external cylindrical grinding applications.

The settings used for grinding must comply with the machine parameter manual.

2.2.1 Machine Parameters

Defining the axes:

The following axes have to be defined:
- X / Z: basic external/internal cylindrical grinder,
- X / Z / U: external cylindrical grinder with roller dresser.

P2: Measured axes

P3: Servo-controlled and interpolated axes

P4: Axes programmed by diameter
- Word N0 = 01: axis 0 (X) programmed by diameter.

P9: Axis assignment to groups
- Word N0 = 0: X axis
- Word N1 = 2: Z axis

Miscellaneous parameters

P7: Forcing of manual mode (M12)
- Word N1 = bit 1

P35: Subroutine call by M function
- Word N0 = 06 : function M06
- Word N1 = 9910 : subroutine %9910 called by M06
- Word N2 = 140 : function M140
- Word N3 = 9940 : subroutine %9940 called by M140
- Word N4 = 145 : function M145
- Word N5 = 9945 : subroutine %9945 called by M145
- Word N6 = 160 : function M160
- Word N7 = 9920 : subroutine %9920 called by M160

P97: Number of axis groups in the system
- Word N0 = n: number of CNC axis groups
- Word N1 = n: number of PLC axis groups

REMARK A file %9910.X must be defined for each axis group declared.

2.2.2 Functionalities

According to the machine type and use, a distinction is made between:
- basic functionalities,
- supplementary functionalities.

Basic functionalities:
- turning functions (60),
- dynamic operators (11),
- inclined axes (14),
- emergency retraction (70),
- structured programming, programme stack, symbolic variables (46),
- transfer of active values in programme (47).

Supplementary functionalities:
- parametric accuracy (41),
- PROCAM interpreter (40),
- PROCAM GRIND «cylindrical grinding» (103),
- on-the-fly measurement acquisition (71).

2.2.3 Equipping the PLC

In the sample PLC programme provided, the input/output board locations are as follows:
- Two 32-input boards: locations 5 and 6,
- One 32-output board: location 7.

REMARK *The programme provided must be adapted to special machine configurations.*

2.2.4 CNC and PLC Memories

CNC memory

The CNC must have a 256-Kbyte memory.

PLC memory

The PLC must have a 64-Kbyte memory - PLC_TOOL.

2.2.5 Programming Language

The PLC can be programmed in ladder language or C using PLC_TOOL.

REMARK *Assembler cannot be used for programming.*

2.3 General Commissioning Information

The use of the grinding software requires:

- loading all the .xpi files into the CNC RAM,
- loading the PLC files,
- setting the grinding wheel parameters in the relevant parameter file. For example, T1 M06 is programmed in parameter file %9900.1 (see files supplied on the diskette),
- writing the wheel data limits in file %9921 for T1, %9922 for T2, and so on to monitor them,
- running the dresser origin setting procedure,
- running workpiece origin setting procedure,
- shaping the wheel,
- homing the axes,
- writing the grinding programme with cycle.

2.4 Adapting Machine and Wheel Data Files

The files present in the system must be adapted by the OEM. These files include:
- machine data files,
- wheel data files,
- machine limit files.

The files described below include comments related to certain variables. Only the variables whose comments are marked «*» are to be specified by the user (some using the conditions defined in the comment). The other variables must not be modified.

2.4.1 Machine Data File MCHDTA1.XPI

It should be noted that additional information concerning GENERAL DATA blocks N13, N14 and N15 and FIXED DRESSER DATA block N113 is given at the end of this file.

```
Fichier MCHDTA1.XPI

( ====================   mchdta1.xpi)
( MACHINE DATA FILE - FOR CYLINDRICAL )
( GRINDING MACHINES ------ GR 1 )
( WARNING :DON'T MODIFY THE STRUCTURE )
( OF THIS PROGRAM !!! ============== )

( ========== GENERAL DATA ========== )
N10 @X =      X        (name of axis 0 )
N11 @Z =      Z        (name of axis 2 )
N12 @U =      U        (name of axis 3 )

N13 L0 =      .2       (saf.under f.diam.)


N14 L1 =       4       (dum.gauge ax.addr)


N15 L2 =       0       (gauge type )



( ==========  WHEEL DATA 1 ========== )
N100 L0 =      0       (PREF axis 0 dres.)
N101 L1 =      0       (PREF axis 2 dres.)
N102 L2 =      0       (PREF axis 0 part )
N103 L3 =      0       (PREF axis 2 part )
N104 L4 =      1       (W.int=0 / W.ext=1)
N105 L5 =      1       (Dress. type 1,2,3)


N106 L6 =   6000       (Max. wheel speed )
```

* To be specified as per parameter P9

* To be specified as per parameter P9

* To be specified as per parameter P9 but only if roller dresser present

* To be specified for grinding with measurement. Lacking an interrupt, grinding continues beyond the programmed dimension until reaching L0.

* To be specified for gap elimination grinding with measurement or grinding with measurement. Specifies the dummy axis number

* To be specified for gap elimination grinding with measurement or grinding with measurement. Specifies the dummy axis number and measurement by contact (=0) or BCD (=1).

Described by the dressing setup program

Described by the dressing setup program

Described by the part setup program

Described by the part setup program

* External wheel = 1; internal wheel = 0

* 1: Fixed two-diamond dresser without intermediate position of axis 2

* 2: Fixed two-diamond dresser with intermediate position of axis 2

* 3: Roller dresser

* Maximum wheel speed

```
( ======  FIXED DRESSER DATA  ======= )
N110 L7 =       0       (Diamond radius )
N111 L8 =       0       (Diam. dist.axis 0)
N112 L9 =       0       (Diam. dist.axis 2)
N113 L10 =      0       (Dress.int.posit. )
```

* Diamond radius
Described by programme %9940
Described by programme %9940
* See details on N113 at end of file

```
( ============ WHEEL DATA 2 ========== )
N200 L0 =       0       (PREF axis 0 dres.)
N201 L1 =       0       (PREF axis 2 dres.)
N202 L2 =       0       (PREF axis 0 part )
N203 L3 =       0       (PREF axis 2 part )
N204 L4 =       1       (W.int=0 / W.ext=1)
N205 L5 =       1       (Dress. type 1,2,3)
N206 L6 =       6000    (Max. wheel speed )

( ======  FIXED DRESSER DATA  ======= )
N210 L7 =       0       (Diamond radius   )
N211 L8 =       0       (Diam. dist.axis 0)
N212 L9 =       0       (Diam. dist.axis 2)
N213 L10 =      0       (Dress.int.posit. )

( ========== WHEEL DATA 3 ========= )
N300 L0 =       0       (PREF axis 0 dres.)
N301 L1 =       0       (PREF axis 2 dres.)
N302 L2 =       0       (PREF axis 0 part )
N303 L3 =       0       (PREF axis 2 part )
N304 L4 =       1       (W.int=0 / W.ext=1)
N305 L5 =       1       (Dress. type 1,2,3)
N306 L6 =       6000    (Max. wheel speed )

( ======  FIXED DRESSER DATA  ======= )
N310 L7 =       0       (Diamond radius   )
N311 L8 =       0       (Diam. dist.axis 0)
N312 L9 =       0       (Diam. dist.axis 2)
N313 L10 =      0       (Dress.int.posit. )

( ========== WHEEL DATA 4 ========= )
N400 L0 =       0       (PREF axis 0 dres.)
N401 L1 =       0       (PREF axis 2 dres.)
N402 L2 =       0       (PREF axis 0 part )
N403 L3 =       0       (PREF axis 2 part )
N404 L4 =       1       (W.int=0 / W.ext=1)
N405 L5 =       3       (Dress. type 1,2,3)
N406 L6 =       6000    (Max. wheel speed )

( ======  FIXED DRESSER DATA  ======= )
N410 L7 =       0       (Diamond radius )
N411 L8 =       0       (Diam. dist.axis 0)
N412 L9 =       0       (Diam. dist.axis 2)
N413 L10 =      0       (Dress.int.posit. )
```

```
( ========== WHEEL DATA 5 ========= )
N500 L0 =       0      (PREF axis 0 dres.)
N501 L1 =       0      (PREF axis 2 dres.)
N502 L2 =       0      (PREF axis 0 part )
N503 L3 =       0      (PREF axis 2 part )
N504 L4 =       1      (W.int=0 / W.ext=1)
N505 L5 =       1      (Dress. type 1,2,3)
N506 L6 =       6000   (Max. wheel speed)

( =====  FIXED DRESSER DATA  ======= )
N510 L7 =       0      (Diamond radius)
N511 L8 =       0      (Diam. dist.axis 0)
N512 L9 =       0      (Diam. dist.axis 2)
N513 L10 =      0      (Dress.int.posit )

( ========== WHEEL DATA 6 ========= )
N600 L0 =       0      (PREF axis 0 dres.)
N601 L1 =       0      (PREF axis 2 dres.)
N602 L2 =       0      (PREF axis 0 part )
N603 L3 =       0      (PREF axis 2 part )
N604 L4 =       1      (W.int=0 / W.ext=1)
N605 L5 =       1      (Dress. type 1,2,3)
N606 L6 =       6000   (Max. wheel speed)

( =====  FIXED DRESSER DATA  ======= )
N610 L7 =       0      (Diamond radius )
N611 L8 =       0      (Diam. dist.axis 0)
N612 L9 =       0      (Diam. dist.axis 2)
N613 L10 =      0      (Dress.int.posit )

( ========== WHEEL DATA 7 ========= )
N700 L0 =       0      (PREF axis 0 dres.)
N701 L1 =       0      (PREF axis 2 dres.)
N702 L2 =       0      (PREF axis 0 part )
N703 L3 =       0      (PREF axis 2 part )
N704 L4 =       0      (W.int=0 / W.ext=1)
N705 L5 =       0      (Dress. type 1,2,3)
N706 L6 =       6000   (Max. wheel speed )

( =====  FIXED DRESSER DATA  ======= )
N710 L7 =       0     (Diamond radius )
N711 L8 =       0     (Diam. dist.axis 0)
N712 L9 =       0     (Diam. dist.axis 2)
N713 L10 =      0     (Dress.int.posit. )
```

```
( ========== WHEEL DATA 8 ========== )
N800 L0 =       0      (PREF axis 0 dres.)
N801 L1 =       0      (PREF axis 2 dres.)
N802 L2 =       0      (PREF axis 0 part )
N803 L3 =       0      (PREF axis 2 part )
N804 L4 =       0      (W.int=0 / W.ext=1)
N805 L5 =       0      (Dress. type 1,2,3)
N806 L6 =    6000   (Max. wheel speed)

( =====  FIXED DRESSER DATA  ======= )
N810 L7 =       0      (Diamond radius )
N811 L8 =       0      (Diam. dist.axis 0)
N812 L9 =       0      (Diam. dist.axis 2)
N813 L10 =      0      (Dress.int.posit. )
( ================================ )
```

2.4.1.1 Information on Blocks N13, N14, N15 and N113

Measurement by Interrupt

Block N13: Safety Clearance

The value assigned to variable L0 specifies the overtravel on the axis (X and/or Z) beyond the target position if no interrupt is received from the measurement system.

Example in the file supplied: N13 L0 = .2

Block N14: Dummy axis number

The value assigned to variable L1 is the address of the dummy axis used for measurement by interrupt. This axis is masked.

Example in the file supplied: N14 L1 = 4

REMARK *The physical address of the dummy axis used in function G10 to interrupt movement along the X or Z axis must be specified in the machine data file.*

N15: Measurement acquisition type

The value assigned to variable L2 is used to define measurement acquisition.

Contact measurement = 0: case where the PLC is connected to several contacts.

BCD measurement = 1: case where the PLC is connected to a BCD measurement system.

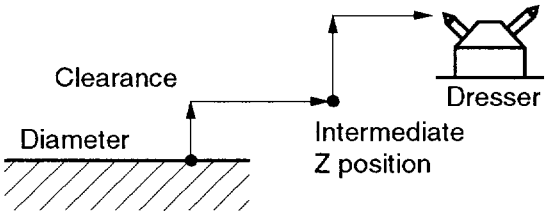
REMARK *If both types of measurement are used (e.g. contact measurement for gap elimination and BCD measurement for workpiece), the BCD type must mandatorily be declared, i.e. BCD: L2 = 1.*

Example in the file supplied: N15 L2 = 0.

N113: Intermediate position for type 2 dresser

Example in the file supplied: N113 L10 = 0 (dressing int. posit.)

Type 2



2.4.2 Wheel Files

When a machine includes several wheels of the same type (e.g. two straight wheels), it is necessary to copy the file concerned and adapt it for each wheel.

The files described below include comments related to certain variables. Only the variables whose comments are marked «*» are to be specified by the user (some using the conditions defined in the comment). The other variables must not be modified.

2.4.2.1 Standard Straight Wheel File WDSTRGHT.XPI

```
File WDSTRGHT.XPI

( ====================   WDSTRGHT.XPI)
( STANDARD SRTIGHT WHEEL DATA)
(FIXED DRESSER------ )
(Dimensions :          position :mm)
(                      feed : mm/min)
(                      time: sec.)

( ========== GENERAL DATA ========== )
[WD(1)] =     100      (Home pos. axis 0)
[WD(3)] =     100      (Home pos. axis 2)
[WD(8)] =     0        (Number for special)
                       (Dressing cycle)


( ========== GEOMETRICAL DATA ========== )
[WD(32)] =    10       (Wheel witdh)
[WD(33)] =    0        (Radius/chamf.left)
[WD(34)] =    0        (Radius/chamf.right)
[WD(35)] =    0        (relief lengh)
[WD(36)] =    0        (relief angle)
[WD(37)] =    5        (Smallest w.witdh)
[WD(38)] =    100      (Diam. unused Wheel)
[WD(39)] =    20       (Diam. used Wheel)
[WD(41)] =    35       (Max.grinding wheel)
                       (surface speed)

( ========== DRESSING DATA ========== )
[WD(51)] =    1+6      (No=0/ fa=1  1s=2)

[WD(52)] =    30       (Face dressing feed)
[WD(53)] =    30       (side dressing feed)
[WD(54)] =    .1       (Dress.inc. axis 0)
[WD(55)] =    .1       (Dress.inc. axis 2)
[WD(58)] =    .05      (Safety distance)
[WD(59)] =    0        (N.part b face d.)
[WD(60)] =    0        (N.part b left d.)
[WD(61)] =    0        (N.part b right d.)
```

* Axis 0 retraction position
* Axis 2 retraction position
* User dressing programme number
In this case, all the functions normally performed by the standard dressing programme must be programmed here (e.g. save, homing position of axes 0 and 2, activation of dressing DAT1 shifts, etc.)

* Wheel width
* Left fillet/chamfer
* Right fillet/chamfer
* Relief height
* Relief angle
* Smallest wheel width
* Unused wheel diameter
* Used wheel diameter
* Maximum tangential wheel speed (initialised)

* Default dressing value: 1 = periphery; 2 = left wall...

* Periphery dressing speed
* Wall dressing speed
* Axis 0 increment
* Axis 2 increment
* Dressing return safety clearance
* Number of parts ground between 2 periphery dressing passes
* Number of parts ground between 2 left wall dressing passes
* Number of parts ground between 2 right wall dressing passes

```
( ========== SHAPING DATA ========== )
[WD(71)] =    0+0      (No=0/ fa=1  1s=2)
[WD(72)] =    1        (Shaping amount)
[WD(73)] =    .1       (Shaping increment)
[WD(74)] =    30       (Face shaping feed)
[WD(75)] =    30       (Side shaping feed)

( ******** END OF WHEEL DATA *********)
```

* Default shaping value
* Shaping amount
* Shaping increment
* Periphery shaping speed
* Wall shaping speed

2.4.2.2 Standard Angular Wheel File WDANGUL.XPI

File WDANGUL.XPI

```
( ====================   WDANGUL.XPI)
( STANDARD ANGULAR WHEEL DATA)
(FIXED DRESSER          ------ )
(Dimensions :           position:mm)
(                       feed: mm/min)
(                       time: sec.)
( ========= GENERAL DATA ========== )
[WD(1)] =     100       (Home pos. axis 0)
[WD(3)] =     100       (Home pos. axis 2)
[WD(8)] =     0         (Number for special)
                        (Dressing cycle)


  ( ========== GEOMETRICAL DATA ========== )
[WD(31)] =    0         (@ axis angle)
[WD(32)] =    20        (Wheel witdh)
[WD(33)] =    0         (Radius/chamf.left)
[WD(35)] =    10        (Heigth)
[WD(38)] =    100       (Diam. unused Wheel)
[WD(39)] =    20        (Diam. used Wheel)
[WD(41)] =    35        (Max.grinding wheel)
                        (surface speed)

( ========== DRESSING DATA ========== )
[WD(51)] =    3         (No=0/ fa=1  1s=2)
[WD(52)] =    30        (Face dressing feed)
[WD(53)] =    30        (side dressing feed)
[WD(54)] =    .1        (Dress.inc. axis 0)
[WD(55)] =    .1        (Dress.inc. axis 2)
[WD(58)] =    0.05      (Safety distance)
[WD(59)] =    0         (N.part b face d.)
[WD(60)] =    0         (N.part b left d.)
( ========== SHAPING DATA ========== )
[WD(71)] =    3         (No=0/ fa=1  1s=2)
[WD(72)] =    1         (Shaping amount)
[WD(73)] =    .1        (Shaping incrément)
[WD(74)] =    30        (Face shaping feed)
[WD(75)] =    30        (Side shaping feed)

( ******** END OF WHEEL DATA ********* )
```

* Axis 0 retraction position
* Axis 2 retraction position
* User dressing programme number
  In this case, all the functions normally performed by the standard dressing programme must be programmed here (e.g. save, homing position of axes 0 and 2, activation of dressing DAT1 shifts, etc.)

* Inclined axis angle

* Left wall height

* Maximum wheel tangential speed (initialised)

2.4.2.3 Special Wheel File WDSPEC.XPI

File WDSPEC.SXPI

```
( ====================  WDSPEC.XPI)
( SPECIAL WHEEL DATA)
(FIXED DRESSER          ------ )
(Dimensions :           position:mm)
(                       feed: mm/min)
(                       time: sec.)

( ========= GENERAL DATA ========== )

[WD(1)] =     100       (Home pos. axis 0)
[WD(3)] =     100       (Home pos. axis 2)
[WD(7)] =     1         (Special wheel)

[WD(8)] =     0         (Number for special)
                        (Dressing cycle)

[WD(10)] =    0         (Start pos. diam.1)
                        (axis 0)
[WD(11)] =    0         (Start pos. diam.1)
                        (axis 2)
[WD(12)] =    0         (Start pos. diam.2)
                        (axis 0)
[WD(13)] =    0         (Start pos. diam.2)
                        (axis 2)

( ========= GEOMETRICAL DATA ========== )
[WD(31)] =    30        (@ axis angle)
[WD(32)] =    20        (Wheel witdh)
[WD(37)] =    5         (Smallest w.witdh)
[WD(38)] =    100       (Diam. unused Wheel)
[WD(39)] =    20        (Diam. used Wheel)
[WD(41)] =    35        (Max.grinding wheel)
                        (surface speed)

( ========= DRESSING DATA ========== )
[WD(51)] =    7         (No=0/ fa=1  1s=2)
[WD(52)] =    30        (Face dressing feed)
[WD(54)] =    .1        (Dress.inc. axis 0)
[WD(55)] =    .1        (Dress.inc. axis 2)
[WD(58)] =    0.05      (Safety distance)
[WD(59)] =    0         (N.part b face d.)
[WD(61)] =    0         (N.part b right d.)
```

* Data for shaping and dressing programmes

* User dressing programme number
In this case, all the functions normally performed by the standard dressing programme must be programmed here (e.g. save, homing position of axes 0 and 2, activation of dressing DAT1 shifts, etc.)

* Axis 0 start position for diamond 1

* Axis 2 start position for diamond 1

* Axis 0 start position for diamond 2

* Axis 2 start position for diamond 2

* Maximum wheel tangential speed (initialised)

```
( ========= SHAPING DATA ========== )
[WD(71)] =   7        (No=0/ fa=1  1s=2)
[WD(72)] =   1        (Shaping amount)
[WD(73)] =   .1       (Shaping incrément)
[WD(74)] =   30       (Face shaping feed)
[WD(75)] =   30       (Side shaping feed)
[WD(76)] =   0        (Start pos.ax0= left)
[WD(77)] =   0        (Start pos.ax2= left)
[WD(78)] =   0        (Start pos.ax2= rigth)

( ================================== )
( ========= PROFIL DESCRIPTION ========== )


G79 N32765    (Jump end profil)
N32764                #2
N10           #200    (Profil PROFIL1 ) ($D1M2)
N11           #210
N12           #       (PLANE Z X)
N13           #       G1 X0 Z0
N14           #       G1 X5 Z0
N15           #       G1 X5 Z5
N32765                #3
#1 G79 N32763
N32762                #2
N10           #200    (Profil PROFIL 2 ) ($D 2 M2)
N11           #210
N12           #       (PLANE Z X)
N13           #       G1 X0 Z0
N14           #       G1 X-5 Z-5
N32763                #3

( ******** END OF WHEEL DATA ********* )
```

* Left wall starting position on axis 0

* Left wall starting position on axis 0

* Right wall starting position on axis 0

* Start of wheel profile description

2.4.2.4 Roller Dresser File WDDIAM.XPI

File WDDIAM.XPI

```
( ====================   WDDIAM.XPI)
(WHEEL DATA)
(ROLLER DRESSER              ------ )
(Dimensions :          position:mm)
(                      feed: mm/min)
(                      time: sec.)

( ========= GENERAL DATA ========== )
[WD(1)] =     100      (Home pos. axis 0)
[WD(3)] =     100      (Home pos. axis 2)
                       (Dressing cycle)

( ========= GEOMETRICAL DATA ========== )
[WD(31)] =    0        (@ axis angle)
[WD(32)] =    20       (Wheel witdh)
[WD(41)] =    35       (Max.grinding wheel)
                       (surface speed)

( ========= DRESSING DATA ========== )
[WD(51)] =    50       (Home pos.axis 3)
[WD(52)] =    .1       (Dressing incrément)
[WD(53)] =    .02      (Roughing end pos.)
[WD(54)] =    .1       (Rapid feed)
[WD(55)] =    2        (Roughing feed)
[WD(56)] =    .5       (Finishing feed)
[WD(57)] =    1        (Dwell time)
[WD(58)] =    0.05     (Safety distance)
[WD(59)] =    0        (N.part b face d.)


( ******** END OF WHEEL DATA ********* )
```

* Maximum tangential wheel grinding speed (initialised)

* Axis 3 retraction position
* Dressing increment
* Roughing end position
* High speed
* Roughing speed
* Finishing speed
* Dwell time
* Safety clearance
* Number of parts ground between two periphery dressing passes

2.4.3 Machine Limits Files

The machine limits files contain the limit values of the variables contained in the wheel files (the limits are defined by the OEM). All the variables must be specified by the user.

There are eight wheel files %992x (where x = wheel number) (%9921 to %9928).

REMARK *The contents of these files vary according to the wheel type selected:*
- *Straight wheel,*
- *Angular wheel,*
- *Special wheel,*
- *Roller dresser.*

Each [WD(xx)] variable is associated with two variables, [MINWD(xx)] and [MAXWD(xx)], with the same index number. These two variables specify the minimum and maximum limits of the wheel data.

2.4.3.1 Limit File LIMIT2.XPI

This file is given as an example.

```
File LIMIT2.XPI

( ---------- LIMIT2.XPI )
( WHEEL DATA LIMITS - FIXED DRESSER )

( GEOMETRICAL LIMITS ------- )
N10
[MINWD(31)]=  0    [MAXWD(31)]=  1000      * Inclined axis angle
[MINWD(32)]=  0    [MAXWD(32)]=  1000      * Wheel width
[MINWD(33)]=  0    [MAXWD(33)]=  1000      * Left wall fillet/chamfer
[MINWD(34)]=  0    [MAXWD(34)]=  1000      * Right wall fillet/chamfer
[MINWD(35)]=  0    [MAXWD(35)]=  1000      * Relief height or left wall height for inclined axis

[MINWD(36)]=  0    [MAXWD(36)]=  1000      * Relief angle
[MINWD(37)]=  0    [MAXWD(37)]=  1000      * Minimum wheel width
[MINWD(38)]=  0    [MAXWD(38)]=  1000      * Unused wheel diameter
[MINWD(39)]=  0    [MAXWD(39)]=  1000      * Used wheel diameter
[MINWD(41)]=  0    [MAXWD(41)]=    45      * Tangential wheel speed (not used)

( DRESSING LIMITS -------- )
[MINWD(51)]=  0    [MAXWD(51)]=  1000      * Default dressing value
[MINWD(52)]=  0    [MAXWD(52)]=  1000      * Periphery dressing speed
[MINWD(53)]=  0    [MAXWD(53)]=  1000      * Wall dressing speed
[MINWD(54)]=  0    [MAXWD(54)]=  1000      * Axis 0 increment
[MINWD(55)]=  0    [MAXWD(55)]=  1000      * Axis 2 increment
[MINWD(58)]=  0    [MAXWD(58)]=  1000      * See [WD(58)] for standard straight wheel

[MINWD(59)]=  0    [MAXWD(59)]=  1000      * See [WD(59)] for standard straight wheel

[MINWD(60)]=  0    [MAXWD(60)]=  1000      * See [WD(60)] for standard straight wheel

[MINWD(61)]=  0    [MAXWD(61)]=  1000      * See [WD(61)] for standard straight wheel
```

```
( SHAPING LIMITS ---------- )
[MINWD(71)]=   0     [MAXWD(71)]=   1000
[MINWD(72)]=   0     [MAXWD(72)]=   1000
[MINWD(73)]=   0     [MAXWD(73)]=   1000
[MINWD(74)]=   0     [MAXWD(74)]=   1000
[MINWD(75)]=   0     [MAXWD(75)]=   1000

[MINWD(76)]=   0     [MAXWD(76)]=   1000

[MINWD(77)]=-1000    [MAXWD(77)]=   1000

(======================= END =====)
```

* See [WD(71)] for standard straight wheel
* See [WD(72)] for standard straight wheel
* See [WD(73)] for standard straight wheel
* See [WD(74)] for standard straight wheel
* See [WD(75)] for standard straight wheel

* See [WD(76)] for special wheel

* See [WD(77)] for special wheel

2.4.3.2 Limit File LIMIT1.XPI

This file is given as an example.

```
Fichier LIMIT1.XPI

( ---------- LIMIT1.XPI )
( GEOMETRICAL LIMITS ------- )
N10
[MINWD(31)]=-1000   [MAXWD(31)]=   1000
[MINWD(32)]=-1000   [MAXWD(32)]=   1000
[MINWD(33)]=-1000   [MAXWD(33)]=   1000
[MINWD(34)]=-1000   [MAXWD(34)]=   1000
[MINWD(35)]=+1.001  [MAXWD(35)]=   1000
[MINWD(36)]=-1000   [MAXWD(36)]=   1000
[MINWD(37)]=-1000   [MAXWD(37)]=   1000
[MINWD(38)]=-1000   [MAXWD(38)]=   1000
[MINWD(39)]=-1000   [MAXWD(39)]=   1000
[MINWD(40)]=-1000   [MAXWD(40)]=   1000
[MINWD(41)]=-1000   [MAXWD(41)]=   1000

( DRESSING LIMITS -------- )
[MINWD(51)]=-1000   [MAXWD(51)]=   1000
[MINWD(52)]=-1000   [MAXWD(52)]=   1000
[MINWD(53)]=-1000   [MAXWD(53)]=   1000
[MINWD(54)]=-1000   [MAXWD(54)]=   1000
[MINWD(55)]=-1000   [MAXWD(55)]=   1000
[MINWD(56)]=-1000   [MAXWD(56)]=   1000
[MINWD(57)]=-1000   [MAXWD(57)]=   1000
[MINWD(58)]=-1000   [MAXWD(58)]=   1000
[MINWD(59)]=-1000   [MAXWD(59)]=   1000
[MINWD(60)]=-1000   [MAXWD(60)]=   1000
[MINWD(61)]=-1000   [MAXWD(61)]=   1000

( SHAPING LIMITS --------- )
[MINWD(71)]=-1000   [MAXWD(71)]=   1000
[MINWD(72)]=-1000   [MAXWD(72)]=   1000
[MINWD(73)]=-1000   [MAXWD(73)]=   1000
[MINWD(74)]=-1000   [MAXWD(74)]=   1000
[MINWD(75)]=-1000   [MAXWD(75)]=   1000
[MINWD(76)]=-1000   [MAXWD(76)]=   1000
[MINWD(77)]=-1000   [MAXWD(77)]=   1000
[MINWD(78)]=-1000   [MAXWD(78)]=   1000
[MINWD(79)]=-1000   [MAXWD(79)]=   1000
[MINWD(80)]=-1000   [MAXWD(80)]=   1000
[MINWD(81)]=-1000   [MAXWD(81)]=   1000

(======================== END =====)
```

2.5 Contents of the Grinding Programme

2.5.1 Grinding Cycles and Associated Programmes

Functions and cycles Gxx and the associated programmes included in the tables are of the following types:
- General function (g),
- External and internal grinding (r),
- Dressing (d).

Code	Description	Type	CNC Subroutine	CNC File
G200	Plunge/multiplunge cycle (external)	r	%10200	gc_g200.xpi
G201	Plunge/multiplunge cycle (internal)	r	%10201	gc_g201.xpi
G202	Plunge cycle with inclined axis (external)	r	%10202	gc_g202.xpi
G203	Plunge cycle with inclined axis (internal)	r	%10203	gc_g203.xpi
G204	Oscillating plunge/multiplunge cycle (external)	r	%10204	gc_g204.xpi
G205	Oscillating plunge/multiplunge cycle (internal)	r	%10205	gc_g205.xpi
G206	Cylindrical traverse cycle (external)	r	%10206	gc_g206.xpi
G207	Cylindrical traverse cycle (internal)	r	%10207	gc_g207.xpi
G208	Profile grinding cycle (external)	r	%10208	gc_g208.xpi
G209	Profile grinding cycle (internal)	r	%10209	gc_g209.xpi
G210	Conical traverse cycle (external)	r	%10210	gc_g210.xpi
G211	Conical traverse cycle (internal)	r	%10211	gc_g211.xpi
G212	Oscillating shoulder cycle (external)	r	%10212	gc_g212.xpi
G213	Oscillating shoulder cycle (internal)	r	%10213	gc_g213.xpi
G214	Shoulder traverse cycle (external)	r	%10214	gc_g214.xpi
G215	Shoulder traverse cycle (internal)	r	%10215	gc_g215.xpi
G216	Shoulder cycle with fillet/chamfer (external)	r	%10216	gc_g216.xpi
G217	Shoulder cycle with fillet/chamfer (internal)	r	%10217	gc_g217.xpi
G230	Wheel speed calculation according to diameter	g	%10230	gc_g230.xpi
G231	Axial correction cycle	r	%10231	pos231.xpi

Subroutines and Files Related to Grinding Cycles

Description	Type	CNC Subroutine	CNC File
Part common to all grinding cycles	r	%9970	gx_analy.xpi
Start oscillation	g	%9971	osc_strt.xpi
Stop oscillation	g	%9972	oscstop.xpi
Dwell time	g	%9973	dwell_tm.xpi
Automatic measurement	g	%9974	gc_meas.xpi
Dressing at user request	r	%9975	gc-act.xpi
In G79+/-, end of execution of the current block	r	%9976	gc_g79_F.xpi
Check of X and Z position with operator O21	g	%9977	gc_9977.xpi

2.5.2 Measurement and Dressing Cycles and Associated Programmes

The measurement and dressing cycles and associated programmes given in the tables are of the following types:
- General function (g),
- External and internal grinding (r),
- Dressing (d).

Code	Description	Type	CNC Subroutine	CNC File
G232	Manual measurement cycle	r	%10232	manmeas.xpi
G240	Dressing cycle with fixed or roller dresser	d	%10240	dress240.xpi
G245	Wheel shaping cycle with fixed dresser	d	%10245	shape245.xpi

Subroutines Related to the Measurement and Dressing Cycles

Description	Type	CNC Subroutine	CNC File
User programme called at start of measurement cycle	r	%9931	
User programme called at end of measurement cycle	r	%9932	
User programme called at start of dressing cycle	d	%9941	
User programme called at end of dressing cycle	d	%9942	
User programme called at start of fixed dresser shaping cycle	d	%9946	
User programme called at end of fixed dresser shaping cycle	d	%9947	
Rapid retraction of fixed dresser (call to G75)	d	%9950	
Rapid retraction of roller dresser (call to G75)	d	%9951	

Information Concerning User Programmes

Certain additional functions may be required. They can be included in the user programmes.

For instance, the programme called at the start of the intermediate measurement cycle (%9931) can contain the following functions:
- Wheel speed reduction,
- Coolant off,
- Door opening, etc.

2.5.3 M Functions and Associated Programmes

The M functions and associated programmes given in the tables are of the following types:
- General function (g),
- External and internal grinding (r),
- Dressing (d).

Code	Description	Type	CNC Subroutine	CNC File
M06	Wheel and work environment selection	g	%9910	init6_c.xpi
M140	Dresser setup	r,d	%9940	setup140.xpi
M145	Part setup	r	%9945	setup145.xpi
M160	Test counter for periodic dressing	d	%9920	drc160.xpi
M170	Start axial correction cycle	r		
M171	Cancel axial correction cycle	r		
M174	Reset feed register	g		
M175	Wheel wear limit	r		
M176	Enable BCD measurement	g		
M177	Calculate wheel rotation speed	g		
M178	Enable measurement requested by the user	g		
M179	Enable dressing requested by the user	g		
M200	Initialise measurement value	g		
M201	Enable gap elimination	g		
M202 to M209	Select measurement contact	g		
M210	Activate measurement value	g		

2.5.4 General Subroutines

The general subroutines given in the tables are of the following types:
- General function (g),
- External and internal grinding (r),
- Dressing (d).

Description	Type	CNC Subroutine	CNC File
Wheel data (in %990x.x: x.x specify wheel No. Txx)	g	%990x.x	
Sample data for straight wheel (fixed dresser)	g	%9900.1	
Sample data for angular wheel (fixed dresser)	g	%9900.2	
Sample data for special wheel (fixed dresser)	g	%9900.3	
Sample wheel data (roller dresser)	g	%9900.4	
Machine data (in %9910.x: x = axis group)	g	%9910.x	
Sample machine data	g	%9910.1	
Wheel limit data N.x (x = 1 to 8)	g	%9921 to %9928	

CNC Message and Error Message Files for Grinding Cycles

The files are listed in Appendix A.

Description	Type	CNC Subroutine	CNC File
Messages	d	%9960	message.xpi
Errors	g	%20300	gc_error.xpi

2.6 CNC/PLC Link

The following tables define the connections between the CNC and the PLC.

2.6.1 Wheel Rotation Speed According to Rotation Speed

Direction	Number	Value	Description
CNC —> PLC	E30120	0 to 32 bits	Wheel speed for spindle 1
CNC —> PLC	E30121	0 to 32 bits	Wheel speed for spindle 2
CNC —> PLC	E30122	0 to 32 bits	Wheel speed for spindle 3
CNC —> PLC	E30123	0 to 32 bits	Wheel speed for spindle 4
CNC —> PLC	E30124	0 to 32 bits	Wheel speed for spindle 5
CNC —> PLC	E30125	0 to 32 bits	Wheel speed for spindle 6
CNC —> PLC	E30126	0 to 32 bits	Wheel speed for spindle 7
CNC —> PLC	E30127	0 to 32 bits	Wheel speed for spindle 8
CNC —> PLC	M177		Calculated wheel speed

2.6.2 Homing

Direction	Number	Value	Description
CNC —> PLC	M140		Call %9940 for dresser setup
CNC —> PLC	M145		Call %9945 for workpiece setup

2.6.3 Register Update

Direction	Number	Value	Description
CNC <— PLC	E20028	1	Flag register reset
CNC —> PLC	M174		Register reset executed

REMARK *Function M174 defines acknowledgement of reset of the PLC flag register (E20028 can be reset by the PLC). The flag register is parameter E560xx (where xx = active T * 4-3). It contains data on the workpiece and dresser setup.*

2.6.4 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 1	Inactive Dressing requested
CNC —> PLC	M178		Dressing executed

2.6.5 Oscillations - Traversing

Direction	Number	Value	Description
CNC —> PLC	E10031	1	Oscillation axis in left/right window
CNC <— PLC	E42000 to E42003	0 to 255	Copy the value of the feed rate override potentiometer 0: Stop oscillation

2.6.6 Axial correction cycle

Direction	Number	Value	Description
CNC —> PLC	M170		Start of axial correction cycle (head to measuring position)
CNC —> PLC	M210		Activation of measurement value
CNC <— PLC	M171		End of axial correction cycle (head to home position)
CNC <— PLC	E42124 E42125 E42126 E42127	0 0 0 to 255 0 to 255	Axis 2 (Z) correction value Not used Measured binary value MSB Measured binary value LSB

REMARK *Functions M170, M171 and M210 are generated by the axial correction (passive measurement) cycle. These functions must not be used in the user programme.*

2.6.7 Gap elimination and measuring procedure (standard contact type)

Direction	Number	Value	Description
CNC —> PLC	M200		Initialisation 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	E42124 E42125 E42126 E42127	0 0 0 to 255 0 to 255	Pseudo-value for contact measuring

REMARK *Functions M200 to M209 are generated by the grinding cycle using argument EG (see Programming Manual). These functions must not be used in the user programme.*

The following PLC programmes are used for contact measurement and gap elimination (also see Sec. 2.8)

- INI.XLA %INI subroutine
- COMMAND.XLA %SP205 subroutine
- MAINBIT.XLA %TS0 subroutine
- BIT_BIN.XLA %SP201 subroutine

2.6.8 Measuring procedure (BCD output)

Direction	Number	Value	Description
CNC —> PLC	M176		Activation of BCD measurement
CNC —> PLC	M202 to M209		Selection of measuring contact (with EG2 to EG9. Roughing, semi-finishing, etc.)
CNC <— PLC	E42124 E42125 E42126 E42127	0 0 0 to 255 0 to 255	Converted measurement value

REMARK *Functions M200 to M209 are generated by the grinding cycles using argument EG (see Programming Manual). These functions must not be used in the user programme. It should be noted that the BCD measuring process is designed for units with three decades plus sign.*

The following PLC programmes are used for BCD measurement (also see Sec. 2.8)
- INI.XLA %INI subroutine
- COMMAND.XLA %SP205 subroutine
- MAINBCD.XLA %TS0 subroutine
- BCD_BIN.XLA %SP200 subroutine
- BIT_BIN.XLA %SP201 subroutine (if gap elimination is used)

2.6.9 Manual measurement

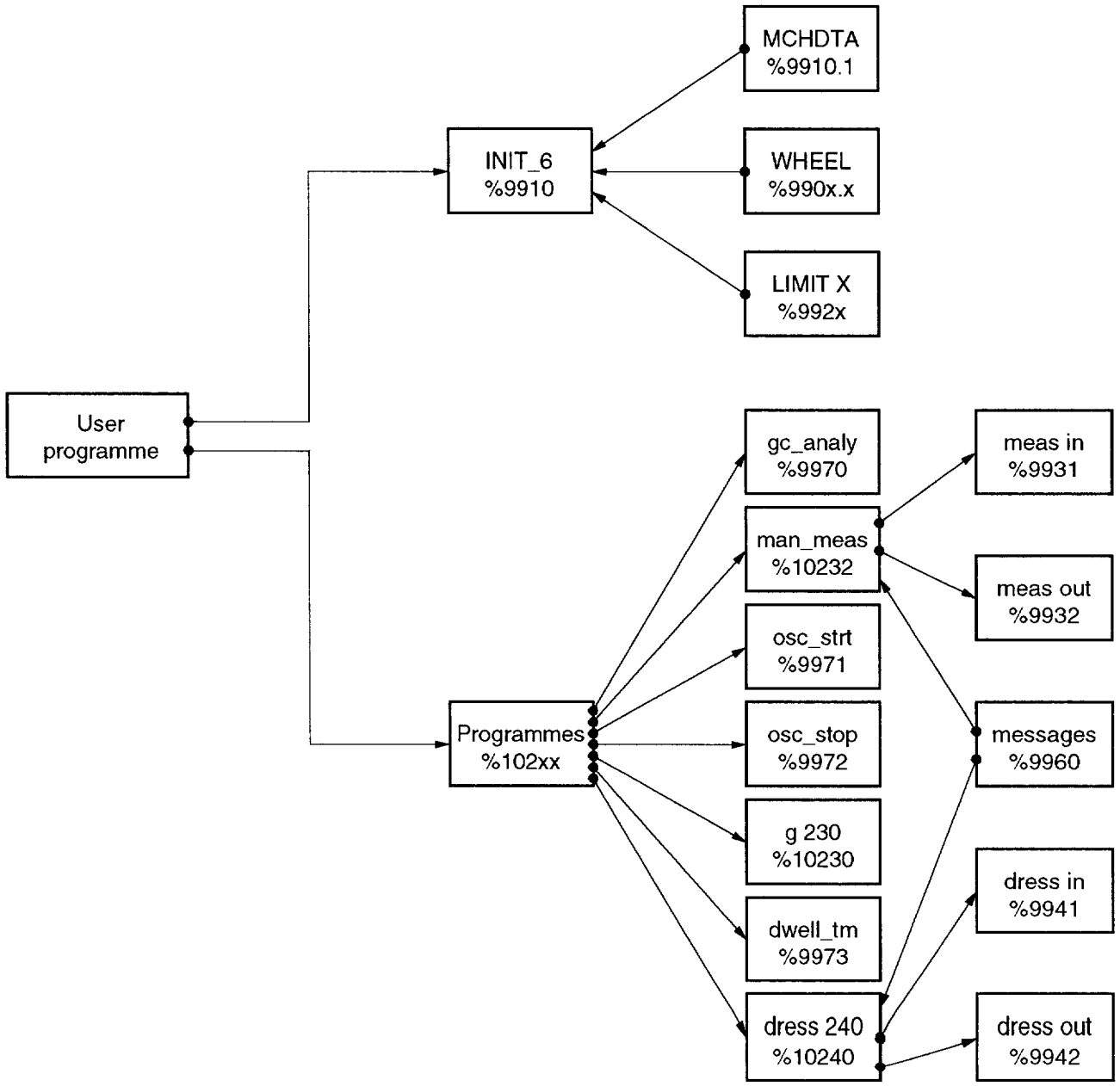
Direction	Number	Value	Description
CNC <— PLC	E20031	0 1	Manual measurement not requested Manual measurement requested (with EG98)
CNC —> PLC	M179		Manual measurement executed

2.6.10 Function call by PLC

Direction	Number	Value	Description
CNC <— PLC	%Wg00.4	1	Call programme %9999
CNC <— PLC	E40032	1 to 8	Wheel number
CNC <— PLC	E40033	0 to 7	Requested function - 0: Dressing requested by pushbutton - 1: Dresser origin setting - 2: Workpiece origin setting - 3: Wheel shaping - 4: Wheel dressing - 5: Manual working - 6: Axes to home position - 7: Manual measurement
CNC <— PLC	E40034	0 to 7	Wheel dressing (see ED)

2.7 General Flowchart

The flowchart below gives an overview of the programmes executed when a G2xx grinding cycle is initiated from the user programme.



2.8 PLC Programmes and Files

2.8.1 General

The following PLC programmes are supplied (see software diskette). They are intended to serve as templates for the applications.

Each template includes the code required for interfacing with the two major measuring systems (BCD measurement, standard measurement), in order to select the wheel, the operating mode and calling of the emergency retract subroutine.

For information on the decoded M functions and external E parameters to be used, refer to Sections 2.6.7 and 2.6.8 above.

REMARK *The PLC programme supplied includes two TS0 sequential tasks, one for BCD measuring, the other for standard measuring.*

2.8.2 Programme Description

The three main programmes are:
- BCD_BIN.XLA
- BIT_BIN.XLA
- COMMAND.XLA

2.8.2.1 Programme BCD_BIN.XLA

BCD sensor programme BCD_BIN.XLA reads the measured BCD value at the PLC inputs and converts it into a signed binary value. This value is loaded in parameters E42124-E42127 which are used by the grinding cycles to proceed to the next grinding phase when the measured value become less than the programmed threshold.

Call

spy (200, Measurement, Commands)

Parameters

Measurement: BCD measurement -> %I602.W
Commands: Sensor outside limits -> %I503.B

CAUTION
Only bit %I503.7 (sensor outside limits) is used. If another address is used, bit %Y7.7 of the subroutine must be modified.

2.8.2.2 Programme BIT_BIN.XLA

STANDARD sensor programme BIT_BIN.XLA reads the bits on the PLC inputs and writes a predetermined value into E42124-E42127 for the change of state of each input (9001 for the change of state of the first signal, 8001 for the change of state of the second signal, and so on). This is a measurement simulation that allows the same procedure to be used for both types of sensors in the grinding cycle.

Call

spy (201, Gbits)

Parameters

Gbits: output in bits (discrete output) from a standard sensor -> %I600.B

2.8.2.3 Programme COMMAND.XLA

Programme COMMAND.XLA calls the following commands;
- JOG (manual axis control),
- START CYCLE,
- HOLD,
- RETRACT,
- %9999 SUBROUTINE CALL,
- G10 INTERRUPT.

Programme COMMAND.XLA initialises the corresponding signals of the PLC-CNC interface.

The wheel number and operating mode are selected by the PLC inputs.

The selected wheel number is written in parameter E40032.

The selected operating mode is written in parameter E40033.

The basic CNC enable signals are set to 1.

Call

sp(205)

2.8.2.4 Files

INIT.XLA
MAINBCD.XLA
MAINBIT.XLA
COMMAND.XLA
BCD_BIN.XLA
BIT_BIN.XLA

GENINFO.XTX
GAUGE.XSY
GAUGE.XPJ
CONFIG.XCF

The following PLC programmes and subroutines have to be loaded to test a standard gauge:
- INI.XLA %INI subroutine
- COMMAND.XLA %SP205 subroutine
- MAINBIT.XLA %TS0 subroutine
- BIT_BIN.XLA %SP201 subroutine

Reminder

The following PLC programmes and subroutines must be loaded to test a BCD gauge:
- INI.XLA %INI subroutine
- COMMAND.XLA %SP205 subroutine
- MAINBCD.XLA %TS0 subroutine
- BCD_BIN.XLA %SP200 subroutine (if gap elimination is used)

- BIT_BIN.XLA %SP201 subroutine

2.8.2.5 Description of Subroutines

%INI: INITIALISATION PROGRAMME (INIT.XLA)

%TS0: SUBROUTINE CALL

(MAIN_BCD.XLA FOR A BCD GAUGE - MAIN_BIT.XLA FOR A STANDARD GAUGE)

%SP200: CONVERSION OF THE BCD MEASUREMENT INTO A SIGNED BINARY VALUE AND WRITING TO E42124/127 (BCD_BIN.XLA)

%SP201: MEASURING, SIMULATING, TESTING A DISCRETE OUTPUT OF A MEASURING INSTRUMENT AND WRITING IN E42124/E42127 (BIT_BIN.XLA)

%SP205: GRINDING SOFTWARE BASIC TEST COMMANDS (COMMAND.XLA)

Memory Space Used

See file GAUGE.XSY

3 Typical Grinder Setup

Setup is illustrated by a typical example of an internal/external grinder.

3.1 Machine Configuration

The machine characteristics are as follows:
- 1 axis group,
- 2 axes,
- . X axis (@0),
  . Z axis (@2).
- 2 wheels,
  . straight wheel T1 for external grinding,
  . straight wheel T2 for internal grinding.

3.2 Software Configuration

The software configuration includes:
- Tangential wheel speed in m/s,
- Wheel called by M06 Tx,
- Part and dresser setup programmes called by M function,
- Manual intermediate measurement during the cycle,
- Inclusion of gap elimination.

3.3 CNC Programmes to Be Loaded

The programmes listed below are to be loaded in the CNC.

List of programmes:
- %9910.1 Machine data for axis group 1 (1 file %9910.x «MCHDTA1»)
  . Axes: N10 - N15
  . External wheel T1: N100 - N113
  . Internal wheel T2: N200 - N213
- %9900.1 Grinding data for T1 (file WDSTRGHT.XPI)
- %9900.2 Grinding data for T2 (file WDSTRGHT.XPI)
- %9921 Limits for file T1 (LIMIT2.XPI)
- %9922 Limits for file T2 (LIMIT2.XPI).

The programmes below are customised according to the machine configuration. The customisation can be carried on a PC.
- %9960 Messages
- %20300 Errors
- %9910 Wheel selection
- %9940 Dresser setup
- %9945 Part setup
- %9950 Emergency retraction of fixed dresser
- %10245 Shaping cycle with fixed dresser
- %9946 User programme called at start of shaping cycle
- %9947 User programme called at end of shaping cycle
- %10240 Dressing cycle with fixed or roller dresser
- %9941 User programme called at start of dressing cycle
- %9942 User programme called at end of dressing cycle
- %10230 Calculation of wheel rotation speed from tangential speed
- %10232 Manual measurement cycle
- %9931 User programme called at start of measurement cycle
- %9932 User programme called at end of measurement cycle

Grinding Cycle Subroutines

The following programmes are used by the grinding cycles:
- %10200
- %10201
- %10202
- %10203
- %10204
- %10205
- %10206
- %10207
- %10208
- %10209
- %10210
- %10211
- %10212
- %10213
- %10214
- %10215
- %10216
- %10217

%9970 Part common to all cycles
- %9971 Start oscillation and traverse
- %9972 Stop oscillation
- %9973 Dwell time
- %9974 Measurement during the cycle
- %9975 Dressing at user request
- %9976 In G79 +/-, end of execution of the current block
- %9977 Check of position on X and Z for operator O21

3.4 Machine Parameters to Be Defined

The following parameters must be declared:

P2: Word N0 = 3 (measured axes)

P3: Word N0 = 3 (slaved and interpolated axes)

P4: Word N0 = 1 (X axis programmed by diameter)

P7: Word N1 = bit 1 (intervention mode forced with M12)

P9: (assigning axes to the group
- Word N0 = 0
- Word N1 = 2

P35: Subroutines called by M function
- Word N0 = 06 (function M06)
- Word N1 = 9910 (subroutine %9910 called by M06)
- Word N2 = 140 (function M140)
- Word N3 = 9940 (subroutine %9940 called by M140)
- Word N4 = 145 (function M145)
- Word N5 = 9945 (subroutine %9945 called by M145)

P97: Word N0 = 1 (number of axis groups in the system)

3.5 PLC Programming

Transfer of the manufacturer's PLC programme to the CNC.

The PLC programme created must include read of:

- Parameters E42000-E42003 (feed rate override potentiometer). Otherwise, the oscillation functions are ignored (%9971 and %9972),
- Parameter E20031 (measurement requested by the user. If E20031 = 1, measurement is requested),
- Function M179 (requested measurement executed, acknowledged and E20031 reset by the PLC),
- Parameter E20030 (dressing requested by the user. If E20030 = 1, dressing is requested),
- Function M178 (requested dressing executed, acknowledged and E20030 reset by the PLC),
- Function M175 (wheel wear limit),
- Parameter E30120 (rotation speed for external wheel),
- Parameter E30121 (rotation speed for internal wheel),
- Function M177 (calculated wheel rotation speed),
- Functions M200-M209 (selection of measuring contact, Module BIT_BIN.XLA),
- Parameter E20028 (reset of the Flag register),
- Function M174 (register reset).

3.6 Preliminary Operations Before Starting a Cycle

The following operations must be completed before starting a cycle:
- Wheels installed,
- Homing completed,
- Wheels called for external or internal grinding,
- Wheel tangential speed defined,
- Wheel rotating,
- Dresser set up,
- Wheel shaped,
- Part set up,
- Part programme written with cycle.

3.6.1 Wheels Installed

Wheels installed on wheelheads for internal and external grinding.

3.6.2 Homing Completed

Homing is required on the X and Z axes (see Internal/External Grinding Programming Manual).

3.6.3 Wheel Called for External (or Internal) Grinding

The wheel for external grinding is wheel number 1 and is called by M06 T1 (see Internal/External Grinding Programming Manual). All the data concerning the wheel are loaded (offsets D1 to D4 are associated with T1).

3.6.4 Tangential Speed defined and Wheel Rotating

The wheel speed is programmed by function G230 S.. (see Internal/External Grinding Programming Manual).

3.6.5 Dresser Set up

The zero points on X and Z for dressing are declared by function M140 (see Internal/External Grinding Programming Manual).

3.6.6 Wheel Shaped

The external grinding wheel is shaped by function G245 (see Internal/External Grinding Programming Manual).

3.6.7 Part Set up

The part is set up by function M145 (see Internal/External Grinding Programming Manual).

3.6.8 Part Programme Written with Cycle

Example of Programme Structure

Programme number	%500
Wheel selection	T01 M06 ...
Wheel speed	G230 S...
Part rotation	M04 M40 S...
Manufacturer function	M08
Cycle call	G2xx ...
Cycle phase 1	...
Cycle phase 2	...
...	...
End of programme	M02

REMARK *When the programme is written using PROCAM (interactive programming), a subroutine containing the manufacturer machine functions (part rotation, coolant, etc.) must be called. This subroutine is called by G77 H9911.*

Appendix A CNC Messages and Error Messages

A

A.1 Homing Messages

The values assigned to the variables defined in the file are given only as an illustration.

Message File

N100$0 *** FIXED DRESSERS SET ————OK?
N101$0 X ORIGIN: MOVE WHEEL ON DIAMOND 1
N102$0 Z ORIGIN: MOVE WHEEL ON DIAMOND 1
N103$0 X ORIGIN: MOVE WHEEL ON DIAMOND 2
N104$0 Z ORIGIN: MOVE WHEEL ON DIAMOND 2
N105$0 *** END OF FIXED DRESSER SETUP ***
N106
N107$0 *** ROLLER DRESSER SETUP—— OK?
N108$0 MOVE ROLLER DRESSER ON THE WHEEL
N109
N120$0 MOVE WHEEL TO Z INTERMEDIATE POSITION
N200$0 *** PART SETUP ———————— OK?
N201$0 MOVE WHEEL ON THE REFERENCE DIAMETER
N202$0 MEASURE THE PART AND START CYCLE
N203$0 INPUT DIAMETER MEASURE
N204$0 MOVE WHEEL ON THE REFERENCE SHOULDER
N205$0 REFERENCE SHOULDER POSITION
N206$0 *** END OF PART SETUP ***
N207
N300$0 *** WHEEL DRESSING ————— OK?
N301$0 *** WHEEL DRESSING IN PROGRESS ***
N302$0 *** WHEEL SHAPING ————— OK?
N303$0 *** WHEEL SHAPING IN PROGRESS ***
N304$0 *** MANUAL WORKING—— OK?
N305$0 *** MANUAL WORKING ***
N306$0 *** AXES TO HOME POSITION ———— OK?
N307$0 *** AXES TO HOME POSITION ***
N308$0 *** MANUAL MEASUREMENT —— OK?
N309
N310$0 WARNING! MOVE X TO SAFETY POSITION
N311$0 COMPENS. ARE NOT NULL - RESET? (Y/N)
N320$0—>> RAPID RETRACTION <<—
N321
N400$0 *** MANUAL MEASUREMENT CYCLE ***
N401$0 DO YOU WANT TO MODIFY X ORIGIN? (Y/N)
N402$0 DO YOU WANT TO MODIFY Z ORIGIN? (Y/N)
N403$0 *** CORRECTION VALUE :
N404$0 *** END OF MEASURING CYCLE ***
N405$0 CORRECTION VALUE OUT OF LIMITS

A.2 Cycle Error Messages

The lists below contain the messages generated in case of internal or external grinding programming errors.

The messages are defined for:
- Wheel dressing and part measurement
- Grinding cycles.

A.2.1 Wheel dressing and workpiece measuring errors

N301	DRESSER SETUP NOT EXECUTED
N302	PART SETUP NOT EXECUTED
N303	WHEEL NUMBER ERROR
N304	MACHINE DATA ERROR
N305	MACHINE MODE NOT EXECUTED
N306	PART COMPENSATION ERROR
N307	POSITIONING CYCLE - WORKHEAD SPEED ERROR
N308	CORRECTION VALUE OUT OF LIMITS
N309	MEASURE OUT OF RANGE
N310	WHEEL LEFT SIDE NOT SHAPED
N311	WHEEL RIGHT SIDE NOT SHAPED
N320	WORKING WHEEL SIDE CODE NOT PROGRAMMED
N340	WHEEL GEOMETRICAL ERROR
N341	WHEEL DRESSING ERROR
N342	WHEEL SHAPING ERROR

A.2.2 Grinding cycle errors

N350	X: definition of X missing
N351	Z: definition of Z missing
N352	EP: plunge offset not programmed
N353	Wheel width zero
N354	Grinding distance < wheel width
N355	D: invalid tool correction number
N356	ER: invalid skip diameter
N357	EH: invalid safety diameter
N358	EC: invalid value
N359	EC: not programmed
N360	F: traverse feed not programmed
N361	EQ: plunge offset not programmed
N362	EX: second X position not programmed
N363	EZ: second Z position not programmed
N364	EZ: oscillation amplitude not programmed
N365	R: not programmed
N366	EL: not programmed
N367	ES: invalid radius corrector
N368	ES: not programmed
N369	F: profil feed not programmed
N370	EX: oscillation amplitude not programmed
N371	F: plunge feed not programmed
N372	EI/EJ: increment not programmed
N373	ED: invalid dressing part
N374	EG: invalid measuring mode
N375	EB: invalid value
N376	S: cutting speed not programmed
N377	Max rotation speed exceeded
N378	T: tool nr must be [1 to 8]
N379	Wheel overlap >= wheel width
N380	Part setup not executed
N381	Dressing setup not executed
N382	H: profile programme number not programmed
N383	N: sequence of profile not programmed
N384	Invalid wheel size
N385	Current tool number <> selected tool number
N386	EU,EX: invalid taper angle
N387	Shoulder radius < Stock
N389	Not enough space in dynamic operator table