Mitutoyo (Schweiz) AG
Steinackerstrasse 35
8902 Urdorf

Von der Schweizerischen Akkreditierungsstelle akkreditierte Kalibrierstelle
Laboratoire d'étalonnage accrédité par le Service d'Accréditation Suisse
Calibration Laboratory accredited by the Swiss Accreditation Service

Akkreditierungs-Nr.
No d'accréditation
Accreditation No.

**SCS 0074**

The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

**Zertifikat Nr.**
**No du certificat**
**Certificat No.**

17-4Q26



Kunde / Zuständig
Client / Responsable
Customer / Responsible

Messtec GmbH / Herr Oecalan

# SCS KALIBRIERZERTIFIKAT CERTIFICAT D'ETALONNAGE CALIBRATION CERTIFICATE SCS

Gegenstand / Hersteller / Typ
Object / Fabricant / Type
Object / Manufacturer / Model

Bildverarbeitungsmessgerät / Mitutoyo / QV Apex 404 Pro TP

Serien Nr. / Inv. Nr.
No de série / No d'inv.
Serial No. / Inv. Nr.

003371103 / 067 17 002

Bemerkungen
Remarques
Remarks

Auftragsnummer
No de commande
No. of command

120917-4Q26

Ort der Kalibrierung
Lieu de l'étalonnage
Place of Calibration

Messraum

Datum der Kalibrierung
Date de l'étalonnage
Date of Calibration

12. 09. 2017

Dieses Kalibrierzertifikat dokumentiert die Rückverfolgbarkeit auf nationale Normale zur Darstellung der physikalischen Einheiten (SI).
Ce certificat d'étalonnage confirme le raccordement aux étalons nationaux qui matérialisent les grandeurs physiques (SI).
This calibration certificate documents the traceabillty to national standards, which realize the physical units of measurements (SI).

Messresultate, Messunsicherheiten mit Vertrauensbereich und Messverfahren sind auf den folgenden Seiten aufgeführt und sind Teil des Zertifikates.
Les résultats, les incertitudes avec le niveau de confiance et les méthodes de mesure sont donnés aux pages suivantes et font partie du certificat.
Measurements, uncertainties with confidence probability and calibration methods are given on the following pages and are part of the certificate.

Dieses Kalibrierzertifikat darf ohne die schriftliche Zustimmung des Laboratoriums nicht auszugsweise vervielfältigt werden.
Ce certificat d'étalonnage ne doit pas être reproduit, sinon en entier, sans l'autorisation écrite du laboratoire.
This calibration certificate shall not be reproduced except in full, without written approval of the laboratory.

| Stempel und Datum<br>Timbre et date<br>Stamp and date | Der Prüfer<br>Operateur<br>Inspector | Leiter der Kalibrierstelle<br>Chef du laboratoire d'étalonnage<br>Head of the Calibration Laboratory |
|---|---|---|
| Urdorf, 12. September 2017 | Stefan Widmer | Daniel Wiederkehr |

## INHALTSVERZEICHNIS


| | |
|---|---|
| Seite 1 | Protokolldaten / Rückverfolgbarkeit |
| Seite 2 | Inhaltsverzeichnis / Zusammenfassung |
| Seite 3 | Kalibrierverfahren |
| Seite 4 | Messergebnisse: Übersicht (Zusammenfassung) |
| Seite 5 - 14 | Messergebnisse: Detaillierte Messergebnisse |


## ZUSAMMENFASSUNG

### Gerätebeschreibung

CNC gesteuertes Bildverarbeitungsmesssystem

| | |
|---|---|
| Typ: | QV Apex 404 Pro TP |
| Messbereich: | X 400 mm Y 400 mm Z 250 mm |
| Auflösung: | 0.1 µm |

**Grenzwerte** (Mitutoyo Spezifikationen)

Umgebungsbedingungen

| | |
|---|---|
| Temperatur | 19 - 21°C |

Unidirektionale Längenmessabweichung in XY

$E_{UXY,MPE} = \pm (2.0\ \mu m + 4.0 \cdot 10^{-6} \cdot L)$

Unidirektionale Längenmessabweichung in Z

$E_{UZ,MPE} = \pm (1.5\ \mu m + 4.0 \cdot 10^{-6} \cdot L)$

# KALIBRIERVERFAHREN

## Grundlage

Management-System der SCS Kalibrierstelle 0074 Kapitel, K08-KV-11

## Verwendete Messmittel und Normale

| Messgrösse | Normal / Serien Nr. | Bereich / Unsicherheit | Kalibrierschein / Nr. |
|---|---|---|---|
| $E_{UXY}$ | Glasmassstab 400 mm / 32 | 400 mm / 0.08 µm + 1.0 x $10^{-6}$ x $L_S$ | RvA K 086 / T-00389186 |
| $E_{UZ}$ | Keramik-Endmasssatz 20 mm bis 200 mm / QV-002 | 200 mm / (03+1.0 · L) µm, L in m x $10^{-6}$ x $L_S$ | SCS 030 / 302678 |
| Temp.°C | Thermo Hygrometer Almemo 2390-8 / H05030038 | 16°C - 24°C / (0.1+0.01rF) %rF / 0.03°C | SCS 066 / 2017-570 |

## Überprüfung der unidirektionalen Längenmessabweichung

Für die $E_{UXY}$-Messungen wird das Normal zu der entsprechenden X- oder Y-Maschinenachse parallel ausgerichtet und zusätzlich bei 45° und 135° (diagonal) auf dem Maschinentisch gelegt und optisch mit der Kamera gemessen.
Für die $E_{UZ}$-Messungen werden Endmasse verwendet.
Ausgehend von der grösstmöglichen Testlänge in der Messlinie, werden mindestens 5 Messstufen festgelegt und mit mindestens drei Wiederholungen gemessen.

## MESSERGEBNISSE

Die Konformitätsaussagen auf den Messprotokollen zu diesem Zertifikat beurteilen die Übereinstimmung der Genauigkeit des KMG mit den Mitutoyo-Spezifikationen bezüglich der Parameter $E_{UXY}$ und $E_{UZ}$ gemäss der Norm EN ISO 10360-7. Bei diesen Konformitätsaussagen wurde die unten angegebene Messunsicherheit berücksichtigt.

### Messunsicherheit

Die Messunsicherheit beträgt für $U(E_{UXY,UZ}) = 0.4\ \mu m + 0.5 \cdot 10^{-6} \cdot L$. Angegeben ist die erweiterte Messunsicherheit, die sich aus der Standardmessunsicherheit durch Multiplikation mit dem Erweiterungsfaktor k = 2 ergibt. Sie setzt sich zusammen aus Anteilen des Prüflings, der Kalibiereinrichtung, des Messbereichs und den Umgebungsbedingungen. Die Messunsicherheit wurde gemäss der Norm ISO/TS 23165 ermittelt. Der Wert der Messgrösse liegt mit einer Wahrscheinlichkeit von 95% im zugeordneten Werteintervall.

### Temperaturen

| | |
|---|---|
| Temperatur Luft | 19.10 - 19.53°C |
| Temperatur Messtisch | 19.07 - 19.56°C |
| Temperatur Bezugsnormal | 19.10 - 19.22°C |

Bemerkung: Die Mitutoyo-Spezifikationen für die Umgebungsbedingungen wurden während der Kalibrierung in Bezug zur Temperatur erfüllt.

### Unidirektionale Längenmessabweichung in XY

$E_{UXY}$ siehe Protokollseiten 5 - 12

### Unidirektionale Längenmessabweichung in Z

$E_{UZ}$ siehe Protokollseiten 13 - 14

### Änderung der KMG Kompensation

Die Linear- und Winkelfehler- Kompensationsdaten, vor und nach der Kalibrierung, werden protokoliert und auf Verlangen nachgereicht.

*Wichtig:* Der Inhalt dieses Zertifikates darf nur in vollständiger Form veröffentlicht oder weitergegeben werden und bedarf der Genehmigung der ausstellenden Kalibrierstelle.

09/12/17

Measuring_Accuracy U1 3 Times Data_File: X_u1.tx.txt Instrumental_File: 32_15_320.ida S/N: 32
Comment: T1-3:19.10,19.07,19.10°C
Start_Position: 0.0 [mm] End_Position: 320.0 [mm]
Specification_Value: 1.60 + 3.50/1000.0 *L [um]

Average

| Nominal [mm] | Actual [mm] | Inst.Err [mm] | Deviation [mm] | Std.Deviation [um] | Max-Min [um] |
|---|---|---|---|---|---|
| 0.0 | -0.00001 | 0.00000 | -0.00001 | 0.06 | 0.20 |
| 40.0 | 39.99958 | -0.00039 | -0.00003 | 0.05 | 0.12 |
| 80.0 | 79.99913 | -0.00067 | -0.00020 | 0.12 | 0.28 |
| 160.0 | 159.99889 | -0.00093 | -0.00018 | 0.08 | 0.19 |
| 240.0 | 239.99874 | -0.00112 | -0.00014 | 0.15 | 0.37 |
| 320.0 | 319.99781 | -0.00198 | -0.00021 | 0.19 | 0.45 |

Pooled Standard Deviation = 0.12

No. 1 of 3

| Nominal [mm] | Actual [mm] | Inst.Err [mm] | Deviation [mm] | Result | -10.0 | 0.0 | 10.0 |
|---|---|---|---|---|---|---|---|
| 0.0 | 0.00000 | 0.00000 | 0.00000 | OK | \| | : O : | \| |
| 40.0 | 39.99962 | -0.00039 | 0.00001 | OK | \| | : O : | \| |
| 80.0 | 79.99919 | -0.00067 | -0.00014 | OK | \| | : O : | \| |
| 160.0 | 159.99882 | -0.00093 | -0.00025 | OK | \| | : O : | \| |
| 240.0 | 239.99873 | -0.00112 | -0.00015 | OK | \| | : O : | \| |
| 320.0 | 319.99788 | -0.00198 | -0.00014 | OK | \| | : O : | \| |
| 0.0 | -0.00001 | 0.00000 | -0.00001 | OK | \| | : O : | \| |

MaxError : 0.01 [um] MaxErrorPosition: 40.00 [mm]
MinError : -0.25 [um] MinErrorPosition: 160.00 [mm]
MaxSlopeError: -0.15 [um] MaxSlopePosition: 80.00 [mm] MaxSlopePitch: 40.0 [mm]

No. 2 of 3

| Nominal [mm] | Actual [mm] | Inst.Err [mm] | Deviation [mm] | Result | -10.0 | 0.0 | 10.0 |
|---|---|---|---|---|---|---|---|
| 0.0 | 0.00000 | 0.00000 | 0.00000 | OK | \| | : O : | \| |
| 40.0 | 39.99961 | -0.00039 | -0.00000 | OK | \| | : O : | \| |
| 80.0 | 79.99925 | -0.00067 | -0.00008 | OK | \| | : O : | \| |
| 160.0 | 159.99900 | -0.00093 | -0.00007 | OK | \| | : O : | \| |
| 240.0 | 239.99893 | -0.00112 | 0.00005 | OK | \| | : O : | \| |
| 320.0 | 319.99800 | -0.00198 | -0.00002 | OK | \| | : O : | \| |
| 0.0 | 0.00008 | 0.00000 | 0.00008 | OK | \| | : O : | \| |

MaxError : 0.08 [um] MaxErrorPosition: 0.00 [mm]
MinError : -0.08 [um] MinErrorPosition: 80.00 [mm]
MaxSlopeError: -0.08 [um] MaxSlopePosition: 80.00 [mm] MaxSlopePitch: 40.0 [mm]

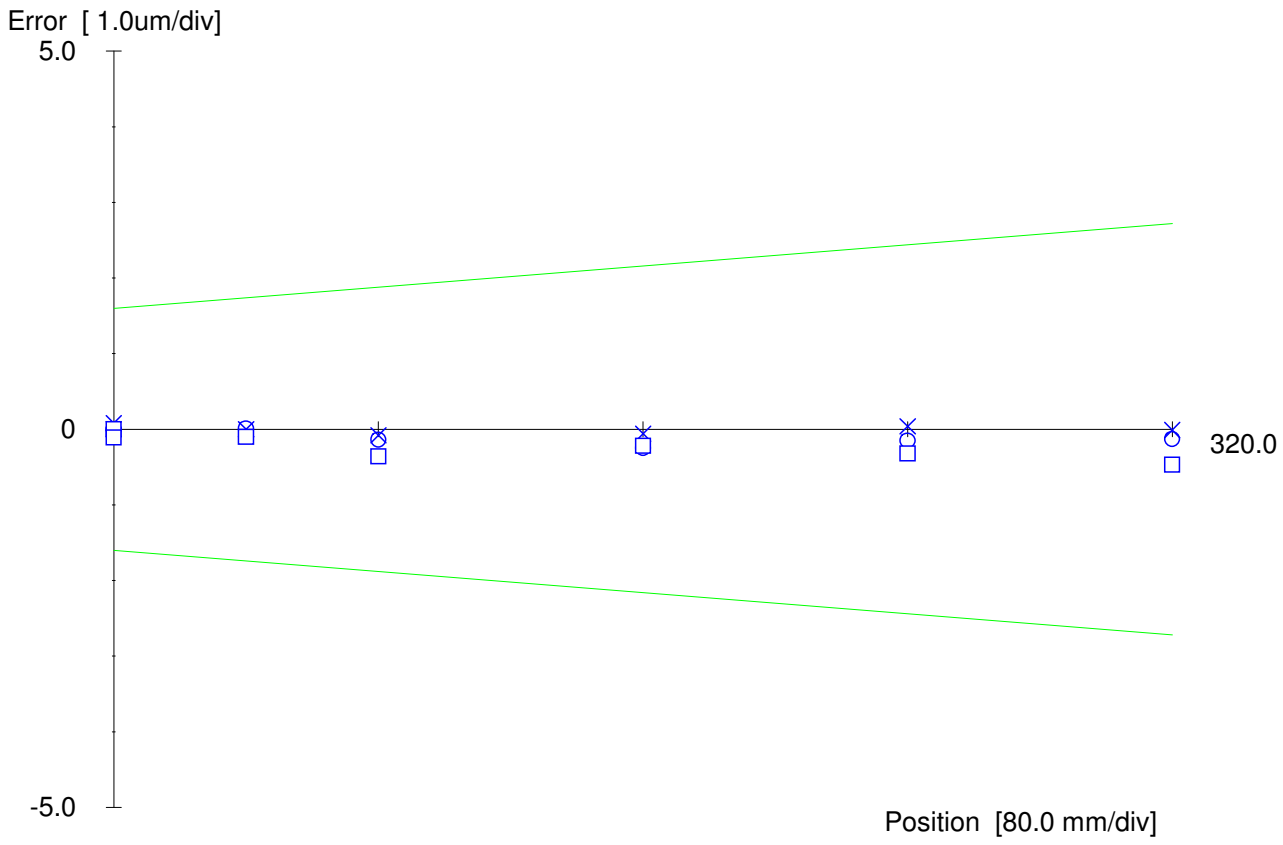
No. 3 of 3

| Nominal [mm] | Actual [mm] | Inst.Err [mm] | Deviation [mm] | Result | -10.0 | 0.0 | 10.0 |
|---|---|---|---|---|---|---|---|
| 0.0 | 0.00000 | 0.00000 | 0.00000 | OK | \| | : O : | \| |
| 40.0 | 39.99951 | -0.00039 | -0.00010 | OK | \| | : O : | \| |
| 80.0 | 79.99897 | -0.00067 | -0.00036 | OK | \| | : O : | \| |
| 160.0 | 159.99884 | -0.00093 | -0.00023 | OK | \| | : O : | \| |
| 240.0 | 239.99856 | -0.00112 | -0.00032 | OK | \| | : O : | \| |
| 320.0 | 319.99755 | -0.00198 | -0.00047 | OK | \| | : O : | \| |
| 0.0 | -0.00012 | 0.00000 | -0.00012 | OK | \| | : O : | \| |

MaxError : 0.00 [um] MaxErrorPosition: 0.00 [mm]
MinError : -0.47 [um] MinErrorPosition: 320.00 [mm]
MaxSlopeError: -0.26 [um] MaxSlopePosition: 80.00 [mm] MaxSlopePitch: 40.0 [mm]

09/12/17

Measuring_Accuracy U1 3 Times Data_File: X_u1.tx.txt Instrumental_File: 32_15_320.ida S/N: 32
Comment: T1-3:19.10,19.07,19.10°C
Specification_Value: 1.60 + 3.50/1000.0 *L [um]




○ :1Times × :2Times □ :3Times

09/12/17

Measuring_Accuracy U1 3 Times Data_File: Y_u1.txt Instrumental_File: 32_15_320.ida S/N: 32
Comment: T1-3:19.12,19.10,19.16°C,RF:50%
Start_Position: 0.0 [mm] End_Position: 320.0 [mm]
Specification_Value: 1.60 + 3.50/1000.0 *L [um]

Average

| Nominal [mm] | Actual [mm] | Inst.Err [mm] | Deviation [mm] | Std.Deviation [um] | Max-Min [um] |
|---|---|---|---|---|---|
| 0.0 | -0.00004 | 0.00000 | -0.00004 | 0.05 | 0.11 |
| 40.0 | 39.99946 | -0.00039 | -0.00015 | 0.04 | 0.10 |
| 80.0 | 79.99931 | -0.00067 | -0.00002 | 0.08 | 0.18 |
| 160.0 | 159.99910 | -0.00093 | 0.00003 | 0.04 | 0.10 |
| 240.0 | 239.99882 | -0.00112 | -0.00006 | 0.10 | 0.23 |
| 320.0 | 319.99771 | -0.00198 | -0.00031 | 0.03 | 0.08 |

Pooled Standard Deviation = 0.06

No. 1 of 3

| Nominal [mm] | Actual [mm] | Inst.Err [mm] | Deviation [mm] | Result | -10.0 | 0.0 | 10.0 |
|---|---|---|---|---|---|---|---|
| 0.0 | 0.00000 | 0.00000 | 0.00000 | OK | \| | : O : | \| |
| 40.0 | 39.99941 | -0.00039 | -0.00020 | OK | \| | : O : | \| |
| 80.0 | 79.99938 | -0.00067 | 0.00005 | OK | \| | : O : | \| |
| 160.0 | 159.99908 | -0.00093 | 0.00001 | OK | \| | : O : | \| |
| 240.0 | 239.99896 | -0.00112 | 0.00008 | OK | \| | : O : | \| |
| 320.0 | 319.99775 | -0.00198 | -0.00027 | OK | \| | : O : | \| |
| 0.0 | -0.00005 | 0.00000 | -0.00005 | OK | \| | : O : | \| |

MaxError : 0.08 [um] MaxErrorPosition: 240.00 [mm]
MinError : -0.27 [um] MinErrorPosition: 320.00 [mm]
MaxSlopeError: 0.25 [um] MaxSlopePosition: 80.00 [mm] MaxSlopePitch: 40.0 [mm]

No. 2 of 3

| Nominal [mm] | Actual [mm] | Inst.Err [mm] | Deviation [mm] | Result | -10.0 | 0.0 | 10.0 |
|---|---|---|---|---|---|---|---|
| 0.0 | 0.00000 | 0.00000 | 0.00000 | OK | \| | : O : | \| |
| 40.0 | 39.99945 | -0.00039 | -0.00016 | OK | \| | : O : | \| |
| 80.0 | 79.99920 | -0.00067 | -0.00013 | OK | \| | : O : | \| |
| 160.0 | 159.99916 | -0.00093 | 0.00009 | OK | \| | : O : | \| |
| 240.0 | 239.99873 | -0.00112 | -0.00015 | OK | \| | : O : | \| |
| 320.0 | 319.99771 | -0.00198 | -0.00031 | OK | \| | : O : | \| |
| 0.0 | -0.00011 | 0.00000 | -0.00011 | OK | \| | : O : | \| |

MaxError : 0.09 [um] MaxErrorPosition: 160.00 [mm]
MinError : -0.31 [um] MinErrorPosition: 320.00 [mm]
MaxSlopeError: -0.16 [um] MaxSlopePosition: 40.00 [mm] MaxSlopePitch: 40.0 [mm]

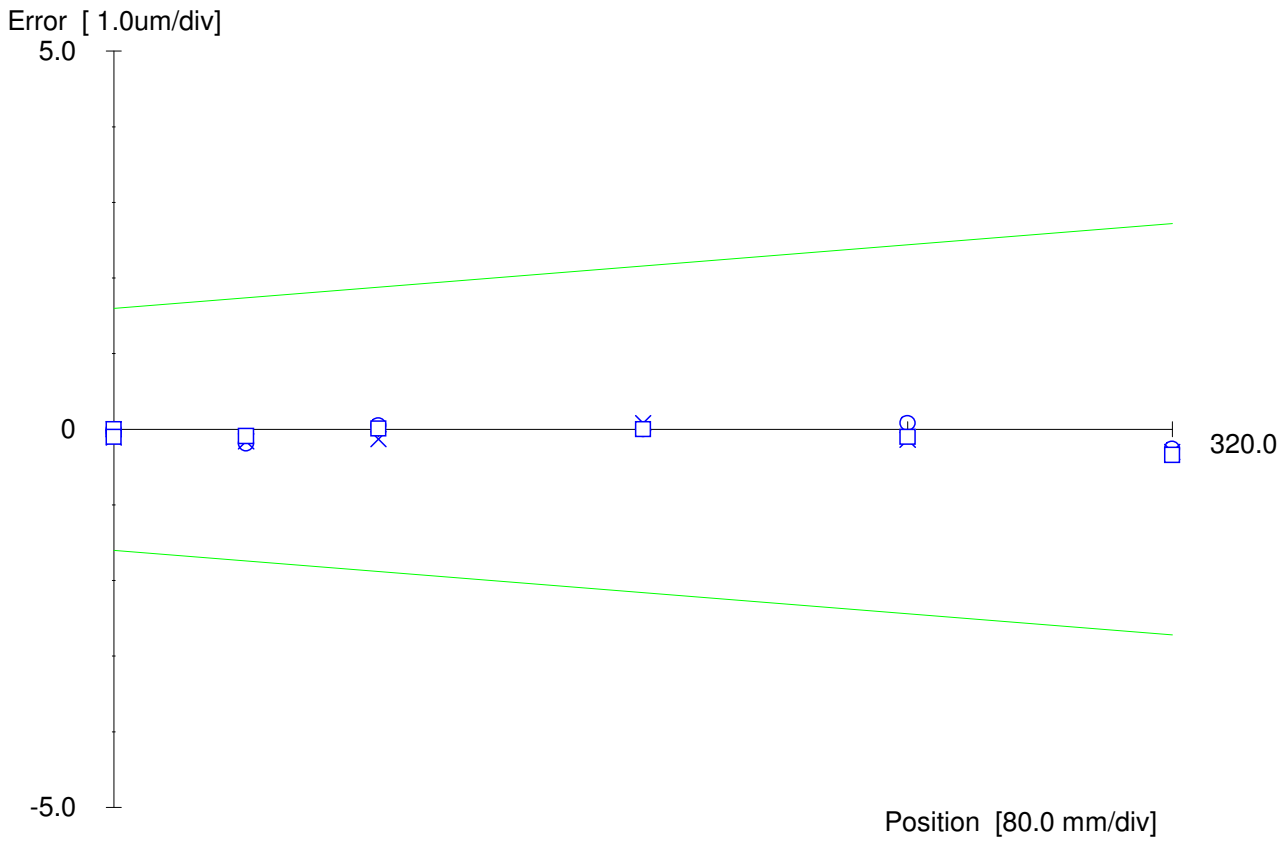
No. 3 of 3

| Nominal [mm] | Actual [mm] | Inst.Err [mm] | Deviation [mm] | Result | -10.0 | 0.0 | 10.0 |
|---|---|---|---|---|---|---|---|
| 0.0 | 0.00000 | 0.00000 | 0.00000 | OK | \| | : O : | \| |
| 40.0 | 39.99951 | -0.00039 | -0.00010 | OK | \| | : O : | \| |
| 80.0 | 79.99934 | -0.00067 | 0.00001 | OK | \| | : O : | \| |
| 160.0 | 159.99906 | -0.00093 | -0.00001 | OK | \| | : O : | \| |
| 240.0 | 239.99877 | -0.00112 | -0.00011 | OK | \| | : O : | \| |
| 320.0 | 319.99767 | -0.00198 | -0.00035 | OK | \| | : O : | \| |
| 0.0 | -0.00010 | 0.00000 | -0.00010 | OK | \| | : O : | \| |

MaxError : 0.01 [um] MaxErrorPosition: 80.00 [mm]
MinError : -0.35 [um] MinErrorPosition: 320.00 [mm]
MaxSlopeError: -0.24 [um] MaxSlopePosition: 320.00 [mm] MaxSlopePitch: 80.0 [mm]

09/12/17

Measuring_Accuracy U1 3 Times Data_File: Y_u1.txt Instrumental_File: 32_15_320.ida S/N: 32
Comment: T1-3:19.12,19.10,19.16°C,RF:50%
Specification_Value: 1.60 + 3.50/1000.0 *L [um]




○ :1Times × :2Times □ :3Times

09/12/17

Measuring_Accuracy U1 3 Times Data_File: L-R45_u1.txt Instrumental_File: 32_15_400_80.ida S/N: 32
Comment: T1-3:19.37,19.23,19.20°C,RF:49%
Start_Position: 0.0 [mm] End_Position: 400.0 [mm]
Specification_Value: 1.60 + 3.50/1000.0 *L [um]

Average

| Nominal [mm] | Actual [mm] | Inst.Err [mm] | Deviation [mm] | Std.Deviation [um] | Max-Min [um] |
|---|---|---|---|---|---|
| 0.0 | 0.00001 | 0.00000 | 0.00001 | 0.04 | 0.12 |
| 80.0 | 79.99868 | -0.00067 | -0.00065 | 0.14 | 0.30 |
| 160.0 | 159.99795 | -0.00093 | -0.00112 | 0.02 | 0.05 |
| 240.0 | 239.99740 | -0.00112 | -0.00148 | 0.08 | 0.18 |
| 320.0 | 319.99617 | -0.00198 | -0.00185 | 0.01 | 0.04 |
| 400.0 | 399.99705 | -0.00253 | -0.00042 | 0.11 | 0.27 |

Pooled Standard Deviation = 0.08

No. 1 of 3

| Nominal [mm] | Actual [mm] | Inst.Err [mm] | Deviation [mm] | Result | -10.0 | 0.0 | 10.0 |
|---|---|---|---|---|---|---|---|
| 0.0 | 0.00000 | 0.00000 | 0.00000 | OK | \| | : O : | \| |
| 80.0 | 79.99877 | -0.00067 | -0.00056 | OK | \| | : O : | \| |
| 160.0 | 159.99795 | -0.00093 | -0.00112 | OK | \| | :O\| : | \| |
| 240.0 | 239.99733 | -0.00112 | -0.00155 | OK | \| | :O \| : | \| |
| 320.0 | 319.99618 | -0.00198 | -0.00184 | OK | \| | :O \| : | \| |
| 400.0 | 399.99693 | -0.00253 | -0.00054 | OK | \| | : O : | \| |
| 0.0 | 0.00006 | 0.00000 | 0.00006 | OK | \| | : O : | \| |

MaxError : 0.06 [um] MaxErrorPosition: 0.00 [mm]
MinError : -1.84 [um] MinErrorPosition: 320.00 [mm]
MaxSlopeError: 1.30 [um] MaxSlopePosition: 400.00 [mm] MaxSlopePitch: 80.0 [mm]

No. 2 of 3

| Nominal [mm] | Actual [mm] | Inst.Err [mm] | Deviation [mm] | Result | -10.0 | 0.0 | 10.0 |
|---|---|---|---|---|---|---|---|
| 0.0 | 0.00000 | 0.00000 | 0.00000 | OK | \| | : O : | \| |
| 80.0 | 79.99847 | -0.00067 | -0.00086 | OK | \| | :O\| : | \| |
| 160.0 | 159.99792 | -0.00093 | -0.00115 | OK | \| | :O\| : | \| |
| 240.0 | 239.99737 | -0.00112 | -0.00151 | OK | \| | :O \| : | \| |
| 320.0 | 319.99615 | -0.00198 | -0.00187 | OK | \| | :O \| : | \| |
| 400.0 | 399.99702 | -0.00253 | -0.00045 | OK | \| | : O : | \| |
| 0.0 | 0.00003 | 0.00000 | 0.00003 | OK | \| | : O : | \| |

MaxError : 0.03 [um] MaxErrorPosition: 0.00 [mm]
MinError : -1.87 [um] MinErrorPosition: 320.00 [mm]
MaxSlopeError: 1.42 [um] MaxSlopePosition: 400.00 [mm] MaxSlopePitch: 80.0 [mm]

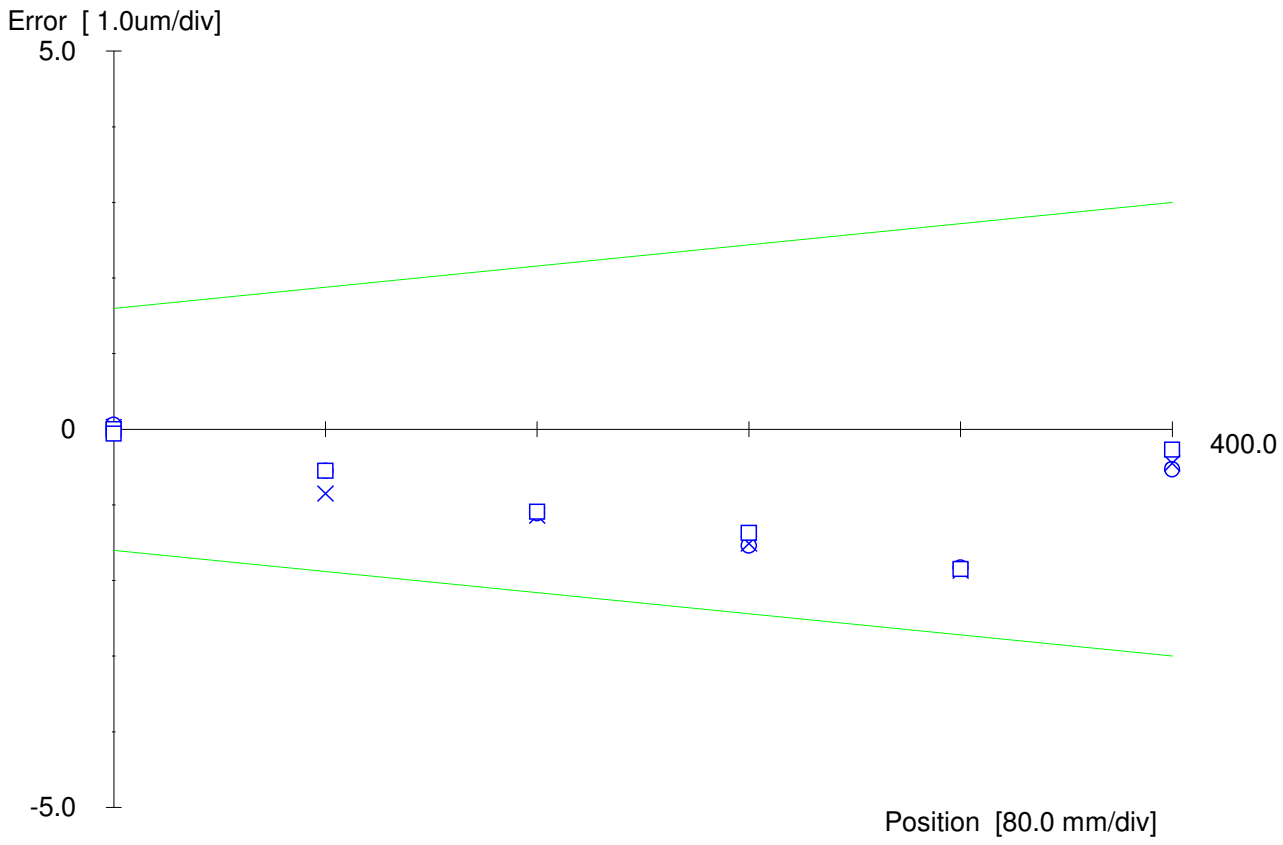
No. 3 of 3

| Nominal [mm] | Actual [mm] | Inst.Err [mm] | Deviation [mm] | Result | -10.0 | 0.0 | 10.0 |
|---|---|---|---|---|---|---|---|
| 0.0 | 0.00000 | 0.00000 | 0.00000 | OK | \| | : O : | \| |
| 80.0 | 79.99878 | -0.00067 | -0.00055 | OK | \| | : O : | \| |
| 160.0 | 159.99797 | -0.00093 | -0.00110 | OK | \| | :O\| : | \| |
| 240.0 | 239.99751 | -0.00112 | -0.00137 | OK | \| | :O \| : | \| |
| 320.0 | 319.99617 | -0.00198 | -0.00185 | OK | \| | :O \| : | \| |
| 400.0 | 399.99720 | -0.00253 | -0.00027 | OK | \| | : O : | \| |
| 0.0 | -0.00006 | 0.00000 | -0.00006 | OK | \| | : O : | \| |

MaxError : 0.00 [um] MaxErrorPosition: 0.00 [mm]
MinError : -1.85 [um] MinErrorPosition: 320.00 [mm]
MaxSlopeError: 1.58 [um] MaxSlopePosition: 400.00 [mm] MaxSlopePitch: 80.0 [mm]

09/12/17

Measuring_Accuracy U1 3 Times Data_File: L-R45_u1.txt Instrumental_File: 32_15_400_80.ida S/N: 32
Comment: T1-3:19.37,19.23,19.20°C,RF:49%
Specification_Value: 1.60 + 3.50/1000.0 *L [um]




○ :1Times × :2Times □ :3Times

09/12/17

Measuring_Accuracy U1 3 Times Data_File: R-L135_u1.txt Instrumental_File: 32_15_400_80.ida S/N: 32
Comment: T1-3:19.23,19.16,19.17°C,RF:49%
Start_Position: 0.0 [mm] End_Position: 400.0 [mm]
Specification_Value: 1.60 + 3.50/1000.0 *L [um]

Average

| Nominal [mm] | Actual [mm] | Inst.Err [mm] | Deviation [mm] | Std.Deviation [um] | Max-Min [um] |
|---|---|---|---|---|---|
| 0.0 | 0.00008 | 0.00000 | 0.00008 | 0.10 | 0.27 |
| 80.0 | 79.99845 | -0.00067 | -0.00088 | 0.05 | 0.12 |
| 160.0 | 159.99821 | -0.00093 | -0.00086 | 0.07 | 0.17 |
| 240.0 | 239.99690 | -0.00112 | -0.00198 | 0.03 | 0.08 |
| 320.0 | 319.99617 | -0.00198 | -0.00185 | 0.10 | 0.22 |
| 400.0 | 399.99658 | -0.00253 | -0.00089 | 0.06 | 0.15 |

Pooled Standard Deviation = 0.07

No. 1 of 3

| Nominal [mm] | Actual [mm] | Inst.Err [mm] | Deviation [mm] | Result | -10.0 | 0.0 | 10.0 |
|---|---|---|---|---|---|---|---|
| 0.0 | 0.00000 | 0.00000 | 0.00000 | OK | \| | : O : | \| |
| 80.0 | 79.99844 | -0.00067 | -0.00089 | OK | \| | :O\| : | \| |
| 160.0 | 159.99821 | -0.00093 | -0.00086 | OK | \| | : O\| : | \| |
| 240.0 | 239.99692 | -0.00112 | -0.00196 | OK | \| | O \| : | \| |
| 320.0 | 319.99609 | -0.00198 | -0.00193 | OK | \| | :O \| : | \| |
| 400.0 | 399.99665 | -0.00253 | -0.00082 | OK | \| | : O\| : | \| |
| 0.0 | 0.00010 | 0.00000 | 0.00010 | OK | \| | : O : | \| |

MaxError : 0.10 [um] MaxErrorPosition: 0.00 [mm]
MinError : -1.96 [um] MinErrorPosition: 240.00 [mm]
MaxSlopeError: 1.11 [um] MaxSlopePosition: 400.00 [mm] MaxSlopePitch: 80.0 [mm]

No. 2 of 3

| Nominal [mm] | Actual [mm] | Inst.Err [mm] | Deviation [mm] | Result | -10.0 | 0.0 | 10.0 |
|---|---|---|---|---|---|---|---|
| 0.0 | 0.00000 | 0.00000 | 0.00000 | OK | \| | : O : | \| |
| 80.0 | 79.99839 | -0.00067 | -0.00094 | OK | \| | :O\| : | \| |
| 160.0 | 159.99813 | -0.00093 | -0.00094 | OK | \| | : O\| : | \| |
| 240.0 | 239.99685 | -0.00112 | -0.00203 | OK | \| | O \| : | \| |
| 320.0 | 319.99610 | -0.00198 | -0.00192 | OK | \| | :O \| : | \| |
| 400.0 | 399.99658 | -0.00253 | -0.00089 | OK | \| | : O\| : | \| |
| 0.0 | 0.00012 | 0.00000 | 0.00012 | OK | \| | : O : | \| |

MaxError : 0.12 [um] MaxErrorPosition: 0.00 [mm]
MinError : -2.03 [um] MinErrorPosition: 240.00 [mm]
MaxSlopeError: -1.08 [um] MaxSlopePosition: 240.00 [mm] MaxSlopePitch: 80.0 [mm]

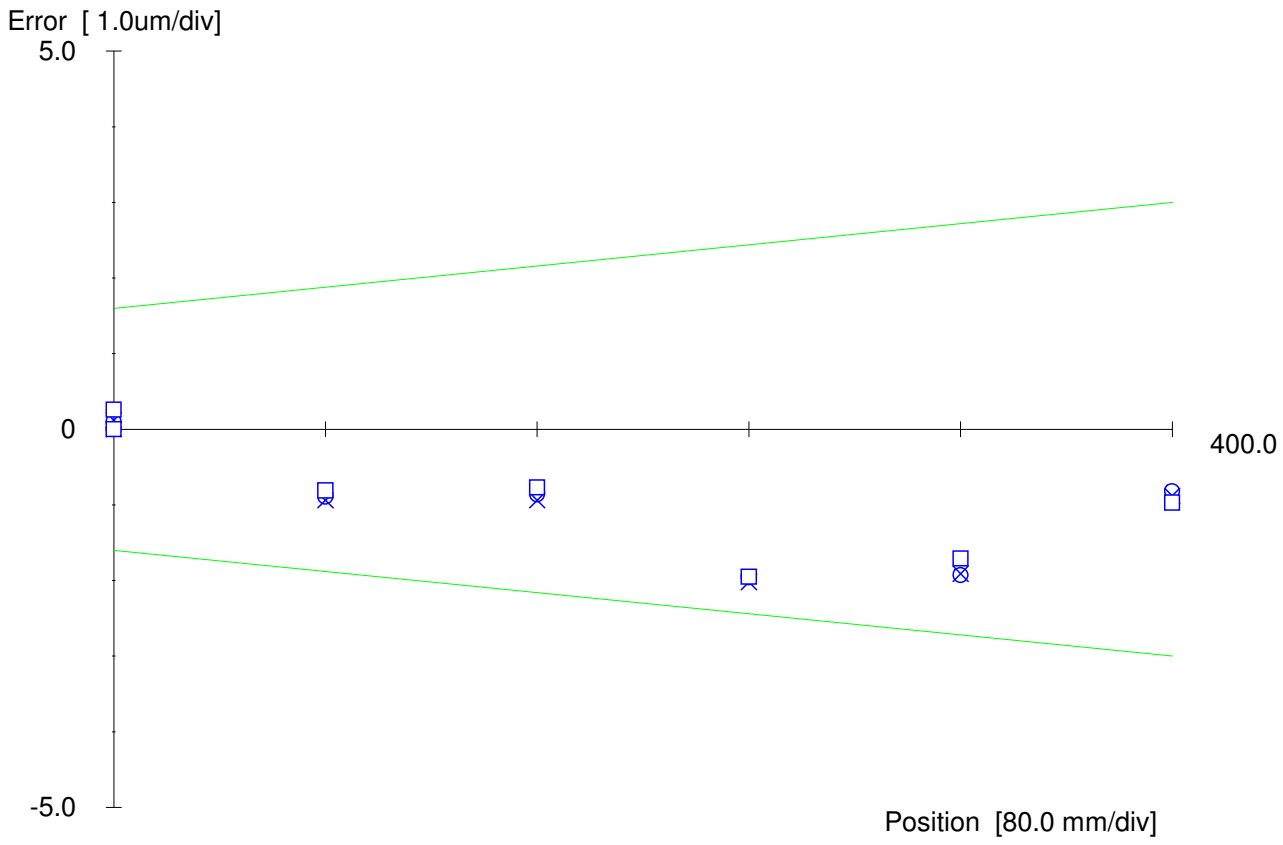
No. 3 of 3

| Nominal [mm] | Actual [mm] | Inst.Err [mm] | Deviation [mm] | Result | -10.0 | 0.0 | 10.0 |
|---|---|---|---|---|---|---|---|
| 0.0 | 0.00000 | 0.00000 | 0.00000 | OK | \| | : O : | \| |
| 80.0 | 79.99851 | -0.00067 | -0.00082 | OK | \| | :O\| : | \| |
| 160.0 | 159.99830 | -0.00093 | -0.00077 | OK | \| | : O\| : | \| |
| 240.0 | 239.99693 | -0.00112 | -0.00195 | OK | \| | O \| : | \| |
| 320.0 | 319.99631 | -0.00198 | -0.00171 | OK | \| | :O \| : | \| |
| 400.0 | 399.99650 | -0.00253 | -0.00097 | OK | \| | : O\| : | \| |
| 0.0 | 0.00027 | 0.00000 | 0.00027 | OK | \| | : O : | \| |

MaxError : 0.27 [um] MaxErrorPosition: 0.00 [mm]
MinError : -1.95 [um] MinErrorPosition: 240.00 [mm]
MaxSlopeError: -1.18 [um] MaxSlopePosition: 240.00 [mm] MaxSlopePitch: 80.0 [mm]

09/12/17

Measuring_Accuracy U1 3 Times Data_File: R-L135_u1.txt Instrumental_File: 32_15_400_80.ida S/N: 32
Comment: T1-3:19.23,19.16,19.17°C,RF:49%
Specification_Value: 1.60 + 3.50/1000.0 *L [um]




○ :1Times × :2Times □ :3Times

09/12/17

Measuring_Accuracy U1 3 Times Data_File: Z_u1.txt Instrumental_File: Z_200_JIS.ida S/N: QV-002
Comment: T1-3:19.53,19.56,19.22°C,RF:49%
Start_Position: 0.0 [mm] End_Position: 200.0 [mm]
Specification_Value: 1.10 + 3.50/1000.0 *L [um]

Average

| Nominal [mm] | Actual [mm] | Inst.Err [mm] | Deviation [mm] | Std.Deviation [um] | Max-Min [um] |
|---|---|---|---|---|---|
| 0.0 | 0.00001 | 0.00000 | 0.00001 | 0.02 | 0.05 |
| 40.0 | 39.99959 | -0.00001 | -0.00040 | 0.01 | 0.02 |
| 80.0 | 79.99972 | -0.00004 | -0.00024 | 0.05 | 0.13 |
| 120.0 | 119.99917 | -0.00004 | -0.00079 | 0.02 | 0.05 |
| 160.0 | 159.99961 | -0.00010 | -0.00029 | 0.03 | 0.08 |
| 200.0 | 199.99881 | 0.00010 | -0.00129 | 0.01 | 0.03 |

Pooled Standard Deviation = 0.03

No. 1 of 3

| Nominal [mm] | Actual [mm] | Inst.Err [mm] | Deviation [mm] | Result | -10.0 | 0.0 | 10.0 |
|---|---|---|---|---|---|---|---|
| 0.0 | 0.00000 | 0.00000 | 0.00000 | OK | \| | :O: | \| |
| 0.0 | 0.00000 | 0.00000 | 0.00000 | OK | \| | :O: | \| |
| 40.0 | 39.99959 | -0.00001 | -0.00040 | OK | \| | :O : | \| |
| 80.0 | 79.99971 | -0.00004 | -0.00025 | OK | \| | :O : | \| |
| 120.0 | 119.99916 | -0.00004 | -0.00080 | OK | \| | :O\| : | \| |
| 160.0 | 159.99957 | -0.00010 | -0.00033 | OK | \| | : O : | \| |
| 200.0 | 199.99880 | 0.00010 | -0.00130 | OK | \| | O\| : | \| |
| 0.0 | 0.00003 | 0.00000 | 0.00003 | OK | \| | :O: | \| |

MaxError : 0.03 [um] MaxErrorPosition: 0.00 [mm]
MinError : -1.30 [um] MinErrorPosition: 200.00 [mm]
MaxSlopeError: -0.97 [um] MaxSlopePosition: 200.00 [mm] MaxSlopePitch: 40.0 [mm]

No. 2 of 3

| Nominal [mm] | Actual [mm] | Inst.Err [mm] | Deviation [mm] | Result | -10.0 | 0.0 | 10.0 |
|---|---|---|---|---|---|---|---|
| 0.0 | 0.00000 | 0.00000 | 0.00000 | OK | \| | :O: | \| |
| 0.0 | 0.00000 | 0.00000 | 0.00000 | OK | \| | :O: | \| |
| 40.0 | 39.99958 | -0.00001 | -0.00041 | OK | \| | :O : | \| |
| 80.0 | 79.99980 | -0.00004 | -0.00016 | OK | \| | :O : | \| |
| 120.0 | 119.99920 | -0.00004 | -0.00076 | OK | \| | :O\| : | \| |
| 160.0 | 159.99964 | -0.00010 | -0.00026 | OK | \| | : O : | \| |
| 200.0 | 199.99883 | 0.00010 | -0.00127 | OK | \| | O\| : | \| |
| 0.0 | 0.00005 | 0.00000 | 0.00005 | OK | \| | :O: | \| |

MaxError : 0.05 [um] MaxErrorPosition: 0.00 [mm]
MinError : -1.27 [um] MinErrorPosition: 200.00 [mm]
MaxSlopeError: -1.01 [um] MaxSlopePosition: 200.00 [mm] MaxSlopePitch: 40.0 [mm]

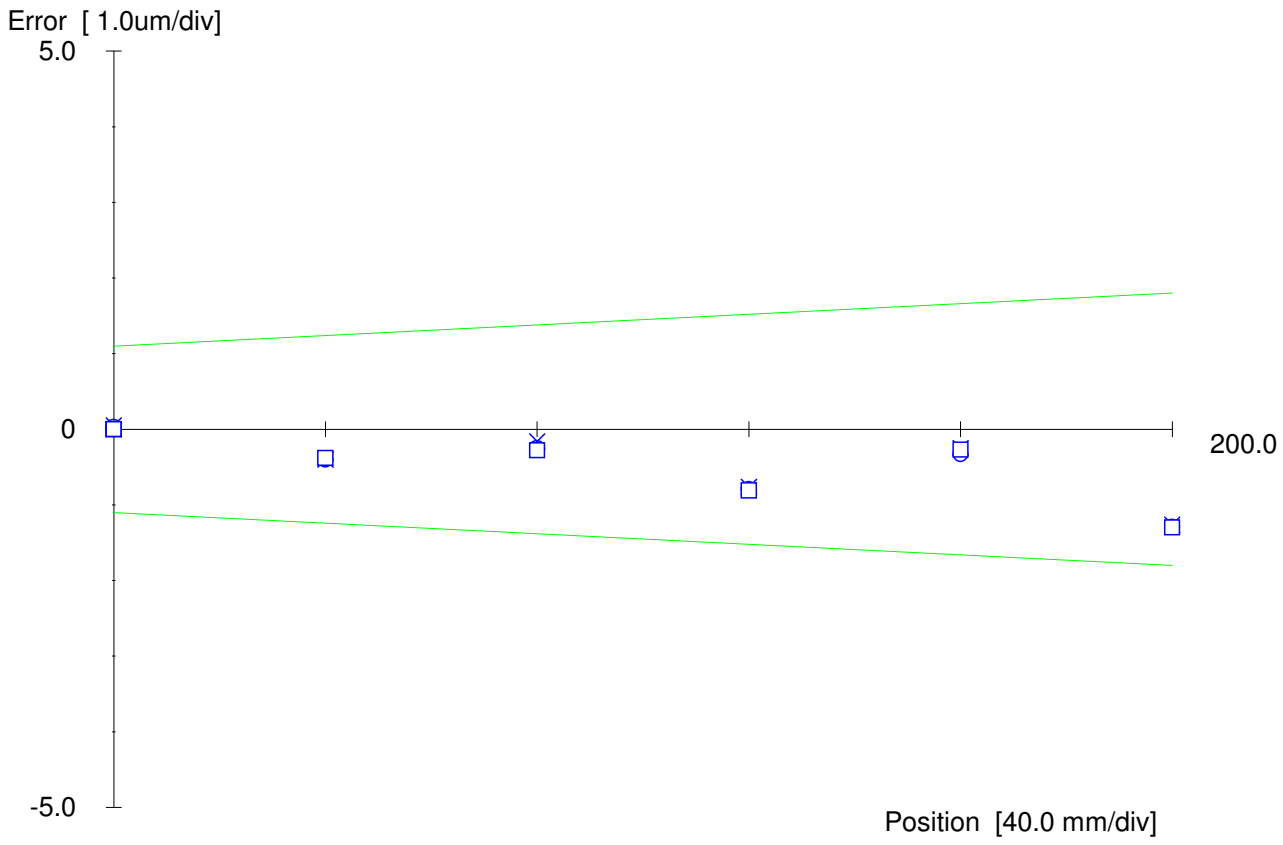
No. 3 of 3

| Nominal [mm] | Actual [mm] | Inst.Err [mm] | Deviation [mm] | Result | -10.0 | 0.0 | 10.0 |
|---|---|---|---|---|---|---|---|
| 0.0 | 0.00000 | 0.00000 | 0.00000 | OK | \| | :O: | \| |
| 0.0 | 0.00000 | 0.00000 | 0.00000 | OK | \| | :O: | \| |
| 40.0 | 39.99960 | -0.00001 | -0.00039 | OK | \| | :O : | \| |
| 80.0 | 79.99967 | -0.00004 | -0.00029 | OK | \| | :O : | \| |
| 120.0 | 119.99915 | -0.00004 | -0.00081 | OK | \| | :O\| : | \| |
| 160.0 | 159.99963 | -0.00010 | -0.00027 | OK | \| | : O : | \| |
| 200.0 | 199.99880 | 0.00010 | -0.00130 | OK | \| | O\| : | \| |
| 0.0 | 0.00000 | 0.00000 | 0.00000 | OK | \| | :O: | \| |

MaxError : 0.00 [um] MaxErrorPosition: 0.00 [mm]
MinError : -1.30 [um] MinErrorPosition: 200.00 [mm]
MaxSlopeError: -1.03 [um] MaxSlopePosition: 200.00 [mm] MaxSlopePitch: 40.0 [mm]

09/12/17

Measuring_Accuracy U1 3 Times Data_File: Z_u1.txt Instrumental_File: Z_200_JIS.ida S/N: QV-002
Comment: T1-3:19.53,19.56,19.22°C,RF:49%
Specification_Value: 1.10 + 3.50/1000.0 *L [um]




○ :1Times × :2Times □ :3Times

Mitutoyo