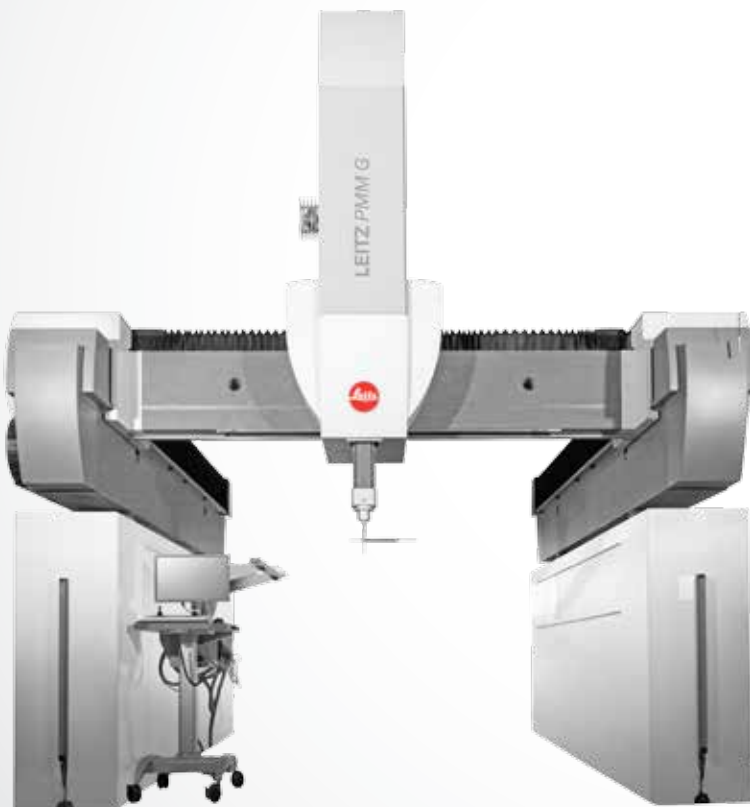


LEITZ PMM-F / PMM-G

Coordinate Measuring Machines and Gear Inspection Centers
Version 2013-5



Description	High accuracy, large volume measuring machines and gear inspection centers in overhead design.
Applications	
Coordinate measurements	Universal CMMs for high accuracy inspection of any kind of geometry. Part inspections for R&D, manufacturing and quality control centers.
Gear inspection	Capable of measuring any kind of gears, gear segments and gear racks. No rotary table required. Leitz PMM-F: for gear diameters up to 1950 mm (external) respectively 2500 mm (internal). Leitz PMM-G: for gears up to 5000 mm diameter.
Form testing	Quality control of industrial form tolerances - roundness, cylindricity, flatness, straightness, profile form and 2D/3D surfaces.
Design	
Design principle	Leitz PMM-F / PMM-G: Modern overhead design with minimized moving masses. Drive forces are applied close to the center of gravity. Ceramic Z-ram. Leitz PMM-F: Massive machine body in U-shape, completely made of granite. Leitz PMM-G: Massive granite guiding structures in X and Y, mounted on two-point-support. Machine base made of re-inforced concrete, in U-shape. With integrated temperature gradient compensation (optional).
Guide ways	Precision air bearings in all axes.
Drives	Dual drives in X-direction. Power transmission by self lubricating precision ball screw drives. High performance servo motors with electronic thrust force control.
Length measuring system	High resolution steel scales with incremental, electro-optical transducers. Dual scales in X-direction.
Resolution	0.02 μm .
Temperature compensation	Automatic temperature compensation for scales and work piece.
Vibration isolation	Leitz PMM-F: Integrated vibration damping system with active pneumatic dampers. No foundation required. Leitz PMM-G: Vibration damping through dead weight. Optional: active pneumatic damping system. Note: A vibration analysis of the installation site is required before quoting.



Leitz Probe System

Type	High resolution 3D-probe system Leitz LSP-S2
Measuring methods	Dynamic single-point probing, 3D self-centering and Variable High-Speed-Scanning
Data rate	Up to 1000 points/sec
Probing force	0.1 to 1.2 N, continuously selectable
Max. stylus length	800 mm
Max. stylus weight	1000 g (including stylus clamping)
Automatic styli change	Leitz PMM-G: Length of magazine: 2000 mm; Leitz PMM-F: optional

Electronics and Safety

Electronics control	Modern microprocessor controller in a service-friendly, modular design with integrated monitoring. Worldwide remote diagnostics through Hexagon Metrology service and internet connection available.
Collision protection	For the complete machine (probe head, styli and Z-ram), in setup mode.
Safety devices	Light curtains at the front and rear of the machine.
Safety standards	CE-conform with machine directive (2006/42/EG), EMI-directive (2004/108/EG).

Supply Specifications

	Leitz PMM-F	Leitz PMM-G
Controller	B4	B5
Protection class	IP 54	IP 54
Operating voltage	208-500 V, $\pm 10\%$; 50- 60 Hz; 3P + PE	230 V, $\pm 10\%$; 50 - 60 Hz; P, N, PE
Power requirement	2.4 KVA	1.8 KVA
Power consumption	0.8 KVA	0.8 KVA
Rated current	10 A	8 A
Recommended main fuse	16 A	16 A

Air Supply

Pressure	≥ 0.6 MPa (6 bar)	≥ 0.8 MPa (8 bar)
Consumption [Nl/min]:	ca. 200, incl. air dampers	Y = 2000 mm: 220; Y = 3000 mm: 250 Y = 4000 mm: 280 With option "pneumatic damping system": Y = 2000 mm: 340; Y = 3000 mm: 405 Y = 4000 mm: 470
Quality	Class 4 according to ISO 8573, part 1	Class 4 according to ISO 8573, part 1

Options

- Leitz PMM-F: Automatic styli changer
- Leitz PMM-G: Active pneumatic damping system, with integrated leveling
- Automatic Workpiece Temperature Sensor
- Manual and automated part loading systems
- Climate controlled room
- Project engineering (fixtures, programming, etc.)
- Rotary tables

Leitz PMM-F

30.20.10

30.20.16

Measuring Error in μm according to ISO 10360-2 (2010)

Temperature limits

Volumetric length measuring error ⁽¹⁾	E_0 / E_{150}	18°-22°C	1.7 + L / 400	2.3 + L / 400
	E_0 / E_{150}	22°-24°C	1.7 + L / 300	2.3 + L / 300
Repeatability range ⁽²⁾	R_0		1.2	1.4

according to ISO 10360-4 (2000)

Single stylus form error, scanning ⁽³⁾	THP		2.0 / 52s	2.2 / 52s
---	-----	--	-----------	-----------

according to ISO 10360-5 (2011)

Single stylus form error ⁽²⁾	P_{FTU}		1.5	1.7
Multi styli form error ⁽⁴⁾	P_{FTM}		3.5	3.8
Multi styli size error ⁽⁴⁾	P_{STM}		1.5	1.8
Multi styli location error ⁽⁴⁾	P_{LTM}		2.6	2.9

according to ISO 12181 2 (2011)

Form measurement error ⁽⁵⁾	RONT		2.0	2.3
---------------------------------------	------	--	-----	-----

Permitted Environmental Conditions

Temp. gradient per hour/day/meter	1 K / 1.5 K / 1 K
Relative air humidity	30 % – 70 %, non condensing

Throughput

Max. probing frequency	35 /min
Max. acceleration	3000 mm/s ²
Max. positioning speed (set up mode)	600 mm/s (170 mm/s)

⁽¹⁾ E_0 , E_{150} and R_0 are valid for a length gauge with an uncertainty of calibration of $\leq 0.08 + 0.3 \times L/1000$.
for a length gauge with a calibrated coefficient of expansion (CTE) between $8 \times 10^{-6}/\text{K}$ and $13 \times 10^{-6}/\text{K}$.
for measuring lengths up to 2/3 of the diagonal; for measuring lengths of more than 1500 mm the availability of adequate gauges has to be confirmed with the manufacturer respectively with the local representative.

⁽²⁾ E_0 , R_0 and P_{FTU} are valid for Leitz styli from $\varnothing 3 \times 35$ mm up to $\varnothing 8 \times 130$ mm, without extension; anywhere in the measuring volume.

⁽³⁾ THP is valid for a Leitz stylus $\varnothing 5 \times 80$ mm.

⁽⁴⁾ P_{FTM} , P_{STM} , P_{LTM} are valid for 5 Leitz styli $\varnothing 5 \times 80$ mm.

⁽⁵⁾ RONT (MZCI) is valid for a Leitz stylus $\varnothing 5 \times 80$ mm, filter 50 W/U, with precision calibration. Verification with QUINDOS only.
Form measurement error (roundness) at a $\varnothing 50$ mm ring gauge, in scanning mode, acc. to EN 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.

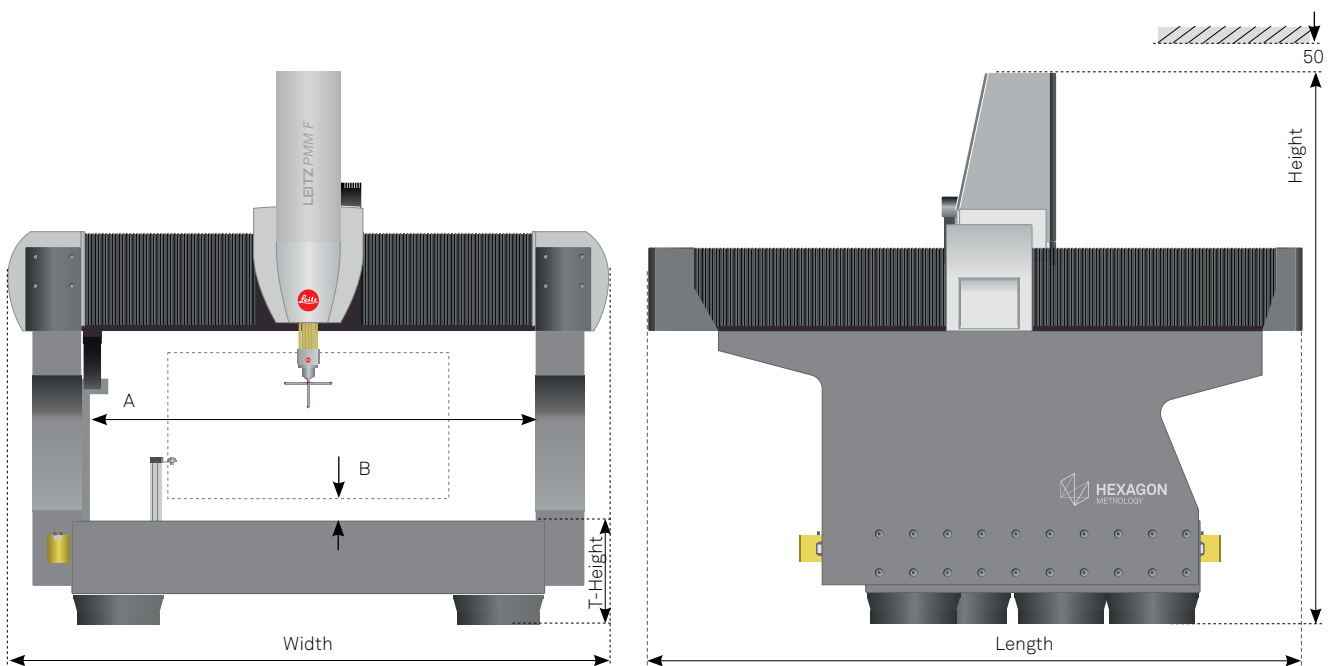
Measuring Ranges (X x Y x Z)

Leitz PMM-F 30.20.10	3000 x 2000 x 1000 mm
Leitz PMM-F 30.20.16	3000 x 2000 x 1600 mm

Permitted Table Load

Leitz PMM-F 30.20.10	5000 kg (optional: 8000 kg)
Leitz PMM-F 30.20.16	8000 kg

Dimensions in mm



Model	Length [mm]	Width [mm]	Height [mm]	T-Height [mm]	Clearance A [mm]	Clearance B [mm]	Weight [kg]
Leitz PMM-F 30.20.10	4500	4360	3780	665	3040	154	24.000
Leitz PMM-F 30.20.16	4500	4360	5054	765	3040	154	29.500
Controller B4	600	800	2000				300

Required lift capacity for installation on site, if disassembled: Leitz PMM-F 30.20.10: 10,4 t; Leitz PMM-F 30.20.16: 13 t

Measuring Error MPE in μm	ISO 10360-2 (2010)		ISO 10360-4 (2000)	ISO 10360-5 (2011)	ISO 12181 (2011)
	Volumetric length measuring error ⁽¹⁾	Repeatability range ⁽²⁾	Single stylus form error, scanning ⁽³⁾	Single stylus form error ⁽²⁾	Form measure- ment error ⁽⁴⁾
	E_0 / E_{150}	R_0	THP	P_{FTU}	RONt
Leitz PMM-G XX.20.12	2.0 + L / 400	1.4	2.2 / 64s	1.5	2.0
Leitz PMM-G XX.30.12	2.4 + L / 400	1.4	2.7 / 64s	1.8	2.4
Leitz PMM-G XX.40.12	2.8 + L / 400	1.4	2.7 / 64s	1.8	2.4
Leitz PMM-G XX.45.12	2.8 + L / 400	1.4	2.7 / 64s	1.8	2.4
Leitz PMM-G XX.20.16	2.6 + L / 400	1.6	2.7 / 64s	1.9	2.5
Leitz PMM-G XX.30.16	2.8 + L / 400	1.6	2.7 / 64s	2.0	2.5
Leitz PMM-G XX.40.16	3.0 + L / 400	1.6	2.7 / 64s	2.2	2.5
Leitz PMM-G XX.45.16	3.2 + L / 400	1.6	2.7 / 64s	2.2	2.5
Leitz PMM-G XX.20.20	2.6 + L / 400	1.7	2.9 / 64s	1.9	2.6
Leitz PMM-G XX.30.20	3.0 + L / 400	1.7	3.3 / 64s	2.2	2.8
Leitz PMM-G XX.40.20	3.3 + L / 400	1.7	3.3 / 64s	2.4	3.0
Leitz PMM-G XX.45.20	3.5 + L / 400	1.7	3.3 / 64s	2.4	3.2
Leitz PMM-G XX.30.25	3.4 + L / 400	2.0	3.7 / 64s	2.5	3.3
Leitz PMM-G XX.40.25	3.9 + L / 400	2.0	3.9 / 64s	2.7	3.5
Leitz PMM-G XX.30.30	3.9 + L / 400	2.5	4.2 / 64s	2.9	3.7
Leitz PMM-G XX.40.30	4.3 + L / 400	2.5	4.4 / 64s	3.0	3.9

Permitted Environmental Conditions

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

Throughput

Max. probing frequency	35 / min
Max. acceleration	1000 mm/s ²
Max. positioning speed (setup mode)	500 mm/s (170 mm/s)

⁽¹⁾ E_0, E_{150} and R_0 are valid for a length gauge with an uncertainty of calibration of $\leq 0.08 + 0.3 \times L/1000$.
for a length gauge with a calibrated coefficient of expansion (CTE) between $8 \times 10^{-6}/\text{K}$ and $13 \times 10^{-6}/\text{K}$.
for measuring lengths up to 2/3 of the diagonal; for measuring lengths of more than 1500 mm the availability of adequate gauges has to be confirmed with the manufacturer respectively with the local representative.

⁽¹⁾⁽²⁾ E_0, R_0 and P_{FTU} are valid for Leitz styli from $\varnothing 3 \times 35$ mm up to $\varnothing 8 \times 130$ mm, without extension; anywhere in the measuring volume.

⁽³⁾ THP is valid for a Leitz stylus $\varnothing 5 \times 80$ mm.

⁽⁴⁾ RONt (MZCI) is valid for a Leitz stylus $\varnothing 5 \times 80$ mm, filter 50 W/U, with precision calibration. Verification with QUINDOS only.
Form measurement error (roundness) at a $\varnothing 50$ mm ring gauge, in scanning mode, acc. to EN 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.

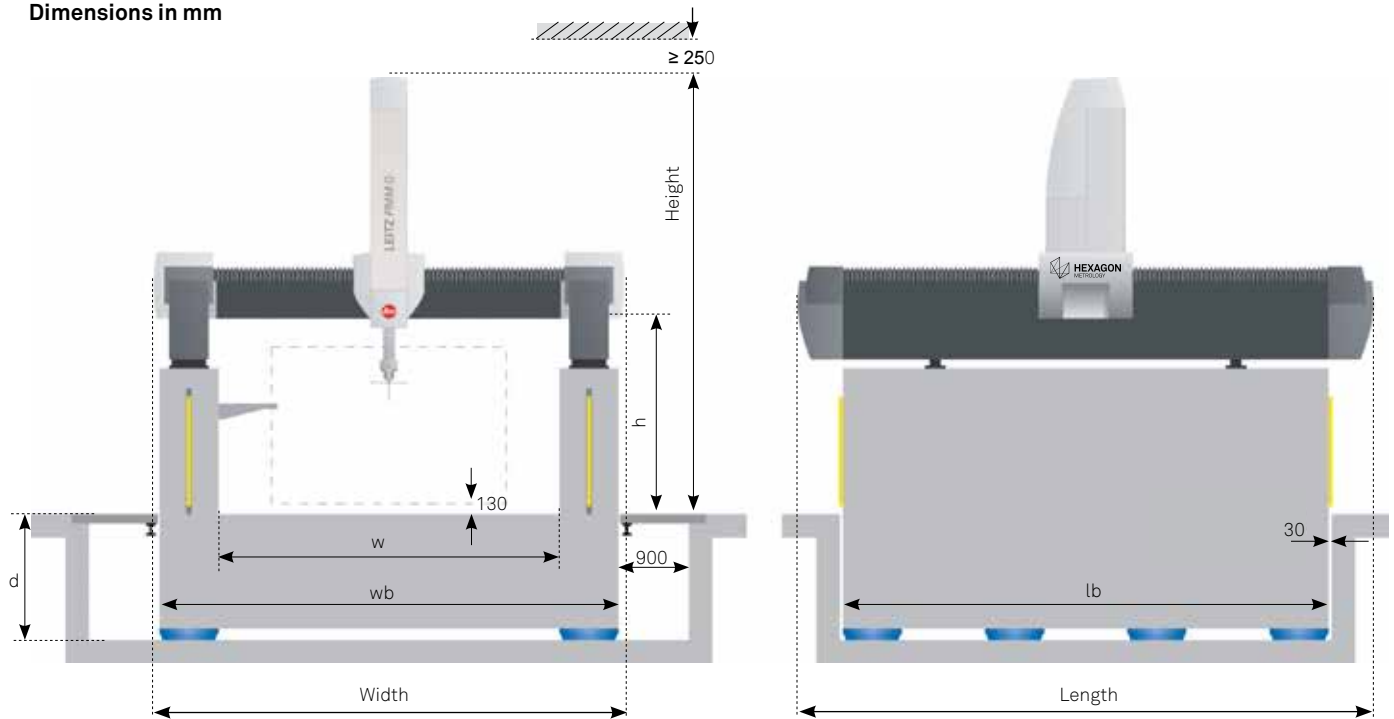
Measuring Ranges (X x Y x Z)

Leitz PMM-G	X: 3000 / 4000 / 5000 / 6000 / 7000 mm	Y: 2000 mm	Z: 1200 / 1600 / 2000 mm
Leitz PMM-G	X: 3000 / 4000 / 5000 / 6000 / 7000 mm	Y: 3000 mm	Z: 1200 / 1600 / 2000 / 2500 / 3000 mm
Leitz PMM-G	X: 5000 / 6000 / 7000 mm	Y: 4000 mm	Z: 1200 / 1600 / 2000 / 2500 / 3000 mm
Leitz PMM-G	X: 5000 / 6000 / 7000 mm	Y: 4500 mm	Z: 1200 / 1600 / 2000 mm

Larger sizes on request.

Max. part load: 15 tons. Higher loads up to 150 tons on request.

Dimensions in mm



All dimensions in mm		Length	Width	Height	h	w	wb	lb	d
Leitz PMM-G	30/40.20(30).12	5050/6050	4900 (5900)	4370	1640	3360 (4360)	4660 (5660)	4200/5200	1460
Leitz PMM-G	50/60/70.20(30).12	7150/8150/9550	4900 (5900)	4370	1640	3360 (4360)	4860 (5860)	6200/7200/8200	1760
Leitz PMM-G	50/60/70.40(45).12	7150/8150/9550	7100 (7600)	4370	1640	5360 (5860)	6860 (7360)	6200/7200/8200	1760
Leitz PMM-G	30/40.20(30).16	5050/6050	4900 (5900)	4770	2040	3360 (4360)	4660 (5660)	4200/5200	1460
Leitz PMM-G	50/60/70.20(30).16	7150/8150/9550	4900 (5900)	4770	2040	3360 (4360)	4860(5860)	6200/7200/8200	1760
Leitz PMM-G	50/60/70.40(45).16	7150/8150/9550	7100 (7600)	4770	2040	5360 (5860)	6860 (7360)	6200/7200/8200	1760
Leitz PMM-G	30/40.20(30).20	5050/6050	4900 (5900)	5570	2430	3360 (4360)	4660 (5660)	4200/5200	1460
Leitz PMM-G	50/60/70.20(30).20	7150/8150/9550	5100 (6100)	5570	2430	3360 (4360)	4860(5860)	6200/7200/8200	1760
Leitz PMM-G	50/60/70.40(45).20	7150/8150/9550	7100 (7600)	5570	2430	5360 (5860)	6860 (7360)	6200/7200/8200	1760
Leitz PMM-G	30/40.30.25	5050/6050	5900	6570	2930	4360	5660	4200/5200	1460
Leitz PMM-G	50/60/70.30.25	7150/8150/9550	6100	6570	2930	4360	5860	6200/7200/8200	1760
Leitz PMM-G	50/60/70.40.25	7150/8150/9550	7100	6570	2930	5360	6860	6200/7200/8200	1760
Leitz PMM-G	30/40.30.30	5050/6050	5900	7570	3430	4360	5660	4200/5200	1460
Leitz PMM-G	50/60/70.30.30	7150/8150/9550	6100	7570	3430	4360	5860	6200/7200/8200	1760
Leitz PMM-G	50/60/70.40.30	7150/8150/9550	7100	7570	3430	5360	6860	6200/7200/8200	1760
Controller B5		800	400	1200					

Crane load capacity for installation: X = 3000: 4.8t; X = 4000: 5.5t; X = 5000: 10t, X = 6000: 11t, X = 7000: 12t

CMM Capability Charts - Diameters and Distances

Tolerance [mm]	Distance or diameter [mm]						
	50	100	200	400	600	1000	2000
± 0.010	0.9 + L / 400	0.8 + L / 500	0.6 + L / 500	0.5 + L / 800			
± 0.015	1.4 + L / 400	1.3 + L / 400	1.0 + L / 400	0.7 + L / 500	0.6 + L / 700		
± 0.020	1.9 + L / 400	1.8 + L / 400	1.5 + L / 400	1.0 + L / 400	0.8 + L / 500	0.6 + L / 700	
± 0.030	2.9 + L / 400	2.8 + L / 400	2.5 + L / 400	2.0 + L / 400	1.5 + L / 400	1.0 + L / 500	0.5 + L / 800
± 0.050	4.8 + L / 300	4.8 + L / 400	4.5 + L / 400	4.0 + L / 400	2.6 + L / 400	2.5 + L / 400	1.0 + L / 500
± 0.070	6.7 + L / 200	6.7 + L / 350	6.3 + L / 300	5.4 + L / 250	5.0 + L / 300	4.5 + L / 400	2.0 + L / 400
± 0.100	9.7 + L / 200	9.5 + L / 200	9.0 + L / 200	8.1 + L / 200	7.0 + L / 200	6.0 + L / 250	4.3 + L / 350

Example: A diameter of 400 mm has a tolerance of ± 0.050 mm.
 For the inspection of this feature a CMM with a length measuring error $E_0 = 4.0 + L / 400$ [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
P_{FTU} [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 0.015 mm a CMM with a single stylus form error $P_{FTU} = 1.5$ µm (single-point probing) respectively with a single stylus form error (scanning) THP = 1.5 µm is required.
 Note: P_{FTU} and THP are only specified for small areas up to 30 mm.

Important: 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

Volumetric length measuring 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 $\pm E_0$.

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 P_{FTU}

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

Single stylus form error, scanning THP (also: "Scanning probing error")

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

Multi styli errors Form P_{FTM} , Size P_{STM} , Location P_{LTM}

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

Form measurement error (2D) RONT (MZCI)

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

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
Curvic couplings	
Gear cutting tools	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, 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

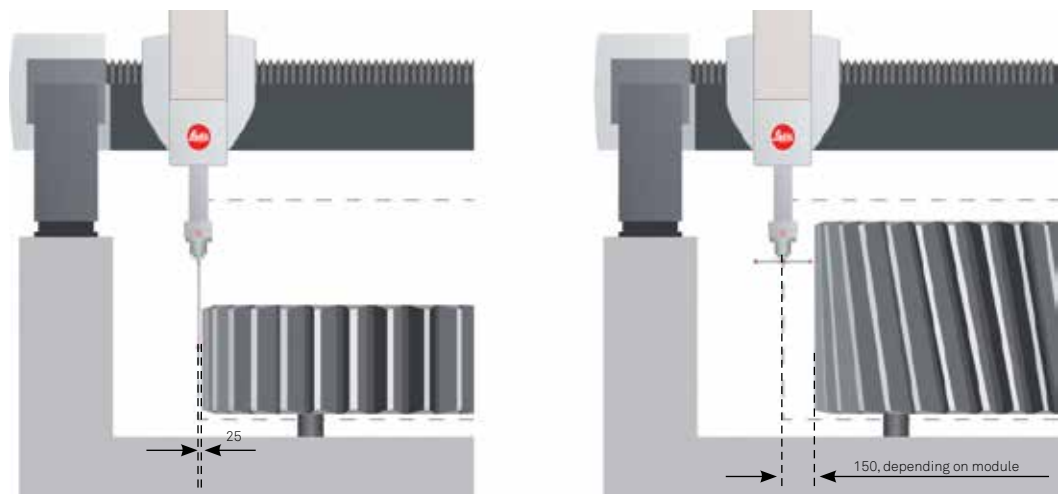
- Cylindrical gear
- Unknown gear
- Gear gauges
- CAT gear
- Straight bevel gear
- Spiral bevel gear
- Hob cutter
- Form cutter
- Shaving gear
- Shaper cutter
- Broach
- Sprocket / chain wheel
- Cylindrical worm
- Worm wheel
- Globoid worm
- Curvic couplings

Gear related Specifications

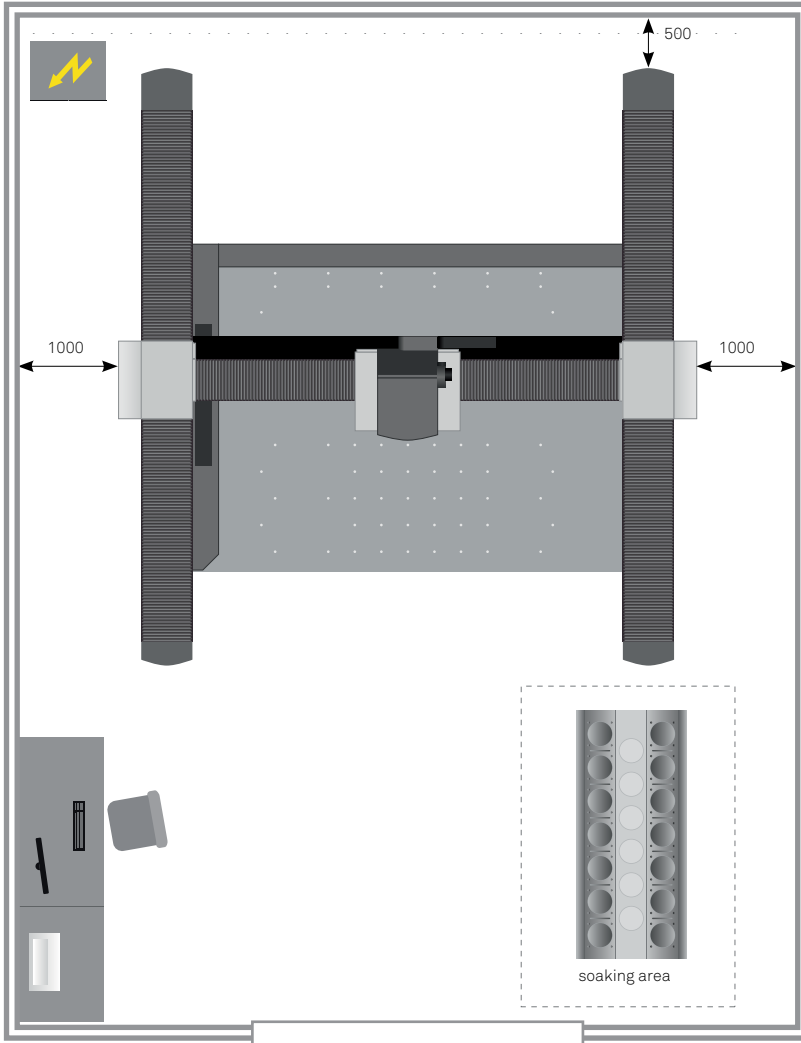
Max. gear weight	see permitted table load, page 5, 7
Module range	0.8 - 100 mm
Max. gear width	= Z-range of the machine (vertical orientation), e. g. 1600 mm for a PMM-F 30.20.16
Max. shaft length	= X-range of the machine (horizontal orientation), e. g. 6000 mm for a PMM-G 60.40.20
Spiral angle	0° - 90°
Machine accuracy	Group 1 according to VDI/VDE 2612/2613, page 1 and 2

Gear diameter (external)	xx.20.zz	xx.30.zz	xx.40.zz	xx.45.zz
Spur gear	10 - 1950 mm	10 - 2950 mm	10 - 3950 mm	10 - 4450 mm
Helical gear ⁽¹⁾	10 - 1600 mm	10 - 2600 mm	10 - 3600 mm	10 - 4100 mm

⁽¹⁾depending on module and styli configuration

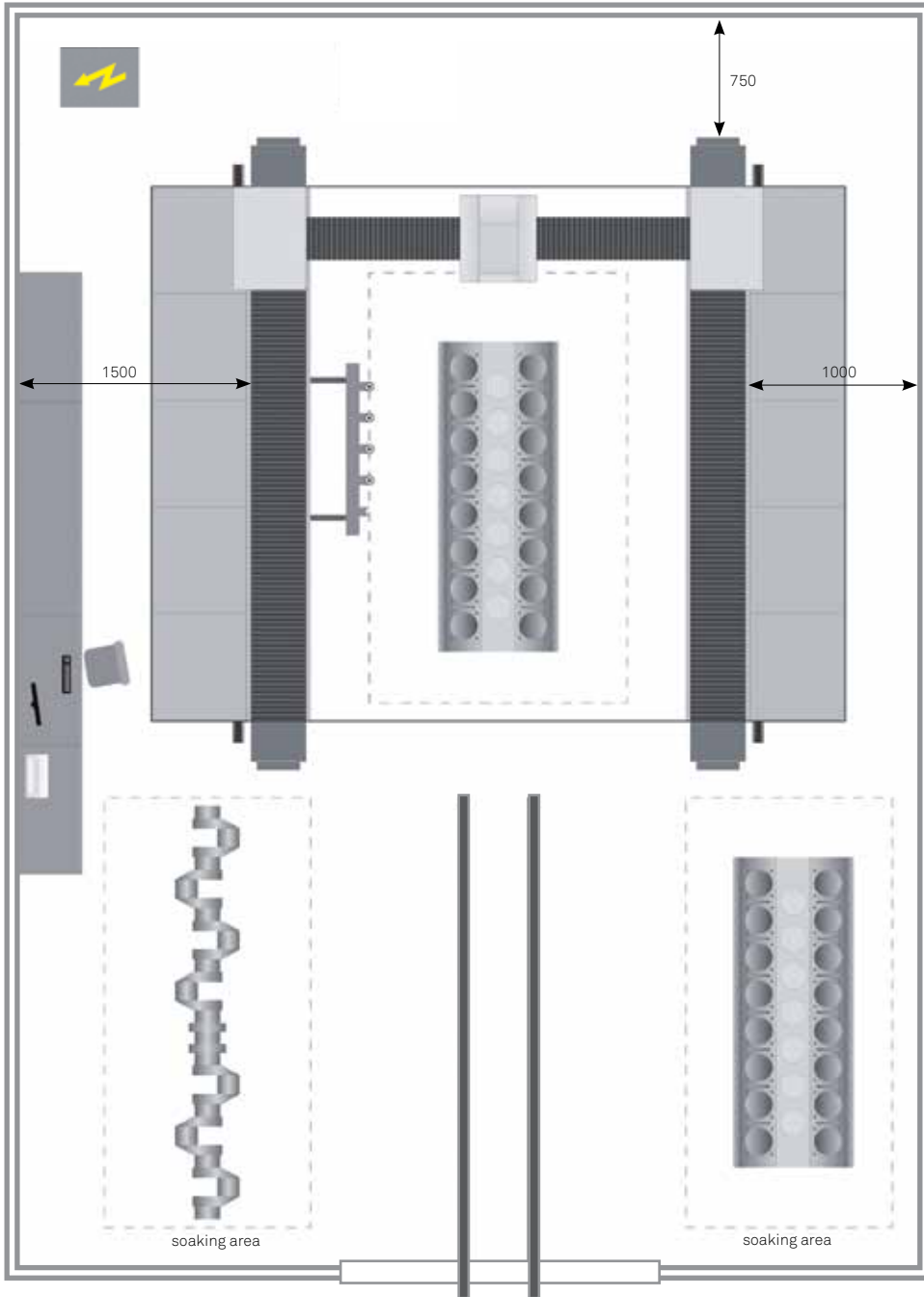


M42-250-004-203



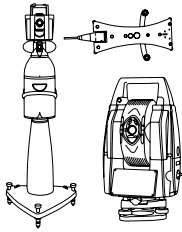
Above room layout shows the recommended minimum clearance and is for reference only. Individual room designs may differ.





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

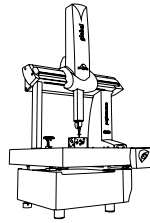




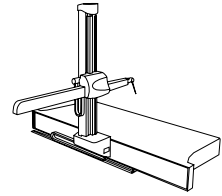
LASER TRACKERS & STATIONS



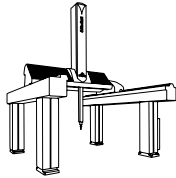
PORTABLE MEASURING ARMS



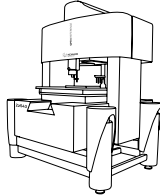
BRIDGE CMMS



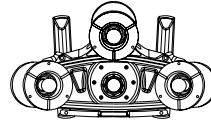
HORIZONTAL ARM CMMS



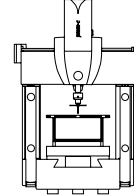
GANTRY CMMS



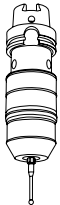
MULTISENSOR & OPTICAL SYSTEMS



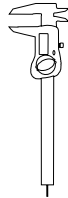
WHITE LIGHT SCANNERS



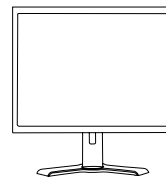
ULTRA HIGH ACCURACY CMMS



SENSORS



PRECISION MEASURING INSTRUMENTS



SOFTWARE SOLUTIONS



Hexagon Metrology offers a comprehensive range of products and services for all industrial metrology applications in sectors such as automotive, aerospace, energy and medical. We support our customers with actionable measurement information along the complete life cycle of a product – from development and design to production, assembly and final inspection.

With more than 20 production facilities and 70 Precision Centers for service and demonstrations, and a network of over 100 distribution partners on five continents, we empower our customers to fully control their manufacturing processes, enhancing the quality of products and increasing efficiency in manufacturing plants around the world.

For more information, visit www.hexagonmetrology.com

Hexagon Metrology is part of Hexagon (Nordic exchange: HEXA B). Hexagon is a leading global provider of design, measurement and visualisation technologies that enable customers to design, measure and position objects, and process and present data.

Learn more at www.hexagon.com

© 2013 Hexagon Metrology. Part of Hexagon

Due to continuing product development, Hexagon Metrology GmbH reserves the right to change product specifications without prior notice.

Version 2013-5. Printed in Germany. October 2013

