Schedule of Accreditation

issued by

United Kingdom Accreditation Service

2 Pine Trees, Chertsey Lane, Staines-upon-Thames, TW18 3HR, UK

0331

Accredited to ISO/IEC 17025:2017

SGS United Kingdom Limited

Issue No: 047 **Issue date:** 20 July 2020

2 Martin Close
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Nottingham
NG6 8UW

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Calibration performed by the Organisations at the locations specified below

Locations covered by the organisation and their relevant activities

Laboratory locations:

Location details		Activity	Location code
Address 2 Martin Close Blenheim Industrial Estate Bulwell Nottingham NG6 8UW	**Local contact** Mr S Cooke	Dimensional Electrical Pressure Temperature Humidity	Nottingham

Site activities performed away from the locations listed above:

Location details		Activity	Location code
Customers' sites or premises The customers' site or premises must be suitable for the nature of the particular calibrations undertaken and will be the subject of contract review arrangements between the laboratory and the customer.	Mr S Cooke	Dimensional Electrical Pressure Temperature	Based at Nottingham

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DETAIL OF ACCREDITATION

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETRES UNLESS OTHERWISE STATED				Nottingham
LENGTH			NOTE	
Plain plug gauges (parallel), cylindrical setting standards and rollers	1 to 50 50 to 100 100 to 150 150 to 200 200 to 300	0.50 0.80 1.0 1.2 1.6	Plain cylindrical limit gauges are calibrated using a single axis measuring machine and referecnce standards	
Thread measuring cylinders	BS 5590 0.1 to 5	 0.50		
Plain ring gauges (parallel) and setting standards	2 to 10 diameter 10 to 25 25 to 50 50 to 100 100 to 150 150 to 250	1.0 0.80 1.0 1.5 2.0 3.0		
Length gauges, flat and spherical ended	0 to 600	1.0 + (8.0 x length in m)		
Plain gap gauges (parallel)	0.5 to 100 100 to 200 200 to 300	3.0 5.0 8.0	Using gauge block	
Feeler Gauges and paint thickness folils	BS 957:2008 0.025 to 1	1.0	Using a single axis measuring machine	
Screw plug gauges (parallel) including check and setting plugs See Note 3	1 to 100 diameter 100 to 150 150 to 200	2.5 5.0 on pitch 8.0 diameter	Thread gauges are calibrated using NPL methods described in Notes on Applied Science No. 1	
Screw plug gauges (taper) including check plugs See Note 2	5 to 100 diameter	5.0 on pitch diameter		
Screw ring gauges (parallel) See Notes 3 and 4	3 to 75 diameter 75 to 150 150 to 250	 5.0 on pitch 7.0 diameter 10		
Screw ring gauges (taper) See Note 2	6 up to 150 diameter	7.0 on pitch diameter		
Screw pitch Screw flank angle	0.2 to 8 0° to 52°	1.5 5.0 minutes of arc		
Parallels	BS906:1972 5 to 50 x 100 x 400	 1.5 up to 5.0		

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
RANGE IN MILLIMETRES AND UNCERTAINTY IN MICROMETRES UNLESS OTHERWISE STATED				Nottingham
LENGTH (cont'd)				
Vee blocks	BS 3731:1987 20 to 150	2.5 to 5.0		
Receiver, position and profile gauges, jigs, fixtures See note 5	Maximum dimensions 0 to 1000 x 750 x 500 (Limited to gauges where a specific procedure and uncertainty budget are available).	Minimum per co-ordinate: 3.0 + (10 x length in m)	Documented in-house methods using a cmm and first priciples	
ANGLE				
Squares Blade type	BS 939:2007 50 to 300 300 to 600	 3.0 On squareness 5.0 See Note 1		
Angle plates and box angle plates	BS 5535:1978 50 to 600	Squareness: 3.0 + (1.0 per 100 mm) Parallelism: 1.0 + (1.0 per 100 mm) See Note 1		
Sine bars and tables	BS 3064:1978 0 to 500 length	Linear dimensions: 1.0 + (10 x length in m) Overall performance: 3.0 seconds of arc		
FORM				
Surface plates Granite and Cast iron	BS 817:2008 and above 160 x 100 to 1600 x 1000	1.5 + (0.80 diagonal in m) See Note 1		
Steel balls	1 to 25 diameter	0.50 on diameter	Single axis measuring machine and reference standard	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
MEASURING INSTRUMENTS AND MACHINES				
Micrometers External	BS 870:2008 0 to 600	Heads: 2.0		
Internal	BS 959:2008 0 to 900	Setting and extension rods 1.0 + (8.0 x length in m)		
Depth	BS 6468:2008 0 to 300			
Micrometer heads	BS 1734:1951 0 to 50	1.0		
Bench micrometer	NPL MOY/SCMI 22 0 to 100	Overall performance 1.0		
Vernier caliper, height and depth gauges	BS 887:2008 0 to 1000 BS 1643:2008 0 to 1000 BS 6365:2008 0 to 600	Overall performance 10 + (30 x length in m)		
Height gauges - (Simple) including vernier, dial and digital types.	As BS EN ISO 13225:2012 0 to 1000	Length measurement error (E): 2.0 + (5.0 x length in metres)		
Dial gauges and dial test indicators	BS 907:2008 and BS 2795:1981 0 to 50	1.0		
Comparators (external)	BS 1054:1975 250 to 10 000 magnifications	1.0 % of range Minimum 0.20		
Graduated rules	BS 4372:1968 0 to 1000	5.0 + (10 x length in m)		
Bevel protractors	BS 1685:2008 0° to 360°	6.0 minutes of arc		
Electronic height gauges with microprocessor control	0 to 1000	2.0 + (5.0 x length in m)	Documented in-house methods	

Notes for length, angle and form

1 The uncertainty quoted is for the departure from flatness, straightness, parallelism, or squareness, i.e. the distance separating the two parallel planes which just enclose the surface under consideration.

2. Single start, symmetrical thread forms only.

3. Single and multi-start symmetrical and asymmetrical thread forms.

4. Includes use of check plugs for screw rings from 1 mm to 14 mm diameter

5. Features and associated parts of these gauges can be measured to the uncertainties given for equivalent items listed in this schedule.

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
ELECTRICAL			Electrical calibrations are performed as a comparison against a reference standard These values can be generated for the calibration of measuring instruments, Outputs of instruments can be measured directly	Nottingham
DC Voltage	0 mV to 200 mV 200 mV to 2 V 2 V to 20 V 20 V to 200 V 200 V to 1000 V 1kV to 50 kV	10 ppm + 0.80 μV 7.0 ppm + 1.0 μV 8.0 ppm + 3.5 μV 8.0 ppm +60 μV 8.0 ppm + 0.60 mV 0.20 % + 7.0 V		
DC Resistance	0 Ω to 20 Ω 20 Ω to 200 Ω 200 Ω to 2 kΩ 2 kΩ to 20 kΩ 20 kΩ to 200 kΩ 200 kΩ to 2 MΩ 2 MΩ to 20 MΩ 20 MΩ to 200 MΩ 200 MΩ to 1 GΩ	18 ppm + 24 μΩ 11 ppm + 0.10 mΩ 9.0 ppm + 0.80 mΩ 9.0 ppm + 8.0 mΩ 13 ppm + 80 mΩ 22 ppm + 1.7 Ω 38 ppm + 100 Ω 200 ppm + 11 kΩ 0.12 % + 0.10 MΩ		
DC Current	0 μA to 200 μA 200 μA to 2 mA 2 mA to 20 mA 20 mA to 200 mA 200 mA to 2 A 2 A to 30 A	35 ppm + 0.80 nA 30 ppm + 6.0 nA 35 ppm + 52 nA 46 ppm + 1.2 μA 70 ppm + 25 μA 400 ppm + 0.30 mA		
AC Voltage	*20 Hz to 60 Hz* 1 mV to 200 mV 200 mV to 2 V 2 V to 20 V 20 V to 200 V 200 V to 1000 V *60 Hz to 3 kHz* 1 mV to 200 mV 200 mV to 2 V 2 V to 20 V 20 V to 200 V 200 V to 1000 V *3 kHz to 30 kHz* 1 mV to 200 mV 200 mV to 2 V 2 V to 20 V 20 V to 200 V *3 kHz to 10 kHz* 200 V to 1000 V	 0.025 % + 5.0 μV 0.024 % + 24 μV 0.021 % + 0.23 mV 0.021 % + 2.3 mV 0.024 % + 12 mV 0.022 % + 5.0 μV 0.014 % + 24 μV 0.014 % + 0.23 mV 0.015 % + 2.3 mV 0.020 % + 12 mV 0.025 % + 10 μV 0.015 % + 50 μV 0.015 % + 0.50 mV 0.016 % + 5.0 mV 0.040 % + 120 mV		

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
ELECTRICAL (cont'd)				Nottingham
AC Voltage (cont'd)	*30 kHz to 100 kHz* 1 mV to 200 mV 200 mV to 2 V 2 V to 20 V 20 V to 200 V	 0.060 % + 24 μV 0.075 % + 0.24 mV 0.030 % + 2.3 mV 0.050 % + 23 mV		
	100 kHz to 500 kHz 200 mV to 2 V 2 V to 20 V	 0.20 % + 2.4 mV 0.30 % + 23 mV		
	500 kHz to 1 MHz 200 mV to 2 V 2 V to 20 V	 0.25 % + 24 mV 0.25 % + 230 mV		
	50 Hz 1 kV to 50 kV	 0.60 % + 60 V		
AC Current				
	40 Hz to 1 kHz 1 μA to 200 μA 200 μA to 2 mA 2 mA to 20 mA 20 mA to 200 mA	 0.040 % + 24 nA 0.040 % + 0.24 μA 0.040 % + 2.4 μA 0.045 % + 24 μA		
	40 Hz to 100 Hz 200 mA to 2 A	 0.030 % + 0.50 mA		
	100 Hz to 1 kHz 200 mA to 2 A	 0.065 % + 1.0 mA		
	1 kHz to 5 kHz 1 μA to 200 μA 200 μA to 2 mA 2 mA to 20 mA 20 mA to 200 mA 200 mA to 2 A	 0.10 % + 24 nA 0.075 % + 0.24 μA 0.075 % + 2.4 μA 0.090 % + 24 μA 0.14 % + 1.0 mA		
	50 Hz to 60 Hz 2 A to 30 A	 0.040 % + 2.5 mA		

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
ELECTRICAL (cont'd)				Nottingham
Electrical calibration of temperature indicators for the following sensors:				
Noble metal thermocouples	0 °C to 1600 °C	0.50 °C	Including cold junction compensation	
	0 °C to 1600 °C	0.15 °C	Cold junction disabled	
Base metal thermocouples	-200 °C to +1300 °C	0.13 °C	Including cold junction compensation	
	-200 °C to +1300 °C	0.060 °C	Cold junction disabled	
Resistance sensors	-200 °C to +250 °C +250 °C to +650 °C	5.0 m°C 30 m°C		
Cold junction compensation of thermocouple indictors and sources	At ambient temperature	0.10 °C		
Capacitance Sourcing	1 nF 10 nF 20 nF 50 nF 100 nF 1 μF 10 μF	4.2 pF 30 pF 48 pF 72 pF 93 pF 2.0 nF 50 nF		
Frequency Measurement	0 Hz to 3 GHz 3 GHz to 26 GHz	4.0 in 10^{12} + 3.0 mHz 3.0 in 10^{9}		
Generation	0 Hz to 6 GHz	4.0 in 10^{12}		
Period	10 ns to 1700 s	1.5 in 10^{9}		
Time interval	1 s to 8 x 10^{5} s	8.0 in 10^{9}		

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
ELECTRICAL (cont'd)				
17th and 18th edition electrical test insturments			Using the calibrator to generate known quantities to simulate measurements made by the Elecrical Test Instruments	
Insulation Testers				
Resistance	10 kΩ to 10 MΩ 10 MΩ to 100 MΩ 100 MΩ to 1 GΩ	0.30 % 0.85 % 1.5 %		
Output Voltage DC	50 V to 1000 V	0.40 %		
Output Current DC	0 mA to 1 mA	0.060 % + 6.0 µA		
Continuity Resistance	50 mΩ to 1 Ω 1 Ω to 50 kΩ	0.30 % + 12 mΩ 0.40 %		
Continuity Current DC	0 mA to 320 mA	0.70 mA		
Voltage AC	100 V to 400 V at 50 Hz	0.40 %		
Loop Testers				
Loop Resistance	0 Ω to 5 Ω 9 Ω to 1000 Ω	0.60 % + 24 mΩ 0.60 % + 45 mΩ		
RCD Testers				
Current Measurement AC	0.1mA to 3000mA at 50 Hz	1.4 % + 0.070 mA		Nottingham
Trip time	0 ms to 390 ms 390 ms to 5 s	0.70 ms 8.2 ms		
Appliance Testers				
Insulation Resistance	0.1 MΩ to 10 MΩ	0.30 %		
Earth Bond Resistance	50 mΩ to 10 Ω 10 Ω to 1000 Ω	0.60 % + 8.0 mΩ 0.60 % + 35 mΩ		
Earth Bond Current AC	0.1 mA to 500 mA at 50 Hz 500 mA to 30 A at 50 Hz	1.75 % + 7.0 mA 1.75 % + 75 mA		
Leakage Current AC	1 mA to 8 mA at 50 Hz	1.75 % + 10 µA		
Flash Test (Accessory)				
AC Voltage	0.1 kV to 3 kV at 50 Hz	2.0 % + 12 V		
AC Leakage Current	0.1 mA to 3 mA at 50 Hz	6.0 % + 17 µA		

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
ELECTRICAL (cont'd)				Nottingham
Electrical verification of ultrasonic flaw detection equipment	AS BS EN 12668-1:2010			
	Stability after warm up (height)	0.30 % of screen height		
	Stability after warm up (width)	0.020 % of screen width		
	Jitter – screen height	0.30 % of screen height		
	Jitter – screen width	0.30 % of screen width		
	Stability against supply variations (height)	0.30 % of screen height		
	Stability against supply variations (width)	0.020 % of screen width		
	Pulser Voltage	3.6 V		
	Pulser Rise Time	1.7 ns		
	Pulser Reverberation	1.0 % of pulsar voltage		
	Pulse Duration	1.7 ns		
	Frequency Response			
	0.1 MHz to 25 MHz	30 kHz at -3 dB point		
	Equivalent input noise	2.4 x 10^{-9} V√Hz		
	Calibrated Attenuator			
	0 MHz to 100 MHz	0.60 dB		
	Vertical Linearity	0.70 % of screen height		
	Linearity of Timebase	0.25 % relative to 20 % and 80 % of the horizontal scale		
PRESSURE				
<u>Gas Pressure Gauge</u>			Methods consistent with EURAMET CG3	
Calibration of pressure indicating instruments and gauges	-95 kPa to -20 kPa	0.012 % + 66 Pa		
	-20 kPa to 20 kPa	0.015 % + 10 Pa		
	20 kPa to 200 kPa	0.012 % + 66 Pa		
	200 kPa to 2 MPa	0.012 % + 590 Pa		
<u>Gas Pressure Absolute</u>				
Calibration of pressure indicating instruments and gauges	3.5 kPa to 120 kPa	100 Pa		
	120 kPa to 200 kPa	140 Pa		
<u>Hydraulic Pressure Gauge</u>				
Calibration of pressure indicating instruments and gauges	0 Pa to 13.5 MPa	0.010 % + 6.0 kPa		
	13.5 MPa to 70 MPa	0.015 % + 20 kPa		

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
TEMPERATURE			Calibration by Comparison with reference instruments	Nottingham
Resistance thermometers	-20 °C to +100 °C 100 °C to 250 °C 250 °C to 600 °C	0.055 °C 0.075 °C 0.15 °C	Liquid bath Block calibrator	
Thermocouples	-20 °C to 250 °C 250 °C to 600 °C 600 ˚C to 1100 ˚C 1100 ˚C to 1300 ˚C	0.50 °C 0.90 °C 1.9 ˚C 2.8 ˚C	Liquid bath Block calibrator Spherical furnace	
Temperature indicators with probes	-20 °C to +100 °C 100 °C to 250 °C 250 °C to 600 °C	0.060 °C 0.090 °C 0.15 °C	Liquid bath Block calibrator	
	Ambient (typically 20 °C)	0.070 °C	Ambient air	
Dry Block Calibrators	-20 °C to +600 °C	0.13 °C		
Radiation thermometers (Pyrometers)	0 °C to +100 °C 100 °C to 200 °C 200 °C to 350 °C 350 °C to 500 °C	1.0 °C 1.5 °C 2.5 °C 3.5 °C	Radiation thermometers working in the wavelength range 8 µm to 14 µm	
Calibration in air chamber	5 °C to 23 °C 23 °C to 60 °C	0.10 °C 0.15 °C	Comparison in air chamber	
HUMIDITY			Calibration by comparison with a reference hygrometer and reference thermometers	
Relative humidity meters	*At 5 °C to 12 °C* 15 %rh to 90 %rh *At 12 °C to 23 °C* 10 %rh to 90 %rh *At 23 °C to 60 °C* 10 %rh to 90 %rh	 0.45 %rh to 1.9 %rh 0.50 %rh to 1.9 %rh 0.50 %rh to 1.6 %rh	Comparison in air chamber	

Measured Quantity Instrument or Gauge	Range	Calibration and Measurement Capability (CMC) Expressed as an Expanded Uncertainty (k = 2)	Remarks	Location Code
DIMENSIONAL				On site calibrations Based at Nottingham
Surface plates Granite and Cast iron	BS 817:2008 and above 160 x 100 to 1600 x 1000	1.5 + (0.80 diagonal in m) See Note 1		
Electronic height gauges with microprocessor control	0 to 1000	2.0 + (5.0 x length in m)		
ELECTRICAL				
Electrical calibration of temperature indicators for the following sensors:				
Noble metal thermocouples	0 °C to 1600 °C	0.90 °C	Including cold junction compensation	
Base metal thermocouples	-200 °C to +1300 °C	0.70 °C	Including cold junction compensation	
Resistance sensors	-200 °C to +850 °C	0.30 °C		
PRESSURE			Methods consistent with EURAMET CG3	
<u>Gas Pressure Gauge</u>				
Calibration of pressure indicating instruments and gauges	-95 kPa to -20 kPa -20 kPa to 20 kPa 20 kPa to 200 kPa 200 kPa to 2 MPa	0.012 % + 66Pa 0.015 % + 10 Pa 0.012 % + 66 Pa 0.012 % + 590 Pa		
<u>Gas Pressure Absolute</u>				
Calibration of pressure indicating instruments and gauges	3.5 kPa to 120 kPa 120 kPa to 200 kPa	100 Pa 140 Pa		
<u>Hydraulic Pressure Gauge</u>				
Calibration of pressure indicating instruments and gauges	0 Pa to 13.5 MPa 13.5 MPa to 70 MPa	0.010 % + 6.0 kPa 0.015 % + 20 kPa		
TEMPERATURE				
Resistance thermometers	50 °C to 300 °C 300 °C to 600 °C	0.50 °C 1.3 °C	Comparison in block calibrator	
Thermocouples	0 °C to 130 °C 130 °C to 350 °C 350 °C to 600 °C	0.60 °C 0.85 °C 1.5 °C		
Temperature indicators with probes	0 °C to 130 °C 130 °C to 350 °C 350 °C to 600 °C	0.50 °C 0.80 °C 1.4 °C		
END				

Appendix - Calibration and Measurement Capabilities

Introduction

The definitive statement of the accreditation status of a calibration laboratory is the Accreditation Certificate and the associated Schedule of Accreditation. This Schedule of Accreditation is a critical document, as it defines the measurement capabilities, ranges and boundaries of the calibration activities for which the organisation holds accreditation.

Calibration and Measurement Capabilities (CMCs)

The capabilities provided by accredited calibration laboratories are described by the Calibration and Measurement Capability (CMC), which expresses the lowest uncertainty of measurement that can be achieved during a calibration. If a particular device under calibration itself contributes significantly to the uncertainty (for example, if it has limited resolution or exhibits significant non-repeatability) then the uncertainty quoted on a calibration certificate will be increased to account for such factors. The CIPM-ILAC definition of the CMC is as follows:

A CMC is a calibration and measurement capability available to customers under normal conditions:
(a) as published in the BIPM key comparison database (KCDB) of the CIPM MRA; or
(b) as described in the laboratory's scope of accreditation granted by a signatory to the ILAC Arrangement.

The CMC is normally used to describe the uncertainty that appears in an accredited calibration laboratory's schedule of accreditation and is the uncertainty for which the laboratory has been accredited using the procedure that was the subject of assessment. The CMC is calculated according to the procedures given in M3003 and is normally stated as an expanded uncertainty at a coverage probability of 95 %, which usually requires the use of a coverage factor of $k = 2$. An accredited laboratory is not permitted to quote an uncertainty that is smaller than the published CMC in certificates issued under its accreditation.

The CMC may be described using various methods in the Schedule of Accreditation:

As a single value that is valid throughout the range.
As an explicit function of the measurand or of a parameter (see below).
As a range of values. The range is stated such that the customer can make a reasonable estimate of the likely uncertainty at any point within the range.
As a matrix or table where the CMCs depend on the values of the measurand and a further quantity.
In graphical form, providing there is sufficient resolution on each axis to obtain at least two significant figures for the CMC.

Expression of CMCs - symbols and units

In general, only units of the SI and those units recognised for use with the SI are used to express the values of quantities and of the associated CMCs. Nevertheless, other commonly used units may be used where considered appropriate for the intended audience. For example, the term "ppm" (part per million) is frequently used by manufacturers of test and measurement equipment to specify the performance of their products. Terms like this may be used in Schedules of Accreditation where they are in common use and understood by the users of such equipment, providing their use does not introduce any ambiguity in the capability that is being described.

When the CMC is expressed as an explicit function of the measurand or of a parameter, this often comprises a relative term (e.g., percentage) and an absolute term, i.e. one expressed in the same units as those of the measurand. This form of expression is used to describe the capability that can be achieved over a range of values. Some examples are shown below. It should be noted that these expressions are *not* mathematical formulae but are instead written in a commonly used shorthand for expressing uncertainties - therefore, for purposes of clarity, an indication of how they are to be interpreted is also provided below.

DC voltage, 100 mV to 1 V: 0.0025 % + 5.0 µV

Over the range 100 mV to 1 V, the CMC is 0.0025 %·V + 5.0 µV, where V is the measured voltage.

Hydraulic pressure, 0.5 MPa to 140 MPa: 0.0036 % + 0.12 ppm/MPa + 4.0 Pa

Over the range 0.5 MPa to 140 MPa, the CMC is 0.0036 %·p + ($0.12 \cdot 10^{-6} \cdot p \cdot 10^{-6}$) + 4.0 Pa, where p is the measured pressure in Pa.

It should be noted that the percentage symbol (%) simply represents the number 0.01. In cases where the CMC is stated only as a percentage, this is to be interpreted as meaning percentage of the measured value or indication.

Thus, for example, a CMC of 1.5 % means $1.5 \cdot 0.01 \cdot i$, where i is the instrument indication.