Typ3 osa

Measuring cycles for touch-trigger probes Programming manual

Edition

101

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Contents

1 Safety Instructions

Please read this manual before commissioning the measuring cycles for touch-trigger probes with the Typ3 osa. Store this manual in a place to which all users have access at any time.

1.1 Proper use

This manual contains all instructions required for the proper use of the control system. However, for reasons of clarity, not all the details of all possible combinations of functions could be listed, nor could each and every conceivable condition of integration or operation be covered because the control system is usually part of a major installation or system.

The Typ3 osa is used to

- activate feed drives, spindles and auxiliary axes of a machine tool via a SERCOS interface for the purpose of guiding a processing tool along a programmed path to machine a workpiece (CNC). Additionally, a PLC is required with appropriate I/O components which provides – in communication with the actual CNC – integrated control of the machine tooling process and also serves to monitor technical safety.
- program contours and the tooling technique (feedrate, spindle feed, tool change) used for a workpiece.

Any other application will be deemed improper use!

The products described

- have been developed, manufactured, tested, and documented in compliance with the relevant safety standards. These products normally pose no danger to persons or property if they are used in accordance with the handling stipulations and safety notes prescribed for their configuration, mounting, and proper operation.
- meet the requirements of
  - the EMC directive (89/336/EEC, 93/68/EEC, and 93/44/EEC)
  - the low-voltage directive (73/23/EEC)
  - the harmonized standards EN 50081-2 and EN 50082-2
- are designed for operation in industrial environments. For operation in residential environments, in trade and commercial applications and small enterprises, an individual permit of the national authority or test institution is required; in Germany, please contact the Bundesanstalt für Post und Telekommunikation or its local branch offices.

The faultless, safe functioning of the product requires proper transport, storage, erection and installation as well as careful operation.

1.2 Qualified personnel

The requirements as to qualified personnel depend on the qualification profiles described by ZVEI (central association of the electrical industry) and VDMA (association of German machine and plant builders) in:
Weiterbildung in der Automatisierungstechnik
edited by: ZVEI and VDMA
MaschinenbauVerlag
Postfach 71 08 64
D-60498 Frankfurt

This instruction manual has been designed specifically for CNC programmers. They require special skills in cycle programming.

Specifically trained expert personnel only may program, start or operate this system, or change its program parameters! This personnel must be able to recognize potential hazards that may be caused by programming, program modifications and generally by mechanical, electrical, or electronic equipment.

Any intervention in the hardware and software of our products, unless described otherwise in this manual, is reserved to our specialized personnel.

Tampering with the hardware or software, ignoring warning signs attached to the components, or non-compliance with the warning notes given in this manual may result in serious bodily injury or property damage.

Only **electrotechnicians** as recognized under VDE 1000-10 who are familiar with the contents of this manual may install and service the products described in this manual.

Such personnel are

- individuals who, being well trained and experienced in their technical fields and familiar with the relevant standards, are able to understand the jobs being carried out and recognize any potential hazards.
- individuals who have acquired the same amount of expert knowledge through years of experience that would normally be acquired through formal technical training.

Please note our comprehensive range of training courses.
Our training center will be pleased to provide you with further information, telephone: +49 (0)6062 78-258.

1.3 Safety markings on components

Danger: High voltage!

Danger: Battery acid!

Electrostatically sensitive components!

Disconnect from mains before opening!

Pin for connecting PE conductor only!

Conductor shield

1.4 Safety instructions in this manual

DANGEROUS ELECTRICAL VOLTAGE
This symbol is used to warn of a **dangerous electrical voltage**. Failure to observe the instructions in this manual in whole or in part may result in **personal injuries**.

DANGER
This symbol is used if failure to observe the instructions in this manual in whole or in part may result in **personal injury**.

CAUTION
This symbol is used if failure to observe the instructions in this manual in whole or in part may result in **damage to equipment or data files**

☞ This symbol is used to draw the user's attention to special information.

1.5 Safety instructions for the described product

DANGER
Danger to life if EMERGENCY-STOP devices are inadequate!
EMERGENCY-STOP devices must be active and within reach in all system modes. Releasing an EMERGENCY-STOP device must not result in an uncontrolled system restart! First check the EMERGENCY-STOP circuit, then switch the system on.

DANGER
Danger of personal injuries and damage to equipment !
First, new programs must be tested carefully without axis movement. For this purpose, the control system offers the possibility of blocking axis movement and/or auxiliary function outputs by appropriate softkeys in the AUTOMATIC group mode.

DANGER
Moving tools or axes may cause serious or fatal injuries!

Feed and spindle motors generate very powerful mechanical forces and can accelerate very quickly due to their high dynamics. You should therefore always stay outside the danger area of the machine when it is running!

Do not ever – not even briefly – deactivate the safety-relevant functions of the unit!

Report any malfunction of the unit to your servicing and repairs department immediately.

Inappropriate working clothes may cause serious or fatal injuries! Careless operators' hair or clothing may get caught by moving parts of machines, pulling operators into the machine! Therefore:

- **Wear a hair net!**
- **Wear a protective suit!**
- **Take off protective gloves before working near moving parts!**
- **Take off any jewelry and wristwatches!**

Remember that drillings, borings, etc. may be cast out during operation of the machine! They can cause eye injuries and burns. Therefore:

- **Wear protective goggles!**
- **Wear a protective suit !**

There is also a risk of injury from sharp edges on the workpieces and tools! Therefore:

- **Wear protective gloves!**

1.6 Documentation, versions and trademarks

Documentation

The present manual provides information on the programming of measuring cycles.

Overview of available manuals:

Manual title	Part no.	
	German	English
Connection Conditions Information on project planning and maintenance	1070 073 704	1070 073 736
Operating Instructions Standard operator interface	1070 073 726	1070 073 739
Diagnostics Operating Instructions	1070 073 779	1070 073 780
Programming Instructions DIN Programming in accordance with DIN 66025	1070 073 725	1070 073 738
Programming Instructions CPL	1070 073 727	1070 073 740
System Description ICL 700 Program structure of the integrated PLC	1070 073 706	1070 073 737
Project Planning Manual ICL 700 Software interfaces and CNC interface signals of the integrated PLC	1070 073 728	1070 073 741
MACODA Operation and configuration of all machine parameters	1070 073 705	1070 073 742
Tool Management Parameter Setting	1070 073 782	–
Measuring Cycles for Touch-Trigger Switching Probes	1070 073 788	1070 073 789

★ This symbol indicates the description of an activity to be performed by the user.

Version

☞ **This description refers to version:**
Software: 4.3

☞ **You can check the current version numbers of your individual software modules by hitting the ”Control Diagnostic” softkey in the ”Diagnostics” group mode.**

☞ **For more information on your Windows 95 or Windows NT software version, select the ”My Computer” icon on the start screen and then the HELP function in the ”About Windows 95” or ”About Windows NT” submenus.**

Trademarks

All trademarks of software pre-installed on Bosch products when delivered are the property of the respective manufacturers.

Any and all pre-installed software delivered with Bosch products is protected by copyright and may not be reproduced without the permission of Bosch or subject to the license agreements of the respective manufacturers.

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SERCOS interface® is a registered trademark of Interessengemeinschaft SERCOS interface e. V.

2 General

The measuring cycles of the Typ3 osa control fall into two categories:

- tool gauging and
- workpiece measuring.

For **tool gauging**, a permanently installed probe must be available in the working area of the machine. The tool to be gauged is mounted in the spindle during the measuring process.

For **workpiece measurement**, the probe is fitted in the spindle. The type of probe used may be one that takes all points to be measured with a fixed spindle position.
The measuring cycles, however, also permit measuring with variable spindle positions. This makes it possible to measure a bore by taking three test points. For tool gauging, the measuring cycles allow for two different probes to be used on one machine. Also for workpiece measuring, 2 different probes can be used. The data for probe 1 is stored in declarations memory K99, the data for probe 2 in declarations memory K100. K99 and K100 are actually geometric offset tables originally not intended for this purpose.

Prerequisites

The following prerequisites must be met for all measuring cycles:

- The probe must be fitted in the spindle
  (only for measuring workpiece features).
- The probe electronics must be switched on.
- The spindle must be aligned (not if variable spindle positioning is used).
- Signal transmission must be live.
- The axes must positioned so that the contact points can be approached.
- Cutter compensation, scaling, part rotation, paraxial compensation G43/44 and inch system programming must be deactivated.
- The data pertaining to a measuring cycle must be available in the declarations memory.
- Datum offset or length compensation may remain active.

Interface, PLC program and machine parameters

- It must be defined in the machine parameter program (P100100011) whether the probe shall send an L → H or an H → L edge to the Typ3 osa when contacting a test point.
- It is advisable also to have the switching signal of the touch-trigger probe sent to the PLC. This permits initiation of an EMERGENCY OFF if the probe is deflected while no measuring cycle is running.
- The PLC program must send a HIGH signal to the Typ3 osa whenever BLOCK SEARCH or TEST WITHOUT MOVEMENT are active (see description of the declarations memory H1, Chapter 5).
- When a probe deflection is expected in the measuring cycle, the output as defined under H2 in the declarations memory is set to HIGH.
- If axis positions ≧ 1,000 mm are to be saved in the declarations memory, this must be taken into account when entering the machine parameters.
- The following safety control function must become active approx. 2 seconds after the probe electronics are switched on:
  - Initiation of an EMERGENCY OFF whenever the probe is deflected (leading edge) although the Typ3 osa control is not sending an interface signal indicating that a probe deflection is expected.
- When the probe electronics are active, the stationary spindle method must be permitted if required.

☞ **After each measuring cycle, absolute programming G90 and linear interpolation G1 are active.**
When working area limitation is active, the specified end point must lie within these limits during a measuring cycle.

Error messages are displayed as plain text messages.

3 Tool gauging

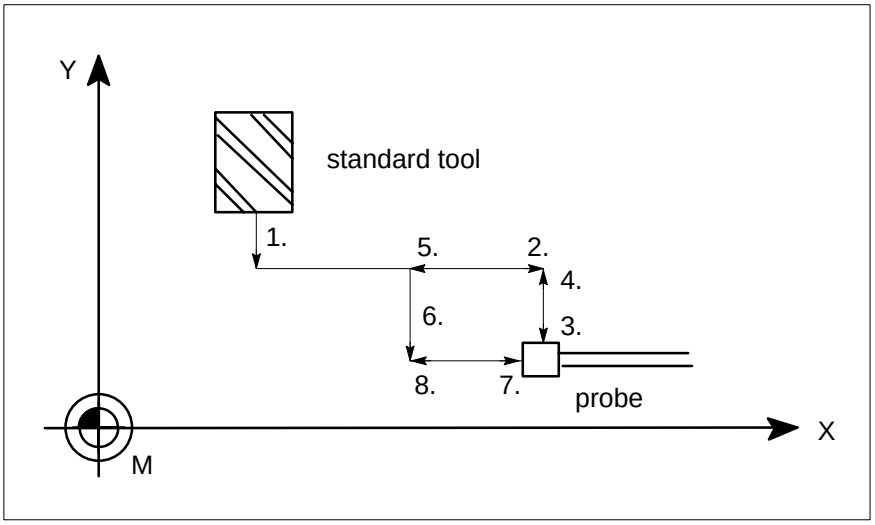
3.1 Measuring cycle package: Tool gauging

P999999901 Probe qualification using a standard tool

As a prerequisite for tool gauging, a permanently installed probe must be available in the working area of the machine.

★ To **qualify this probe**, a standard tool of known radius and length compensation values is fitted in the spindle. The probe path with its axis and direction as well as the probe position are stored in the declarations memory and are thus available for future gauging of tool lengths and radii.
Upon completion of the probe qualifying cycle, the exact trigger point of the probe is available.

Geometry



Prerequisites:
The standard tool must be fitted in the spindle and the respective length and radius compensation must be active.

Procedure:
Probe qualification in the longitudinal axis

1. Setting the longitudinal axis to home position.
2. Setting the axes defined under H13/H15 to contacting position.
3. Contacting in the longitudinal axis.
4. Resetting the longitudinal axis to home position.
5. Setting the radial axis to home position.
6. Setting the axis defined under H19/H21 to contacting position.
7. Contacting in the radial axis.
8. Resetting the radial axis to home position.

Input parameters

P1 1 – Probe qualification in the longitudinal axis
2 – Probe qualification in the radial axis
3 – Probe qualification in the longitudinal and radial axes

P2 Selection of probe 1 or 2
(If no entry is made, probe 1 is selected automatically.)

Declarations memory data used

For a detailed description of the declarations memory, see Chapter 5.

H4 Standard too clearance from the probe upon G75 activation

H5 Overtravel

H6 Positioning feed

H7 Contacting feed

H11 Selection of the longitudinal probe axis, incl. sign to indicate the contacting direction

H12 Position of the probe installed on the machine in the longitudinal axis

H13 Axis number 1. Positioning axis for contacting in the longitudinal axis

H14 Position of the axis as defined under H13

H15 Axis number 2. Positioning axis for contacting in the longitudinal axis

H16 Position of the axis as defined under H15

H17 Selection of the radial probe axis, incl. sign to indicate the contacting direction

H18 Position of the probe installed on the machine in the radial axis

H19 Axis number 1. Positioning axis for contacting in the radial axis

H20 Position of the axis as defined under H19

H21 Axis number 2. Positioning axis for contacting in the radial axis

H22 Position of the axis as defined under H21

Result parameters

Upon completion of this measuring cycle, the exact switching position of the probe is transferred to the declarations memory:

H12 Exact position in the longitudinal axis

H18 Exact position in the radial axis

Example

CPL call: **N100G22P999999901 [3]**

declarations memory	H4	– Z	20.000
	H5	– Z	10.000
	H6	– Z	5000.000
	H7	– Z	500.000
	H11	– Z	–3.000
	H12	– Z	–300.000
	H13	– Z	1.000
	H14	– Z	150.000
	H15	– Z	2.000
	H16	– Z	–55.000
	H17	– Z	1.000
	H18	– Z	130.000
	H19	– Z	3.000
	H20	– Z	–305.000
	H21	– Z	2.000
	H22	– Z	–55.000

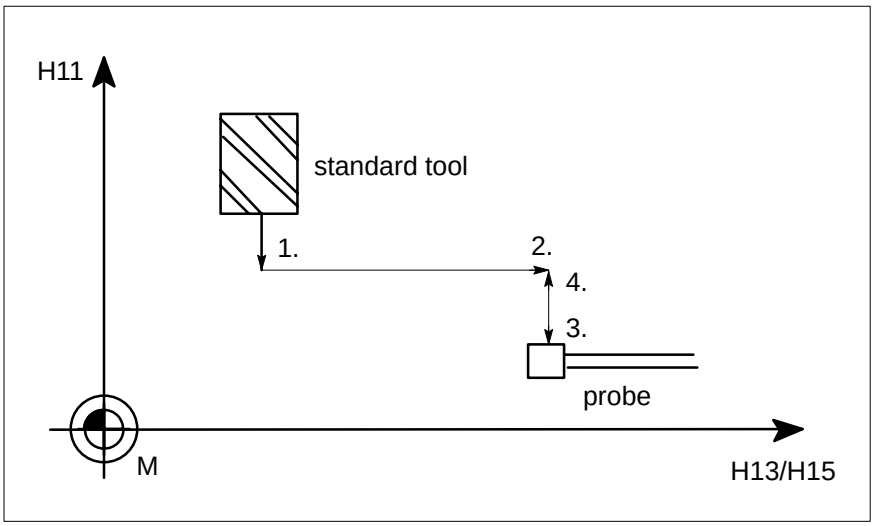
Procedure under this CPL call:

1. Setting the Z-axis to Z –280.000 (H12 + H4) (–300.000+ 20.000)
2. Positioning to X 130.000 Y–55.000
3. Contacting in the Z-axis in negative direction (setting: –310.000)
4. Setting the Z-axis to Z –280.000
5. Setting the X-axis to X 110.000 (130.000–20.000)
6. Positioning to Y –55.000 Z –305.000
7. Contacting in the X-axis in positive direction (setting: X 140.000)
8. Setting the X-axis to X 110.000

P999999902 Gauging the length of a tool

This cycle serves to determine the length of the tool fitted in the spindle. The number of the longitudinal axis and the position of the probe installed in the machine working area are taken from the declarations memory. An offset value in the plane can be entered in order to align the cutting edge of the tool with the probe.

Geometry



Prerequisite:
The probe must have been qualified with program P999999901.

Procedure:

1. Setting the longitudinal axis to home position
2. Positioning the axes as defined under H13/H15 to contacting position
3. Contacting in the longitudinal axis
4. Setting the longitudinal axis to home position

Input parameters

P1 Offset for contacting in the longitudinal axis

P2 Offset for contacting in the axis as defined under H13

P3 Offset for contacting in the axis as defined under H15

P4 Selection of probe 1 or 2
(If no entry is made, probe 1 is selected automatically.)

☞ **If no values are entered for P1 ... P3, the offset is 0.**

Declarations memory data used

H1, H2, H4, H5, H6, H7, H11 – H16.

Result parameters

Upon completion of this measuring cycle, the result is available for further processing as global variables as well as in the declarations memory K99. Subsequently, an evaluation program (e.g. P999999933, P999999935 or P999999936) must be called up in order to calculate the length compensation, if any.

H46 – #ZKORR – Measured value of tool length compensation

H35 – #PNR% – Number of the measuring program

☞ **Length compensation H, which was active prior to this measuring cycle, must be reactivated after completion of a measuring cycle.**

Example

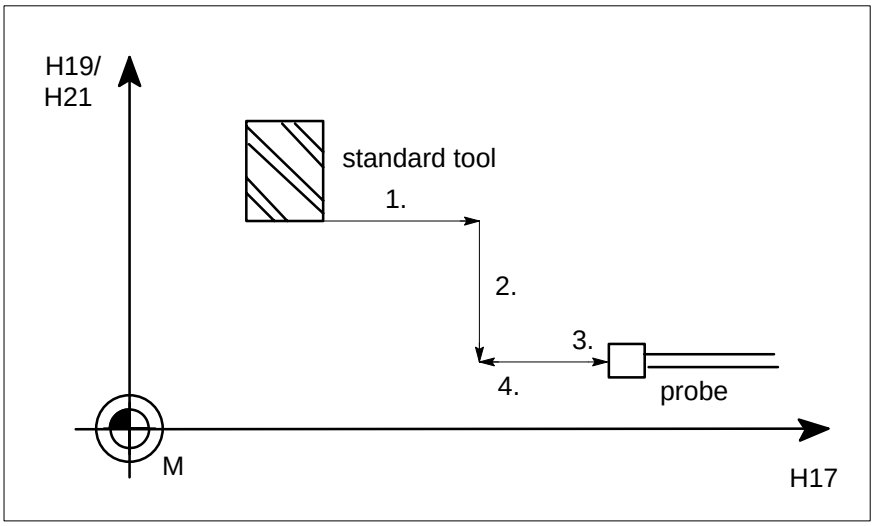
CPL call: **N100G22P999999902**

P999999903

Gauging the radius of a tool

This cycle serves to determine the radius of a tool fitted in the spindle. Offset values can be entered for all axes involved in order to align the cutting edge of the tool with the probe.

Geometry



Prerequisite:
The probe must have been qualified with program P999999901.

Procedure:

1. Setting the radial axis to home position
2. Setting the axes as defined under H19/H21 to contacting position
3. Contacting in the radial axis
4. Resetting the radial axis to home position

Input parameters

P1 Offset for contacting in the radial axis

P2 Offset for contacting in the axis as defined under H19

P3 Offset for contacting in the axis as defined under H21

P4 Selection of probe 1 or 2
(If no entry is made, probe 1 is selected automatically.)

☞ **If no values are entered for P1 ... P3, the offset is 0.**

Declarations memory data used

H1, H2, H4, H5, H6, H7, H17 – H22.

Result parameters

Upon completion of this measuring cycle, the result is available for further processing as global variables as well as in the declarations memory K99. Subsequently, an evaluation program (e.g. P999999934, P999999935 or P999999936) must be called up in order to calculate the radius compensation, if any.

H46 – #XKORR – Measured value of tool radius compensation

H35 – #PNR% – Number of the measuring program

Example

CPL call: **N100G22P999999903**[**–20,,,2**]

4 Measuring workpieces

4.1 Measuring cycle package: Measuring without variable spindle positioning

P999999911 Qualifying probes using a reference bore

This measuring cycle serves to determines the exact trigger points in the plane of a probe fitted in the spindle.

A probe requires different, yet constant paths for switching in the X–, X+, Y–, Y+ directions. Although deflection up to the trigger point is different in each direction, reproducibility is nevertheless very high.

In order to obtain the most accurate results possible, the trigger points of a probe must be qualified from time to time or prior to carrying out high-accuracy measurements. The probe qualifying cycle must be run in the same axis and direction used later for workpiece measuring.

For probe qualification, a reference bore aligned with the spindle must be available on the machine. Both the exact position of this reference bore and its diameter must be known.

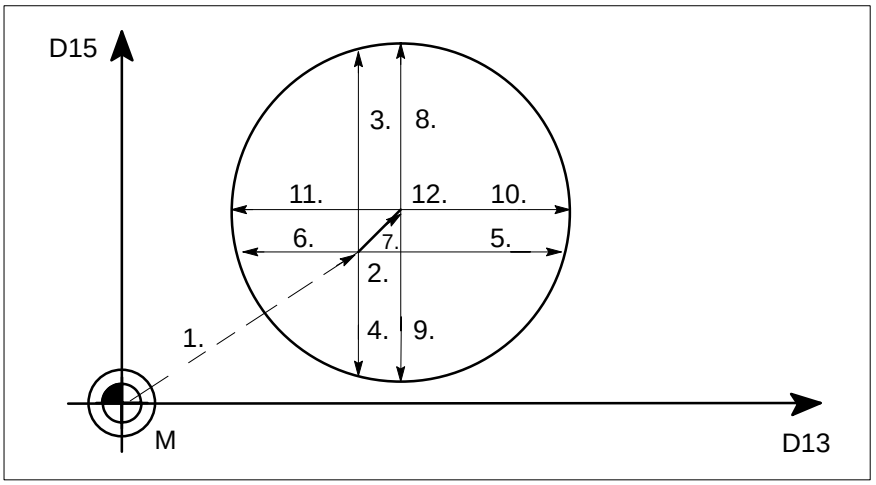
If a fixed reference bore attached on the machine is used, its data may be stored permanently in the declarations memory. If instead a reference bore on a workpiece is used, its position data and diameter may be transferred when the measuring cycle is called up.

Upon completion of the probe qualification run, a dimensional deviation (compensation value) is stored in the declarations memory. This compensation value is taken into account in subsequent measuring cycles.

This value will compensate for the following probe characteristics:

- Positional deviation of the probe tip from the center point of spindle rotation
- Diameter of the probe tip
- Trigger points of the probe

Geometry



Procedure:

1. Setting the two axes (D13 + D15) in the center of the bore
2. Setting the longitudinal axis so as to pass through the bore

3.–6. Determination of center point deviation

7. Positioning the probe tip in the center of the reference bore

8.–11. Determination of the trigger points

12. Resetting the longitudinal axis to home position

Input parameters

P1	Selection of probe 1 or 2 (If no entry is made, probe 1 is selected automatically.)
P2	Position of the reference bore in the 1st axis of the plane. This entry is not mandatory. However, if a value is entered, it is registered against the current datum offset and the result is stored in the declarations memory (D14) as the new position on the machine. This new position is then used in the probe qualifying cycle.
P3	Position of the reference bore in the 2nd axis of the plane. Same effect as P2. New machine position stored under D16 in the declarations memory.
P4	Position of the reference bore in the longitudinal axis. Same effect as P2. New machine position stored under D12 in the declarations memory.
P5	Diameter of the reference bore. This entry is not mandatory. However, if a value is entered, it is stored as the new diameter under D17 in the declarations memory.

Declarations memory data used

H1	IF input Test/Block Search
H2	IF output for G75
H5	Overtravel for G75
H6	Positioning feed
H7	Contacting feed
H32	Probe length – contacting in the plane
D11	Definition of the longitudinal axis
D12	Position of D11 (not applicable if P4 has been entered)
D13	Definition of the 1st axis in the plane

D14 Exact position of D13 (not applicable if P2 has been entered)

D15 Definition of the 2nd axis in the plane

D16 Exact position of D15 (not applicable if P3 has been entered)

D17 Exact diameter of the reference bore
(not applicable if P5 has been entered)

Result parameters

The following measured values are committed to the declarations memory:

D1 Positional deviation of the probe in the plane (1st axis).
For subsequent measurements, the position of this axis (D13) is offset by the deviation value determined as described above before the actual measuring cycle starts so as to ensure that the measurements are taken exactly at the required point.

D2 Positional deviation of the probe in the plane (2nd axis) (see D1)

D3 Lobing in positive approach direction in the 1st axis (D13).
To obtain exact results in subsequent measurements, points taken are offset by this lobing value after completion of measuring cycles.

D4 Lobing in negative approach direction in the 1st axis (D13)

D5 Lobing in positive approach direction in the 2nd axis (D15)

D6 Lobing in negative approach direction in the 2nd axis (D15)

D12 If P4 has been entered, D12 is updated

D14 If P2 has been entered, D14 is updated

D16 If P3 has been entered, D16 is updated

D17 If P5 has been entered, D17 is updated

Example

CPL call: **N100G22P999999911**

declarations memory	H32	– Z	150.000
	D11	– X	3.000
	D12	– X	–530.000
	D13	– X	1.000
	D14	– X	155.300
	D15	– X	2.000
	D16	– X	200.501
	D17	– X	25.500

Procedure under this CPL call:

1. Setting the X-axis to the fixed machine position 155.3 mm and the Y-axis to 200.501 mm.
2. Setting the Z-axis to –380 mm (–530 + 150 mm)
3. Bore measuring
4. Resetting the Z-axis to home position

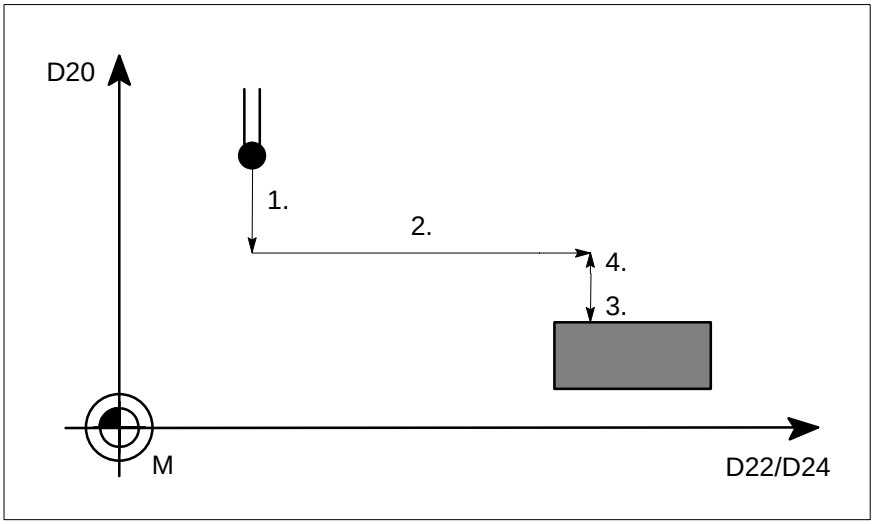
P999999912

Qualifying probes in the longitudinal axis

This measuring cycle serves to determine the exact trigger point of the probe in the longitudinal axis. A reference surface of known position within the machine working area is required for this probe qualifying cycle.

The exact probe length determined is committed to the declarations memory for subsequent measuring cycles.

Geometry



Procedure:

1. Setting the longitudinal axis with a clearance in front of the reference surface
2. Setting the axes as defined under D22 and D24 in front of the reference surface
3. Contacting the reference surface
4. Resetting to position 1

Input parameters

P1 Selection of probe 1 or 2 (If no entry is made, probe 1 is selected automatically.)

P2 Probe qualifying position in the 1st axis in the plane. This entry is not mandatory. However, if a value is entered, it is registered against the current datum offset and the result is stored in the declarations memory D23 as the new position on the machine. This new position is then used in the probe qualifying cycle.

P3 Same effect as P2. The new position is stored under D25 in the declarations memory.

P4 Same effect as P2. The new position is stored under D 21 in the declarations memory.

Declarations memory data used

H1 IF input Test/Block Search

H2 IF output for G75

H4 Clearance for G75

H5 Overtravel for G75

H6 Positioning feed

H7 Contacting feed

D7 Min. probe length

D8 Max. probe length

D20 Definition of the longitudinal axis
(Sign indicates the contacting direction)

D21 Exact position of the axis as defined under D20 (not applicable if P4 has been entered)

D22 Definition of the 1st axis in the plane

D23 Position as defined under D22 (not applicable if P2 has been entered)

D24 Definition of the 2nd axis in the plane

D25 Position as defined under D24 (not applicable if P3 has been entered)

Result parameters

The measured results are committed to the declarations memory:

H33 Qualified probe length

D21 If P4 has been entered, D21 is updated

D23 If P2 has been entered, D23 is updated

D25 If P3 has been entered, D25 is updated

Example

CPL call: **N100G22P999999912[2]**

declarations memory	H4	– Z	10.000
	D8	– X	160.000
	D20	– X	–3.000
	D21	– X	–780.000
	D22	– X	1.000
	D23	– X	250.000
	D24	– X	2.000
	D25	– X	–290.000

Procedure under this CPL call:

1. Setting the 3rd axis to the fixed machine position –510 mm
(D21 + D8 + H4 = –780 mm + 160 mm + 10 mm)
2. Setting the 1st axis to position 250 mm and the 2nd axis to position –290 mm
3. Contacting the reference position
4. Resetting the 3rd axis to position –510 mm

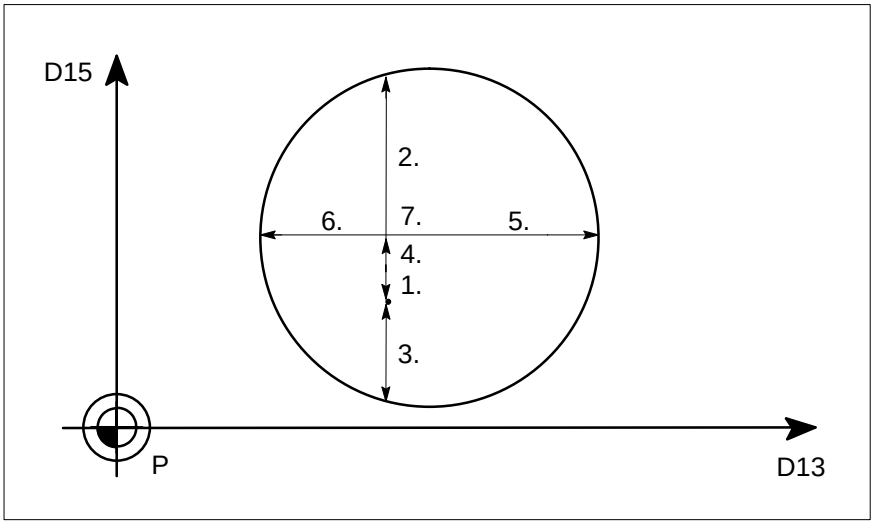
P999999913

Measuring a bore

This cycle serves to determine the center point and the diameter of a bore.

Upon completion of this cycle, the measured results are available as global variables as well as in the declarations memory for further processing. The measured results are evaluated by separate programs, which can be called up after completion of this measuring cycle.

Geometry



Prerequisites:

- The programming plane in which the bore to be measured is located must be active (G17, G18, G19, or G20).
- The probe must be positioned so that the center of the spindle is in line with the setpoint center of the bore.
- The probe must have been qualified with program P999999911.

Procedure:

1. Setting the longitudinal axis so as to pass through the bore
2. Contacting in the 2nd axis in positive direction
3. Contacting in the 2nd axis in negative direction
4. Positioning the probe tip in the center of the bore
5. Contacting in the 1st axis in positive direction
6. Contacting in the 1st axis in negative direction
7. Resetting the longitudinal axis to home position

Input parameters

P1 Measuring position of the bore in the longitudinal axis relative to program datum

P2 Setpoint diameter of the bore

P3 Selection of probe 1 or 2 (If no entry is made, probe 1 is selected automatically.)

Declarations memory data used

H1, H2, H4, H5, H6, H7, D1 – D6, D11, D13, D15.

Result parameters

H38 – #SPOSMP1	Setpoint position of the center of the 1st axis (D13)
H41 – #SPOSMP2	Setpoint position of the center of the 2nd axis (D15)
H44 – #SDURCHM	Setpoint diameter of the bore
H39 – #IPOSMP1	Actual position of the center of the 1st axis
H42 – #IPOSMP2	Actual position of the center of the 2nd axis
H45 – #IDURCHM	Actual diameter of the bore
H40 – #DPOSMP1	Positional deviation (difference), 1st axis (setpoint – actual)
H43 – #DPOSMP2	Positional deviation (difference), 2nd axis (setpoint – actual)
H46 – #DDURCHM	Difference in diameter
H35 – #PNR%	Program number of the measuring cycle. The program number must be specified for the subsequent evaluation cycle to recognize where the data originated.
H36 – #AX1%	Axis number of the 1st axis (D13)
H37 – #AX2%	Axis number of the 2nd axis (D15)

Example

CPL call: **N100G22P999999913**[**–290,30.4**]

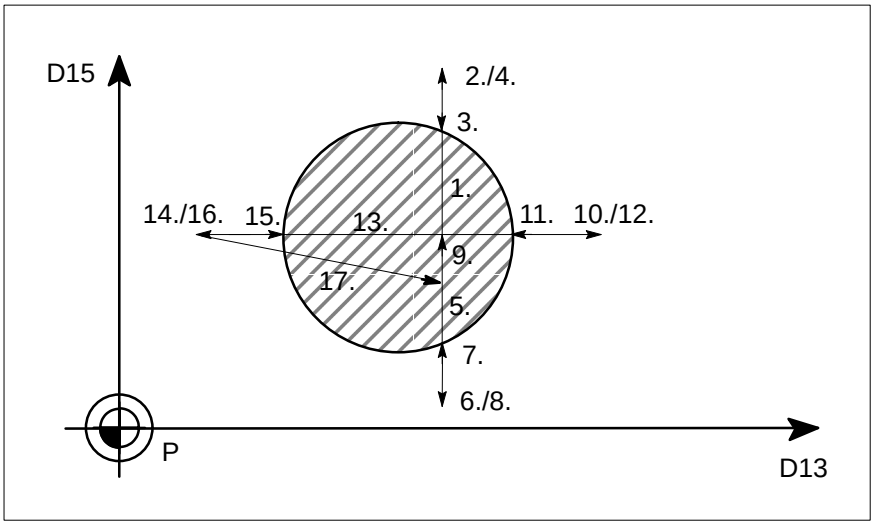
P999999914

Measuring a cylinder

This cycle serves to determine the center point and the diameter of a cylinder.

Upon completion of this cycle, the measured results are available as global variables as well as in the declarations memory for further processing. The measured results are evaluated by separate programs, which can be called up after completion of this measuring cycle.

Geometry



Prerequisites:

- The programming plane in which the bore to be measured is located must be active (G17, G18, G19, or G20).
- The probe must be positioned so that the center point of the spindle is in line with the setpoint center of the bore.
- The probe must have been qualified with program P999999911.

Procedure:

1. Setting to contacting position. The clearance in the plane is the value as defined under H4 in the declarations memory
2. Setting the longitudinal axis in the measuring plane
3. Contacting in the 2nd axis in negative direction
4. Resetting the longitudinal axis for being moved to the 2nd contacting position

6. Setting to 2nd contacting position

10. Setting to 3rd contacting position

14. Setting to 4th contacting position

17. Resetting to home position

Input parameters

P1	Measuring position of the cylinder in the longitudinal axis relative to program datum
P2	Setpoint diameter of the cylinder
P3	Incremental return path (incl. sign) in order to approach the next point to be taken
P4	Selection of probe 1 or 2 (If no entry is made, probe 1 is selected automatically.)

Declarations memory data used

H1, H2, H4, H5, H6, H7, D1 – D6, D11, D13, D15

Result parameters

H38 – #SPOSMP1	Setpoint position of the center of the 1st axis (D13)
H41 – #SPOSMP2	Setpoint position of the center of the 2nd axis (D15)
H44 – #SDURCHM	Setpoint diameter of the bore
H39 – #IPOSMP1	Actual position of the center of the 1st axis
H42 – #IPOSMP2	Actual position of the center of the 2nd axis
H45 – #IDURCHM	Actual diameter of the bore
H40 – #DPOSMP1	Positional deviation (difference), 1st axis (setpoint – actual)
H43 – #DPOSMP2	Positional deviation (difference), 2nd axis (setpoint – actual)
H46 – #DDURCHM	Difference in diameter
H35 – #PNR%	Program number of the measuring cycle. The program number must be specified for the subsequent evaluation cycle to recognize where the data originated.
H36 – #AX1%	Axis number of the 1st axis (D13)
H37 – #AX2%	Axis number of the 2nd axis (D15)

Example

CPL call: **N100G22P999999914**[**–630,5,200,–20,2**]

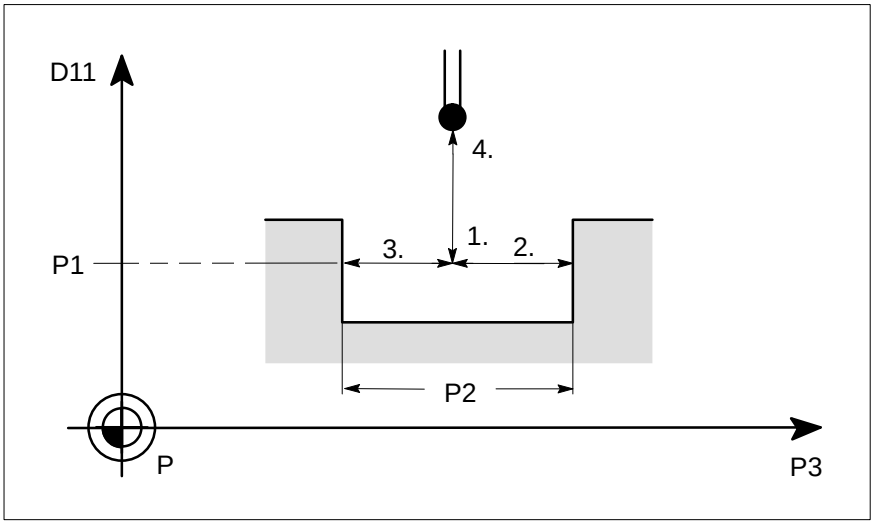
P999999915

Measuring a slot

This cycle serves to determine the position and the width of a paraxial slot.

Upon completion of this cycle, the measured results are available as global variables as well as in the declarations memory for further processing. The measured results are evaluated by separate programs, which can be called up after completion of this measuring cycle.

Geometry



Prerequisites:

- The probe must be positioned so that the center point of the spindle is in line with the setpoint center of the slot.
- The probe must have been qualified with program P999999911.
- The measuring axis must be an axis of the respective reference bore.

Procedure:

1. Setting the longitudinal axis in the slot
2. Contacting the slot in positive direction in the axis defined in the CPL call
3. Contacting the slot in negative direction
4. Resetting the longitudinal axis to home position

Input parameters

P1	Measuring position of the slot in the longitudinal axis relative to program datum
P2	Setpoint width of the slot
P3	Axis number of the measuring axis
P4	Selection of probe 1 or 2 (If no entry is made, probe 1 is selected automatically.)

Declarations memory data used

H1, H2, H4, H5, H6, H7, D1 – D6, D11, D13, D15.

Result parameters

H38 – #SPOSMP	Setpoint position of the slot center
H39 – #IPOSMP	Actual position of the slot center

H40 – #DPOSMP	Positional deviation (difference) of the slot (setpoint – actual)
H44 – #SBREITE	Setpoint width of the slot
H45 – #IBREITE	Actual width of the slot
H46 – #DBREITE	Difference in slot width
H35 – #PNR%	Program number of the measuring cycle
H36 – #AX%	Axis number of the measuring axis

Example

CPL call: **N100G22P999999915**[**–190,22,2**]

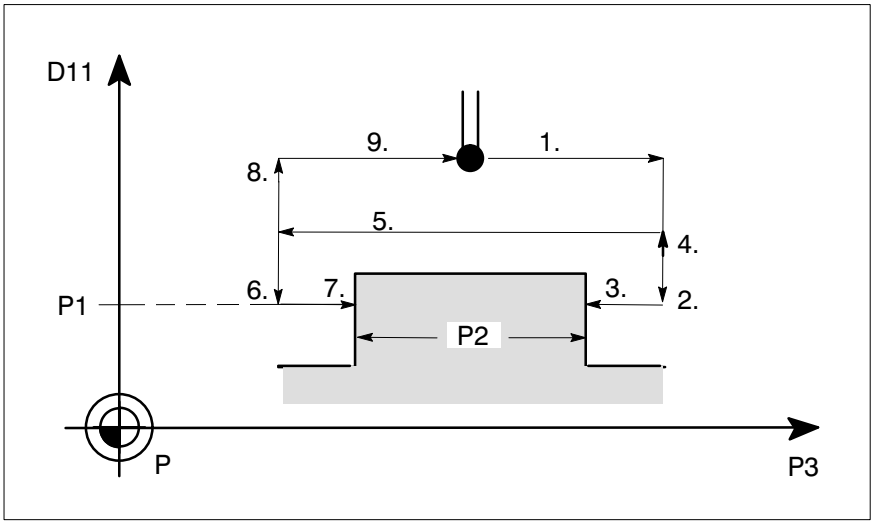
P999999916

Measuring a key

This cycle serves to determine the width and the position of a paraxial key.

Upon completion of this cycle, the measured results are available as global variables as well as in the declarations memory for further processing. The measured results are evaluated by separate programs, which can be called up after completion of this measuring cycle.

Geometry



Prerequisites:

- The probe must be positioned so that the center point of the spindle is in line with the setpoint center of the key.
- The probe must have been qualified with program P999999911.
- The measuring axis must be an axis of the respective reference bore.

Procedure:

1. Moving the selected axis in positive direction to the 1st contacting position
2. Setting the longitudinal axis in the measuring plane
3. Contacting in the selected axis in negative direction
4. Withdrawing the longitudinal axis for moving it to the 2nd contacting position
5. Setting for the 2nd contacting position
9. Resetting to home position

Input parameters

P1 Measuring position of the key in the longitudinal axis relative to program datum

P2 Setpoint width of the key

P3 Axis number of the measuring axis

P4 Incremental withdrawal path (incl. sign) in order to approach the 2nd point to be taken

P5 Selection of probe 1 or 2 (If no entry is made, probe 2 is selected automatically.)

Declarations memory data used

H1, H4, H5, H6, H7, D1 – D6, D11, D13, D15

Input parameters

H38 – #SPOSMP	Setpoint position of the center of the key
H39 – #IPOSMP	Actual position of the center of the key
H40 – #DPOSMP	Positional deviation (difference) of the key (setpoint – actual)
H44 – #SBREITE	Setpoint width of the key
H45 – #IBREITE	Actual width of the key
H46 – #DBREITE	Difference in key width
H35 – #PNR%	Program number of the measuring cycle
H36 – #AX%	Axis number of the measuring axis

Example

CPL call: **N100G22P999999916**[**–1015.5,10.5,1,–15,2**]

P999999917 Single-point measuring / multi-point measuring

This cycle serves to determine the exact position of a surface. Measuring can be done either in the longitudinal axis or in the plane.

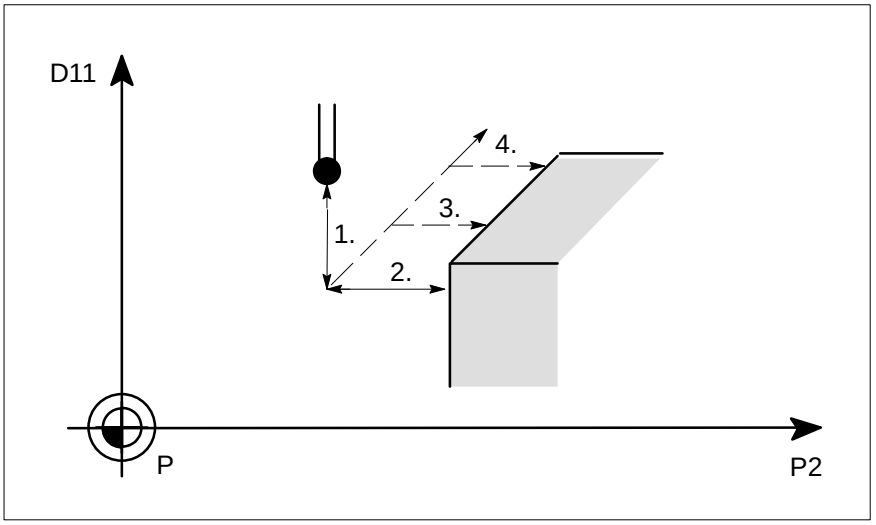
Upon completion of this cycle, the measured results are available as global variables as well as in the declarations memory for further processing. The measured results are evaluated by separate programs, which can be called up after completion of this measuring cycle.

Geometry

Prerequisites:

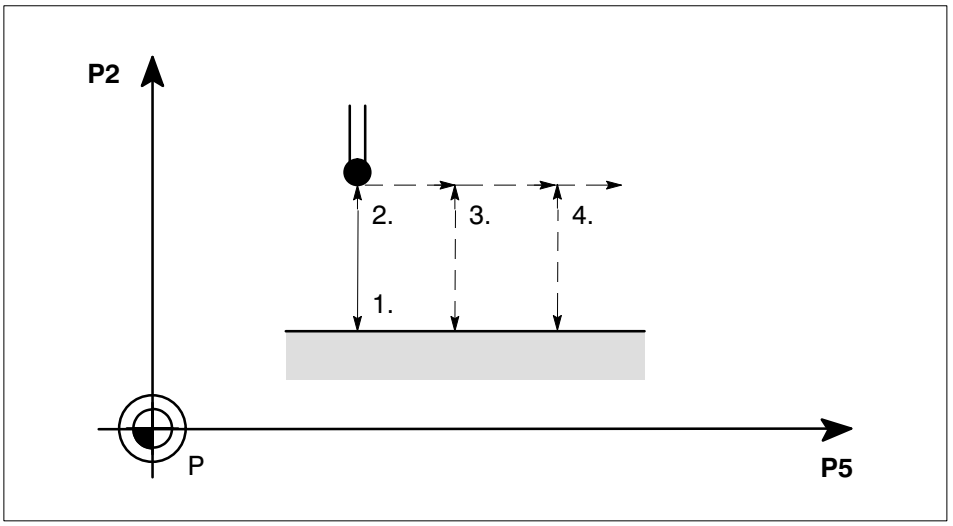
- The measuring axis must be a qualified axis of the selected probe
- For measuring in the longitudinal axis, the axes in the plane must be set so as to permit direct measurement

Procedure 1:
Measuring in the plane



- Setting the longitudinal axis in front of the point to be taken. The probe length as defined under H32 is taken into account.
- Contacting the required point in positive or negative direction
- Incremental offset depending on input parameter P4 and repeated measurement(s)
- Resetting the longitudinal axis to home position

Procedure 2:
Measuring in the longitudinal axis



- Setting the longitudinal axis in front of the point to be taken. The clearance as defined under H4 is adjusted in accordance with the probe length stored under H33
- Contacting towards the required point
- Incremental offset depending on input parameter P4 and repeated measurement(s)
- Resetting the longitudinal axis to home position

Input parameters

P1	Setpoint position
P2	Axis number of the measuring axis
P3	Position of the longitudinal axis when contacting in the plane
P4	Selection of probe 1 or 2 (If no entry is made, probe 1 is selected automatically.)
P5	Axis number of the axis of movement
P6	Incremental offset per measurement
P7	Number of measurements

Declarations memory data used

Procedure 1: H1, H2, H4, H5, H6, H7, H32, D1–D6, D11, D13, D15

Procedure 2: H1, H2, H4, H5, H6, H7, H33, D11, D13, D15

Result parameters

H38 – #SPOS	Setpoint position
H39 – #IPOS	Actual position In the case of multi-point measurement (P7 >1), #IPOS is the arithmetic mean of all points taken
H40 – #DPOS	Positional deviation (setpoint – actual)
H37 – #RI	Contacting direction (1 = positive, –1 = negative)
H36 – #AX%	Axis number of the measuring axis
H35 – #PNR%	Program number of the measuring cycle

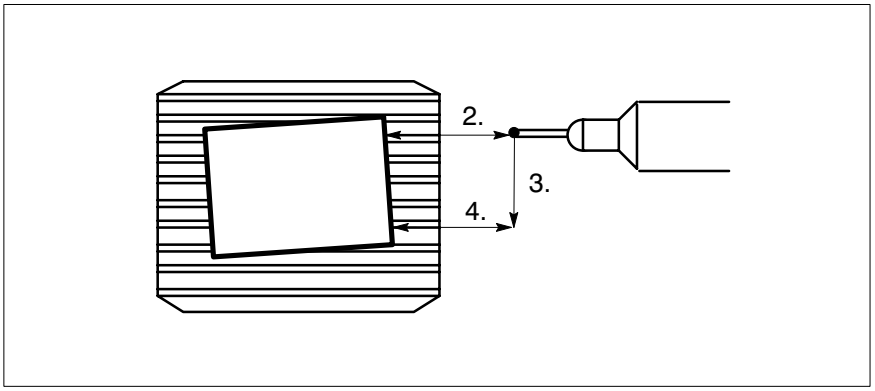
Example

CPL call: **N100G22P999999917**[**–352.75,3**]

P999999918 Two-point measurement

This cycle serves to determine an angular deviation from axial parallelism by paraxial contacting of 2 points. A measured angular deviation can be used to adjust the position of a rotary axis correspondingly. Upon completion of this cycle, the measured results are available as global variables as well as in the declarations memory for further processing. The measured results are evaluated by separate programs, which can be called up after completion of this measuring cycle.

Geometry



Prerequisites:

- The probe must have been qualified in the selected contacting direction.

Procedure:

1. Setting the longitudinal axis to contacting position unless the measuring cycle is run in the longitudinal axis.
2. Contacting the 1st position
3. Setting for contacting the 2nd position
4. Contacting the 2nd position
5. Resetting the longitudinal axis to home position

Input parameters

P1	Axis number of the measuring axis
P2	Setpoint position of the 1st point to be taken
P3	Setpoint position of the 2nd point to be taken
P4	Axis number of the shifting axis
P5	Distance between the points taken in the shifting axis (incl. sign)
P6	Position of the longitudinal axis for contacting in the plane
P7	Selection of probe 1 or 2 (If no entry is made, probe 1 is selected automatically.)

Declarations memory data used

H1, H2, H4, H5, H6, H7, H32, H33, D1 – D6, D11, D13, D15

Result parameters

H38 – #SPOS1	Setpoint position of the 1st point taken
H41 – #SPOS2	Setpoint position of the 2nd point taken
H39 – #IPOS1	Actual position of the 1st point taken

H42 – #IPOS2	Actual position of the 2nd point taken
H40 – #DPOS1	Positional deviation of the 1st point taken (setpoint – actual)
H43 – #DPOS2	Positional deviation of the 2nd point taken (setpoint – actual)
H45 – #WI	Angular deviation of the 2nd position

$$\#WI = ATN \frac{\#DPOS2 - \#DPOS1}{P5}$$

#RI	Contacting direction (1 = positive, –1 = negative)
H36 – #AX1%	Axis number of the measuring axis
H37 – #AX3%	Axis number of the shifting axis
H35 – #PNR%	Program number of the measuring cycle

Example

CPL call: **N100G22P999999918** [**1,350,350,2,–170,–360**]

4.2 Measuring cycle package: Measuring with variable spindle positioning

This measuring cycle package supports measuring with a probe which can be deflected in only one direction and which features omnidirectional signal transmission. Additionally, measuring in the longitudinal axis (Z-axis) is supported, depending on the design of the probe.

☞ **When using this measuring cycle package, make sure that the probe tip is aligned as precisely as possible with the rotational center of the spindle because otherwise the point taken will be off the required point.**

P999999921 Qualifying probes using a reference surface

This cycle serves to determine the trigger point of a probe in contacting direction in the plane.
For this probe qualifying cycle, a reference surface is required in the machine working area which the probe will contact in one of the axes of the active plane.

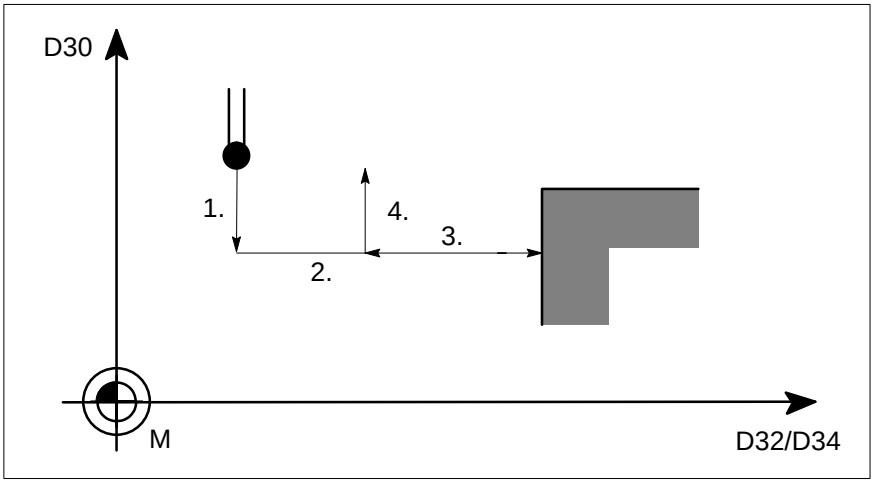
This probe qualifying cycle compensates for the following errors (characteristic data) of the probe:

- Positional deviation of the probe in the measuring axis
- Lobing of the probe in contacting direction
- Diameter of the probe tip

For measuring the diameter of a bore, a pin, the width of a slot or a key, e.g., it is essential that the probe be qualified.

For determining the position of a bore, pin, slot, or key, qualification of the probe is not required with variable spindle positioning.

Geometry



Prerequisites:

- Freely variable spindle positioning
- Signal transmission from the probe must be ensured for any spindle position (omnidirectional signal transmission)

- If the value stored under D30 in the declarations memory is set to zero, the longitudinal axis must first be set to the correct position.
- If P2 and P3 have been defined, the other axis in the active plane must first be set to the correct contacting position.

Procedure:

1. The spindle is set at 0 degrees from the contacting direction
2. If D30 ≠ 0, setting of the longitudinal axis
3. Setting of the axes as defined under D32/D34, or of the axis as defined under P2 to home position
4. Contacting the reference surface
5. Resetting the measuring axis in front of the contacting position at the clearance as defined under H4
6. If D30 ≠ 0, setting of the longitudinal axis to home position

Input parameters

P1 Selection of probe 1 or 2 (If no entry is made, probe 1 is selected automatically.)

P2 Selection of the axis for contacting in the active plane incl. sign to define the contacting direction. If no entry is made for P2, the program will use the axis as defined under D32. If an entry is made for P2, also P3 must be defined. P2 will then be stored under D32 in the declarations memory.

P3 Position of the reference surface relative to the current program datum. If P3 is defined following an entry for P2, this position is offset against the current datum offset and the result is stored as the new machine position under D33 in the declarations memory. D34 and D35 are set to 0 in this process, i.e. no other axis (except the longitudinal axis) will be moved.

Declarations memory data used

H1, H2, H4, H5, H6, H7, H32, D30 – D35, D37

Result parameters

The following measured values are committed to the declarations memory:

D36 Measured lobing
(spindle position S0 in contacting direction)

D32 If an entry was made for P2, D32 is updated

D33 If an entry was made for P3, D33 is updated

D34 If entries were made for P2/P3, D34 is set to 0

D35 If entries were made for P2/P3, D35 is set to 0

Example

CPL call: **N100G22P999999921**

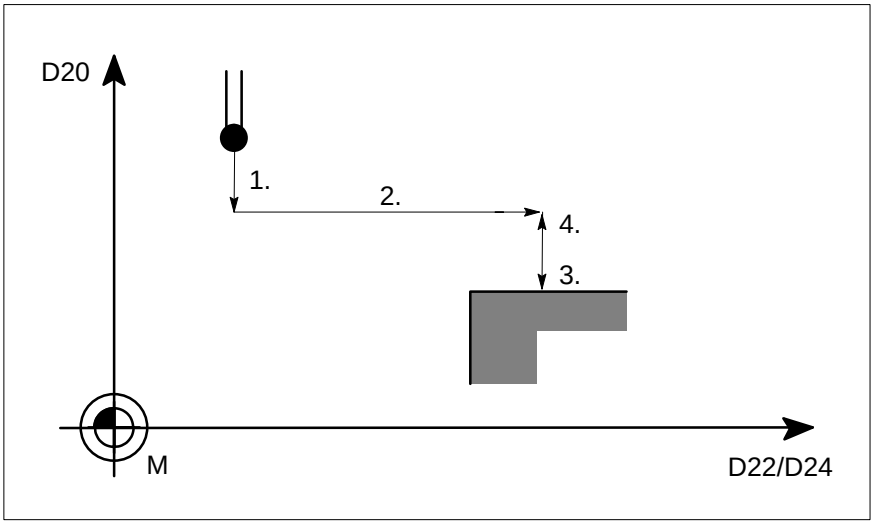
P999999922

Qualifying probes in the longitudinal axis

This measuring cycle serves to determine the exact trigger point of a probe in the longitudinal axis. For this probe qualifying cycle, a reference surface of known position in the machine working area is required.

The exact probe length determined is committed to the declarations memory for subsequent measuring cycles.

Geometry



Procedure:

- Setting the longitudinal axis at a clearance in front of the reference surface
- Setting the axes as defined under D22 and D24 in front of the reference surface
- Contacting the reference surface
- Resetting to position 1.

Input parameters

P1 Selection of probe 1 or 2 (If no entry is made, probe 1 is selected automatically.)

P2 Probe qualifying position of the 1st axis in the plane. This entry is not mandatory. However, if a position is entered, it is offset against the current datum offset and the result is stored as the new machine position under D23 in the declarations memory. This new position is then used in the probe qualifying cycle.

P3 Same effect as P2. The new position is stored under D25 in the declarations memory.

P4 Same effect as P2. The new position is stored under D21 in the declarations memory.

Declarations memory data used

H1	IF input Test/Block Search
H2	IF output for G75
H4	Clearance for G75
H5	Overtravel for G75
H6	Positioning feed
H7	Contacting feed
D7	Min. probe length
D8	Max. probe length
D20	Axis definition of the longitudinal axis
D21	exact position of the axis as defined under D20
D22	Axis definition of the 1st axis in the plane
D23	Position as defined under D22
D24	Axis definition of the 2nd axis in the plane
D25	Position as defined under D24

Result parameters

The following measured results are committed to the declarations memory:

H33	Qualified probe length
D21	If an entry was made for P4, D21 is updated
D23	If an entry was made for P2, D23 is updated
D25	If an entry was made for P3, D25 is updated

Example

CPL call: **N100G22P999999912**[**2**]

declarations memory	H4	Z	10.000
	D8	X	160.000
	D20	X	–3.000
	D21	X	–780.000
	D22	X	1.000
	D23	X	250.000
	D24	X	2.000
	D25	X	–290.000

Procedure under this CPL call:

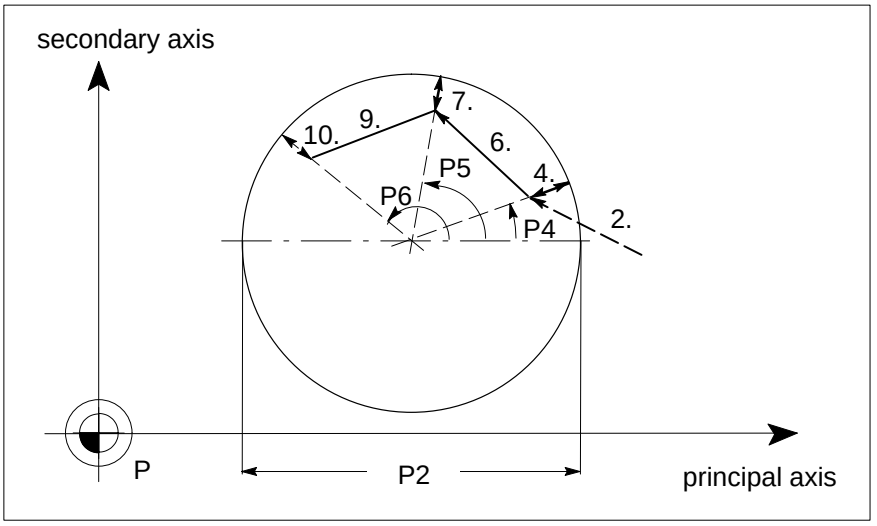
1. Setting the 3rd axis to fixed machine position –510 mm (–780 mm + 160 mm + 10 mm)
2. Setting the 1st axis to position 250 mm and the second axis to position –290 mm
3. Approaching the reference position
4. Resetting the 3rd axis to position –510 mm

P999999923 Measuring a bore

This cycle serves to determine the diameter and position of a bore. 3 points set at 120° angles are measured.

Upon completion of this cycle, the measured results are available as global variables as well as in the declarations memory for further processing. The measured results are evaluated by separate programs, which can be called up after completion of this measuring cycle.

Geometry



Prerequisites:

- The probe must have been qualified with P999999921.
- The programming plane in which the bore to be measured is located must be active (G17, G18, G19, or G20).
- Unless P7 and P8 have been defined, the probe must be positioned so that the center point of the spindle is in line with the setpoint center of the bore.

Procedure:

1. Positioning the spindle for the 1st approach
2. Positioning in front of the 1st point to be taken (clearance as defined under H4)
3. Setting the longitudinal axis in the bore
4. Contacting the 1st point to be taken at the angle as defined for P4
5. Positioning the spindle for the 2nd approach
6. Positioning in front of the 2nd point to be taken
7. Contacting the 2nd point to be taken at the angle as defined for P5 or P4 + 120°
8. Positioning the spindle for the 3rd approach
9. Positioning in front of the 3rd point to be taken
10. Contacting the 3rd point to be taken at the angle as defined for P6 or P4 + 240°
11. Resetting the longitudinal axis to home position
12. Calculation of the result parameters

Input parameters

P1 Measuring position of the bore in the longitudinal axis relative to program datum.

P2 Set diameter of the bore.
Unless the diameter is to be calculated by the program, a value must be entered for P2.

P3 Selection of probe 1 or 2 (If no entry is made, probe 1 is selected automatically.)

P4 Angle relative to the principal axis for the 1st approach.
If no entry is made, the approach direction must be defined under D38 of the declarations memory.

P5 Angle relative to the principal axis for the 2nd approach.
If no entry is made, the approach is made at an angle of P4 + 120°.

P6 Angle relative to the principal axis for the 3rd approach.
If no entry is made, the approach is made at an angle of P4 + 240°.

P7 Center point of the bore or circle segment to be measured in the principal axis. If no entry is made, the probe must be aligned with the center point of the bore prior to calling up the measuring cycle.

P8 Center point of the bore or circle segment to be measured in the secondary axis. If no entry is made, the probe must be aligned with the center point of the bore prior to calling up the measuring cycle.

Declarations memory data used

H1, H2, H4, H5, H6, H7, H32, D30, D32, D36, D37, D38

Result parameters

H38 – #SPOSMP1	Setpoint position of the center of the principal axis
H41 – #SPOSMP2	Setpoint position of the center of the secondary axis
H44 – #SDURCHM	Setpoint diameter of the bore
H39 – #IPOSMP1	Actual position of the center of the principal axis
H42 – #IPOSMP2	Actual position of the center of the secondary axis
H45 – #IDURCHM	Actual diameter of the bore
H40 – #DPOSMP1	Positional deviation in the principal axis (setpoint – actual)
H43 – #DPOSMP2	Positional deviation in the secondary axis (setpoint – actual)
H46 – #DDURCHM	Difference in diameter
H35 – #PNR%	Program number of the measuring cycle The program number must be specified for the subsequent evaluation cycle to recognize where the data originated.
H36 – #AX1%	Axis number of the principal axis
H37 – #AX2%	Axis number of the secondary axis

Example

CPL call: **N100G22P999999923**[**–320,50**]

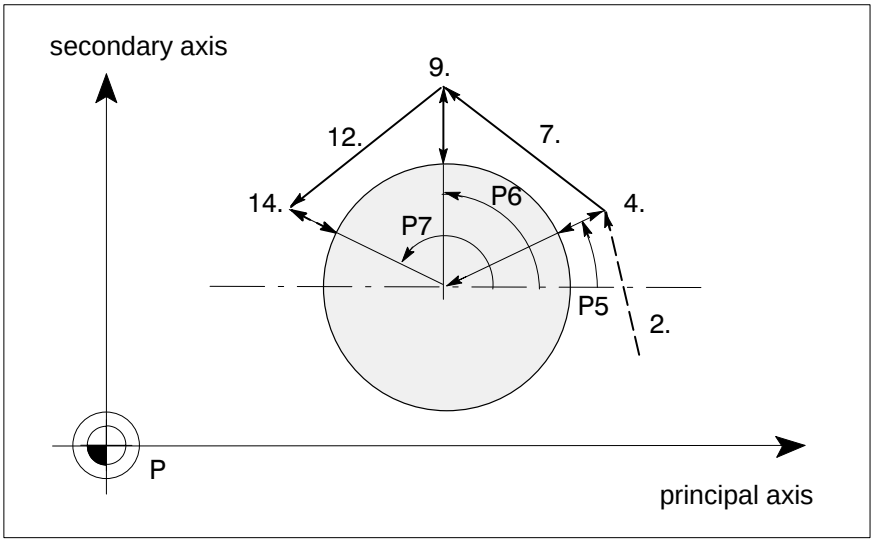
P999999924

Measuring a cylinder

This cycle serves to determine the center point and diameter of a cylinder.

Upon completion of this cycle, the measured results are available as global variables as well as in the declarations memory for further processing. The measured results are evaluated by separate programs, which can be called up after completion of this measuring cycle.

Geometry



Prerequisites:

- The probe must have been qualified with P999999921.
- The programming plane in which the bore to be measured is located must be active (G17, G18, G19, or G20)
- Unless P8 and P9 have been defined, the probe must be positioned so that the center point of the spindle is in line with the setpoint center of the bore.

Procedure:

1. Positioning the spindle for the 1st approach
2. Positioning in front of the 1st point to be taken (clearance H4)
3. Setting the longitudinal axis for contacting
4. Contacting the 1st point to be taken (angle P5)
5. Positioning the spindle for the 2nd approach
6. Withdrawing the longitudinal axis by clearance P3
7. Positioning in front of the 2nd point to be taken (clearance H4)
8. Setting the longitudinal axis for contacting
9. Contacting the 2nd point to be taken (angle P6 or P5 + 120°)
10. Positioning the spindle for the 3rd approach
11. Withdrawing the longitudinal axis by clearance P3
12. Positioning in front of the 3rd point to be taken (clearance H4)
13. Setting the longitudinal axis for contacting
14. Contacting the 3rd point to be taken (angle P7 or P5 + 240°)
15. Resetting the longitudinal axis to home position

Input parameters

P1 Measuring position of the cylinder in the longitudinal axis relative to program datum

P2 Setpoint diameter of the cylinder

P3 Incremental withdrawal (incl. sign) before approaching the next point to be taken

P4 Selection of probe 1 or 2 (If no entry is made, probe 1 is selected automatically.)

P5 Angle relative to the principal axis for 1st approach.
If no entry is made, the approach direction must be defined under D39 in the declarations memory.

P6 Angle relative to the principal axis for 2nd approach.
If no entry is made, the approach is made at an angle of P5 + 120°.

P7 Angle relative to the principle axis for 3rd approach.
If no entry is made, the approach is made at an angle of P5 + 240°.

P8 Center point of the bore or circle segment to be measured in the principal axis. If no entry is made, the probe must be aligned with the center point of the bore prior to calling up the measuring cycle.

P9 Center point of the bore or circle segment to be measured in the secondary axis. If no entry is made, the probe must be aligned with the center point of the bore prior to calling up the measuring cycle.

Declarations memory data used

H1, H2, H4, H5, H6, H7, H32, D30, D32, D36, D37, D39

Result parameters

H38 – #SPOSMP1	Setpoint position of the center of the principal axis
H41 – #SPOSMP2	Setpoint position of the center of the secondary axis
H44 – #SDURCHM	Setpoint diameter of the cylinder
H39 – #IPOSMP1	Actual position of the center of the principal axis
H42 – #IPOSMP2	Actual position of the center of the secondary axis
H45 – #IDURCHM	Actual diameter of the cylinder
H40 – #DPOSMP1	Positional deviation in the principal axis (setpoint – actual)
H43 – #DPOSMP2	Positional deviation in the secondary axis (setpoint – actual)
H46 – #DDURCHM	Difference in diameter
H35 – #PNR%	Program number of the measuring cycle. The program number must be specified for the subsequent evaluation cycle to recognize where the data originated.
H36 – #AX1%	Axis number of the principal axis
H37 – #AX2%	Axis number of the secondary axis

Example

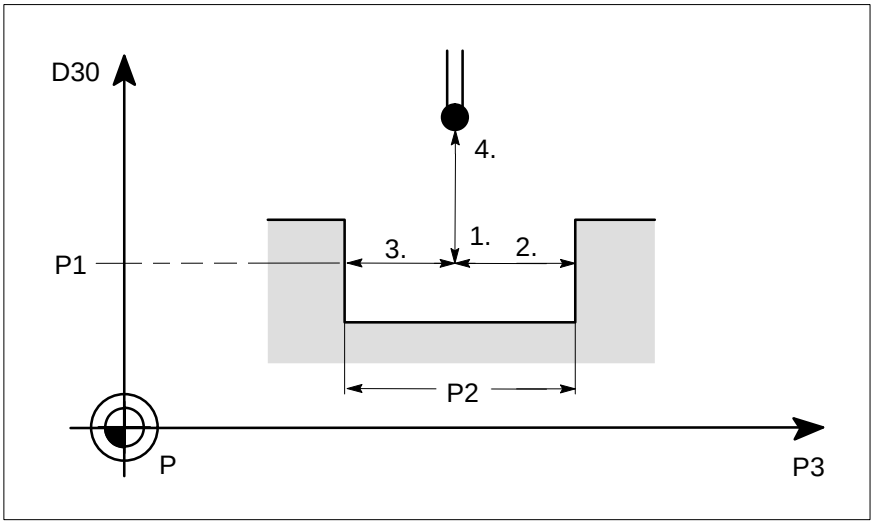
CPL call: **N100G22P999999924**[**–400,80,–30,,60**]

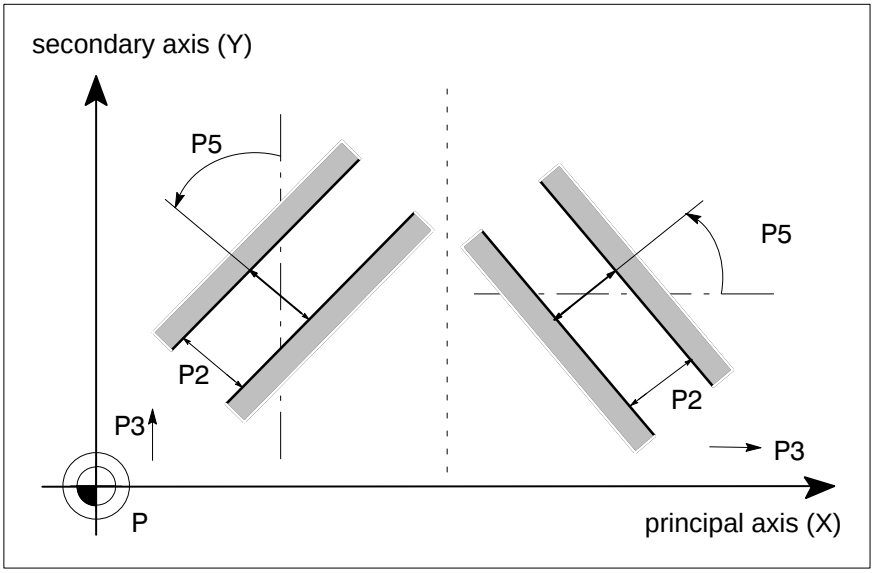
P999999925 Measuring a slot

This cycle serves to determine the length and width of a slot.

Upon completion of this cycle, the measured results are available as global variables as well as in the declarations memory for further processing. The measured results are evaluated by separate programs, which can be called up after completion of this measuring cycle.

Geometry





Prerequisites:

- The probe must have been calibrated with P999999921.
- The programming plane in which the slot to be measured is located must be active (G17, G18, G19, or G20)
- The probe must be positioned so that the center point of the spindle is aligned with the setpoint center of the slot.

Procedure:

1. Positioning the spindle
2. Setting the longitudinal axis in the slot
3. Contacting the slot (angle P5)
4. Rotating the spindle by 180°
5. Contacting the slot (angle P5 + 180°)

Input parameters

P1 Measuring position of the slot in the longitudinal axis relative to program datum.

P2 Setpoint width of the slot.
Unless the slot width is to be determined, it must be specified.

P3 Axis number of the measuring axis.

P4 Selection of probe 1 or 2 (If no entry is made, probe 1 is selected automatically.)

P5 Angle relative to the measuring axis. P5 is the contacting angle, not the angle of the slot position. If no entry is made for P5, the angle is set to 0 automatically.

Declarations memory data used

H1, H2, H4, H5, H6, H7, H32, D30, D32, D36, D37

Result parameters

H38 – #SPOSMP1	Setpoint position of the center of the slot in the principal axis
H41 – #SPOSMP2	Setpoint position of the center of the slot in the secondary axis
H39 – #IPOSMP1	Actual position of the center of the slot in the principal axis
H42 – #IPOSMP2	Actual position of the center of the slot in the secondary axis
H40 – #DPOSMP1	Positional deviation of the slot (setpoint – actual) in the principal axis
H43 – #DPOSMP2	Positional deviation of the slot (setpoint – actual) in the secondary axis
H44 – #SBREITE	Setpoint width of the slot
H45 – #IBREITE	Actual width of the slot
H46 – #DBREITE	Difference in slot width
H35 – #PNR%	Program number of the measuring cycle
H36 – #AX1%	Axis number of the principal axis
H37 – #AX2%	Axis number of the secondary axis

Example

CPL call: **N100G22P999999925**[**–220.5,120.475,2**]

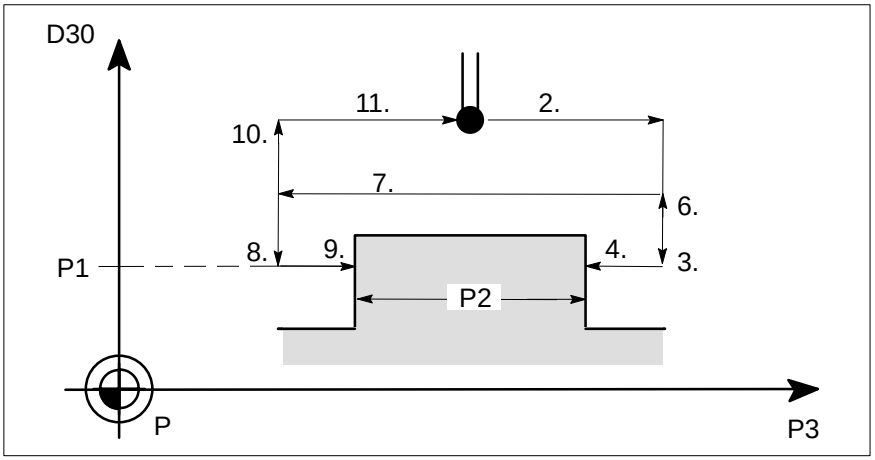
P999999926

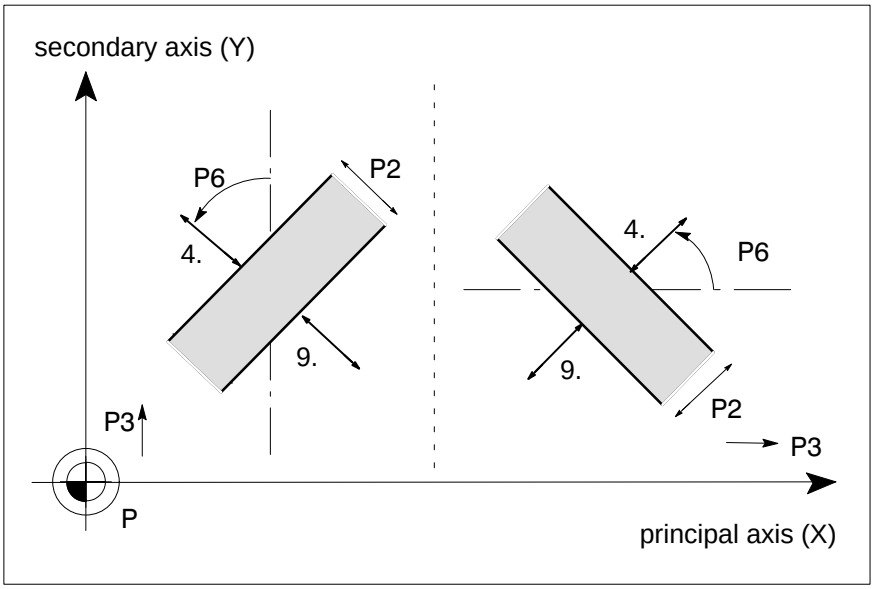
Measuring a key

This cycle serves to determine the width and length of a paraxial key.

Upon completion of this cycle, the measured results are available as global variables as well as in the declarations memory for further processing. The measured results are evaluated by separate programs, which can be called up after completion of this measuring cycle.

Geometry





Prerequisites:

- The probe must have been calibrated with P999999921.
- The programming plane in which the key to be measured is located must be active (G17, G18, G19, or G20).
- The probe must be positioned so that the center point of the spindle is in line with the setpoint center of the key.

Procedure:

1. Positioning the spindle
2. Setting the principal and the secondary axes in front of the point to be taken

3. Setting the longitudinal axis
4. Contacting the side face (angle P6 + 180°)
5. Rotating the spindle by 180°
6. Withdrawing the longitudinal axis by clearance P4
7. Setting the principal and the secondary axes in front of the next point to be taken
8. Setting the longitudinal axis
9. Contacting the side face (angle P6)
10. Setting the longitudinal axis to home position
11. Setting the principal and the secondary axes to home position

Input parameters

P1	Measuring position of the key in the longitudinal axis relative to the program datum
P2	Setpoint width of the key
P3	Axis number of the measuring axis
P4	Incremental path of withdrawal (incl. sign) before approaching the 2nd point to be taken
P5	Selection of probe 1 or 2 (If no entry is made, probe 1 is selected automatically)
P6	Angle relative to the measuring axis. P6 is the angle of approach, not the position of the key. If no entry is made for P6, the angle is set to 0 automatically.

Declarations memory data used

H1, H2, H4, H5, H6, H7, H32, D30, D32, D36, D37

Result parameters

H38 – #SPOSMP1	Setpoint position of the center of the key in the principal axis
H41 – #SPOSMP2	Setpoint position of the center of the key in the secondary axis
H39 – #IPOSMP1	Actual position of the center of the key in the principal axis
H42 – #IPOSMP2	Actual position of the center of the key in the secondary axis
H40 – #DPOSMP1	Positional deviation of the key (setpoint – actual) in the principal axis
H43 – #DPOSMP2	Positional deviation of the key (setpoint – actual) in the secondary axis
H44 – #SBREITE	Setpoint width of the key
H45 – #IBREITE	Actual width of the key
H46 – #DBREITE	Difference in key width
H35 – #PNR%	Program number of the measuring cycle
H36 – #AX1%	Axis number of the principal axis
H37 – #AX2%	Axis number of the secondary axis

Example

CPL call: **N100G22P999999926**[**200,35,1,–20**]

P999999927 Single-point measurement / multi-point measurement

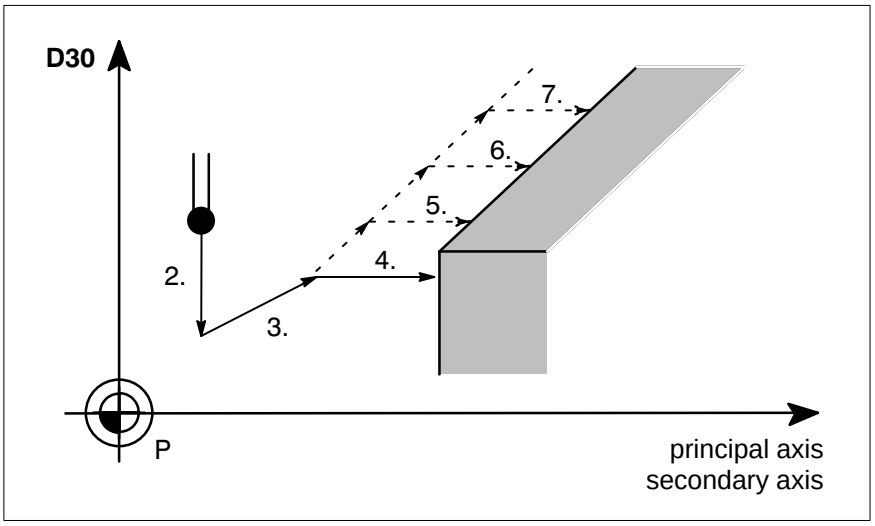
This cycle serve to determine the exact position of a surface. Measuring can be done either in the longitudinal axis or in the plane. Upon completion of this cycle, the measured results are available as global variables as well as in the declarations memory for further processing. The measured results are evaluated by separate programs, which can be called up after completion of this measuring cycle.

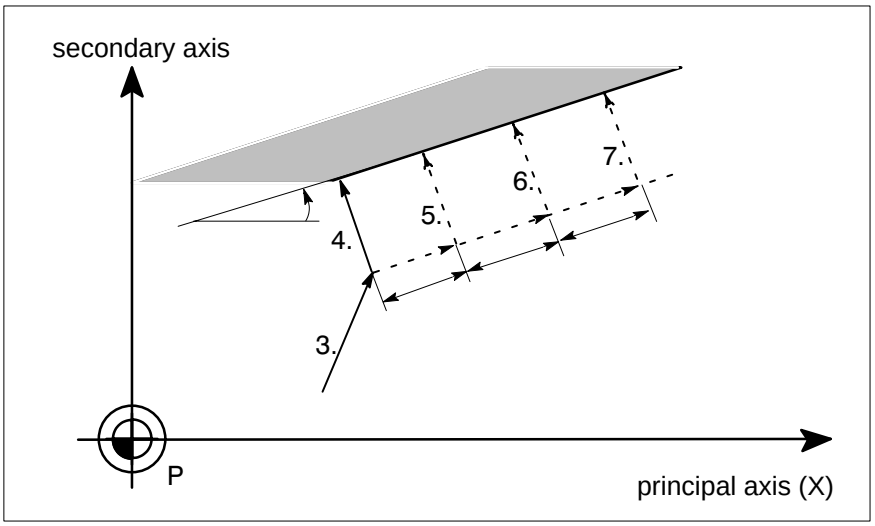
Geometry

Prerequisites:

- The probe must have been qualified with program P999999921 or P999999922.
- For measuring in the longitudinal axis, the axes in the plane must be set so as to permit direct measurement of the 1st point.

Procedure 1: Measuring in the plane



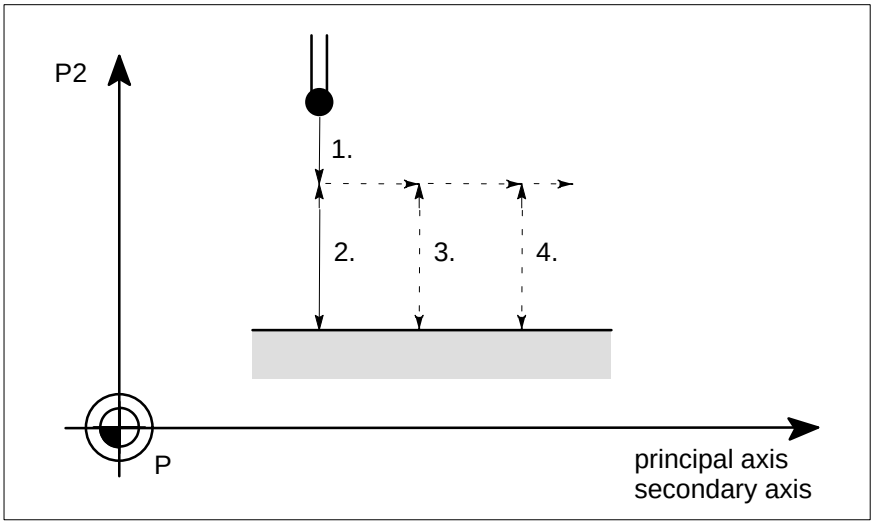


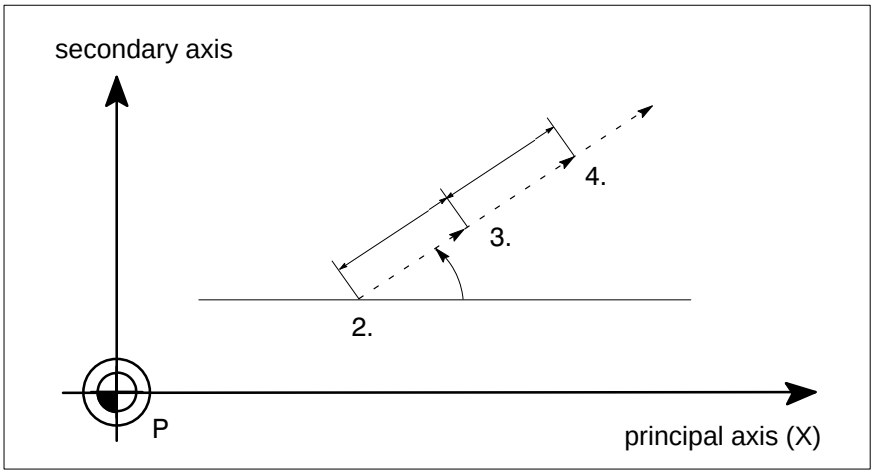
1. Positioning the spindle
2. Setting the longitudinal axis (D30) if P3 has been defined
3. Positioning the principal and the secondary axes in front of the point to be taken (clearance H4)
4. Contacting the point to be taken

5.–7. Contacting the other points if a value > 1 has been set for P7

8. Resetting the longitudinal axis (D30) to home position

Procedure 2: Measuring in the longitudinal axis





1. Positioning the longitudinal axis in front of the point to be taken
2. Measuring in the longitudinal axis
3.–4. Further measuring in the longitudinal axis if a value >1 has been set for P7
5. Resetting the longitudinal axis to home position

Input parameters

P1 Setpoint position
Procedure 1:
paraxial – setpoint position of the measuring axis
non-paraxial – setpoint position of the axis as defined under P2
Procedure 2:
Setpoint position of the longitudinal axis

P2 Axis number of the measuring axis. For non-paraxial measurement in the plane, the principal or the secondary axis can be defined here. The angle defined for P6 is then relative to the axis selected

P3 Position of the longitudinal axis for measuring in the plane
(No entry → The longitudinal axis is not moved)

P4 Selection of probe 1 or 2 (If no entry is made, probe 1 is selected automatically)

P5 Setpoint position of the 2nd axis in the active plane.
An entry is required only for non-paraxial measurement in the plane

P6 Angle for non-paraxial measurement
Procedure 1:
paraxial – no entry required
non-paraxial – angle of the surface relative to the axis as defined for P2
Procedure 2:
Angle in the plane relative to the axis as defined for P2

P7 Number of measurements (No entry = 1 point will be taken)

P8 Space between the points taken (0 is also permissible)

Declarations memory data used

Procedure 1: H1, H2, H4, H5, H6, H7, H32, D11, D36, D37

Procedure 2: H1, H2, H4, H5, H6, H7, H33, D20

Result parameters

H38 – #SPOS1	Arithmetic mean of the principal/measuring axis setpoint position
H41 – #SPOS2	Arithmetic mean of the secondary axis setpoint position
H39 – #IPOS1	Arithmetic mean of the principal/measuring axis actual position
H42 – #IPOS2	Arithmetic mean of the secondary axis actual position
H40 – #DPOS1	Arithmetic mean of the principal axis positional deviation
H43 – #DPOS2	Arithmetic mean of the secondary axis positional deviation
H36 – #AX1%	Axis number of the measuring axis (P2)
H44 – #AX2%	Axis number of the secondary axis
H45 – #WI	Approach angle (as defined under P6)
H46 – #DPOS	Positional deviation (setpoint – actual) in the measuring axis or in the plane
H37 – #RI	Approach direction (1 = positive, –1 = negative) For measuring in the plane, the value for #RI is set to 1
H35 – #PNR%	Program number of the measuring cycle

Example

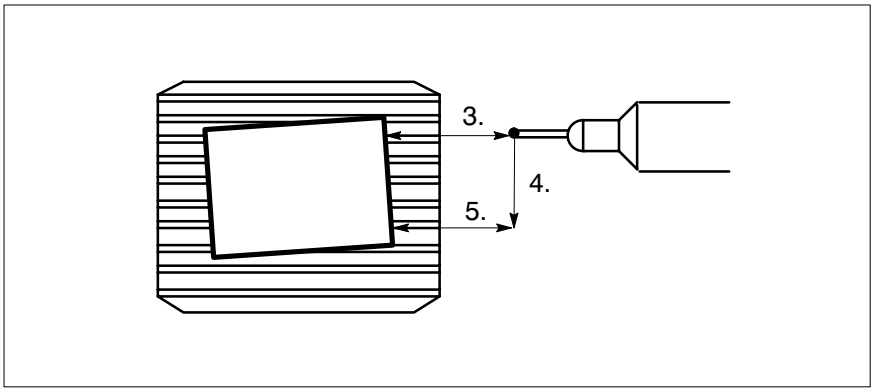
CPL call: **N100G22P999999927**[**–352.75,3**]

P999999928 Two-point measurement

This cycle serves to determine the angular deviation of 2 paraxial points.

Upon completion of this cycle, the measured results are available as global variables as well as in the declarations memory for further processing. The measured results are evaluated by separate programs, which can be called up after completion of this measuring cycle. The measured results can be used, e.g., for changing the position of a rotary axis so as to eliminate any angular deviation.

Geometry



Prerequisites:

- The probe must have been qualified with program P999999921 or P999999922.

Procedure:

1. Positioning the spindle unless the measuring cycle is run in the longitudinal axis.
2. Setting the longitudinal axis to contacting position unless the measuring cycle is run in the longitudinal axis.
3. Contacting the 1st point to be taken
4. Setting to the 2nd contacting position
5. Contacting the 2nd point to be taken
6. Setting the longitudinal axis to home position

Input parameters

P1	Axis number of the measuring axis
P2	Setpoint position of the 1st point taken
P3	Setpoint position of the 2nd point taken
P4	Axis number of the shifting axis
P5	Space between the points taken in the shifting axis (incl. sign)
P6	Position of the longitudinal axis for contacting in the plane
P7	Selection of probe 1 or 2 (If no entry is made, probe 1 is selected automatically)

Declarations memory data used

H1, H2, H4, H5, H6, H7, H32, H33, D11, D20, D36, D37

Result parameters

H38 – #SPOS1	Setpoint position of the 1st point taken
H41 – #SPOS2	Setpoint position of the 2nd point taken
H39 – #IPOS1	Actual position of the 1st point taken
H42 – #IPOS2	Actual position of the 2nd point taken
H40 – #DPOS1	Positional deviation of the 1st point taken (setpoint – actual)
H43 – #DPOS2	Positional deviation of the 2nd point taken (setpoint – actual)
H45 – #WI	Angular deviation of the 2nd point taken $\#WI = ATN \frac{\#DPOS2 - \#DPOS1}{P5}$
#RI	Contacting direction (pos. = 1, neg. = –1)
H36 – #AX1%	Axis number of the measuring axis
H37 – #AX3%	Axis number of the shifting axis
H35 – #PNR%	Program number of the measuring cycle

Example

CPL call: **N100G22P999999928**[**3,150,190,–135**]

Your notes:

5 Description of the declarations memory

H1 Number of the interface input for “Block Search” and for operating mode “Test without Movement”. If a measuring cycle is run in the operating mode “Block Search” or “Test without Movement”, the entire measuring cycle is skipped.
In the operating modes “Block Search” or “Test without Movement”, the PLC program must send a HIGH signal to the NC input defined here.
H1 Z 250.000 represents interface input bit 250.

H2 Number of the interface output which signals to the PLC that a triggering operation of the probe is expected.
If the PLC is additionally connected to the probe trigger signal output, this signal output can be used as a safety circuit to protect the probe. If the probe is deflected (leading edge) although there is no H2 “HIGH” signal, the connected PLC can trip an “EMERGENCY OFF”.

H3 Not assigned.

H4 Clearance at which G75 is activated.
Points to be taken in a measuring cycle are first approached at a high feed rate. At the clearance defined here, G75 is activated. The actual clearance is compensated for the probe radius.
H4 Z 025.000 stands for a clearance of 25 mm from the point to be taken where G75 is activated.

H5 Approach overtravel for contacting.
When a point to be taken is approached, the respective axis moves on all the way defined here unless the probe is deflected. Subsequently, the measuring cycle is stopped and an error message is displayed.
H5 Z 010.00 means that the measuring axis/axes will overtravel the point to be taken by 10 mm unless the probe is deflected earlier.

H6 Positioning feed.
For axis positioning, the axes are moved at the feed rate defined here.
H6 Z 5000.000 means that an axis is moved at a feed rate of 5,000 mm/min.

H7 Contacting feed.
This is the feed rate at which axes are moved when a probe deflection is expected. A practical feed rate would be 500 mm/min.

H8 Maximum positive compensation.
If the dimensional deviation is within the maximum range of positive compensation, it is transferred to the respective table. However, if the dimensional deviation exceeds the compensation range, the data is not transferred to the table and an error message is displayed.
Maximum positive compensation takes effect only if no zero offset range is entered when the dimensional deviation transfer function is called up.
H8 Z 3.500 means that dimensional deviations up to a maximum of 3.5 mm will be compensated for.

H9 Maximum negative compensation.
Same as H8, but for negative dimensional deviations.
H9 Z–2.500 means that dimensional deviations up to a maximum of 2.5 mm will be compensated for.

H10 Zero compensation range.
If the dimensional deviation is within the zero compensation range, no data transfer to the respective table is effected.
This zero compensation range takes effect only if no zero compensation range is entered when the dimensional deviation transfer function is called up.
H10 Z 0.005 means that dimensional deviations of ±5 increments will not be compensated for.

Tool gauging

H11 Selection of the longitudinal axis.
For tool gauging, the axis number of the longitudinal axis must be stored here. The sign specifies the direction of approach.
H11 Z–003.000 defines that the 3rd axis (usually the Z-axis) will be used as the longitudinal axis. The approach will be made in negative direction.

H12 Position in the longitudinal axis of the probe permanently installed on the machine.
Exact qualification of this position is not required because this is done in the qualifying cycle.

H13 Selection of a positioning axis for contacting in the longitudinal axis.
To permit contacting in the longitudinal axis, an additional axis is defined here, which must first be moved to a fixed machine position.
H13 Z 1.000 means that the 1st axis (usually the X-axis) is positioned before the measuring cycle is run.
H13 Z0 means that no axis positioning is required.

H14 Fixed machine position of the axis as defined under H13.
If this position lies beyond the input format of ±3.3, the input range in the machine parameter program must be changed.

H15 Selection of an additional positioning axis for contacting in the longitudinal axis (same as H13).

H16 Fixed machine position of the axis as defined under H15 (see H14).

H17 Selection of the radial axis.
Similar to H11, except that here the axis is defined for gauging the tool radius.

H18 Position in the radial axis of the probe permanently installed on the machine.

H19 Selection of the 1st positioning axis for radius gauging (same as H13, but for radius gauging).

H20 Fixed machine position of the axis as defined under H19.

H21 Selection of the 2nd positioning axis for radius gauging (similar to H19).

H22 Fixed machine position of the axis as defined under H21.

Workpiece measuring

H32 Probe length for contacting in the plane

H33 Qualified probe length for contacting in the longitudinal axis

D1 Positional deviation of the probe in the plane (1st axis)

D2 Positional deviation of the probe in the plane (2nd axis)

D3 Lobing with positive approach direction in the 1st axis

D4 Lobing with negative approach direction in the 1st axis

D5 Lobing with positive approach direction in the 2nd axis

D6 Lobing with negative approach direction in the 2nd axis

D7 Minimum probe length

D8 Maximum probe length

D9 Not assigned

D10 Not assigned

Probe qualification using a reference bore

D11 Definition of the longitudinal axis

D12 Position in the longitudinal axis (D11) to enable bore contacting

D13 Definition of the 1st axis for contacting inside the bore

D14 Exact center point position of the reference bore in the 1st axis (D13)

D15 Definition of the 2nd axis for contacting inside the bore

D16 Exact center point position of the reference bore in the 2nd axis (D15)

D17 Exact diameter of the reference bore

D18 Not assigned

D19 Not assigned

Probe qualification in the longitudinal axis

D20 Definition of the longitudinal axis (see H11)

D21 Exact position of the reference surface for contacting in the longitudinal axis

D22 Definition of the 1st positioning axis for contacting in the longitudinal axis

D23 Positioning the axis as defined under D22

D24 Definition of the 2nd positioning axis for contacting in the longitudinal axis

D25 Position relative to the axis as defined under D24

Probe qualification using a reference surface – probe with variable spindle positioning

D30 Definition of the longitudinal axis. If D30 is defined with a negative sign, this axis will not be moved when qualifying program P999999921 is run.

D31 Position of the longitudinal axis (D30) to enable contacting the reference surface in the active plane.

D32 Definition of the measuring axis, including approach direction (e.g., 1 signifies that the 1st axis is moved in positive direction towards the reference surface).

D33 Exact position in the measuring axis of the reference surface to be contacted.

D34 Definition of an additional axis to be positioned before the reference surface can be contacted.

D35 Position of D34

D36 Probe lobing determined for contacting in the plane. It is assumed that the S0 spindle position is set in contacting direction.

D37 Definition of direction of spindle rotation.
The S0 spindle position must always point in contacting direction for measuring.

Example:

With G17 as the active plane, the 1st axis is the principal axis (X) and the 2nd axis is the secondary axis (Y).
When approaching in +X direction, the spindle is set at zero degrees. For the probe to be deflected in the same direction in the Y-axis, the spindle must be rotated through +90 degrees or –90 degrees. Depending on the direction of rotation, the value to be stored under D37 must be +1 or –1, respectively.

D38 Measuring a bore with program P999999923.
For measuring a bore, the approach direction for the 1st point to be taken can be defined relative to the principal axis.

D39 Measuring a cylinder with program P999999924
Angle setting as described for D38.

6 Required storage space

Tool gauging		Storage space in bytes
P999999901	Probe qualification with a standard tool	3768
P999999902	Tool length gauging	2185
P999999903	Tool radius gauging	2014

Workpiece measurement without variable spindle positioning		Storage space in bytes
P999999911	Probe qualification in a reference bore	3566
P999999912	Probe qualification in a longitudinal axis	2408
P999999913	Measuring a bore	3874
P999999914	Measuring a cylinder	3865
P999999915	Measuring a slot	2958
P999999916	Measuring a key	2807
P999999917	Single-point measuring	3659
P999999918	Two-point measuring	3415

Workpiece measurement with variable spindle positioning		Storage space in bytes
P999999921	Probe qualification with a reference surface	2589
P999999922	Probe qualification in the longitudinal axis	2481
P999999923	Measuring a bore (three-point measuring)	5793
P999999924	Measuring a cylinder (three-point measuring)	5655
P999999925	Measuring a slot	3817
P999999926	Measuring a key	3833
P999999927	Single-point measuring	5646
P999999928	Two-point measuring	3911

Your notes:

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