

# LEITZ PMM-C LINE

VERSION 2016-6



NEW

**SENIMATION**

Intelligent Sensor Automation



**Description**

High and ultra high accuracy, fast universal measuring machines in “Closed Frame” design.  
Optional laser sensors and roughness measurement.  
New: SENMATION Technology - intelligent sensor automation.

**Applications**

|                         |                                                                                                                                                                                                |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Coordinate measurements | Inspection of any kind of parts and geometries for production and R&D. Calibration of tools.<br>Reference measuring machines for manufacturing, quality control centers and metrology labs.    |
| Gear inspection         | For gear diameters of up to 1550 mm. Capable of measuring any type of gear, gear segments, gear racks and any type of gear cutter. No rotary table required for the measurements.              |
| Form testing            | Quality control of form tolerances: roundness, cylindricity, flatness, straightness and profil form.<br>Non contact inspection of high precision surfaces: lenses, mirrors, optical flats etc. |
| Roughness measurement   | tactile: Profiler R roughness sensor, automatically exchangeable<br>non contact: Precitec LR, automatically exchangeable                                                                       |

**Design**

|                             |                                                                                                                                                                                   |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Frame                       | Unique “Closed Frame”- design with fixed portal and moving table. Unitary cast iron / granite construction. No aluminium used in main structure.                                  |
| Guideways                   | Pre-loaded air bearings in all axes. Load carrying bearings with electronic gap monitoring.                                                                                       |
| Drives                      | High performance servo motors with rotary encoders and electronic thrust force control.<br>Power transmission near the center of gravity by re-circulating precision ball drives. |
| Length measuring system     | High resolution steel scales (Infinity: glass ceramics) with electro-optical transducers.                                                                                         |
| Resolution                  | Leitz Infinity: 1 nm (0.001 µm) / Leitz Ultra, PMM-C, PMM-Xi: 5 nm (0.005 µm)                                                                                                     |
| Temperature compensation    | Automatic temperature compensation for scales and workpiece.                                                                                                                      |
| Number of workpiece sensors | Leitz Infinity: 4 / Leitz Ultra, PMM-C: 1 (optional: 4) / Leitz PMM-Xi: 1                                                                                                         |
| Damping system              | Leitz Infinity, Ultra: Active pneumatic damping.<br>Leitz PMM-C, PMM-Xi: Elastomer damping (optional: active pneumatic damping).                                                  |



**SENMATION**  
Intelligent Sensor Automation

**Leitz Probe Heads  
Infinity, Ultra, PMM-C**
**LSP-S2 Scan+**
**LSP-S2**
**LSP-S4**


Leitz Infinity

●

○<sup>(1)(2)</sup>

Leitz Ultra, PMM-C XX.YY.6/7

●

○<sup>(1)(2)</sup>

Leitz PMM-C XX.YY.10

●

○<sup>(2)</sup>

Measuring methods

3D-self-centering Scanning, variable High Speed Scanning  
Tag Scan, Scan Catch, Four Axis Scan, Optical Scan

Max. data rate

1000 points/s

1000 points/s

1000 points/s

Probing force

0.1 to 1.2 N

0.1 to 1.2 N

0.02 to 0.16 N

Max. stylus length

800 mm

800 mm

800 mm

Max. stylus weight  
(incl. clamping)

650 g

1000 g

1000 g

Smallest tip diameter

0.1 mm

0.1 mm

0.1 mm

Optical sensors (optional)

-

Precitec LR, HP-O

Precitec LR, HP-O

Roughness sensor (optional)

Profilor R

Profilor R

Profilor R

For optional probe heads LSP-S2/S4 the following specifications are valid: <sup>(1)</sup>THP = THP + 0.4µm + 5s; PFTU = PFTU + 0.1µm

<sup>(2)</sup>PFTM = PFTM + 1µm; PLTM = PLTM + 0.5µm; RONT = RONT + 0.2µm

**Leitz Probe Heads  
PMM-Xi, PMM-C SENMATION**
**HP-S-X5-HD**
**HH-AS-2.5T  
HP-S-X1H**


Leitz PMM-Xi

●

Leitz PMM-C, Xi SENMATION

●

○

Measuring methods

3D-self-centering Scanning, variable High Speed Scanning  
Tag Scan, Scan Catch, Four Axis Scan, Optical Scan

Max. data rate

1000 points/s

1000 points/s

Probing force

0.1 to 1.2 N

0.05 to 0.6 N

Max. stylus length

800 mm

20-225 mm  
cranked styli ≤ 100 mm

Max. stylus weight  
(incl. clamping)

650 g

33 g

Smallest tip diameter

0.1 mm

0.1 mm

Optical sensors (optional)

Precitec LR

-

Roughness sensor (optional)

Profilor R

-

● standard    ○ optional

| Optical Sensors                           | Precitec LR                                        |                                  | HP-O                            |                                 |
|-------------------------------------------|----------------------------------------------------|----------------------------------|---------------------------------|---------------------------------|
|                                           |                                                    |                                  | Short range                     | Mid range                       |
| Measuring methods                         | Chromatic confocal                                 |                                  | Interferometric                 |                                 |
| Measuring angle to surface                | rough:<br>reflecting:                              | $\pm 35^\circ$<br>$\pm 35^\circ$ | $\pm 30^\circ$<br>$\pm 4^\circ$ | $\pm 30^\circ$<br>$\pm 1^\circ$ |
| Working distance / measuring range        | 6.5 mm / 0.1 mm                                    |                                  | 6.5 mm / 0.4 mm                 | 10.5 mm / 2 mm                  |
| Resolution in Z direction                 | < 3 nm                                             |                                  | < 3 nm                          | < 3 nm                          |
| Spot diameter                             | 1.4 $\mu\text{m}$                                  |                                  | 11 $\mu\text{m}$                | 40 $\mu\text{m}$                |
| Applications                              | Optical glasses, mirrors,<br>all kinds of surfaces |                                  | Metallic technical surfaces     |                                 |
| Laser protection class <sup>(1) (2)</sup> | 1                                                  |                                  | 2                               | 2                               |

| Roughness Sensors        | Profiler R (tactile)                                                                                                                     | Precitec LR (optical)             |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|
| Measuring length / range | 12.5 mm (15 mm) / 500 $\mu\text{m}$                                                                                                      | not limited / 100 $\mu\text{m}$   |
| Probe tip                | 2 $\mu\text{m}$ / 90°, exchangeable                                                                                                      | 1.4 $\mu\text{m}$ (spot diameter) |
| Parameter                | $R_a$ , $R_z$ , $R_q$ , $R_t$ and more according to ISO 4287 and ISO 13565                                                               |                                   |
| Measuring deviation      | $R_a$ = 8% for measuring range 0.2 $\mu\text{m}$ - 2 $\mu\text{m}$<br>$R_z$ = 10% for measuring range 1 $\mu\text{m}$ - 10 $\mu\text{m}$ |                                   |

#### Options

- Optical point sensor Precitec LR
- SENMATION - Automatic sensor exchange
- Roughness sensor Profiler R
- Automatic Workpiece Temperature Sensor
- Automatic styli changer
- Rotary table, integrated or „on top“
- Optical point sensor HP-O
- Extended Z-measuring range 100/150/175 mm
- Climate controlled room
- Manual and automated part loading system
- Environment Monitoring System



Optical point sensor  
Precitec LR



Optical point sensor  
HP-O



Roughness sensor  
Profiler R

<sup>(1)</sup> Class 1 laser devices are safe under reasonably foreseeable operating conditions. In general they would not be expected to emit any radiation which is strong enough to damage eyes or the skin.

<sup>(2)</sup> Under reasonably foreseeable operating conditions, Class 2 laser devices would not be expected to cause any permanent eye damage, provided that any exposure can be terminated through the eyelid closing reflex (assumed to be 0.25 s).

| Max. permissible error MPE [µm] acc. to ISO 10360-2 (2010) |                                    | Leitz Infinity 12.10.6    | Leitz Ultra 12.10.7 | Leitz Ultra 16.12.7 / 24.12.7 |
|------------------------------------------------------------|------------------------------------|---------------------------|---------------------|-------------------------------|
| Volumetric length measuring error <sup>(1)(2)</sup>        | E <sub>0</sub>                     | 0.3 + L / 1000            | 0.4 + L / 850       | 0.7 + L / 850                 |
| Volumetric length measuring error <sup>(1)</sup>           | E <sub>150</sub>                   | 0.5 + L / 1000            | 0.6 + L / 850       | 0.9 + L / 850                 |
| Repeatability range <sup>(1)(2)</sup>                      | R <sub>0</sub>                     | 0.25                      | 0.27                | 0.3                           |
| ISO 10360-4 (2000)                                         |                                    |                           |                     |                               |
| Single stylus Form error, scanning <sup>(3)</sup>          | THP                                | 0.8/60s                   | 0.9/40s             | 1.0/40s                       |
| ISO 10360-5 (2011)                                         |                                    |                           |                     |                               |
| Single stylus Form error <sup>(2)</sup>                    | PFTU                               | 0.4                       | 0.45                | 0.55                          |
| Multi styli Form error <sup>(4)</sup>                      | PFTM                               | 1.7                       | 1.8                 | 2.0                           |
| Multi styli Size error <sup>(4)</sup>                      | PSTM                               | 0.4                       | 0.5                 | 0.6                           |
| Multi styli Location error <sup>(4)</sup>                  | PLTM                               | 1.1                       | 1.2                 | 1.4                           |
| ISO 12181                                                  |                                    |                           |                     |                               |
| Form measurement error <sup>(5)</sup>                      | RONt                               | 0.4                       | 0.45                | 0.55                          |
| Specifications for optical sensors Precitec LR / HP-0      |                                    |                           |                     |                               |
| ISO 10360-8 (2013)                                         |                                    |                           |                     |                               |
| Form error                                                 | P <sub>Form. Sphere 1x25:Tr</sub>  | 1.9 / 2.5                 | 1.9 / 2.8           | 1.9 / 2.8                     |
| Size error                                                 | P <sub>Size. Sphere 1x25:Tr</sub>  | 4.9 / 5.5                 | 4.9 / 5.8           | 4.9 / 5.8                     |
| ISO 10360-9 (2013)                                         |                                    |                           |                     |                               |
| Multi probing system Form error                            | P <sub>Form. Sphere 2x25:MPS</sub> |                           | 3.9                 |                               |
| Multi probing system Size error                            | P <sub>Size. Sphere 2x25:MPS</sub> |                           | 3.5                 |                               |
| Multi probing system Location error                        | L <sub>Dia. 2x25:MPS</sub>         |                           | 4.9                 |                               |
| Permitted Environmental Conditions                         |                                    |                           |                     |                               |
| Temperature limits                                         |                                    |                           | 19-21°C             |                               |
| Temperature gradient per hour / day / meter                |                                    | 0.3 / 0.4 / 0.1 K         | 0.3 / 0.5 / 0.2 K   | 0.3 / 0.5 / 0.2 K             |
| Relative air humidity                                      |                                    | 30% - 70%, non condensing |                     |                               |
| Throughput                                                 |                                    |                           |                     |                               |
| Max. probing frequency (tactile)                           |                                    |                           | 20/min              |                               |
| Max. positioning speed                                     |                                    |                           | 300 mm/s            |                               |
| Max. acceleration                                          |                                    |                           | 1500 mm/s²          |                               |

- <sup>(1)</sup> E<sub>0</sub>, E<sub>150</sub> and R<sub>0</sub> are valid for a length gauge with an uncertainty of calibration of  $\leq 0.02 + 0.12 \times L / 1000$  and a CTE between  $8 \times 10^{-6}/K$  and  $13 \times 10^{-6}/K$ . for measuring lengths of more than 1000 mm the availability of adequate gauges has to be confirmed with the manufacturer.
- <sup>(2)</sup> E<sub>0</sub>, R<sub>0</sub> and PFTU are valid for Leitz Infinity styli  $\varnothing 5 \times 80$  mm and  $\varnothing 8 \times 130$  mm, without extension; anywhere in the measuring volume.
- <sup>(3)</sup> THP is valid for a Leitz Infinity stylus  $\varnothing 5 \times 80$  mm.
- <sup>(4)</sup> PFTM, PSTM, PLTM are valid for 5 Leitz Infinity styli  $\varnothing 5 \times 80$  mm. To be tested near the reference sphere.
- <sup>(5)</sup> RONt (MZCI) is valid for a Leitz Infinity stylus  $\varnothing 5 \times 80$  mm, filter 50 UPR, with precision calibration. Verification with QUINDOS only. Form measurement error (roundness) at a  $\varnothing 50$  mm ring gauge, in scanning mode, acc. to ISO 12 181 (VDI/VDE 2617, part 2.2).

Specifications for acceptance test with ball plates on request.  
Specifications are valid with original Leitz accessories only.

| Max. permissible error MPE [µm] acc. to ISO 10360-2 (2010) |                  | 8.10.6<br>12.10.6<br>12.10.7 | 16.12.7<br>24.12.7 | 16.12.10<br>24.12.10<br>24.16.7 | 24.16.10      |
|------------------------------------------------------------|------------------|------------------------------|--------------------|---------------------------------|---------------|
| Volumetric length measuring error <sup>(1)(2)</sup>        | E <sub>0</sub>   | 0.5 + L / 700                | 0.8 + L / 650      | 1.0 + L / 650                   | 1.5 + L / 600 |
| Volumetric length measuring error <sup>(1)</sup>           | E <sub>150</sub> | 0.7 + L / 700                | 1.1 + L / 650      | 1.3 + L / 650                   | 1.7 + L / 600 |
| Repeatability range <sup>(1)(2)</sup>                      | R <sub>0</sub>   | 0.3                          | 0.4                | 0.5                             | 0.6           |
| <b>ISO 10360-4 (2000)</b>                                  |                  |                              |                    |                                 |               |
| Single stylus Form error, scanning <sup>(3)</sup>          | THP              | 0.9/40s                      | 1.0/40s            | 1.1/40s                         | 1.4/40s       |
| <b>ISO 10360-5 (2011)</b>                                  |                  |                              |                    |                                 |               |
| Single stylus Form error <sup>(2)</sup>                    | PFTU             | 0.45                         | 0.6                | 0.7                             | 1.0           |
| Multi styli Form error <sup>(4)(5)</sup>                   | PFTM             | 1.8                          | 2.0                | 2.1                             | 2.2           |
| Multi styli Size error <sup>(4)(5)</sup>                   | PSTM             | 0.5                          | 0.6                | 0.8                             | 1.0           |
| Multi styli Location error <sup>(4)(5)</sup>               | PLTM             | 1.3                          | 1.4                | 1.5                             | 1.6           |
| <b>ISO 12181</b>                                           |                  |                              |                    |                                 |               |
| Form measurement error <sup>(6)</sup>                      | RONT             | 0.5                          | 0.6                | 0.65                            | 0.8           |

#### Specifications for optical sensors Precitec LR / HP-0

| ISO 10360-8 (2013)                  |                                    |           |
|-------------------------------------|------------------------------------|-----------|
| Form error                          | P <sub>Form. Sphere 1x25:Tr</sub>  | 2.1 / 3.1 |
| Size error                          | P <sub>Size. Sphere 1x25:Tr</sub>  | 4.9 / 6.1 |
| ISO 10360-9 (2013) <sup>(5)</sup>   |                                    |           |
| Multi probing system Form error     | P <sub>Form. Sphere 2x25:MPS</sub> | 4.2       |
| Multi probing system Size error     | P <sub>Size. Sphere 2x25:MPS</sub> | 3.8       |
| Multi probing system Location error | L <sub>Dia. 2x25:MPS</sub>         | 5.2       |

#### Permitted Environmental Conditions

|                                             |                           |             |             |             |
|---------------------------------------------|---------------------------|-------------|-------------|-------------|
| Temperature limits                          | 19-21°C                   | 18-22°C     | 18-22°C     | 18-22°C     |
| Temperature gradient per hour / day / meter | 0.5 / 0.5 / 0.5 K         | 1 / 2 / 1 K | 1 / 2 / 1 K | 1 / 2 / 1 K |
| Relative air humidity                       | 30% - 70%, non condensing |             |             |             |

#### Throughput

|                                  |                        |
|----------------------------------|------------------------|
| Max. probing frequency (tactile) | 40/min                 |
| Max. positioning speed           | 400 mm/s               |
| Max. acceleration                | 2400 mm/s <sup>2</sup> |

- <sup>(1)</sup> E<sub>0</sub>, E<sub>150</sub> and R<sub>0</sub> are valid for a length gauge with an uncertainty of calibration of 0.02 + 0.12 x L / 1000 (column 1) respectively for a step gauge with an uncertainty of calibration of ≤ 0.08 + 0.3 x L / 1000 (columns 2-4) and a calibrated CTE between 8 x 10<sup>-6</sup>/K and 13 x 10<sup>-6</sup>/K. for measuring lengths of more than 1000 mm the availability of adequate gauges has to be confirmed with the manufacturer .
- <sup>(2)</sup> E<sub>0</sub>, R<sub>0</sub> and PFTU are valid for all Leitz styli from ø 3 x 35 mm up to ø 8 x 130 mm, without extension; anywhere in the measuring volume.
- <sup>(3)</sup> THP is valid for a Leitz stylus ø 5 x 80 mm.
- <sup>(4)</sup> PFTM, PSTM, PLTM are valid for 5 Leitz styli ø 5 x 80 mm. To be tested near the reference sphere.
- <sup>(5)</sup> For probe head change (SENMATION) 1 µm has to be added.
- <sup>(6)</sup> RONT (MZCI) is valid for a Leitz stylus ø 5 x 80 mm, filter 50 UPR, with precision calibration. Verification with QUINDOS only.
- Form measurement error (roundness) at a ø 50 mm ring gauge, in scanning mode, acc. to ISO 12 181 (VDI/VDE 2617, part 2.2).

Specifications for acceptance test with ball plates on request.  
Specifications are valid with original Leitz accessories only.

| Max. measuring error MPE [ $\mu\text{m}$ ] acc. to ISO 10360-2 (2010) |                  | 8.10.6<br>12.10.6<br>12.10.7 | 16.12.7<br>24.12.7 | 16.12.10<br>24.12.10<br>24.16.7 | 24.16.10      |
|-----------------------------------------------------------------------|------------------|------------------------------|--------------------|---------------------------------|---------------|
| Volumetric length measuring error <sup>(1)(2)</sup>                   | E <sub>0</sub>   | 0.5 + L / 500                | 1.0 + L / 500      | 1.2 + L / 500                   | 1.7 + L / 500 |
| Volumetric length measuring error <sup>(1)</sup>                      | E <sub>150</sub> | 0.8 + L / 500                | 1.2 + L / 500      | 1.4 + L / 500                   | 2.1 + L / 500 |
| Repeatability range <sup>(1)(2)</sup>                                 | R <sub>0</sub>   | 0.4                          | 0.6                | 0.6                             | 0.7           |
| <b>ISO 10360-4 (2000)</b>                                             |                  |                              |                    |                                 |               |
| Single stylus Form error, scanning <sup>(3)</sup>                     | THP              | 0.9/40s                      | 1.0/40s            | 1.1/40s                         | 1.6/40s       |
| <b>ISO 10360-5 (2011)</b>                                             |                  |                              |                    |                                 |               |
| Single stylus Form error <sup>(2)</sup>                               | PFTU             | 0.5                          | 0.7                | 0.8                             | 1.1           |
| Multi styli Form error <sup>(4)(5)</sup>                              | PFTM             | 1.9                          | 2.0                | 2.2                             | 2.3           |
| Multi styli Size error <sup>(4)(5)</sup>                              | PSTM             | 0.6                          | 0.7                | 0.9                             | 1.1           |
| Multi styli Location error <sup>(4)(5)</sup>                          | PLTM             | 1.3                          | 1.4                | 1.5                             | 1.7           |
| <b>ISO 12181</b>                                                      |                  |                              |                    |                                 |               |
| Form measurement error <sup>(6)</sup>                                 | RONt             | 0.5                          | 0.65               | 0.7                             | 0.9           |

#### Specifications for optical sensor Precitec LR ISO 10360-8 (2013)

|            |                                   |     |
|------------|-----------------------------------|-----|
| Form error | P <sub>Form. Sphere 1x25:Tr</sub> | 2.4 |
| Size error | P <sub>Size. Sphere 1x25:Tr</sub> | 5.2 |

#### ISO 10360-9 (2013) <sup>(5)</sup>

|                                     |                                    |     |
|-------------------------------------|------------------------------------|-----|
| Multi probing system Form error     | P <sub>Form. Sphere 2x25:MPS</sub> | 4.5 |
| Multi probing system Size error     | P <sub>Size. Sphere 2x25:MPS</sub> | 4.1 |
| Multi probing system Location error | L <sub>Dia. 2x25:MPS</sub>         | 5.5 |

#### Permitted Environmental Conditions

|                                             |                             |             |             |             |
|---------------------------------------------|-----------------------------|-------------|-------------|-------------|
| Temperature limits                          | 19-21°C                     | 18-22°C     | 18-22°C     | 18-22°C     |
| Temperature gradient per hour / day / meter | 0.5 / 1.0 / 0.5 K           | 1 / 2 / 1 K | 1 / 2 / 1 K | 1 / 2 / 1 K |
| Relative air humidity                       | 30 % – 70 %, non condensing |             |             |             |

#### Throughput

|                        |                       |
|------------------------|-----------------------|
| Max. probing frequency | 25/min                |
| Max. positioning speed | 400 mm/s              |
| Max. acceleration      | 900 mm/s <sup>2</sup> |

- <sup>(1)</sup> E<sub>0</sub>, E<sub>150</sub> and R<sub>0</sub> are valid for a length gauge with an uncertainty of calibration of 0.02 + 0.12 x L / 1000 (column 1) respectively for a step gauge with an uncertainty of calibration of  $\leq 0.08 + 0.3 \times L / 1000$  (columns 2-4) and a calibrated CTE between  $8 \times 10^{-6}/\text{K}$  and  $13 \times 10^{-6}/\text{K}$ . for measuring lengths of more than 1000 mm the availability of adequate gauges has to be confirmed with the manufacturer .
- <sup>(2)</sup> E<sub>0</sub>, R<sub>0</sub> and PFTU are valid for all Leitz styli from  $\varnothing 3 \times 35$  mm up to  $\varnothing 8 \times 130$  mm, without extension; anywhere in the measuring volume.
- <sup>(3)</sup> THP is valid for a Leitz stylus  $\varnothing 5 \times 80$  mm.
- <sup>(4)</sup> PFTM, PSTM, PLTM are valid for 5 Leitz styli  $\varnothing 5 \times 80$  mm. To be tested near the reference sphere. SENMATION sensor exchange repeatability  $\leq 1 \mu\text{m}$ .
- <sup>(5)</sup> For probe head change (SENMATION) 1  $\mu\text{m}$  has to be added.
- <sup>(6)</sup> RONt (MZCI) is valid for a Leitz stylus  $\varnothing 5 \times 80$  mm, filter 50 UPR, with precision calibration. Verification with QUINDOS only.
- Form measurement error (roundness) at a  $\varnothing 50$  mm ring gauge, in scanning mode, acc. to ISO 12 181 (VDI/VDE 2617, part 2.2).

Specifications for acceptance test with ball plates on request.  
Specifications are valid with original Leitz accessories only.

| Max. measuring error MPE [ $\mu\text{m}$ ] acc. to<br>ISO 10360-2 (2010) |                  | 8.10.6<br>12.10.6<br>12.10.7 | 16.12.7<br>24.12.7 | 16.12.10<br>24.12.10<br>24.16.7 | 24.16.10      |
|--------------------------------------------------------------------------|------------------|------------------------------|--------------------|---------------------------------|---------------|
| Volumetric length measuring error <sup>(1)(2)</sup>                      | E <sub>0</sub>   | 0.8 + L / 500                | 1.3 + L / 500      | 1.4 + L / 500                   | 2.0 + L / 500 |
| Volumetric length measuring error <sup>(1)</sup>                         | E <sub>200</sub> | 1.1 + L / 500                | 1.5 + L / 500      | 1.7 + L / 500                   | 2.4 + L / 500 |
| Repeatability range <sup>(1)(2)</sup>                                    | R <sub>0</sub>   | 0.5                          | 0.7                | 0.8                             | 0.9           |
| <b>ISO 10360-4 (2000)</b>                                                |                  |                              |                    |                                 |               |
| Single stylus Form error, scanning <sup>(3)</sup>                        | THP              | 1.3/45s                      | 1.4/45s            | 1.5/45s                         | 2.0/45s       |
| <b>ISO 10360-5 (2011)</b>                                                |                  |                              |                    |                                 |               |
| Single stylus Form error <sup>(2)</sup>                                  | PFTU             | 0.9                          | 1.1                | 1.2                             | 1.5           |
| Multi styli Form error <sup>(4)</sup>                                    | PFTM             | 3.7                          | 3.9                | 4.3                             | 4.5           |
| Multi styli Size error <sup>(4)</sup>                                    | PSTM             | 1.5                          | 1.8                | 2.4                             | 2.7           |
| Multi styli Location error <sup>(4)</sup>                                | PLTM             | 2.7                          | 2.9                | 3.1                             | 3.5           |
| <b>ISO 12181</b>                                                         |                  |                              |                    |                                 |               |
| Form measurement error <sup>(5)</sup>                                    | RONT             | 1.2                          | 1.4                | 1.5                             | 1.7           |
| <b>Permitted Environmental Conditions and Throughput</b>                 |                  |                              |                    |                                 |               |
| For PMM-C see page 6, for PMM-Xi see page 7.                             |                  |                              |                    |                                 |               |



- <sup>(1)</sup> E<sub>0</sub>, E<sub>200</sub> and R<sub>0</sub> are valid for a step gauge with an uncertainty of calibration of  $\leq 0.08 + 0.3 \times L / 1000$  and a CTE between  $8 \times 10^{-6}/\text{K}$  and  $13 \times 10^{-6}/\text{K}$ . For measuring lengths of more than 1000 mm the availability of adequate gauges has to be confirmed with the manufacturer.
- <sup>(2)</sup> E<sub>0</sub>, R<sub>0</sub> and PFTU are valid for a Leitz stylus  $\varnothing 3 \times 50$  mm without extension; anywhere in the measuring volume.
- <sup>(3)</sup> THP is valid for a Leitz stylus  $\varnothing 3 \times 50$  mm.
- <sup>(4)</sup> PFTM, PSTM, PLTM are valid for a Leitz stylus  $\varnothing 3 \times 50$  mm. To be tested near the reference sphere. For probe head change (SENMATION)  $1 \mu\text{m}$  has to be added.
- <sup>(5)</sup> RONT (MZCI) is valid for a Leitz stylus  $\varnothing 3 \times 50$  mm, filter 50 UPR, with precision calibration. Verification with QUINDOS only. Form measurement error (roundness) at a  $\varnothing 50$  mm ring gauge, in scanning mode, acc. to ISO 12 181 (VDI/VDE 2617, part 2.2).

Specifications for acceptance test with ball plates on request.  
Specifications are valid with original Leitz accessories only.

## CMM Capability Charts - Distances and Diameters

| Tolerance [mm] | Distance or diameter [mm] |              |              |              |              |             |              |
|----------------|---------------------------|--------------|--------------|--------------|--------------|-------------|--------------|
|                | 50                        | 100          | 200          | 400          | 600          | 1000        | 2000         |
| ± 0.003        | 0.3 + L/1000              |              |              |              |              |             |              |
| ± 0.005        | 0.5 + L/900               | 0.4 + L/1000 | 0.3 + L/1000 |              |              |             |              |
| ± 0.007        | 0.7 + L/700               | 0.5 + L/500  | 0.5 + L/1000 | 0.3 + L/1000 |              |             |              |
| ± 0.010        | 0.9 + L/400               | 0.8 + L/500  | 0.6 + L/500  | 0.5 + L/800  | 0.4 + L/1000 |             |              |
| ± 0.015        | 1.3 + L/300               | 1.2 + L/350  | 0.9 + L/350  | 0.7 + L/500  | 0.6 + L/700  | 0.4 + L/900 |              |
| ± 0.020        | 1.8 + L/250               | 1.6 + L/250  | 1.3 + L/300  | 0.9 + L/350  | 0.8 + L/500  | 0.6 + L/700 | 0.3 + L/1200 |
| ± 0.030        | 2.8 + L/200               | 2.6 + L/250  | 2.2 + L/250  | 1.7 + L/300  | 1.5 + L/400  | 1.0 + L/500 | 0.5 + L/800  |

Example: A diameter of 400 mm has a tolerance of ± 0.010 mm. For the inspection a CMM with a length measuring error  $E_0 = 0.5 + L/800 \mu\text{m}$  is required.

CMM Capability Charts - Form Tolerances 

| Tolerance              | 0.005 mm | 0.007 mm | 0.010 mm | 0.015 mm | 0.020 mm | 0.030 mm | 0.050 mm |
|------------------------|----------|----------|----------|----------|----------|----------|----------|
| PFTU [ $\mu\text{m}$ ] | 0.5      | 0.7      | 1.0      | 1.5      | 2.0      |          |          |
| THP [ $\mu\text{m}$ ]  |          |          | 1.0      | 1.5      | 2.0      | 3.0      | 5.0      |

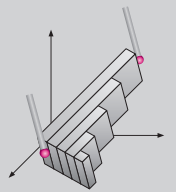
Example: For inspection of a roundness tolerance of 0.010 mm a CMM with a single stylus form error PFTU = 1.0  $\mu\text{m}$  resp. THP = 1.0  $\mu\text{m}$  (scanning) is required. Note: PFTU and THP are only specified for small areas (up to 30 mm).

CMM capability charts are applicable only, if the feature can be measured with a stylus for which the accuracy of the CMM is specified.

## ISO 10360

## ISO 10360-2

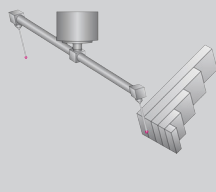
Volumetric length measuring error  
 $E_0$



5 gauges have to be measured 3 times with one probing each end, in 7 different directions. All measuring results must be within » $E_{150}$ «

## ISO 10360-2

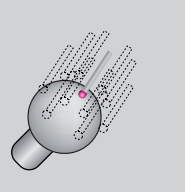
Volumetric length measuring error  
 $E_{150}$



5 length gauges have to be measured 3 times in the YZ- or XZ plane with opposite styli, mounted 150 mm off the Z spindle axis.

## ISO 10360-5

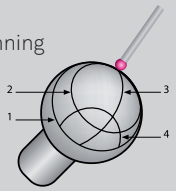
Single stylus form error  
PFTU



A precision sphere has to be measured with 25 probings. PFTU is the range of all radii.  $PFTU = R_{\max} - R_{\min}$  = sphere form.

## ISO 10360-4

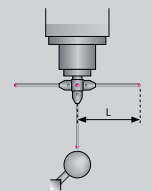
Single stylus form error scanning  
THP



A precision sphere has to be scanned with 4 defined lines. THP is the range of all radii.  $THP = R_{\max} - R_{\min}$  = sphere form, scanning.

## ISO 10360-5

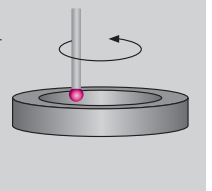
Multi styli error  
form PFTM  
size PSTM  
location PLTM



A sphere is measured with 5 styli (fixed PH) or with 1 stylus in 5 orientations (articulating PH) with 5 x 25 probings. Form, size and location error over 125 points

## ISO 12181

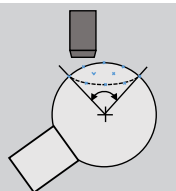
Form measurement error  
RONt (MZCI)



A ring gauge,  $\varnothing 50$  mm, is scanned with high point density. The range of radial distances is then evaluated on a calculated Tschebyscheff-circle.

## ISO 10360-8

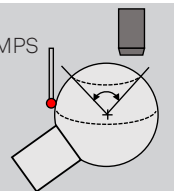
Optical Sensors  
Form error  
Size error



A sphere is measured with 25 optical probings.  $P_{\text{Form.Sphere.1x25;tr}}$  is the range of all radii =  $R_{\max} - R_{\min}$  (sphere form)  $P_{\text{Size.Sphere.1x25;tr}}$  is the diameter deviation  $D_{\text{meas}} - D_{\text{cal}}$

## ISO 10360-9

Multiple Probing Systems: MPS  
Form error  
Size error  
Location error



A sphere is measured with contact and non contact sensor, with 25 probings each. Form and size error over all 50 points. Location error  $L_{\text{Dia.2x25;MPS}}$  = space distance between both center points

### Gear Measuring Capability

|                      |                                                                                     |
|----------------------|-------------------------------------------------------------------------------------|
| Cylindrical gears    | Spur, helical, double helical, splines (internal and external)                      |
| Clutch gears         | internal and external                                                               |
| Gear segments        | minimum No. of teeth: 1                                                             |
| Gear racks           | constant ratio, variable ratio                                                      |
| Bevel gears          | Straight bevel, spiral bevel, hypoid bevel, crown gears                             |
| Couplings            | Curvic, Hirth                                                                       |
| Gear cutting tool    | Hob cutter, indexable insert hob, broach, shaper cutter, shaving gears, form cutter |
| Evaluation standards | DIN, ISO, AGMA, ANSI, JIS, CNOMO, CAT                                               |
| Available interfaces | Gleason GAGE 4/WIN, Klingelnberg KIMOS, DMG Mori, Depo                              |

### Available QUINDOS Software Modules for Gear Inspection

|                 |                                                                                                                                     |                                                                                                                                                   |                                                                                                            |                                                                                                                       |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| Gears and Worms | <ul style="list-style-type: none"> <li>• Gear</li> <li>• Spiral Bevel Gear</li> <li>• Sprocket</li> <li>• Rack, constant</li> </ul> | <ul style="list-style-type: none"> <li>• Gear Gauges</li> <li>• Cylindrical Worm</li> <li>• Curvic Couplings</li> <li>• Rack, variable</li> </ul> | <ul style="list-style-type: none"> <li>• Unknown Gear</li> <li>• Worm Wheel</li> <li>• CAT Gear</li> </ul> | <ul style="list-style-type: none"> <li>• Straight Bevel Gear</li> <li>• Globoid Worm</li> <li>• Hirth Gear</li> </ul> |
| Cutting Tools   | <ul style="list-style-type: none"> <li>• Hob Cutter</li> <li>• Form Cutter</li> </ul>                                               | <ul style="list-style-type: none"> <li>• Shaper Cutter</li> </ul>                                                                                 | <ul style="list-style-type: none"> <li>• Shaving Gear</li> </ul>                                           | <ul style="list-style-type: none"> <li>• Broach</li> </ul>                                                            |

### Gear related Specifications

|                    |                                                                               |
|--------------------|-------------------------------------------------------------------------------|
| Module range       | 0.3 - 100 mm                                                                  |
| Max. gear width    | = Z-range of the PMM-C (vertical orientation), e. g. 1000 mm for a 24.12.10   |
| Max. shaft length  | = X-range of the PMM-C (horizontal orientation), e. g. 2400 mm for a 24.12.10 |
| Spiral angle       | 0° - 90°                                                                      |
| Machine accuracy   | Group 1 according to VDI/VDE 2612/2613, page 1 and 2                          |
| Min. gear diameter | not limited                                                                   |
| Max. gear diameter |                                                                               |

|                             | 8.10.6 | 12.10.7 | XX.12.ZZ | XX.16.ZZ |
|-----------------------------|--------|---------|----------|----------|
| Spur gear                   | 750 mm | 950 mm  | 1150 mm  | 1550 mm  |
| Helical gear <sup>(1)</sup> | 500 mm | 700 mm  | 900 mm   | 1300 mm  |

<sup>(1)</sup>depending on module and styli configuration

| Supply Specifications | Voltage                         | Protection | Power req. | Consumption | Rat. current | Main fuse |
|-----------------------|---------------------------------|------------|------------|-------------|--------------|-----------|
| B5                    | 230 V, ±10%; 50-60 Hz; P, N, PE | IP 54      | 1.4 KVA    | 0.6 KVA     | 6 A          | 16 A      |
| B5 - USA, Japan       | 115 V, ±10%; 50-60 Hz; P, N, PE | IP 54      | 1.4 KVA    | 0.6 KVA     | 12 A         | 16 A      |

|                 |                                                                     |
|-----------------|---------------------------------------------------------------------|
| Air Pressure    | ≥ 0.55 MPa (5.5 bar) ≥ 0.65 MPa (6.5 bar), if table load ≥ 1500 kg) |
| Air Consumption | approx. 125 NL/min (with active pneumatic damping: 225 NL/min)      |
| Air Quality     | Class 4 according to ISO 8573, part 1                               |

### Safety

|                      |                                                                                                                                                     |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| Collision protection | Collision protections for the complete machine (probehead, styli and Z-ram), in set up mode. Leitz PMM-Xi: for probehead and styli, in set up mode. |
| Safety devices       | Contact devices at the columns.<br>Leitz Infinity, Ultra and PMM-C: Additional protection system for the Z-ram.                                     |
| Safety standards     | CE-conform with machine directive (2006/42/EG), EMC-directive (2014/30/EU).<br>NRTL and NFPA79 on request.                                          |

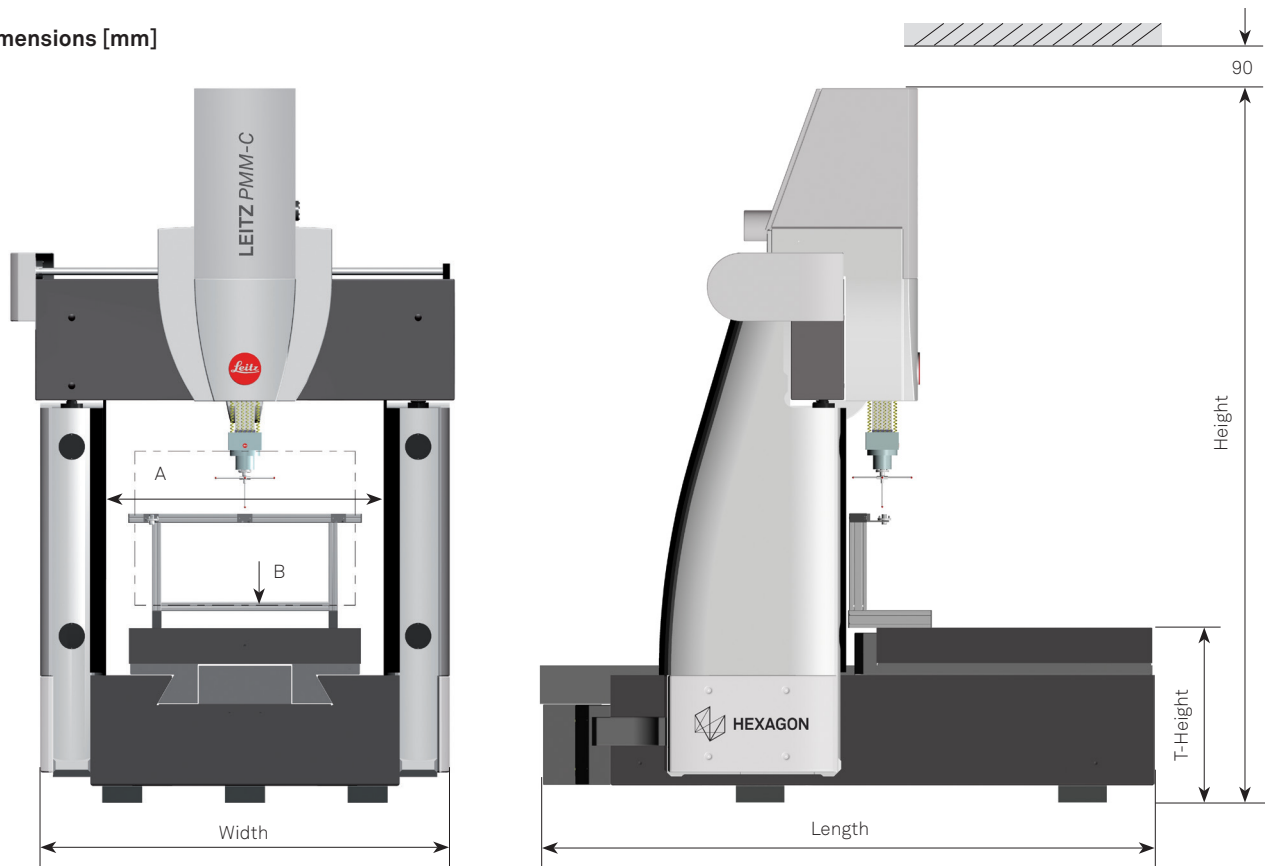
### Software

QUINDOS 7  
PC-DMIS (not for Infinity, Ultra, SENMATION, HP-O, Precitec LR, Profiler R)

### Measuring Ranges (Standard / SENMATION)

|               |                             |              |                            |
|---------------|-----------------------------|--------------|----------------------------|
| Size 8.10.6   | 800 x 1000 x 575 / 465 mm   | Size 12.10.6 | 1200 x 1000 x 575 / 465 mm |
| Size 12.10.7  | 1200 x 1000 x 700 / 675 mm  | Size 16.12.7 | 1600 x 1200 x 700 / 675 mm |
| Size 16.12.10 | 1600 x 1200 x 1000 / 925 mm | Size 24.12.7 | 2400 x 1200 x 700 / 675 mm |
| Size 24.12.10 | 2400 x 1200 x 1000 / 925 mm | Size 24.16.7 | 2400 x 1600 x 700 / 675 mm |
| Size 24.16.10 | 2400 x 1600 x 1000 / 925 mm |              |                            |

### Dimensions [mm]



| Model                           | Length<br>[mm] | Width<br>[mm] | Height <sup>(3)</sup><br>[mm] | T-Height<br>[mm] | A<br>[mm] | B <sup>(3)</sup><br>[mm] | B <sup>(3)(4)</sup><br>[mm] | Weight<br>[kg] | Max. Load<br>[kg] |
|---------------------------------|----------------|---------------|-------------------------------|------------------|-----------|--------------------------|-----------------------------|----------------|-------------------|
| 8.10.6 <sup>(1)</sup>           | 2395           | 2013          | 3026                          | 755              | 1250      | 15                       | 15                          | 6700           | 750               |
| 12.10.6 <sup>(2)</sup>          | 2795           | 2460          | 2986                          | 755              | 1250      | 15                       | 15                          | 7250           | 750               |
| Infinity 12.10.6 <sup>(2)</sup> | 2795           | 2013          | 3106                          | 875              | 1250      | 15                       | 15                          | 7250           | 750               |
| 12.10.7 (Ultra <sup>(2)</sup> ) | 2795           | 2013          | 3246 (3326)                   | 795              | 1250      | 100                      | 15                          | 7400           | 1750 (1250)       |
| 16.12.7 (Ultra <sup>(2)</sup> ) | 3595           | 2213          | 3246 (3326)                   | 795              | 1450      | 100                      | 15                          | 10200          | 1750 (1500)       |
| 24.12.7 (Ultra <sup>(2)</sup> ) | 4395           | 2213          | 3346 (3426)                   | 895              | 1450      | 100                      | 15                          | 13800          | 1750 (1500)       |
| 24.16.7                         | 4395           | 2613          | 3346                          | 895              | 1850      | 50                       | 15                          | 14800          | 2000              |
| 16.12.10                        | 3595           | 2213          | 3796                          | 795              | 1450      | 50                       | 15                          | 10300          | 2000              |
| 24.12.10                        | 4395           | 2213          | 3896                          | 895              | 1450      | 50                       | 15                          | 13900          | 2000              |
| 24.16.10                        | 4395           | 2613          | 3896                          | 895              | 1850      | 50                       | 15                          | 14900          | 2000              |
| Controller B5                   | 800            | 400           | 1200                          |                  |           |                          |                             | 115            |                   |

Height and T-height as specified are valid for standard damping system. In case of an active damping system 80 mm have to be added to the height dimension.  
Table size for PMM-C 24.YY.ZZ is 1600 x 1200 mm.

<sup>(1)</sup> Dimensions with active damping system: Width: 2460 mm, Height: 2986 mm.

<sup>(2)</sup> With active damping system only.

<sup>(3)</sup> The option "Extended Z measuring range" extends the clearance and the height by 100/150/175 mm respectively. Not available for Infinity and Ultra.

<sup>(4)</sup> with SENMATION and HP-S-X5-HD



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