RENISHAW
apply innovation™

Inspection cycles for Mazak machining centres when using an L-shaped stylus

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EQUIPMENT REGISTRATION RECORD

Please complete this form (and Form 2 overleaf if applicable) after the Renishaw equipment has been installed on your machine. Keep one copy yourself and return a copy to your local Renishaw office (for contact details, see **www.renishaw.com/contact**). The Renishaw installation engineer should normally complete these forms.

MACHINE DETAILS

Machine description .....

Machine type .....

Controller .....

Special control options .....

.....

.....

.....

RENISHAW HARDWARE	**RENISHAW SOFTWARE**
Inspection probe type	Inspection software media .....
Interface type	.....
	.....
Tool setting probe type	Tool setting software media.....
Interface type	.....
	.....

SPECIAL SWITCHING M-CODES (OR OTHER) WHERE APPLICABLE

	Dual systems only
Switch (Spin) probe on	Switch on inspection probe .....
Switch (Spin) probe off	Switch on tool setting probe .....
Start/Error signal	Other .....
	.....

ADDITIONAL INFORMATION

☐ Tick box if Form 2 overleaf has been filled in.

Customer's name	
Customer's address	Date installed .....
.....	
.....	Installation engineer .....
.....	
Customer's tel. no	Date of training .....
Customer's contact name	

Form 2

SOFTWARE DEVIATION RECORD

Standard Renishaw kit no.	Software media nos.
Reason for deviation	
Software no. and subroutine no.	Comments and corrections

A copy of this deviation sheet will be retained by Renishaw plc.

A copy of the software amendments must be retained by the customer – they cannot be retained by Renishaw plc.

Caution – Software safety

The software you have purchased is used to control the movements of a machine tool. It has been designed to cause the machine to operate in a specified manner under operator control and has been configured for a particular combination of machine tool hardware and controller.

Renishaw has no control over the exact program configuration of the controller with which the software is to be used, nor over the mechanical layout of the machine. Therefore, it is the responsibility of the person putting the software into operation to:

- ensure that all machine safety guards are in position and are correctly working before commencement of operation.
- ensure that any manual overrides are disabled before commencement of operation.
- verify that the program steps invoked by this software are compatible with the controller for which they are intended.
- ensure that any moves which the machine will be instructed to make under program control would not cause the machine to inflict damage upon itself or upon any person in the vicinity.
- be thoroughly familiar with the machine tool and its controller, understand the operation of work co-ordinate systems, tool offsets, program communication (uploading and downloading) and the location of all emergency stop switches.

IMPORTANT: This software makes use of controller variables in its operation. During its execution, adjustment of these variables, including those listed within this manual, or of tool offsets and work offsets, may lead to malfunction. Ensure that all variable and program numbers required and/or used by the Renishaw system are not used by any other function or software package already installed on the CNC machine tool.

Example code format

For clarity, code examples contained within this document are shown with spaces separating each input of the program call. In practice, it is not a requirement that these spaces be included.

For example, the following code:

G65 P9411 X50. E21. F0.8 H0.2 M0.2 Q10. S1. T20. U0.5 V0.5 W1.

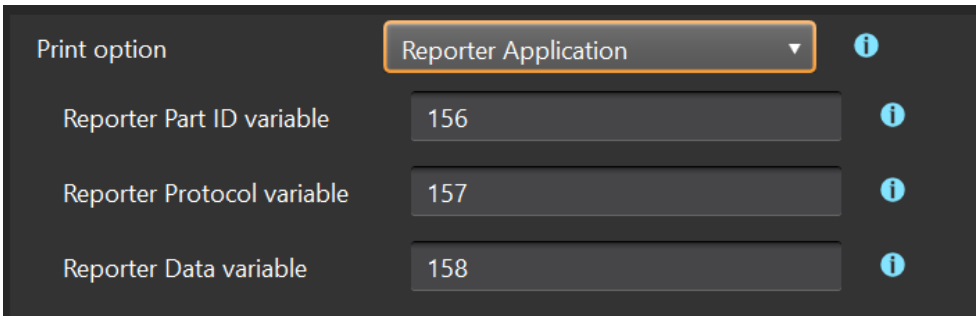
may be entered as:

G65P9411X50.E21.F0.8H0.2M0.2Q10.S1.T20.U0.5V0.5W1.

NOTE: All code examples are shown with input data followed by a decimal point. Some controllers may operate correctly with these decimal points omitted; however, care should be taken to determine that this is the case before running any programs.

Reporter

There is a Reporter option in the installation wizard which can be used to display trends of component measurement. (Reporter app v3.3 or later is required.)



This option requires the Reporter app (A-5999-4300) to be installed and connected to the machine tool to receive measured data. If the option is selected and the Reporter app is not connected, the measuring program will continue to run. (See “Reporter Print” in Chapter 13, “General information”, for further information.)

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Appendix A Features, cycles and limitations of the inspection software

Intended use

The software is only intended for use with Renishaw touch-trigger probes using an L-shaped stylus. Use of the software with non-Renishaw probes is not supported. This software is for use with Mazak SMOOTH and MATRIX controllers.

About the Renishaw inspection software

The Renishaw inspection software described in this manual is for use on Mazak machining centres.

For a comprehensive description of the features provided by the software, as well as the limitations of the software, see Appendix A, “Features, cycles and limitations of the inspection software”.

About this manual

This programming manual contains detailed information about how to use the Renishaw inspection software, when using a stylus positioned at right angles to the probe, to program, operate and control your machine tool.

Comprising 13 self-contained chapters and one appendix, the manual is structured to provide the information that you require to use the inspection software effectively.

- Chapter 1, “Installing the software”, describes how to install and customise the inspection software on your machine.
- Chapter 2, “Optional inputs”, describes the optional inputs that are available with some of the cycles.
- Chapter 3, “Cycle outputs”, provides a complete list of the outputs that are produced by some of the cycles.
- Chapter 4, “Probe start and probe stop cycles”, describes the cycles used to switch the probe on and off.
- Chapter 5, “Calibrating the probe in X”, explains why a probe stylus must be calibrated before you start using it, then describes how to use the cycles that are provided for calibrating a probe.
- Chapter 6, “Protected positioning cycle for probes parallel to the X axis”, describes how to use the protected positioning cycle. When used correctly, this cycle prevents damage to the probe stylus if the probe collides with the workpiece.
- Chapter 7, “X-axis measuring cycles”, describes how to use the measuring cycles in the X axis.
- Chapter 8, “Calibrating the probe in Y”, explains why a probe stylus must be calibrated before you start using it, then describes how to use the cycles that are provided for calibrating a probe.

- Chapter 9, “Protected positioning cycle for probes parallel to the Y axis”, describes how to use the protected positioning cycle. When used correctly, this cycle prevents damage to the probe stylus if the probe collides with the workpiece.
- Chapter 10, “Y-axis measuring cycles”, describes how to use the measuring cycles in the Y axis.
- Chapter 11, “Alarms and error messages”, describes the cycle alarm numbers and messages that may be displayed on the screen of the machine tool controller when an error occurs. An explanation of the meaning and possible cause of each alarm message is provided, together with typical actions you must take to correct the fault causing the message.
- Chapter 12, “Configuration”, describes setting information and details about the variables used in the inspection software.
- Chapter 13, “General information”, contains general information and reference material that is relevant to the inspection software package.

Measurement values used in this manual

Throughout this manual, metric units of measurement (for example, millimetres) are used in the examples. Where appropriate, the equivalent imperial values (for example, inches) are shown in brackets.

Associated publication

When you are using the inspection software, you may find it useful to refer to the following Renishaw publication if it has been provided with the software package.

- Installation manual *Probe systems for machine tools* (Renishaw part no. H-2000-6040).

Software kit part no. A-4013-2006

The kit comprises the following item:

- Software media assembly: part no. A-4013-2007.

The software media contains the following files and folders:

\Readme.txt	This is an information file.
\Macros\<files>	This folder contains various source files.
\Documentation\<files>	This folder contains software documentation.

Memory requirements

Establish how much free program memory is available on the machine controller. This must be considered when deciding which cycles to load.

Using the installation wizard to issue the software

After you have selected the cycles you wish to use, press “Run”. A message will appear showing the amount of memory that will be required in kilobytes (KB). If this is too big, press “Cancel” and modify your cycle selections, or increase the memory available on the machine.

Machine parameter settings

Be aware that this software requires certain machine parameters to be set. See “Machine parameter settings” in Chapter 12, “Configuration”.

Use of inch/mm units

CAUTION: It is a feature of this software that all unit-dependent probe data is stored in metric (mm) units, regardless of the current machine units. When this data is read, it is converted as required to suit the active machine units. This differs from previous versions of the inspection software.

Renishaw customer services

Calling Renishaw

If you have a question about the software, first consult the documentation and other information included with your product.

If you cannot find a solution, you can receive information on how to obtain customer support by contacting the Renishaw company that serves your country (for worldwide contact details, see **www.renishaw.com/contact**).

When you call, it will help the Renishaw support staff if you have the appropriate product documentation at hand. Please be prepared to give the following information (as applicable):

- The software version you are using (see the Equipment registration record form).

  TIP: The software part number and version number are commented at the top of the settings program (O9524).

- The type of hardware that you are using (see the Equipment registration record form).
- The error number and wording of any message that appears on your screen.
- A description of what happened and what you were doing when the problem occurred.
- A description of how you tried to solve the problem.

Chapter 1

Installing the software

This chapter describes how to load the inspection software.

Contained in this chapter

Installing the software

It is important that this software is installed correctly. This means selecting the appropriate cycles and configuring them to run properly on the machine controller – further on-machine customisation may be required afterwards. To complete the task, it will then be necessary to run the calibration cycles to set the calibration data for the probe on the machine.

1. First, refer to Appendix A, “Features, cycles and limitations of the inspection software”, to determine whether the software is suitable for your needs. Also familiarise yourself with Chapter 12, “Configuration”.

2. Use this manual to select the correct programs required for the application and load these directly on to the machine controller.

Using the Installation wizard

Follow the installation wizard and input all data that is required. Doing this correctly will configure the macros for the desired machine specification. Help on using the installation wizard can be found by clicking on the information mark next to each data input.

Manual installation of the software

All cycles can be found on the software media in the macros folder. Either load the whole suite of cycles or choose a suitable subset of cycles:

Category	Cycles	Notes
Basic programs and cycles for use when using a stylus positioned parallel to the Y axis	O9200, O9221, O9222, O9226, O9227, O9402, O9403, O9404, O9406, O9524, O9531, O9532, O9533, O9632, O9633, O9730, O9735	These must always be loaded when using a stylus positioned parallel to the Y axis.
Basic programs and cycles for use when using a stylus positioned parallel to the X axis	O9200, O9521, O9522, O9524, O9526, O9527, O9730, O9531, O9532, O9533, O9602, O9603, O9604, O9606, O9632, O9633, O9735	These must always be loaded when using a stylus positioned parallel to the X axis.
Y-axis cycles and programs.	O9410, O9411, O9412, O9414	These can be added as required.
X-axis cycles and programs.	O9610, O9611, O9612, O9614	These can be added as required.

Manual configuration of the software

Useful information can be found in Chapter 12, “Configuration”, including details of general software settings, customising the software and variable details. Also, see Chapter 4, “Probe start and probe stop commands”, for help setting up multiple stylus directions or multiple probes.

Chapter 2

Optional inputs

Many of the cycles make use of standard optional inputs. Instead of describing them each time they are available, they are described once in this chapter. You will be referred to this chapter from other chapters whenever a standard optional input is available.

Details of each *non-standard* optional input that is available in a cycle is provided in the relevant cycle description.

Contained in this chapter

Optional inputs

The examples described below assume that the machine controller has been configured for metric values (millimetres). The equivalent imperial (inch) values are shown in brackets.

Ee e = Experience value.

Specify the number of a spare tool offset where an adjustment value to the measured size is stored (see Chapter 13, “General information”).

Example: E21. causes the experience value stored in tool offset 21 to be applied to the measured size.

Ff f = This can be either one of the following:

1. The percentage feedback that is used when updating a tool offset (see Chapter 13, “General information”).

   Enter a value between 0 and 1 (0% and 100%).

   Default value: 1 (100%).

2. The feedrate that is used in the protected positioning cycle (O9610 or O9410) (see Chapter 6, “Protected positioning cycle for probes parallel to the X axis” and Chapter 9, “Protected positioning cycle for probes parallel to the Y axis”).

   Example: F15. sets a feedrate of 15 mm/min.
   (F0.6 sets a feedrate of 0.6 in/min.)

Hh h = The tolerance value of a feature dimension being measured (see Chapter 13, “General information”).

Example: For a dimension of 50 mm +0.4 mm −0 mm, the nominal tolerance is 50.2 mm with H0.2.
(For a dimension of 1.968 in +0.016 in −0 in, the nominal tolerance is 1.976 in with H0.008.)

Mm m = The true position tolerance of a feature. This is a cylindrical zone about the theoretical position (see Chapter 13, “General information”).

Example: M0.1 sets a true position tolerance of 0.1 mm.
(M0.004 sets a true position tolerance of 0.004 in.)

Qq q = The probe overtravel distance for use when the default values are unsuitable. The probe will then travel beyond the expected position when it searches for a surface.

Default values: 4 mm (0.16 in) in the Z axis and 10 mm (0.394 in) in the X and Y axes.

Example: Q8. sets an overtravel distance of 8 mm.
(Q0.3 sets an overtravel distance of 0.3 in.)

Rr r = This is an incremental dimension that is used in external features, such as bosses and webs, to give a radial clearance from the nominal target surface prior to a Z-axis move.

Default value: 5 mm (0.200 in).

Example: R10. sets a radial clearance of 10 mm.
(R0.4 sets a radial clearance of 0.4 in.)

R−r −r = This is similar to Rr, except that the clearance is applied in the opposite direction to force an internal boss or web cycle.

Default value: −5 mm (−0.2 in).

Example: R−10. sets a radial clearance of −10 mm.
(R−0.4 sets a radial clearance of −0.4 in.)

Ss s = The number of the work offset to be updated.

S0 or S53	The external work offset.
S1 to S6 or S54 to S59	G54 to G59.
S7	Active WPC (Mazatrol program).
S101 to S400	G54.1 P1 to G54.1 P300 (additional offsets option).
S1001 to S1007	G54.4 P1 to G54.4 P7 option

Examples: S148 (G54.1 P48)
S248 (G54.1 P148)

New work offset = active work offset + error.
New external work offset = external work offset + error.

Tt t = The number of the tool offset to be updated.

Mazatrol tool data suffix code

A suffix code is a letter that can be used to help identify the tool in the Mazatrol tool data table. Each suffix code has a numeric value registered to it:

Normal tools:

Suffix	A	B	C	D	E	F	G	H	J	K	L	M
	1	2	3	4	5	6	7	8	9	11	12	13
Suffix	N	P	Q	R	S	T	U	V	W	X	Y	Z
	14	15	16	17	18	19	21	22	23	24	25	26

Heavy tools:

Suffix	A	B	C	D	E	F	G	H	J	K	L	M
	61	62	63	64	65	66	67	68	69	71	72	73
Suffix	N	P	Q	R	S	T	U	V	W	X	Y	Z
	74	75	76	77	78	79	81	82	83	84	85	86

NOTE: #120 must be set to 1 in macro O9524 for use with Mazatrol tool data.

Examples:

Without a suffix
T10. Update tool offset 10.

With a suffix
T10.02 Update tool offset 10B.

To update a ‘heavy’ tool, add 0.6 to the suffix code number.

Example:

T10.62 Update heavy tool offset 10B.

Uu u = Upper tolerance limit.

If this value is exceeded, no tool offset is updated, and the cycle stops with an alarm. Where applicable, this tolerance applies to both size and position (see Chapter 13, “General information”).

Example: U2. to set the upper tolerance limit to 2 mm.
(U0.08 to set the upper tolerance limit to 0.08 in.)

Vv v = Null band.
This is the tolerance zone in which no tool offset adjustment occurs.

Default value: 0

Example: V0.5 for a tolerance zone of ±0.5 mm.
(V0.02 for a tolerance zone of ±0.02 in.)

Ww w = Print the output data.

W1. = Print flag. This must be used to open the port (POPEN) ready for printing data, but only if subsequent measuring cycles use the print results (Ww) input. This input is used in conjunction with the probe stop cycle (O9633) with the W1. input. In the main level program, assign a value to #156 to print out a component number.

W1.1 = Reporter printing. This requires Reporter app (A-5999-4300) to be installed on the machine. Refer to installation and user guide *Reporter for Mazak* (Renishaw part no.H-5999-8710) for information on this product and how to use the report function. In the main level program, assign a value to #156 to print out a component number.

W2. = Increment the component number and reset the feature number.

Chapter 3

Cycle outputs

This chapter lists the variable outputs that are produced by some of the cycles. You will be referred to this chapter from other chapters when a cycle output is produced.

Contained in this chapter

Cycle outputs

	Single surface in Y	Single surface in X	Web/pocket in Y	Web/ pocket in X	Bore/boss in Y	Bore/boss in X
	G65 P9411	G65 P9611	G65 P9412	G65 P9612	G65 P9414	G65 P9614
#135	X position	X position	X position		X position	
#136	Y position	Y position		Y position		Y position
#137	Z position	Z position	Z position	Z position	Z position	Z position
#138	Size	Size	Size	Size	Size	Size
#139						
#140	X error	X error	X error		X error	
#141	Y error	Y error		Y error		Y error
#142	Z error	Z error	Z error	Z error	Z error	Z error
#143	Size error	Size error	Size error	Size error	Size error	Size error
#144						
#145	True position error	True position error	True position error	True position error	True position error	True position error
#146	Metal condition	Metal condition	Metal condition	Metal condition	Metal condition	Metal condition
#147	Direction indicator	Direction indicator				
#148	Out of tolerance flag (1 to 7)					
#149	Probe error flag (0 to 2)					

Chapter 4

Probe start and probe stop cycles

This chapter describes the cycles used to switch the probe on and off.

Contained in this chapter

Probe start (O9632)

Description

This cycle is used to switch the probe ON, load the relevant calibration data for different probe orientations and open a print port in readiness for printing results in subsequent measuring cycles. Multi probing is supported with this kit (see Example 2 and Example 3 below). If you have manually added another probe, ensure the probe on/off codes have been added into O9632/O9633.

CAUTION: It is compulsory to call in the correct H offset for the stylus prior to running this cycle if using the machine in any ISO tool data mode. If using Mazatrol tool data the tool information will be loaded automatically, so the G43 line can be removed. This cycle must then be run prior to using the probe.

NOTE: If using multiple styli on different probes, macros need to be set for this manually as the installation wizard does not support this.

Application

The probe must be loaded into the spindle and moved to a safe start plane before running this cycle. It will activate the probe and select the operational modes for subsequent cycles to use.

Format

G65 P9632 Dd. [Ww.]

where [ ] denote optional inputs.

Example: G65 P9632 D1. W1.

Compulsory input

Dd d = Direction flag when using Mazatrol tool data.

D1 = X+
D−1 = X−
D2 = Y+
D−2 = Y−

Optional input

Ww w = Print the output data.

W1. Print flag. This must be used to open the port (POPEN) ready for printing data, but only if subsequent measuring cycles use the print results (Ww) input. This input is used in conjunction with the probe stop cycle (O9633) with the W1. input.

W1.1 Reporter printing. This requires Reporter app (A-5999-4300) to be installed on the machine. Refer to installation and user guide *Reporter for Mazak* (Renishaw part no.H-5999-8710) for information on this product and how to use the report function.

Example 1

G43 H20 Z100.	Apply a tool offset and move to a safe plane. (This line can be removed if using Mazatrol tool data.)
G65 P9632 D1.	Switch the probe on. Use a D value if using Mazatrol tool data.
G65 P9610 X—. Y—. F—.	Move to a gauging position.

Example 2: Using multiple styli on the same probe

T001.01 T0 M6	Call the probe stylus into the spindle.
G43 H1 Z100.	Apply the first tool offset and move to a safe plane. (This line can be removed if using Mazatrol tool data.)
G65 P9632 D2.	Switch the probe on and orientate to the Y+ direction.
G65 P9410 X50. F500.	Protected positioning move.
continue measuring cycle.	
G91 G28 Z0.	Return to the home position.
G90	
T001.02 T0 M6	Call the second stylus offset.
G43 H2 Z100.	Apply the second tool offset and move to a safe plane. (This line can be removed if using Mazatrol tool data.)
G65 P9632 D−2.	Switch the probe on and orientate to the Y− direction.
G65 P9410 X50. F500.	Protected positioning move.
continue measuring cycle.	
G65 P9633	Switch the probe off.

G91 G28 Z0.	Return to the home position.
G90	
M30	End of program.

Example 3: Using multiple styli on different probes

T20 T0 M6	Call the first probe into the spindle.
G43 H20 Z100.	Apply the first tool offset and move to a safe plane. (This line can be removed if using Mazatrol tool data.)
G65 P9632 D2.	Switch the probe on and orientate to the Y+ direction.
G65 P9410 X50. F500.	Protected positioning move.
continue measuring cycle.	
G91 G28 Z0.	Return to the home position.
G90	
G65 P9633	Switch the probe off.
T40 T0 M6	Call the second probe into the spindle.
G43 H40 Z100.	Apply the second tool offset and move to a safe plane. (This line can be removed if using Mazatrol tool data.)
G65 P9632 D−2.	Switch the probe on and orientate to the Y− direction.
G65 P9410 X50. F500.	Protected positioning move.
continue measuring cycle.	
G65 P9633	Switch the probe off.
G91 G28 Z0.	Return to the home position.
G90	
M30	End of program.

Probe stop (O9633)

Description

This cycle is used to switch the probe OFF. There is an optional input that can be used to close the port after printing results during previous measuring cycles.

Application

The probe should be retracted to a safe plane before using this cycle. It will stop the probe and optionally close the print port.

Format

G65 P9633 [Ww]

where [ ] denote optional inputs.

Example: G65 P9633 W1.

Optional inputs

Ww w = Print the output data.

W1.= Print flag. This is used to close the port (PCLOS) after printing data is completed. This input is used in conjunction with the probe start cycle (O9632) with the W1. input.

W1.1 Reporter printing. This requires Reporter app (A-5999-4300) to be installed on the machine. Refer to installation and user guide *Reporter for Mazak* (Renishaw part no.H-5999-8710) for information on this product and how to use the report function.

Example

In the example, with a probe tool offset active, the probe is retracted to a safe start plane before it is switched off prior to a tool change.

G65 P9410 Z100.	Retract to a safe plane with the tool offset still active.
G65 P9633 W1.	Switch the probe off and close printing.
G91	
G28 Z0.	Retract.
G90	
continue	

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Chapter 5

Calibrating the probe in X

Before a probe is used, it must be calibrated correctly. This chapter explains why it is so important that the probe is calibrated and then describes how to use the macros to calibrate the probe.

Contained in this chapter

Why calibrate a probe?

When you fit your probe into the machine shank/holder, it is not necessary for the probe stylus to run true to the spindle centre line. A small amount of run-out can be tolerated, but it is good practice to get the stylus mechanically on-centre to reduce the effects of spindle and tool orientation errors. Without calibration of the probe, run-out will lead to inaccurate results. By calibrating the probe, the positional error is automatically accounted for. The calibration cycle macro O9602 provides the data to allow for this run-out when the stylus is parallel to the X axis.

As each Renishaw probe is unique, it is important that you calibrate it in the following circumstances:

- When your probe system is to be used for the first time.
- When a new stylus is fitted to your probe.
- When it is suspected that the stylus has become distorted or that the probe has crashed.
- At regular intervals to compensate for mechanical changes of your machine tool.
- If repeatability of relocation of the probe shank is poor. In this case, the probe may need to be recalibrated each time it is selected.

Three different operations are used to calibrate a probe. They are:

- Calibrating the stylus offset.
- Calibrating the stylus radius.
- Calibrating the probe length.

Calibrating the stylus offset

Calibrating the probe on a diameter with a known position automatically stores values for the offset of the stylus ball to the spindle centre line. The stored values are then automatically used in the measuring cycles. Measured values are compensated by these values so that they are relative to the true spindle centre line.

Calibrating the stylus radius

Calibrating the probe on a known diameter automatically stores values for the radius of the stylus ball. These stored values are then automatically used by the measuring cycles to give the true size of the feature. The values are also used to give true positions of single surface features.

NOTE: The stored radius values are based on the true electronic trigger points. These values are different from the physical sizes.

Setting up the probe stylus

It is important that the probe stylus is set up when the spindle is in its orientated position. This is because the macros call for a spindle orientation and, if required, the spindle will orientate to the required direction for probing. If using multiple styli or a single stylus only used for one direction, the spindle will orientate to 0° and probe in the direction specified.

If using a single probe in multiple locations, the stylus direction needs to be initially set in the X+ direction when the spindle is orientated. This is so that the macros call the spindle orientation to the direction required. If using the installation wizard, it is possible to change the orientation the stylus was set in. This will change the orientation code accordingly so that each spindle orientation is to the correct angle.

If using the installation wizard, the wizard will configure the macros to the specified settings. If installing the macros manually, and a spindle orientation to 90°, 180° or 270° is not required, change all the occurrences of M19S90, M19S180 and M19S270 to M19S0 in 09632.

Calibrating the probe length

Calibrating a probe on a known reference surface determines the length, based on the electronic trigger point. This stored value for length is different from the physical length of the probe assembly. The cycle accurately calculates two length values – one is stored in the tool offset and is controlled by the Tt input, the other is stored in #[#112+5] and represents the distance between the spindle centre line and the end of the stylus (nominally Aa).

Full calibration using a sphere (O9606)

The following cycle provides a complete calibration solution, calculating the probe length, the radius of the stylus ball and the stylus offset. This is the recommended way to calibrate the probe.

NOTE: Before running this cycle, refer to “Editing the probe start cycle O9632” in Chapter 12, Configuration”.

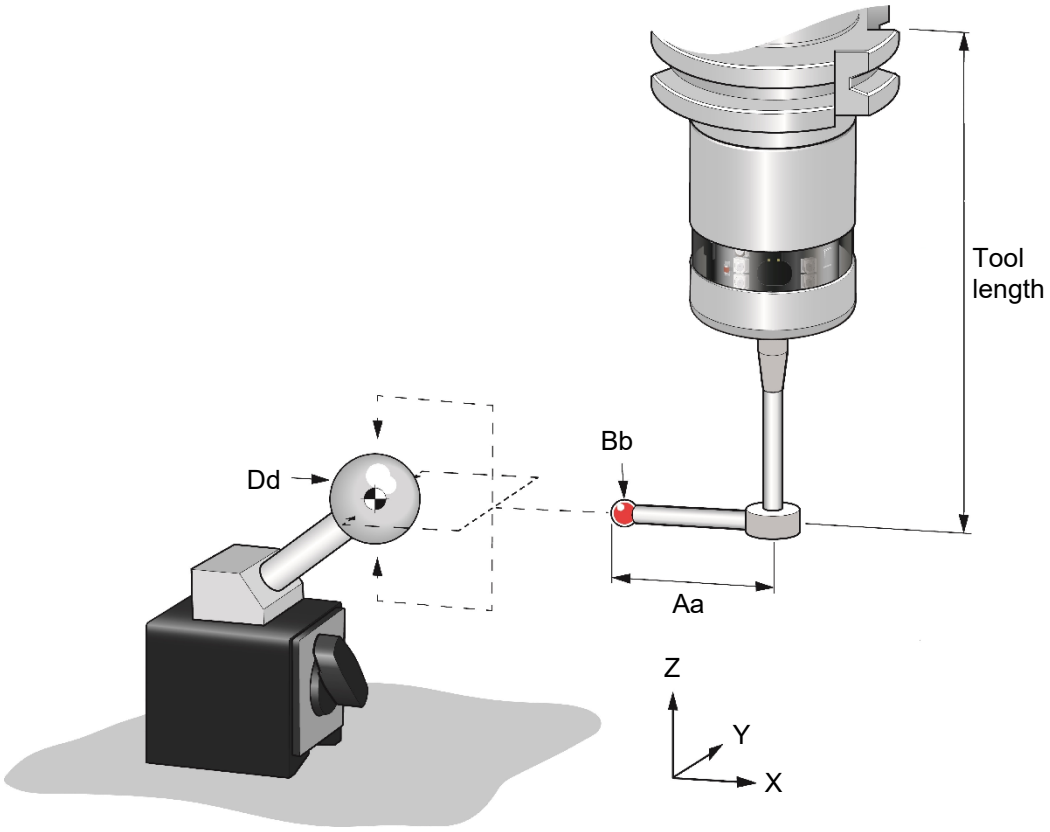

Figure 5.1 Calibrating the probe on a calibration sphere

Application

Fix the calibration sphere in the desired location and set the XYZ work offset to the exact centre of the sphere. Typically, this is achieved using a calibrated length bar or a tool of known length.

NOTE: Set the centre line of the spindle as the X and Y zero, not the centre of the L-shaped stylus ball.

Enter the approximate tool length into the appropriate tool offset.

Format

G65 P9606 Aa Bb Dd [Qq Rr Tt]

where [ ] denote optional inputs.

Example: G65 P9606 A60. B6. D25. Q10. R15. T1.

Compulsory inputs

Aa	a =	The nominal length of the stylus.
Bb	b =	The nominal diameter of the stylus ball.
Dd	d =	The nominal diameter of the calibration artefact.

Optional inputs

Qq	q =	The probe overtravel. **Default value:** 10 mm (0.394 in)
Rr	r =	The radial clearance. **Default value:** 6 mm (0.236 in)
Tt	t =	The tool offset number to be updated. If there is no T input, the cycle updates the Z stylus offset. **Default value:** The active T number

Outputs

The following data is stored:

#[#112]	Z+, Z−, stylus ball radius (ZRAD)
#[#112+1]	Y+, Y−, stylus ball radius(YRAD)
#[#112+2]	Z stylus offset
#[#112+3]	Y stylus offset
#[#112+4]	Back-off factor
#[#112+5]	Stylus crank length

Data storage locations depend on the base number selected for the probe (set in O9632).

Example: Full stylus calibration

A tool offset must be active before running program O9606.

O0003	
G90 G80 G40	Preparatory codes for the machine.
T1T0 M6	Select the probe.
G91 G28 Z0. X0.	Send the tool to the home position.
G43 Z100. H1	Apply the tool offset. (This line can be removed if using Mazatrol tool data.)
G65 P9632 D1.	Switch the probe on.
G0 G90 G54 X−80. Y0.	Start position, clear of the sphere with no stylus length offset applied, assuming a stylus length (Aa) of 60 mm and a sphere diameter (Dd) of 19 mm.
G65 P9606 A60. B6. D19. T1.	Run the full calibration cycle. Update offsets for tool 1.
G65 P9610 Z50. F5000.	Protected positioning move to a safe position.
G0 G91 G28 Z0.	Send the machine home in Z.
G90	Set the machine back to absolute programming.
G65 P9633	Switch the probe off.
M30	

NOTE: When the cycle finishes, the spindle will return to its start point, unless probe length calibration takes place. In this case, it will return to the start point height above its final touch.

Calibration of multiple styli

If using multiple styli, both probe stylus tips will need to be calibrated separately. This example will be using a stylus in the X+ and the X− direction. Please ensure the correct settings have been set when using the installation wizard or, if setting manually, follow the instructions in Chapter 12, “Configuration”, to ensure the macros are prepared for multiple styli.

Application

Fix two calibration spheres in the desired location and set the XYZ work offset to the exact centre of the spheres. Typically, this is achieved using a calibrated length bar or a tool of known length. Use different work offsets for each calibration sphere, for example, set the first calibration sphere as G54 and the second as G55.

NOTE: Set the centre line of the spindle axis as the X0Y0, not the centre of the L-shaped stylus ball. The Z height should be set to the centre of the probe stylus sphere.

Enter the approximate tool length into the appropriate tool offset for each stylus.

Format

G65 P9606 Aa Bb Dd [Qq Rr Tt]

where [ ] denote optional inputs.

Example: G65 P9606 A60. B6. D25. Q10. R15. T1.

Example 1: Full stylus calibration using multiple styli

A tool offset must be active before running program O9606.

O0003

G90 G80 G40	Preparatory codes for the machine.
T001T0 M6	Select the first probe. (If using Mazatrol, include the suffix number for the tool if required.).
G91 G28 Z0. X0. Y0.	Send the tool to the home position.
G43 H1 Z100.	Select the first height offset if using ISO tooling. (This line can be removed if using Mazatrol tool data.)
G65 P9632 D1.	Switch the probe on for the first orientation.
G0 G90 G54 X−80. Y0.	Start position clear of the first sphere, assuming a stylus length (Aa) of 60 mm and a sphere diameter (Dd) of 19 mm.

G65 P9610 Z0. F3000	Protected positioning move to the sphere centre.
G65 P9606 A60. B6. D19. T01	Run the full calibration cycle and update the probe length offset.
G65 P9610 Z50. F5000.	Protected positioning move to a safe position.
G0 G91 G28 Z0.	Send the machine home in Z.
G90	Set the machine back to absolute programming.
G65 P9633	Switch the probe off.
G91 G28 Z0. X0.	Send the tool to the home position.
G90	Set the machine back to absolute programming.
G43 H2 Z100.	Select second height offset using ISO tooling. (This line can be removed if using Mazatrol tool data.)
G65 P9632 D−1.	Switch the probe on for the second orientation.
G0 G90 G55 X80. Y0.	Start position clear of the second sphere, assuming a stylus length (Aa) of 60 mm and a sphere diameter (Dd) of 19 mm.
G65 P9610 Z0. F3000	Protected positioning move to the sphere centre.
G65 P9606 A60. B6. D19.	Run the full calibration cycle. The tool length does not need to be updated if you are using one stylus in multiple directions.
G65 P9610 Z50. F5000.	Protected positioning move to a safe position.
G0 G91 G28 Z0.	Send the machine home in Z.
G90	Set the machine back to absolute programming.
G65 P9633	Switch the probe off.
M30	

Example 2: Full stylus calibration using one stylus in multiple directions

A tool offset must be active before running program O9606. This method will only work when using Mazatrol Tool Data, not with ISO tooling. The set-up method is the same as for multiple styli. Use different work offsets for each calibration sphere, for example, set the first calibration sphere as G54 and the second as G55.This will require using the wizard to set up the macros.

O0003

G90 G80 G40	Preparatory codes for the machine.
T01T0 M6	Select the first probe (If using Mazatrol, include the suffix number for the tool. For ISO tooling, just put the tool number.)
G91 G28 Z0. X0. Y0.	Send the tool to the home position.
G65 P9632 D1.	Switch the probe on. This orientates the probe stylus to the X+ position.
G0 G90 G54 X−80. Y0.	Start position clear of the first sphere, assuming a stylus length (Aa) of 60 mm and a sphere diameter (Dd) of 19 mm.
G65 P9610 Z0. F3000	Protected positioning move to the sphere centre.
G65 P9606 A60. B3. D19. T01.	Run the full calibration cycle on a 19 mm diameter calibration sphere with a 6 mm stylus tip and update the probe length offset.
G65 P9610 Z50. F5000.	Protected positioning move to a safe position.
G0 G91 G28 Z0.	Send the machine home in Z.
G90	Set the machine back to absolute programming.
G65 P9633	Switch the probe off.
G91 G28 Z0. X0.	Send the tool to the home position.
G90	Set the machine back to absolute programming.
G65 P9632 D−1.	Switch the probe on. This orientates the probe stylus to the X position.
G0 G90 G55 X80. Y0.	Start position clear of the second sphere, assuming a stylus length (Aa) of 60 mm and a sphere diameter (Dd) of 19 mm.

G65 P9610 Z0. F3000	Protected positioning move to the sphere centre.
G65 P9606 A60. B6. D19.	Run the full calibration cycle on a 19 mm diameter calibration sphere (Dd) with a 6 mm stylus tip (Bb) and a stylus length (Aa) of 60 mm.
G65 P9610 Z50. F5000.	Protected positioning move to a safe position.
G0 G91 G28 Z0.	Send the machine home in Z.
G90	Set the machine back to absolute programming.
G65 P9633	Switch the probe off.
M30	

Re-establishing the Y stylus offset

In certain circumstances it might be useful to reset just the Y stylus offset; this is primarily done if there is some concern over the probe (with an L-shaped stylus fitted) orientating correctly each time it is called into the spindle. In order to complete this process, a slot, or web of known size and position, is required inside the machine tool.

Example

O0003	
G90 G80 G40	Preparatory codes for the machine.
T1T0 M6	Select the probe.
G91 G28 Z0. X0.	Send the tool to the home position.
G43 Z100. H1	Apply the tool offset. (This line can be removed if using Mazatrol tool data.)
G65 P9632 D1.	Switch the probe on.
G0 G90 G54 X80. Y0.	Start position clear of the web, assuming a stylus length (Aa) of 60 mm.
G65 P9610 Z0.	Move to the required Z height for probing.
#[#112+3]=0	Reset the Y stylus offset.
G65 P9612 X0. Y25.	Run the web program at the X0 position with a 25 mm web.
#[#112+3]=#141	Update the Y stylus offset.
G65 P9633	Switch the probe off.
M30	

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Chapter 6

Protected positioning cycle for probes parallel to the X axis

As a probe moves around the workpiece, it is important that the stylus is protected against a collision with the workpiece. This chapter describes how to use cycle O9610 to set up the protected positioning of the probe. This is critical when using a stylus positioned at right angles to the probe, as it enables the software to calculate the position required for the machine to move safely when considering the length of the stylus. After it is set correctly, the probe will stop moving in the event of a collision.

Before starting, check that this cycle is available, as the full suite of cycles may not be installed on the machine.

Contained in this chapter

Protected positioning in X (probe trigger monitoring) (O9610)

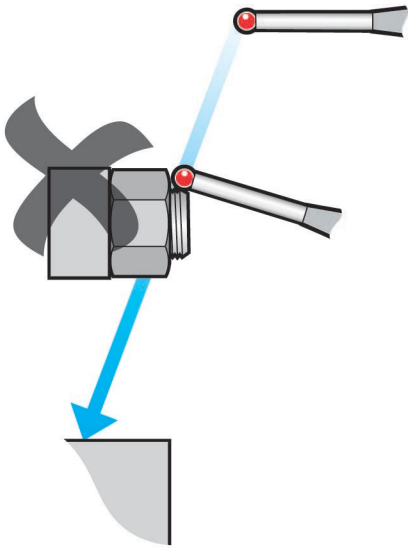

Figure 6.1 Protected positioning of the probe

Description

It is important to protect the probe stylus against damage, should it collide with an obstacle as the probe moves around the workpiece. When this cycle is used, the machine will stop in the event of a collision.

Alternatively, the cycle can detect misloaded components (the optional Mm input is required).

Application

The probe is selected and moved to a safe plane, with the length of the stylus added to the move. At this point the probe is made active. It can then be moved to the measuring position using this cycle.

In the event of a collision, the machine will stop. Either a PATH OBSTRUCTED alarm will be generated or an error flag (#148) will be set (see the Mm input).

Format

G65 P9610 Xx Yy Zz [Ff Mm C1.]

where [ ] denote optional inputs.

Example: G65 P9610 Z10. F3000. M1. C1.

Compulsory inputs

Xx	x =	
Yy	y =	These are the target positions for the probe positioning move.
Zz	z =	

Optional inputs

Ff f = This input can be used to specify a different feedrate. A default is set in O9524, as shown below:

#119=5000(FAST*FEED*MM)

M1. This will set a probe trigger flag (but with no PATH OBSTRUCTED alarm). The probe does not automatically return to the start point. Make a G0 or G1 move to get off the surface.

#148=0 No probe trigger.
#148=7 Probe triggered.

M2. This will set a probe trigger flag (but with no PATH OBSTRUCTED alarm). The probe will return to the start point.

#148=0 No probe trigger.
#148=7 Probe triggered.

C1. Positioning is normally applied at the probe stylus tip position. Using this flag, it is possible to position in the spindle axis to the stylus ball centre.

Example 1: Protected positioning

G1 G54 X80. Y0.

G43 H20 Z100.	Move to a safe plane. (This line can be removed if using Mazatrol tool data.)
G65 P9632 D1.	Switch the probe on and apply the relevant calibration data.
G65 P9610 X−10. Z10.	Protected positioning move (F input is optional).
G65 P9611 Z0. S1.	Single surface measurement with work offset update.

Example 2: Check for misloaded component

G65 P9610 X−10. Z1. F3000. M2.

IF[#148EQ0]GOTO10

#3000=100 (MISLOAD COMPONENT TOO HIGH)

N10 (CONTINUE PROGRAM)

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Chapter 7

X-axis measuring cycles

This chapter describes how to use the X-axis measuring cycles. Before using these cycles, the radius of the stylus ball must be calibrated using cycle O9606 (see Chapter 5, “Calibrating the probe in X”).

Before starting, check that the cycles are available on the machine, as the full suite of cycles may not have been installed.

Contained in this chapter

XYZ single surface measurement (O9611)

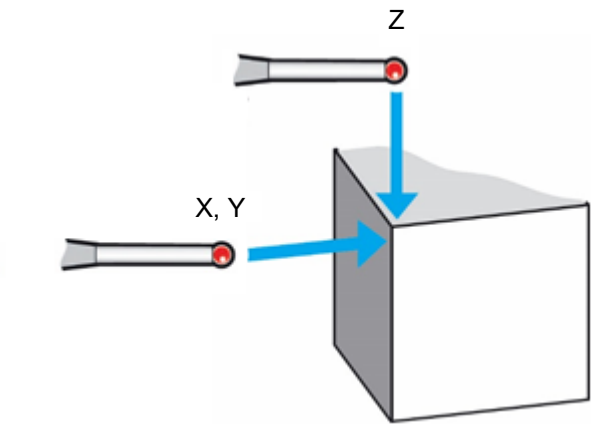

Figure 7.1 Measurement of a single surface

Description

This cycle measures a surface to establish the size or position.

Application

With its tool offset active, position the probe adjacent to the surface. The cycle measures the surface and returns to the start position.

The measured surface can be considered in one of two ways:

1. As a size, where the tool offset is updated in conjunction with the Tt and Hh inputs.
2. As a reference surface position, for the purpose of adjusting a work offset using the Ss and Mm inputs.

Format

G65 P9611 Xx. or Yy. or Zz. [Ee. Ff. Hh. Mm. Qq. Ss. Tt. Uu. Vv. Ww.]

where [ ] denote optional inputs.

Example: G65 P9611 X50. E21. F0.8 H0.2 M0.2 Q10. S1. T20. U0.5 V0.5 W2.

Compulsory inputs

Xx	x =	
or		
Yy	y =	The surface position or size.
or		
Zz	z =	

Optional inputs

See Chapter 2, “Optional inputs”.

Example: Measuring a single surface in X and Z

T01T0 M06	Select the probe.
G54 X0. Y0.	Start position.
G43 H1 Z100.	Activate offset 1 and go to 100 mm (3.94 in) above. (This line can be removed if using Mazatrol tool data.)
G65 P9632 D1.	Switch the probe on.
G65 P9610 X−10. F3000.	Protected positioning move to the X start position.
G65 P9610 Z−8. F3000.	Protected positioning move to the Z start position.
G65 P9611 X0. T10.	Single surface measurement with a tool offset update.
G65 P9610 Z10.	Protected positioning move.
G65 P9610 X10.	Protected positioning move.
G65 P9611 Z0. T11.	Single surface measurement.
G65 P9610 Z100.	Protected positioning move.
G65 P9633	Switch the probe off (where applicable).
G28 Z100.	Reference return.

continue

The radius offset (10) and length offset (11) of the tool are updated by the errors of the surface positions.

Web/pocket measurement (O9612)

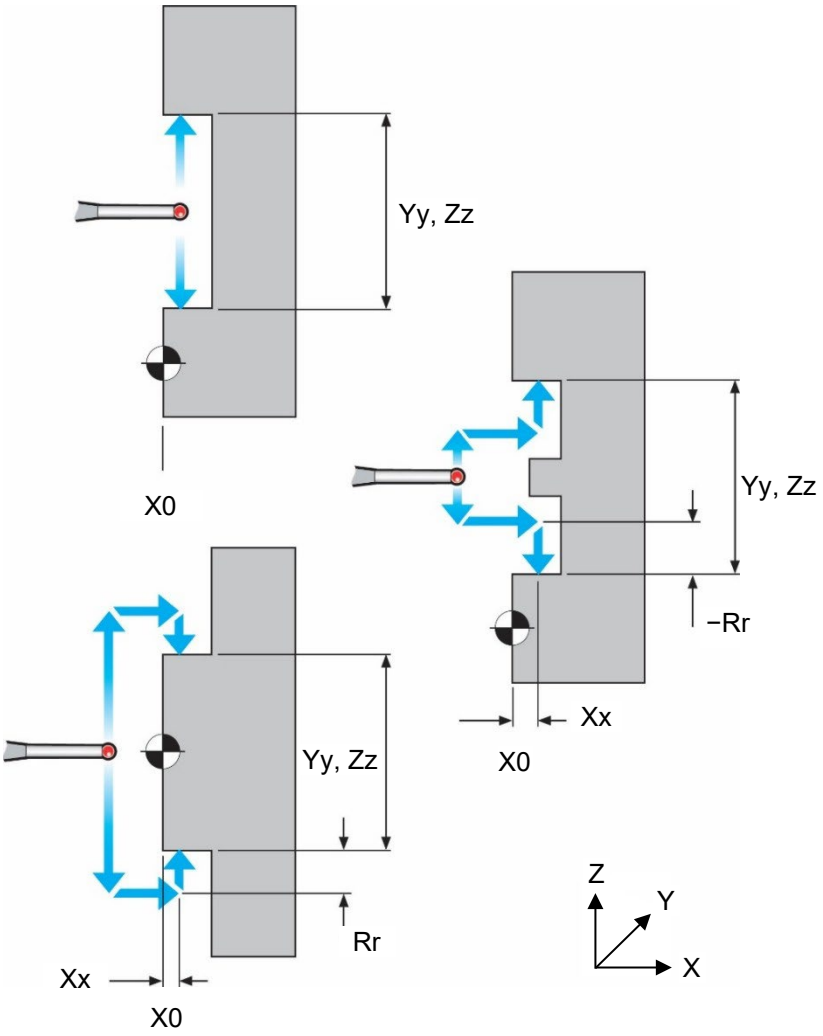

Figure 7.2 Measurement of a web or pocket feature

Description

This cycle measures a web or pocket feature using two measuring moves along the YZ axis.

Application

With the probe and probe offset active, position the probe to the expected centre line of the feature and at a suitable position in the X axis. Run the cycle with suitable inputs.

Format

G65 P9612 Yy. [Ee. Ff. Hh. Mm. Qq. Rr. Ss. Tt. Uu. Vv. Ww.]

or

G65 P9612 Zz. [Ee. Ff. Hh. Mm. Qq. Rr. Ss. Tt. Uu. Vv. Ww.]

or

G65 P9612 Yy. Xx. [Ee. Ff. Hh. Mm. Qq. Rr. Ss. Tt. Uu. Vv. Ww.]

or

G65 P9612 Zz. Xx. [Ee. Ff. Hh. Mm. Qq. Rr. Ss. Tt. Uu. Vv. Ww.]

where [ ] denote optional inputs.

Example: G65 P9612 X50. Z100. E21. F0.8 H0.2 M0.2 Q10. R10. S1. T20. U0.5 V0.5 W2.

Compulsory inputs

Yy y = Nominal size of the feature when measured in the Y axis.
or
Zz z = Nominal size of the feature when measured in the Z axis.

Xx x = The absolute X-axis position when measuring a web feature. If this is omitted, a pocket cycle is assumed.

Optional inputs

Rr r = This can be used, as shown in the diagrams above, to pre-position before each measurement. It can also be used for an internal pocket cycle using an R+ input (and no Xx input). The fast pre-positioning will improve cycle time on large pockets but will produce an alarm if the probe stylus is triggered during pre-positioning.

Default: Pocket cycle with no fast pre-positioning.

For other optional inputs, see Chapter 2, “Optional inputs”.

Outputs

See Chapter 3, “Cycle outputs”.

Example 1: Measuring a Z web

T01T0 M06	Select the probe.
G54 X0. Y0.	Start position.
G43 H1 Z100.	Activate offset 1 and go to 100 mm (3.94 in) above. (This line can be removed if using Mazatrol tool data.)
G65 P9632 D1.	Switch the probe on.
G65 P9610 X−10. F3000.	Protected positioning move.
G65 P9610 Z0.	Protected positioning move.
G65 P9612 Z50. X10. S2.	Measure a 50 mm (1.968 in) wide web.

G65 P9610 Z100.	Protected positioning move.
G65 P9633	Switch the probe off (where applicable).
G28 Z100.	Reference return.

continue

The centre line of the feature in the Z axis is stored in work offset 02 (G55).

Example 2: Measuring a Y pocket (referred datum)

T01T0 M06	Select the probe.
G54 X0. Y50.	Start position.
G43 H1 Z100.	Activate offset 1 and go to 100 mm (3.94 in) above. (This line can be removed if using Mazatrol tool data.)
G65 P9632 D1.	Switch the probe on.
G65 P9610 X−10. F3000.	Protected positioning move.
G65 P9610 Z0. F3000.	Protected positioning move.
G65 P9610 X10. F3000.	Protected positioning move into the pocket.
G65 P9612 Y30. S2.	Measure a 30 mm (1.181 in) wide pocket.
G65 P9610 X−10.	Protected positioning move.
G65 P9610 Z100.	Protected positioning move.
G65 P9633	Switch the probe off (where applicable).
G28 Z100.	Reference return.

continue

The error of the centre line is referred to the datum point Y0. The revised Y0 position is set in work offset 02 (G55).

Bore/boss measurement (O9614)

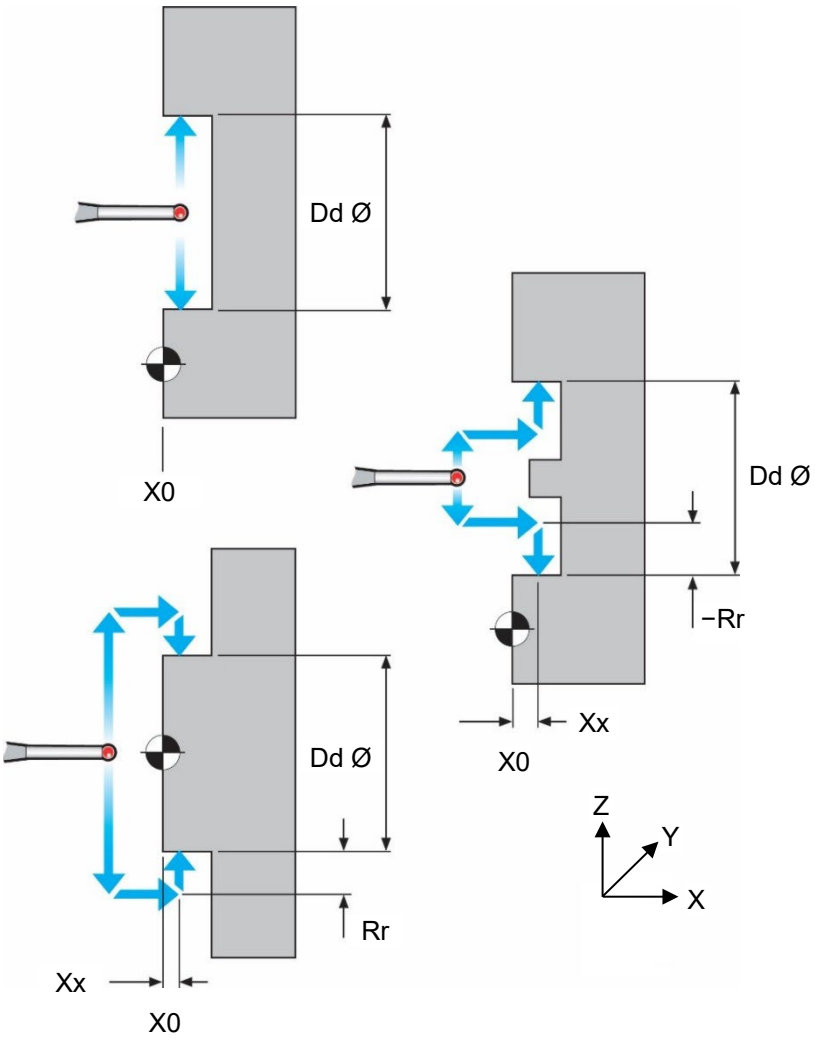

Figure 7.3 Measurement of a bore or boss feature

Description

This cycle measures a bore or boss feature using four measuring moves along the YZ axis.

Application

With the probe and probe offset active, position the probe to the expected centre line of the feature and at a suitable position in the X axis. Run the cycle with suitable inputs.

Format

G65 P9614 Dd. [Ee. Ff. Hh. Mm. Qq. Rr. Ss. Tt. Uu. Vv. Ww.]

or

G65 P9614 Dd. Xx. [Ee. Ff. Hh. Mm. Qq. Rr. Ss. Tt. Uu. Vv. Ww.]

where [ ] denote optional inputs.

Example: G65 P9614 D50.005 X100. E21. F0.8 H0.2 M0.2 Q10. R10. S1. T20. U0.5 V0.5 W1.1

Compulsory inputs

Dd d = Nominal size of the feature.

Xx x = The absolute X-axis position when measuring a boss feature. If this is omitted, a bore cycle is assumed.

Optional inputs

Rr r = This can be used, as shown in the diagrams above, to pre-position before each measurement. It can also be used for an internal bore cycle using an R+ input (and no Xx input). The fast pre-positioning will improve cycle time on large bores but will produce an alarm if the probe stylus is triggered during pre-positioning.

Default: Bore cycle with no fast pre-positioning.

For other optional inputs, see Chapter 2, “Optional inputs”.

Outputs

See Chapter 3, “Cycle outputs”.

Example 1: Measuring a boss

T01T0 M06	Select the probe.
G54 X0. Y0.	Start position.
G43 H1 Z100.	Activate offset 1 and go to 100 mm (3.94 in) above. (This line can be removed if using Mazatrol tool data.)
G65 P9632 D1.	Switch the probe on.
G65 P9610 X−10. F3000.	Protected positioning move.
G65 P9610 Z0. F3000.	Protected positioning move.
G65 P9614 D50. X10. S2.	Measure a 50 mm (1.968 in) diameter boss and set G55 offset.
G65 P9610 Z100.	Protected positioning move.
G65 P9633	Switch the probe off (when applicable).
G28 Z100.	Reference return.

continue

The centre line of the feature in the Y and Z axis is stored in work offset 02 (G55).

Example 2: Measuring a bore (referred datum)

T01T0 M06	Select the probe.
G54 X0. Y0.	Start position.
G43 H1 Z100.	Activate offset 1 and go to 100 mm (3.94 in) above. (This line can be removed if using Mazatrol tool data.)
G65 P9632 D1.	Switch the probe on.
G65 P9610 X−10. Y50. F3000.	Protected positioning move.
G65 P9610 Z−20. F3000.	Protected positioning move.
G65 P9610 X10. F3000.	Protected positioning move.
G65 P9614 D30. S2.	Measure a 30 mm (1.181 in) diameter bore.
G65 P9610 X−10. F3000.	Protected positioning move.
G65 P9610 Z100.	Protected positioning move.
G65 P9633	Switch the probe off (when applicable).
G28 Z100.	Reference return.

continue

The error of the centre line is referred to the datum point Y0, Z0. The revised Y0, Z0 position is set in work offset 02 (G55). This means the work offset is adjusted by the error between the start position and the actual centre line of the feature.

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Chapter 8

Calibrating the probe in Y

Before a probe is used, it must be calibrated correctly. This chapter explains why it is so important that the probe is calibrated and then describes how to use the macros to calibrate the probe.

Contained in this chapter

Why calibrate a probe?

When you fit your probe into the machine shank/holder, it is not necessary for the probe stylus to run true to the spindle centre line. A small amount of run-out can be tolerated, but it is good practice to get the stylus mechanically on-centre to reduce the effects of spindle and tool orientation errors. Without calibration of the probe, run-out will lead to inaccurate results. By calibrating the probe, the positional error is automatically accounted for. The calibration cycle macro O9402 provides the data to allow for this run-out when the stylus is positioned parallel to the Y axis.

As each Renishaw probe is unique, it is important that you calibrate it in the following circumstances:

- When your probe system is to be used for the first time.
- When a new stylus is fitted to your probe.
- When it is suspected that the stylus has become distorted or that the probe has crashed.
- At regular intervals to compensate for mechanical changes of your machine tool.
- If repeatability of relocation of the probe shank is poor. In this case, the probe may need to be recalibrated each time it is selected.

Three different operations are used to calibrate a probe. They are:

- Calibrating the stylus offset.
- Calibrating the stylus radius.
- Calibrating the probe length.

Calibrating the stylus offset

Calibrating the probe on a diameter with a known position automatically stores values for the offset of the stylus ball to the spindle centre line. The stored values are then automatically used in the measuring cycles. Measured values are compensated by these values so that they are relative to the true spindle centre line.

Calibrating the stylus radius

Calibrating the probe on a known diameter automatically stores values for the radius of the stylus ball. These stored values are then automatically used by the measuring cycles to give the true size of the feature. The values are also used to give true positions of single surface features.

NOTE: The stored radius values are based on the true electronic trigger points. These values are different from the physical sizes.

Setting up the probe stylus

It is important that the probe stylus is set up when the spindle is in its orientated position. This is because the macros call for a spindle orientation and, if required, the spindle will orientate to the required direction for probing. If using multiple styli or a single stylus only used for one direction, the spindle will orientate to 0° and probe in the direction specified.

If using a single probe to use in multiple locations, the stylus direction needs to be initially set in the X+ direction when the spindle is orientated. This is so that the macros call the spindle orientation to the direction required. If using the installation wizard, it is possible to change the orientation the stylus was set in. This will change the orientation code accordingly so that each spindle orientation is to the correct angle.

If using the installation wizard, the wizard will configure the macros to the specified settings. If installing the macros manually and a spindle orientation to 90°, 180° or 270° is not required, change all the occurrences of M19S90, M19S180 and M19S270 to M19S0 in 09632.

Calibrating the probe length

Calibrating a probe on a known reference surface determines the length, based on the electronic trigger point. This stored value for length is different from the physical length of the probe assembly. The cycle accurately calculates two length values – one is stored in the tool offset and is controlled by the Tt input, the other is stored in #[#112+5] and represents the distance between the spindle centre line and the end of the stylus (nominally Aa).

Full calibration using a sphere (O9406)

The following cycle provides a complete calibration solution, calculating the probe length, the radius of the stylus ball and the stylus offset. This is the recommended way to calibrate the probe.

NOTE: Before running this cycle, refer to “Editing the probe start cycle O9632” in Chapter 12, Configuration”.

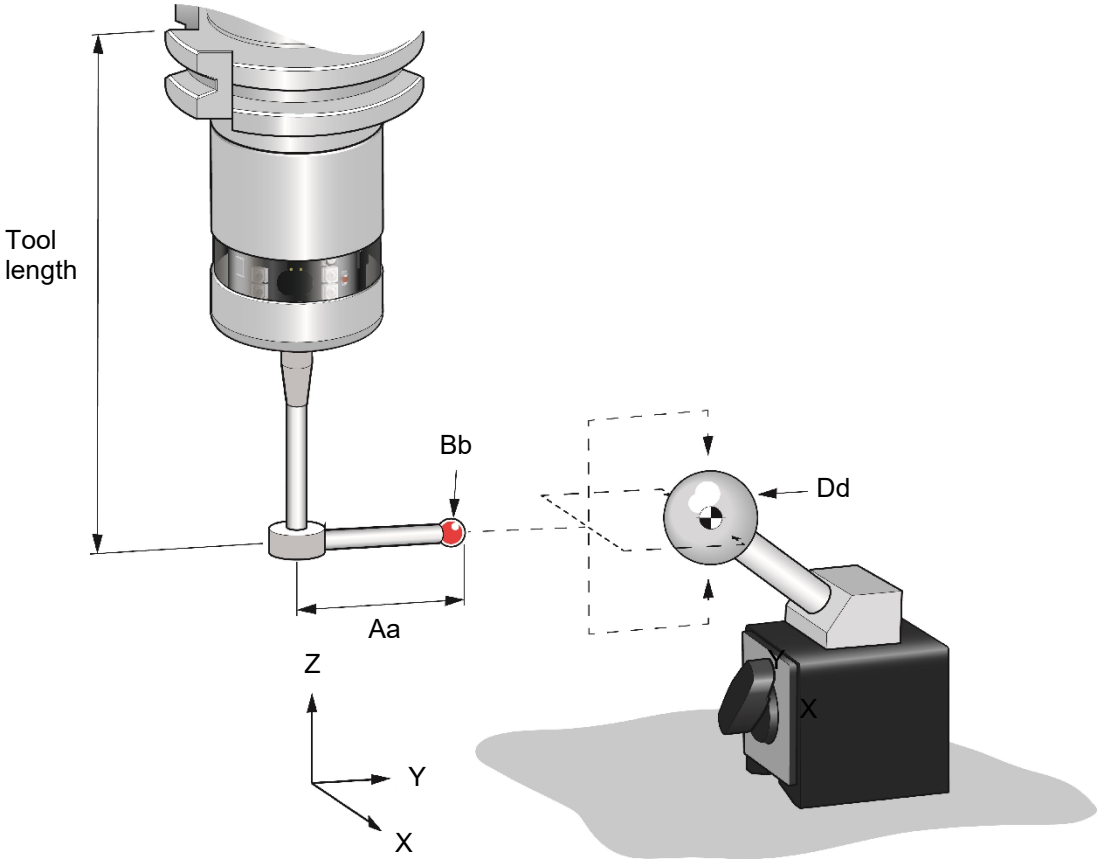

Figure 8.1 Calibrating the probe on a calibration sphere

Application

Fix the calibration sphere in the desired location and set the XYZ work offset to the exact centre. Typically, this is achieved using a calibrated length bar or a tool of known length.

NOTE: Set the centre line of the spindle as the X and Y zero, not the centre of the L-shaped stylus ball.

Enter the approximate tool length into the appropriate tool offset.

Format

G65 P9406 Aa Bb Dd [Qq Rr Tt]

where [ ] denote optional inputs.

Example: G65 P9406 A60. B6. D25. Q10. R15. T1.

Compulsory inputs

Aa	a =	The nominal length of the stylus.
Bb	b =	The nominal diameter of the stylus ball.
Dd	d =	The nominal diameter of the calibration artefact.

Optional inputs

Qq	q =	The probe overtravel. **Default value:** 10 mm (0.394 in)
Rr	r =	The radial clearance. **Default value:** 6 mm (0.236 in)
Tt	t =	The tool offset number to be updated. If there is no T input, the cycle updates the Z stylus offset. **Default value:** The active T number

Outputs

The following data is stored:

#[#112]	Z+, Z−, stylus ball radius (ZRAD)
#[#112+1]	X+, X−, stylus ball radius (XRAD)
#[#112+2]	Z stylus offset
#[#112+3]	X stylus offset
#[#112+4]	Back-off factor
#[#112+5]	Stylus length

Data storage locations depend on the base number selected for the probe (set in O9632).

Example: Full stylus calibration

A tool offset must be active before running program O9406.

O0003

G90 G80 G40	Preparatory codes for the machine.
T1T0 M6	Select the probe.
G91 G28 Z0. X0. Y0.	Send the tool to the home position.
G43 Z100. H1	Apply the tool offset 100 mm clear. (This line can be removed if using Mazatrol tool data.)
G65 P9632 D2.	Switch the probe on.
G0 G90 G54 X0. Y−80.	Start position clear of the sphere, assuming a stylus length (Aa) of 60 mm and a sphere diameter (Dd) of 19 mm.
G65 P9406 A60. B6. D19.	Run the full calibration cycle.
G65 P9410 Z50. F5000.	Protected positioning move to a safe position.
G0 G91 G28 Z0.	Send the machine home in Z.
G90	Set the machine back to absolute programming.
G65 P9633	Switch the probe off.

M30

NOTE: When the cycle finishes, the spindle will return to its start point, unless probe length calibration takes place. In this case, it will return to the start point height above its final touch.

Calibration of multiple styli

If using multiple styli, both probe stylus tips will need to be calibrated separately. This example will be using a stylus in the Y+ and the Y− direction. Please ensure the correct settings have been set when using the installation wizard. If setting manually, follow the instructions in Chapter 21, “Configuration”, to ensure the macros are prepared for multiple styli.

Application

Fix two calibration spheres in the desired location and set the XYZ work offset to the exact centre of the spheres. Typically, this is achieved using a calibrated length bar or a tool of known length. Use different work offsets for each calibration sphere, for example, set the first calibration sphere as G54 and the second as G55.

NOTE: Set the centre line of the spindle as the X0Y0, not the centre of the L-shaped stylus ball. The Z height should be set to the centre of the probe stylus sphere.

Enter the approximate tool length into the appropriate tool offset for each stylus.

Format

G65 P9406 Aa Bb Dd [Qq Rr Tt]

where [ ] denote optional inputs.

Example: G65 P9406 A60. B6. D25. Q10. R15. T1.

Example: Full stylus calibration using multiple styli

A tool offset must be active before running program O9406.

O0003

G90 G80 G40	Preparatory codes for the machine.
T001T0 M6	Select the first probe. (If using Mazatrol, include the suffix number for the tool, if required.)
G91 G28 Z0. X0.	Send the tool to the home position.
G43 H1 Z100.	Select the first height offset if using ISO tooling. (This line can be removed if using Mazatrol tool data.)
G65 P9632 D2.	Switch the probe on for the first orientation.

G0 G90 G54 X0. Y−80.	Start position clear of the first sphere, assuming a stylus length (Aa) of 60 mm and a sphere diameter (Dd) of 19 mm.
G65 P9410 Z0. F3000	Protected positioning move to the sphere centre.
G65 P9406 A60. B6. D19. T01	Run the full calibration cycle and update the probe length offset.
G65 P9410 Z50. F5000.	Protected positioning move to a safe position.
G0 G91 G28 Z0.	Send the machine home in Z.
G90	Set the machine back to absolute programming.
G65 P9633	Switch the probe off.
G91 G28 Z0. X0.	Send the tool to the home position.
G43 H2 Z100.	Select second height offset is using ISO tooling. (This line can be removed if using Mazatrol tool data.)
G65 P9632 D−2.	Switch the probe on for the second orientation.
G0 G90 G55 X0. Y80.	Start position clear of the second sphere, assuming a stylus length (Aa) of 60 mm and a sphere diameter (Dd) of 19 mm.
G65 P9410 Z0. F3000	Protected positioning move to the sphere centre.
G65 P9406 A60. B6. D19.	Run the full calibration cycle. The tool length does not need to be updated if you are using one stylus in multiple directions.
G65 P9410 Z50. F5000.	Protected positioning move to a safe position.
G0 G91 G28 Z0.	Send the machine home in Z.
G90	Set the machine back to absolute programming.
G65 P9633	Switch the probe off.
M30	

Example: Full stylus calibration using one stylus in multiple directions

A tool offset must be active before running program O9406. This method will only work when using Mazatrol Tool Data, not with ISO tooling. The method of set-up is the same as for multiple styli. Typically, this is achieved using a calibrated length bar or a tool of known length. Use different work offsets for each calibration sphere, for example, set the first calibration sphere as G54 and the second as G55. This will require using the wizard to set up the macros.

O0003

G90 G80 G40	Preparatory codes for the machine.
T01T0 M6	Select the first probe. (If using Mazatrol, include the suffix number for the tool. For ISO tooling, just put the tool number.)
G91 G28 Z0. X0. Y0.	Send the tool to the home position.
G65 P9632 D2.	Switch the probe on. This orientates the probe stylus to the Y+ position.
G0 G90 G54 X0. Y−80.	Start position clear of the first sphere, assuming a stylus length (Aa) of 60 mm and a sphere diameter (Dd) of 19 mm.
G65 P9410 Z0. F3000	Protected positioning move to the sphere centre.
G65 P9406 A60. B6. D19. T01.	Run the full calibration cycle on a 19 mm diameter calibration sphere with a 6 mm stylus tip and update the probe length offset.
G65 P9410 Z50. F5000.	Protected positioning move to a safe position.
G0 G91 G28 Z0.	Send the machine home in Z.
G90	Set the machine back to absolute programming.
G65 P9633	Switch the probe off.
G91 G28 Z0. Y0.	Send the tool to the home position.
G90	Set the machine back to absolute programming.
G65 P9632 D−2.	Switch the probe on. This orientates the probe stylus to the Y− position.
G0 G90 G55 X0. Y80.	Start position clear of the second sphere, assuming a stylus length (Aa) of 60 mm and a sphere diameter (Dd) of 19 mm.

G65 P9410 Z0. F3000	Protected positioning move to the sphere centre.
G65 P9406 A60. B6. D19.	Run the full calibration cycle.
G65 P9410 Z50. F5000.	Protected positioning move to a safe position.
G0 G91 G28 Z0.	Send the machine home in Z.
G90	Set the machine back to absolute programming.
G65 P9633	Switch the probe off.
M30	

Re-establishing the X stylus offset

In certain circumstances it might be useful to just reset the X stylus offset; this is primarily done if there is some concern over the probe (with an L-shaped stylus fitted) orientating correctly each time it is called into the spindle. In order to complete this process, a slot, or web of known size and position, is required inside the machine tool.

Example

O0003	
G90 G80 G40	Preparatory codes for the machine.
T1T0 M6	Select the probe.
G91 G28 Z0. X0.	Send the tool to the home position.
G43 Z100. H1	Apply the tool offset. (This line can be removed if using Mazatrol tool data.)
G65 P9632 D2.	Switch the probe on.
G0 G90 G54 Y−80. X0.	Start position clear of the web, assuming a stylus length (Aa) of 60 mm.
#[#112+3]=0	Reset the X stylus offset.
G65 P9412 X25. Y0.	Run the web program.
#[#112+3]=#140	Update the X stylus offset.
G65 P9633	Switch the probe off.
M30	

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Chapter 9

Protected positioning cycle for probes parallel to the Y axis

As a probe moves around the workpiece, it is important that the stylus is protected against a collision with the workpiece. This chapter describes how to use cycle O9410 to set up the protected positioning of the probe. This is critical when using a stylus positioned at right angles to the probe, as it enables the software to calculate the position required for the machine to move safely when considering the length of the stylus. After it is set correctly, the probe will stop moving in the event of a collision.

Before starting, check that this cycle is available, as the full suite of cycles may not be installed on the machine.

Contained in this chapter

Protected positioning in Y (probe trigger monitoring) (O9410)

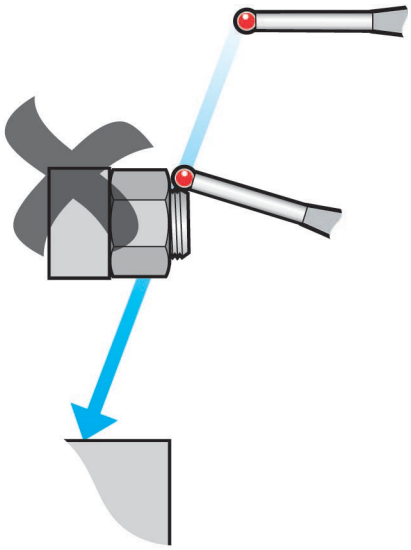

Figure 9.1 Protected positioning of the probe

Description

It is important to protect the probe stylus against damage, should it collide with an obstacle as the probe moves around the workpiece. When this cycle is used, the machine will stop in the event of a collision.

Alternatively, the cycle can detect misloaded components (the optional Mm input is required for this).

Application

The probe is selected and moved to a safe plane, with the length of the stylus added to the move. At this point the probe is made active. It can then be moved to the measuring position using this cycle.

In the event of a collision, the machine will stop. Either a PATH OBSTRUCTED alarm will be generated or an error flag (#148) will be set (see the Mm input).

Format

G65 P9410 Xx Yy Zz [Ff Mm C1.]

where [ ] denote optional inputs.

Example: G65 P9410 Z10. F3000. M1. C1.

Compulsory inputs

Xx	x =	
Yy	y =	These are the target positions for the probe positioning move.
Zz	z =	

Optional inputs

Ff f = This input can be used to specify a different feedrate. A default is set in O9524 as shown below:

#119=5000(FAST*FEED*MM)

M1. This will set a probe trigger flag (but with no PATH OBSTRUCTED alarm). The probe does not automatically return to the start point. Make a G0 or G1 move to get off the surface.

#148=0 No probe trigger.
#148=7 Probe triggered.

M2. This will set a probe trigger flag (but with no PATH OBSTRUCTED alarm). The probe will return to the start point.

#148=0 No probe trigger.
#148=7 Probe triggered.

C1. Positioning is normally applied at the probe stylus tip position. Using this flag, it is possible to position in the spindle axis to the stylus ball centre.

Example 1: Protected positioning

G1 G54 X0. Y80.

G43 H20 Z100.	Move to a safe plane. (This line can be removed if using Mazatrol tool data.)
G65 P9632 D2.	Switch the probe on and apply the relevant calibration data.
G65 P9410 Y−10. Z10.	Protected positioning move (F input is optional).
G65 P9411 Z0. S1.	Single surface measurement with a work offset update.

Example 2: Check for misloaded component

G65 P9410 Y−10. Z1. F3000. M2.

IF[#148EQ0]GOTO10

#3000=100 (MISLOAD COMPONENT TOO HIGH)

N10 (CONTINUE PROGRAM)

Chapter 10

Y-axis measuring cycles

This chapter describes how to use the Y-axis measuring cycles. Before using these cycles, the radius of the stylus ball must be calibrated using cycle O9406 (see Chapter 8, “Calibrating the probe in Y”).

Before starting, check that the cycles are available on the machine, as the full suite of cycles may not have been installed.

Contained in this chapter

XYZ single surface measurement (O9411)

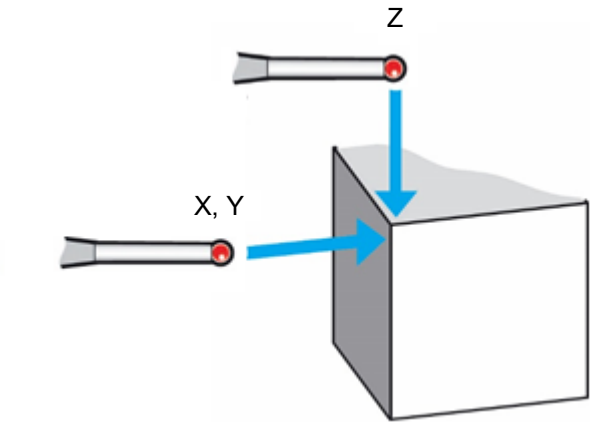

Figure 10.1 Measurement of a single surface

Description

This cycle measures a surface to establish the size or position.

Application

With its tool offset active, position the probe adjacent to the surface. The cycle measures the surface and returns to the start position.

The measured surface can be considered in one of two ways:

1. As a size, where the tool offset is updated in conjunction with the Tt and Hh inputs.
2. As a reference surface position, for the purpose of adjusting a work offset using the Ss and Mm inputs.

Format

G65 P9411 Xx. or Yy. or Zz. [Ee. Ff. Hh. Mm. Qq. Ss. Tt. Uu. Vv. Ww.]

where [ ] denote optional inputs.

Example: G65 P9411 Y50. E21. F0.8 H0.2 M0.2 Q10. S1. T20. U0.5 V0.5 W2.

Compulsory inputs

Xx	x =	
or		
Yy	y =	The surface position or size.
or		
Zz	z =	

Optional inputs

See Chapter 2, “Optional inputs”.

Example: Measuring a single surface in Y and Z

T01T0 M06	Select the probe.
G54 Y0. X0.	Start position.
G43 H1 Z100.	Activate offset 1 and go to 100 mm (3.94 in) above. (This line can be removed if using Mazatrol tool data.)
G65 P9632 D2.	Switch the probe on.
G65 P9410 Y−10. F3000.	Protected positioning move to the Y start position.
G65 P9410 Z−8. F3000.	Protected positioning move to the Z start position.
G65 P9411 Y0. T10.	Single surface measurement with a tool offset update.
G65 P9410 Z10.	Protected positioning move.
G65 P9410 Y10.	Protected positioning move.
G65 P9411 Z0. T11.	Single surface measurement.
G65 P9410 Z100.	Protected positioning move.
G65 P9633	Switch the probe off (where applicable).
G28 Z100.	Reference return.

continue

The radius offset (10) and length offset (11) of the tool are updated by the errors of the surface positions.

Web/pocket measurement (O9412)

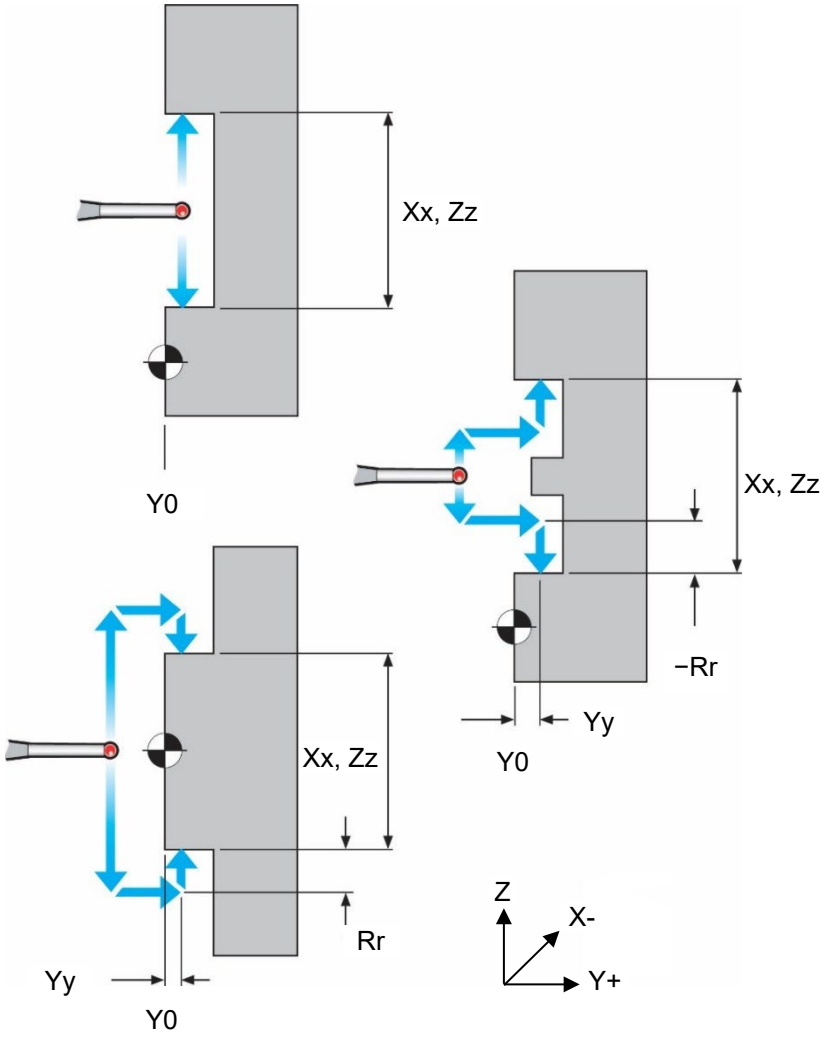

Figure 10.2 Measurement of a web or pocket feature

Description

This cycle measures a web or pocket feature using two measuring moves along the XZ axis.

Application

With the probe and probe offset active, position the probe to the expected centre line of the feature and at a suitable position in the Y axis. Run the cycle with suitable inputs.

Format

G65 P9412 Xx. [Ee. Ff. Hh. Mm. Qq. Rr. Ss. Tt. Uu. Vv. Ww.]

or

G65 P9412 Zz. [Ee. Ff. Hh. Mm. Qq. Rr. Ss. Tt. Uu. Vv. Ww.]

or

G65 P9412 Xx. Yy. [Ee. Ff. Hh. Mm. Qq. Rr. Ss. Tt. Uu. Vv. Ww.]

or

G65 P9412 Yy Zz. [Ee. Ff. Hh. Mm. Qq. Rr. Ss. Tt. Uu. Vv. Ww.]

where [ ] denote optional inputs.

Example: G65 P9412 Y50. Z100. E21. F0.8 H0.2 M0.2 Q10. R10. S1. T20. U0.5 V0.5 W2.

Compulsory inputs

Xx x = Nominal size of the feature when measured in the X axis.
or
Zz z = Nominal size of the feature when measured in the Z axis.

Yy y = The absolute Y-axis position when measuring a web feature. If this is omitted, a pocket cycle is assumed.

Optional inputs

Rr r = This can be used, as shown in the diagrams above, to pre-position before each measurement. It can also be used for an internal pocket cycle using an R+ input (and no Yy input). The fast pre-positioning will improve cycle time on large pockets but will produce an alarm if the probe stylus is triggered during pre-positioning.

Default: Pocket cycle with no fast pre-positioning.

For other optional inputs, see Chapter 2, “Optional inputs”.

Outputs

See Chapter 3, “Cycle outputs”.

Example 1: Measuring a Z web

T01T0 M06	Select the probe.
G54 X0. Y0.	Start position.
G43 H1 Z100.	Activate offset 1 and go to 100 mm (3.94 in) above. (This line can be removed if using Mazatrol tool data.)
G65 P9632 D2.	Switch the probe on.
G65 P9410 Y−10. F3000.	Protected positioning move.
G65 P9410 Z0.	Protected positioning move.
G65 P9412 Z50. Y10. S2.	Measure a 50 mm (1.968 in) wide web.

G65 P9410 Z100.	Protected positioning move.
G65 P9633	Switch the probe off (where applicable).
G28 Z100.	Reference return.

continue

The centre line of the feature in the Z axis is stored in work offset 02 (G55).

Example 2: Measuring an X pocket (referred datum)

T01T0 M06	Select the probe.
G54 X50. Y0.	Start position.
G43 H1 Z100.	Activate offset 1 and go to 100 mm (3.94 in) above. (This line can be removed if using Mazatrol tool data.)
G65 P9632 D2.	Switch the probe on.
G65 P9410 Y−10. F3000.	Protected positioning move.
G65 P9410 Z0. F3000.	Protected positioning move.
G65 P9410 Y10. F3000.	Protected positioning move into the pocket.
G65 P9412 Y30. S2.	Measure a 30 mm (1.181 in) wide pocket.
G65 P9410 Y−10.	Protected positioning move.
G65 P9410 Z100.	Protected positioning move.
G65 P9633	Switch the probe off (where applicable).
G28 Z100.	Reference return.

continue

The error of the centre line is referred to the datum point X0. The revised X0 position is set in work offset 02 (G55).

Bore/boss measurement (O9414)

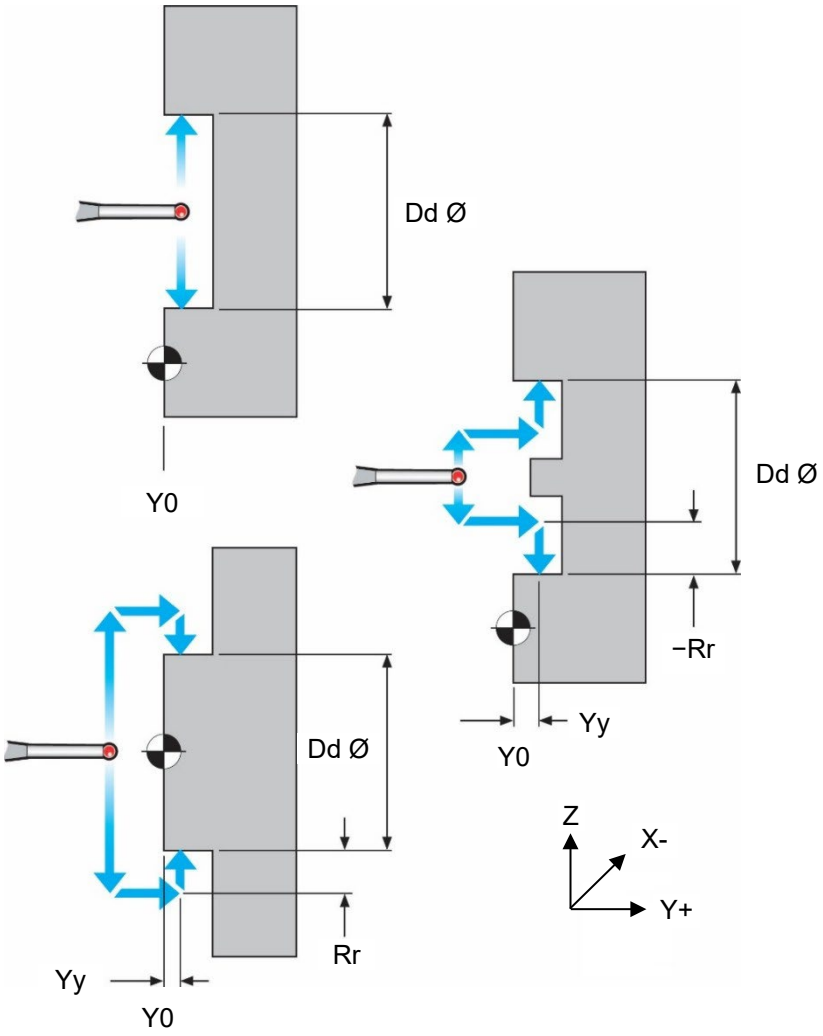

Figure 10.3 Measurement of a bore or boss feature

Description

This cycle measures a bore or boss feature using four measuring moves along the XZ axis.

Application

With the probe and probe offset active, position the probe to the expected centre line of the feature and at a suitable position in the Y axis. Run the cycle with suitable inputs.

Format

G65 P9414 Dd. [Ee. Ff. Hh. Mm. Qq. Rr. Ss. Tt. Uu. Vv. Ww.]

or

G65 P9414 Dd. Yy. [Ee. Ff. Hh. Mm. Qq. Rr. Ss. Tt. Uu. Vv. Ww.]

where [ ] denote optional inputs.

Example: G65 P9414 D50.005 Y100. E21. F0.8 H0.2 M0.2 Q10. R10. S1. T20. U0.5 V0.5 W2.

Compulsory inputs

Dd d = Nominal size of the feature.

Yy y = The absolute Y-axis position when measuring a boss feature. If this is omitted, a bore cycle is assumed.

Optional inputs

Rr r = This can be used, as shown in the diagrams above, to pre-position before each measurement. It can also be used for an internal bore cycle using an R+ input (and no Yy input). The fast pre-positioning will improve cycle time on large bores but will produce an alarm if the probe stylus is triggered during pre-positioning.

Default: Bore cycle with no fast pre-positioning.

For other optional inputs, see Chapter 2, “Optional inputs”.

Outputs

See Chapter 3, “Cycle outputs”.

Example 1: Measuring a boss

T01T0 M06	Select the probe.
G54 X0. Y0.	Start position.
G43 H1 Z100.	Activate offset 1 and go to 100 mm (3.94 in) above. (This line can be removed if using Mazatrol tool data.)
G65 P9632 D2.	Switch the probe on.
G65 P9410 Y−10. F3000.	Protected positioning move.
G65 P9410 Z0. F3000.	Protected positioning move.
G65 P9414 D50. Y10. S2.	Measure a 50 mm (1.968 in) diameter boss.
G65 P9410 Z100.	Protected positioning move.
G65 P9633	Switch the probe off (when applicable).
G28 Z100.	Reference return.

continue

The centre line of the feature in the X and Z axis is stored in work offset 02 (G55).

Example 2: Measuring a bore (referred datum)

T01T0 M06	Select the probe.
G54 Y0. X0.	Start position.
G43 H1 Z100.	Activate offset 1 and go to 100 mm (3.94 in) above. (This line can be removed if using Mazatrol tool data.)
G65 P9632 D2.	Switch the probe on.
G65 P9410 X50. Y−10. F3000.	Protected positioning move.
G65 P9410 Z−20. F3000.	Protected positioning move.
G65 P9410 Y10. F3000.	Protected positioning move into the bore.
G65 P9414 D30. S2.	Measure a 30 mm (1.181 in) diameter bore.
G65 P9410 Y−10. F3000.	Protected positioning move.
G65 P9410 Z100.	Protected positioning move.
G65 P9633	Switch the probe off (when applicable).
G28 Z100.	Reference return.

continue

The error of the centre line is referred to the datum point X0, Z0. The revised X0, Z0 position is set in work offset 02 (G55). This means the work offset is adjusted by the error between the start position and the actual centre line of the feature.

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Chapter 11

Alarms and error messages

When an error occurs during use of the inspection software, an alarm number or message is generated. This may be displayed on the screen of the controller.

This chapter describes:

- How to identify an alarm number that may be displayed on a Mazak controller.
- The meaning and likely cause of each alarm message that is displayed on the screen of the controller.

It then describes typical actions you need to take to clear the fault.

Contained in this chapter

Mazak controller alarms

Alarm messages may not be displayed on the screen, only the alarm number. The alarm numbers displayed are (500 + n), where n is the alarm number.

Example: 92 (PROBE*OPEN) is alarm 592

General alarms

Format:		**#148 flag**
1 (OUT*OF*TOLERANCE) 1 (OUT*OF*POSITION) 1 (ANGLE*OUT*OF*TOLERANCE) 1 (DIA*OFFSET*TOO*LARGE)	Updates the offset if the cycle start button is pressed to continue	1 2 4 5
1 (UPPER*TOL*EXCEEDED) 1 (EXCESS*STOCK)	No offset update if the cycle start button is pressed to continue	3 6

Action: If message, press cycle start to continue.

If alarm, this is a reset condition. Restart the program from a safe position.

Format: 91 (ZY*INPUT*MISSING)
91 (XZ*INPUT*MISSING)
91 (SH*INPUT*MIXED)
91 (ST*INPUT*MIXED)
91 (TM*INPUT*MIXED)
91 (XZ*INPUT*MIXED)
91 (YZ*INPUT*MIXED)
91 (XYZ*INPUT*MIXED)
91(A*INPUT*MISSING)
91(B*INPUT*MISSING)
91(C*INPUT*MISSING)
91 (D*INPUT*MISSING)
91(E*INPUT*MISSING)
91(F*INPUT*MISSING)
91(I*INPUT*MISSING)
91(J*INPUT*MISSING)
91(K*INPUT*MISSING)
91(M*INPUT*MISSING)
91(S*INPUT*MISSING)
91(T*INPUT*MISSING)
91(W*INPUT*MISSING)
91(X*INPUT*MISSING)
91(Y*INPUT*MISSING)
91(Z*INPUT*MISSING)
91(DATA*#130*TO*#139*MISSING)
91(H*INPUT*NOT*ALLOWED)

91(M*INPUT*NOT*ALLOWED)
91(S*INPUT*NOT*ALLOWED)
91(T*INPUT*NOT*ALLOWED)
91(X0*INPUT*NOT*ALLOWED)
91(Y0*INPUT*NOT*ALLOWED)
91(YZ*INPUT*MIXED)
91(ZK*INPUT*MIXED)
91(XZ*INPUT*MIXED)
91(SH*INPUT*MIXED)
91(ST*INPUT*MIXED)
91(TM*INPUT*MIXED)
91(XYZ*INPUT*MIXED)
91(K*INPUT*OUT*OF*RANGE)
91(FORMAT*ERROR)
91(D*INPUT*STYLUS*DIR*MISSING)
91(OFFSET*NUMBER*MISSING)

Action: Edit the program and start again from a safe start position.

This is a reset condition.

Format: 86 (PATH*OBSTRUCTED)

Cause: The probe has made contact with an obstruction. This occurs only during a protected positioning cycle.

Action: Edit the program. Clear the obstruction and start again from a safe position.

This is a reset condition.

Format: 88 (NO*FEEDRATE)

Cause: This occurs only during a protected positioning cycle.

Action: Edit the program. Insert the F___ code input and start again from a safe position.

This is a reset condition.

Format: 89 (NO*TOOL*LENGTH*ACTIVE)

Cause: G43 or G44 must be active before the cycle is called.

Action: Edit and start again from a safe position.

This is a reset condition.

Format: 91(TOOL*OFFSET*WIZARD*SET*ERROR)

Cause: The tool offset has not been correctly set up in the wizard.

Action: Re-run the wizard, double-checking all the settings and install the macros again. Start the program again.

Format: 92 (PROBE*OPEN)

Cause: This alarm occurs if the probe is already triggered before a move.

The stylus may be in contact with a surface, or the probe has failed to reseat.

This could be due to swarf trapped around the probe eyelid.

Action: Clear the fault and start again from a safe start position.

This is a reset condition.

Format: 93 (PROBE*FAIL)

Cause: This alarm occurs if the probe did not trigger during the move.

Either the surface was not found, or the probe has failed.

Action: Edit the program and start again from a safe start position.

This is a reset condition.

Format: 199(SPINDLE*PROBE*NOT*IN*SPINDLE)

Cause: This alarm occurs if the tool in the spindle is not the probe that has been specified in the wizard.

Action: Edit the program and start again from a safe start position. Change the tool to the probe or adjust the settings in the installation wizard to match the machine data.

This is a reset condition.

Chapter 12

Configuration

This chapter contains setting information and details about the program variables used in the inspection software.

Contained in this chapter

General

When calibration is completed for the first time, and the installation wizard has been used to prepare the software, the cycles are ready to use. However, further manual customisation of the settings is possible. The following configuration information will be of use in this regard.

Installation wizard

This software is supplied with an installation wizard that can be launched from any PC running Windows® 7 (or later versions) and will configure the software for the machine, creating machine-specific and personal customisation prior to installing the software.

Editing the error messages program O9200

#30=3006(3006=MESSAGE*3000=ALARM) edit =3006/=3000 as required

The #30 setting near the top of program O9200 controls the alarm/message type. When 3006 is selected, a mix of #3000 and #3006 messages and alarms is output, depending on which method is best for each alarm or message. Using the setting #30=3006 is the preferred choice – only change this if #3006 is not supported or for specific application preference.

- #3000 alarms will need a program reset to start the program again.
- #3006 messages will allow the cycle to continue if the cycle start button is pressed.

Editing the settings program O9524

This program is called at the beginning of each cycle to establish the necessary modal information. Using the installation wizard will adjust this program to the settings required. If you are not using the installation wizard, the following setting adjustments can be made:

O9524(REN*SETTINGS)

```
(F-4013-2007-0A BASED ON F-4012-1553-0B)
(COPYRIGHT 2021 RENISHAW PLC. ALL RIGHTS RESERVED)
N10
#120=1(SELECT*TOOL*OFFSET*OPTIONS)                    *1
(1=MAZ TOOL DATA)
(2=ISO OFFSET A)
(3=ISO TOOL DATA)
(4=ISO OFFSET B)
#123=.05 (POSITION ZONE MM)                           *2
#123=.002 (POSITION ZONE INCH)                        *2
```

*1 Select which type of tool offset system will be used with the probe:

- #120=1 Mazatrol tool data
- #120=2 ISO/EIA tool offset type A (single register per offset)
- #120=3 ISO/EIA tool data.
- #120=4 ISO/EIA tool offset type B (4 registers per offset).

*2 This is an in-position checking tolerance used within the software to validate a protected or measuring move within the software. Typically, a PROBE OPEN or PROBE FAIL alarm may result from this test.

Edit the metric (.05) and inch (.002) values as a pair to the required new tolerance.

NOTE: It is not usual to modify this setting.

Editing the probe start cycle O9632

This program is called to switch the probe on.

Macro O9632 must be edited as shown below if setting up macros manually (this is set automatically if using the installation wizard):

```
O9632(START*PROGRAM)
(F-4013-2007-0A)
(COPYRIGHT 2023 RENISHAW PLC. ALL RIGHTS RESERVED)
G53

#3001=0
G4
G4P50
G4
(>--USER*M/C*START*CODE)
(<*ADD*M/C*START*CODES*HERE)
(<--USER*M/C*START*CODE)
()
IF[#3001LT40]GOTO999
G65P9524M26.
IF[#7NE#0]GOTO5
G65P9200E380
N5
IF[#7EQ1]GOTO12
IF[#7EQ-1]GOTO22
IF[#7EQ2]GOTO32
IF[#7EQ-2]GOTO42
IF[#7NE1]GOTO20
N12
#112=800(PROBE*X+*DIRECTION*BASE*NUMBER)                    *1
#130=1(FLAG*DIRECTION)
!X+ORIENT*COMMAND!(PROBE1*ON)                               *2
G04X1.
M5
G04X1.0(PROBE1*DWELL)
GOTO60
N20
IF[#7NE-1]GOTO30
N22
#112=820(PROBE*X-*DIRECTION*BASE*NUMBER)                    *1
#130=-1(FLAG*DIRECTION)
!X-ORIENT*COMMAND!(PROBE2*ON)                               *2
G04X1.
M5
G04X1.0(PROBE2*DWELL)
GOTO60
N30
```

```
N30
IF[#7NE2]GOTO40
N32
#112=840(PROBE*Y+*DIRECTION*BASE*NUMBER)                    *1
#130=1(FLAG*DIRECTION)
!Y+ORIENT*COMMAND!(PROBE3*ON)                               *2
G04X1.
M5
G04X1.0(PROBE3*DWELL)
GOTO60
N40
IF[#7NE-2]GOTO50
N42
#112=860(PROBE*Y-*DIRECTION*BASE*NUMBER)                    *1
#130=-1(FLAG*DIRECTION)
!Y-ORIENT*COMMAND!(PROBE4*ON)                               *2
G04X1.
M5
G04X1.0(PROBE4*DWELL)
GOTO60'
```

*1 This is the base number used for calibration data for each stylus direction.

*2 This is the orientation function to align the stylus to the X+/X−/Y+/Y− directions. Most Mazak machine with this function use M19 S__, however horizontal machining centres (HCN) use M119 S__.

CAUTION: If placing the orientation functions (M19 S___) in this macro, you must ensure the stylus is clear of any obstructions when G65 P9632 is called. Failure to do so could result in stylus/probe or component damage.

Editing the probe stop cycle O9633

Entering the probe OFF code

The actual code required will vary from machine to machine and depend on the probe system used. Refer to the machine and relevant Renishaw hardware documentation. This can be input into the wizard or manually after the macros have been loaded onto the machine.

```
(-->*PROBE*OFF)
M00(PROBE*OFF)                                              *1
(<--*PROBE*OFF)
```

*1 Add the relevant probe OFF code. You can use multiple lines comprising M-codes and dwells (G4 Xx) as required.

Machine parameter settings

It is advised that the following parameters are set:

If using Mazatrol tool data (#120=1), set parameters “F93 bit 3” and “F94 bit 7” to 1. This activates the tool length from Mazatrol tool data in an EIA/ISO program. The tool length will be active from the M6 T command.

Set parameter “F114 bit 3” to 1. If this parameter is not set, the Z axis will move by the tool length amount when G49 (tool offset cancel) is commanded.

Mazak vertical machining centres with Smart controllers have a parameter to stop read ahead. Set “F93 bit 6” to 1 to ensure the macros work correctly.

Editing the tool offset program O9532

The following edits can be made.

Tool offset system variables

This must be set, depending on the number of tool offsets available on the machine. This is based on the machine being set to use Mazatrol tool data.

(*TOOL*OFFSET*SETTING)
#[600000+#3020] = (LENGTH)
#[660000+#3020] = (LENGTH WEAR)
#[610000+#3020]=#[610000+#3023]-[#3*2] (DIA RAD)

Tool offset setting	999 tool offsets or less (Mazatrol)	More than 999 tool offsets (Mazatrol)
Length wear Z	66000	660000
Length geometry Z	60000	600000
Radius geometry	61000	610000
Radius wear	64000	640000

Table 12.1 Tool offset system variables

Using the “flag only” method

It is expected that the settings to enable “flag only” alarms will suit FMS machining cells where the requirement is to run unmanned. The process error flag #148 will be set and it should be monitored after the relevant probe cycles for corrective action.

Example:

G65 P9412 X30. H0.2	Set the tolerance on the measured size.
IF[#148EQ1]GOTO999	Test for an out-of-tolerance condition.
continue the part program	
GOTO1000	
N999 G65 P5001	Pallet change. This changes the pallet to select the next component for machining (details are machine-dependent).
GOTO1	Go to the start of the program.
N1000	
M30	

Use of variables

Local variables

#1 to #32	These are used within each program as required for such things as calculations.

Common variables

#100	Stored position data.
#101 to #111	Unused variables.
#112	Calibration base number variable used for storing probe data.
#113	Z fast positioning feedrate (in the units of the machine). This is read in from the # [#112+9] value (mm/min) and the units converted.
#114	Unused.
#115	Unused.
#116	Active tool offset amount.
#117	Reserved.
#118	RADIUS TOO LARGE flag in cycles O9412/O9612, O9414/O9614 and O9222/O9522.
#119	XY fast positioning feedrate (in the units of the machine). This is read in from the # [#112+9] value (mm/min) and the units converted.
#120	Setting variable used in program O9524.
#121	Print option. The component number is incremented by 1 with each program heading. To reset, state #121 = 0.
#122	Print option. The feature number is incremented by 1 with each print program call. To reset, state #122 = 0.
#123	Start and end of block position zone. The normal setting is 0.05 mm (0.002 in). If the skip position is within this zone, the cycle aborts, with either a “PROBE OPEN” or “PROBE FAIL” alarm.
#124	Stored X skip position at the end of the basic move cycle (O9526/O9226).
#125	Stored Y skip position at the end of the basic move cycle (O9526/O9226).
#126	Stored Z skip position at the end of the basic move cycle (O9526/O9226).
#127	X average skip position at the end of the X diameter move cycle (O9521/O9522).

#128	Y average skip position at the end of the Y diameter move cycle (O9221/O9222).
#129	Inch/metric multiplier (1/25.4 [0.03937]/1.0 factor).
#135 to #149	See Chapter 3, “Cycle outputs”, for information.
#150 onwards	These are not used by the software.

Common retained variables

CAUTION: It is a feature of this software that all unit-dependent probe data is stored in millimetres, regardless of the current machine units. When this data is read, it is converted as required to suit the active machine units. This differs from previous versions of Renishaw inspection software.

#[#112+0]	(ZRAD) stylus calibration radius.
#[#112+1]	(XRAD/YRAD) X or Y stylus calibration radius.
#[#112+2]	Z stylus offset.
#[#112+3]	X or Y stylus offset.
#[#112+4]	Back-off factor.
#[#112+5]	L2 (crank) length.
#[#112+8]	Positioning feedrate.

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Chapter 13

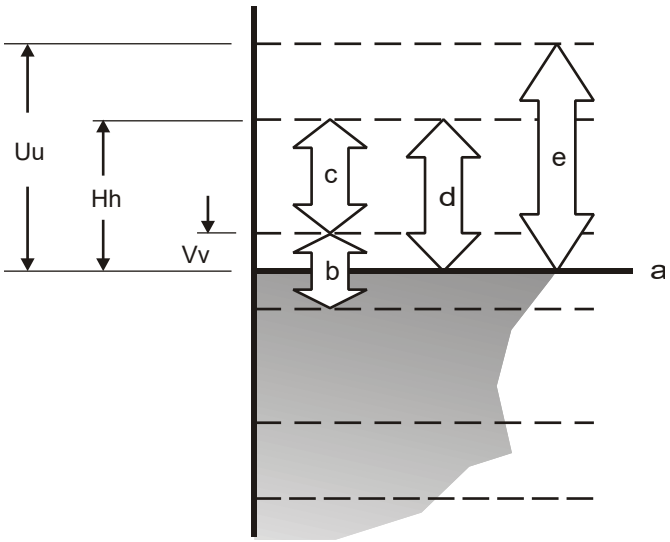
General information

This chapter contains general information and reference material that is relevant to the inspection software package.

Contained in this chapter

Tolerances

Inputs Uu, Hh and Vv apply to the size and tool offset updates only.



a = Nominal size.

b = Null band. This is the tolerance zone in which no tool offset adjustment occurs.

c = Area where the Ff input is effective in percentage feedback. F (0 to 1) gives 0% to 100% feedback to the tool offset.

Example: F0.5 will feed back 50% as the error.

d = OUT OF TOLERANCE alarm occurs. The tolerance value that applies to the size of the feature is defined by input Hh.

e = Uu upper tolerance. If this value is exceeded, no tool offset or work offset is updated and the cycle stops with an alarm. This tolerance applies to both size and position where applicable.

Figure 13.1 Size and tool offset update tolerances

True position tolerances

For a true position tolerance (Mm input), see Figure 13.2 below.

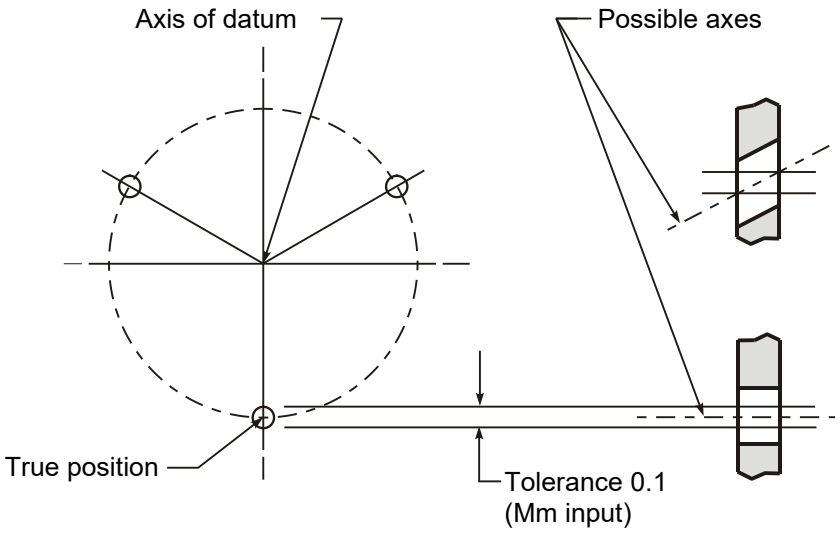


Figure 13.2 Cylinders centred on true positions

Experience values Ee

The measured size can be adjusted by an amount stored in a spare tool offset.

Example

Measure a 40 mm diameter and update tool offset 20.

G65 P9614 D40. T20. E21. — The experience value stored in tool length offset 21 will be added to the measured size.

Reason for using this option

Component clamping forces in some applications can influence the measured size. Therefore, an adjustment value to relate measurement to a traceable standard, such as a co-ordinate measuring machine, is desirable. Thermal effects can also be compensated for by using this method.

Additional spare tool offsets

The range of spare tool offsets can be extended when either a Type B or Type C tool offset option is installed on the machine.

Experience no.	Type A	Type B	Type C
E1 to En	✓	✓	✓
E201 to E20n		✓	✓
E601 to E60n			✓

where ‘n’ is the tool offset number.

From the table, you can see that you should add either 200 or 600 to the tool offset number.

These additional tool offset registers can safely be used for Ee experience values. The tool offset number is not used as a normal tool offset location.

Reporter print

Reporter print requires the Reporter app (A-5999-4200) to be installed and connected to the machine tool to receive measured data. This section explains the variables defined during software installation and gives a programming example.

Reporter Part ID variable

The Reporter Part ID variable is a machine variable that is used to set the Part ID number. The default variable is #156 but, if this is already being used by other programs, another appropriate variable can be selected during software installation.

Reporter requires the inclusion of a Part ID so that it can identify which component the measurement data is associated with. Typically, the program number is used as the Part ID. However, setting a different ID for each start and end sequence is possible assuming each number is unique. The Part ID can later be renamed in the Reporter app, but the number chosen still needs to be unique.

The G-code line to set the Part ID (for example, #156=2000) must be inserted in the program before the Data Send start macro (O9735).

Reporter Protocol variable

This variable is set during software installation and is used to specify the type of data being received. The default value is 157.

If you change the default value, you will also need to change the related variable in the Reporter app settings menu. For further information, refer to the Installation and user guide *Reporter for Mazak* (Renishaw part no. H-5999-8710).

Reporter Data variable

The data variable is set in the Reporter app configuration settings and is used to specify the base number for a range of 29 sequential machine variables required to hold data. For example, enter the value 158 to use machine variable range #158 to #186 (#158 + 28 variables).

If you change the default value, you will also need to change the related variable in the Reporter app settings menu. For further information, refer to Installation and user guide *Reporter for Mazak* (Renishaw part no. H-5999-8710).

NOTE: If these values are changed from their default value, ensure that no other applications or G-code programs use these variables.

On-machine programming

Once the inspection macros have been installed and configured on the CNC, programs can be created to measure features on components and the measuring results can be viewed in Reporter.

NOTE: If Set and Inspect is connected to the machine tool, manual programming of component inspection and reporting will not be required.

Data Send start and end

Reporting is enabled and disabled using the Data Send start and end macro which is embedded within the Probe Start and Probe Stop macros. The command line is written as shown below and is enabled with a W1.1 on the end of the Probe Start and Probe Stop macros. The example assumes #156 is used for the Part ID.

G65 P9632 W1.1

Embedded Data Send start macro:

G65 P9735 A1. B1. C0. I#156

After the measuring of features is complete, the Data Send macro must be run again.

G65 P9633 W1.1

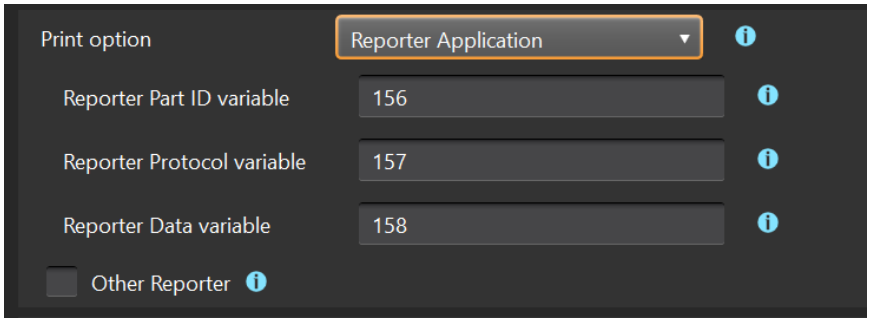
Embedded Data Send stop macro:

G65 P9735 A1. B2. C0. I#156

Description of Data Send inputs

Macro	O9735 call line	Description
Data Send – Start	`G65 P9735 A1. B1. C0. I#156`	A1. = informs Data Collector to expect one additional input containing data after the C input. **B1.** = informs Data Collector this is a Part Start command. C0. = not applicable (future requirement). **I#156** = informs Data Collector the variable containing the Part ID (for example #156).
Data Send – End	`G65 P9735 A1. B2. C0. I#156`	A1. = informs Data Collector to expect one additional input containing data after the C input. **B2.** = informs Data Collector this is a Part Stop command. C0. = not applicable (future requirement). **I#156** = informs Data Collector the variable containing the Part ID (for example #156).

NOTE: If other Reporter packages are present on the controller, the library will have the Data Send start and end macro already loaded. A tick box option is available within the wizard that pevents the Data Send (O9735) start and end macro being generated when the wizard is run.



W input for measured feature macros

The W input acts as the feature ID number. The feature number that is being measured must be added to the feature measurement macro line.

NOTE: A suffix of ".1" must be added to the W inputs to output measurement results to Reporter.

Example: XYZ single surface measurement with reporting

O2000	
G40 G80	
G91 G28 Z0.	
G90	
M6 T1	Select the probe.
G54	Start position.
G01 G43 H1 Z15. F3000.	Set the probe to the retract position away from the surface.
#156=2000	Part ID set to 2000.
G65 P9632 W1.1	Switch on the probe (this includes M19). Also starts the print option for Reporter app.
G65 P9410 Z10. F3000.	Protected positioning move to the start position.
G65 P9411 Z0.0 W1.1	Measure the surface position in Z and set the feature as 1 in Reporter app.
G65 P9410 Z15.	Protected positioning move to the retract position.
G65 P9633 W1.1	Switch off the probe (this includes M19). Also stops the print option for Reporter app.
G91 G28 Z0.	
G90	
M30	

Print program (O9730)

The print program (O9730) is called automatically by a cycle using the Ww input. A formatted print report is then generated as the cycle runs. The component number can be incremented by cycle control (see input Ww in Chapter 2, “Optional inputs”). However, it must be reset external to the cycles when necessary (i.e. set #121=1).

Example of printing a cycle output

```
---------------------------------------------------------------------------
COMPONENT NO /31/ FEATURE NO /1
---------------------------------------------------------------------------
POSN R/79.0569/ ACTUAL /79.0012/ TOL TP/ 0.2000/ DEV /−0.0557
POSN X/−45.0000/ ACTUAL /−45.1525/ TOL TP /0.2000/ DEV /−0.1525
POSN Y/−65.0000/ ACTUAL /−64.8263/ TOL TP /0.2000/ DEV /0.1737
+++++OUT OF POS+++++ ERROR TP /0.1311/ RADIAL
ANG /−124.6952/ ACTUAL /−124.8578/ DEV /−0.1626
---------------------------------------------------------------------------
COMPONENT NO /31/ FEATURE NO /2
---------------------------------------------------------------------------
SIZE D/71.0000/ ACTUAL /71.9072/ TOL /0.1000/ DEV /0.9072
+++++OUT OF TOL+++++ ERROR /0.8072
POSN X/−135.0000/ ACTUAL /−135.3279/ DEV /−0.3279
POSN Y/−65.0000/ ACTUAL /−63.8201/ DEV /1.1799
```

NOTE: Additional “/” characters are included for use as a delimiter, allowing easy loading of the results into a spreadsheet if required.

Variables #121 and #122

When Renishaw non-contact tool setting (NCTS) software is used in conjunction with this inspection software, you must be aware that variables #121 and #122 will be overwritten by the NCTS software. These variables are used as counters in the inspection software print program. Use alternative free variables instead of #121 and #122 and edit O9730 accordingly. Alternatively, they can be set manually in part programs:

Example: #121=1
#122=1

General probing applications

Use of probe switch-on and protected positioning cycles

As the crank length of the stylus is added during the probe switch-on cycle, it is important that this cycle is run before any other programs are used.

It is also recommended that all stylus moves within the machining envelope are performed using the protected positioning cycle, as this will add the correct stylus length to any moves in the correct axis orientation.

Probe direction flag (#130) using multiple styli in the same orientation with different configurations

In certain circumstances it is necessary to use two styli in the same orientation but with different configurations, such as different ball diameters or stylus lengths. In this situation, the probe switch-on cycle (O9632) must be edited to suit as follows:

N22

#112=820(PROBE*X-*DIRECTION*BASE*NUMBER)

#130=-1(FLAG*DIRECTION) See note 1

M19S0(EDIT*PROBE*ORIENT*COMMAND)

GOTO60

Note 1 Edit this line to match the stylus orientation required. If multiple X+ stylus orientations are required, then ensure this is set to #130=1.

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Appendix A

Features, cycles, and limitations of the inspection software

Contained in this appendix

Features of the inspection software

- Protected positioning.
- Measurement of internal and external features to determine both size and position. This includes:
  - ▶ Obtaining a hard copy printout of feature data.
  - ▶ Applying tolerances to both size and position.
- Additional features for feedback of errors include:
  - ▶ Experience values can be applied to the measured size.
  - ▶ Percentage feedback of the error can be applied.
  - ▶ Null band zone for no tool offset update.
- Software option to turn off the tolerance alarms and provide a flag-only alarm. Suitable for FMS and unmanned applications.
- Built-in stylus collision for all cycles.
- Diagnostic and format error-checking routines for all cycles.
- Active workpiece co-ordinate (WPC) updating.
- Mazatrol tool data and ISO tool offset updating.

Cycles

- Protected positioning.
- Calibration cycles (calibrating on a sphere).
- Measurement:
  - ▶ XYZ single surface.
  - ▶ Web/pocket.
  - ▶ Bore/boss (four measuring points).

Limitations

General

- The probe cycles will not run if “mirror image” is active.
- Consider macro variable availability.
- Requires G31 skip function and custom macro.

This software package can be used with Mazatrol Matrix and Smooth controllers.

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