

Certificado de Calibración

Calibration Certificate

DATOS DEL USUARIO

User data

Nombre: VAZQUEZ TELLEZ CESAR
Name
Domicilio: Cerrada Sierra San Juan Mz. 6 Lt. 7 C4, Mirador del Valle,
Address 14658 Tlalpan, Ciudad de México.

DATOS DEL INSTRUMENTO

Instrument data

Instrumento: NIVEL DIGITAL
Instrument
Marca: DUAL AXIS
Brand name
Modelo: DXL360
Model
Número de serie: 3606F98
Serial number
Identificación: E1
ID number

CONFORMIDAD

Conformity

Criterio de Evaluación: NO APLICA
Evaluation criterion
Declaración: VER OBSERVACIONES
Statement
Próxima calibración: 2023-06-20 POR SOLICITUD DEL USUARIO
Next calibration

CONDICIONES DE CALIBRACIÓN

Calibration conditions

Fecha de recepción: 2022-06-09
Reception date
HRE No.: 58833
Reception number
Temperatura ambiente: (22 ± 1) °C
Environmental temperature
Humedad Relativa: (46 ± 10) %HR
Relative humidity
Fecha de emisión: 2022-06-21
Issue date

Procedimiento(s) utilizado(s): IM-PRO-DI03
Procedure(s) used

Lugar de la calibración: Laboratorio de Metrología en Dimensional
Calibration site

Calibró:

Calibrated by



Beatriz Hernández Calzada
Coordinador del Laboratorio

ISO/IEC 17025:2017



Laboratorio CL-101

Aprobó:

Approved by



Alberto Kbarca Reyes
Gerente de Laboratorio

ESPECIFICACIONES DEL INSTRUMENTO

Instrument specifications

Intervalo de Medida: Measuring interval	0 a 360 grados (4 cuadrantes)
Resolución: Resolution	6 minutos
Error Máximo Permitido: Maximum permissible error	± 12 minutos

PATRONES DE REFERENCIA

Reference standards

Instrumento/ Instrument: BLOQUES ANGULARES DE 12 PIEZAS			
Marca/ Brand name: FOWLER	Modelo/ Type: SIN MODELO	No. de Serie/ Serial No.: 53666000	Identificación/ ID Number / TAG: DI02.02
Incertidumbre / Uncertainty: ± 5.5 seg de arco	Calibró/ Calibrated by: CENAM	No. de Certificado/ Certificate No.: CNM-CC-740-296/2022	
Fecha de calibración/ Calibration date: 2022-06-14	Próxima calibración/ Next calibration: 2026-07-13	Trazabilidad/ Traceability: CENAM	

TRAZABILIDAD DE LA MEDICIÓN

Measurement traceability

Los resultados de calibración emitidos son trazables al Sistema Internacional de Unidades (SI), a través de una cadena ininterrumpida de calibraciones vinculadas a patrones primarios, mantenidos por el Centro Nacional de Metrología (CENAM) o a otro Laboratorio Primario Nacional reconocido internacionalmente (NIST, NRC, NPL, PTB, etc.).

Algunas mediciones pueden ser trazables a constantes físicas fundamentales o a patrones de medición por consenso. La documentación de soporte relativa a la trazabilidad de la medición está disponible para su revisión en nuestro Laboratorio a través de una cita previa.

VALIDEZ Y RECONOCIMIENTO DE LA ACREDITACIÓN

Validity and recognition of the accreditation

Este Laboratorio está acreditado de acuerdo con la reconocida norma internacional ISO/IEC 17025. Esta acreditación demuestra la competencia técnica para un alcance definido y la operación del Laboratorio con un Sistema de Gestión de la Calidad. (Refiérase al comunicado conjunto de ISO-ILAC-IAF fechado en abril de 2017, al siguiente vínculo:
https://www.nist.gov/system/files/documents/2017/07/05/joint-iso-iec-17025-communicue-2017-final-signed_1.pdf

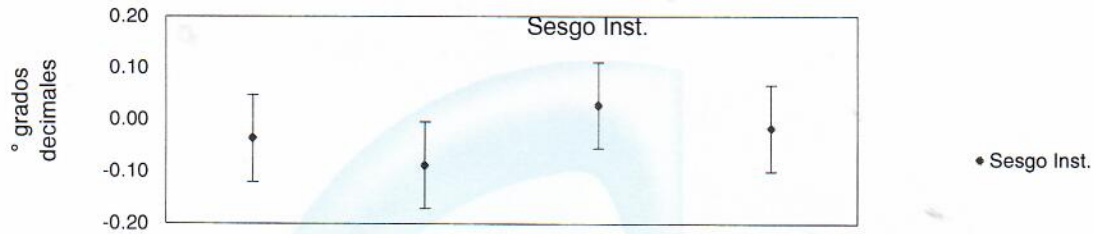
INyMET, S.A. de C.V. está acreditado con el número de certificado CL-101, el cual fue emitido por el organismo de acreditación denominado International Accreditation Service, Inc. (IAS). El certificado con el alcance definido de las magnitudes acreditadas puede ser consultado en el sitio web:
<https://www.iasonline.org/wp-content/uploads/2017/05/CL-101-Cert-New-3.pdf>

International Accreditation Service, Inc. (IAS) es uno de los organismos de acreditación de laboratorios de calibración que han firmado el Acuerdo de Reconocimiento Mutuo llamado ILAC MRA, por sus siglas en inglés (Mutual Recognition Arrangement of International Laboratory Accreditation Cooperation), el cual permite la aceptación de los Certificados de Calibración a través de las fronteras nacionales de los países signatarios. En el sitio web de ILAC en: <https://www.ilac.org> se pueden encontrar mayores detalles del ILAC MRA y la lista de signatarios se consulta en: <https://ilac.org/ilac-mra-and-signatories/>

RESULTADOS DE LA CALIBRACIÓN

Calibration results

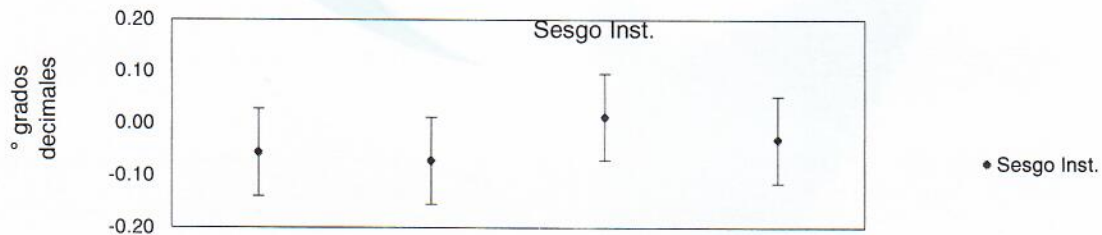
CUADRANTE X



	Patrón (gra.: min.)	IBC		Sesgo Instrumental		Incertidumbre (k=2)	
		(gra.: min.)	(° gra. dec.)	(min.: seg.)	(° gra. dec.)	(min.: seg.)	(° gra. dec.)
1	30:00	29:57	29.964°	02:10	-0.036°	± 05:00	± 0.083°
2	45:00	44:54	44.912°	05:17	-0.088°	± 05:00	± 0.083°
3	60:00	60:01	60.028°	01:41	0.028°	± 05:00	± 0.083°
4	90:00	89:59	89.984°	00:58	-0.016°	± 05:00	± 0.083°

IBC= Instrumento Bajo Calibración

CUADRANTE -X



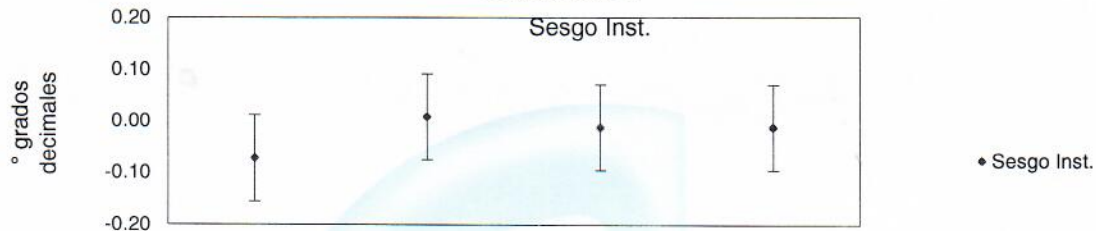
	Patrón (gra.: min.)	IBC		Sesgo Instrumental		Incertidumbre (k=2)	
		(gra.: min.)	(° gra. dec.)	(min.: seg.)	(° gra. dec.)	(min.: seg.)	(° gra. dec.)
1	30:00	29:56	29.944°	03:22	-0.056°	± 05:00	± 0.083°
2	45:00	44:55	44.928°	04:19	-0.072°	± 05:00	± 0.083°
3	60:00	60:00	60.012°	00:43	0.012°	± 05:00	± 0.083°
4	90:00	89:58	89.968°	01:55	-0.032°	± 05:00	± 0.083°

IBC= Instrumento Bajo Calibración

RESULTADOS DE LA CALIBRACIÓN

Calibration results

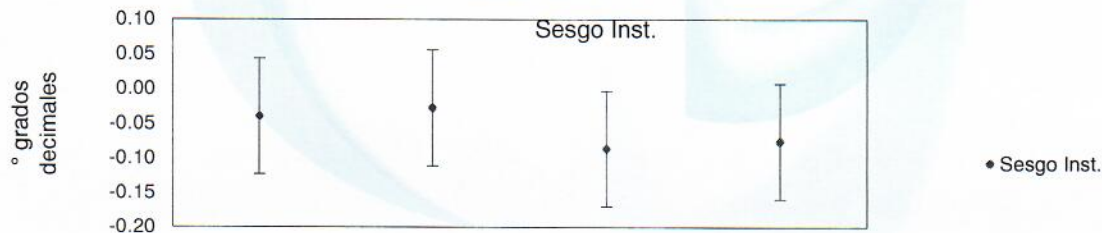
CUADRANTE Y



	Patrón	IBC		Sesgo Instrumental		Incertidumbre (k=2)	
	(gra.: min.)	(gra.: min.)	(° gra. dec.)	(min.: seg.)	(° gra. dec.)	(min.: seg.)	(° gra. dec.)
1	30:00	29:55	29.928°	04:19	-0.072°	± 05:00	± 0.083°
2	45:00	45:00	45.008°	00:29	0.008°	± 05:00	± 0.083°
3	60:00	59:59	59.988°	00:43	-0.012°	± 05:00	± 0.083°
4	90:00	89:59	89.988°	00:43	-0.012°	± 05:00	± 0.083°

IBC= Instrumento Bajo Calibración

CUADRANTE -Y



	Patrón	IBC		Sesgo Instrumental		Incertidumbre (k=2)	
	(gra.: min.)	(gra.: min.)	(° gra. dec.)	(min.: seg.)	(° gra. dec.)	(min.: seg.)	(° gra. dec.)
1	30:00	29:57	29.960°	02:24	-0.040°	± 05:00	± 0.083°
2	45:00	44:58	44.972°	01:41	-0.028°	± 05:00	± 0.083°
3	60:00	59:54	59.913°	05:12	-0.087°	± 05:00	± 0.083°
4	90:00	89:55	89.924°	04:34	-0.076°	± 05:00	± 0.083°

IBC= Instrumento Bajo Calibración

OBSERVACIONES Y CONCLUSIONES

Observations and conclusions

La estimación de la incertidumbre de medición se realizó en base a la guía JCGM 100:2008, GUM 1995 with minor corrections "Evaluation of measurement data - Guide to the expression of uncertainty in measurement", con un factor de cobertura de $k = 2$ (nivel de confianza del 95,45 %).

Es responsabilidad del usuario determinar si los resultados obtenidos en este certificado de calibración satisfacen los requisitos de su Sistema de Gestión.

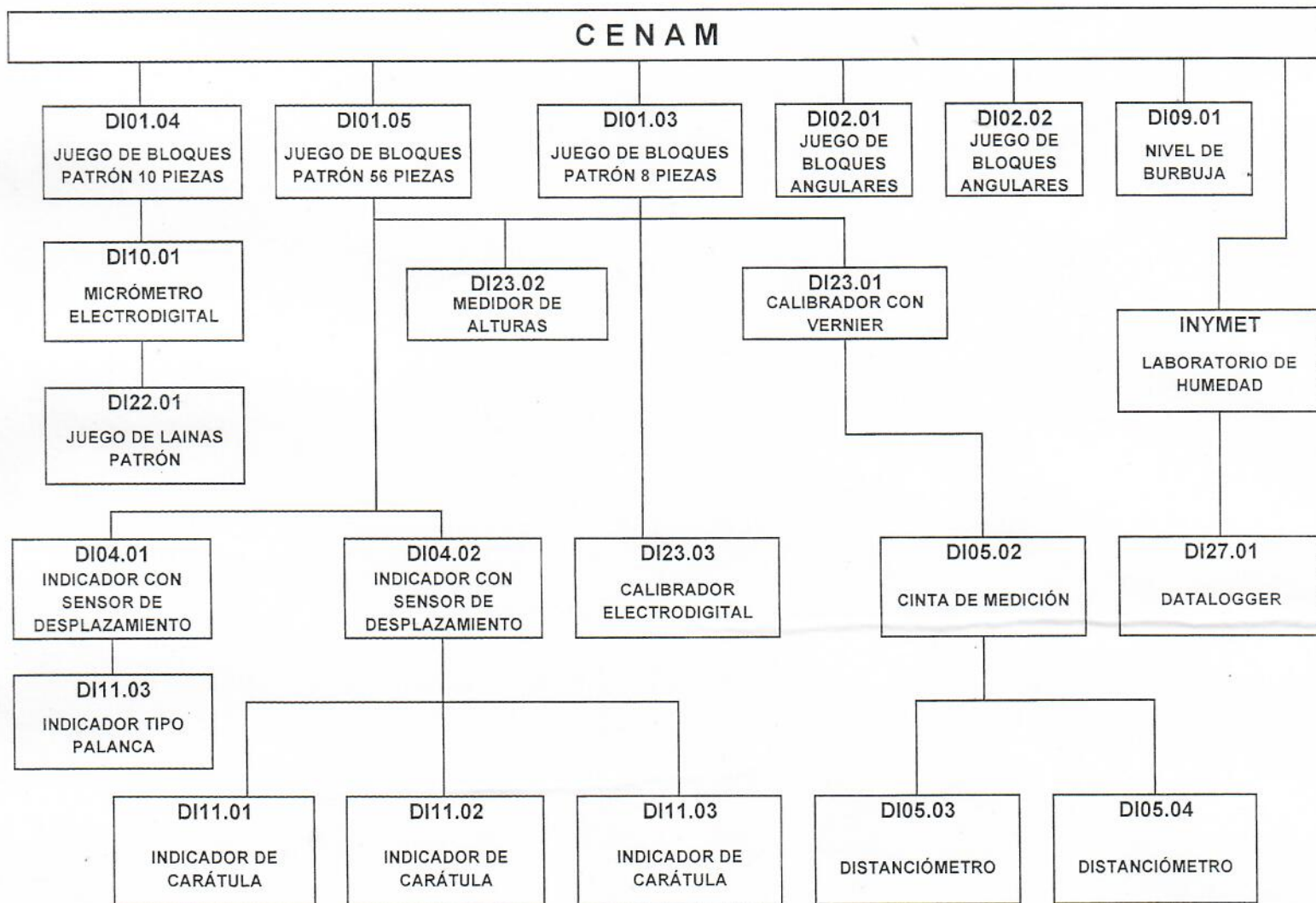
El presente certificado de calibración sólo ampara las mediciones reportadas. Es responsabilidad del usuario determinar el uso adecuado de estos resultados.

Fin del certificado.



INyMET
INDISPENSABLES PARA LA CALIDAD

CADENA DE TRAZABILIDAD METROLÓGICA LABORATORIO DE METROLOGÍA EN DIMENSIONAL





INTERNATIONAL
ACCREDITATION
SERVICE®

CERTIFICATE OF ACCREDITATION

This is to attest that

INYMET

SALVATIERRA NO. 32-5, COL SAN BARTOLO ATEPEHUACAN
GUSTAVO A MADERO, 07730, UNITED MEXICAN STATES (MEXICO)

Calibration Laboratory CL-101

has met the requirements of AC204, *IAS Accreditation Criteria for Calibration Laboratories*, and has demonstrated compliance with ISO/IEC Standard 17025:2017, *General requirements for the competence of testing and calibration laboratories*. This organization is accredited to provide the services specified in the scope of accreditation.

Effective Date April 6, 2021

Expiration Date April 1, 2024



A handwritten signature in black ink, reading "Raj Nathan".

President

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INYMET

Contact Name LAI. Alejandra Gonzalez

Contact Phone + 52 55-5754-3087 ext.
211

Accredited to ISO/IEC 17025:2017

Effective Date April 6, 2021

CALIBRATION AND MEASUREMENT CAPABILITY (CMC)*

MEASURED QUANTITY or DEVICE TYPE CALIBRATED	RANGE	UNCERTAINTY ^{1,2} (±)	CALIBRATION PROCEDURE AND/OR STANDARD EQUIPMENT USED
<i>Dimensional</i>			
Calipers (Vernier and dial)	Up to 100 mm Up to 1000 mm	11 µm 20 µm	Direct Comparison Method Gauge blocks
Calipers (Digital-electronic)	Up to 150 mm Up to 300 mm Up to 600 mm	8 µm 10 µm 12 µm	Direct Comparison Method Gauge blocks
Outside Micrometers	Up to 25 mm Up to 50 mm Up to 300 mm	0.7 µm 0.8 µm 12 µm	Direct Comparison Method Gauge blocks
Inside Micrometer	5 mm to 30 mm 50 mm to 300 mm	8 µm 10 µm	Direct Comparison Method Gauge blocks & gauge block holder
Depth Micrometer	Up to 100 mm	7.5 µm	Direct Comparison Method Gauge blocks
Height Gauges (Vernier & dial type)	Up to 300 mm Up to 600 mm Up to 1000 mm	15 µm 18 µm 20 µm	Direct Comparison Method Gauge blocks, long gauge blocks and electronic pick-up
Height Gauges (Digital-electronic)	Up to 600 mm Up to 1.000 mm	2 µm 3.5 µm	Direct Comparison Method Gauge blocks
Dial Indicators (Plunger Type) Electronic	Up to 25 mm Up to 100 mm Up to 10 mm	1.0 µm 2.6 µm 8 µm	Direct Comparison Method Gauge blocks
Mechanical			
Dial Indicator (Lever Type)	Up to 0.14 mm Up to 0.2 mm Up to 2 mm	1 µm 1.5 µm 8 µm	Direct Comparison Method Gauge blocks Electrical comparator

* If information in this CMC is presented in non-SI units, the conversion factors stated in NIST Special Publication 811 "Guide for the Use of the International System of Units (SI)" apply.

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MEASURED QUANTITY or DEVICE TYPE CALIBRATED	RANGE	UNCERTAINTY ^{1,2} (±)	CALIBRATION PROCEDURE AND/OR STANDARD EQUIPMENT USED
Electrical Comparator (Analog / Digital Display)	Up to 50 mm	0.4 µm	Direct Comparison Method Gauge blocks
End Standards	Up to 25 mm 25 mm to 50 mm 50 mm to 100 mm 100 mm to 200 mm 200 mm to 500 mm 500 mm to 1000 mm	1 µm 1.5 µm 2 µm 2.5 µm 3.8 µm 7 µm	Direct Comparison Method Gauge blocks, long gauge blocks and electronic pick-up
Scales/Steel Rules/Steel Tapes	Up to 1 m Up to 50 m	0.3 mm (0.5 + 0.02L) mm Where L is in meters	Direct Comparison Method Standard Ruler Standard glass scale & reticles, Vernier Caliper 1m
Feeler Gauges	Up to 1 mm 1 mm to 2 mm	1.2 µm 2.0 µm	Direct Comparison Method Micrometer (digital)
Bevel Protractor Analog / Digital	Up to 360°	5'	Direct Comparison Method Angle Gauges
Surface Plate	Up to 1600 mm x 1000 mm	10 µm	Direct Comparison Method Using precision level of 0.02 mm/m sensitivity

Mechanical

Pressure Gauges Absolute	1.24 kPa to 62.16 kPa 5 inH ₂ O to 250 inH ₂ O	0.025 % 0.025 %	Direct Comparison Method Pressure Balance
	Up to 7.5 kPa	0.05 % FS	Direct Comparison Method Pressure Transducer, Pressure Calibrator.
	Up to 30 inH ₂ O	0.05 % FS	
	21 kPa to 700 kPa (3 psig to 100 psig)	0.015 %	Direct Comparison Method Pressure Balance,
	70 kPa to 7000 kPa (10 psig to 1000 psig)	0.015 %	Direct Comparison Method Pressure Balance
	1380 kPa to 70 MPa (200 psig to 10000 psig)	0.01 %	Direct Comparison Method Pressure Balance
	Up to 2000 psi	0.025 % FS	Direct Comparison Method Pressure Transducer, Pressure Calibrator
	Up to 10000 psi	0.025 % FS	Direct Comparison Method Pressure Transducer
	206.84 kPa to 2068.4 kPa (30 psig to 300 psig)	0.025 % FS	Direct Comparison Method Pressure Calibrator
Vacuum and Pressure	10 kPa to 110 kPa	0.01 % FS	Direct Comparison Method Pressure Calibrator
	Up to -100 kPa Up to -1 bar	0.01 % FS	Direct Comparison Method Pressure Calibrator

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Vacuum and Pressure continued	-101 kPa to 207 kPa (-14 psi to 30 psi)	0.025 % FS	Direct Comparison Method Pressure Calibrator
Volume – Glass	100 µL to 5 mL	0.30 %	Gravimetric Method Electronic Balance, Automatic Micropipette
	1 mL to 150 mL	0.07 %	Gravimetric Method Electronic Balance, Glassware
	150 mL to 4000 mL 4L to 20 L	0.16 % 0.16 %	
Volume - Metal	2L to 20 L	0.017 %	Gravimetric Method
	20 L to 500 L	0.02 %	Electronic Balance
	20 L to 50 L	0.023 %	Direct Transfer Method Volumetric Standard
	50 L to 200 L	0.03 %	
	200 L to 5000 L	0.03 %	Direct Transfer Method Dual Rotor Turbine, Coriolis Meter, Volumetric Standard
Liquid Flow By Total Mass	10 kg to 24 kg	0.10 %	Gravimetric Method Electronic Balance
	20 kg to 500 kg	0.10 %	
	2 kg to 5 x 10 ⁶ kg	0.15 %	Against Ref Std. (in lab or in field) Flowmeter
Liquid Flow By Total Volume	10 L to 500 L	0.12%	Gravimetric Method Electronic Balance
	2 L to 5 x 10 ⁶ L	0.20%	Against Ref Std. (in lab or in field) Flowmeter
Liquid Flow Rate Mass per Unit Time	0.001 g/min to 200 g/min	0.35%	Gravimetric Method Electronic Balance
	100 g/min to 8 kg/min	0.35%	
	1 kg/min to 24 kg/min	0.40%	
	20 kg/min to 1000 kg/min	0.40%	Against Ref. Std. (in lab or field) Flowmeter
	2 kg/min to 1000 kg/min	0.15%	
Liquid Flow Rate Volume per Unit Time	0.1 mL/min to 200 mL/min	0.35%	Gravimetric Method Electronic Balance
	100 mL/min to 8 L/min	0.35%	
	1 L/min to 24 L/min	0.35%	
	20 L/min to 1000 L/min	0.35%	

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Liquid Flow Rate Volume per Unit Time continued	2 L/min to 1000 L/min	0.20 %	Against Ref Std. (in lab or in field) Flowmeter
Gas Flow By Total Mass	0.001 g to 200 g 0.1 g to 8000 g 1.0 kg to 24 kg	0.30% 0.30% 0.40%	Gravimetric Method Electronic Balance
	100 mg to 5 x 10 ⁶ kg	0.40 %	Against Ref. Std. (in lab or field) Flowmeter
Gas Flow By Total Volume	0.001 L to 200 L 0.1 L to 8000 L 1000 L to 24000 L	0.35 % 0.35 % 0.40%	Gravimetric Method Electronic Balance
	1 mL to 5 x 10 ⁶ L	0.40 %	Against Ref. Std. (in lab or field) Flowmeter
Gas Flow Rate Mass per Unit Time	0.001 g/min to 10 g/min	0.35 %	Gravimetric Method Electronic Balance
	2,0 g/min to 500 g/min	0.35%	Gravimetric Method Electronic Balance
	1 kg/min to 5 kg/min	0.35%	Gravimetric Method Electronic Balance
	50 mg/min to 1000 kg/min	0.15%	Against Ref Std. (in lab or field) Flowmeter
Gas Flow Rate Volume per Unit Time	0.1 mL/min to 10 L/min 2.0 L/min to 500 L/min 100 L/min to 5000 L/min	0.35% 0.35% 0.35%	Gravimetric Method Electronic Balance
	50 mL/min to 1000 L/min	0.40 %	Against Ref. Std. (in lab or field) Flowmeter
Torque Wrenches	0 N·m to 25 N·m 25 N·m to 160 N·m 160 N·m to 1000 N·m	0.075 N·m 0.48 N·m 3.0 N·m	Direct Comparison Method 25 N·m Transducer 160 N·m Transducer 1000 N·m Transducer
Torque Analyzers and Torque Transducers	0 N·m to 10 N·m 10 N·m to 100 N·m 100 N·m to 1000 N·m	0.006 N·m 0.04 N·m 0.5 N·m	Direct Comparison Method Balance Arms: 1 m, 0.5 m, 0.1 m & Wheel: 0.1m 1000 N·m Transducer Balance Arms: 1 m & Wheel: 0.1m Mass sets: 1g to 5kg and 10 kg to 100 kg

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MEASURED QUANTITY or DEVICE TYPE CALIBRATED	RANGE	UNCERTAINTY ^{1,2} (±)	CALIBRATION PROCEDURE AND/OR STANDARD EQUIPMENT USED
Vibration Transducer Sensitivity or Vibration of Meter (10 Hz to 10 kHz)	0.1 m/s ² to 98 m/s ²	1 %	Direct Comparison Method Portable Accelerometer Calibrator
Thermal			
PRT	-80 °C to 660 °C	0.01 °C	Direct Comparison Method Precision Thermometry Bridge with RTD
Thermocouples (J,K,R,S,T,B)	0 °C to 1000 °C	0.5 °C	Indirect Comparison Method Thermocouple and Digital Multimeter or Digital Thermometer
Thermocouples type J, K, T, R, S, B or RTD or Thermistor with Digital or Analog Readouts	-80 °C to 600 °C	0.03 °C	Direct Comparison Method Digital Thermometer
Forced convection ovens and furnaces	Up to 300 °C	1.5 °C	Direct Comparison Method Energy Meter and Digital Thermometer with 12 T-type TCs
Infrared Thermometers	-38 °C to 500 °C	0.3 %	Direct Comparison Method IR Calibrator, Digital Thermometer and RTD or Thermocouple
Liquid in Glass Thermometer	-38 °C to 250 °C	0.07 °C	Direct Comparison Method Digital Thermometer or similar
Humidity Generate ³	25 %RH to 90 %RH (15 °C to 50 °C)	0.61 %RH	Direct Comparison Method General Eastern Hygrometer, Humidity Chamber
Humidity Measure ⁴	5 %RH to 95 %RH (5 °C to 100 °C)	0.39 %RH	Direct Comparison Method General Eastern Hygrometer
Electrical – DC/LF			
DC Voltage – Generate ³	1 V 10 V	0.5 ppm 0.5 ppm	Transfer Method Zener Reference
	0 mV to 330 mV 330 mV to 3.3 V 3.3 V to 33 V 33 V to 330 V 100 V to 1020 V	60 µV/V + 3 µV 50 µV/V + 5 µV 50 µV/V + 50 µV 55 µV/V + 500 µV 55 µV/V + 1.5 mV	Direct Method Multifunction Calibrator

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DC Voltage – Generate ³ continued	0 mV to 12 V	0.004 % RDG + 0.004 % RNG	Direct Method Multifunction Calibrator
	0.1 mV to 110 mV 110 mV to 1.1 V 1.1 V to 19.5 V 19.5 V to 110 V 110 V to 1100 V	3 µV/V 1.5 µV/V 1.5 µV/V 2 µV/V 2 µV/V	Replacement Method Multi-standard transfer with Vcc Source
DC Voltage – Measure ⁴	0 mV to 100 mV	9 µV/V RDG + 3 µV/V RNG	Direct Method Digital Multimeter
	100 mV to 1 V	8 µV/V RDG + 0.3 µV/V RNG	
	1 V to 10 V	8 µV/V RDG + 0.05 µV/V RNG	
	10 V to 100 V	10 µV/V RDG + 0.3 µV/V RNG	Direct Method Digital Multimeter
	100 V to 1000 V	10 µV/V RDG + 0.1 µV/V RNG	
	0 mV to 100 mV 100 mV to 60 V	0.004 % RDG + 0.004 % RNG 0.01 % RDG + 0.006 % RNG	
DC Current – Generate ³	0.1 mV to 110 mV 110 mV to 1.1 V 1.1 V to 19.5 V 19.5 V to 110 V 110 V to 1100 V	3 µV/V 1.5 µV/V 1.5 µV/V 2 µV/V 2 µV/V	Direct Method Multi-standard transfer
	0 mA to 3.3 mA 3.3 mA to 33 mA 33 mA to 330 mA 330 mA to 2.2 A 2.2 A to 11 A	130 µA/A + 50 nA 100 µA/A + 0.25 µA 100 µA/A + 3.3 µA 300 µA/A + 44 µA 600 µA/A + 330 µA	Direct Method Multifunction Calibrator
	20 A to 1000 A	0.6 %	Direct Method Multifunction Calibrator with 100-turn coil
	0 mA to 24 mA	0.025 % FS	Direct Method Multifunction Calibrator
	0.1 µA to 110 µA 0.11 mA to 1.1 mA 1.1 mA to 11 mA 11 mA to 110 mA 110 mA to 1.1 A 1.1 A to 11 A	7 µA/A 7 µA/A 7 µA/A 7 µA/A 15 µA/A 20 µA/A	Replacement Method Multi-standard transfer with Current Source
	0 nA to 100 nA 100 nA to 1 µA	30 µA/A RDG + 400 µA/A RNG 20 µA/A RDG + 40 µA/A RNG	Direct Method Digital Multimeter

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DC Current –Measure ⁴ continued	1 µA to 10 µA	20 µA/A RDG + 10 µA/A RNG	Direct Method Digital Multimeter
	10 µA to 100 µA	20 µA/A RDG + 8 µA/A RNG	
	0.1 mA to 10 mA	20 µA/A RDG + 5 µA/A RNG	
	10 mA to 100 mA	35 µA/A RDG + 5 µA/A RNG	
	100 mA to 1 A	110 µA/A RDG + 10 µA/A RNG	
	0.1 µA to 110 µA	7 µA/A	Direct Method Multi-standard transfer
	0.1 mA to 1.1 mA	7 µA/A	
	1.1 mA to 11 mA	7 µA/A	
	11 mA to 110 mA	7 µA/A	
	110 mA to 1.1 A	15 µA/A	
	1.1 A to 11 A	20 µA/A	
	0 mA to 52 mA	0.005 % RDG + 0.01 % RNG	Indirect Method Shunt with Digital Multimeter
	1 A to 75 A	0.01 %	Indirect Method Shunt with Digital Multimeter
AC Current Generate ³	0.03 mA to 0.33 mA (45 Hz to 1 kHz) (1 kHz to 5 kHz) (5 kHz to 10 kHz)	0.13 % + 0.25 µA 0.4 % + 0.15 µA 1.3 % + 0.15 µA	Direct Method Multifunction Calibrator
	0.33 mA to 3.3 mA (45 Hz to 1 kHz) (1 kHz to 5 kHz) (5 kHz to 10 kHz)	0.1 % + 0.3 µA 0.2 % + 0.3 µA 0.6 % + 0.3 µA	
	3.3 mA to 33 mA (45 Hz to 1 kHz) (1 kHz to 5 kHz) (5 kHz to 10 kHz)	0.09 % + 3 µA 0.2 % + 3 µA 0.6 % + 3 µA	
	33 mA to 330 mA (45 Hz to 1 kHz) (1 kHz to 5 kHz) (5 kHz to 10 kHz)	0.09 % + 30 µA 0.2 % + 30 µA 0.6 % + 30 µA	
	330 mA to 2.2 A (45 Hz to 1 kHz) (1 kHz to 5 kHz)	0.1 % + 300 µA 0.75 % + 300 µA	
	2.2 A to 11 A (45 Hz to 65 Hz) (65 Hz to 500 kHz) (500 Hz to 1 kHz)	0.06 % + 2 mA 0.10 % + 2 mA 0.33 % + 2 mA	

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MEASURED QUANTITY or DEVICE TYPE CALIBRATED	RANGE	UNCERTAINTY ^{1,2} (±)	CALIBRATION PROCEDURE AND/OR STANDARD EQUIPMENT USED
AC Current Generate ³ continued	20 A to 750 A (50 Hz/60 Hz)	1 %	Direct Method Multifunction Calibrator with 100-turn coil
	90 µA to 110 µA (36 Hz to 1.1 kHz) (4.5 kHz to 5.5 kHz) (9 kHz to 11 kHz)	50 µA/A 100 µA/A 300 µA/A	Replacement Method Multi-standard transfer with Current Source
	0.9 mA to 1.1 A (36 Hz to 1.1 kHz) (4.5 kHz to 5.5 kHz) (9 kHz to 11 kHz)	40 µA/A 70 µA/A 200 µA/A	
	9 A to 11 A (36 Hz to 1.1 kHz) (4.5 kHz to 5.5 kHz) (9 kHz to 11 kHz) (18 kHz to 22 kHz)	200 µA/A 300 µA/A 600 µA/A 1000 µA/A	
AC Current – Measure ⁴	90 µA to 110 µA (36 Hz to 1.1 kHz) (4.5 kHz to 5.5 kHz) (9 kHz to 11 kHz)	50 µA/A 100 µA/A 300 µA/A	Direct Method Multi-standard transfer
	0.9 mA to 1.1 A (36 Hz to 1.1 kHz) (4.5 kHz to 5.5 kHz) (9 kHz to 11 kHz)	40 µA/A 70 µA/A 200 µA/A	
	9 A to 11 A (36 Hz to 1.1 kHz) (4.5 kHz to 5.5 kHz) (9 kHz to 11 kHz) (18 kHz to 22 kHz)	200 µA/A 300 µA/A 600 µA/A 1000 µA/A	
AC Voltage Generate ³	1 mV to 33 mV (45 Hz to 10 kHz) (10 kHz to 20 kHz) (20 kHz to 50 kHz) (50 kHz to 100 kHz) (100 kHz to 500 kHz)	0.15 % + 20 µV 0.2 % + 20 µV 0.25 % + 20 µV 0.35 % + 33 µV 1 % + 60 µV	Direct Method Multifunction Calibrator
	33 mV to 330 mV (45 Hz to 10 kHz) (10 kHz to 20 kHz) (20 kHz to 50 kHz) (50 kHz to 100 kHz) (100 kHz to 500 kHz)	0.05 % + 20 µV 0.1 % + 20 µV 0.16 % + 40 µV 0.24 % + 170 µV 0.7 % + 330 µV	

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AC Voltage Generate ³ continued	330 mV to 3.3 V (45 Hz to 10 kHz) (10 kHz to 20 kHz) (20 kHz to 50 kHz) 330 mV to 3.3 V (50 kHz to 100 kHz) (100 kHz to 500 kHz)	0.03 % + 60 µV 0.08 % + 60 µV 0.14 % + 300 µV 0.24 % + 1.7 mV 0.5 % + 3.3 mV	Direct Method Multifunction Calibrator continued
	3.3 V to 33 V (45 Hz to 10 kHz) (10 kHz to 20 kHz) (20 kHz to 50 kHz) (50 kHz to 100 kHz)	0.04 % + 600 µV 0.08 % + 2.6 mV 0.19 % + 5 mV 0.24 % + 17 mV	
	33 V to 330 V (45 Hz to 1 kHz) (1 kHz to 10 kHz) (10 kHz to 20 kHz)	0.5 % + 6.6 mV 0.08 % + 15mV 0.09 % + 33 mV	
	330 V to 1020 V (45 Hz to 1 kHz) (1 kHz to 5 kHz) (5 kHz to 10 kHz)	0.05 % + 80 mV 0.20 % + 100 mV 0.20 % + 500 mV	
	0.9 mV to 110 mV (36 Hz to 33 kHz) (45 kHz to 55 kHz) (90 kHz to 110 kHz) (270 kHz to 330 kHz) (450 kHz to 550 kHz)	20 µV/V + 2 µV 30 µV/V + 2 µV 50 µV/V + 3 µV 100 µV/V + 3 µV 200 µV/V + 3 µV	Replacement Method Multi-standard transfer with Voltage Source
	0.9 V to 11 V (270 kHz to 330 kHz) (450 kHz to 550 kHz)	70 µV/V 100 µV/V	
	0.9 V to 110 V (36 Hz to 33 kHz) (45 kHz to 55 kHz) (90 kHz to 110 kHz)	10 µV/V 20 µV/V 30 µV/V	
	90 V to 110 V (180 kHz to 220 kHz)	50 µV/V	
	110 V to 1100 V (36 Hz to 33 kHz)	15 µV/V	

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AC Voltage Measure ⁴	0.9 mV to 110 mV (36 Hz to 33 kHz) (45 kHz to 55 kHz) (90 kHz to 110 kHz) (270 kHz to 330 kHz) (450 kHz to 550 kHz)	20 $\mu\text{V/V} + 2 \mu\text{V}$ 30 $\mu\text{V/V} + 2 \mu\text{V}$ 50 $\mu\text{V/V} + 3 \mu\text{V}$ 100 $\mu\text{V/V} + 3 \mu\text{V}$ 200 $\mu\text{V/V} + 3 \mu\text{V}$	Direct Method Multi-standard transfer
	0.9 V to 11 V (270 kHz to 330 kHz) (450 kHz to 550 kHz)	70 $\mu\text{V/V}$ 100 $\mu\text{V/V}$	
	0.9 V to 110 V (36 Hz to 33 kHz) (45 kHz to 55 kHz) (90 kHz to 110 kHz)	10 $\mu\text{V/V}$ 20 $\mu\text{V/V}$ 30 $\mu\text{V/V}$	
	90 V to 110 V (180 kHz to 220 kHz)	50 $\mu\text{V/V}$	
	110 V to 1100 V (36 Hz to 33 kHz)	15 $\mu\text{V/V}$	
DC Resistance – Generate ³	1 Ω 10 Ω 1 k Ω 10 k Ω	8.0 $\mu\Omega/\Omega$ 2 $\mu\Omega/\Omega$ 2 $\mu\Omega/\Omega$ 2 $\mu\Omega/\Omega$	Direct Method Indirect Method Resistances Standard
	100 $\mu\Omega$ 1 m Ω 10 m Ω 100 m Ω 1 Ω 10 Ω 100 Ω 1 k Ω 10 k Ω	30 $\mu\Omega/\Omega$ 10 $\mu\Omega/\Omega$ 10 $\mu\Omega/\Omega$ 3 $\mu\Omega/\Omega$ 2 $\mu\Omega/\Omega$ 2 $\mu\Omega/\Omega$ 2 $\mu\Omega/\Omega$ 2 $\mu\Omega/\Omega$ 2 $\mu\Omega/\Omega$	
	0.1 Ω to 1 Ω 1 Ω to 10 Ω 10 Ω to 100 Ω 100 Ω to 100 k Ω 100 k Ω to 1 M Ω 1 M Ω to 10 M Ω 10 M Ω to 100 M Ω 100 M Ω to 1 G Ω	200 $\mu\Omega/\Omega$ 35 $\mu\Omega/\Omega$ 26 $\mu\Omega/\Omega$ 15 $\mu\Omega/\Omega$ 22 $\mu\Omega/\Omega$ 80 $\mu\Omega/\Omega$ 550 $\mu\Omega/\Omega$ 0.6 %	Replacement Method Digital Multimeter with Decade Resistors
	0.1 Ω to 1 Ω 1 Ω to 10 Ω 10 Ω to 100 Ω 100 Ω to 1 k Ω 1 k Ω to 1 M Ω	1 % 0.1 % 0.01 % 0.03 % 0.01 %	

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DC Resistance – Generate ³ continued	0.01 Ω to 0.1 Ω 0.1 Ω to 1 Ω 1 Ω to 10 Ω 10 Ω to 100 Ω 100 Ω to 10 M Ω	7 % 0.7 % 0.10 % 0.04 % 0.03 %	Direct Method Decade Resistors
	0.1 Ω to 2 Ω 2 Ω to 4 Ω 9 Ω to 19.5 Ω 20 Ω to 195 Ω 0.2 k Ω to 1.95 k Ω 2 k Ω to 19.5 k Ω 20 k Ω to 195 k Ω 0.2 M Ω to 1.95 M Ω 2 M Ω to 19.5 M Ω 20 M Ω to 110 M Ω	20 $\mu\Omega/\Omega$ 15 $\mu\Omega/\Omega$ 5 $\mu\Omega/\Omega$ 3 $\mu\Omega/\Omega$ 3 $\mu\Omega/\Omega$ 3 $\mu\Omega/\Omega$ 5 $\mu\Omega/\Omega$ 8 $\mu\Omega/\Omega$ 12 $\mu\Omega/\Omega$ 180 $\mu\Omega/\Omega$	Replacement Method Multi-standar transfer with Resistance generator
DC Resistance – Measure ⁴	0.1 Ω to 10 Ω 10 Ω to 100 Ω 100 Ω to 100 k Ω 100 k Ω to 1 M Ω 1 M Ω to 10 M Ω 10 M Ω to 100 M Ω 100 M Ω to 1 G Ω	20 $\mu\Omega/\Omega$ 17 $\mu\Omega/\Omega$ 11 $\mu\Omega/\Omega$ 17 $\mu\Omega/\Omega$ 60 $\mu\Omega/\Omega$ 510 $\mu\Omega/\Omega$ 0.6 %	Direct Method Digital Multimeter
	0.1 Ω to 2 Ω 2 Ω to 4 Ω 9 Ω to 19.5 Ω 20 Ω to 195 Ω 0.2 k Ω to 1.95 k Ω 2 k Ω to 19.5 k Ω 20 k Ω to 195 k Ω 0.2 M Ω to 1.95 M Ω 2 M Ω to 19.5 M Ω 20 M Ω to 110 M Ω	20 $\mu\Omega/\Omega$ 15 $\mu\Omega/\Omega$ 5 $\mu\Omega/\Omega$ 3 $\mu\Omega/\Omega$ 3 $\mu\Omega/\Omega$ 3 $\mu\Omega/\Omega$ 5 $\mu\Omega/\Omega$ 8 $\mu\Omega/\Omega$ 12 $\mu\Omega/\Omega$ 180 $\mu\Omega/\Omega$	Direct Method Multi-standar transfer
RF/Microwave and Electromagnetics			
AC Power – Measure ⁴	-30 dBm to 20 dBm (10 Hz to 1 MHz)	0.01 dB	Direct method Multimeter Power meter + power sensor
AC Power – Generate ³	-30 dBm to 20 dBm (10 Hz to 1 MHz)	0.01 dB	Direct method Multimeter Power meter + power sensor
Frequency – Measure ⁴ (Pulse, Square or Sinusoidal Signal)	In laboratory: 500 MHz to 18 GHz	4.7×10^{-11}	Direct method Primary time base + universal counter
	At customer site: 500 MHz to 18 GHz	2.0×10^{-9}	Direct method Primary time base + universal counter

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Frequency – Generate ³ (Pulse, Square or Sinusoidal Signal)	In laboratory: 500 MHz to 18 GHz	4.3×10^{-11}	Direct method Primary time base + universal counter
	At customer site: 500 MHz to 18 GHz	3.0×10^{-10}	Direct method Primary time base + universal counter
RF Power – Measure ⁴	-60 dBm to -30 dBm (10 MHz to 18 GHz)	0.1 dB	Direct method Power meter + power sensor
	-20 dBm to 15 dBm (100 kHz to 4.2 GHz)	0.1 dB	Direct method Power meter + power sensor
	-30 dBm to 10 dBm (50 MHz to 18 GHz)	0.1 dB	Direct method Power meter + power sensor
Bandwidth – Measure ⁴	For reference power of -20 dBm to +10 dBm 50 kHz to 1 GHz	0.2dB	Direct method Leveled sine wave generator
Bandwidth – Measure ⁴ continued	For reference power of -60 dBm to +10 dBm 1 GHz to 18 GHz	0.1 dB	Direct method Power meter + power sensor
Time and Frequency			
Frequency – Measure ⁴ (Sine, Square, Pulse Signal)	In laboratory: 1 mHz to <10 Hz	1.5×10^{-5}	Direct method Primary time base + universal counter
	At customer site: 1 mHz to <10 Hz	2.5×10^{-5}	Direct method Primary time base + universal counter
	In laboratory: 10 Hz a 1 kHz 1 kHz to 1 MHz 1 MHz to 200 MHz 200 MHz to 500 MHz	1.9×10^{-9} 4.3×10^{-10} 1.9×10^{-11} 3.7×10^{-11}	Direct method Primary time base + universal counter
	At customer site: 10 Hz a 1 kHz 1 kHz to 1 MHz 1 MHz to 200 MHz 200 MHz to 500 MHz	3.7×10^{-7} 3.0×10^{-8} 3.0×10^{-8} 2.0×10^{-9}	Direct method Primary time base + universal counter
Frequency – Generate ³ (Pulse, Sinusoidal, Square Signal)	In laboratory: 1 mHz to 500 MHz	4.3×10^{-11}	Direct method Primary time base + function generator
	At customer site: 1 mHz to 500 MHz	3.0×10^{-10}	Direct method Primary time base + function generator

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Period – Measure ⁴ (Pulse, Sinusoidal, Square Signal)	In laboratory: 1 ns to 1 ms 1 ms to 1 s 1 s to 1000 s	4.7 x 10 ⁻¹¹ 3.0 x 10 ⁻⁷ 3.0 x 10 ⁻⁴	Direct method Primary time base + universal counter
	At customer site: 1 ns to 1 ms 1 ms to 1 s 1 s to 1000 s	2.0 x 10 ⁻⁹ 3.0 x 10 ⁻⁷ 3.0 x 10 ⁻⁴	Direct method Primary time base + universal counter
Period – Generate ³ (Pulse, Sinusoidal, Square Signal)	In laboratory: 1 ns to 1000 s	4.3 x 10 ⁻¹¹	Direct method Primary time base + function generator or time mark generator
	At customer site: 1 ns to 1000 s	3.0 x 10 ⁻¹⁰	Direct method Primary time base + function generator or time mark generator
Time Interval – Measure ⁴	In laboratory: 1.25 ns to 86400 s	4.7 x 10 ⁻¹¹	Direct method Primary time base + universal counter
	At customer site: 1.25 ns to 86400 s	3.0 x 10 ⁻¹⁰	Direct method Primary time base + universal counter
Time Interval – Generate ³	In laboratory: 1.25 ns to 86400 s	4.3 x 10 ⁻¹¹	Direct method Primary time base + universal counter
	At customer site: 1.25 ns to 86400 s	3.0 x 10 ⁻¹⁰	Direct method Primary time base + universal counter
Timers – Measure ⁴	At customer site: 10 ms to 86400 s	0.58 ms	Direct method Chronometer
Bandwidth – Generate ³	DC to 26 GHz	0.18 dB	Direct method Primary time base + synthesized signal generator

¹The uncertainty covered by the Calibration and Measurement Capability (CMC) is expressed as the expanded uncertainty having a coverage probability of approximately 95 %. It is the smallest measurement uncertainty that a laboratory can achieve within its scope of accreditation when performing calibrations of a best existing device. The measurement uncertainty reported on a calibration certificate may be greater than that provided in the CMC due to the behavior of the calibration item and other factors that may contribute to the uncertainty of a specific calibration.

²When uncertainty is stated in relative terms (such as percent, a multiplier expressed as a decimal fraction or in scientific notation), it is in relation to instrument reading or instrument output, as appropriate, unless otherwise indicated.

³Capability is suitable for the calibration of measuring devices in the stated ranges.

⁴Capability is suitable for the calibration of devices intended to generate the indicated quantity in the stated ranges.