PCMM System Specifications
Leica Absolute Tracker
and Leica T-Products
Leica Absolute Tracker accuracy

The measurement uncertainty of a coordinate "Uxyz" 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.

All accuracies are specified with Leica Geosystems precision 1.5" Red Ring Reflectors, measurement mode of 1 second per point under stable environmental conditions and a maximum distance of 40 radial meters from the measurement sensor. All specifications are stated in maximum permissible error (MPE). Typical results are half the MPE.

### Uxyz – Full Range

*Full Range Definition: 360° horizontally, ± 45° vertically*

<table>
<thead>
<tr>
<th>Feature</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robust construction and superior thermal stability with homogenous internal design and non-heat emitting tracker sensor head</td>
<td>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</td>
</tr>
<tr>
<td>The AIFM or &quot;Absolute Interferometer&quot; combines the absolute measurement from the ADM with the almost instantaneous update rate of the interferometer to produce the most accurate, stable, technologically mature distancing unit we have ever created</td>
<td>Waiting for the tracker to &quot;lock-on&quot; is now a thing of the past. Simply catch the beam and you are measuring again without delay. No matter if you are using a reflector, Leica T-Probe, Leica T-Scan or Leica T-Mac, the AIFM can instantly re-establish a broken laser beam and immediately start measuring the moving target.</td>
</tr>
<tr>
<td>6 Degrees of Freedom (6DOF) Portable CMM available as an option</td>
<td>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</td>
</tr>
<tr>
<td>Lean construction and compact dimensions, weighing 22 kg and 620 mm in length</td>
<td>Easy one-person transportation and installation, in full compliance with labor department regulations; whole system fits in an average-sized station wagon</td>
</tr>
<tr>
<td>ADM/IFM with small beam diameter</td>
<td>Use of 0.5&quot; reflectors over full measurement range</td>
</tr>
<tr>
<td>Versatile Mounting</td>
<td>Mounts vertically and horizontally providing versatility in measurement volume.* **</td>
</tr>
</tbody>
</table>

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**Typical results within specifications.**

**Can not be used with the T-Cam in the horizontal position.**
### Leica Absolute Tracker

<table>
<thead>
<tr>
<th>AT 901-B</th>
<th>AT 901-MR</th>
<th>AT 901-LR</th>
</tr>
</thead>
</table>

#### Compatibility
- Compatible with Leica T-Cam: No, Yes, Yes
- 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

<table>
<thead>
<tr>
<th>Typical Volume (Ø)</th>
<th>Horizontal</th>
<th>Vertical</th>
</tr>
</thead>
<tbody>
<tr>
<td>160 m (525 ft)</td>
<td>360°</td>
<td>± 45°/360° *</td>
</tr>
<tr>
<td>50m (164 ft)</td>
<td>360°</td>
<td>± 45°/360° *</td>
</tr>
<tr>
<td>160 m (525 ft)</td>
<td>360°</td>
<td>± 45°/360° *</td>
</tr>
</tbody>
</table>

* in horizontal setup

#### 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

#### Absolute Interferometer (AIFM)
- Principle technology:
  - Single Beam Heterodyne Interferometer with Polarization Modulation Absolute Reference
- Wavelength: 633 nm / 795 nm (visible / IR)
- Warm-up time, cold start: 8 min
- Warm-up time, warm start: 5 min
- Largest Beam diameter: 4 mm
- Interferometer Distance Resolution: 0.32 µm (0.000013")
- Interferometer Distance Accuracy: ± 0.5 µm/m (± 0.000006"/ft)
- Dynamic Lock-On Accuracy: ± 10 µm (± 0.00039")
- Typical Lock-On working range:
  - 1.0 – 80.0 m (3.3 – 262 ft)
  - 1.0 – 9.0 m (3.3 – 29 ft)
  - 1.0 – 80.0 m (3.3 – 262 ft)

#### Laser Safety
- The Laser Tracking System is a Class 2 Laser Product
- IEC 60825-1; Second Edition (2007-03)

#### Accuracy information
- Angular resolution: ± 0.14 arc sec
- Angular repeatability, full range and in 2.5 x 5 x 10 m volume:
  - ± 7.5 µm + 3 µm/m
  - (±0.0003" + 0.00004"/ft)
- Angle accuracy, full range:
  - ± 15 µm + 6 µm/m
  - (±0.0006" + 0.00007"/ft)
- Angle accuracy in 2.5 x 5 x 10 m volume:
  - ± 10 µm + 5 µm/m
  - (±0.0004" + 0.00006"/ft)

#### Size and weight
- Sensor size: 620 / 290 / 240 mm (24 / 11 / 9")
- Sensor weight: 22 kg (48.5 lbs)
- Controller size: 510 / 485 / 200 mm (20 / 19 / 7.9")
- Controller weight: 17 kg (37.5 lbs)
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 6 m 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. Accuracy shown is the maximum permissible error (MPE). Typical results are half the MPE.

Measurement uncertainty of 3D Point (MPE)

\[
U_{3d} = \begin{cases} 
100 \, \mu m & \text{if under } 7 \, m (0.004" \text{ if under } 23 \, ft) \\
30 \, \mu m + 10 \, \mu m/m & \text{if greater than } 7 \, m \\
(0.0012" + 0.00012"/ft & \text{if greater than } 23 \, ft) 
\end{cases} 
\]

Measurement uncertainty of spatial length (MPE)

\[
U_l = \begin{cases} 
60 \, \mu m & \text{if under } 8.5 \, m (\pm 0.0024" \text{ if under } 27.9 \, ft) \\
7 \, \mu m/m & \text{if greater than } 8.5 \, m \\
(\pm 0.00008"/ft & \text{if greater than } 27.9 \, ft) 
\end{cases} 
\]

Measurement uncertainty of sphere radius (MPE)

\[
U_r = \begin{cases} 
20 \, \mu m + 2 \, \mu m/m & \text{if under } 8.5 \, m (\pm 0.0008" + 0.00002"/ft) 
\end{cases} 
\]

Leica T-Probe AT 901-MR AT 901-LR

Accuracy shown is the maximum permissible error (MPE). Typical results are half the MPE.

<table>
<thead>
<tr>
<th>Measurement volume</th>
<th>Leica T-Probe AT 901-MR</th>
<th>Leica T-Probe AT 901-LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximal volume (Ø)</td>
<td>18 m (59 ft)</td>
<td>30 m (98 ft)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Acceptance angle</th>
<th>Leica T-Probe AT 901-MR</th>
<th>Leica T-Probe AT 901-LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal</td>
<td>360°</td>
<td>360°</td>
</tr>
<tr>
<td>Vertical</td>
<td>± 45°</td>
<td>± 45°</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Measuring and tracking performance</th>
<th>Leica T-Probe AT 901-MR</th>
<th>Leica T-Probe AT 901-LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring rate output</td>
<td>1,000 points per second</td>
<td></td>
</tr>
<tr>
<td>Tracking speed all directions</td>
<td>&gt; 1 m/s (≈ 3.3 ft/s)</td>
<td></td>
</tr>
<tr>
<td>Acceleration, all directions</td>
<td>1 g</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Weight</th>
<th>Leica T-Probe AT 901-MR</th>
<th>Leica T-Probe AT 901-LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leica T-Probe with standard tip and battery</td>
<td>670 g (≈ 1.48 lb)</td>
<td>570 g (≈ 1.26 lb)</td>
</tr>
<tr>
<td>Leica T-Probe with standard tip and without battery</td>
<td>720 g (≈ 1.59 lb)</td>
<td>620 g (≈ 1.36 lb)</td>
</tr>
<tr>
<td>Leica T-Cam MR and LR</td>
<td>4.7 kg (≈ 10.36 lb)</td>
<td></td>
</tr>
</tbody>
</table>
Leica T-Mac system accuracy

**Accuracy of rotation angles**
0.01° = 18 µm/100mm (0.002”/ft)

**Accuracy of time stamp**
<5 µs

**Positioning accuracy for typical robotic drilling applications**
50 µm (0.002”)

**Positional accuracy**
± 15 µm + 6 µm/m (±0.0006” + 0.00007”/ft)

Accuracy shown is the maximum permissible error (MPE). Typical results are half the MPE.

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

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### Measurement volume

<table>
<thead>
<tr>
<th>Feature</th>
<th>Leica T-Mac AT 901-MR</th>
<th>Leica T-Mac AT 901-LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximal volume</td>
<td>18 m (59 ft)</td>
<td>30 m (98 ft)</td>
</tr>
<tr>
<td>Horizontal</td>
<td>360°</td>
<td>360°</td>
</tr>
<tr>
<td>Vertical</td>
<td>± 45°</td>
<td>± 45°</td>
</tr>
</tbody>
</table>

### 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 (0.002”/ft)
- Accuracy of time stamp: <5 µs
- Positional accuracy: ± 15 µm + 6 µm/m (±0.0006” + 0.00007”/ft)

### Weight

Leica T-Mac: 1,480 g (∼3.26 lb)

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**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 (0.00012”)
Multiple reflector nests on Leica T-Mac housing | Calibrated reflector locations as known home points for easy establishing of object orientation
6DOF Dynamic Lock-On | No more waiting for the tracker to "lock on" – AIFM can instantly re-establish a broken laser beam

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Comfort through true intelligence

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

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 system accuracy

Measurement uncertainty of spatial length "UL" 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 6 m 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 "UR" is the deviation between a measured sphere radius and its nominal value. The measurement uncertainty of the sphere surface "US" is defined as the 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 "UP" is defined as the 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 (2 sigma)
UL = ± 60 um if under 8.5 m (± 0.0024" if under 27.9 ft)
UL = ± 26 um + 4 um/m if greater than 8.5 m (± 0.0010" + 0.00005"/ft if greater than 27.9 ft)

Measurement uncertainty of sphere radius (2 sigma)
UR = ± 50 um if under 8.5 m (± 0.002" if under 27.9 ft)
UR = ± 16 um + 4 um/m if greater than 8.5 m (± 0.0006 " + 0.00005"/ft if greater than 27.9 ft)
US = ± 85 um + 1.5 um/m (±0.0033" + 0.00002"/ft)

Measurement uncertainty of plane surface (2 sigma)
UP = ± 80 um + 3 um/m (±0.0031" + 0.00004"/ft)

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

<table>
<thead>
<tr>
<th>Maximal volume (Ø)</th>
<th>18 m</th>
<th>30 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>(59 ft)</td>
<td>(98 ft)</td>
<td></td>
</tr>
</tbody>
</table>

#### Acceptance angle

- **Horizontal:** 360°
- **Vertical:** ± 45°

#### Measuring and tracking performance

- **Tracking speed all directions:** > 1 m/s (≈ 3.3 ft/s)
- **Acceleration all directions:** 1g

#### Leica T-Scan sensor

- **Measuring depth:** 78 mm (3.07”)
- **Mean scan width:** 90 mm (3.54”)
- **Mean measuring distance:** 86 mm (3.39”)
- **Line frequency:** up to 140 lines/second
- **Measurement sampling rate:** 20,000 points per second
- **Point density:** 0.07 mm – 0.98 mm (0.0028” – 0.039”)
- **Accuracy:** ± 20 µm (0.00079”)

#### Laser Safety

- **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)

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### Feature | Benefit
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Measurement volume of up to 30 m (98 ft) | Measure large object without repositioning laser tracker
Optimized laser optics | Better data quality: Higher performance on dark or shiny surfaces. Up to 20% less noise than before. More materials can be scanned without spray.
Doubled data rate | Time savings: Scan large surfaces in half the time compared to the previous Leica T-Scan generation.
Minimal point distance cut in half | Increased accuracy: Sheet metal features and contours can be digitised more precisely.
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
6DOF Dynamic Lock-On | No more waiting for the tracker to “lock on” – AIFM can instantly re-establish a broken laser beam.
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 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 laser trackers, Local Positioning Technology (LPT) based systems, hand-held scanners, 3D software and high-precision total stations. Those who use Leica Metrology products every day trust them for their dependability, the value they deliver, and the world-class service & support that’s second to none.

Precision, reliability and service from Leica Geosystems Metrology.

Leica Geosystems
Metrology Products
Moenchmattweg 5
CH-5035 Unterentfelden
Switzerland
Phone +41 62 737 67 68
Fax +41 62 737 68 68

www.leica-geosystems.com/metrology

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