



For Tool Setting Probes



Tool Measurement



Tool Length Measurement



Tool Breakage Detection



Axes Compensation

Programming instructions English

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We always supply the latest software version. If another version is requested, please contact our Service Department / Hotline.

Prior to the start-up procedure it is mandatory to check if the parameters and the software range are already used by other programmes. If so, the cycles must be adapted because overwriting of used parameters and data can have unpredictable influence on the machine and could cause damage.

After finishing the installation, the used parameters and the performed changes to programme and machine must be documented.

Blum-Novotest GmbH is not liable for damages to the machine due to programming errors or faulty application of the measuring cycles. Installing the measuring cycles, the mentioned warranty exclusions are accepted.

We reserve the right for technical modifications which improve the product. All suggestions for improvement are gladly accepted.

Decisive for the technical content is the language version of the manufacturer (DE/EN).

Original operating instructions

Please read the manual carefully first, then start up the measuring system and the measuring cycles!

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Content

1. Introduction	4
1.1 Explanation of warnings	4
1.2 Keys.....	4
1.3 Further applicable documents.....	4
1.4 Abbreviations.....	4
1.5 Intended use	4
2. System description	5
2.1 Operating mode.....	5
2.2 Applications	6
2.3 Programme overview.....	6
2.4 General information	7
2.4.1 Operating mode.....	7
2.4.2 Cycle call	7
2.4.3 Approach and retracting strategy.....	7
2.4.4 Process error.....	7
2.4.5 Tool data processing	7
2.4.6 Unknown tool length	7
3. Description of the Measuring Cycles.....	8
3.1 Call parameter	8
3.2 Entering the call parameter (mm/inch)	8
3.3 Calibration of the probe.....	9
3.4 Temperature compensation of the NC axes	9
3.5 Tool length measurement	10
3.6 Examples.....	12
3.6.1 Calibration / temperature compensation.....	12
3.6.2 Drill Ø 8mm.....	13
3.6.3 Cutting head Ø 60mm.....	14
3.6.4 End mill Ø 6mm	15
3.6.5 Ball mill Ø 6mm.....	16
4. Error messages	17

1. Introduction

1.1 Explanation of warnings



CAUTION!

signifies a danger, which may cause injuries, if it is not avoided.

NOTICE

indicates measures to prevent material damage.

1.2 Keys



Additional advice



Further applicable documents, related literature

Please also observe the documentation of the machine manufacturer.

1.3 Further applicable documents



Installation instructions P83.0175-029.390

1.4 Abbreviations

TC Temperature compensation

1.5 Intended use

The BLUM measuring cycles can be used with the following BLUM measuring systems:

- Z-Nano / Z-Nano IR / Z-Nano RC / Z-Pico

2. System description

The tool setting probe is a tactile high-precision measuring system for automated measurement of the tool geometry within the working area of a machining centre working under normal operating conditions. When measuring the tool length, incorrectly loaded tools or inaccurately pre-set tools are recognized in due time, as well as worn or damaged tools. This helps to avoid further damage to the workpiece or to the following tool.

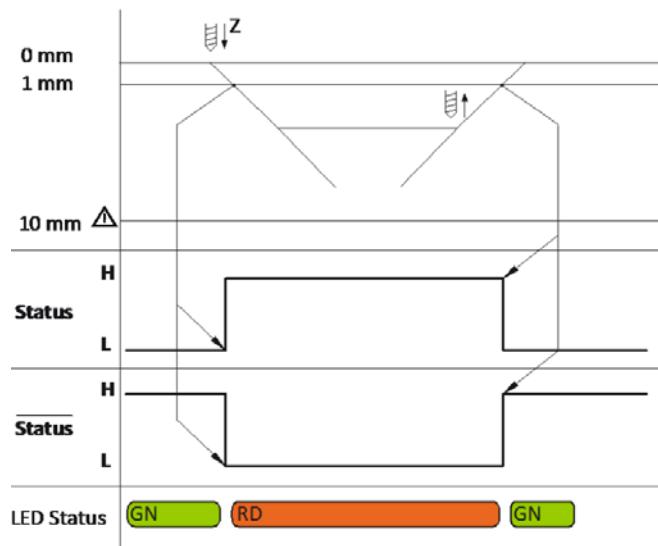
Advanced possibilities for tool setting, breakage detection and contour monitoring of rotating tools are available with the non-contact BLUM Laser System. Further information can be obtained from our technical service department.

2.1 Operating mode

The tool setting probe is a high-precision switch and is built into a rigid body together with the corresponding electronic parts. When the measuring system is deflected, the status of the probe changes at a certain defined position.

Blum offers two kinds of technologies. The cable bound as well as the infrared or radio probes. Both systems are designed for operating voltage 24V DC. The output signals have the same voltage level. The cable bound systems are ready for operation immediately after the operating voltage is switched on. Infrared and radio systems have to be switched on and off before and after measurement. The following output signals are available:

- The **Output STATUS** issues the following signal levels depending on the probe deflection:
0 V with not actuated tool setting probe (probe not deflected)
24 V with actuated tool setting probe (probe deflected)
- The **Output STATUS INVERSE** issues the following signal levels depending on the probe deflection:
24 V with not actuated tool setting probe (probe not deflected)
0 V with actuated tool setting probe (probe deflected)



Notes concerning measuring sequence

NOTICE

Risk of collision

- Limit measuring block overtravel within 2 mm

 Pay attention to maximum feed rate of the machine manufacturer

 Calibration and tool measurement at the same constant feed rate

For further information concerning the corresponding probe, please refer to the operating instructions.

2.2 Applications

The following measuring tasks can be solved with the BLUM standard cycles:

- Calibration of the measuring system (with O8914)
- Compensation of thermal drift (with O8914)
- Tool length measurement (with O8915)
- Tool wear monitoring (with O8915)
- Tool breakage detection (with O8915)

2.3 Programme overview

Subroutines:

The subroutines are called by the individual measuring cycles. During commissioning, machine-specific adaptations must be made in the subroutine marked with #.

- O8917 # Machine-specific constants, User Start / User End Programme
O8918 Error messages

Available measuring cycles:

- O8914 Measuring cycle calibration / temperature compensation
O8915 Measuring cycle tool length measurement

Example programmes:

The example programmes show, which parameters have to be defined when calling the measuring cycles and how the measuring cycles can be called from the machining programme.

- O0914 Example programme for cycle call O8914 calibration / temperature compensation
O0915 Example programme for cycle call O8915 tool length measurement

2.4 General information

NOTICE

Risk of collision

Blum-Novotest GmbH is not liable for damages to the machine due to programming errors or faulty application of the measuring cycles.

2.4.1 Operating mode

The probe sends a signal (STATUS or STATUS INVERSE) which is connected with a measurement input of the control. In the measuring block, the signal is detected by the control and the axis positions at the trigger point will be saved. These axis positions are read and processed in the measuring cycles. The axis positions (trigger points) at tool measurement are compensated with those of calibration. Therefore, the tool dimensions are determined.

2.4.2 Cycle call

The measuring cycles can only be carried out in operating mode "AUTO" or "MDI". The measuring task will be defined by the called measuring cycle and the call parameters.

The input of the call parameters must always take place in the measuring system of the machine, otherwise the cycle is interrupted with an error message. For all examples, metric system has been selected.

Some call parameters are optional, i. e. they are not required to be programmed. Parameters, which have not been transmitted, are automatically set to default values. In the following chapters they are marked as optional parameters. Essential parameters must be programmed in any case. We recommend that all parameters are specified to make sure that the programme is precisely defined.

2.4.3 Approach and retracting strategy

Before the measuring task, the machine moves to a retract position in the tool length axis. Following that, the radius and minor axis will be positioned above the probe. Now, the measuring task is being executed. It ends with the approach of the retract position in the tool length axis.

2.4.4 Process error

During cycle call, the set parameters are evaluated. If any incorrect values are detected or if there is risk of collision, the cycle is interrupted with an error message.

2.4.5 Tool data processing

The cycles are using the tool corrections of the actual H-number of the tool in the spindle. For positioning the tool, the tool length (geometry and wear) will be added.

Used tool length:

$$\#102 = \#134 + \#136$$

In order to ensure correct operation of the tool checking cycles, an initial measurement has to be made with each tool (e.g. with O8915 and measuring mode **B0.**). If errors on the workpiece are corrected via the tool data (e.g. in the wear values), the tolerance limits must be extended at the tool control.

2.4.6 Unknown tool length

Tools with unknown tool length can be measured by the measuring mode **B0.**, if the value 0 is entered in the tool offset memory. Tools with unknown tool length, the prepositioning above the probe is not applicable. Measurement is started on the maximum permitted tool length (search run with non-rotating spindle). At unknown tool lengths, there is risk of collision with the probe system. It is recommended to enter a rough tool length or a rough tool radius (+/- 2 mm).

3. Description of the Measuring Cycles

3.1 Call parameter

	Definition / Meaning	Option
H	Tool offset number (H-code). H-code of the tool to be measured. Note: If H is not defined, the H-code is automatically determined.	Optional
B	Measuring mode cycle 08914 calibration 0 = calibration, 1 = TC-reference measurement, 2 = TC-comparative measurement Note: If B is not defined, calibration will be executed with B0. (calibration). Measuring mode cycle 08915 length measurement 0 = measurement 1 = verification, 2 = check Note: If B is not defined, measurement will be executed with B0. (measuring).	Optional
Q	Wear tolerance tool length At B1. the tool is checked to be within tolerance. The wear value will be written into the tool memory. At B2. the tool is checked to be within tolerance. No wear value is written in the tool memory. Note: If Q is not defined, #138 is used as wear tolerance.	Optional
R	Radial position for length measurement ROFFS Offset in X- or Y-direction for accentric positioning of the tool above the probe. Note: If R is not defined, the radius value from the tool table is used.	
U	Maximum admissible offset at TC comparative measurement The thermal increase of the machine is limited. To detect errors during measurement, a tolerance limit for the TC comparative measurement is defined. Note: If U is not defined, the max. admissible offset #149 is used.	

3.2 Entering the call parameter (mm/inch)

The current measuring system of the machine (mm/inch) is read at the beginning of the cycle. The basic settings of the variables in the subroutine O8917 are calculated automatically. Therefore, these variables need not be modified.

NOTICE

Malfunction

- The call parameters have to be entered depending on the measuring system of the machine (values given in mm or inch). All programming examples are displayed in mm.

Proceeding after change of measuring system from mm to inch.

- Executing of programme calibration with values in inch: e.g. G65 P8914 H99. B0.
- Call of the desired cycles with values in inch: e.g. length measurement G65 P8915 H9. B0. R1.1811

Proceeding after change of measuring system from inch to mm.

- Executing of programme calibration with values in mm: e.g. G65 P8914 H99. B0.
- Call of the requested cycles with values in mm: e.g. length measurement G65 P8915 H9. B0. R30.

3.3 Calibration of the probe

Before the Z-probe can be used for measuring, the measuring system must be calibrated. That means, the precise position of the trigger point will be determined. For this purpose, a wear-free calibration tool is used, e.g. a cylindrical pin ($\varnothing > 4\text{mm}$). The calibration tool is clamped into a tool holder. The length of the calibration tool must be determined precisely (μm resolution), either with a tool pre-setting device or inside the machine with a dial gauge and then stored in the tool memory.

The cycle determines the trigger point positions and calculates the calibration values as the difference to the known dimensions of the calibration tool. They are entered as parameters and must not be overwritten by any other programme. On future tool length measurement, these values are used for positioning and calculation of the tool length.

Call: G65 P8914 H.. B..

Parameter	Description	Default value
1. H	Tool offset number (H-code)	optional
2. B	Measuring mode	0 optional

Example for calibration:

T99 M6	Tool call
G65 P8914 H99. B0.	Cycle call with B0. (calibration). The input of B0. is not mandatory.

Attention:

- The exact length and radius of the reference tool has to be recorded in the accompanying tool offset memory.
- The override should be set on 100% to avoid measuring errors by different measuring feed rates.

3.4 Temperature compensation of the NC axes

For increased accuracy requirements, the temperature drift of the machine can be compensated with the help of the Z-probe system and the calibration tool. The cycle defines the trigger point position and calculates the TC reference values (**B1.**) or TC offset values (**B2.**) depending on the defined length of the calibration tool. They are entered as parameters and must not be overwritten by any other programme.

Call: G65 P8914 H.. B.. U..

Parameter	Description	Default value
1. H	Tool offset number (H-code)	optional
2. B	Measuring mode	0 optional
3. U	Maximum admissible offset at TC comparative measurement	0.2 mm optional

Notes:

The integration of TC measurement into a normal machining process should be performed as follows:

- Calibration of the probe with the calibration tool.
- Measurement of all used tools.
- Test machining of the first workpiece, until all workpiece dimensions are in compliance with the rated dimensions.
- TC reference measurement (**B1.**), keeping the actual machine status as a reference value.
- Machining of the next workpiece.
- TC comparative measurement (**B2.**) for determination of the present axis offset with respect to the reference values and for calculation of the additive zero point offset, for example.
- Depending on the temperature drift of the machine and required precision, TC comparative measurement can be performed, before or after any desired number of machining tasks.

Example for a reference measurement:

T99 M6
G65 P8914 H99. B1.

Tool call
Cycle call with **B1.** (reference measurement).

Example for TC comparative measurement:

T99 M6
G65 P8914 H99. B2. U0.2

Tool call
Cycle call with **B2.** (comparative measurement). The input of **U0.2** is not mandatory. In this case, the reference value is used of **#149.**

Return parameter:

- The measured drift of the length axis is available in the parameter **#[#139+1].**
- At comparative measurement and exceeding of the max. admissible tolerance, an error message is given.

Attention:

- The exact tool length of the reference tool has to be written in the accompanying tool offset memory.
- The override should be set on 100% to avoid measuring errors by different measuring feed rates.

3.5 Tool length measurement

The tool length can be measured precisely by the probe. The rough tool length (+/- 2 mm) **should** be entered into the tool offset memory. The temperature related dilatation of the machine can be compensated if the calibration cycle is carried out first.

At the beginning of the measurement, the pre-set tool length and tool wear are read from the tool offset memory and used for positioning. At the end of the measurement, the determined length is written into the tool offset memory, the wear value is set to 0.

Call: **G65 P8915 H.. B.. Q.. R..**

Parameter	Description	Default value
1. H	Tool offset number (H-code)	optional
2. B	Measuring mode	0 optional
3. Q	Wear tolerance tool length	0.02 optional
4. R	Radial position for length measurement ROFFS	0 optional

Example for tool length measurement:

T7 M6
G65 P8915 H7. B0. Q0.02 R0.

Tool call
Cycle call with **B0.** (first measurement). The input of **B0.** is not mandatory.

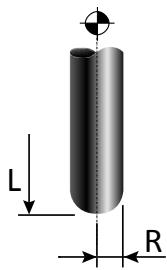
Attention:

- The rough tool length **should** be entered into the known tool offset memory. Tools with unknown tool length can be measured if the length value 0 is entered into the tool memory. At unknown tool lengths, there is risk of collision with the probe system. It is recommended to enter a rough tool length (+/- 2 mm).
- For tool length measurement (first measurement), **B0.** must be set.
- For tool wear measurement, **B1.** must be set. Depending on the wear value, it will be written in the tool offset memory. If tolerance **Q** is exceeded, the error message "E8 Out of tolerance" will be displayed. If double tolerance **Q** is exceeded, the error message "E9 tool broken" will be displayed.

- For tool control, **B2.** must be set. No wear value is written. If tolerance **Q** is exceeded, the error message "E8 Out of tolerance" will be displayed. If double tolerance **Q** is exceeded, the error message "E9 tool broken" will be displayed.
- Alternatively to the radius value of the tool offset memory, an eccentric offset ROFFS in **R** can be indicated.
- If **Q** is not defined, the default value will be used from O8917 (see installation instruction "machine-specific constants" chapter 4.6).
- The override should be set on 100% to avoid measuring errors by different measuring feed rates.

3.6 Examples

3.6.1 Calibration / temperature compensation



Calibration **B0.**:

T99 M6

Tool call

G65 P8914 H99. B0.

Cycle call with **B0.** (calibration). The input of **B0.** is not mandatory.

TC reference measurement **B1.**:

T99 M6

Tool call

G65 P8914 H99. B1.

Cycle call with **B1.** (reference measurement).

TC comparative measurement **B2.**:

T99 M6

Tool call

G65 P8914 H99. B2. U0.1

Cycle call with **B2.** (comparative measurement) and a max. allowed offset at the TC comparative measurement of **U0.1.**

3.6.2 Drill Ø 8mm



Measuring **B0**:

T7 M6

Tool call

G65 P8915 H7. B0.

Cycle call with **B0**. (first measurement). The input of **B0**. is not mandatory.

Verification **B1**:

T7 M6

Tool call

G65 P8915 H7. B1. Q0.02

Cycle call with **B1**. (wear measurement) and the tool length-wear tolerance **Q 0.02**.

Check / breakage detection **B2**:

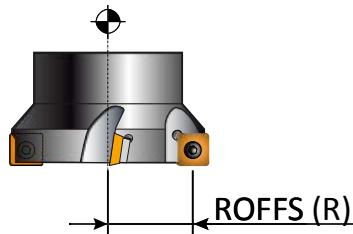
T7 M6

Tool call

G65 P8915 H7. B2. Q0.05

Cycle call with **B2**. Cycle call with **B2**. (breakage detection) and the tool length-wear tolerance / breakage tolerance **Q0.05**.

3.6.3 Cutting head Ø 60mm



Measuring **B0.**:

T9 M6

Tool call

G65 P8915 H9. B0. R30.0

Cycle call with **B0.** (first measurement) and radial offset ROFFS **R30.0** in X- or Y-direction. The input of **B0.** is not mandatory.

Verification **B1.**:

T9 M6

Tool call

G65 P8915 H9. B1. Q0.02 R30.0

Cycle call with **B1.** (wear measurement), radial offset ROFFS **R30.0** in X- or Y-direction, and tool length offset tolerance **Q0.02.**

Check / breakage detection **B2.**:

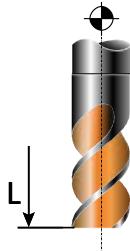
T9 M6

Tool call

G65 P8915 H9. B2. Q0.05 R30.0

Cycle call with **B2.** (breakage detection), radial offset ROFFS **R30.0** in X- or Y-direction, and tool length wear tolerance / breakage tolerance **Q0.05.**

3.6.4 End mill Ø 6mm



Measuring **B0.**:

T10 M6

Tool call

G65 P8915 H10. B0.

Cycle call with **B0.** (first measurement). The input of **B0.** is not mandatory.

Verification **B1.**:

T10 M6

Tool call

G65 P8915 H10. B1. Q0.02

Cycle call with **B1.** (wear measurement) and tool length wear tolerance **Q0.02.**

Check / breakage detection **B2.**:

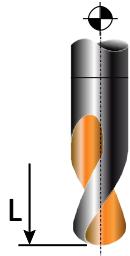
T10 M6

Tool call

G65 P8915 H10. B2. Q0.05

Cycle call with **B2.** (breakage detection) and tool length wear tolerance / breakage tolerance **Q0.05**

3.6.5 Ball mill Ø 6mm



Measuring **B0.**:

T15 M6

Tool call

G65 P8915 H15. B0.

Cycle call with **B0.** (first measurement). The input of **B0.** is not mandatory.

Verification **B1.**:

T15 M6

Tool call

G65 P8915 H15. B1. Q0.02

Cycle call with **B1.** (wear measurement) and tool length wear tolerance **Q0.02.**

Check / breakage detection **B2.**:

T15 M6

Tool call

G65 P8915 H15. B2. Q0.05

Cycle call with **B2.** (breakage detection) and tool length wear tolerance / breakage tolerance **Q0.05.**

4. Error messages

If an error occurs, the error number is set in the error parameter **#108** and an error message will be displayed. The programme must be interrupted by the key RESET, the cause of the error must be eliminated and the programme must be restarted.

Legend:

E1	= Error message
	= Error description
	= Check the following points
	= Remedy

E1 Call parameter H undefined

 Tool correction number **H** is 0. Reading or writing of tool data is not possible.

 (1) Was tool offset number **H** programmed in the programme call?

 (1) Programme tool correction number **H**.

E4 Incorrect call parameter

 One or more call parameter are set with a critical or invalid value.

 (1) Are the call parameter **H, B, Q, R** and **U** set correctly?

 (1) Check all the call parameters for valid values.

E5 Wrong tool length / radius

 The inserted tool length or the measuring position is faulty. Risk of collision.

 (1) Are the parameters **#131** or **#132** in programme O8917 set correctly?
 (2) Do the tool data exceed the limit?

 (1) Define the limits in programme O8917 correctly.
 (2) The tool cannot be measured.

E6 Error start measuring block

 The measuring block cannot be executed, as the measuring signal is already high-active or the tool is in a wrong starting position towards the probe.

 (1) Is the probe wired correctly?
 (2) Are the measuring positions in the parameters **#111 - #113** defined correctly?

 (1) Check function of probe.
 (2) Check measuring position in programme O8917.

E7	Measuring block without trigger point
	No trigger signal has been detected during the measuring block.
	(1) Is the probe wired correctly? (2) Is the tool shorter than the minimum tool length in parameter #132? (3) Are the measuring positions in the parameters #111 - #113 defined correctly?
	(1) Check function of probe. (2) Define the tool limit measurements in programme O8917 correctly. (3) Define measuring positions in programme O89917 correctly.
E8	Tool out of tolerance
	The admissible wear tolerance was exceeded.
	(1) Is the tool worn or broken? (2) Was the tool drawn out of the holder? (3) Are there chips on the probe or on the cutting edge?
	(1) Check tool or tool data. (2) Replace tool. (3) Remove the chips.
E9	Tool broken
	The admissible wear tolerance was exceeded twice. No trigger point was recognized at tool measurement.
	(1) Is the tool broken?
	(1) The tool has to be replaced.
E10	Wrong calibration or TC parameter
	The calibration values differ too much from the measuring position in the calibration cycle. Risk of collision with the tool setting probe!
	(1) Are the measuring positions in the parameters #111 - #113 defined correctly? (2) Is the tool setting probe calibrated?
	(1) Define measuring positions in programme O8917 correctly. (2) Run calibration cycle O8914.
E11	Temperature drift exceeds limit
	The measured temperature drift exceeds the admissible limit.
	(1) Is the tolerance U set too small? (2) Is the machine at operating temperature?
	(1) Increase tolerance U . (2) Carry out warming-up programme.

E12 Incorrect table parameter

With the parameters set in section 1 / programme O8917 the measuring cycle can not be executed.



Are the parameters in section 1 of programme O8917 defined correctly?



(1) Check the input values of the following parameters:

- #116 = Diameter probe
- #125 = Number of the radius axis
- #126 = Approach side radius axis
- #129 = Safety distance
- #130 = Maximum overtravel
- #138 = Tool wear tolerance
- #139 = Start address for calibration parameters
- #142 = Programme stop with error message
- #147 = Spindle indexing at standing spindle
- #149 = Max. admissible offset at TC comparative measurement



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