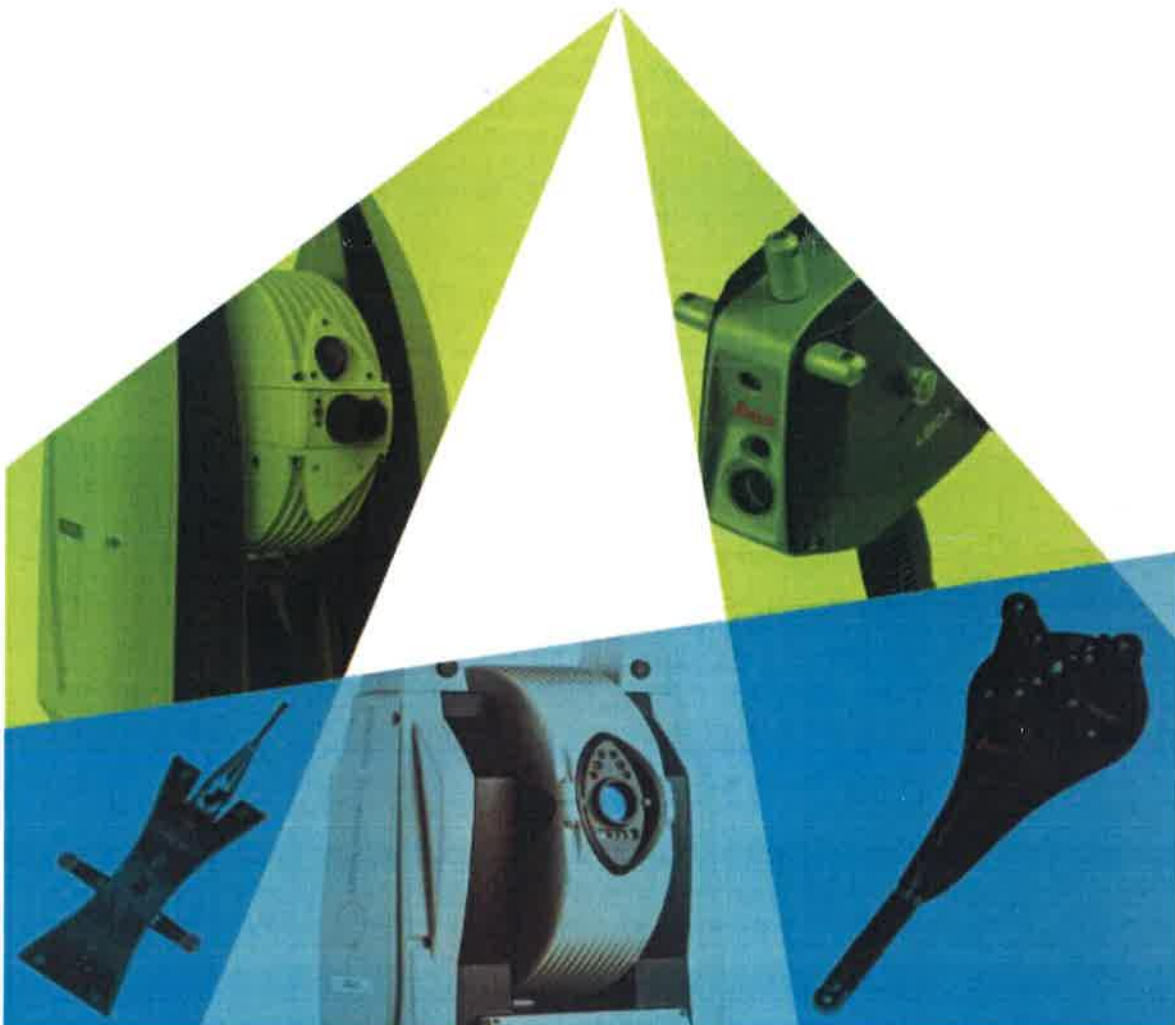




LEICA GEOSYSTEMS LASER TRACKER

Service Report and compensation data





As Left Data

Hexagon Detroit Solution Center
46444 Hexagon Way
Novi, MI 48377
USA
http://hexagonmi.com

Calibration Certificate Metrology

Calibration Certificate Metrology with measurement values issued by Manufacturer

Product :	Leica Absolute Tracker AT403	Certificate Nr. : 394712-26052021
Article Nr.:	576361 with 576360	Calibration Date: 26-May-2021
Serial Nr. :	394712	Calibration Due Date: 26-May-2022
Asset Nr. :	.	P.O. Number : .
Customer :	Argonne National Laboratory 9700 S. Cass Avenue, #46 Lemont, IL 60439 - USA	Calibration performed at: Hexagon Detroit Solution Center

Status : As Left Data
Status Notes: .

Compliance:

Hexagon Manufacturing Intelligence certifies that at the time of shipment the above listed instrument meets or exceeds manufacturer specifications. The calibrations within the certificate/report are traceable through NIST or another National Metrology Institute to the International Systems of Units (SI) and at the environmental condition stated above. The measurement uncertainty was calculated according to NIST Technical Note 1297, where possible, with a coverage factor k=2 which provides a level of confidence of approximately 95%. For all Z-540-1 reports a TUR of 4:1 or better is achieved on all points tested for the above listed instrument unless otherwise stated.

Hexagon Manufacturing Intelligence quality management system is ANSI/NCSL Z-540-1-1994 and ISO 17025: 2017 Accredited. This certificate shall not be reproduced, except in full, without written consent from Hexagon Manufacturing Intelligence unless otherwise indicated in the remarks section. ANAB ISO 17025 Certification Number: AC-1745.

Uncertainty: The expanded uncertainty of measurement is 14.1 µm (coverage factor k=2)*.

Certificate : We hereby certify that the product described has been tested with the following result:

Compliance - The test results are within the specification of the product.*

** Reported uncertainties are expressed as expanded uncertainty values at an approximately 95% confidence level using a coverage factor of k=2. Statements of compliance are based on test results without considering measurement of uncertainty.*

Hexagon Manufacturing Intelligence 26-May-2021

Service Technician – Michael Swain

QA Signature



Specifications

a) Measurement Tolerance for spatial length (MPE) of 2600 mm observed at a distance of:	2 m	≤	± 0.036 mm
	10 m	≤	± 0.103 mm
	20 m	≤	± 0.191 mm
b) Tolerance for ADM measurement throughout working range (Expanded Uncertainty (k=2)):		≤	± 0.016 mm
c) Repeatability Tolerance for ADM measurement throughout the working range (Expanded Uncertainty (k=2)):		≤	± 0.005 mm
d) Embedded Meteostation Temperature:		≤	± 0.3 °C
e) Embedded Meteostation Pressure:		≤	± 1.0 hPa
f) Embedded Meteostation Relative Humidity:		≤	± 5.0 %

Test Results

a) Maximum observed deviation of measurements at the spatial distance of:	2 m	0.006 mm
	10 m	-0.015 mm
	20 m	-0.004 mm
b) Maximum observed Deviation of ADM		0.014 mm
c) Maximum observed Repeatability of ADM between 1.5 m and 80 m:		0.002 mm
d) Maximum observed deviation of Temperature:		-0.2°C
e) Maximum observed deviation of Pressure:		0.3 hPa
f) Maximum observed deviation of Relative Humidity:		0.0 %

Calibration Certificate Metrology - Appendix

Calibration Certificate Metrology with measurement values issued by Manufacturer

Test Procedure

a) Process Documentation

The verification is performed per procedure: LTSWI-05
 Revision Nr. B

b) Spatial Length Measurement (Scale Bar)

The spatial length measurements, respective to coordinate determination are carried out on a scale bar.
 The reference distances are determined with equipment traceable to METAS/NIST or other recognized national standards laboratories.

c) Embedded Meteostation (Temperature / Pressure / Humidity)

The reported measuring results are deviations to measurements of a reference meteo station traceable to national standards, which has been calibrated by an accredited body.

Test Equipment

a) Process Documentation

LTSWI-05 Revision Nr. B

b) Spatial Length Measurement (Scale Bar)

	Type:	Serial No.:	Certificate No.:	Calibration Date:	Due Date:
Scalebar	Brunson Invar Kit	08-MSP1-395	L200520KG1	15-Dec-2020	14-Dec-2022

c) Embedded Meteostation (Temperature/Pressure/Humidity)

	Type:	Serial No.:	Certificate No.:	Calibration Date:	Due Date:
Meteostation	AT-Meteostation (Lufft)	1717	CBRE-3150-TLB	8-Apr-2021	8-Apr-2023



Measurement Report

a) Spatial Length Measurement (Scale Bar)

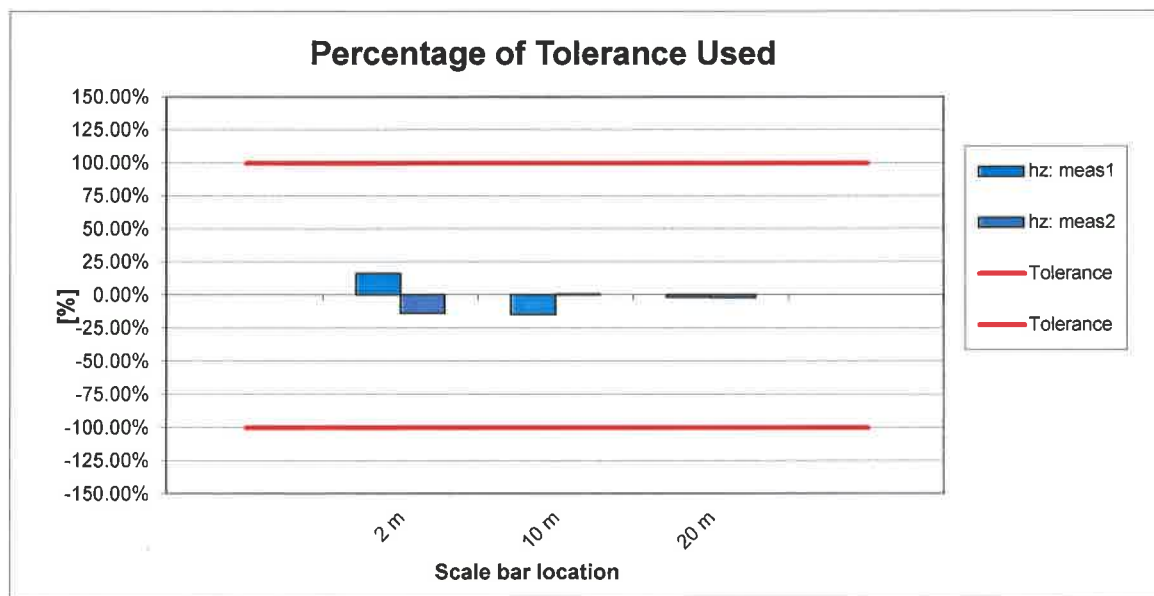
Calibrated by: Michael Swain
 Calibration Date: 26-May-2021
 Calib. Due Date: 26-May-2022

Temperature: 20.1 °C
 Pressure: 979.7 hPa
 Humidity: 39.0 %

Product: Leica Absolute Tracker AT403
 Serial No: 394712

Reflector Serial No.: 25284 & 23739

Reference distance [mm] at certification temperatures:								2550.0300	
Reference distance corrected [mm] at @ Scale Bar measurements:								2550.0303	
Scale bar setup			Actual measurements		Repeatability	Actual minus nominal		Tolerance	
Quadrant [deg]	Distance [m]	Scale bar setup	meas 1 [mm]	meas 2 [mm]	$\Delta M1 - M2$ [mm]	meas 1 [mm]	meas 2 [mm]	[mm]	out-of-tol.
0	2	horizontal	2550.036	2550.025	0.011	0.006	-0.005	± 0.036	
0	10	horizontal	2550.015	2550.031	-0.016	-0.015	0.000	± 0.103	
0	20	horizontal	2550.027	2550.026	0.000	-0.003	-0.004	± 0.191	





Measurement Report

b) Distance Measurement (ADM)

Calibrated by: Michael Swain
 Calibration Date: 26-May-2021
 Calib. Due Date: 26-May-2022

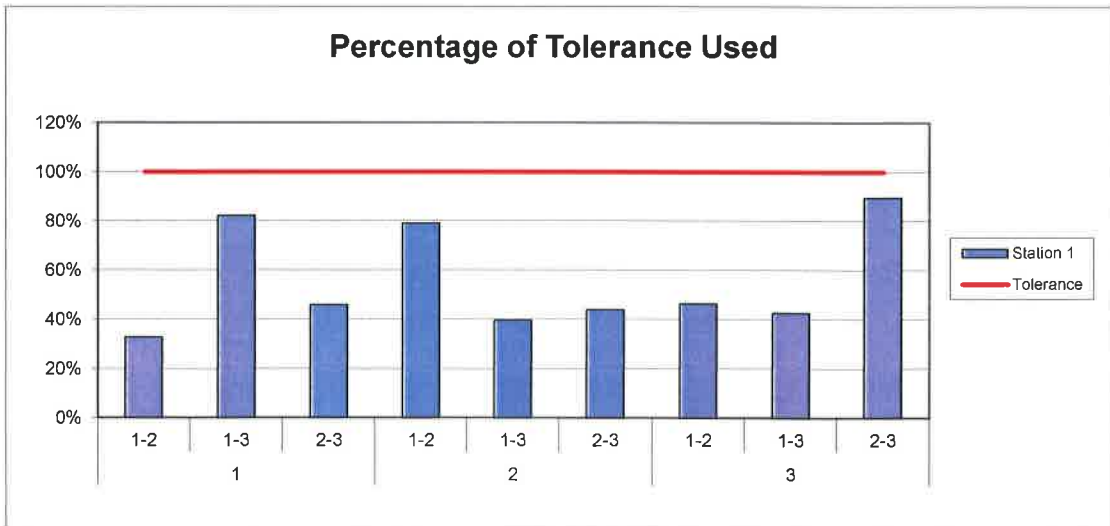
Temperature: 20.1 °C
 Pressure: 979.7 hPa
 Humidity: 39.0 %

Product: Leica Absolute Tracker AT403
 Serial No.: 394712

Reflector Serial No.: 25284 & 23739

Weighted Averaged Reference Lengths		
from Target	to Target	Length [mm]
1	2	4030.421
1	3	21005.864
2	3	16975.455

Station	from Target	to Target	Length [mm]	Residual [mm]	Tolerance	Percentage	Verdict
1	1	2	4030.416	-0.005	0.015	33%	passed
	1	3	21005.851	-0.013	0.016	82%	passed
	2	3	16975.448	-0.007	0.016	46%	passed
2	1	2	4030.433	0.012	0.015	79%	passed
	1	3	21005.870	0.006	0.016	39%	passed
	2	3	16975.448	-0.007	0.016	44%	passed
3	1	2	4030.414	-0.007	0.015	46%	passed
	1	3	21005.871	0.007	0.016	42%	passed
	2	3	16975.469	0.014	0.016	89%	passed





Measurement Report

c) Distance Repeatability Measurement (ADM)

Calibrated by: Michael Swain
 Calibration Date: 26-May-2021
 Calib. Due Date: 26-May-2022

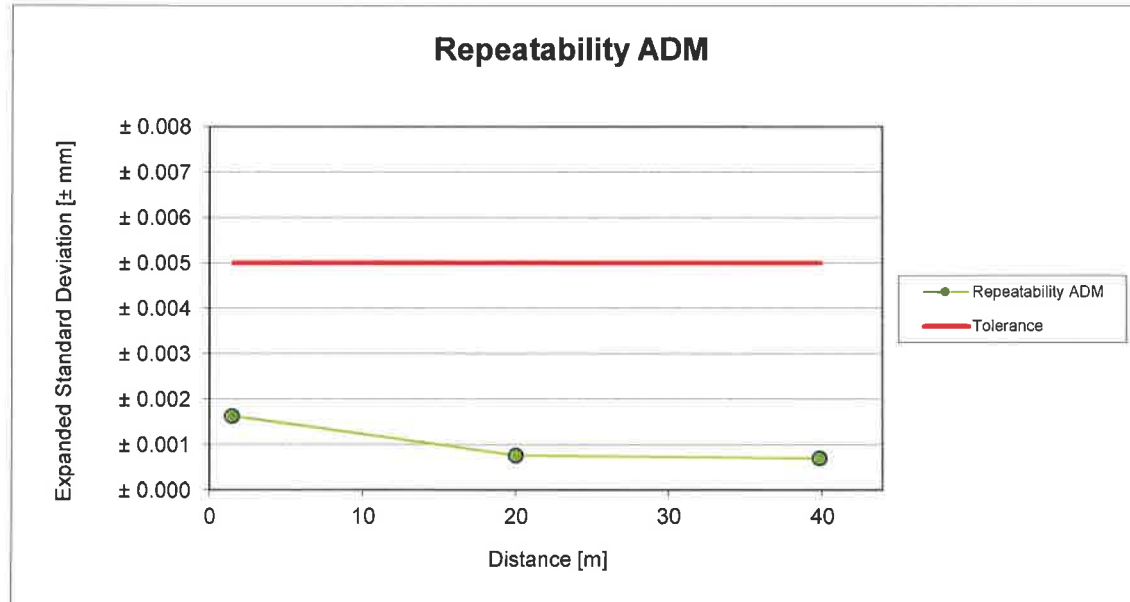
Temperature: 20.1 °C
 Pressure: 979.7 hPa
 Humidity: 39.0 %

Product: Leica Absolute Tracker AT403
 Serial No: 394712

Reflector Serial No.: 25284 & 23739

Repeatability

Distance approximate [m]	Distance average measured [mm]	Standard Deviation [mm]	Expanded Standard Deviation (k=2) [mm]	Verdict
1.5	1503.744	± 0.0008	± 0.0016	passed
20	19997.378	± 0.0004	± 0.0008	passed
40	39865.304	± 0.0004	± 0.0007	passed





Measurement Report

d) Embedded Meteostation (Temperature / Pressure / Humidity)

Calibrated by: Michael Swain
 Calibration Date: 26-May-2021
 Calib. Due Date: 26-May-2022

Product: AT Controller 400
 Serial No: 394712
 Ext. Temp. Sensor Serial No:

Results

	Reference value	Actual value	Deviation	Verdict
Temperature Air	20.1 °C	19.9 °C	-0.2 °C	passed
Temperature Object	20.1 °C	19.9 °C	-0.2 °C	passed
Pressure	979.7 hPa	980.0 hPa	0.3 hPa	passed
Relative Humidity	39.0 %	39.0 %	0.0 %	passed

Note: The reference values are the environmental conditions recorded by a reference weather station at the time of the meteo station calibration.
 Accuracy of air temperature and relative humidity of the device under test is ensured with connected external air temperature sensor only.



HEXAGON
MANUFACTURING INTELLIGENCE

Hexagon Manufacturing Intelligence helps industrial manufacturers develop the disruptive technologies of today and the life-changing products of tomorrow. As a leading metrology and manufacturing solution specialist, our expertise in sensing, thinking and acting – the collection, analysis and active use of measurement data – gives our customers the confidence to increase production speed and accelerate productivity while enhancing product quality.

Through a network of local service centres, production facilities and commercial operations across five continents, we are shaping smart change in manufacturing to build a world where quality drives productivity. For more information, visit HexagonMI.com.

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