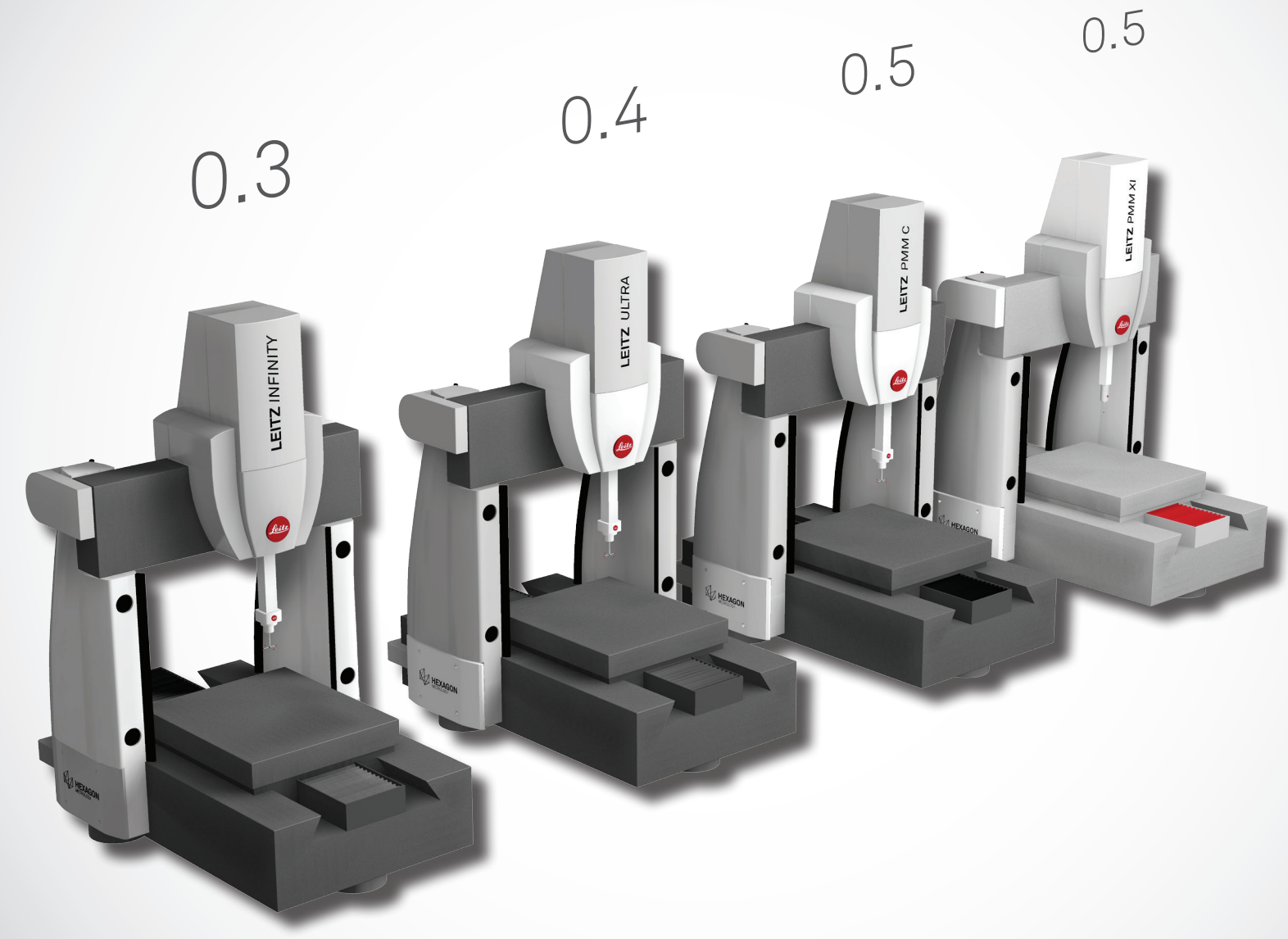
TECHNICAL DATA

HEXAGON METROLOGY

LEITZ PMM-C LINE

Version 2015-5



Description	High and ultra high accuracy, fast universal measuring machines in “Closed Frame” design. Optional laser sensors and roughness measurement.

Applications

Coordinate measurements	Inspection of any kind of parts and geometries. Measurements for research and development, calibration of measuring tools. 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 gears, gear segments, gear racks and any type of gear cutter. No rotary table required.
Form testing	Quality control of industrial form tolerances - roundness, cylindricity, flatness, straightness, profile form and 2D/3D surfaces. - non contact inspection of high precision surfaces: lenses, mirrors, optical flats etc.
Roughness measurement	- tactile: Profiler R roughness sensor, automatic interchangeable. - non contact: Leitz Precitec LR, automatic interchangeable

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. 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 Ultra, PMM-C, PMM-Xi: 0.02 µm Leitz Infinity: 0.004 µm
Temperature compensation	Automatic temperature compensation for scales and workpiece.
Number of workpiece sensors	Leitz Ultra, PMM-C: 1 (optional: 4) / Leitz PMM-Xi: 1 / Leitz Infinity: 4
Damping system	Leitz PMM-C, PMM-Xi: Passive elastomer damping (optional: active pneumatic damping). Leitz Ultra, Infinity: Active pneumatic damping.





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Probe Heads	**Z ≤ 700 mm**	**Z > 700 mm**
Type	Leitz LSP-S2 Scan+	Leitz LSP-S2
Probing methods	3D-self-centering Scanning, variable High Speed Scanning Tag Scan, Scan Catch, Four Axis Scan, Optical Scan	
Max. data rate	1000 points/s	
Probing force	0.1 to 1.2 N	
Max. stylus length	800 mm	
Max. stylus weight	600 g (incl. stylus clamping)	1000 g (incl. stylus clamping)
Smallest stylus tip-ø	0.3 mm	
Optical sensors (optional)	Leitz Precitec LR, Hexagon HP-O	
Roughness sensor (optional)	Profiler R	

Optical Laser Sensors	**Leitz Precitec LR**	**Hexagon HP-O**		
		Short range	Mid range	Long range
Measuring methods	Chromatic confocal		Interferometry	
Measuring angle to surface	rough: ± 40° reflecting: ± 40°	± 30° ± 4°	± 30° ± 1°	± 10° ± 0.3°
Working distance	6.5 mm	7 mm	11 mm	16 mm
Measuring range	0.1 mm	0.4 mm	2 mm	20 mm
Resolution in Z direction	< 3 nm	< 3 nm	< 3 nm	< 3 nm
Spot diameter	1.4 µm	11 µm	40 µm	220 µm
Applications	Optical glasses, mirrors, all kinds of surfaces	Metallic technical surfaces		
Laser protection class [1] [2]	1	2	2	2

Roughness Sensors	**Profiler R**	**Leitz Precitec LR**
Type	tactile, traditional	non contact [3]
Measuring length/range	12.5 mm(15 mm)/ ± 250 µm	not limited
Probe tip	2 µm/90°, exchangeable	1.4 µm (spot diameter)
Parameter	R_a, R_z, R_q, R_t et. al. according to ISO 4287 and 13565	

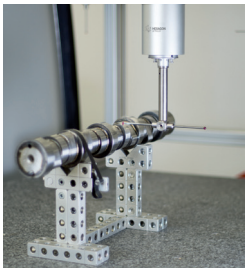
[1] Class 1 laser devices are safe under reasonably foreseeable operating conditions. In general they would not be expected to emit any radiation which is strong enough to damage they eyes or the skin.

[2] 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).

[3] Roughness results measured non-contact might not be identical compared with traditional systems due to different principles.



Leitz LSP-S2 Scan+



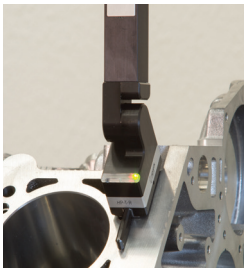
Leitz LSP-S2 Scan+



Leitz LSP-S2 + Precitec LR



Leitz LSP-S2 + HP-O



Profiler R

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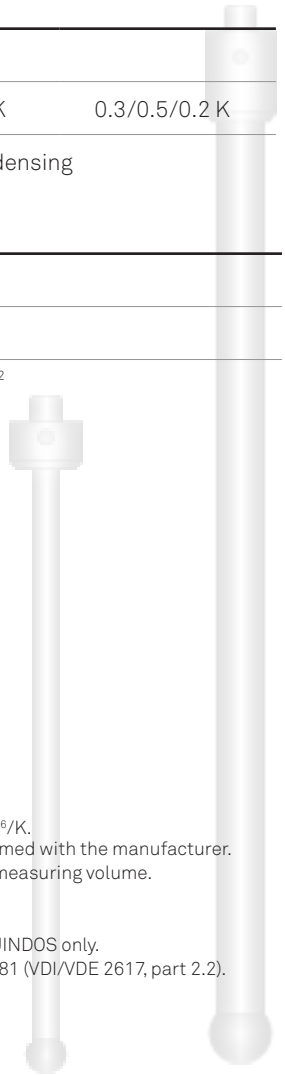
Measuring Error MPE in [µm] according to ISO 10360-2 (2010)		**Leitz Infinity 12.10.6**	**Leitz Ultra 12.10.7**	**Leitz Ultra 16.12.7 / 24.12.7**
Volumetric length measuring error [1]	E_0	0.3 + L / 1000	0.4 + L / 850	0.7 + L / 850
Volumetric length measuring error [1]	E_{150}	0.5 + L / 1000	0.6 + L / 850	0.9 + L / 850
Repeatability range [2]	R_0	0.2	0.25	0.3
according to ISO 10360-4 (2000)				
Single styli form error, scanning [3]	THP	0.8 / 50s	0.9 / 40s	1.0 / 40s
according to ISO 10360-5 (2011)				
Single styli form error [2]	PFTU	0.40	0.45	0.55
Multi styli form error [4]	PFTM	1.7	1.7	2.0
Multi styli size error [4]	PSTM	0.4	0.5	0.6
Multi styli location error [4]	PLTM	1.0	1.0	1.3
according to ISO 12181				
Form measurement error [5]	RONt	0.40	0.45	0.55

Permitted Environmental Conditions

Temperature limits	19° C – 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	20 / min
Max. positioning speed	300 mm/s
Max. acceleration	1500 mm/s²



[1] E_0, E_{150} and R_0 are valid — for a length gauge with an uncertainty of calibration of 0.02 + 0.12 x L/1000. for a length gauge with a calibrated coefficient of expansion (CTE) between 8 x 10^{-6}/K and 13 x 10^{-6}/K. for measuring lengths of more than 1000 mm the availability of adequate gauges has to be confirmed with the manufacturer.

[1] [2] E_0, R_0 and PFTU — are valid for Leitz Infinity styli ø 5 x 80 mm and ø 8 x 130 mm, without extension; anywhere in the measuring volume.

[3] THP is valid — for a Leitz Infinity stylus ø 5 x 80 mm.

[4] PFTM, PSTM, PLTM are valid — for 5 Leitz styli ø 5 x 80 mm. To be tested near the reference sphere.

[5] RONt (MZCI) is valid — for a Leitz Infinity 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 only with original Leitz accessories.

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Leitz PMM-C **easuring Error MPE in [µm]** **according to ISO 10360-2 (2010)**		**8.10.6** **12.10.6** **12.10.7**	**16.12.7** **24.12.7**	**16.12.10** **24.12.10** **24.16.7**	**24.16.10**
Volumetric length measuring error [1]	E_0	0.5 + L / 700	0.8 + L / 650	0.9 + L / 650	1.5 + L / 600
Volumetric length measuring error [1]	E_{150}	0.7 + L / 700	1.1 + L / 650	1.2 + L / 650	1.7 + L / 600
Repeatability range [2]	R_0	0.3	0.4	0.5	0.6
according to ISO 10360-4 (2000)					
Single stylus form error, scanning [3]	THP	0.9 / 40s	1.0 / 40s	1.0 / 40s	1.4 / 40s
according to ISO 10360-5 (2011)					
Single stylus form error [2]	PFTU	0.45	0.6	0.7	1.0
Multi styli form error [4]	PFTM	1.8	2.0	2.1	2.2
Multi styli size error [4]	PSTM	0.5	0.6	0.8	1.0
Multi styli location error [4]	PLTM	1.1	1.4	1.4	1.6
according to ISO 12181					
Form measurement error [5]	RONt	0.5	0.6	0.65	0.8

Permitted Environmental Conditions				
Temperature limits	19° C - 21° C	18° C – 22° C	18° C – 22° C	18° C – 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 PMM-C	
Max. probing frequency	40 / min
Max. positioning speed	400 mm/s
Max. acceleration	2400 mm/s²

[1] E_0, E_{150} and R_0 are valid for a length gauge (column 1) with an uncertainty of calibration of 0.02 + 0.12 x L/1000 respectively for a step gauge (columns 2-4) with an uncertainty of calibration of ≤ 0.08 + 0.3 x L/1000.
for a length gauge with a calibrated coefficient of expansion (CTE) between 8 x 10^{-6}/K and 13 x 10^{-6}/K.
for measuring lengths of more than 1000 mm the availability of adequate gauges has to be confirmed with the manufacturer.

[1] [2] E_0, R_0 and PFTU are valid for Leitz styli from ø 3 x 35 mm up to ø 8 x 130 mm, without extension; anywhere in the measuring volume.

[3] THP is valid for a Leitz stylus ø 5 x 80 mm.

[4] PFTM, PSTM, PLTM are valid for 5 Leitz styli ø 5 x 80 mm. To be tested near the reference sphere.

[5] 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 only with original Leitz accessories.

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Leitz PMM-Xi **Measuring Error MPE in [µm]** **according to ISO 10360-2 (2010)**		**8.10.6** **12.10.6** **12.10.7**	**16.12.7** **24.12.7**	**16.12.10** **24.12.10** **24.16.7**	**24.16.10**
Volumetric length measuring error [1]	E_0	0.5 + L / 500	1.0 + L / 550	1.1 + L / 550	1.7 + L / 500
Volumetric length measuring error [1]	E_{150}	0.8 + L / 500	1.2 + L / 550	1.4 + L / 550	2.1 + L / 500
Repeatability range [2]	R_0	0.4	0.6	0.6	0.7
according to ISO 10360-4 (2000)					
Single stylus form error, scanning [4]	THP	0.9 / 40s	1.0 / 40s	1.1 / 40s	1.6 / 40s
according to ISO 10360-5 (2011)					
Single stylus form error [2]	PFTU	0.5	0.7	0.8	1.1
Multi styli form error [5]	PFTM	1.9	2.0	2.2	2.3
Multi styli size error [5]	PSTM	0.6	0.7	0.9	1.1
Multi styli location error [5]	PLTM	1.2	1.4	1.5	1.7
according to ISO 12181					
Form measurement error [6]	RONt	0.5	0.65	0.7	0.9

Permitted Environmental Conditions				
Temperature limits	19° C - 21° C	18° C – 22° C	18° C – 22° C	18° C – 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/s²

[1] E_0, E_{150} and R_0 are valid — for a length gauge with an uncertainty of calibration of ≤ 0.08 + 0.3 x L/1000. for a length gauge with a calibrated coefficient of expansion (CTE) between 8 x 10^{-6}/K and 13 x 10^{-6}/K. for measuring lengths of more than 1000 mm the availability of adequate gauges has to be confirmed with the manufacturer .

[1] [2] E_0, R_0 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.

[4] THP is valid — for a Leitz stylus ø 5 x 80 mm.

[5] PFTM, PSTM, PLTM are valid — for 5 Leitz styli ø 5 x 80 mm. To be tested near the reference sphere.

[6] 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 only with original Leitz accessories.

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CMM Capability Charts - Diameters and Distances

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
± 0.050	4.7 + L / 150	4.3 + L / 150	4.0 + L / 200	3.0 + L / 200	2.6 + L / 400	1.7 + L / 300	1.0 + L / 500
± 0.070	6.5 + L / 100	6.0 + L / 100	5.7 + L / 150	5.0 + L / 200	4.0 + L / 200	2.0 + L / 200	2.0 + L / 400

Example: A diameter of 400 mm has a tolerance of ± 0.010mm.
For the inspection of this feature a CMM with a length measuring error E_0 = 0.5 + L / 800 [µm] is required.

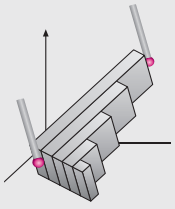
CMM Capability Charts - Form Tolerances

Tolerance	0.005 mm	0.007 mm	0.010 mm	0.015 mm	0.020 mm	0.030 mm	0.050 mm
PFTU [µm]	0.5	0.7	1.0	1.5	2.0		
THP [µm]			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 µm respectively with a single stylus form error, scanning THP = 1.0 µm is required.
Note: PFTU and THP are only specified for small areas (up to 30 mm).

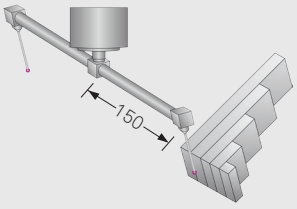
CMM capability charts are applicable only, if the feature can be measured with a stylus for which the accuracy of the CMM is specified.

Volumetric length measruing error
E_0



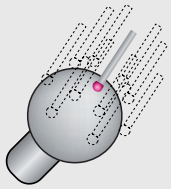
5 gauges have to be measured 3 times with one probing at each end, in 7 different directions. All measuring results must be within »E_0«.

Volumetric length measuring error
E_{150}



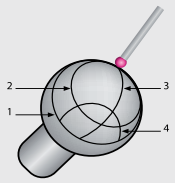
5 length gauges have to be measured 3 times in the YZ- or XZ plane with opposite styli, mounted 150 mm off the Z spindle axis.

Single stylus form error
PFTU



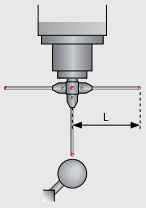
A precision sphere has to be measured with 25 probings. PFTU is the range of all radii.
PFTU = R_{max} - R_{min} = sphere form.

Single stlyus form error, scanning
THP



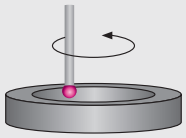
A precision sphere has to be scanned with 4 defined lines. THP is the range of all radii.
THP = R_{max} - R_{min} = sphere form, scanning.

Multi styli error
form **PFTM**, size **PSTM**, location **PLTM**



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

Form measurement error
RONt (MZCI)



A ring gauge, ø 50 mm, is measured in scanning mode, with high point density. The range of radial distances is then evaluated on a calculated Tschebyscheff-circle.

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Electronics and Safety

Electronics control	Microprocessor controller in a service-friendly, modular design with integrated monitoring. Worldwide remote diagnostics through Hexagon Metrology service and internet available.
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. Leitz Infinity, Ultra and PMM-C: Additional protection system for the Z ram.
Safety standards	CE-conform with machine directive (2006/42/EG), EMI-directive (2004/108/EG).

Supply Specifications

Controller	B5 - Europa	B5 - USA, Japan
Protection class	IP 54	IP 54
Operating voltage	230 V, ±10 %; 50 - 60 Hz; P, N, PE	115 V, ±10 %; 50 - 60 Hz; P, N, PE
Power requirement	1,4 KVA	1,4 KVA
Power consumption	0,6 KVA	0,6 KVA
Rated current	6 A	12 A at 400 V
Recommended main fuse	16 A	16 A

Air Supply

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

Software

QUINDOS 7

PC-DMIS, optional for Leitz PMM-C and Leitz PMM-Xi

Options

- New:
  - Laser point sensor Leitz Precitec LR
  - Laser point sensor Hexagon HP-O
  - Roughness sensor Profiler R
- Automatic styli changer
- Extended Z measuring range 150 mm
- Automatic Workpiece Temperature Sensor
- Environment Monitoring System (Standard for Leitz Infinity and Leitz Ultra)
- Manual and automated part loading system
- Rotary table, integrated or „on top“
- Climate controlled room







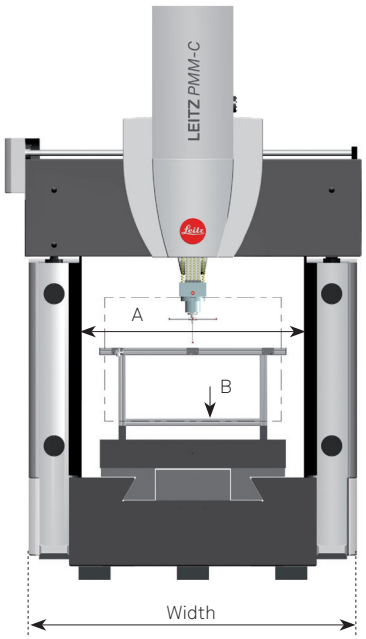

Measuring Ranges (X x Y x Z)

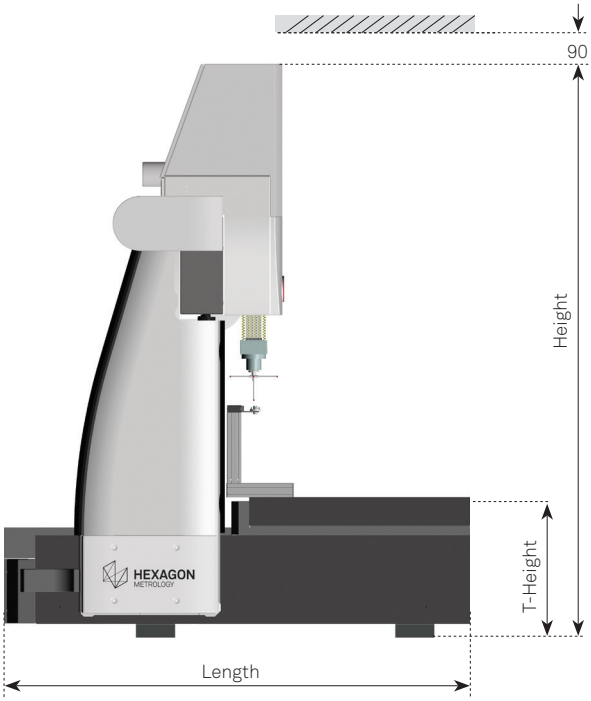
Size 8.10.6	800 x 1000 x 575 mm	Size 12.10.6	1200 x 1000 x 575 mm
Size 12.10.7	1200 x 1000 x 700 mm	Size 16.12.7	1600 x 1200 x 700 mm
Size 16.12.10	1600 x 1200 x 1000 mm	Size 24.12.7	2400 x 1200 x 700 mm
Size 24.12.10	2400 x 1200 x 1000 mm	Size 24.16.7	2400 x 1600 x 700 mm
Size 24.16.10	2400 x 1600 x 1000 mm		

Permitted Table Load

Size 8.10.6 / 12.10.6 / Leitz Infinity	750 kg	Size 12.10.7 / 16.12.7 /24.12.7	1750 kg
Leitz PMM-Xi 12.10.7 / Leitz Ultra 12.10.7	1250 kg	Size 16/24.12.10 / 24.16.7 / 24.16.10	2000 kg
Leitz Ultra 16/24.12.7	1500 kg		

Dimensions in mm





Model		Length [mm]	Width [mm]	Height [mm]	T-Height [mm]	Clearance A [mm]	Clearance B[3] [mm]	Weight [kg]
Size	8.10.6 [1]	2395	2013	3026	755	1250	2	6700
Size	12.10.6 [2]	2795	2460	2986	755	1250	2	7250
Size	Infinity 12.10.6	2795	2013	3106	875	1250	3	7250
Size	12.10.7 (Ultra)	2795	2013	3246 (3326)	795	1250	100	7400
Size	16.12.7 (Ultra)	3595	2213	3246 (3326)	795	1450	100	10200
Size	24.12.7 (Ultra)	4395	2213	3346 (3426)	895	1450	100	13800
Size	24.16.7	4395	2613	3346	895	1850	50	14800
Size	16.12.10	3595	2213	3796	795	1450	50	10300
Size	24.12.10	4395	2213	3896	895	1450	50	13900
Size	24.16.10	4395	2613	3896	895	1850	50	14900
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.
[1] Dimensions with active damping system: Width: 2460 mm, Height: 2986 mm; [2] With active damping system only.
[3] The option “Extended Z measuring range” extends the clearance by 150 mm. Not available for Infinity and Ultra.

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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	
Bevel gears	Straight bevel, spiral bevel, hypoid bevel, crown gears
Couplings	Curvic, Hirth
Gear cutting tool	Hob cutter, 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

Inspection Methods

Measuring principle	3-Axes, gear fixed anywhere in the measuring volume. No rotary table required. Profile and flank inspection with Variable High-Speed-Scanning with involute path control.
Alignment of the gear axis	Vertical or horizontal
Max. no. of gears on pallet	Not limited, depending on gear diameter and machine measuring range.

Available Software Modules for Gear Inspection

- Cylindrical gear
- Unknown gear
- Gear gauges
- CAT gear
- Hirth gearing
- Straight bevel gear
- Spiral bevel gear
- Hob cutter
- Form cutter
- Shaving gear
- Shaper cutter
- Broach
- Sprocket / chain wheel
- Cylindrical worm
- Worm wheel
- Globoid worm
- Curvic couplings

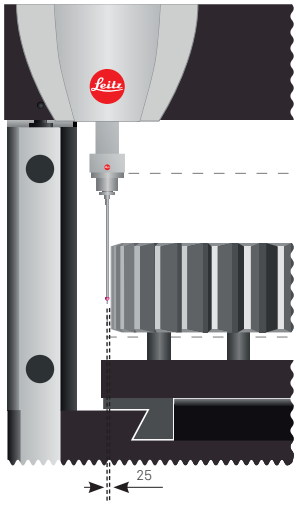
Gear related Specifications

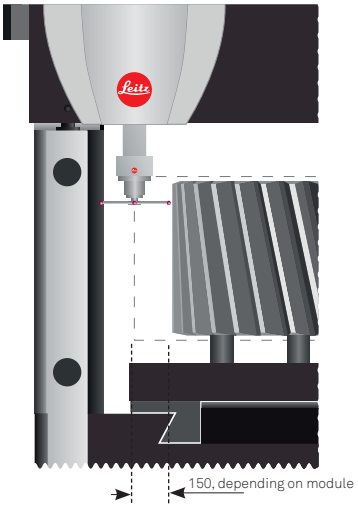
Max. gear weight	see permitted table load, page 9
Module range	0.5 - 100 mm
Max. gear width	= Z-range of the PMM-C (vertical orientation), e. g. 1000 mm for a 24.12.10
Max. shaft length	= X-range of the PMM-C (horizontal orientation), e. g. 2400 mm for a 24.12.10
Min. gear diameter	not limited
Max. gear diameter	

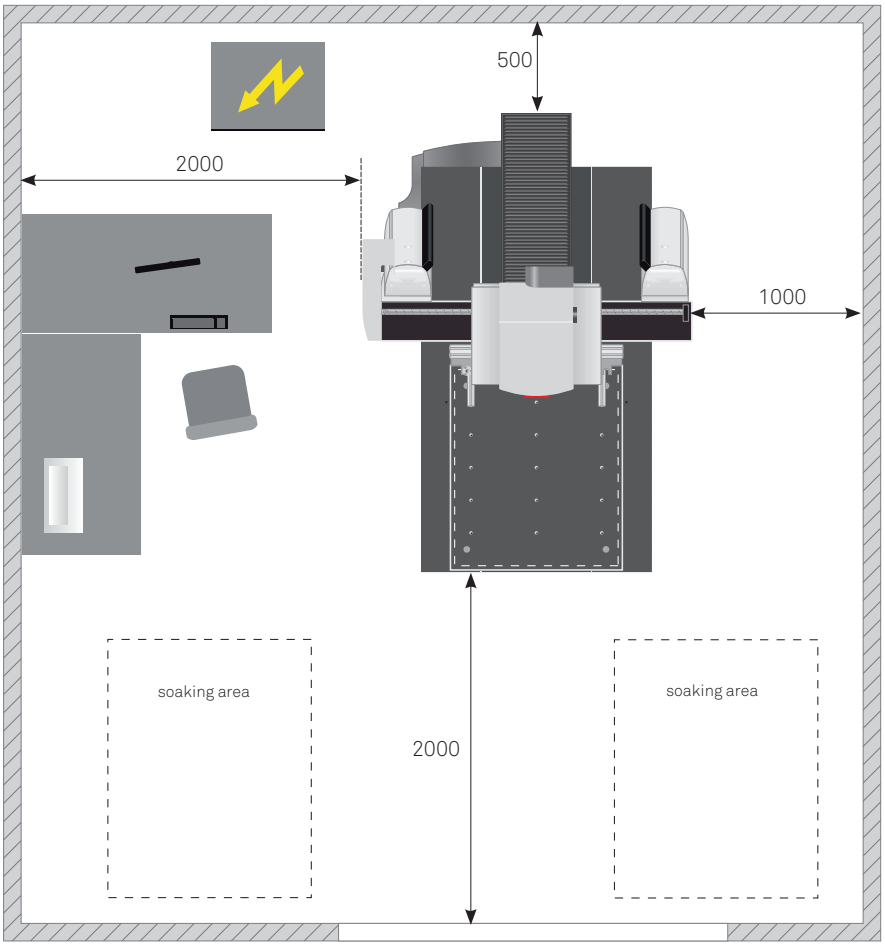
	8.10.6	12.10.7	xx.12.zz	xx.16.zz
Spur gear	750 mm	950 mm	1150 mm	1550 mm
Helical gear(1)	500 mm	700 mm	900 mm	1300 mm

(1) depending on module and styli configuration

Spiral angle	0° - 90°
Machine accuracy	Group 1 according to VDI/VDE 2612/2613, page 1 and 2

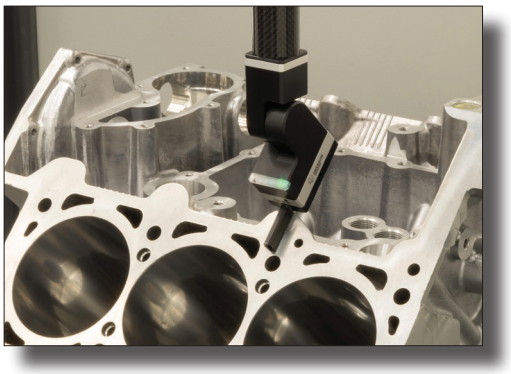






Above room layout shows the minimum clearance and is for reference only.
Individual room designs may differ.

To maintain the climatic conditions for the Leitz Infinity we recommend to place the controller outside the measuring room.

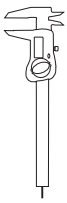


Roughness sensor Profiler R

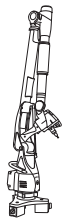


Leitz PMM-C with option
“Extended Z-measuring range”

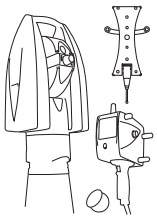
M42-205-004-203



PRECISION MEASURING INSTRUMENTS



PORTABLE MEASURING ARMS



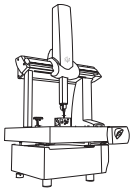
LASER TRACKERS & STATIONS



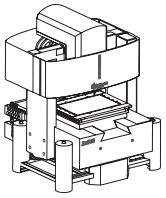
WHITE LIGHT SCANNERS



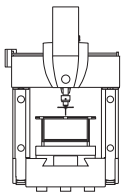
SENSORS



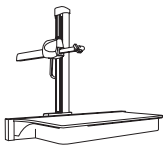
BRIDGE CMMS



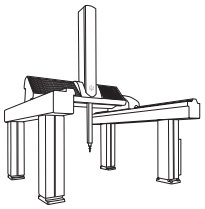
MULTISENSOR & OPTICAL SYSTEMS



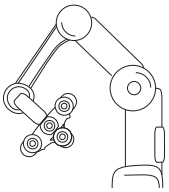
ULTRA HIGH ACCURACY CMMS



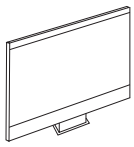
HORIZONTAL ARM CMMS



GANTRY CMMS



AUTOMATED APPLICATIONS



SOFTWARE SOLUTIONS

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