PCMM System Specifications
Leica Absolute Tracker and Leica T-Products

- when it has to be **right**

Leica Geosystems

Leica Absolute Tracker accuracy

The measurement uncertainty of a coordinate "U_{xyz}" is defined as the deviation between a measured coordinate and the nominal coordinate of that point. This measurement uncertainty is specified as a function of the distance between the laser tracker and the measured point.

The accuracy specified below is achieved with Leica Geosystems precision reflectors and a measurement mode of 1 second per point under stable environmental conditions.

U_{xyz}, Full Range

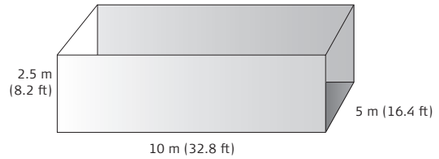
(Full Range Definition: 360° horizontally, ± 45° vertically and up to max. distance range of sensor)

AT901-B, AT901-MR, AT901-LR
± 15 µm + 6 µm/m
(±0.6 thou + 0.07 thou/ft)

U_{xyz}, in 2.5 x 5 x 10 m volume (8.2 x 16.4 x 32.8 ft)

(Prerequisite: The laser tracker sensor is anywhere inside the volume)

AT901-B, AT901-MR, AT901-LR
± 10 µm + 5 µm/m
(±0.4 thou + 0.06 thou/ft)



Leica Laser Tracker, Leica T-Cam and Leica T-Probe

Ambient conditions	
Working temperature	+0°C to +40°C (32 F to 104 F)
Storage temperature	-10°C to +60°C (14 F to 140 F)
Relative humidity	10 – 90%, non-condensing
Operational elevation	0 – 3,050 m (0 – 10,000 ft)
Storage elevation	0 – 21,000 m (0 – 70,000 ft)

Marks of conformity	
CB-certified by electrosuisse	Yes
CE	Yes
	Yes

Feature	Benefit
Robust construction and superior thermal stability with homogenous internal design and non-heat emitting tracker sensor head	Continuous on-spec operation in tough industrial environments with no need for frequent compensation routines; a yearly calibration is all your Leica Absolute Tracker will ever need
Absolute Interferometer utilizing both an absolute distance meter (ADM) and an interferometer (IFM)	A simple, insusceptible, technologically mature design for high-accuracy measurements in all operating conditions; tremendous data redundancies achieved with combined ADM&IFM systems
6 Degrees of Freedom (6DOF) Portable CMM available as an option	The world's only technologically mature PCMM system that can probe like a fixed CMM, scan like a laser scanner and track automated applications – all in one system
Lean construction and compact dimensions, weighing 22 kg and 620 mm in length	Easy one-person transportation and installation, in full compliance with labor department regulations; whole system fits in an average-sized station wagon
ADM/IFM with small beam diameter	Use of small reflectors (0.5") over full measurement range

Leica Laser Tracker	**AT 901-B**	**AT 901-MR**	**AT 901-LR**
(2 sigma specifications)			
Compatibility			
Compatible with Leica T-Cam	No	T-Cam MR	T-Cam LR
Compatible with Leica T-Probe	No	Yes	Yes
Compatible with Leica T-Scan	No	Yes	Yes
Compatible with Leica T-Mac	No	Yes	Yes
Measurement Volume			
Maximal Volume (Ø)	80 m (262 ft)	50m (164 ft)	80 m (262 ft)
Horizontal	360°	360°	360°
Vertical	± 45°	± 45°	± 45°
Measuring and tracking performance			
Measuring rate	3,000 points per second		
Measuring rate output	1,000 points per second		
Tracking speed lateral	› 4 m/s (13 ft/s)		
Tracking speed radial	› 6 m/s (19 ft/s)		
Acceleration lateral	› 2 g		
Acceleration radial	unlimited		
Laser Interferometer sensor IFM			
Principle technology	Heterodyne, single-beam		
Wavelength	633 nm (visible)		
Safety class	21CFR: Safety Class I; IEC 60825-1, Second Edition (2007-03)		
Laser tube MTBF	50,000 hrs		
Warm-up time, cold start	8 min		
Warm-up time, warm start	5 min		
IFM beam diameter for accurate use of small reflectors	4.0 mm (0.1575 in)		
Distance resolution	0.32 µm (0.0125 thou)		
Distance accuracy	± 0.5 ppm		
Integrated Absolute Interferometer	Yes	Yes	Yes
Maximal ADM distance	1.0 – 40 m (3.3 – 131 ft)	1.0 – 9 m (3.3 – 29 ft)	1.0 – 40 m (3.3 – 131 ft)
Underlying operational principle	Modulation of polarization		
Wavelength	795 nm (infrared)		
Safety class	21CFR: Safety Class II; IEC 60825-1, Second Edition (2007-03)		
Small beam diameter for accurate use of small reflectors	2.5 mm (0.0984 in)		
Distance resolution	0.1 µm (0.004 thou)		
Distance accuracy over full range	± 25 µm (± 0.98 thou)		
Automated Lock-On when beam broken	Yes	Yes	Yes
Accuracy information	**AT 901-B, AT 901-MR & AT 901-LR**		
Angular resolution	0.14 arc sec		
Angular repeatability, full range	± 7.5 µm + 3 µm/m		
and in 2.5 x 5 x 10 m volume	(±0.30 thou + 0.04 thou/ft)		
Angle accuracy, full range	± 15 µm + 6 µm/m (±0.59 thou + 0.07 thou/ft)		
Angle accuracy in 2.5 x 5 x 10 m volume	± 15 µm + 6 µm/m (±0.59 thou + 0.07 thou/ft)		
Size and weight			
Sensor size	620 / 290 / 240 mm (24 / 11 / 9 in)		
Sensor weight	22 kg (48.5 lbs)		
Controller size	510 / 485 / 200 mm (20 / 19 / 7.9 in)		
Controller weight	17 kg (37.5 lbs)		

AT 901-B, AT 901-LR

AT 901-MR

Leica T-Probe system accuracy

The measurement uncertainty of 3D points "U_{3D}" is defined as the distance between a measured point and the nominal position of that point. This measurement uncertainty is specified as a function of the distance between the laser tracker and the measured point.

The measurement uncertainty of spatial length "U_L" is defined as the deviation between a measured length and its nominal value. This measurement uncertainty is specified as a function of the shortest distance between the laser tracker and the measured length. The length can be up to 6m and is positioned perpendicularly to the laser beam (Leica T-Probe held in constant orientation).

Measurement uncertainty of sphere radius "U_R" is defined as the deviation between a measured sphere radius and its nominal value. This specification assumes a reference sphere with a radius between 10 mm and 50 mm. This measurement uncertainty is specified as a function of the distance between the Laser Tracker and the measured sphere (Leica T-Probe held in constant orientation).

The uncertainty specified below is achieved with Leica T-Probe (110 mm stylus in mount 1/2) and a measurement mode of 1s per point under stable environmental conditions.

Measurement uncertainty of 3D Point (2 sigma)
U_{3D} = 100 µm if under 7 m (3.94 thou if under 23 ft)

U_{3D} = 30 µm + 10 µm/m if greater than 7 m
(1.18 thou + 0.12 thou/ft if greater than 23 ft)

Measurement uncertainty of spatial length (2 sigma)
U_L = ± 60 µm if under 8.5 m (± 2.36 thou if under 27.9 ft)

U_L = ± 7 µm/m if greater than 8.5 m
(± 0.08 thou/ft if greater than 27.9 ft)

Measurement uncertainty of sphere radius (2 sigma)
U_R = ± 20 µm + 2 µm/m (± 0.79 thou + 0.02 thou/ft)

unfiltered measurement data (100%)

Leica T-Probe	AT901-MR	AT901-LR
Measurement volume		
Maximal volume (Ø)	18 m (60 ft)	30 m (98 ft)
Horizontal	360°	
Vertical	± 45°	
Acceptance angle		
(Freedom to rotate)		
Pitch angle	± 45°	
Jaw angle	± 45°	
Roll angle	360°, unlimited	
Measuring and tracking performance		
Measuring rate output	1,000 points per second	
Tracking speed all directions	› 1 m/s (≈ 3.3 ft/s)	
Acceleration, all directions	1 g	
Weight		
Leica T-Probe with standard tip and battery	670 g (≈ 1.48 lb)	
Leica T-Probe with standard tip and without battery	570 g (≈ 1.26 lb)	
Leica T-Cam MR and LR	4.7 kg (≈ 10.36 lb)	

Comfort through true intelligence

Feature	Benefit
Armless operations	Full "Walk-Around" freedom
Wireless operations	Speed and safety increase
No direct line of sight between probe tip and laser tracker required	Reaches hidden, recessed or hard-to-reach parts without needing to reposition laser tracker
Probe self-identification	Eliminates handling errors
Stylus self-identification	Eliminates handling errors
Acoustic system feedback in your hand	Accelerates measurement process
Visual system feedback in your hand	Accelerates measurement process
Precision quick release for stylus	Flexibility with speed
Wide variation of styli type and length	Highest probing flexibility

Leica AT901-MR gives you a measurement volume of up to 18 m (59 ft), Leica AT901-LR up to 30 m (98 ft)

Leica T-Mac system accuracy

Accuracy of rotation angles
0.01° = 18 µm/100mm (0.71 thou per 3.94")

Accuray of time stamp
‹5 µs

Typical positioning accuracy for applications on drilling robots
50 µm (1.97 thou)

Positional accuracy
± 15 µm + 6 µm/m (±0.59 thou + 0.07 thou/ft)

unfiltered measurement data (100%)

Leica T-Mac	AT901-MR	AT901-LR
Measurement volume		
Maximal volume	18 m (60 ft)	30 m (98 ft)
Horizontal	360°	
Vertical	± 45°	
Acceptance angle		
(Freedom to rotate)		
Pitch angle	± 45°	
Jaw angle	± 45°	
Roll angle	360°, unlimited	
Measuring and tracking performance		
Measuring rate output	1,000 points per second	
Tracking speed all directions	› 1 m/s (≈ 3.3 ft/s)	
Acceleration all directions	1 g	
Accuracy		
Accuracy of rotation angles	0.01° = 18 µm/100mm (0.71 thou per 3.94")	
Accuray of time stamp	‹5 µs	
Positional accuracy	± 15 µm + 6 µm/m (±0.59 thou + 0.07 thou/ft)	
Weight		
Leica T-Mac	1,480 g (≈ 3.26 lb)	

Comfort through true intelligence

Feature	Benefit
Sealed housing	Work in toughest industrial environments
Robust design, with no internal moving parts or mechanisms	Designed for use in real production environments, easy to service and with no "wear and tear"
Simple mechanical interface	Direct mounting on a robot or a machine
Adaptation of tool exchange interface	Automatic connection to robot with high repeatability of under 3 µm (0.12 thou)
Multiple reflector nests on	Calibrated reflector locations as known home points for easy establishing of object orientation

Leica T-Scan system accuracy

Measurement uncertainty of spatial length "U_L" is the deviation between a measured length and its nominal value. This measurement uncertainty is specified as a function of the shortest distance between the Laser Tracker and the measured length. The length can be up to 6m and is perpendicular positioned to the laser beam.The centers of two fix-mounted spheres (sphere radius between 15 mm and 20 mm) at the end of the reference length are representing the nominal distance. The measured distance between the sphere centers is calculated using scan data of all four Leica T-Scan sides.

Measurement uncertainty of sphere radius "U_R" is the deviation between a measured sphere radius and its nominal value. The measurement uncertainty of the sphere surface "U_S" is defined as the 2-sigma value of all deviation from the best-fit sphere that is calculated with all measured points. This specification assumes a reference sphere with a radius between 10 mm and 50 mm. These measurement uncertainties are specified as a function of the distance between the Laser Tracker and the sphere. Data of all four Leica T-Scan sides is utilized for the calculation of the sphere radius and the sphere surface.

Measurement uncertainty of plane surface "U_P" is defined as the 2-sigma value of all deviation from the best-fit plane that is calculated with all measured points. Data from all four Leica T-Scan sides is utilized for the calculation of the plane surface.

The uncertainty specified below is achieved with Leica T-Scan using a point density setting of at least 0.35 mm and a line spacing of at least 0.35 mm under stable environmental conditions.

Measurement uncertainty of spatial length
U_L = ± 60 µm if under 8.5 m (± 2.36 thou if under 27.9 ft)
U_L = ± 7 µm/m if greater than 8.5 m (± 0.08 thou/ft if greater than 27.9 ft)

Measurement uncertainty of sphere radius (2 sigma)
U_R = ± 50 µm if under 8.5 m (± 2.36 thou if under 27.9 ft)
U_R = ± 7 µm/m if greater than 8.5 m (± 0.08 thou/ft if greater than 27.9 ft)
U_S = ± 95 µm + 1.5 µm/m (±3.74 thou + 0.02 thou/ft)

Measurement uncertainty of plane surface (2 sigma)
U_P = ± 95 µm + 3 µm/m (±3.74 thou + 0.04 thou/ft)

The specs shown herein are based on true and unfiltered data. Typical accuracy on filtered values is about 50% better than the values shown above.

Leica AT901-MR gives you a measurement volume of up to 18 m (59 ft), Leica AT901-LR up to 30 m (98 ft)

Leica T-Scan	AT 901-MR	AT 901-LR
Measurement volume		
Maximal volume (Ø)	18 m (60 ft)	30 m (98 ft)
Horizontal	360°	
Vertical	± 45°	
Acceptance angle		
(Freedom to rotate)		
Pitch angle	± 45°	
Jaw angle	± 45°	
Roll angle	360°, unlimited	
Measuring and tracking performance		
Measuring rate output	7,000 points per second	
Tracking speed all directions	< 1 m/s (≈ 3.3 ft/s)	
Acceleration all directions	1g	
Leica T-Scan sensor		
Measuring depth	75 mm (2.95 in)	
Mean scan width	90 mm (3.54 in)	
Mean measuring distance	83 mm (3.27 in)	
Line frequency	up to 140 lines/second	
Measurement sampling rate	10,000 points per second	
Distance resolution	1 µm (0.04 thou)	
Point density	0.14 mm – 1.96 mm (5.5 thou – 77.2 thou)	
Accuracy	±30 µm (1.18 thou)	
Safety class IEC 60825-1; 1993+A1:	21CFR: Safety Class II 1997 + A2: 2001, class 2	
Working temperature	+16°C to +24°C (61 F to 75 F)	
Storage temperature	-10°C to +60°C (14 F to 140 F)	
Relative humidity	10 – 90% non-condensing	
Weight		
Leica T-Scan	1,200 g (≈ 2.6 lbs)	

Feature	Benefit
Measurement volume of up to 30 m (98 ft)	Measure large object without repositioning laser tracker
20% weight reduction and 30% smaller volume than previous model	Improved portability, ease of use on long, demanding jobs and better access to toght spaces with difficult geometries
Optmized marker positions	More accurate 6DOF readings over the full range of scanner positions
"Instant Temperature Compensation"	No-nonsense measurements in almost any environment without user intervention
Enhanced operator feedback with new intuitive LED pattern	Accurate information about optimal scanning distance
Improved ergonomics with optimized handle design and reduced weight	Leica T-Scan is the most comfortable-to-work-with hand-held laser scanner in the industry

Whether building the fastest car, the biggest plane or the most precise tooling, you need exact measurements to improve quality and productivity. So when it has to be right, professionals trust Leica Geosystems metrology products to help collect, analyze and present 3-dimensional (3D) data for industrial measurement.

Leica Geosystems Metrology is best known for its broad array of control and industrial measurement products, including high-precision industrial theodolites and total stations, laser trackers and 6 Degrees of Freedom-based (6DOF) Portable CMM systems. The latter include the Leica T-Probe hand-held armless probe, Leica T-Scan hand-held laser scanner and Leica T-Mac tracking device for automated applications. Leica Geosystems also offers a broad range of 3D metrology software solutions. Those who use the metrology products by Leica Geosystems every day trust them for their dependability, the value they deliver and the world-class service and support that's second to none.

Precision, reliability and service from Leica Geosystems metrology products.

When it has to be right.

For more information, please contact info.metrology@leica-geosystems.com

Leica Absolute Tracker
Product Brochure
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Leica Geosystems AG
Metrology Products
Moenchmattweg 5
CH-5035 Unterentfelden
Switzerland
Phone +41 62 737 67 67
Fax +41 62 723 07 34
info.metrology@leica-geosystems.com

www.leica-geosystems.com/metrology

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