

Certificate ID: L1T10655051321



For AS Found refer to; F1T10655051121

Manufacturer Carl Zeiss

Model CenterMax 11/12/7 Navigator

Serial Number 135391

Customer ID -

Customer Miltera Machining Research Corp.
60 Struck Crt.
Cambridge, Ontario N1R 8L2 CA

Job Number T10655

The equipment identified in this certificate was calibrated with standards that are traceable to national metrology institutes (e.g. NIST) through calibration laboratories accredited to ISO 17025. All results are reported in units of measure as defined by the International System of Units (SI).

A2LA is a signatory to several bilateral and multilateral recognition agreements. These agreements facilitate the acceptance of test and calibration data between A2LA-accredited laboratories and 46 economies around the globe. In addition, A2LA has recognition from over 30 federal, state and local government agencies, companies and associations.

Calibration Certificate page 1 of 19

The user is responsible for definition of appropriate intervals of calibration.

Date of Calibration 2021-05-13

Please store in a secure location. Elliott-Matsuura Canada Inc. is not responsible for loss of data

UAWT Version 9.6.0.752

Calibration Procedure ISO-10360

Uncertainty of Length Measurement = $0.1 + L/1600$ [μm] Temperature 20.38 °C

Calibration certificates without signature are not valid.

Signature / Name
Matthew Joyce



Date
2021-05-13

The most noteworthy contributor to the uncertainty budget of a CMM is the deviation of temperature away from the standard of 20 degrees Celsius. This calibration certificate shall not be reproduced, except in full, without written approval of Elliott-Matsuura Canada Inc. Unless otherwise annotated in protocol results, machine condition is in good working order. The reported results relate only to the item(s) specified above. All measurements performed at 95% confidence level (K=2).

1. Calibration task

Indication error E_0 for length measurements and probing error P_{FTU} are measured on the coordinate measuring machine for sensor systems with scanning capability, scanning probing error THP and the time for the scanning test are calibrated.

For sensor systems with scanning capability, roundness form measuring error $RONt$ ($MZCI$) was measured. If a rotary table is installed, the four-axis errors FR , FT and FA were measured if this measurement was ordered.

The coordinate measuring machine had the following configuration at the time of calibration:

Controller:	C99N (850Mhz) #AK003217 / FW: 24.08
Probe:	VAST Gold #0017UABS
Measurement SW:	CALYPSO 2019
Reference sphere:	#R5043 r=14.9890
Rotary table:	-
X measuring range:	1100mm
Y measuring range:	1200mm
Z measuring range:	700mm

2. Calibration procedure

Calibration of the metrological features of the coordinate measuring machine was performed according to Carl Zeiss IMT procedure CL-1001. This procedure is established and validated using international metrological methods.

Efforts were made to achieve ISO 10360-2, 6.3.2 which states *"The longest calibrated test length for each position shall be at least 66 % of the maximum travel of the CMM along a measurement line through the calibrated test length."*

When unable, $\geq 66\%$ of each linear axis is measured, via additional measurements if necessary.

The roundness form measurement errors $RONt$ ($MZCI$) were determined by measuring a master ring in the scanning mode with $D = 50\text{mm}$.

The four-axis measurement deviations FR (radial), FT (tangential) and FA (axial) were determined using two ceramic spheres with $D = 30\text{mm}$. The ceramic spheres were clamped with a horizontal distance from the rotary axis of $r = 206\text{mm}$ and a horizontal distance of $d = 412\text{mm}$ as well as a vertical distance of $h = 206\text{mm}$.

The single stylus form error P_{FTU} as well as the scanning probing error THP and their test duration were determined on a ceramic sphere with $D = 25\text{mm}$.

The customer is identified on page 1. The machine location is specified in section 3.

The calibration standards used are specified in the relevant sections of the measurement result documentation.

3. Ambient conditions

The maximum temperature deviation from 20°C during the measurement was 0.67°C.

The calibration was performed on-site. The coordinate measuring machine is installed at the following location:

Miltera Machining Research Corp.
60 Struck Crt.
Cambridge, Ontario N1R 8L2 CA

QA Lab

4. Measurement results

The measurement results apply only to the specified time of measurement. They also apply only to the relevant installation site and machine settings at the time of calibration. All settings and correction values were documented by the calibration laboratory.

4.1 Indication error for length measurements E_0

The following parallel and stepped gauge blocks are used to determine indication errors:

GCS number: E44 valid to 2021-07-13

The following temperature measuring device was utilized to perform temperature measurement to calculate deviation from a reference temperature of 20°C (if applicable).

GCS number: E32 valid to 2023-01-22

The determined indication errors E_0 and the maximum permissible indication error for length measurements $E_{0, MPE}$ are represented in the following diagrams.

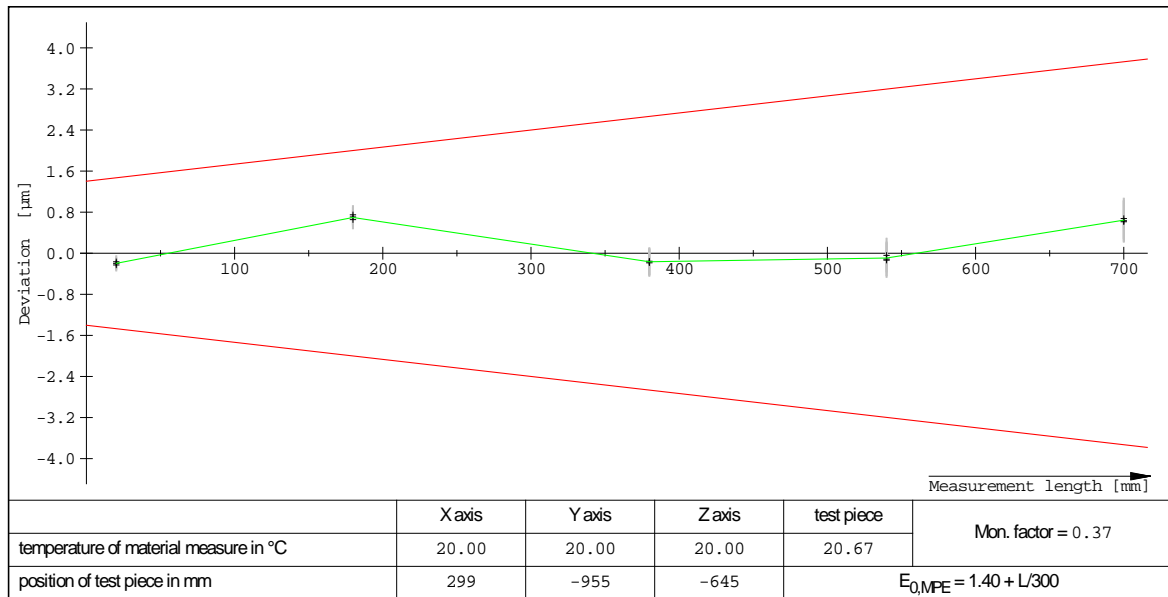
The maximum permissible indication error amounts to:

$$MPE_{E_0} = \pm (A + L/K) \leq B \quad (L \text{ in mm})$$

$$MPE_{E_0} = \pm (1.40 + L/300) \quad \mu\text{m}$$

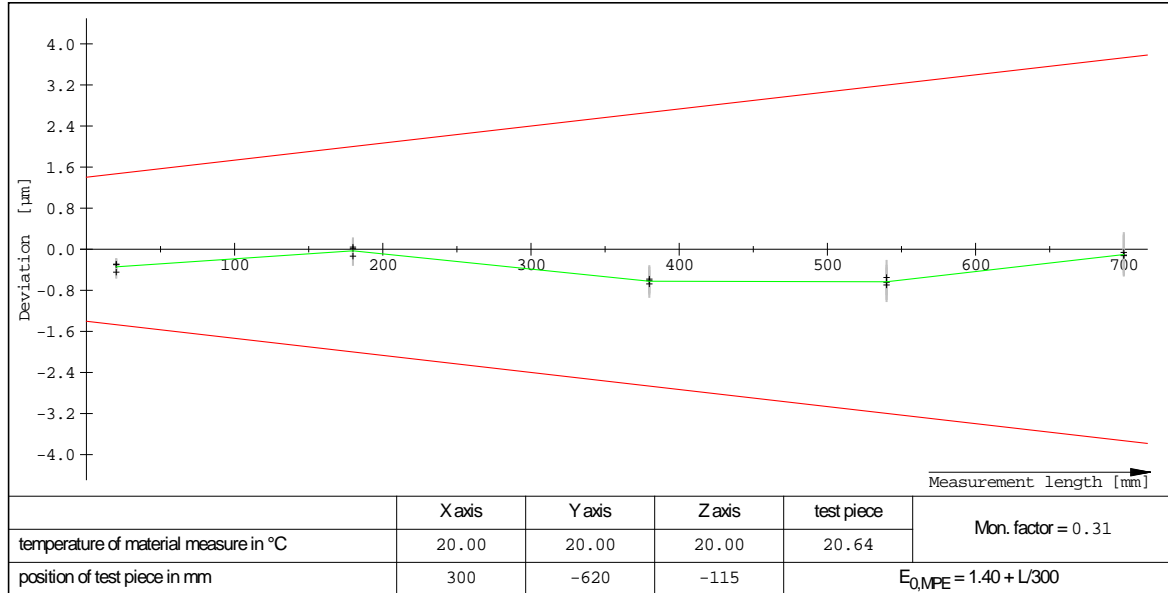
The measured results were determined with a stylus $L = 94 \text{ mm}$ and $D = 12.0 \text{ mm}$.

indication error in pos. 1 (X axis (bottom))



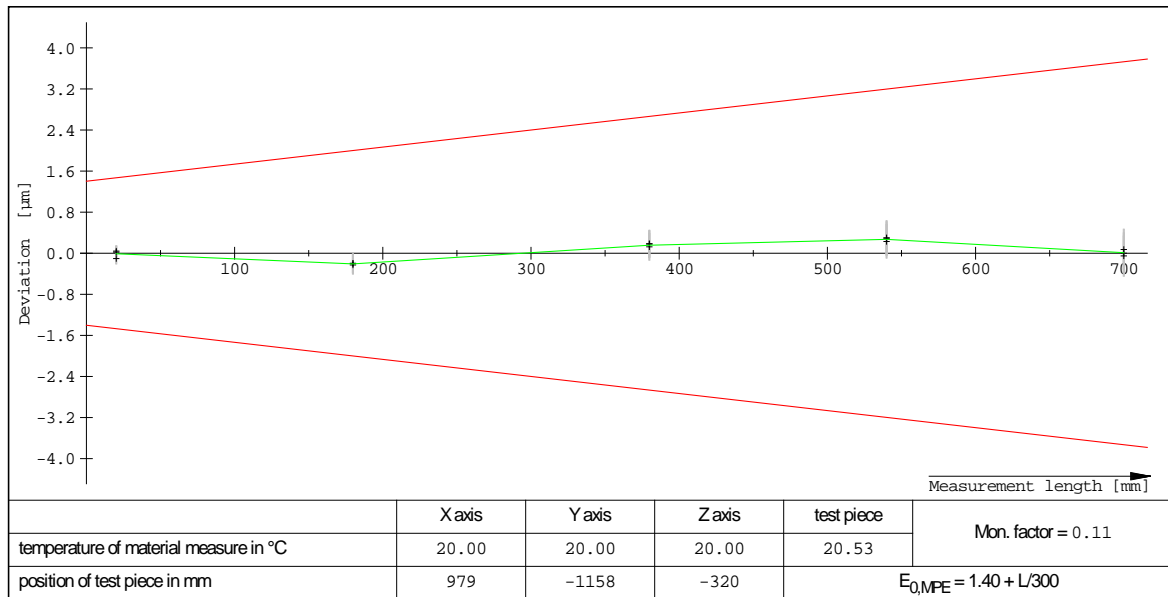
Measuring length L in mm		Deviations in mm		
nominal value	actual value	mean value	minimum	maximum
20.0045	20.0043	-0.0002	-0.0002	-0.0002
179.9338	179.9345	0.0007	0.0007	0.0007
379.9153	379.9152	-0.0002	-0.0002	-0.0002
539.8482	539.8481	-0.0001	-0.0001	0.0000
699.9049	699.9055	0.0006	0.0006	0.0007

indication error in pos. 2 (X axis (top))



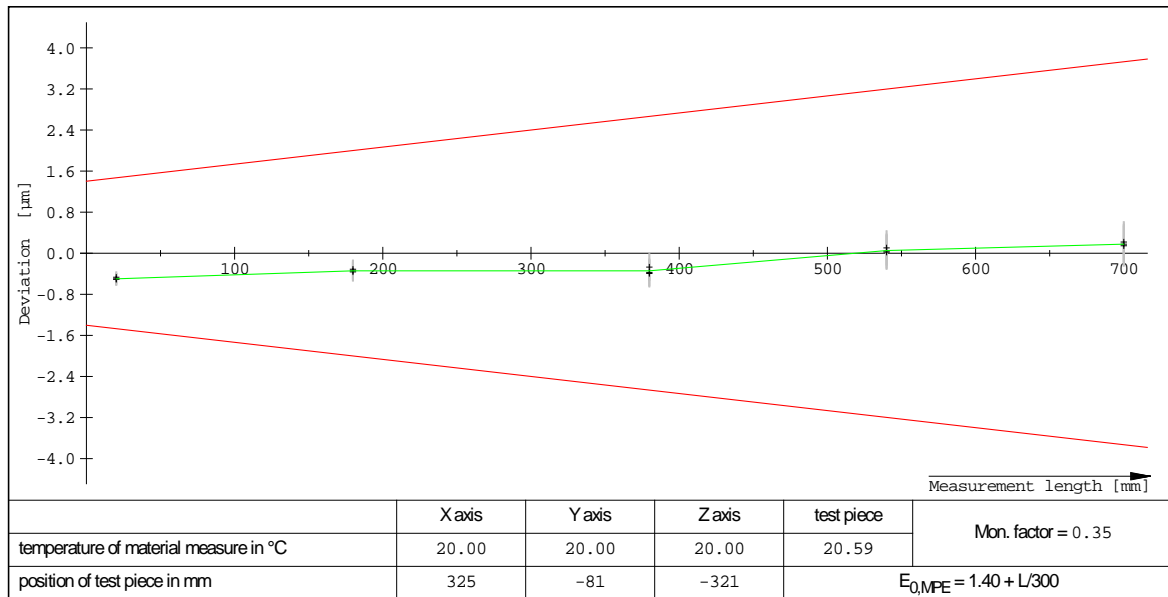
Measuring length L in mm		Deviations in mm		
nominal value	actual value	mean value	minimum	maximum
20.0045	20.0042	-0.0003	-0.0004	-0.0003
179.9338	179.9338	0.0000	-0.0001	0.0000
379.9153	379.9147	-0.0006	-0.0007	-0.0006
539.8482	539.8476	-0.0006	-0.0007	-0.0006
699.9049	699.9048	-0.0001	-0.0001	-0.0001

indication error in pos. 3 (Y axis (front-right))



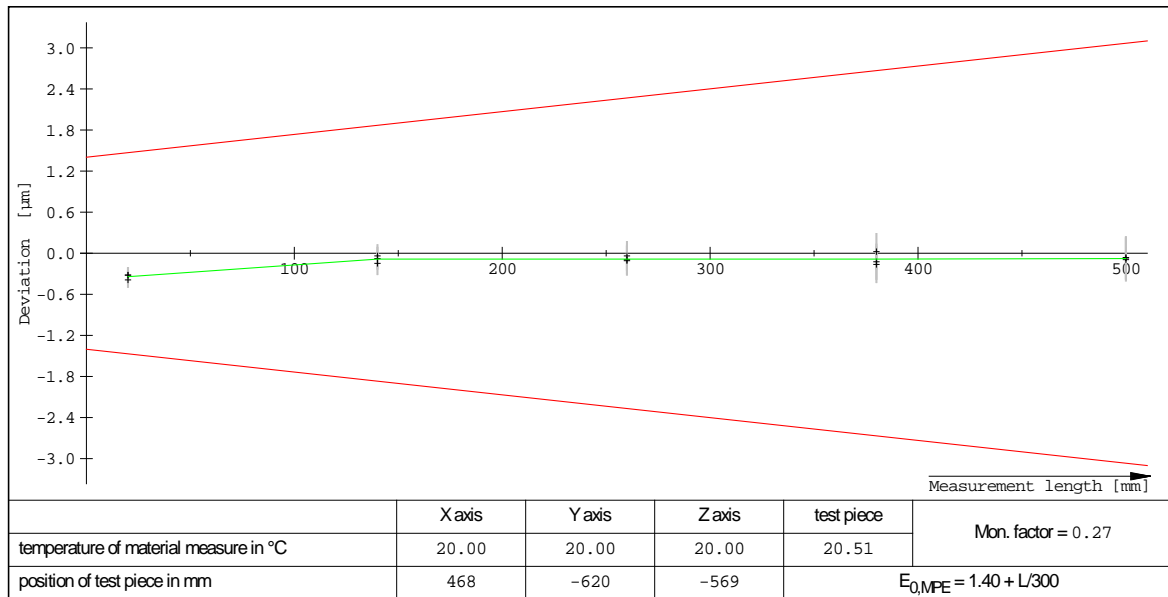
Measuring length L in mm		Deviations in mm		
nominal value	actual value	mean value	minimum	maximum
20.0045	20.0045	0.0000	-0.0001	0.0000
179.9338	179.9336	-0.0002	-0.0002	-0.0002
379.9153	379.9155	0.0002	0.0001	0.0002
539.8482	539.8485	0.0003	0.0002	0.0003
699.9049	699.9049	0.0000	-0.0001	0.0001

indication error in pos. 4 (Y axis (rear-left))



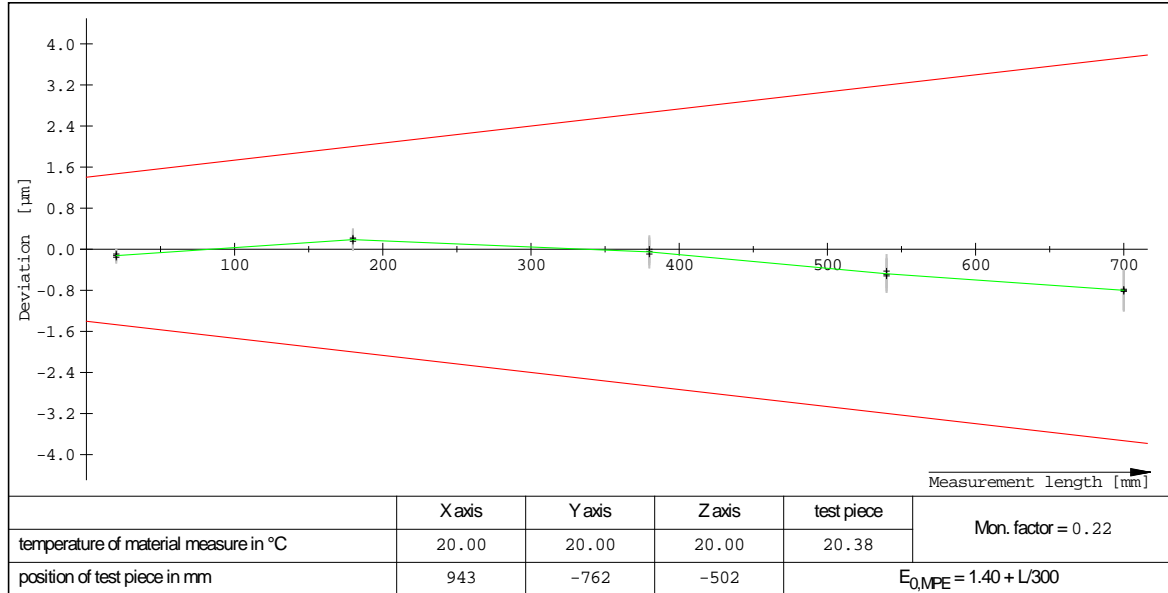
Measuring length L in mm		Deviations in mm		
nominal value	actual value	mean value	minimum	maximum
20.0045	20.0040	-0.0005	-0.0005	-0.0005
179.9338	179.9335	-0.0003	-0.0004	-0.0003
379.9153	379.9150	-0.0003	-0.0004	-0.0003
539.8482	539.8483	0.0001	0.0000	0.0001
699.9049	699.9050	0.0002	0.0001	0.0002

indication error in pos. 5 (Z axis)



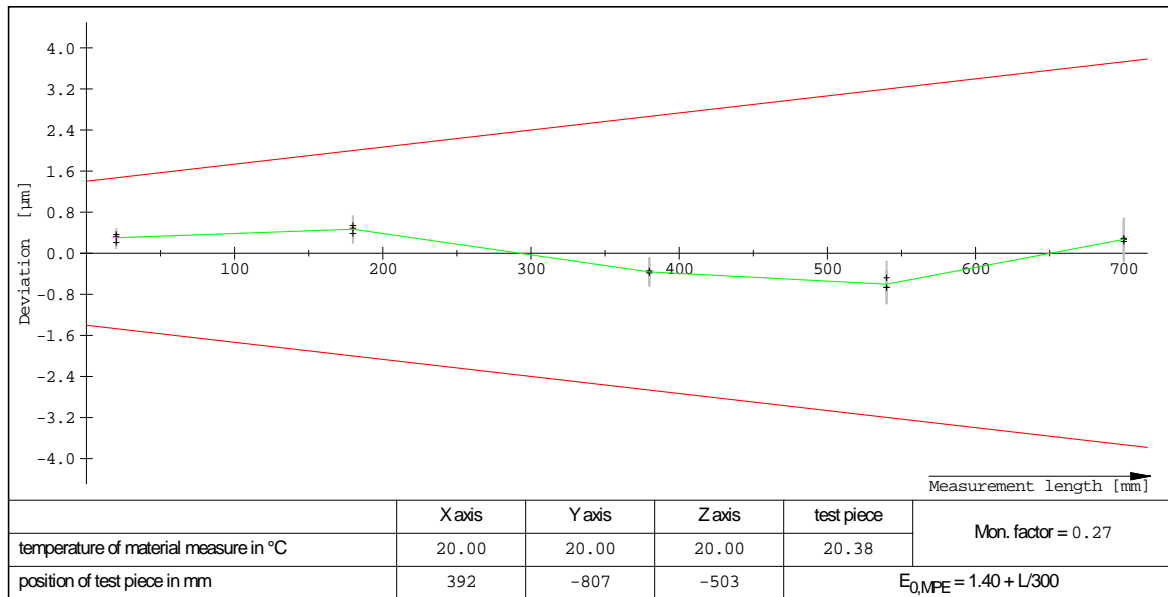
Measuring length L in mm		Deviations in mm		
nominal value	actual value	mean value	minimum	maximum
20.0045	20.0042	-0.0003	-0.0004	-0.0003
139.9404	139.9403	-0.0001	-0.0001	0.0000
259.9603	259.9602	-0.0001	-0.0001	0.0000
379.9153	379.9152	-0.0001	-0.0002	0.0000
499.9018	499.9017	-0.0001	-0.0001	-0.0001

indication error in pos. 6 (Spatial (front-right))



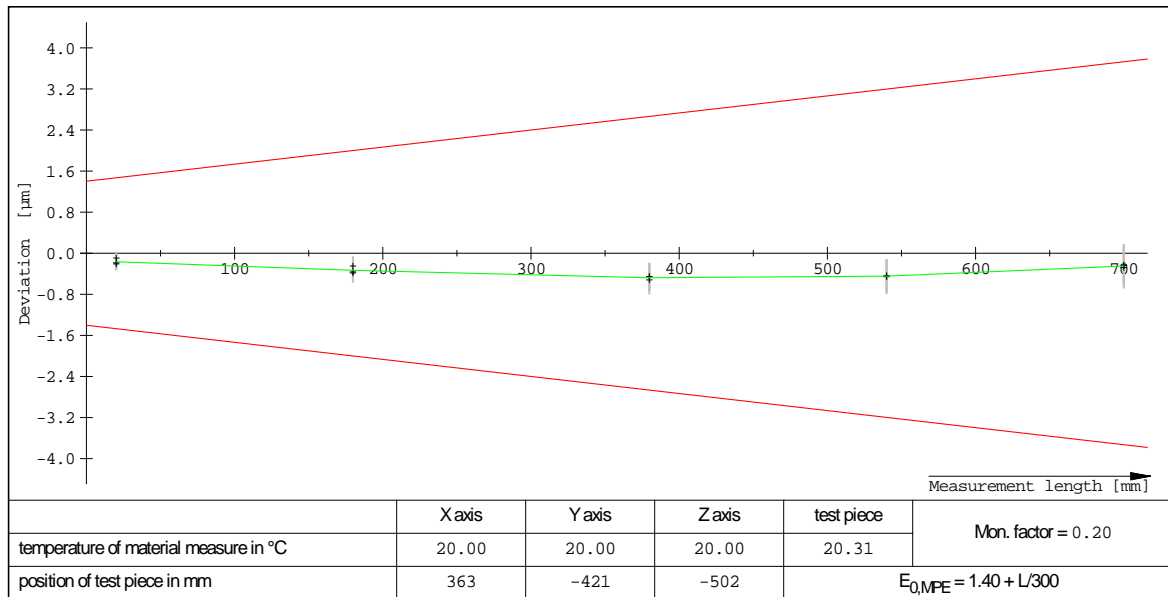
Measuring length L in mm		Deviations in mm		
nominal value	actual value	mean value	minimum	maximum
20.0045	20.0044	-0.0001	-0.0002	-0.0001
179.9338	179.9340	0.0002	0.0002	0.0002
379.9153	379.9153	0.0000	-0.0001	0.0000
539.8482	539.8478	-0.0005	-0.0005	-0.0004
699.9049	699.9041	-0.0008	-0.0008	-0.0008

indication error in pos. 7 (Spatial (front-left))



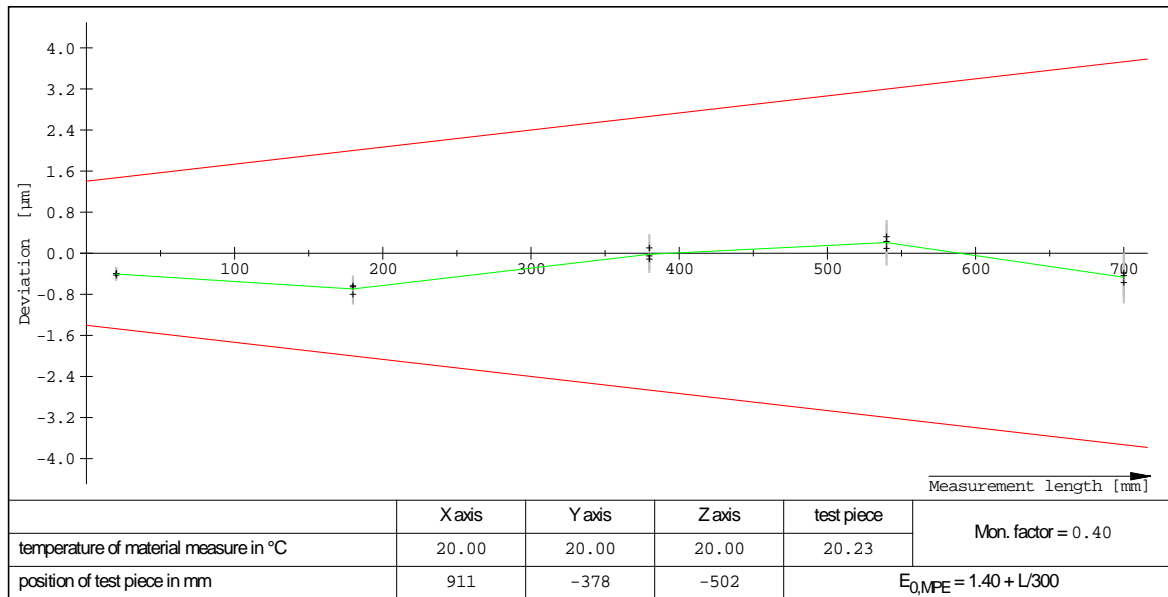
Measuring length L in mm		Deviations in mm		
nominal value	actual value	mean value	minimum	maximum
20.0045	20.0048	0.0003	0.0002	0.0004
179.9338	179.9343	0.0005	0.0004	0.0005
379.9153	379.9150	-0.0004	-0.0004	-0.0003
539.8482	539.8476	-0.0006	-0.0007	-0.0005
699.9049	699.9051	0.0003	0.0002	0.0003

indication error in pos. 8 (Spatial (rear-left))



Measuring length L in mm		Deviations in mm		
nominal value	actual value	mean value	minimum	maximum
20.0045	20.0044	-0.0002	-0.0002	-0.0001
179.9338	179.9335	-0.0003	-0.0004	-0.0003
379.9153	379.9148	-0.0005	-0.0005	-0.0005
539.8482	539.8478	-0.0004	-0.0005	-0.0004
699.9049	699.9046	-0.0002	-0.0003	-0.0002

indication error in pos. 9 (Spatial (rear-right))



Measuring length L in mm		Deviations in mm		
nominal value	actual value	mean value	minimum	maximum
20.0045	20.0041	-0.0004	-0.0004	-0.0004
179.9338	179.9331	-0.0007	-0.0008	-0.0006
379.9153	379.9153	0.0000	-0.0001	0.0001
539.8482	539.8485	0.0002	0.0001	0.0003
699.9049	699.9044	-0.0005	-0.0006	-0.0004

4.2 Probing error P_{FTU}

The following ceramic sphere was used to determine the probing error:

GCS number: E57 valid to 2021-06-12

The max. permissible value : **1.4 μm**

Measured value: **$P_{FTU} = (0.4 \pm 0.09) \mu\text{m}$**

Position of test object: X = 483mm Y = -750mm Z = -408mm

Temperature of test object in °C: 19.80

The measured results were determined with a stylus L = 94 mm and a D of 12.0 mm.

4.3 Scanning probing error THP and scanning test duration

The following ceramic sphere was used to determine scanning probing error THP and the scanning test duration:

GCS number: E57 valid to 2021-06-12

The max. permissible value for scanning probing error THP: **2.4 μm**

The measured value of the : **THP = (1.7 \pm 0.09) μm**

The max. permissible value for the scanning test duration is: **29 s *)**

The measured value : **= (26 \pm 0.90) s *)**

Position of test object: X = 483mm Y = -750mm Z = -408mm

Temperature of test object in °C: 19.89

The measured results were determined with a stylus L = 50 mm and a D of 3.0 mm.

*) NOTE: This measurement is outside the scope of this laboratory's A2LA scope of accreditation

4.4 Roundness form measurement error RONT (MZCI)

The following master ring is used to determine roundness form measurement error **RONT (MZCI)**:

GCS number: E11 valid to 2023-01-22

Max. permissible roundness error: $t = 1.7 \mu\text{m}$

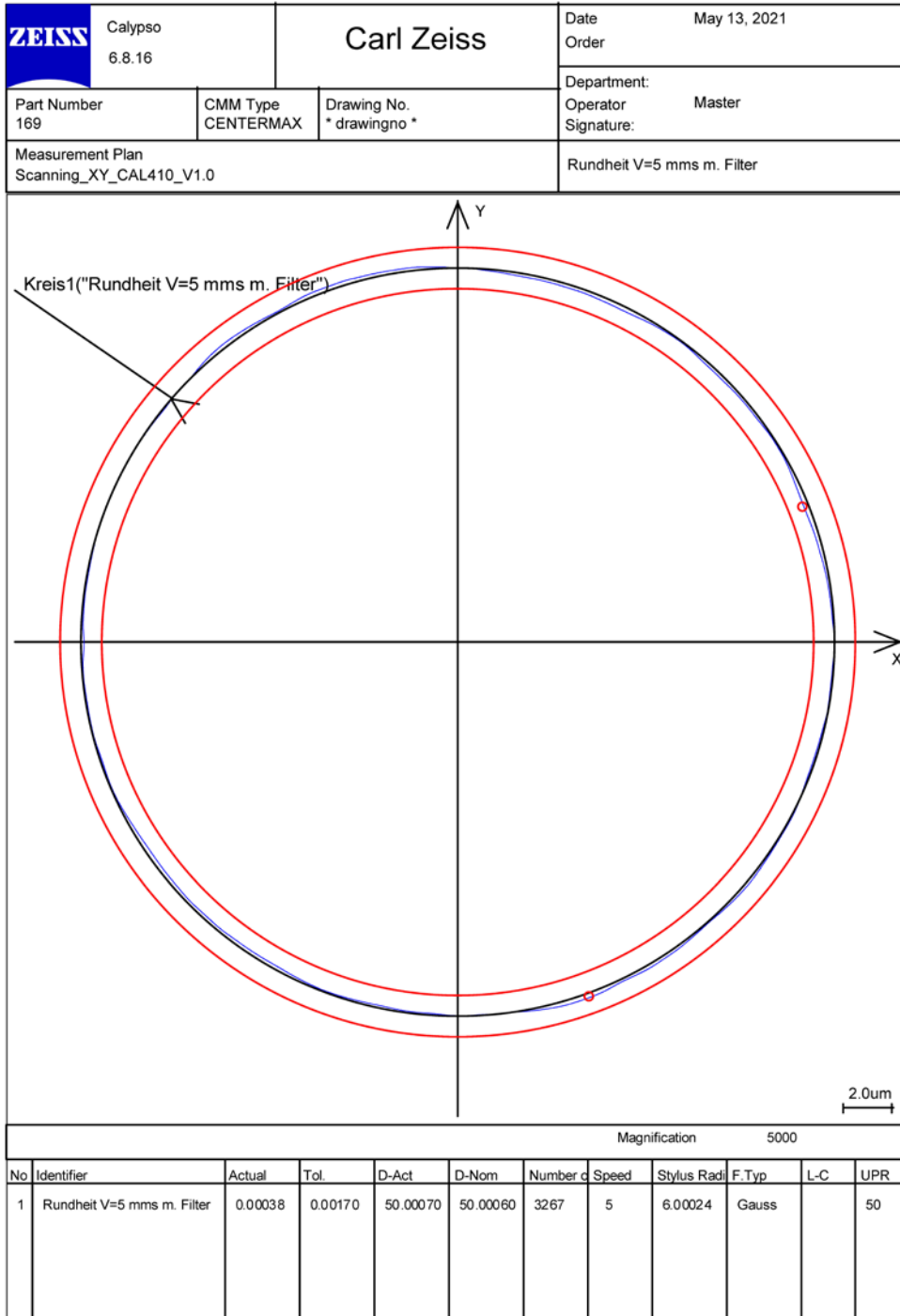
Measurement results:

In the X/Y plane: $t = (0.4 \pm 0.14) \mu\text{m}$ ($T = 20.6^\circ\text{C}$; stylus L = 94mm and D = 12.0mm)

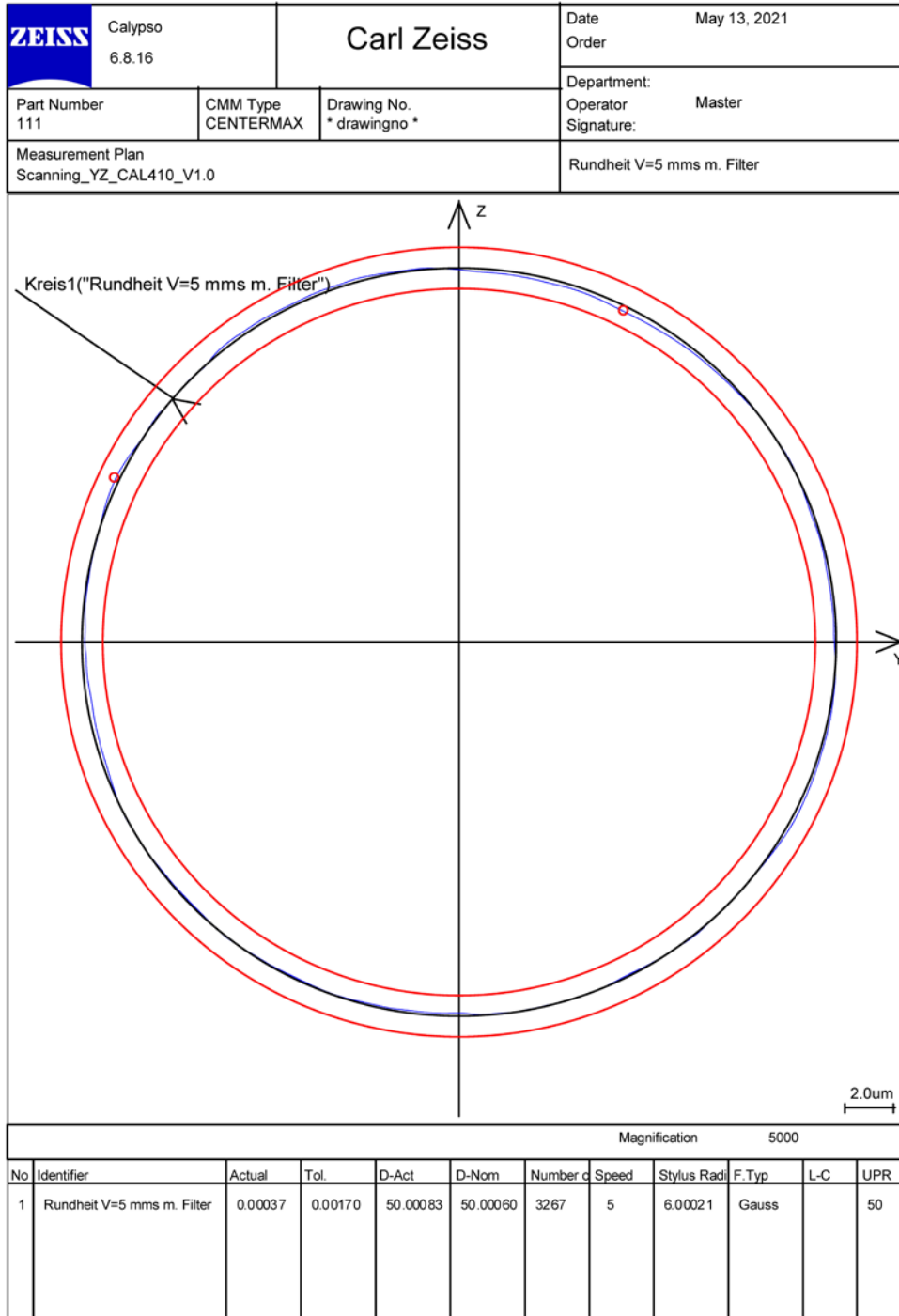
In the X/Z plane: $t = (0.5 \pm 0.14) \mu\text{m}$ ($T = 20.4^\circ\text{C}$; stylus L = 94mm and D = 12.0mm)

In the Y/Z plane: $t = (0.4 \pm 0.14) \mu\text{m}$ ($T = 20.5^\circ\text{C}$; stylus L = 94mm and D = 12.0mm)

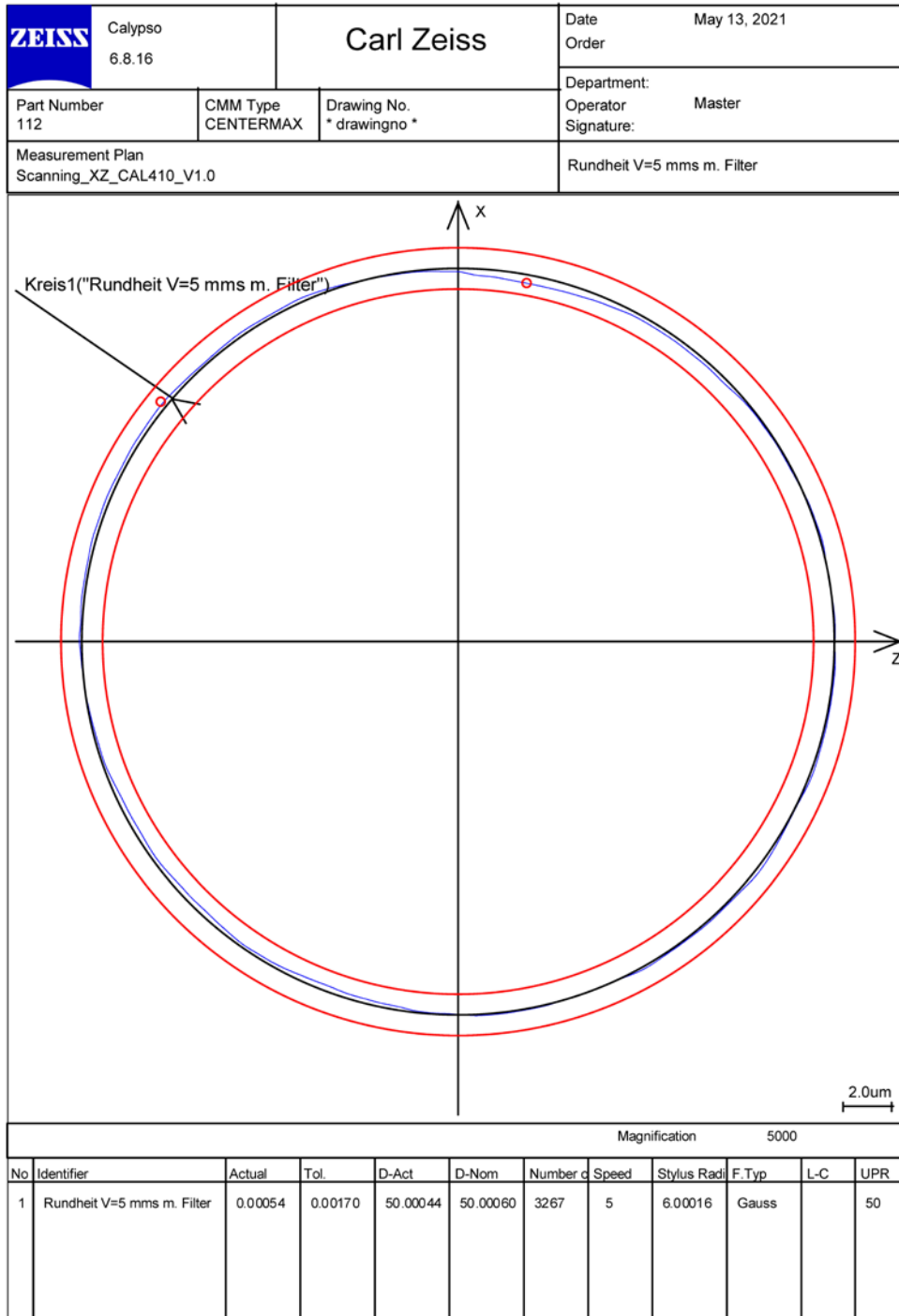
Roundness form measurement error RONt (MZCI) XY-Plane



Roundness form measurement error RONt (MZCI) YZ-Plane



Roundness form measurement error RONT (MZCI) XZ-Plane



5. Measuring uncertainty

The greatest measuring uncertainty experienced during calibration is reported on page 1 of the calibration certificate.

Zero Guard Banding: Uncertainty of measurement was not factored when determining compliance to relevant specifications.

The uncertainty of measurement represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $K=2$. The probability that the value of the measured variable will lie within the allocated value interval is 95%.

6. Certificate of conformity

If confirmed below, the coordinate measuring machine fulfills the specified requirements. The performance of the coordinate measuring machine has been calibrated according to the relevant specifications.

[The coordinate measuring machine meets the original manufacturer's specification.](#)

7. Opinions / Interpretations resulting from calibration

Refer to the following Appendices:

1. Appendix A for MPE_{PFTU} results
2. Appendix B for MPE_{THP} results



ZEISS CALYPSO

6.8.16

Part name	MPE-P-C44-V070523-DuraMax		
Drawing number			
Order number	Appendix A	Last 1 measurements ▶ Approval ≠ Blocked	
Variant			
Company		Part id	n.a93
Department		Time/Date	5/13/2021 2:59 PM
CMM Type	CENTERMAX	Run	All Characteristics
CMM No.	135391	No. measured values	37
Operator	Master	No. values: red	0
Text	<input type="text"/>	Measurement Duration	00:01:36.0

Name	Measured value	Nominal value	+Tol	-Tol	Deviation +/-
^Temperature Compensation	19.80				
Temperature AVG START	19.79960	0.00000			19.79960
MPE-P Value	0.00036	0.00000	0.00140	-0.00140	0.00036
X	483.29225	0.00000			483.29225
Y	-750.85329	0.00000			-750.85329
Z	-408.10216	0.00000			-408.10216
Time	64.00000	64.00000			0.00000
TimePerProbing	2.60000	2.60000			0.00000
Minimaler Radius	12.49765	12.49798	0.00250	-0.00250	-0.00033
Maximaler Radius	12.49801	12.49798	0.00250	-0.00250	0.00004
Radii(1)	12.49784	12.49798	0.00140	-0.00140	-0.00013
Radii(2)	12.49787	12.49798	0.00140	-0.00140	-0.00010
Radii(3)	12.49794	12.49798	0.00140	-0.00140	-0.00004
Radii(4)	12.49790	12.49798	0.00140	-0.00140	-0.00007
Radii(5)	12.49775	12.49798	0.00140	-0.00140	-0.00023
Radii(6)	12.49780	12.49798	0.00140	-0.00140	-0.00018
Radii(7)	12.49790	12.49798	0.00140	-0.00140	-0.00007
Radii(8)	12.49765	12.49798	0.00140	-0.00140	-0.00033
Radii(9)	12.49773	12.49798	0.00140	-0.00140	-0.00025
Radii(10)	12.49792	12.49798	0.00140	-0.00140	-0.00005
Radii(11)	12.49781	12.49798	0.00140	-0.00140	-0.00017
Radii(12)	12.49796	12.49798	0.00140	-0.00140	-0.00001
Radii(13)	12.49788	12.49798	0.00140	-0.00140	-0.00010
Radii(14)	12.49789	12.49798	0.00140	-0.00140	-0.00009



ZEISS CALYPSO

6.8.16

Part name **MPE-P-C44-V070523-DuraMax**
 Order number Appendix A
 Part ident n.a93
 Operator Master
 Time/Date 5/13/2021 2:59 PM

Name	Measured value	Nominal value	+Tol	-Tol	Deviation +/-	
Radii(15)	12.49788	12.49798	0.00140	-0.00140	-0.00010	
Radii(16)	12.49775	12.49798	0.00140	-0.00140	-0.00022	
Radii(17)	12.49780	12.49798	0.00140	-0.00140	-0.00018	
Radii(18)	12.49789	12.49798	0.00140	-0.00140	-0.00008	
Radii(19)	12.49801	12.49798	0.00140	-0.00140	0.00004	
Radii(20)	12.49785	12.49798	0.00140	-0.00140	-0.00013	
Radii(21)	12.49782	12.49798	0.00140	-0.00140	-0.00016	
Radii(22)	12.49770	12.49798	0.00140	-0.00140	-0.00028	
Radii(23)	12.49778	12.49798	0.00140	-0.00140	-0.00020	
Radii(24)	12.49786	12.49798	0.00140	-0.00140	-0.00012	
Radii(25)	12.49787	12.49798	0.00140	-0.00140	-0.00011	
Temperature AVG END	19.81350	0.00000			19.81350	
Roundness1	0.00029	0.00000	0.00140	0.00000	0.00029	



ZEISS CALYPSO

6.8.16

Part name **MPE-THP-C46-V0804010-DuraMax**
 Drawing number VAST __VAST Speed: 25/25
 Order number Appendix B
 Variant
 Company
 Department
 CMM Type CENTERMAX
 CMM No. 135391
 Operator Master
 Text

Last 1 measurements
 ► Approval ≠ Blocked

Part id 273
 Time/Date 5/13/2021 3:02 PM
 Run All Characteristics
 No. measured values 14
 No. values: red 0
 Measurement Duration 00:00:57.0

Name	Measured value	Nominal value	+Tol	-Tol	Deviation +/-
^Temperature Compensation	19.89				
Temperature AVG START	19.89485	0.00000			19.89485
DIN EN ISO 10360-4					
Result 1: MPE-THP	0.00166	0.00240	0.00000	-0.00240	-0.00074
Result 2: MPTtau	26.00000	29.00000	0.00000	-29.00000	-3.00000
DIN EN ISO 10360-4 ► Service Information					
Form error 'Sphere THP' filtered	0.00166	0.00000	0.00240	0.00000	0.00166
Form error 'Sphere THP' unfiltered	0.00593	0.00000	1000.00000	0.00000	0.00593
Rnom-Ract	0.00116	0.00000	2.40000		0.00116
R_min	12.49682	12.49798	0.00240	-0.00240	-0.00116
R_max	12.49887	12.49798	0.00240	-0.00240	0.00090
Diameter Sphere THP	24.99491	24.99595			-0.00104
X-Value 'Sphere THP'	483.29197	0.00000			483.29197
Y-Value 'Sphere THP'	-750.85457	0.00000			-750.85457
Z-Value 'Sphere THP'	-408.10187	0.00000			-408.10187
Temperature AVG - END	19.90680	0.00000			19.90680