Safety Instructions

This height measuring instrument employs the state-of-the-art technology and complies with recognized safety regulations. Nevertheless, the operator or third parties can risk life or limb if the following safety instructions are not strictly observed!

1. All operators must read the safety instructions and the enclosed operating instructions thoroughly before putting the height measuring instrument into operation.
2. This height measuring instrument must only be used if it is in perfect technical condition. Any malfunctions, particularly those impairing safety, must be eliminated immediately.
3. This height measuring instrument must only be used for the intended purposes and in accordance with the operating instructions provided. The operating instructions must be stored in the immediate proximity of the site where the height measuring instrument is being used.
4. Before connecting the height measuring instrument to the mains, make sure that the voltage specified on the rating plate agrees with the local mains voltage. If the two voltages do not agree, do not connect the height measuring instrument under any circumstances!
5. The height measuring instrument may only be connected to socket outlets with properly grounded contacts. Extension cables must meet the stipulations of the local electrical standards or similar.
6. Any modification or manipulation of the height measuring instrument requires the express written approval of Mahr GmbH and must be carried out by qualified personnel. Unauthorized opening of the height measuring instrument and unauthorized intervention invalidates the warranty and frees Mahr GmbH from any liability. Before opening the height measuring instrument, switch off the unit and pull the mains plug from the mains socket outlet.
7. Before cleaning the height measuring instrument, pull the mains plug from the mains socket outlet. Never let any liquids penetrate the height measuring instrument! Do not use cleaning agents that are harmful to plastics.
8. If a fuse needs replacing, only a fuse of the same type - in terms of Amperage and blow characteristics - may be used. When exchanging fuses, follow the procedure outlined in the operating instructions.
9. All relevant safety and accident prevention regulations must be complied with. Your safety expert will provide further instructions based on local circumstances and in-house guidelines.
10. Do not operate the height measuring instrument in rooms filled with explosive gases. An electrical spark could trigger an explosion.
11. Never move the height measuring instrument to the edge of the base plate at speed. The air cushion carrying the column will be unable to dissipate quickly enough to decelerate the height measuring instrument before it reaches the edge. This could cause the height measuring instrument to fall off the base plate and harm the operator.

When returning the height measuring instrument, please ONLY ship the height measuring instrument in its original carrying case and on an appropriate pallet! Failure to do this will invalidate the warranty!
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15. Declaration of conformity
1. Delivery and setting up

1.1 Scope of supply
1.2 Unpacking
5

![Warning](image)

- 350 mm: 25 kg
- 600 mm: 30 kg
- 1000 mm: 35 kg
1.3 Description and explanation of the height measuring instrument

1.3.1 Height measuring instrument

1. Transport protection screw
2. Mount for probing element carrier
3. Probing element carrier
4. Contact point
5. Limit plate
6. LED display
7. Handle for manually moving the slide
8. Control and evaluation unit
9. Display
10. Keypad
11. Quick-keys
12. Hand grip
13. Transport handle
14. Switch for activating the air bearings
15. Socket for mains power charger
16. ON/OFF switch (power supply)
17. Rechargeable battery compartment (accumulator)
18. Interface connection for the measuring column (HEIGHT GAGE)
19. Interface connection for digital indicators (INPUT 1) required for perpendicularity checks
20. Interface connection for incremental probes P1514H (INPUT 2) required for perpendicularity checks
21. RS232 OUT to send individual measured values to a PC and/or a statistics printer
22. USB B port for connection to a PC
23. USB A port for connecting a printer
24. Plug for mains power supply
1.3.2 Keypad

- **Measuring function keys**
- **Variable function keys**
- **Evaluation function and measuring program keys**
- **Calibration and set up function keys**
- **Delete and accept function keys**
- **Keypad**
- **Active / deactivate the Quick Mode**
- **Arrow keys**
1.3.2.1 Measuring functions

Refer to chapters 4.3 - 4.7

1.3.2.2 Evaluation functions and measuring program

Show or hide the measuring results

Measuring program functions – See chapter 7

Statistics functions – See chapter 8

1.3.2.3 Calibration and set up functions

Calibrate a probe – See chapter 4.1

Zero point – See chapter 4.2

Menu settings – See chapter 6

1.3.2.4 Delete or accept a function

Data transmission / select data for transmission – See chapter 9.1

Delete values and return to sub menu / cancel – See chapter 5

Confirm a function – switch the Height Measuring Instrument ON / OFF
1.3.2.5 Variable function keys

Depending upon the measuring task, the bitmap symbols above the variable function keys change accordingly. By pressing the individual key, the function will be activated or you will enter a subdirectory / lower level. The different meanings are described in the operating instructions.

1.3.2.6 Input pad

Each key is assigned a multiple character function, by repeatedly pressing a key the next assigned character will appear, for example:

2 -> A -> B -> C -> 2 -> A . . .

1.3.2.7 Quick-Mode

Activate / deactivate

1.3.2.8 Arrow keys

Arrow keys left / right - Cursor jumps 5 times left / right
Arrow keys up / down - Cursor jumps once up / down
1.3.3 Display

- Characteristic number
- Actual measured value
- Quick Mode activated/deactivated
- Quick Mode plane / bore
- Actual axis
- 2 D Mode is activated
- Unit of measurement
- Date and time
- Charging condition of the battery
- Variable function keys
- Actual character
- Display field
- Stored measured values
1.3.4 Interface connections

- **USB-Interface**
  - Type A: Port for a USB printer
  - Type B: PC port

- **RS 232 Interface**
  - OUT: To connect either a PC or statistics printer

- **SUB D-Interface 15-pin**
  - To connect an incremental probe, required for perpendicularity checks

- **SUB D-Interface 25-pin**
  - To connect to the measuring column

See chapter 9.2
See chapter 4.4.2
See chapter 4.4.2
See chapter 1.2
1.3.5 Description of the symbols

1.3.5.1 Keypad symbols

- Contacting a plane / surface from above
- Contacting a plane / surface from below
- Measuring a groove
- Measuring a bar
- Measuring a bore
- Measuring a shaft
- Contacting a shaft from above
- Contacting a shaft from below
- Contacting a bore from above
- Contacting a bore from below
- Determining the center of a bore / displaying the position
- Min-Max function
- Perpendicularity
- Measuring a taper / angle
- 2D-selection key
- Calibrating a probe
- Zero point
- Delete / Return to last value
- Select data for transmission
- Menu settings
- ON / OFF / Confirm
- Measuring program functions
- Statistics function
- Display the list of measured values
- ON / OFF
1.3.5.2 Symbols - function keys

- **Calculate distance**
  - Calculating the symmetry between 2 planes
- **Auto**
  - Automatic calculation of the distance
- **Automatic zero point 01, last measured value**
  - Zero point, last measured value
- **Relative value**
  - Absolute value
- **Stop / Accept**
  - Pause
- **Repeat/ Continue**
  - Cancel
- **Delete last characteristic**
  - Delete all characteristics
- **Calibrate twin probe**
  - Inferior calibrated value
- **Calibrate probe / groove**
  - Calibrate the probe / ledge
- **Calibrate ledge from below**
  - Calibrate ledge from above
- **Vertically contact a ledge**
  - Horizontally contact a ledge
- **Select horizontal probe**
  - Select vertical probe
- **Travel upwards**
  - Travel downwards
- **Contacting a bar from above**
  - Contacting a shaft from above
Set the zero point on the base plate

Work piece, zero point 02

Enter Preset

Direct / select data transmission

Store on internal memory

Paper feed

TAB-function

Determining distance and angle

two elements

Rotate coordinates X / Z

Determining distance and angle

three elements

Tilting the workpiece arithmetically

Manually enter the tilting angle

Rotate clockwise

Set X-value to zero

Work piece, zero point 01

Work piece, zero point 03

Change between zero points

Print

Transfer a series of measurements to a PC

Position the cursor to the beginning

Switch between upper and lower case

Coordinate transformation

Rotate according to angle

Tilting angle $\alpha$

Index circle

Determine the tilting angle with a probe

Rotate anti-clockwise

Set Z-value to zero
1.3.5.3 Symbols - display

- Bore from above
- Bore from below
- Shaft from below
- Shaft from above
- Bore
- Shaft
- Contacting from above
- Contacting from below
- Symmetry
- Distance, bar
- Distance
- Min Max
- Distance, groove
- Internal angle
- Perpendicularity
- Display diameter
- External angle
- Taper
- Index circle
- Coordinate
- Straightness
- Distance 2D
2. Commissioning / First steps

<table>
<thead>
<tr>
<th>Description / Sequence</th>
<th>Symbols / Pictures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2.1 Switching ON</strong></td>
<td></td>
</tr>
<tr>
<td>– Switch the mains power supply switch to ON = (1)</td>
<td><img src="ON_OFF.png" alt="Switch ON/OFF" /></td>
</tr>
<tr>
<td>Press the ON/OFF key; this will start the boot up.</td>
<td></td>
</tr>
<tr>
<td><strong>Note:</strong> At the first commissioning, by a RESET or when updating the software, the following questions (the basic settings) will appear:</td>
<td></td>
</tr>
</tbody>
</table>

| **2.2 Basic settings** | |
| These can be selected by using the arrow keys, confirm by pressing the Enter key. | |
| Enter the time and date via the keypad | ![Select Language](Select_Language.png)  |
| ![Select Unit of measurement](Select_Unit_of_measurement.png) | |
| ![Select Resolution](SelectResolution.png) | |
| ![Enter the date and time](Enter_the_date_and_time.png) | |
2.3 Setting the reference point

The measuring carriage moves automatically to the reference point (reference point height ca. 50 mm) and sets the zero point on the base plate.

**Note:** Once the zero point has been accepted, confirmation is given by a twofold optical (LED) and acoustic signal (beep). After the reference point has been confirmed, any zero point can be selected.

2.4 Calibrating a probe

a) Press the calibrate probe key

b) Press the function key „Calibrate in a groove“, the probe moves automatically to the center of the groove of the setting standard.

c) Slide the setting standard, so that the probe is within the groove. The groove will be automatically measured for a second time.

d) The determined probe constant will be displayed.

**Note:**
The determined probe constant is always slightly smaller than the actual diameter of the probe (please refer to 4.1).
2.5 Auto-Off function

In the basic setting mode, the background lit display switches off after 1 minute, by pressing any key the background lit display will be reactivated.
The height measuring instrument switches off after 5 minutes.

To change this basic setting, please refer to chapter 6.10

Note: No measuring results are lost when the height measuring instrument switches off.

2.6 First measurement

Note:
In order to obtain highest accuracy the instrument requires at least a warm-up period of 15 minutes.

2.6.1 Contacting a plane from above

- Position the probe

- Press key to start the measuring procedure

In the upper section of the display will appear the measured value.
3 Brief guide to measurement methods

3.1 Start a measurement procedure with the function keys

The function keys can be used to start different measuring functions with one touch of a key.

The procedure is always the same:
– Position the probe either above or below the point that is to be measured
– Press the function key to start the measuring function

The probe automatically travels to the surface to be measured and accepts the measured value. When conducting dynamic measurements, where a maximum or a minimum (bore or shaft) is to be measured either the workpiece or the measuring instrument must then be moved so that the measuring instrument can determine an extreme value. When measuring with 2 contacts (e.g. a bore, groove or shaft), the first contact must be upwards (from below).

Function keys:
1 Contacting a surface / plane from above or below
2 Determining the center and width of a groove
3 Determining the center and width of a ledge
4 Determining the center and diameter of a bore
5 Determining the center and diameter of a shaft
6 Measuring a bore (maximum or minimum)
7 Measuring a shaft (maximum or minimum)

3.1.1 First measurement

3.1.2 Contacting a surface from above

– Position the probe

– Press the key to start the measuring procedure

The measured value will appear in the upper section of the display.
### Description / Sequence

#### 3.1.3 Measuring a bore

- Position the probe in the bore (not in the center / eccentrically)

- Press key to start the measuring procedure

- The probe will automatically travel upwards; the bore is contacted from below

- Move the workpiece parallel to the stopping face in order to determine the reversal point / maximum

- Acceptance of the reversal point will be confirmed by an acoustic signal (beep)

- The probe will automatically travel downwards; the bore is contacted from above

- Move the workpiece parallel to the stopping face in order to determine the reversal point / maximum

- Acceptance of the reversal point will be confirmed by an acoustic signal and the results (center and diameter) will appear in the display
### 3.1.4 Measuring a shaft

- Position the probe below the shaft (eccentrically)

- Press key to start the measuring procedure

- The probe will automatically travel upwards and make contact from below

- Move the workpiece parallel to the stopping face in order to determine the reversal point / maximum

- Acceptance of the reversal point will be confirmed by an acoustic signal (beep)

- Position the probe above the shaft (eccentrically).

- Press the function key „Contacting a shaft from above“

- The probe will automatically travel downwards and make contact

- Move the workpiece parallel to the stopping face in order to determine the reversal point / maximum

- Acceptance of the reversal point will be confirmed by an acoustic signal (beep) and the results (center and diameter) will appear in the display.
3.2  **Start a measurement procedure in Quick Mode**

The Quick Mode is a new and unique measuring procedure patented by Mahr, which both simplifies and accelerates measurement. The intelligent system recognizes the desired measuring function on the movement of the measuring carriage and starts automatically; therefore the operator can fully concentrate of measuring. The operator can conduct for example chain measurements or measurement upon several bores (e.g. calculation of a index circle) extremely efficiently and fast!

### Description / Sequence

<table>
<thead>
<tr>
<th>3.2.1</th>
<th>Active / deactivate Quick Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Press the Quick Mode key</td>
</tr>
<tr>
<td></td>
<td>In the status window appears the word „QUICK“</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3.2.2</th>
<th>Quick Mode - Switch between contacting a plane / bore</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Press the shift key on the base</td>
</tr>
</tbody>
</table>

|       | If the „Contact a plane“ is active then after „Quick“ will appear the following symbol |
|       | If the „Contact a bore“ is active then after „Quick“ will appear the following symbol |

### Symbols / Pictures

- **Active / deactivate Quick Mode**
  - Press the Quick Mode key
  - In the status window appears the word „QUICK“

- **Quick Mode - Switch between contacting a plane / bore**
  - Press the shift key on the base
  - If the „Contact a plane“ is active then after „Quick“ will appear the following symbol
  - If the „Contact a bore“ is active then after „Quick“ will appear the following symbol
3.2.3 **Contacting a plane**

Note: Both the Quick Mode and „contacting a plane“ must be active. See chapters 3.2.1 and 3.2.2

3.2.3.1 **Contacting a plane from above**

– Using the handle move the probe into a position above the plane to be measured, push the measuring carriage in the direction of the plane to be measured

– In Quick Mode the instrument recognizes that it has to contact a plane and automatically starts the measuring function

– Once contact has been made and the measured value has been accepted (this is confirmed by an acoustic signal, beep) and the value appears in the display.

3.2.3.2 **Contacting a plane from below**

– Using the handle move the probe into a position below the plane to be measured, push the measuring carriage in the direction of the plane to be measured

– In Quick Mode the instrument recognizes that it has to contact a plane and automatically starts the measuring function

– Once contact has been made and the measured value has been accepted (this is confirmed by an acoustic signal, beep) and the value appears in the display.

– Afterwards, further planes can be contacted.
### 3.2.3.3 Measuring a bore

**Note:** Both the Quick Mode and „measuring a bore“ must be active. See chapters 3.2.1 and 3.2.2

- Manually position the probe using the handle eccentrically into the bore
- The Quick Mode automatically recognizes the desired measuring function „measure a bore“ and starts the measuring function
- The probe moves automatically upwards and makes contact
- Move the workpiece parallel to the stopping face in order to determine the reversal point / maximum
- Acceptance of the reversal point will be confirmed by an acoustic signal (beep)
- The probe moves automatically downwards and makes contact
- Move the workpiece parallel to the stopping face in order to determine the reversal point / minimum
- Acceptance of the reversal point will be confirmed by an acoustic signal (beep)
- Results (center and diameter) will appear in the display.

**Note:**
The measurement can be cancelled at any time by pressing any of the following keys, see chapter 3.4, or the variable keys or by moving the measuring carriage in the opposite direction.
3.3 Start a measurement procedure with the speed keys

With the speed keys that are located on the base, the operator can move the motor driven measuring carriage comfortably into the desired position; in addition a measurement can be started by briefly pressing a key. This simplifies the measurement of large workpieces that cannot be easily or are too heavy to be moved into position; the operator has both hands free to operate the measuring instrument (air pump and the speed keys), thus measuring the workpiece in one run.

### Description / Sequence

<table>
<thead>
<tr>
<th>3.3.1 Motorized positioning of the probe</th>
</tr>
</thead>
<tbody>
<tr>
<td>By activating and holding down either of the two keys the motor driven measuring carriage will travel in the required direction. Once the button is released the measuring carriage will stop.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3.3.2 Contacting a plane</th>
</tr>
</thead>
<tbody>
<tr>
<td>Briefly press (&lt;0.5 sec.) either one of the keys to start the measuring function, the motor driven carriage will travel to the plane to be measured. Once the plane has been contacted and the measured value has been accepted an acoustic signal will be emitted (beep) and the measured value will be shown in the display.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3.3.3 Switching between contacting a plane / bore</th>
</tr>
</thead>
<tbody>
<tr>
<td>Press the shift key on the base plate</td>
</tr>
</tbody>
</table>

- If the „Contact a plane“ is active the following symbol will appear 🌋 ▼

- If the „Contact a bore“ is active the following symbol will appear (↔️)
3.3.4 Measuring a bore

Note: „Measuring a bore“ must be active. See chapter 3.3.3

- Position the probe into the bore, the probe must be off-set
- To start measurement, briefly press the speed key.

3.4 Abort a measurement:

Should a measurement have been inadvertently started, simply press a speed key or the cancel key, this is sufficient to abort the measurement.
4. Operating and measuring in detail

4.1 Standard calibration / calibrate a probe

Each calibration will automatically be conducted twice (x 2).

When calibrating the probe, it will automatically travel to the preset height of the gage block, this value can be changed in the probe calibration menu.

(See chapter 6.14.3 Probe calibration parameter)

Note:
The probe constant can be influenced by any of the following factors:
- Strain on the holder and the probe
- The reversal point of the measuring system
- The diameter of the probe

Attention:
The probe constant must be re-determined once a probe has been exchanged.

The calibration of a taper probe can be found in Chapter 4.7!

### Description / Sequence

4.1.1 Calibrating a probe using a setting standard

- Press the „calibration“ key

- Press the function key „calibrate using a groove“. The probe automatically travels the center of the groove of the setting standard

- Slide the setting standard, so that the probe is inside the groove. The groove will automatically be measured twice.

- The determined probe constant will be displayed
### Description / Sequence

<table>
<thead>
<tr>
<th>4.1.2 Calibrate a twin probe</th>
<th>Symbols / Pictures</th>
</tr>
</thead>
<tbody>
<tr>
<td>– Press the „calibration“ key</td>
<td><img src="image1.jpg" alt="Image" /></td>
</tr>
<tr>
<td>– Press the function key „Twin probe“. The probe automatically travels the center of the groove of the setting standard</td>
<td><img src="image2.jpg" alt="Image" /></td>
</tr>
<tr>
<td>– Slide the setting standard, so that the probe is inside the groove. The groove will automatically be measured twice</td>
<td><img src="image3.jpg" alt="Image" /></td>
</tr>
<tr>
<td>– Position the vertical probe above the ledge</td>
<td><img src="image4.jpg" alt="Image" /></td>
</tr>
<tr>
<td>– Press the function key „Calibrate vertical probe“. The measured value is automatically accepted</td>
<td><img src="image5.jpg" alt="Image" /></td>
</tr>
<tr>
<td>– Position the horizontal probe above the ledge</td>
<td><img src="image6.jpg" alt="Image" /></td>
</tr>
<tr>
<td>– Press the function key „Calibrate horizontal probe“. The measured value is automatically accepted</td>
<td><img src="image7.jpg" alt="Image" /></td>
</tr>
<tr>
<td>– The probe constant of the horizontal probe and the distance between the horizontal and vertical probes will be displayed. The calibration procedure is complete</td>
<td><img src="image8.jpg" alt="Image" /></td>
</tr>
<tr>
<td>– Select horizontal or vertical probe</td>
<td><img src="image9.jpg" alt="Image" /></td>
</tr>
</tbody>
</table>
### 4.1.3 Calibrate a probe with a ledge

- Press the probe calibration key
- Press the **“Calibrate with a ledge”** key
  - The probe automatically travels to the center of the groove of the setting standard
  - Position the probe below the ledge, the probe moves upwards and makes contact
  - Position the probe above the ledge, the probe moves downwards and makes contact
  - Position the probe for a second time below the ledge, the probe moves upwards and makes contact
  - Position the probe for a second time above the ledge, the probe moves downwards and makes contact

**Note:**

_When calibrating with a ledge, it is advisable to use a disc probe._

**Attention:**

_The probe must be manually positioned according to the diameter above the ledge!_
4.1.4 Deviations

Probes that have a large deflection (very long or very thin probes) can have a probe deviation of > 2.2 µm

In the display is the determined probe constant and the deviation between the 2 conducted measurement.

The following function keys appear:

Conduct calibration once more, the average (mean) value will be calculated from the previous determined probe constant and the newly measured constant.

Accept the deviation and value.
Probe dia. ? will appear in the display

Deviation is not accepted, the old value will be maintained.

Abort measurement, all previous probe constants will be maintained.
4.2 Zero points

- The workpiece zero point can be set only on an already determined characteristic

- Basic-zero point, base plate

- Workpiece zero point 01

- Workpiece zero point 02

- Change between set zero points

- Preset - alternative zero point

- Zero point 03, when zero points 01 and 02 are already set

**Description / Sequence**

4.2.1 Set the zero point on the base plate

- Press the zero point key on the keypad

- Press the function „Zero point on the base plate“

- The probe travels automatically to the base plate, the zero point is set

**Symbols / Pictures**
4.2.2 Workpiece zero point 01

- Contact a plane
- Press „zero point“ key
- Press the function key „Workpiece zero point 01“
- By several characteristics the selection can be made using the arrow keys
- Confirm by pressing the A key
- Workpiece zero point 01 is set
- The previous zero points will be deleted (02, 03, Preset)
### Description / Sequence

<table>
<thead>
<tr>
<th>4.2.3 Workpiece zero point 02</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workpiece zero point 02 can only be set when workpiece zero point 01 has already been set and the characteristics for workpiece zero point 02 are set after zero point 01.</td>
</tr>
</tbody>
</table>

- Contact a plane

- Press the „Zero point“ key

- Press the function key „Workpiece zero point 02“

- Use the arrow keys to make a selection

**Note:** The characteristic 02 must follow 01

- Confirm by pressing the A key

- Workpiece zero point 02 is set

The previous zero points will be deleted (03, Preset)

---

### Symbols / Pictures

- Contact a plane

- Press the „Zero point“ key

- Press the function key „Workpiece zero point 02“

- Use the arrow keys to make a selection

- Confirm by pressing the A key

- Workpiece zero point 02 is set

The previous zero points will be deleted (03, Preset)
<table>
<thead>
<tr>
<th>Description / Sequence</th>
<th>Symbols / Pictures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>4.2.4 Workpiece zero point 03</strong></td>
<td><img src="image1.png" alt="Image" /></td>
</tr>
<tr>
<td>– Follow the same procedure as setting „workpiece zero point 02“.</td>
<td></td>
</tr>
<tr>
<td><strong>4.2.5 Switching between the zero points</strong></td>
<td><img src="image2.png" alt="Image" /></td>
</tr>
<tr>
<td>– By pressing the 01/02 key, you can change between the set zero points.</td>
<td><img src="image3.png" alt="Image" /></td>
</tr>
<tr>
<td>– In the display the characteristics for the particular zero point will be shown</td>
<td><img src="image4.png" alt="Image" /></td>
</tr>
</tbody>
</table>
### Description / Sequence

#### 4.2.6 Entering a PRESET value

The preset is actually a zero point with selectable offset.

The height of 150.000 is assigned to a position of 50.000, thus the measuring range is expanded by 100 mm, it is sufficient from 100 mm to 700 mm (with an height measuring instrument with a 600 mm measuring path).

**Note:**
Refer to 4.2.7 extension of the measuring range

- Contact a plane

- Press the „Zero point“ key

- Press the function key Preset

- When there are several characteristics, use the arrow keys to make a selection, confirm by pressing both the A key and the function key Preset

- Use the keypad to enter a Preset value; 150.000 mm and confirm by pressing the function key.
**Description / Sequence**

⇒ Value 50.000 mm will change to 150.000 mm.

⇒ When measuring a 100.000 mm gage block, the height measuring instrument will show 200.000 mm in the display.

**Note:**
Reset the actual Preset value by pressing the zero point key and the variable function key „Basis-zero point, base plate“
### Description / Sequence

4.2.7 Expanding the measuring range

- Basis-zero point, base plate

- Use either a gage block or a predetermined workpiece that is larger than 180 mm.

- The probe moves downwards and contacts the gage block or workpiece.

- Loosen the clamping screw and turn the probe holder around 180°. Then tighten the clamping screw back into position.

- The probe moves downwards and contacts the gage block or workpiece.
– Press the „Zero point“ key

– Press the „Preset“ key

– Use the cursor to select characteristics 2.
– Confirm by pressing the function key characteristic
– Use the keypad to enter the actual size.

– Press the „Preset“ key

– Confirm by pressing the ON/OFF key

– To check, move the holder upwards and confirm by pressing the bore center key.

⇒ The measuring range has been expanded by 174 mm.
4.2.8 Zero point errors

- Before setting workpiece zero point 02 or 03, workpiece zero point must be set first.
- Index 02 means that 02 must have a higher characteristic number than 01.
- Index 03 means that 03 have a higher characteristic number than 01 or 02

4.2.9 Further zero point functions

- Please refer to Chapter „Variable functions key 4.8“

Attention!

Within a measuring program only 1 zero point may be set!
### 4.3 Basic measuring functions

<table>
<thead>
<tr>
<th>Measuring tasks</th>
<th>Function key</th>
<th>Quick-Mode</th>
<th>Speed keys</th>
<th>Results as shown in the display</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.3.1 Contact from above (plane)</td>
<td><img src="image" alt="Down arrow" /></td>
<td><img src="image" alt="Quick Mode" /></td>
<td><img src="image" alt="Down arrow" /></td>
<td><img src="image" alt="Display Image" /></td>
</tr>
<tr>
<td>4.3.2 Contact from below (plane)</td>
<td><img src="image" alt="Up arrow" /></td>
<td><img src="image" alt="Quick Mode" /></td>
<td><img src="image" alt="Up arrow" /></td>
<td><img src="image" alt="Display Image" /></td>
</tr>
<tr>
<td>4.3.3 Determine the center of a ledge and the width of the ledge</td>
<td><img src="image" alt="Number 1" /> <img src="image" alt="Down arrow" /> <img src="image" alt="Up arrow" /></td>
<td><img src="image" alt="Display Image" /></td>
<td><img src="image" alt="Display Image" /></td>
<td></td>
</tr>
<tr>
<td>4.3.4 Determine the center of a groove and the width of the groove</td>
<td><img src="image" alt="Down arrow" /> <img src="image" alt="Up arrow" /></td>
<td><img src="image" alt="Display Image" /></td>
<td><img src="image" alt="Display Image" /></td>
<td></td>
</tr>
</tbody>
</table>
### Basic measuring functions

<table>
<thead>
<tr>
<th>Measuring tasks</th>
<th>Measuring procedure</th>
<th>Results as shown in the display</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>4.3.5</strong>&lt;br&gt;Determine the center of a bore and the diameter of the bore</td>
<td><img src="image1.png" alt="Diagram" /></td>
<td><img src="image2.png" alt="Display" /></td>
</tr>
<tr>
<td><strong>4.3.6</strong>&lt;br&gt;Determine the center of a shaft and the diameter of the shaft</td>
<td><img src="image3.png" alt="Diagram" /></td>
<td><img src="image4.png" alt="Display" /></td>
</tr>
<tr>
<td><strong>4.3.7</strong>&lt;br&gt;Contact from below to determine the reversal point (maximum)</td>
<td><img src="image5.png" alt="Diagram" /></td>
<td><img src="image6.png" alt="Display" /></td>
</tr>
</tbody>
</table>

*only available when Quick-Mode settings is set to automatic recognition of plane / bore*
## Basic measuring functions

<table>
<thead>
<tr>
<th>Measuring tasks</th>
<th>Function key</th>
<th>Quick-Mode settings</th>
<th>Speed keys</th>
<th>Results as shown in the display</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.3.8 Contact from above to determine the reversal point (minimum)</td>
<td><img src="image1" alt="Function key" /></td>
<td><img src="image2" alt="Quick-Mode" /></td>
<td><img src="image3" alt="Speed keys" /></td>
<td><img src="image4" alt="Results" /></td>
</tr>
<tr>
<td>Contact from below to determine the reversal point (minimum)</td>
<td><img src="image5" alt="Function key" /></td>
<td><img src="image6" alt="Quick-Mode" /></td>
<td><img src="image7" alt="Speed keys" /></td>
<td><img src="image8" alt="Results" /></td>
</tr>
<tr>
<td>Contact from above to determine the reversal point (maximum)</td>
<td><img src="image9" alt="Function key" /></td>
<td><img src="image10" alt="Quick-Mode" /></td>
<td><img src="image11" alt="Speed keys" /></td>
<td><img src="image12" alt="Results" /></td>
</tr>
</tbody>
</table>
4.4 Dynamic measuring functions

<table>
<thead>
<tr>
<th>Description / Sequence</th>
<th>Symbols / Pictures</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.4.1 MAX-MIN-Function</td>
<td>![Graph showing MAX-MIN function]</td>
</tr>
<tr>
<td>– Select the MAX-MIN function</td>
<td></td>
</tr>
<tr>
<td>– Select contacting a plane from <strong>above</strong> or <strong>below</strong></td>
<td>![Select above or below]</td>
</tr>
<tr>
<td>– Move the <strong>workpiece</strong></td>
<td>![Move workpiece]</td>
</tr>
<tr>
<td>A bar graph appears in the display and shows the actual value.</td>
<td></td>
</tr>
<tr>
<td><strong>1 = Pause</strong></td>
<td>![Pause button]</td>
</tr>
<tr>
<td><strong>2 = Stop – Cancel function</strong></td>
<td>![Stop button]</td>
</tr>
<tr>
<td><strong>3 = Relative and/or Absolute value</strong></td>
<td>![Relative and Absolute value]</td>
</tr>
<tr>
<td><strong>4 = Set to zero</strong></td>
<td>![Set to zero]</td>
</tr>
<tr>
<td><strong>5 = Switch the bargraph ON/OFF</strong></td>
<td>![Switch bargraph]</td>
</tr>
<tr>
<td><strong>6 = Abort</strong></td>
<td>![Abort]</td>
</tr>
</tbody>
</table>

– Cancel the **MAX-MIN** function, print out the displayed values

**Display:** Maximum - Minimum

– **Select**
  - minimum value
  - maximum value

**Display:** Accept the maximum / minimum value
4.4.2 Measuring the perpendicularity error

Determine the perpendicularity error with either an incremental probe or a digital indicator.

- Connect the incremental probe P1514 H via the INPUT 2 interface or the digital indicator 1081, 1086 / 87 to a 16 EXr data cable via the INPUT 1 interface.

- Press the menu key and under the perpendicularity error select the required input.

Input 1: (e.g. 1086 / 1087) Digital indicator

Input 2: P1514 H Incremental probe

A maximum of 500 measuring points can be accepted. Depending upon the speed and the measuring instrument (350/600/1000 mm) the number of measuring points and the set measuring track can alter accordingly.

- Mount the probe into the holder on the measuring carriage

- Select the perpendicularity error function

1 = Start an upwards measurement
2 = Start an downwards measurement
3 = Set the X-value to zero
4 = Set the Z-value to zero
5 = Enter the measuring path
6 = Abort
<table>
<thead>
<tr>
<th>Description / Sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>– Set the X- and Z-values to zero, if applicable enter the measuring path</td>
</tr>
<tr>
<td>Only positive values are possible!</td>
</tr>
<tr>
<td>– Start measurement by pressing</td>
</tr>
<tr>
<td>– Stop measurement by pressing</td>
</tr>
<tr>
<td>– Select</td>
</tr>
<tr>
<td>- Graphic for perpendicularity error</td>
</tr>
<tr>
<td>- Graphic for straightness</td>
</tr>
</tbody>
</table>

To interrupt the measurement press

<table>
<thead>
<tr>
<th>Symbols / Pictures</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Symbol for zero values" /></td>
</tr>
<tr>
<td><img src="image2.png" alt="Start measurement symbol" /></td>
</tr>
<tr>
<td><img src="image3.png" alt="Stop measurement symbol" /></td>
</tr>
<tr>
<td><img src="image4.png" alt="Select perpendicularity error" /></td>
</tr>
<tr>
<td><img src="image5.png" alt="Select straightness" /></td>
</tr>
<tr>
<td><img src="image6.png" alt="Interrupt measurement symbol" /></td>
</tr>
</tbody>
</table>

![Measurement screen](image7.png)

Number of measuring points

![Perpendicularity error graph](image8.png)

![Straightness graph](image9.png)
<table>
<thead>
<tr>
<th>Description / Sequence</th>
<th>Symbols / Pictures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 = Skip between graphics</td>
<td>![Symbol Image]</td>
</tr>
<tr>
<td>2 = Conclude the perpendicularity error measurement</td>
<td>![Symbol Image]</td>
</tr>
<tr>
<td>3 = Print graphic (via. USB printer)</td>
<td>![Symbol Image]</td>
</tr>
<tr>
<td>4 = Save all measuring points (USB memory)</td>
<td>![Symbol Image]</td>
</tr>
<tr>
<td>5 = Abort</td>
<td>![Symbol Image]</td>
</tr>
</tbody>
</table>

Once the perpendicularity error has been evaluated, you can additionally show the straightness error as a value.

- Use the arrow keys to reduce the range of evaluation.

---

*Abb. 40*

1 Initial value  
2 Overall error  
3 Error in pos. direction  
4 Error in neg. direction  
5 Compensating line  
6 Measuring path  
7 Starting point

Perpendicularity error evaluation, calculate measuring range.
4.5 Measuring in 2D mode

An introduction to 2D

With that 817 CLM you can conduct all the usual 2D measuring tasks, as for example the computation of index circle (bestfit circle) or angles and distances between bore holes. In addition the measured values of both Z-axis and X-axis can be measured and stored separately.

The procedures for 2D measurements are always the same; first activate the 2D measurement function and measure the characteristics in the Z-axis. Then after a defined tilt or rotation of the workpiece (normally 90°) you can switch to measure in the X-axis and repeat the same procedure to measure the characteristics in the X-axis. Finally, you can conduct the required computations.

<table>
<thead>
<tr>
<th>Description / Sequence</th>
<th>Symbols / Pictures</th>
</tr>
</thead>
<tbody>
<tr>
<td>2D Functions</td>
<td></td>
</tr>
<tr>
<td>Via, the 2D key</td>
<td>2D</td>
</tr>
<tr>
<td>the operator is led</td>
<td></td>
</tr>
<tr>
<td>into the 2D mode</td>
<td></td>
</tr>
<tr>
<td>The following menus</td>
<td></td>
</tr>
<tr>
<td>will appear:</td>
<td></td>
</tr>
<tr>
<td>– Manually enter a</td>
<td></td>
</tr>
<tr>
<td>tilting angle</td>
<td>α</td>
</tr>
<tr>
<td>– Measure the</td>
<td></td>
</tr>
<tr>
<td>tilting angle</td>
<td>⊥α</td>
</tr>
<tr>
<td>– Active the 2D mode</td>
<td>2D ON</td>
</tr>
<tr>
<td>– Tilt the workpiece</td>
<td>z</td>
</tr>
<tr>
<td>With the variable</td>
<td></td>
</tr>
<tr>
<td>function keys, the</td>
<td></td>
</tr>
<tr>
<td>basic requirements</td>
<td></td>
</tr>
<tr>
<td>for the computation</td>
<td></td>
</tr>
<tr>
<td>function are</td>
<td></td>
</tr>
<tr>
<td>activated.</td>
<td></td>
</tr>
<tr>
<td>To deactivate the 2D</td>
<td></td>
</tr>
<tr>
<td>mode press:</td>
<td></td>
</tr>
<tr>
<td>2D OFF</td>
<td></td>
</tr>
</tbody>
</table>
### Description / Sequence

Before the characteristics can be determined the 2D mode must be activated.

In the top right hand corner of the display will appear the 2D symbol

Afterwards, all characteristics that are measured in the 2D mode will be marked with 2D in the display.

### Tilting angle

Measuring a workpiece two-dimensionally requires that the workpiece be tilted by a known angle. If not specified otherwise, this angle should be exactly 90°. Angles other than 90° can be either entered via the keypad or measured directly with an incremental probe.

**Note:** The more accurate the given tolerance is for the measuring values, thus the tilting angle must also be more accurate.

### Tilting the workpiece

The workpiece will be tilted from one axis to another. In the display will appear the axis in the top right hand corner of the display either (X) or (Z).

All the characteristics in both axis must be measured in the exactly the same sequence.

After a minimum of 2 characteristics (bore/shaft) in both axis has been measured the operator can automatically select in the menu the computation functions.
<table>
<thead>
<tr>
<th>Description / Sequence</th>
<th>Symbols / Pictures</th>
</tr>
</thead>
<tbody>
<tr>
<td>– Determine the distance and angle of 2 elements</td>
<td><img src="image1" alt="Symbol" /></td>
</tr>
<tr>
<td>– Determine the distance and angle of 3 elements</td>
<td><img src="image2" alt="Symbol" /></td>
</tr>
<tr>
<td>– Index circle / best fit circle</td>
<td><img src="image3" alt="Symbol" /></td>
</tr>
<tr>
<td>– Coordinate transformation— aligning the test piece arithmetically</td>
<td><img src="image4" alt="Symbol" /></td>
</tr>
<tr>
<td>– Deactivate the 2D mode</td>
<td><img src="image5" alt="Symbol" /></td>
</tr>
<tr>
<td>– Tilt the workpiece</td>
<td><img src="image6" alt="Symbol" /></td>
</tr>
</tbody>
</table>

### 4.5.1 Manually enter a tilting angle

- Active the 2D key

Select:
- Manually enter the tilting angle
- Calculate tilting angle
- Active 2D
- Tilt workpiece

- Manually enter the tilting angle (standard is 90°)

If the tilting angle is < or > than 90° then the „X-correction“ will appear in the 2D mode.
4.5.2 Entering a tilting angle  
(arithmetic workpiece alignment)

Mount both the probe and holder, see chapter 4.4.2

- Press the 2D key

Select:
- Manually enter the tilting angle
- Calculate tilting angle
- Active 2D
- Tilt workpiece

- Measure the tilting angle

The following menu appears in the determination of the perpendicularity error

- See chapter 4.4.2
  Measuring the perpendicularity error

The following menu will appear:

- Accept the angle

- Stop measurement and go to the graphic mode

- Accept the tilting angle $\alpha$

- Abort

Accept the tilting angle $\alpha$:
Calculating the tilted angle can be used for further 2D measurements.
4.5.3 Determine the distance and angle of 2 elements

The distance and angle between 2 elements (e.g. bores/shafts) that are not located one above the other can be calculated. The operator can select between the internal and the external angles.

Description / Sequence

- Press „CE“ to delete all data
- Press the 2D key

Select:
- Manually enter the tilting angle
- Calculate tilting angle
- Active 2D
- Or manually enter the tilting angle (standard is 90°), see 4.5.1
- Active 2D ON

- Measure the bore holes 1-2 in the Z-axis
- Tilt the workpiece
  (The workpiece will be arithmetically aligned at 90°)

- Measure the bore holes 1-2 in exactly the same procedure in the X-axis
- Tilt the workpiece back into its original position
- Active the „distance and angle between 2 elements“ function
4.5.4 Determine the distance and angle of 3 elements

The distance between 3 elements (e.g. bores) that are not located one above the other and the angle and the direct distances are to be determined. The angle is always put into the characteristic, whose number is in the middle of the three numbers. The origin of the angle is therefore lies in the center second characteristic. The operator can select between the internal and the external angles, as well as the different distances.

Select:
- Manually enter the tilting angle
- Calculate tilting angle
- Active 2D
- Tilt the workpiece

Press „CE“ to delete all data
Press the 2D key

The cursor shows the selected characteristic.

When there are 2 characteristics they will be automatically adopted as follows: A = 1 B = 2

By the evaluation of an angle the specification of the angle will first appear and then the distance (hypotenuse).
– Or manually enter the tilting angle (standard is 90°)

– Press 2D ON

– Measure bore holes 1 - 3 in the Z-axis

– Tilt the workpiece
  (The workpiece will be arithmetically aligned at 90°)

– Measure the bore holes 1-3 in exactly the same sequence as with the X-axis

– Tilt the workpiece

– Active the „distance and angle between 3 elements“
– Select a bore hole

If several bore holes are to be measured select the characteristics using the arrow keys and adopt them using the characteristic A, B and C.

When there are 3 characteristics they will be automatically adopted as follows:

A = 1  B = 2  C = 3

The cursor shows the selected characteristic.
Description / Sequence

– Confirm

– Use the arrow keys to move to the required results, select with the cursor and accept the result by pressing the ON/OFF key.

– Use the arrows key to select further results and press the ON/OFF key to accept them.

– To end the measuring procedure press the CE key.

– Press the 2D OFF key to exit the 2D function.
4.5.5  Index circle / Best fit circle

The circle diameter of an index circle consisting of \( n \) bores or shaft centers are to be determined using the Gaussian method of the least squares. The circle / shaft center and the circle diameter consists of a minimum of 3 and a maximum 50 bores or shafts, which the 817 CLM can calculate.

---

Description / Sequence

- Press „CE“ to delete all data

- Press the 2D key
  - Active 2D
  - Measure bores 1-3 in the Z-axis

At first the display indicates the Z values; and subsequently the diameter

- Tilt the workpiece (The workpiece will be arithmetically aligned at 90°)
  - Measure bores 1 – 3 in exactly the same sequence as with the X-axis

At first the display indicates the Z values; and subsequently the X values

- Tilt the workpiece back into the original position
  - Index circle function
### Description / Sequence

The index circle is calculated from the center of the 3 bore holes.

Adding the characteristics (bore holes/shafts) to be used for the calculation of the index circle.

Deselecting the characteristics (bore hole/shaft) to be used for the calculation of the index circle.

Number of bore holes/shafts

- Active the calculation of the index circle

#### Symbols / Pictures

<table>
<thead>
<tr>
<th>Description / Sequence</th>
<th>Symbols / Pictures</th>
</tr>
</thead>
<tbody>
<tr>
<td>The index circle is calculated from the center of the 3 bore holes.</td>
<td><img src="image1" alt="Symbol" /></td>
</tr>
<tr>
<td>Adding the characteristics (bore holes/shafts) to be used for the calculation of the index circle.</td>
<td><img src="image2" alt="Symbol" /></td>
</tr>
<tr>
<td>Deselecting the characteristics (bore hole/shaft) to be used for the calculation of the index circle.</td>
<td><img src="image3" alt="Symbol" /></td>
</tr>
<tr>
<td>Number of bore holes/shafts</td>
<td><img src="image4" alt="Symbol" /></td>
</tr>
<tr>
<td>Active the calculation of the index circle</td>
<td><img src="image5" alt="Symbol" /></td>
</tr>
<tr>
<td>In the display appears the following</td>
<td><img src="image6" alt="Symbol" /></td>
</tr>
<tr>
<td>the Z coordinates,</td>
<td><img src="image7" alt="Symbol" /></td>
</tr>
<tr>
<td>the X coordinates</td>
<td><img src="image8" alt="Symbol" /></td>
</tr>
<tr>
<td>and the diameter of the index circle</td>
<td><img src="image9" alt="Symbol" /></td>
</tr>
</tbody>
</table>

Error report appears when:

- No exact allocation has been given
- The numbers of measured bores are different in each axis

<table>
<thead>
<tr>
<th>Symbols / Pictures</th>
<th>Description / Sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image10" alt="Symbol" /></td>
<td>Error report appears when:</td>
</tr>
<tr>
<td><img src="image11" alt="Symbol" /></td>
<td>- No exact allocation has been given</td>
</tr>
<tr>
<td><img src="image12" alt="Symbol" /></td>
<td>- The numbers of measured bores are different in each axis</td>
</tr>
</tbody>
</table>
4.5.6 Coordinate transformation - aligning the workpiece arithmetically

A workpiece can only be aligned when both axis are measured. Only bores, shafts and index circles can be used for alignment.

For some workpieces, the origin of workpiece coordinates is not situated at an edge of the workpiece, but in bores or shafts. Since the workpiece coordinate system is rotated with respect to the coordinate system formed by height measuring instrument and base plate, the coordinates need to be converted. This conversion is called coordinate transformation or arithmetic workpiece alignment.

The coordinate transformation uses two elements (two shafts or two bores) to determine the origin and the X-axis of the workpiece coordinates.

The origin of coordinates is placed in the center of the element that was selected first. The X-axis (abscissa) runs through the centers of the selected elements. The Z-axis is with the first characteristic intersects perpendicular to the X-axis. Additionally the coordinate system can be rotated around the origin coordinate.

To rotate the coordinate system:

There are 3 possibilities to rotate the coordinate system.

1. A transformation without rotating the coordinate system.

2. A transformation is performed via the X and Z coordinates of the second characteristic. The rotation angle is calculated from the coordinate values that have been entered. The coordinate system is rotated so that second characteristic does not lie on the X-axis, but rather on the coordinates that are entered

3. A transformation takes place when a rotation angle is entered. Positive rotation angle = clockwise direction Negative rotation angle = anti-clockwise direction The maximum entry for a rotation angle of ± 180° must not be exceeded!
<table>
<thead>
<tr>
<th>Description / Sequence</th>
<th>Symbols / Pictures</th>
</tr>
</thead>
<tbody>
<tr>
<td>– Press „CE“ to delete all data</td>
<td>CE</td>
</tr>
<tr>
<td>– Press the 2D key</td>
<td>2D</td>
</tr>
<tr>
<td>– Or manually enter the tilting angle (standard is 90°)</td>
<td>α</td>
</tr>
<tr>
<td>– Active 2D ON</td>
<td>2D ON</td>
</tr>
<tr>
<td>– Measure bores 1-4 in the Z-axis</td>
<td></td>
</tr>
<tr>
<td>In the display appears</td>
<td></td>
</tr>
<tr>
<td>the Z value and</td>
<td></td>
</tr>
<tr>
<td>the diameter</td>
<td></td>
</tr>
<tr>
<td>– Tilt the workpiece</td>
<td></td>
</tr>
<tr>
<td>(The workpiece will be arithmetically aligned at 90°)</td>
<td></td>
</tr>
<tr>
<td>– Measure bores 1 – 4 in exactly the same sequence as with the X-axis</td>
<td></td>
</tr>
<tr>
<td>– Tilt the workpiece back into the original position</td>
<td></td>
</tr>
<tr>
<td>In the display appears</td>
<td></td>
</tr>
<tr>
<td>the Z value and</td>
<td></td>
</tr>
<tr>
<td>the X value</td>
<td></td>
</tr>
</tbody>
</table>
Description / Sequence

- Active the „coordinate transformation“ function

- Use the arrow keys to select bores 1 and 4, use the cursor to adopt the character symbols A and B.

  In bore 1 (A) lies the coordinate origin / zero point.
  The X-axis (abscissa) runs through bore 1 (A) and bore 4 (B)

- Determine the tilting direction of the workpiece
  (The tilting direction is defined from the point of view of the height measuring instrument to the workpiece)

- Tilt to the right / clockwise

- Rotate to the left / anti-clockwise

- Select the type of rotation for the coordinate system

1. The transformation will be conducted without rotation of the coordinates system.
2. **Input the coordinate of the second characteristic (bore hole 4) in the X and/or Z to calculate the rotation angle**
   (The desired values in a drawing)
   - Enter the Z value according to the drawing for the second characteristic (bore 4)
   - Confirm by pressing the ON/OFF key
   - Enter the X value according to the drawing for the second characteristic (bore 4)
   - Confirm by pressing the ON/OFF key

3. **Enter the rotation angle**
   
   Clockwise rotation = Positive angle
   Anti-clockwise rotation = Negative angle
   - Confirm by pressing the ON/OFF key

<table>
<thead>
<tr>
<th>Description / Sequence</th>
<th>Symbols / Pictures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>View</strong></td>
<td></td>
</tr>
<tr>
<td>of the Z-axis</td>
<td><img src="image" alt="Z-Axis View" /></td>
</tr>
<tr>
<td>and the diameter</td>
<td></td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Diameter View" /></td>
</tr>
<tr>
<td>Tilt the workpiece</td>
<td></td>
</tr>
<tr>
<td>back into its original</td>
<td><img src="image" alt="Workpiece Tilt" /></td>
</tr>
<tr>
<td>position</td>
<td></td>
</tr>
<tr>
<td>(Change the view to the</td>
<td></td>
</tr>
<tr>
<td>X-axis)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description / Sequence</th>
<th>Symbols / Pictures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>View</strong></td>
<td></td>
</tr>
<tr>
<td>of the Z-axis</td>
<td></td>
</tr>
<tr>
<td>of the X-axis</td>
<td><img src="image" alt="X-Axis View" /></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>To exit the 2D mode</td>
<td></td>
</tr>
<tr>
<td>press the 2D OFF key</td>
<td><img src="image" alt="2D OFF Button" /></td>
</tr>
</tbody>
</table>
4.6 Measuring a taper / calculating an angle

Description / Sequence

On a taper, the angle $\alpha$ between its mean line and the base plate is to be determined. It must be possible to laterally displace the workpiece by a clearly defined amount. To do this, attach a stop to the base plate and place a gage block between the stop and the workpiece.

A gage block is required, which is somewhat shorter in length than the height of the taper.

For the measurement, a probing element with cylindrical styli is necessary which must be aligned parallel to the base plate.

Procedure

– Calibrate a cylindrical probe (standard or with a groove), see chapter 2.1

– Place the gage block between the workpiece and the stop and position the probe above the narrow end of the taper.

– Contact from above (arrow 1)

– Remove the gage block and slide the workpiece towards the stop until it makes contact

– Contact from above (arrow 2)

– Press the taper function key

The following menu will appear:

– Using the arrow keys select characteristic A and characteristic B (use the function keys A and B to accept them)

– Press taper evaluation and enter the dimension 10.000

– Confirm – angle will be displayed

<table>
<thead>
<tr>
<th>Description / Sequence</th>
<th>Symbols / Pictures</th>
</tr>
</thead>
<tbody>
<tr>
<td>On a taper, the angle $\alpha$ between its mean line and the base plate is to be determined. It must be possible to laterally displace the workpiece by a clearly defined amount. To do this, attach a stop to the base plate and place a gage block between the stop and the workpiece.</td>
<td><img src="image1.png" alt="Diagram" /></td>
</tr>
<tr>
<td>A gage block is required, which is somewhat shorter in length than the height of the taper.</td>
<td><img src="image2.png" alt="Diagram" /></td>
</tr>
<tr>
<td>For the measurement, a probing element with cylindrical styli is necessary which must be aligned parallel to the base plate.</td>
<td><img src="image3.png" alt="Diagram" /></td>
</tr>
<tr>
<td>Procedure</td>
<td><img src="image4.png" alt="Diagram" /></td>
</tr>
<tr>
<td>– Calibrate a cylindrical probe (standard or with a groove), see chapter 2.1</td>
<td><img src="image5.png" alt="Diagram" /></td>
</tr>
<tr>
<td>– Place the gage block between the workpiece and the stop and position the probe above the narrow end of the taper.</td>
<td><img src="image6.png" alt="Diagram" /></td>
</tr>
<tr>
<td>– Contact from above (arrow 1)</td>
<td><img src="image7.png" alt="Diagram" /></td>
</tr>
<tr>
<td>– Remove the gage block and slide the workpiece towards the stop until it makes contact</td>
<td><img src="image8.png" alt="Diagram" /></td>
</tr>
<tr>
<td>– Contact from above (arrow 2)</td>
<td><img src="image9.png" alt="Diagram" /></td>
</tr>
<tr>
<td>– Press the taper function key</td>
<td><img src="image10.png" alt="Diagram" /></td>
</tr>
<tr>
<td>The following menu will appear:</td>
<td><img src="image11.png" alt="Diagram" /></td>
</tr>
<tr>
<td>– Using the arrow keys select characteristic A and characteristic B (use the function keys A and B to accept them)</td>
<td><img src="image12.png" alt="Diagram" /></td>
</tr>
<tr>
<td>– Press taper evaluation and enter the dimension 10.000</td>
<td><img src="image13.png" alt="Diagram" /></td>
</tr>
<tr>
<td>– Confirm – angle will be displayed</td>
<td><img src="image14.png" alt="Diagram" /></td>
</tr>
</tbody>
</table>
4.7 Measuring with a taper probe

Area of application:
For rapid determination of coordinates on workpieces with a rough tolerances (e.g. master gage for holes, perforated plate, threads...) +/- 0.2 mm

Procedure:
- Measure a bore with a taper probe. Requirement: the taper probe is calibrated. The bore must be smaller the diameter of the taper <30.00 mm

- Note the measured center of the bore e.g. 207.516 mm

- Loosen the knurled screw and remove the standard probe, replace this with a taper probe and tighten up the knurled screw.

- Calibrate the probe

- Select taper probe

- Enter the diameter of the taper

- Confirm by pressing the the taper symbol
<table>
<thead>
<tr>
<th>Description / Sequence</th>
<th>Symbols / Pictures</th>
</tr>
</thead>
<tbody>
<tr>
<td>– Contact the base plate with the taper probe.</td>
<td><img src="image" alt="Image of taper probe touching base plate" /></td>
</tr>
<tr>
<td>– Center the taper probe in the same bore hole and press function „Bore center“</td>
<td><img src="image" alt="Image of bore center function" /></td>
</tr>
</tbody>
</table>

**Important!**

When changing to a standard probe, travel once again to the reference point on the base plate and calibrate the standard probe once again.
### 4.8 Variable function keys

#### 4.8.1 Measuring a distance

Calculate the difference between 2 saved measuring results. In order to calculate the distance 2 characteristics must be selected, the 817 CLM will propose the last measured characteristics/ values, provided that they seem suitable for further evaluation. Using the arrow keys any characteristic or results can be selected (DISP must be activated).

The selected characteristics will be shown in the display as A and B

**Procedure:**
- Contacting a plane from above F1
- Contacting a plane from above F2
- Distance - 16.000 will be shown in the display

The characteristics and the successful distance measurements are shown in the display.
4.8.2 Calculating the height of a symmetry line

The symmetry (height of a horizontal center plane) between two measuring values saved earlier (e.g. the faces of a groove) can be determined.

In order to calculate the symmetry 2 results must be selected, the height measuring instrument will propose the last measured characteristics / values, provided that they seem suitable for further evaluation. Using the arrow keys any characteristic or results can be selected.

Procedure:

– Contact the plane F6 from above

– Contact the plane F5 from below

– Symmetry - the dimension 36.004 will be shown

– In the display the characteristics are shown and there symmetry is calculated.

The height of the symmetry plane above the reference point is displayed.
4.8.3 AUTO
Standard settings - select further AUTO functions

4.8.4 Automatically setting the zero point
By using the symbol AUTO zero point you can automatically set the previous measured result to zero, thus all following characteristics will referred to this future zero point. If the AUTO zero point function key is active, it will remain so until AUTO key has been pressed.

Procedure:
- Press the function key AUTO (1 x )
- Contact the plane F1 from above
- Contact the plane F2 from above

Results: Dimension 16.000 in reference to plane F1
The previous characteristic will automatically be set to zero

Further measurements:
- Contact the plane F3 from above

Results: Dimension 12.999 in reference to plane F2
- Contact the plane F4 from above

Results: Dimension 21.001 in reference to plane F3
4.8.5 Automatically setting the distance

With the AUTO Distance symbol, measuring results e.g. contacting from above and the distance to a previous characteristic will be automatically displayed.

If the AUTO Distance function key is activated, this remains active until the AUTO key has been pressed.

Procedure:

– Press the function key AUTO (2 x)

– Contact the plane F1 from above

– Contact the plane F2 from above

Results:
Dimension 26.002 and distance to plane F1; distance 16.001 will be displayed

In the display are the actual characteristic and the distance to the previous contacting.

Further measurements

– Contact the plane F3 from above

Results:
Dimension 39.001 and distance to plane F2; distance 12.998 will be displayed

In the display are the actual characteristic and the distance to the previous contacting.
4.8.6 Relative zero point

- Contact the plane F4 from above

⇒ Result 60.001 will be displayed

- Press the function key „Set zero point“, the last measured characteristic will appear in the display as Workpiece-zero point 01.
  In this example: Dimension = 60.001

⇒ Value 0.000 will be displayed

- Contact the plane F4 from above. Plane F4 is set to „Zero“.

⇒ See Workpiece-zero point 01

All further characteristics refer to plane F4 until a further workpiece zero point is set, or zero point 01 is deleted.
### Description / Sequence

#### 4.8.7 Absolute zero point

- Press the ABS key to set the zero point back to the base plate,

  then the function key „0.00“ appears.

  ![Reference to the base plate](image)

All further measurements will be in reference to the base plate.

#### 4.8.8 Displaying the characteristics

The function key display characteristic provides a better overview; the actual characteristics will be displayed, provided that they are suitable for further calculation. The third display characteristic C is only required for angle and coordinate calculation in the 2D mode.

- Characteristic A

- Characteristic B

- Characteristic C

<table>
<thead>
<tr>
<th>Description / Sequence</th>
<th>Symbols / Pictures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>4.8.7 Absolute zero point</strong></td>
<td><img src="image" alt="ABS" /> 0,00</td>
</tr>
<tr>
<td><img src="image" alt="Reference to the base plate" /></td>
<td></td>
</tr>
<tr>
<td><strong>4.8.8 Displaying the characteristics</strong></td>
<td><img src="image" alt="Characteristic A" /> <img src="image" alt="Characteristic B" /> <img src="image" alt="Characteristic C" /></td>
</tr>
<tr>
<td>The function key display characteristic provides a better overview; the actual characteristics will be displayed, provided that they are suitable for further calculation. The third display characteristic C is only required for angle and coordinate calculation in the 2D mode.</td>
<td></td>
</tr>
</tbody>
</table>
5 Deleting, saving and printing measured values

5.1 Delete measured values

### Description / Sequence

<table>
<thead>
<tr>
<th>Description / Sequence</th>
<th>Symbols / Pictures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>5.1.1 Delete</strong></td>
<td></td>
</tr>
<tr>
<td>Press the CE key</td>
<td>CE</td>
</tr>
</tbody>
</table>

**Select**

- Delete the last characteristic
- Delete all characteristics

By pressing one of these keys, either the last or all characteristics will be deleted.

**Note:**
Once there are more than 99 characteristics, the first characteristic will be automatically deleted. There is no warning that the memory is full!

**5.1.2 Clear an entry**

- Use the arrow keys to position the cursor upon the digit to be deleted
- Press the „CE key“ to delete the digit

**Note:**
Further functions regarding „Delete“ can be found in chapter 6.14.7, Delete menu.
5.2 Save measured values

– By a longer activation of the DATA key, the following menu will appear in the display:

1 Deselect a characteristic
2 Select a characteristic
3 Paper feed
4 Transfer to an USB printer
5 Save to the internal USB memory
6 Transfer to a PC (RS232 OUT)

– By pressing the Save key, the measured values / characteristics will be transferred to the internal USB memory.

5.2.1 Save measured values to a PC

– Connect a USB cable to the USB interface (port) on the height measuring instrument (type B) and to the USB interface on a PC.

Note:
The data will be stored as follows

ACTUPART.TXT

ALLPARTS.TXT

Only the actual measured values will be transferred!
<table>
<thead>
<tr>
<th>Description / Sequence</th>
<th>Symbols / Pictures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SELECT.TXT</strong></td>
<td><img src="image1" alt="SELECT Editor" /></td>
</tr>
<tr>
<td>All measured values to be transferred!</td>
<td></td>
</tr>
<tr>
<td>- Should further measured values to be stored, once again press the Save key</td>
<td><img src="image2" alt="Folder Icon" /></td>
</tr>
<tr>
<td>The data will be stored as follows</td>
<td></td>
</tr>
<tr>
<td><strong>ACTUPART.TXT</strong></td>
<td><img src="image3" alt="ACTUPART Editor" /></td>
</tr>
<tr>
<td><strong>ALLPARTS.TXT</strong></td>
<td><img src="image4" alt="ALLPARTS Editor" /></td>
</tr>
<tr>
<td>Only the measured values will be transferred that have not been already saved!</td>
<td></td>
</tr>
<tr>
<td><strong>SELECT.TXT</strong></td>
<td><img src="image5" alt="SELECT Editor" /></td>
</tr>
<tr>
<td>All measured values; even those that have been saved will be transferred!</td>
<td></td>
</tr>
<tr>
<td>See chapter 6.13.6 USB memory administration</td>
<td></td>
</tr>
</tbody>
</table>
5.3 Print measured values / results

5.3.1 Settings

In „menu“ the following settings can be implemented:

The operator can chose to transfer the data and / or the measured values between:

**Manual**  Data transmission, once the „DATA key“ has been pressed
**Automatic**  Automatic data transmission after each value has been measured

---

1. Standstill-time
2. Contacting speed
3. Resolution
4. mm/inch
5. Language
6. Date and time
7. LCD settings
8. Beep ON/OFF
9. Auto – off time (min)
10. Quick-Mode
11. Perpendicularity
12. Data and printer
13. Advanced settings

---

1. DATA auto-transmit on/off
2. USB printer menu
3. Interface parameters RS 232 Out
4. Transmission content RS 232 Out
5. USB file system management
6. Data and printer
7. Advanced settings

---

1. Send using DATA key
2. Send automatically

---

1. Standstill-time
2. Contacting speed
3. Resolution
4. mm/inch
5. Language
6. Date and time
7. LCD settings
8. Beep ON/OFF
9. Auto – off time (min)
10. Quick-Mode
11. Perpendicularity
12. Data and printer
13. Advanced settings

---

1. DATA auto-transmit on/off
2. USB printer menu
3. Interface parameters RS 232 Out
4. Transmission content RS 232 Out
5. USB file system management
6. Data and printer
7. Advanced settings

---

1. Yes
2. No
3. Print part memory

---

1. Yes = The measured values will either be prepared for print manually via the DATA key or automatically, i.e. when a page is full with measured values, the print will be started. By using the paper feed, values can be individually be printed.
2. No = Measured values will not be printed.
3. Workpiece memory = will be printed immediately.
5.3.2 Printing options with a USB printer

Connect a USB cable to a USB interface (type) A to the height measuring instrument and to the USB printer. The printer will automatically recognize that it has been connected.

- By a longer activation of the DATA key, the following menu will appear in the display:

  1. Deselect a characteristic
  2. Select a characteristic
  3. Paper feed
  4. Transfer to an USB printer
  5. Save to the internal USB memory
  6. Transfer to a PC (RS232 OUT)

- By pressing the Printer key, the measured values / characteristics will be transferred to the USB printer.

Note:
Only use a HP Printer with the printer language PCL 3 - GUI. Mahr refers to the HP 5940 ink jet printer, see catalog. This printer has been tested. For all other printer models, Mahr cannot guarantee that all the functions can be executed or performed.
5.3.3 Printing options with a MSP 2 statistics printer

Connect a RS 232 connection cable to the RS 232 OUT interface on the height measuring instrument and connect the other end of the cable to a MSP 2 statistics printer.

**Standard settings Opto-RS232 Duplex**

**Transfer individual data**
- Briefly press the DATA key

Settings on the MSP 2:

**Transfer the complete data**
- Long activation of the DATA key and press the monitor key

Settings on the MSP 2:

Press the DATA key on the MSP 2

Also see chapter 6.13.4 Interface RS232 OUT and chapter 6.13.5 DATA Parameter RS232 Out

5.3.4 Further explanation

1. Deselect a characteristic
2. Select a characteristic
3. Paper feed
4. Transfer to an USB printer
5. Save to the internal USB memory
6. Transfer to a PC (RS232 OUT)
**Deselect a characteristic**

It is possible to deselect a particular characteristic out of an actual list of characteristics, for example, characteristics that are not relevant to a technical drawing or those that are out of tolerance.

- use the arrow keys
- select a characteristic
  or
- deselect a characteristic

*E.g.* Characteristic 4 is deselected

**Select a characteristic**

- With the cursor select an appropriate characteristics number
  
  By pressing key, the characteristic is once again active

**Paper feed**

- The paper feed can be used when for example; data, graphics or characteristics are to be printed on a second sheet of paper.

![Symbols / Pictures](image)
6. Basic settings

6.2 Standstill time

When making contact with the workpiece, the probe bounces for a short time and the measuring value oscillates accordingly. The measuring value can only be accepted when it is stable. Thus a suitable time constant - the die-down time - needs to be selected. The standard die-down time is 1 second. The operator can decide whether to enter a longer die-down time (i.e. any value between 100 and 200 seconds).

Standard standstill time setting = 1 second

6.3 Contacting speed

The height measuring instrument offers a choice of 5 contacting speeds in the measuring mode.
The contacting speed with the speed keys amounts to 40 mm/second

Standard contacting speed setting = 8 mm/second

6.4 Resolution

The resolution of the displayed result can be set.
Standard resolution setting = 0.01 mm

6.5 Unit of measurement mm / inch

Selection can be made between mm or inch.
Standard setting = mm

6.6 Languages

Messages and records are available in several languages:
6.7 Date and time

The current date and time are displayed; use the cursor to change the date.

6.8 LCD settings

- Use the cursor keys to change the contrast setting (brighter or darker) of the LCD display.
- The background lit display can be set to be bright or energy saving (slightly darker).

6.9 Acoustic signal

Active or deactivate the signal tone (beep).

6.10 Auto-OFF

The height measuring instrument automatically switches itself off if it is not used for a certain time. This period can be between 1 and 99 minutes. All measured values will reappear once the instrument is switched back on, thus no measured values are lost.

The background lit display switches itself off, if no key is pressed within the given period of time, e.g. 10 minutes. The background lit display can be switched on again by pressing any key. Once this is done, you can resume work at exactly the same step where it was interrupted.

Standard Auto-OFF setting = 5 min
Standard Background lit display setting = 1 min
6.11 Quick-Mode

The sensitivity can be set.

The types of automatic recognition are as follows:

- **With a flat** (standard setting) must be switched between flat and bore with the shift key on the base of the measuring instrument, as previously described. The symbol in the status window shows the actual mode being used. When the flat symbol is being show then only flat surfaces can be measured, with the bore symbol only bores can be measured.

- **With a flat / bore** the system automatically recognizes in the „flat mode“ whether a flat or an extreme point (maximum or minimum) of a bore is to be measured. Conduct the contacting of a flat as described, wait until the acoustic signal (beep) has been emitted, indicating that the measured value has been accepted. When measuring the maximum or minimum point of a bore proceed as described, once the probe makes contact within the bore, radically move the workpiece until the system has automatically found the maximum or minimum point of the bore and acknowledged this through emitting an acoustic signal (beep). In the „bore mode“ as in the standard settings only complete bores can be measured.

6.12 Perpendicularity error

The perpendicularity error of a workpiece can be determined with the following:

- Incremental probe P1514H
- Digital indicator with an OPTO-RS232 connector (e.g. MarCator 1081, 1086, 1087)

Also see point 4.4.2 Measuring perpendicularity error

The column of the height measuring instrument is not aligned after assembly. It may therefore exhibit a perpendicularity error of 20 µm over its total length of 600 mm. If the perpendicularity error of a workpiece is determined by means of an electronic measuring system, the measuring results are corrected.
6.13 Data and printer

6.13.2 DATA automatic transmit ON / OFF

The operator can chose to transfer the data and/or the measured values between:

**Manual** Data transmission, once the „DATA key“ has been pressed

**Automatic** automatic data transmission after each value has been measured

6.13.3 USB printer menu

6.13.3.2 Print results

– Refer to chapter 5.3

6.13.3.3 Changing record head data

Enter the appropriate text. Above every line to be entered, you will find the text of the record head form. Every line may contain up to max. 28 characters (the consecutive numbering of the lines are not printed). With the cursor keys, you can switch between the lines with even numbers (2, 4, 6, 8 etc.) and alter them accordingly.

**Example of a record head data, the time and date are automatically printed!**

If a statistics printer, e.g. MSP 2 is being used which can only manage 24 characters a line, the record head cannot be printed!
6.13.3.4 Changing the record head form

The record head form can be changed accordingly to the requirement of the operator.

Every line may contain up to max. 28 characters (the consecutive numbering of the lines are not printed). With the cursor keys, you can switch between the lines with odd numbers (1, 3, 5, 7 etc.) and alter them accordingly.

– Switch between upper case / lower case

6.13.3.5 Printer page length

Standard are 58 lines per DIN A4 (2.268” x 11.693”)

6.13.3.6 Change customer-specific headline

The standard text within the framed headline is:

In place of this text, the operator may enter a customer or company specific text. The maximum of 50 characters can be entered in two lines each containing up to 25 characters.

If a printer managing only 24 characters a line is used, the record head cannot be printed.

Example
6.13.3.7 Color printer Yes / No

6.13.3.8 Printer specification

Indicates which USB printer has been connected. Once the printer is connected to the USB interface, the printer specification will appear briefly in the display.

6.13.4 Interface - RS232 OUT

The transfer parameters of the RS232 interface are as follows:

**Opto RS232 Duplex**

Opto RS232 Duplex has a baud rate (transfer speed) of 4800 Bits and set parity of 7 Bits.

**Data format:**

1234.5678_mm<CR>
User defined parameter - RS232

Select the required baud rate (transfer speed)

Select data format:

<table>
<thead>
<tr>
<th></th>
<th>Start bit</th>
<th>Data bit</th>
<th>Parity</th>
<th>Stop bit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>8</td>
<td>non</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>7</td>
<td>even</td>
<td>1</td>
</tr>
</tbody>
</table>

Conclude by selecting the RS232 operating mode
6.13.5 DATA Parameter RS232 OUT

By transmission of the data and/or measured values the operator can choose whether to only send the following:
- Coordinate (center)
- Diameter
- Coordinate center and diameter

to a printer or via the RS232 interface.

6.13.6 Administer the USB memory

ACTUPART  actual measured values – only actual measured values
ALLPARTS  all values – all measured values will be attached to previous measured values
CORRECT  Work correction table, only for info
EXPORT   File - data that were exported
PRG1     Designation of a measuring program

Attention
USB - Format memory – all data in the memory will be deleted.
6.14 Advanced settings

Described in this chapter are settings / functions that are meant for advanced users in which more in depth changes can be performed.

Attention:
Incorrect or inappropriate settings can lead to inaccurate measurement results!

6.14.2 Temperature compensation

If the height measuring instrument is operated in a room which is not equipped with an air conditioning system, or if the workpieces are either too warm or too cold, the workpiece temperature must be taken into consideration to increase the measuring accuracy. To do so, enter the temperature of the workpiece and the coefficient of expansion of the workpiece material. The dimensions measured on the workpiece are then related to a reference temperature of 20 °C / 68°F.

Important requirements:
- The ambient temperature must be stable
- The temperature of the height measuring instrument and the workpiece must be recorded
- The coefficient of expansion of the workpiece must be known.

(Attention: The composition of the workpiece).

By incorrect operation and input of the necessary parameters, accurate measured values cannot be obtained.

1. No temperature compensation (standard setting)
2. Temperature of the workpiece and the temperature of the column are the same
3. Enter the temperature of the workpiece (workpiece is very warm – and the measurement is being concluded in an acclimatized room at 20 °C / 68°F).

Examples of coefficients of expansion $\alpha$, 10 to the power of $-6 / K$ at 20 °C / 68°F:

- Chromium steel: 10.0
- Iron: 12.1
- Aluminum: 23.8
- Brass: 18.0
- Gray cast iron: 11.8
6.14.3 Parameters for calibrating a probe

For the provided setting standard, the following dimensions are specified:

Groove width = 12.700 mm
Ledge width = 6.350 mm
Starting point = 92.000 mm

When using another setting standard these parameters can be changed.

6.14.4 Function key F3

There is the possibility to set up the special functions, e.g. that when measuring a bore hole only the diameter will be saved.
6.14.5 Entering a password

In order to limit access to measuring programs and measuring values, you can enter a password. Firstly, the program will ask you for your old password. If you have not yet entered a password, press ON/OFF key. The message „Enter new password“ a new password can be entered. Should this question be repeated, then enter the „old password“. If all users have forgotten the password, it can be deleted, through a reset.

See point 10.2 „Initialization of the internal memory“

6.14.6 Correction tables

The high accuracy of the height measuring instrument is achieved through arithmetical corrections. The operator can create a correction table for each channel. The correction table programmed at the factory cannot be changed.

The correction tables are particularly useful when implementing long probes, dial gages, caliper gages, etc. The accuracy values specified for the height measuring instruments are only achieved with standard probes and their specific correction factor table.

The type of measuring instrument used is to compile to the correction factor table plus the number of the channel it was connected to be are saved. If a corrected measuring instrument of this type is connected to a different channel or if a different type of instrument is connected to the corrected channel, the computer in the height measuring instrument will not perform any corrections.

Two measuring instruments of the same type will always feature different measuring errors and must therefore be individually corrected!

If a measuring instrument of the same type is connected to the corrected channel, the height measuring instrument cannot recognize this and will use the wrong correction table!

If both correction factors (customer and factory) are active, both are marked with a star, this means that, for example that the factory correction factor is only active in the Z-axis and the operator correction factor is only active for perpendicularity error.
### 6.14.6.2 Factory correction table

The pre-programmed factory correction factor is used by the height measuring instrument. Usually, this correction table is selected automatically if a height measuring instrument is connected to channel 1. The operator cannot adjust the factory correction factor!

### 6.14.6.3 Customer specified correction table

A correction table that has been created by the operator i.e. the customer for a specific measuring instrument is selected. If a customer-specific correction table is used, this is displayed in the basic state with the message „CORRECTION“. The star indicates the operator correction factor is active.

### 6.14.6.4 Create a new correction table Z

Please refer to chapter 10.4 Customer calibration

### 6.14.6.5 Print a correction table

The actual operator correction table will be printed. Please refer to chapter 10.4 Customer calibration
6.14.6.6 Perpendicularity correction table

Use an incremental probe to implement a perpendicularity check for the customer correction factor.

Please refer to chapter 10.4 Customer calibration

6.14.6.7 Service menu (reserved)

This menu is exclusively reserved Mahr-Service personnel.

6.14.6.8 Embedded service test

This menu is exclusively reserved Mahr-Service personnel.

6.14.7 Delete menu / clear function

6.14.7.2 Default parameters

The following interface and basic adjustment parameters are set to values defaulted at the factory:

- Language: English
- Resolution: 0.001 mm
- Plausibility factor: 1.0
- Contacting speed: 8 mm/s
- Standstill-time: 1.0 s
- Temp. of height meas. inst: 20 °C (68°F)
- Temperature of workpiece: 20 °C (68°F)
- Coefficient of expansion: 11.0
- Auto OFF time: 5 minutes
- Background lit OFF: 1 minute
- Printer: page length: 58 lines (DIN A4)
- Tilting angle: 90°
- Amplification factors: 1.00
- Opto RS232: Duplex 4800 baud, 7 bits, even parity

The following data is deleted:

- All values are saved in the measuring value memory
- Measuring value printout is no longer possible
- Offset for the coordinate transformation
- Zero points on part

1. Yes
2. No
6.14.7.3 Delete all programs stored in the memory
Deletes all measuring programs.

6.14.7.4 Delete all data files stored in the memory
Deletes all measuring value files.

6.14.7.5 Delete customer corrections
Delete the selected correction table which the operator can create for each of the four measuring channels.

6.14.7.6 Delete production data tables
Deletes the comment tables containing production specific data.

Please refer to chapter „8. Statistics“

6.14.7.7 Delete all data
Deletes all data in the memory. The menu items (2 to 6) referred to above are executed.
To avoid unintentional deletion, every „Delete“ instruction will be questioned with „Are you sure“, you must confirm your answer by pressing Yes / No; and if necessary also entering the password.

6.14.8 Import language text file (USB)
With this function you can install an additional language, it is necessary that this language has been translated and is available as a text file.

Please refer to chapter 10.3 „Storing additional languages“.

6.14.9 Probing parameters

– Automatic probe lifter ON
– Automatic probe lifter OFF

With this automatic probe lifter, the probe automatically lifts after a contact has been made (fixed parameter is 2 mm). When the probe lifter is switched off, then the probe does not lift (stays in the same position) after contact has been made.
7. Measuring program

The height measuring instrument can save a measuring process and create a measuring program from the saved data.

Measuring programs can be created in order to automate recurring measuring processes. Since any characteristic can be detailed in an inspection plan, the measured values can be saved so that they can be read at any time and evaluated statistically.

A maximum of 40 measuring programs can be saved permanently in the mass memory, up to 8000 measuring values can be saved in the measuring value mass memory. All measuring values recorded during a program run are saved under the name of the program. The file names may comprise of a maximum of 15 alphanumerical characters.

Fundamental is:

- The probe is correctly calibrated
- A suitable die-down time has been set
- All stored measurements be deleted from the memory
- Measure the complete workpiece (also computation functions such as distance, symmetry...)

7.2 Create a learn program (teach-in method)

1. Press CE key to delete all characteristics that are stored in the memory
2. Measure the complete workpiece; all functions are to be carried out automatically after measurement, e.g. computation functions
3. Press the PROG key and select „Create learn program“.
4. Enter the tolerances that most frequently occur in the measuring program as standard tolerances, the tolerances can be adjusted later see menu point 7.3.
5. Assign the program a name (max. 15 characters).
6. Through program START, the learn program will start.

If the program name already exits, use the keypad to enter a new name.
7.3 Create a new measuring program

A measuring program can be directly created on the control and evaluation unit independently of the measuring instruments. Therefore, programs can be created at any location. Before starting to create a new program, determine the order in which the measurements are to be executed. At the points where you might insert one or more program steps later on, you should add one or more „empty“ measuring steps.

Explained in the following menu are how to implement settings, how to make changes to the record head, to the program head and to the program steps, for example tolerances, nominal values, etc.

7.3.2 Changing a program head

1 - Step-by-step mode
When entering NO the workpiece will be measured without the height measuring instrument asking any further questions.

With YES, the question will appear in the display after every single program step:

2 - Positioning the probe
YES
Before starting the measurement, the height measuring instrument automatically positions the probe to the height of the characteristic. The duration of the pause following a positioning operation is given in seconds.

NO
Contacting takes place automatically without stopping at an intermediate position.

3 - Plausibility factor
The plausibility limits result from the multiplication of the allowances with the factor to be entered. If a factor of 1.0 is entered, any value outside the tolerance limits is judged as „implausible“ and must be accepted or rejected by the operator, even if the „step-by-step“ mode is not in use. Implausible measuring values are not saved automatically!

4 - Parts per sample
Here you can define how many workpieces a sample contains (any number between 0 and 250). Enter the required sample size and press the ON/OFF key to accept the proposed sample size.

After a sample has been checked completely, the height measuring instrument completes the program run.

If the sample size is smaller than 2, then nothing can be calculated (statistics). In the top left of the display will appear the number of runs and the actual characteristic number.

---

1. Step-by-step mode : No
2. Stylus positioning : No
3. Plausibility factor : 1.000
4. Parts per sample : 2
5. End of program : Stop after last step
6. UCL-LCL factor : 1.000
7. Ref. point position : 0.000 0.000
8. Enter user partnb. : No

---

Position wait time

0.500

Plausibility factor:

1.000

Number of runs

8 / 7

Number of characteristics

8 / 7
5 - End of program with

Stop after last step / workpiece
– Once the last workpiece in the program run has been measured appears the following question: Cancel or Continue with the next workpiece.

Continue
– After a workpiece has been completely measured, the next workpiece will be inspected. In this case the program run can be aborted.

6 - Upper control limit / lower control limit factors

To avoid having to look at all control charts after having completed the measurement of a sample, the height measuring instrument can output warnings in order to draw the operator’s attention to certain control charts. The warning limits result from the multiplication of the control limits with the entered factor.

Example: With a factor of 0.9 a warning is issued if a mean or range value reaches 90% of the control limit value.

7 - Reference point position

This function is only required if you work with both coordinate transformation and automatic positioning. At this point, enter the origin of the workpiece coordinate system relative to the base plate in both Z and X. With learn programming, these values are entered automatically.

8 - Enter workpiece / part number

YES
The operator can assign a number to each workpiece. This number is saved with the name of the measuring program. When starting a measuring program, the operator can accept the displayed part number or enter a new one. Advantage: the operator can search for a certain part number when evaluating data or for measuring records with individual measuring values. It is also possible to assign the same number to several workpieces.

NO
The part number that is displayed after the start of a measuring program is increased by 1 after each measurement.
7.3.3 Changing a program step

For every program step, the parameters must be entered. The parameter menu looks as follows:

**Explanation:**

**Step**
The program step number should be a number between 1 and 100, in order to display the contents of a certain program step. The program step number is automatically increased by 1 after having confirmed a program step.

**Group number (left column)**
Number of a program step group, which enable it to cover an entire workpiece family with a single measuring program. If certain measurements are not to be carried out on every workpiece, the measurements (program steps) in question can be assigned a special group number. These group numbers cause the measurements (program steps) to be carried out only if this is explicitly confirmed at the program start.

**Group (right column)**
Each group can be assigned a name. The name, however, is not necessary for the functioning of the program. The list of all program subgroups is however displayed when starting a measuring program.

**Measuring functions**
The displayed measuring function is accepted when leaving this field. Program steps without a measurement or computation function are considered nonexistent.

Please remember that the functions „Bore“, „Shaft“, „Polar coordinate“ and „Groove“ require two program steps each, while the „Index circle“ requires three.

**Characteristic (Charact.)**

With the aid of the following keys you can move around the input field:

+ / - scroll between program step to program step

Cursor key, move left or right within the input field

Tab function - to move to another input field

Skip to the start position (step__ 1)

Switch between upper and lower case

The characteristic is assigned a name that may comprise up to 11 alphanumerical characters

**Nominal value (Nom. val)**
The nominal value is entered with the measurement unit (mm or inch)

**Upper allowance (Upp. all.)**
Upper allowance relative to the nominal value, for example: 0.015

**Lower allowance (Low. all.)**
Lower allowance relative to the nominal value, for example: -0.015

**Pareto upper / lower tolerance (Paret. UT / LT)**
To do this, the weighting factor for sizes above the upper tolerance limit must be entered.

Also see statistics, point 8.6 Pareto menu

Measured characteristics can also be evaluated attributively in a Pareto chart. Here, all sizes outside the allowance limits are considered „Rejects“, while all other sizes are considered „Accepts“.

**Comment**
A comment can be entered here, which may be important for the following program step (measurement). The comment is displayed along with the result of the current measurement program step.
Channel
If several measuring instruments are connected this parameter specifies which measuring instrument is being used,
e.g. height measuring instrument = Channel 1
digital caliper 16 EX = Channel 2

The remaining parameters in the parameter menu are only required if you entered a value larger than 1 for parameter „Parts per sample” in the program head menu.
If the control limits are not known, the height measuring instrument can compute them on the basis of either the tolerance values or the saved measuring results.

UCL X
Enter the upper control limit for the mean value (of a certain characteristic) allowed for a sample.
Example: 10.008

LCL X
Enter the lower control limit for the mean value (of a certain characteristic) allowed for a sample.
Example: 9.988.

UCL R or UCL S
Enter the upper control limit for the range (R) or standard deviation (S) (of a certain characteristic) allowed for a sample.
Example: 0.008.

LCL R or LCL S
Enter the lower control limit for the range (R) or standard deviation (S) (of a certain characteristic) allowed for a sample.
Example: 0.000.

7.3.4 Changing record head

Enter the appropriate text, each entered line of text is shown in the record head form. Above every line to be entered, you will find the text of the record head form. Every line may contain up to 28 characters (the consecutive numbering of the lines are not printed).
With the cursor keys, you can switch between the lines with even numbers – and make alterations.

Also see section 6.13.3.3

7.3.5 Save changes

The changed data will be saved in the actual program.
7.4 Change an existing measuring program

Changes to a measuring program are often necessary, due to perhaps a change in a technical drawing (different tolerance, nominal dimension...) or there has been a review of the teach-in program. An existing measuring program can be used as a basis for further programs with similar parts.

Select the measuring program and change or add improvements in the appropriate menu.

Procedure is the same as „Create a new measuring program“.

7.5 Print a measuring program

The complete program is printed out together with the program head. The adjustment of the printer is detailed in section „6.13 Data and printer“ and „5.3 Printing measured values“.

Procedure is the same as „Create a new measuring program“.
7.6  Control limits based on measuring values

In order to compute the control limits, usually 50 workpieces of a homogeneous lot are inspected. A lot is considered homogeneous if all workpieces were produced one after the other in the usual manufacturing rhythm and all measured workpieces are within the tolerance limits.

The control limits are computed on the basis of all measuring values saved under the name of the measuring program. Therefore, the automatic computation of control limits should only be used for newly created programs. Please remember that control limits for an existing program can only be calculated and entered anew, if the Cpk value is larger than 1.00. (For values below 1.00, a warning is given).

Calculation takes place
7.7 Control limits based on allowances (tolerances)

The control limits „Based on allowances“ for the control chart are computed on the basis of the allowances and automatically inserted into the measuring program. For the computation, no measuring values are required. The calculation is based on hypotheses that do not always match the reality.

Under the following menu appear the new control limits.

7.8 File administration

Up to 40 measuring programs (inspection plans) can be saved as files. Each measuring program is assigned a different name. The measuring values measured with a measuring program are all saved in a separate file, but under the same name as the measuring program.

Note: With the USB memory data can be both exported and imported.
7.8.2  Program directory

If more than 5 files have been saved, use the arrow keys to display the names of the other files. In addition to the file names the following information is also displayed: time, the date that the file was saved and the size of the file.

In the bottom of the display are the number of free bytes, i.e. the available memory capacity.

<table>
<thead>
<tr>
<th>Program directory</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PRG1</td>
<td>09:57 04/Sep/06 755</td>
</tr>
<tr>
<td>TEST1</td>
<td>09:59 04/Sep/06 1175</td>
</tr>
<tr>
<td>TEST5</td>
<td>10:18 04/Sep/06 587</td>
</tr>
<tr>
<td>Bytes free</td>
<td>63001</td>
</tr>
</tbody>
</table>

7.8.3  Delete program

– Select program and confirm

<table>
<thead>
<tr>
<th>Delete program</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PRG1</td>
<td>09:57 04/Sep/06 755</td>
</tr>
<tr>
<td>TEST1</td>
<td>09:59 04/Sep/06 1175</td>
</tr>
<tr>
<td>TEST5</td>
<td>10:18 04/Sep/06 587</td>
</tr>
<tr>
<td>Bytes free</td>
<td>63001</td>
</tr>
</tbody>
</table>

7.8.4  Rename program

– Select program and confirm.
– Enter a new program name and confirm.

<table>
<thead>
<tr>
<th>Rename program</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PRG1</td>
<td>09:57 04/Sep/06 755</td>
</tr>
<tr>
<td>TEST1</td>
<td>09:59 04/Sep/06 1175</td>
</tr>
<tr>
<td>TEST5</td>
<td>10:18 04/Sep/06 587</td>
</tr>
<tr>
<td>Bytes free</td>
<td>63001</td>
</tr>
</tbody>
</table>

7.8.5  Export program (USB-memory)

– Program is sent from the program memory to the USB memory

Mark the appropriate program in the program directory and confirm by pressing the ON/OFF key.

Please refer to chapter 6.13.3 Program directory USB memory.

<table>
<thead>
<tr>
<th>Program directory</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PRG1</td>
<td>09:57 04/Sep/06 755</td>
</tr>
<tr>
<td>TEST1</td>
<td>09:59 04/Sep/06 1175</td>
</tr>
<tr>
<td>Bytes free</td>
<td>60457</td>
</tr>
</tbody>
</table>
7.8.6 Import a program (USB memory)

Programs are transferred from the internal USB memory to the program memory. Mark the appropriate program in the program directory and confirm by pressing the ON/OFF key.

In addition, programs can be transferred from a PC via the internal USB interface (e.g. a previously stored program on a PC).

Connect the USB cable to the height measuring instrument using the USB-B port; connect the other end of the cable to a PC with a free USB port. The USB drive will appear in Windows Explorer® (see screen shot)

Copy the measuring program from the PC to the internal USB drive.

Select import program (USB memory) and in the program directory select the appropriate program, confirm by pressing the ON/OFF key. In the display will appear the following message „Import Program“

When transferring data, it could be that the USB connection must firstly be disconnected and then subsequently reconnected!

Please refer to chapter 6.13.3 Program directory USB memory.
7.9 Data administration

A measured value data file contains all the measured actual values of a characteristic within a program.

1. <-_______
2. Learn programming (teach - in)
3. Create new program
4. Change existing program
5. Print out current program
6. UCL / LCL computation (measured values)
7. UCL / LCL computation (tolerances)
8. Menu program file management
9. Menu data file management
10. Program START

7.9.2 Data file directory

If more than 5 files have been saved, use the arrow keys to display the names of the other files. In addition to the file names, the following information is also displayed: time and date that the file was saved and the size of the file. The bottom row shows: the number of memory locations occupied by measuring values (readings), data blocks and files. Every free data block can hold 100 measuring values.

7.9.3 Display contents of data file

All measured data can be displayed in tabular form with the parameters saved along with the measuring values. Select a program in the data file directory; use the cursor keys to select a particular characteristic out of the chosen program.

Select the appropriate characteristic by using the cursor keys.
7.9.4 Print a data file

The measuring values are printed out together with the record head and the chosen comments. The bar graph illustrates the situation of the measuring values in the tolerance window.

7.9.5 Delete data file

The names of the saved measuring value files are shown in the display. Use the cursor keys to select the measured value, to delete the file press the ON/OFF key.

7.9.6 Rename data file

The names of the saved measuring value files are shown in the display. Use the cursor keys to select the measured value, to rename the file press the ON/OFF key.

If no bar appears then the measured value is right in the center of tolerance.
7.9.7 Change data in a data file

If the file still contains inaccurate measured values or incorrect comments these values can be changed.

Use the DATA key to skip between the values.

The measured value can be changed with the numerical keys. Press the ON/OFF key to accept the value. The modified measuring will be shown once again in the display.
7.9.8 Export data file (ASCII)

Select the amount of data to be sent / exported.

Measured values / measured value files can be exported in various ways. In principle, the data is always sent in ASCII format via the RS232 interface. The sending of data via the internal USB memory is further explained in chapter „5.2 Save measured values“ and „5.3 Print measured values“.

2. Only measured values  3. Measured values and characteristic number  4. Databank of the measured values

5. Measured values with the tolerances  6. Measured values; row/part

7. Excel Format YES/NO

Start Excel.
Open the data file in Excel and convert text using the (text import wizard) function.

When not in the Excel format the column separation is through a „comma“.
When in the Excel format the column separation is through a „semi colon“.
7.10 Start a program

Use the program selection to immediately start the measuring program.

Only as many measuring processes are conducted, as entered in the program head (the required sample size).

If a measured value is not plausible, i.e. it is outside of the tolerance, the following possibilities exists:

accept the measured value,

repeat,

delete a process or the complete procedure.
8. Statistics

The height measuring instrument can create statistical evaluations based on stored data with the aid of histograms, process control charts and pareto charts. These results can via the internal USB memory be sent to another data medium (PC) or be directly printed on a USB printer.

8.2 Enter and selecting production data

This menu describes how production data can be entered.

Up to 5 table names can be assigned and each table has up to 49 rows for production data text. Table 6 is normally only used for comments on the samples. The production data entered are saved as comments together with any measured size. The production data can be used later as selection criteria for the evaluation of statistics.

Select data:

Use the left and right arrow keys to skip to the next table.

If a table is marked, use the up and down arrow keys to active and select a production data text (1-49).

Select the comment number 0 of a table, if in this table no production data text is to be saved. With the comment number 0, the field with the „Production data“ will show „Ignore“. 

Finally press the ON/OFF key, to confirm selection and also to leave this menu.
Modifying production data tables:

Press the right arrow key several times until the row „Change prod. data“ is marked.

Press the ON/OFF key, to open the setup window.

Use the up and down arrow keys to highlight one of the 6 tables; press the ON/OFF key to open a further window in which to modify.
Row 0 is now highlighted; in this row specify a table name (e.g. operator, machine, shift, etc.). To modify further press the ON/OFF key, to reopen the editor window.

Use the alphanumerical keypad to enter the appropriate table name (e.g. operator).
In order to exit the editor window, press the ON/OFF key (even if no alterations have been conducted).
Again press the down arrow key to highlight row 1.
Press the ON/OFF key, to edit row 1. Use the alphanumerical keypad to enter the appropriate text (e.g. TURN) and press ON/OFF key to conclude.
To edit row 2 etc., continue as described above (row 2 can only be highlighted and modified when row 1 has been edited, even if no alterations have been conducted).

Note:
If the text of one of the offered options has been already used, it should be neither deleted nor changed, otherwise the allocation to the measuring values is lost!

Once the table names and production data texts have been edited, press the CE key several times to exit the setup menu.

If you work with control charts, the height measuring instrument will automatically use table 6 for comments on the samples.
The entered comment is thus only saved together with a completely measured sample. If you never intend to use control charts (in any program), table six can be used just like the other five tables.
8.3 Control chart settings

In conjunction with a measuring program the height measuring instrument can both display and print (see chapter 8.5) control charts. You can choose between a sigma control chart and a range control chart. The decision you make applies for all measuring programs. Use the arrow keys to select the corresponding field. You can then choose between the two standards Ford Q101 and DGQ, which define the mathematical formulae for the statistical calculations. Choose the desired option with the arrow keys.

8.4 Statistics and histograms

A histogram is the diagram of the frequency distribution of measured values. You proceed to arrange the data according to size and divide the entire range of the sample in k classes. This does not necessarily have to be equally broad, however at least classes equal in size simplify the interpretation within the mid range.

Over each class a bar is established, whose surface is proportional to a specific class frequency. If the surface of the bar is equal to the absolute frequency the histogram is absolute, if the relative frequency is used then the histogram is known as a relative or standardized.

Histograms are used when:

- it is assumed that several factors could affect a process and these should be proven
- it is meaningful to define the specification limits for a process
- it is desired to see the actual process of the frequency distribution and not just single data such as the mean and standard deviation

Histograms are the basis with the aid of a measuring program to calculate measured and stored values which fulfill the chosen selection criteria, see „8.4.5 Selection / sort criteria“
8.4.2 Display histogram and statistics

Display the histogram for the chosen characteristic. The width of the each bar depends on the number of classes processed and is adapted automatically. The dotted lines indicate the tolerance limits (the tolerance limits are not shown if the measuring values lie outside the specified standard deviation - sigma range).

Select the required characteristics

With the cursor keys select a class.

Explanation of statistical terms:

Nominal value : in mm or inch.

Upp. all : Upper allowance.

Low. all : Lower allowance.

Width : Class width – computed on the basis of the tolerance window divided by the number of classes.

Class : Number of classes.

< low. tol : Number of measuring values below the lower tolerance limit.

> upp. tol : Number of measuring values above the upper tolerance limit.

Mean value : Mean of all the measured values of a characteristic.

Up. relia. : Upper reliability limit of the mean value. Shows the limits within which the mean value of the population lies. The reliability is 95%.
Lo. relia. : Lower reliability limit of the mean value. Shows the limits within which the mean value of the population lies. The reliability is 95%.

Sigma workpieces. : Standard deviation. The mean root square deviation was computed on the basis of n-1 workpieces.

Up. relia. : Upper reliability limit of the standard deviation. Shows the limits within which the standard deviation of the population lies. The reliability is 95%.

Lo. relia. : Lower reliability limit of the standard deviation. Shows the limits within which the standard deviation of the population lies. The reliability is 95%.

Range : Range, i.e. difference between maximum and minimum measuring value.

Number of pcs : Number of workpieces matching the selection criteria.

Min-/Maximum : Smallest/largest measured value.

Cm : Machine capability index, \( C_m = \frac{(U.Tol.-L.Tol.)}{6 \sigma} \). The machine capability index assumes a standard distribution.

Cmk : Machine capability index with respect to the mean value's situation relative to the tolerance limits. The Cmk value should be larger than 1.33. The machine capability index assumes a standard distribution.

+3 Sigma : 3 standard deviation values are added to the mean value. Indicates the upper value limit of a normal distribution above which less than 0.2% of all sizes lie.

-3 Sigma : 3 standard deviation values are subtracted from the mean value. Indicates the lower value limit of a normal distribution below which less than 0.2% of all sizes lie.

The machine capability index only provides useful information if a homogeneous lot was checked in a preliminary data collection run (e.g. for computing the control limits).

Information

Data : Name of the evaluated measuring programs.

Workpiece : Number of workpieces measured with this program

No. errors : Number of workpieces measured with this program and classified as „Rejects“.

Total weighting : Sum of the weighting factors of all classes.

Attrib. data only : Selection criteria to which the workpieces were subjected.

Error : Name of the error or the measuring function.

Class : The number of the error class of x selected classes.

Step No. : The number of the program step.

No. errors : The number of errors falling into this class.

% : The frequency of this error with respect to all errors (expressed as percentage).

Weight : The weighting factor assigned to this class. The weights of the classes are only displayed if function „Display weighted Pareto chart“ is selected.
8.4.3 Print histogram and statistics

The histogram and statistics can be printed.

The number of printed classes agrees with the number entered in the „Histogram parameters“ menu. The specified number of classes lies within the tolerance limits and one extra class is added for sizes both above the upper tolerance limit and below the lower tolerance limit. Class limits are shown as dotted lines.

Next to the histogram, the probability net is also shown, this illustrates the deviation from a standard distribution.

Below, the histogram, a table of output which contains the limits of each individual class, the number of parts within each class and the percentage which represents of the total number of workpieces.

8.4.4 Entering the histogram parameters

Enter the number of classes (3-20)

Decide whether the tolerance limits or the sigma values are to be the criteria for sizes to be considered for the histogram. Based on allowances means that no sizes are classified that are more than one class width outside the tolerance limits.

Based on +/- 3 (6) SIGMA means that no sizes are classified which are beyond ± 3 or ± 6 standard deviations.
8.4.5 Selection criteria

Data selection can be activated by selecting the menu „Selection criteria“ by histogram and control chart.

In this example, 6 criterions are selected. Mr. Brown inspects all parts between the 1.02.2007 and the 28.02.2007, from the 2nd shift. They were tested on a coarse tooling machine, for the customer BB and the quality standard is 4.

– Table function, skip to the next criteria

– Return to exit

– Edit selection criteria

8.5 Control charts

The quality control chart is used for the evaluation of inspection data out of a sampling procedure; based on this the inspection data of the sample, for example workpiece sizes can be shown as a graph. Plotted on the quality control chart are so called warning limits and control limits; these could be used for example as define workpiece tolerances.

When reaching the warning limits it is important to intervene at the earliest possible moment as well as to increase the number of inspections and to search for the process error.

When reaching the control limits it is very important to intervene as early as possible to prevent the production of defective parts. When the progression to faulty production has dropped, then it is possible to observe ahead of time in the quality control chart and thus preventing further defective parts being produced. Therefore, there is more time to intervene in the process and to prevent faulty production.

The quality control chart can be viewed as an indicator for the process. With the evaluation of a quality control chart it is essential to be able to differentiate between coincidental and systematic influences. Coincidental influences leads mean variation of the inspection data
on the quality control chart; these are due to such factors as variations in temperature or material composition. Systematic influences lead to a slower shift in the inspection data on the quality control chart, such influential factors are tool wear or inaccurately adjusted machines. Systematic influences are usually foreseeable by using further inspection data.

The height measuring instrument offers a quality control chart in form of a process control chart (mean value), a range chart as well as a sigma chart with upper and lower control limits.

8.5.2 Display the process control chart

Process control charts are computed on the basis of measured values and saved with a measuring program with the chosen selection criteria.

Additionally, there is still the choice of a mean-value process control chart (range control chart) or the sigma control chart. Which of these charts can be appropriately displayed, please refer to 8.3 „Control chart settings“.

The control limits and the mean on mean value chart can be shown in a graph.

The lower control limit is also the basis line for the range control chart or sigma control chart.

If the process control chart is based on less than 5 workpieces or samples, the chart only occupies the right-hand part of the display. If it is based on more than 40 workpieces or samples, only the last 40 are taken into account.

If the sample size was set to 1, each computed point corresponds to a workpiece. For sample sizes >1, each computed point corresponds to a sample.
By pressing the right arrow key, a cursor will appear (on the dotted line) and a window will open which contains all the data of the first sample. Press either the right or left arrow key to leaf through further samples.

The following data is shown:

- Number of the workpiece or sample
- Mean value (X-bar value)
- Range value R or Sigma
- Day, date and time
- Number of the sample comment
- Actual sample comment

If a sample comment already exists, the height measuring instrument will emit an acoustic signal (beep). In every window, the required comment on the sample can be selected by pressing up or down arrow keys. Accept the selected comment with and save it by pressing the ON/OFF key.

If the Cpk value falls below 1.0, the message „100% monitoring required“ is displayed.

### 8.5.3 Print process chart

Process control charts are computed on the basis of measured values, saved with a measuring program and the chosen selection criteria.

Additionally, there is still the choice of a mean-value process control chart (range) or the sigma control chart. Which of these charts are appropriate, please refer to 8.3 „Control chart settings“.

If the process control chart is based on less than 25 workpieces or samples, the chart only occupies the right-hand part of the display. If it is based on more than 100 workpieces or samples, only the last 100 of them will be printed.

If the sample size was set to 1, each computed point corresponds to a workpiece. For sample sizes >1, each computed point corresponds to a sample.

All comments saved for a sample plus the date and time are shown in a table below the control chart. The comments relating to the sample are always taken from production data table 6.

The texts of the required comments must have been entered before (also see chapter 8.2 „Entering and selecting production data“).

### 8.5.3 Select selection criteria

Also see chapter 8.4.5
8.6 Pareto menu

A Pareto chart is a special type of bar chart where the values being plotted are arranged in descending order. The left vertical axis shows the larger values and the right vertical axis indicates the smaller values. The pareto chart is named after the Italian economist Vilfredo Pareto. They are used in statistics and other areas such as quality assurance.

Definition

The pareto chart is based upon the pareto principle, which states the most problems (80%) are attributed to only a few causes (20%). It is a bar chart where the values being plotted are arranged in descending order. See section Pareto distribution.

Intention

With the aid of the pareto - diagram many possible causes of a problem, such as those that have the largest influence can be filtered out, their importance to causing a problem can be read directly from the diagram.

Procedure

At the first the problem must be specified, subsequently, the categories for possible error and/or causes are to be determined. These can be found by brainstorming or on empirically established values. Additionally, a quantity must be determined, with which to clarify the effects of the given problem, the most common sizes are the frequency of the occurrences and the frequency evaluated against costs (number multiplied by the rate). In order to create a pareto diagram, the absolute frequency of each error category percentage has to be determined; in addition the costs per category are calculated. The categories are sorted in a descending order according to their meaning and indicated on the horizontal axis from left to the right. Above each error category is a bar whose height determines the frequency of the occurrences.

Reject and rework can be shown in weighted pareto charts according to e.g. frequency and cost. From practical experience, we know that most quality deficiencies arise from very few sources. It is therefore useful to eliminate the sources of the problems first and then to turn to any quality problems, which still exist.

Pareto charts are computed on the basis of measuring values measured and saved with a measuring program and on the chosen selection criteria.
2-Parameter of a pareto chart

Specify how many characteristics with the most frequent errors (number of classes) are to appear in the pareto chart.

Measured characteristics of a measuring program can also be evaluated attributively. All sizes outside the tolerance limits are classified as „Rejects“ in the pareto chart (all, attributive, measured characteristics).

4-Display weighted pareto charts

In the case of measured characteristics, sizes above the upper or below the lower tolerance limit can be weighted differently. In the pareto chart the sum of the two weighting factors is created and shown as a graph.

5-Print a pareto chart

A pareto chart including all selected characteristics of a measuring program is printed out without the specified weighting factors.

6-Print a weighted pareto chart

The weighting factors entered for the individual characteristics are taken into account (printed without a record head)

7-Selection criteria

Please refer to chapter „8.4.5 Selection criteria“
# Communication

## Description of interfaces

### 9.1.1 Pin assignment for RS232 Input

RS232 input for hand measuring instruments:

<table>
<thead>
<tr>
<th>Pin-No.</th>
<th>Identification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>Not connected</td>
</tr>
<tr>
<td>2</td>
<td>RXD</td>
<td>Data input from a hand meas. instrument</td>
</tr>
<tr>
<td>3</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>4</td>
<td>Request</td>
<td>Output for Data-Request</td>
</tr>
<tr>
<td>5</td>
<td>NC</td>
<td>Not connected</td>
</tr>
<tr>
<td>6</td>
<td>NC</td>
<td>Not connected</td>
</tr>
<tr>
<td>7</td>
<td>+V</td>
<td>+8 V Supply voltage for Opto-Interface</td>
</tr>
<tr>
<td>8</td>
<td>NC</td>
<td>Not connected</td>
</tr>
<tr>
<td>9</td>
<td>NC</td>
<td>Not connected</td>
</tr>
</tbody>
</table>

### 9.1.2 Pin assignment for RS232 Output

RS232 to a PC output:

<table>
<thead>
<tr>
<th>Pin-No.</th>
<th>Identification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NC</td>
<td>Not connected</td>
</tr>
<tr>
<td>2</td>
<td>RXD</td>
<td>Receive Data</td>
</tr>
<tr>
<td>3</td>
<td>TXD</td>
<td>Transmit Data</td>
</tr>
<tr>
<td>4</td>
<td>DTR</td>
<td>Data Terminal Ready</td>
</tr>
<tr>
<td>5</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>6</td>
<td>DSR</td>
<td>Data Set Ready in</td>
</tr>
<tr>
<td>7</td>
<td>RTS</td>
<td>Request to send</td>
</tr>
<tr>
<td>8</td>
<td>CTS</td>
<td>Clear to send in</td>
</tr>
<tr>
<td>9</td>
<td>NC</td>
<td>Not connected</td>
</tr>
</tbody>
</table>

### 9.1.3 USB interface Type A

In a USB cable four wires are required, one pair of wires transfer the data and the other pair supplies the connected instrument with a power supply of 5 V. Instruments that have a USB specification may obtain between 100 mA or 500 mA from the USB port, depending on how much power the port can supply. Instruments that have a performance of up to 2.5 W can also be supplied via a Bus.
The length of a cable from the Hub to an instrument is limited to 5 m (16.40 ft), the Low-Speed-cable due to its specification is reduced to 3 m (9.84 ft) and excludes the possibility of using an extension cables. To overcome longer distances interpose USB Hubs, to bypass a distance between two instruments use either an Ethernet cable or fiber optic light guide.

Connect a USB compatible printer with printer language PCL 3 e.g. HP 5740 / 5940.
Set up in not required as the instrument automatically recognizes the printer.

9.1.4 USB interface Type B
A Type B connector can be used to connect a USB cable to a PC, the PC recognizes the height measuring instrument as an external drive. Data such as programs or measured values can be exported from the USB memory to another directory or storage media, whilst data such as measuring programs or language files can be imported.

9.1.5 SUB D – interface 15-pin
To determine the perpendicularity error when using an incremental probe.

9.1.6 SUB D – interface 25-pin
To connect the measuring column to an evaluation unit.

9.2 Software
For data transmission Mahr offers 2 type of software, you can use your own software in conjunction with the height measuring instrument as long as it is accordance to the interface description.

9.2.1 MarCom Standard or Professional
Transfer measured values directly into MS Excel (as from Version 97) or into a text file (.txt)
Data can be transferred either via USB, (requires an RS232-USB adapter cable) or directly via the serial COM interface.
9.2.2 OptoFace

Measured values can be directly transferred without keyboard activation into an application, for example MS-EXCEL®.

Connect a modem cable to the height measuring instrument to the RS232 OUT interface and to a free COM interface (COM1-COM4) on the PC.

Null modem cable Optoface Order no. 7024634

Settings for the height measuring instrument
Format ASCII
Baud rate (transfer rate) 9600
Data format no parity 8 Bit
Handshake ON (CTS)
10 Additional functions

10.1 Software update

Requirements for a Software update:

Zero modem cable Order no. 7024634
Eprom-Update-Software (RS232 Flash programmer for Main program of Mahr) Version V 2.00.3
- made by Mahr.

<table>
<thead>
<tr>
<th>Description / Sequence</th>
<th>Symbols / Pictures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procedure</td>
<td></td>
</tr>
<tr>
<td>– Connect zero modem cable to the COM 1 interface on the PC and the RS232 OUT interface on the height measuring instrument</td>
<td></td>
</tr>
<tr>
<td>Note:</td>
<td></td>
</tr>
<tr>
<td>When the COM 1 interface is occupied, select another PC</td>
<td></td>
</tr>
<tr>
<td>– Save both the Eprom-Update-Software and the text file (e.g. DX1_Rev. 1.00-02.txt) on the PC (Revision status can be updated)</td>
<td></td>
</tr>
<tr>
<td>– Open Eprom-File with a double left mouse click</td>
<td></td>
</tr>
<tr>
<td>– The Eprom-Update-Software opens</td>
<td></td>
</tr>
<tr>
<td>Note:</td>
<td></td>
</tr>
<tr>
<td>Make sure that the correct COM interface has been specified and „Others“ is highlighted</td>
<td></td>
</tr>
<tr>
<td>– Chose „Select file“.</td>
<td></td>
</tr>
<tr>
<td>– Click on the actual revision and open. The program loads the text file and is ready for transmission</td>
<td></td>
</tr>
<tr>
<td>Description / Sequence</td>
<td>Symbols / Pictures</td>
</tr>
<tr>
<td>------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>– First, shut down the height measuring instrument</td>
<td><img src="image1" alt="Image" /></td>
</tr>
<tr>
<td>– Switch back on to start</td>
<td><img src="image2" alt="Image" /></td>
</tr>
<tr>
<td>– Press the ON-OFF key</td>
<td><img src="image3" alt="Image" /></td>
</tr>
<tr>
<td>– Immediately press key 1 on the variable function keys</td>
<td><img src="image4" alt="Image" /></td>
</tr>
<tr>
<td>“Password” appears.</td>
<td><img src="image5" alt="Image" /></td>
</tr>
<tr>
<td>– Press key 2 and subsequently key 3</td>
<td><img src="image6" alt="Image" /></td>
</tr>
<tr>
<td>“send file” will appear in the Eprom-Software</td>
<td><img src="image7" alt="Image" /></td>
</tr>
</tbody>
</table>

Depending on the size of the data, the software update requires between 5-10 minutes. A black bar on the height measuring instrument and a blue bar on the software indicates the current state of the data transfer.
When **Programming Done** and **INIT RAM** appears in the display, the data transfer was successful

- After the data transfer the height measuring instrument must be rebooted, following requests will appear in the display.

  **Language– Unit– Resolution– Time– Date**

- Close the Eprom-Update-Software and remove the 0-modem cable.

### 10.2 Initialization of the internal memory

**Attention!!**

When initializing all parameters are set to their initial state. All data, such as programs, defined parameters or up-to-date measured characteristics are deleted. **Programs in the USB memory are not deleted.**

**See point 6.14.7.2 Standard parameter**

**Secure regularly your data on an external storage medium!**

**Procedure**

- Shut down the height measuring instrument

  Switch the height measuring instrument off and back on again using the mains switch

- Press the **ON/OFF** key

  The start up phase (booting up) appears in the display – wait until the Mahr symbol appears and immediately

- Press and briefly hold the **CE-** key

  In the display appears the following message „**Delete all data**“.

  The initialization starts and all parameters are in their original status.

  The following requests will appear in the display

  **Language– Unit– Resolution– Time– Date**
### 10.3 Storing additional languages

With this function additional languages can be installed and saved to the memory.

**Note:** The language has been translated and is in a text file format.

**Requirements:**

- USB cable
- Translated text file of the respective language
- Text file “FOREIGN.H”

### Description / Sequence

- Connect the USB cable to the USB interface on the PC and the height measuring instrument
- Windows Explorer will open automatically, the height measuring instrument will be recognized as an external drive.
- Copy the language file „FOREIGN“ to the USB memory. A new translated language muss always be called and displayed as „FOREIGN.H“.
- .H = extension
- Press the menu key

<table>
<thead>
<tr>
<th>Description / Sequence</th>
<th>Symbols / Pictures</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Connect the USB cable to the USB interface on the PC and the height measuring instrument</td>
<td><img src="image1.png" alt="USB connection" /></td>
</tr>
<tr>
<td>- Windows Explorer will open automatically, the height measuring instrument will be recognized as an external drive.</td>
<td><img src="image2.png" alt="Windows Explorer" /></td>
</tr>
</tbody>
</table>
| - Copy the language file „FOREIGN“ to the USB memory. A new translated language muss always be called and displayed as „FOREIGN.H“.
- .H = extension | ![Language copy](image3.png) |
| - Press the menu key | ![Menu](image4.png) |

### Additional Settings

1. Standstill-time
2. Contacting speed
3. Resolution
4. mm/inch
5. Language
6. Date and time
7. LCD setting
8. Beep ON/OFF
9. Auto – off time (min)
10. Quick-Mode
11. Perpendicularity
12. Data and printer
13. Advanced settings

- Temperature compensation
- Probe calibration parameters
- Function key F3
- Enter password
- Correction tables
- Clear functions menu
- Import language from USB
- Probing parameters
- Activate ON/OFF key see point 8 „Import Language-Text-Data (USB)” to start transmission

Requires ca. 1 minute

If the language data has not been copied into the USB memory, the following error will appear in the display

If under Point 6. Language „select any language“, the language is missing, the following error will appear in the display

Copy „FOREIGN.H“ on file system DOS
Then press any key to read the file to leave,
Press on CE!

Flash empty
10.4 Customer calibration

10.4.1 Correction factors in the Z-axis

The accuracy values specified for the Mahr height measuring instruments are only achieved with standard probing elements and the Mahr correction factor table. Please refer to chapter 6.14.6.3.

Settings

Die-down time = 1.0

Contacting speed = 8 mm/s

Before new correction values are determined, the existing Z-values must be deleted.

With „YES“ the values in the customer correction table will be deleted!

Return to „Measuring menu“

Delete all
Creating a measuring program

First a program must have at least 5 program steps.

The first measuring point must be on the base plate and the last value should be as close as possible to the maximum measuring length of the height measuring instrument!

Check with a gage block.

e.g. 0.0 mm ; 20.0 mm ; 70.0 mm ; 110.0 mm ; 180.0 mm ; 240.0 mm ; 350.0 mm

for height measuring instrument with a 350 mm measuring length. Height measuring instruments with a larger measuring range, the measuring points must be set accordingly.

Set the zero point on the base plate

Delete all

Contact from above – contact all values in the measuring series

0.00 mm -> 20.00 mm -> 70.00 mm etc.

Press the Program key

1. <-
2. Learn programming (teach-in)
3. Create new program

Standard tolerances: 0.010

Save program
PRG1 09:57 07/Feb/07 755
TEST1 10:59 07/Feb/07 587
TEST5 10:18 04/Sep/06 587

New file name CORRECT1

Return to „Measuring menu“

Delete all
Adjust the nominal values

Please refer to chapter 7.3.3 Create program steps

Use the following keys to move within the input box:

+ / - to scroll between program steps

Left and right arrow keys to move within the input box

Tab function - to skip between input boxes

Skip to the start (Step __ 1)

Switch between upper and lower case

Enter the „nominal values“ of the gage blocks. Skip with the arrow key to the value 20.012 and adjust.

Confirm with the „ON/OFF“ key, adjust all the nominal values, after the last characteristic press the „Abort“ key, to exit this menu and to save the adjusted values.
Start a measuring program and accept a correction table

Press the „Program“ key

In the next step the correction values in Z will be overwritten and recalculated. Linear interpolation is used for values between two correction points. After the correction, the accuracy of the measuring instrument is proportional to the meticulousness with which the gage block was measured.

Run up several positions to examine the adjusted values, the nominal values must correspond to the actual values!

Password allocation

For security measures it is possible under „Menu“ to allocate a password in order to protect the data from being accessed by a third party.
Connect a printer with an USB connection to the USB A port on the height measuring instrument.

### 10.4.2 Perpendicularity error correction

**Select a measuring instrument**

In order to correction the perpendicularity error an incremental probe P1514 H (Input 2) muss be used. An ideal testing standard is an granite master square.
Press the ON/OFF key to confirm and exit the menu with the „CE key”

**Procedure**

Mount the incremental probe (P1514 H) into the holder for perpendicularity error measurement.

The maximum measuring path depends upon the height of the height measuring instrument, enter the height (Note: ca. 1.0 mm shorter).

The height measuring instrument sets the zero point automatically on the base plate, and travels the measuring path, the correction factor will be automatically be accepted.

To check this function, select the „perpendicularity key“ and manually move the probe upwards. In the display will appear the actual perpendicularity error of the column, the graph shows the maximum and minimum values.

Active customer correction

**Correction value**

Password allocation and printing see correction factors in the Z-axis!
11 Self help, maintenance and care

11.1 Troubleshooting

Height measuring instrument 817 CLM

<table>
<thead>
<tr>
<th>Problem</th>
<th>Reason</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Probe travels to the base plate but does not confirm a zero point</td>
<td>The transport protection screw to lock the slide (see pg.11) is fixed</td>
<td>Unscrew the M5 screw further (see Page.11). Obtain a new zero point</td>
</tr>
<tr>
<td>2. Display switches off after a short time</td>
<td>The set Auto-Off is too short. Standard 5 min</td>
<td>Refer to Chapter 6.10 Auto-Off, to extend the Auto-Off time.</td>
</tr>
<tr>
<td>3. Display is dark after a short time</td>
<td>The set time the display is lit up is too short Standard 1 min</td>
<td>Refer to Chapter 6.10 to extend the period the background lit display is illuminated.</td>
</tr>
<tr>
<td>4. Error in the 2D mode</td>
<td>Measured values do not correspond with one another, different number of Z and X values.</td>
<td>Measure again the incorrect values or if need be measure all and recalculate</td>
</tr>
<tr>
<td>5. Various measuring functions in 2D mode are not available, such as contacting from above / below, groove, ledge or semi circle</td>
<td>In 2D mode only bore, shaft measurement and the cursor are permissible.</td>
<td>Select the results will be visible again when exiting the 2D mode</td>
</tr>
<tr>
<td>6. Message „Probe dia.?“</td>
<td>When calibrating the probe, an inaccurate probe diameter was accepted.</td>
<td>Repeat calibration or use a new probe</td>
</tr>
<tr>
<td>7. Height measuring instrument cannot be switched on or started, the air bearings do not function</td>
<td>Rechargeable battery is empty. Incorrect charger. Switch on the mains switch.</td>
<td>Connect the mains adapter to the height measuring instrument and charge for min. 5 hours.</td>
</tr>
<tr>
<td>8. The carriage travels automatically upwards or downwards once the holder has been moved</td>
<td>Still does not function. Quick Mode is active.</td>
<td>Exchange the rechargeable battery</td>
</tr>
<tr>
<td>9. Contacting a plane / circle does not react in Quick Mode</td>
<td>The incorrect symbol has been selected bore/shaft plane</td>
<td>Deactivate Quick Mode by pressing key</td>
</tr>
<tr>
<td>10. Data transmission does not function.</td>
<td>Incorrect settings. Incorrect data connection cable. Connect to RS232 OUT.</td>
<td>Implement settings in menu 6.13 Data and printer. Connect the correct connection cable (RS232 or USB) to the correct interface on the PC and the height measuring instrument</td>
</tr>
<tr>
<td>Problem</td>
<td>Reason</td>
<td>Solution</td>
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<td>------------------------------------------------------------------------</td>
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<td>-------------------------------------------------------------------------------------------------------------------------------------------</td>
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</table>
| 11. Printing is not possible.                                           | Incorrect settings  
Check that the printer has enough paper in the printer.                                                                 | Implement settings in menu 6.13 Data and printer.  
Insert more paper, check whether there is a paper blockage, if so remove paper. Use a RS232 or USB data connection cable |
| 12. The data for transmission to the PC are not current.                | Improper contacting (impact)  
Probe/workpiece is dirty  
Variation in temperature  
Probe incorrectly calibrated  
Not a standard probe  
Probe is not sufficiently clamped in mount  
Battery is almost empty | Remove the USB connection cable and reconnect – data will be updated.  
Re-calibrate the probe  
Clean the probe/workpiece  
Conduct measurements in an acclimatized room  
Switch on temperature compensation  
Check charge status of the battery, if necessary recharge. |
| 13. Repetitive accuracy is outside of the tolerance.                   | The distance to gage blocks for groove and ledge is wrong                                                                             | Refer to chapter 6.14.3 „probe calibration parameters“ adjust the settings value groove and ledge. |
| 14. The calibration was all right, but the probe display an incorrect probe constant after the calibration. | Operator correction data is wrong  
Dial Indicator or the incremental probe is not ok.                                                                 | Alter the operator correction data or set to the works correction  
Check the dial indicator or incremental probe |
| 15. Measuring error when conducting a perpendicularity error measurement. Perpendicularity error measurement is not possible | Error message „zero point 02 or 03 must be larger than 02 or 03“                                                                          | Workpiece zero point 02 / 03 may only be set once 01 has been set.  
The characteristic for the workpiece zero point 02 / 03 are before the characteristic for the workpiece zero point 01 is in the characteristics list. |
| 16. No characteristics are show in the display                         | Display is hidden                                                                                                                      | Mount the probe in the holder and switch the height measuring instrument off and then back on again, the reference point will be found.  
Remove obstacle and start again. |
| 17. Workpiece zero point 02 and/or 03 cannot be set!                   |                                                                                                                                         | Restart the height measuring instrument with a new reference point. |
| 18. SCALE REF-MARK MISSING  
Does not travel to the reference point! | If when switching on there is no probe holder attached, i.e. the weight balance is incorrect, the carriage will slide automatically upwards.  
If an obstacle is in the way, then it cannot travel to the reference point.  |                                                                                                                                 |
11.2 Maintenance and care

Height measuring instrument 817 CLM

Make sure that the base plate is always clean. The base plate should be freed daily of any dust, oil or cooling agents. Dirt on the air bearings has a negative influence on both the measurement and the accuracy.

The height measuring instrument can be cleaned with a slightly moistened cloth. Do not use detergents, which are harmful to plastics! To clean the air bearings use a little methylated spirits (alcohol).

The battery can be changed without losing any of the data stored, but first detach the plug from the charging device. The charging device should later be reconnected height measuring instrument, when in the display the battery symbol is down to being only a \( \frac{1}{4} \) black.

Over the course of time, batteries, which are not used will discharge. Discharged batteries lose their capacity and may cease to function. To avoid this, batteries should be fully charged every 3 months

Do not short-circuit the batteries. This may cause a fire or even trigger an explosion!

All maintenance work apart from that described above are to be conducted exclusively by Mahr’s after-sales service.

Charging the rechargeable batteries

To charge the batteries, connect a charging device to the corresponding socket. The charging condition of the batteries is displayed in the top right part of the display as a battery symbol.

All black – fully charged, all white – fully discharged.

Example of the charged status

Battery is ca. 60% charged.
If batteries are fully discharged, completely recharging them takes approximately 5 hours. The charging device can be connected for a longer period without any risk, since an intelligent switching circuit prevents overcharging. The batteries can be charged even if the height measuring instrument is switched off.

**Exchanging the batteries**

- Separate the charging device from the height measuring instrument
- Remove the battery cover, by unscrewing the 2 knurled thumb screws, ill. 1
- Loosen the clip for the RJ-plug and carefully pull out, ill. 2
- Remove the battery pack out of the retaining spring (clips), ill. 3
- Press the new battery pack into the retaining spring and reconnect the plug to the battery pack, ill. 4
- Replace the battery cover and insert and tighten the knurled thumb screws
- Attach the new battery pack to the mains adapter and charger for a min. 5 hours.

**Attention**

Please only use the specified battery pack!
## 12 Accessories

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<tr>
<th>Type</th>
<th>Weight</th>
<th>Order no.</th>
</tr>
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<td>Probe M2 complete</td>
<td>15 g (.529 oz)</td>
<td>4429256</td>
</tr>
<tr>
<td>Probe K5/51</td>
<td>15 g (.529 oz)</td>
<td>4429158</td>
</tr>
<tr>
<td>Probe K6/51</td>
<td>15 g (.529 oz)</td>
<td>4429254</td>
</tr>
<tr>
<td>Disc probe</td>
<td>15 g (.529 oz)</td>
<td>4429226</td>
</tr>
<tr>
<td>Cylindrical probe</td>
<td>15 g (.529 oz)</td>
<td>4429227</td>
</tr>
<tr>
<td>Taper probe</td>
<td>25 g (.881 oz)</td>
<td>4429228</td>
</tr>
<tr>
<td>Styli K4/30</td>
<td>102g (3.597 oz)</td>
<td>7023813</td>
</tr>
<tr>
<td>Styli K6/40</td>
<td>102g (3.597 oz)</td>
<td>7023816</td>
</tr>
<tr>
<td>Styli K10/60</td>
<td>102 g (3.597 oz)</td>
<td>7023810</td>
</tr>
<tr>
<td>Styli K10/100</td>
<td>102g (3.597 oz)</td>
<td>7023615</td>
</tr>
<tr>
<td>Catalog no.</td>
<td>Type</td>
<td>Weight</td>
</tr>
<tr>
<td>------------</td>
<td>-------------------------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>817 h1</td>
<td>Standard probe carrier (without probe)</td>
<td>318 g (11.217 oz)</td>
</tr>
<tr>
<td>817 h2</td>
<td>Probe carrier 100 mm</td>
<td>318 g (11.217 oz)</td>
</tr>
<tr>
<td>817 h3</td>
<td>Digital indicator carrier</td>
<td>218 g (7.689 oz)</td>
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<tr>
<td></td>
<td>Incremental probe</td>
<td>115 g (4.056 oz)</td>
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<td></td>
<td>MarCator 1086 / 12.5 mm</td>
<td>130 g (4.585 oz)</td>
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<tr>
<td>817 h4</td>
<td>Probe carrier K4/30-K10/100</td>
<td>231 g (8.148 oz)</td>
</tr>
<tr>
<td>817 h5</td>
<td>Probe carrier with a joint (without probe)</td>
<td>318 g (11.217 oz)</td>
</tr>
<tr>
<td>TMT 120 S</td>
<td>Spherical probe (for depth) M2,5 / M2</td>
<td>333 g (11.746 oz)</td>
</tr>
<tr>
<td>TMT 120</td>
<td>Spherical probe (for depth) M2,5 / M2</td>
<td>333 g (11.746 oz)</td>
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Universal probe set CXt2 consists of: 7034000

<table>
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<td>Taper probe</td>
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<tr>
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</tr>
<tr>
<td>Probe carrier carrier 100 mm (3.9370 inch)</td>
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</tr>
<tr>
<td>Probe carrier K4/30-K10/100</td>
<td>4429220</td>
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<tr>
<td>Styli K4/30</td>
<td>7023813</td>
</tr>
<tr>
<td>Styli K6/40</td>
<td>7023816</td>
</tr>
<tr>
<td>Styli K10/60</td>
<td>7023810</td>
</tr>
<tr>
<td>Styli K10/100</td>
<td>7023615</td>
</tr>
</tbody>
</table>

| Accessories Set 817 t2 in a case        | 4429018 |
| Consists of:                            |---------|
| Probe M2 complete                       | 4429256 |
| Disc probe                              | 4429226 |
| Cylindrical probe                       | 4429227 |
| Taper probe                             | 4429228 |
| Spherical probe (depth) M2.5 / M2       | 4429221 |
| Probe carrier 100 mm (3.9370 inch)      | 4429219 |

**Dimension**

- Measuring crook: $d = 0.5\text{ mm} (~.0197\text{ inch})$, $l = 78\text{ mm} (~3.0708\text{ inch})$
- Pin probe/-tip: $\phi d = 1.2\text{ mm} (~.0472\text{ inch})$, $l = 75\text{ mm} (~2.9527\text{ inch})$
- Taper probe: $\phi d = 0.75\text{ mm} (~.2952\text{ inch})$, $l = 15.5\text{ mm} (~.6102\text{ inch})$
- Spherical probe TC-Φd = 3 mm (.1181 inch), $l = 24\text{ mm} (.9448\text{ inch})$
- Spherical probe TC-Φd = 2 mm (.0787 inch), $l = 24\text{ mm} (.9448\text{ inch})$
- Spherical probe TC-Φd = 1 mm (.0393 inch), $l = 24\text{ mm} (.9448\text{ inch})$
- Extension M3 - M3: $d = 4\text{ mm} (~.1574\text{ inch})$, $l = 20\text{ mm} (.7874\text{ inch})$
- Extension M3 - M2.5: $d = 4\text{ mm} (~.1574\text{ inch})$, $l = 20\text{ mm} (.7874\text{ inch})$

**Shaft length**

- $ls = 15.5\text{ mm} (~.6102\text{ inch})$

**Accessories**

- Software MarCom Standard: 4102551
- Software MarCom Professional: 4102552
- Data cable RS232 to connect to a PC: 7024634
- Adapter cable RS232-USB: 4102333
- Digital indicator MarCator 1086: 4337020
- 12.5 mm / 0.001
- Data connection cable Opto RS232 16EXr: 4102410
- Incremental probe P1514 H: 4426810
- Spare battery 4.8V 7000mAh NiMh: 4862931
- Mains power plug EURO FW 7555M/08: 4102766
- Adapter UK 1717618: 9101328
- Adapter US 1717715: 4102778
- MSP 2 Statistics printer: 4102040
- Data cable to 817 CLM: 7024634
- HP Ink-jet printer 5940 USB: 4429015
- USB cable 1.5 m (4.921 ft): 4883216
### 13 Technical data

**Height measuring instrument 817 CLM**

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<th>Measuring range</th>
<th>350 mm</th>
<th>600 mm</th>
<th>1000 mm</th>
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<tbody>
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<td></td>
<td>14&quot;</td>
<td>24&quot;</td>
<td>40&quot;</td>
</tr>
</tbody>
</table>

**Application range**
respectively ca. 170 mm / 7"

**Measuring error**
1.8 + L/600 (L in mm)

**Perpendicularity error**
< 5 µm    < 6 µm    < 10 µm
(Base plate according to DIN 876 /0 and only in conjunction with a corrected electronic measuring system in the X-axis, with an incremental probe)

**Perpendicularity error mechanic**
15 µm    20 µm    30 µm

**Repeatability +/- 2**
on a plane: 0.5 µm in a bore: 1 µm

**Measuring force, probe 6.0 mm**
1 N +/- 0.2 N

**Contacting speeds**
5, 8, 11, 15, 20 mm/sec. max. 40 mm/sec.

**Max. permissible manual positioning speed of the measuring carriage**
600 mm/s

**Drive mechanism**
motorized

**3-point air cushion**
ca. 9 µm

**Compressed air supply**
integrated compressor

**Interchangeable probes**
see accessories

**Vertical measuring system of the column**
incremental measuring system

**Working- / operating temperature**
10 °C ... 40 °C (50°F...104 °F)

**Storage temperature**
-10 °C...60 °C (14°F...140 °F)

**Permissible relative humidity (operating)**
max. 65% (non-condensing)

**Permissible relative humidity (storage)**
max. 65 % (non-condensing)

**Weight**
ca.
25 kg (55.16 lbs) 30 kg (66.14 lbs) 35 kg (77.16 lbs)

**Thermometer / Sensor error limits**
+/- 0.5 °C (+/- 31.1°F)
Operating time with charged battery: 10 - 16 hours (depending on operation)

Rechargeable battery: ca. <= 6.6Ah

Power consumption:
- background lit display
  - ON = 450 mA
  - OFF = 80 mA
- motor and contacting system: = 100 mA

Charging current, battery voltage:
- <= 5.0 V : > 1000 mA
- >= 5.7 V : > 720 mA

Power supply: mains adapter 7.5V DC, Type FW 7555M/08

Mains voltage / mains frequency: 110V – 230V AC, 50 – 60 Hz

Protection class: IP40

Keypad: membrane keypad with defined point of action

Interface:
- USB (Type A and B), RS232 (OUT and INPUT), SUB D 15-pin (Incremental probe)
- and 24-pin (Column)

Measuring instruments suitable for connection:
- Incremental probe P1514 H
- MarCator 1075 / 1080 / 1086 / 1087 / 1088
- Digital caliper 16EX

Supported languages: German, English, French, Japanese, Chinese, Spanish, Korean, Italian, Czech, free language

Resolution: 0.0001, 0.0005, 0.001, 0.005, 0.01 (mm)
- 0.00001, 0.00005, 0.0001, 0.0005, 0.001 (inch)

Dimensions (D x W x H):
- 350 mm x 280 mm x 730 mm
  - 14” x 11” x 29”
- 600 mm x 280 mm x 980 mm
  - 24” x 11” x 39”
- 1000 mm x 280 mm x 1380 mm
  - 40” x 11” x 54”
14  Alphabetical index

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Mahr GmbH
Reutlingerstrasse 48
D- 73728 Esslingen
Germany

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Bezeichnung: Höhenmessgerät

Typ: 817CLM

ab Lieferdatum oder Serien-Nr.: 6005004

is in conformity with the following standards: EN 55011: 1991; group 1, class B
est conforme aux normes: EN 50082-2 1995 ; level 3
está conforme con las normas siguientes: è conforme alle norme seguenti:

gemäß der Richtlinie(n): Niederspannungsrichtlinie 73/23/EWG, i.d.F. 93/68/EWG
following the Directive(s): Richtlinie Elektromagnetische Verträglichkeit 89/336/EWG, i.d.F. 93/68/EWG
con arreglo a la Directiva: secondo alla Direttiva:

18, Dez. 2006

Ort u. Datum: Esslingen
Prüfbeauftragter

Unterschrift: 

Signature: 

Inspector

Firma: 

Ingegnere

Verificador jefe

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