Element Materials Technology Sheffield Ltd
3 Ignite
Magna Way
Rotherham
S60 1FD
UNITED KINGDOM

P +44 (0) 114 272 6581
F +44 (0) 114 272 3248
info.sheffield@element.com
www.element.com

CALIBRATION CERTIFICATE

PPT GROUP UK LTD
t/a MECMESIN LTD
NEWTON HOUSE
SPRING COPSE BUSINESS PARK
SLINFOLD
HORSHAM
RH13 0SZ TM0199

Certificate No: 2404026
Issue Date: 09 April 2024

Calibration Date: 09 April 2024
Technician: L Shenton

Description: A 25 kN compression and tension strain gauged load cell, used with an associated digital indicator, both manufactured by Interface.

Identification: 278764 on load cell.
59019 (TM0200) (Channel B) on indicator.
TM0200 on cable.

Basis of Calibration: BS EN ISO 376:2011
Increasing Forces Only

Calibration Location: Element Sheffield (address shown in header)

Classification: The force proving instrument satisfies the requirement of BS EN ISO 376:2011 for the following classification range:-

Compression	**Class 0.5 ,**	**25 kN down to 0.5 kN**
Tension,	**Class 0.5 ,**	**25 kN down to 0.5 kN**

Issued by:
R Moore
Force Calibration Technician

UKAS CALIBRATION
0157

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Method:

The calibration was made in the laboratory's No. 4 Force Standard Machine in terms of the SI unit of force, the kilonewton (kN). The uncertainty of the forces applied during the calibration is ± 1 part in 5 000 (±0.02%).

An overload test as specified in Clause B.1 of Annex B of BS EN ISO 376:2011 was carried out prior to the calibration.

A creep test as specified in Clause 7.4.4 of BS EN ISO 376:2011 was performed for between 30 and 300 seconds at maximum load after the final pre-load, the results of which were within the classification parameters stated in Clause 8.2.5 table 2 of BS EN ISO 376:2011.

Two tests were made in compression followed by two tests in tension. Two further tests were then made in compression followed by two further tests in tension. The forces were applied to the device in compression through a soft pad, provided by Element, placed centrally on the domed upper loading boss. In tension the forces were applied to the device through adaptors, also provided by Element.

Measurements:

1. The bearing pad test, Clause B.2 of Annex B of BS EN ISO 376:2011, was carried out during a previous calibration in March 2012, certificate Serial No. 12121615. The force proving instrument satisfies the requirements of the bearing pad test for the following classification range(s):-

   Class 0.5 25 kN down to 0.5 kN

2. The temperature during the calibration tests varied between 20.0°C and 20.5°C.

3. Before calibration commenced the device was zeroed using the Tare button. The no-load readings for compression and tension are shown in the table below. The results on the following pages have been adjusted using a linear progression between the initial and final zero values based on these zero readings.

	Compression				Tension			
	Run 1	Run 2	Run 3	Run 4	Run 1	Run 2	Run 3	Run 4
Initial Zero	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Final Zero	0.6	0.5	0.3	0.4	-0.3	-0.2	-0.3	-0.3

4. The measurements were taken in the "GrsB" mode with the sensor select set to channel B and 278764 also the cable plugged into Load B on the rear of the indicator.

5. The forces applied and the resulting deflections are given in Tables 1 and 2: no correction for temperature has been applied to the results.

6. For calibration in the compression mode in increasing forces, the estimate of the mean deflection was calculated as the mean of the tests 1, 3 and 4.

7. The procedure above was repeated for the calibration in the tension mode.

   For each mode of application of force, the coefficients of a third degree equation relating the estimate of the mean deflection as a function of the applied calibration force were calculated by the method of least squares. The differences between the mean value of deflection with rotation for each force and the computed value of deflection given by the equation were used to determine the relative interpolation error. The coefficients of a third degree equation relating a given applied force to the estimate of the mean deflection were also calculated.

Notes:

1. Clause 8.3.2 of BS EN ISO 376:2011 states that the maximum period of validity of the calibration of a force proving instrument shall not exceed 26 months. The force proving instrument shall be recalibrated if it sustains an overload which exceeds the maximum force by 12%.
2. Clause 9 of BS EN ISO 376:2011 states that the force proving instrument shall be loaded in accordance with the conditions under which it was calibrated. Precautions shall be taken to prevent it from being subject to forces greater than the maximum force to which it is classified.
3. If given or calculated forces are required to be in terms of one of the technical units of force, then the following conversion factors may be used:

Required unit of force	Factor by which the force in kilonewtons must be multiplied
kilogram-force (kgf)	101.972
pound-force (lbf)	224.809
ton-force (tonf)	100.361×10^{-3}

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Results Table 1 : Compression

Test Number	1	2	5	6	Unbiased	Expanded	Expanded
Orientation	0°	0°	120°	240°	estimate	Uncertainty	Uncertainty
					of mean	kN	%
Force (kN)	Deflection (N)					±	
0.5	499.8	499.7	499.4	499.7	499.6	0.000311	0.00062
1	999.3	998.9	998.8	999.1	999.1	0.000700	0.00070
2.5	2497.8	2497.7	2497.5	2497.8	2497.7	0.000600	0.00024
5	4996.1	4996.1	4996.0	4996.1	4996.1	0.001125	0.00023
7.5	7495.2	7495.1	7494.9	7495.2	7495.1	0.001689	0.00023
10	9994.7	9994.7	9994.6	9994.8	9994.7	0.002241	0.00022
12.5	12494.9	12494.7	12494.6	12494.9	12494.8	0.002806	0.00022
15	14995.8	14995.7	14995.3	14995.7	14995.6	0.003375	0.00022
17.5	17496.9	17496.6	17496.6	17496.6	17496.7	0.003923	0.00022
20	19998.2	19997.9	19998.0	19998.2	19998.1	0.004486	0.00022
22.5	22500.1	22499.7	22499.7	22499.9	22499.9	0.005045	0.00022
25	25002.3	25001.9	25001.9	25002.2	25002.1	0.005610	0.00022

Maximum Relative Uncertainty = 0.07%

Coefficients

For a given applied force F (in kN), the expected deflection D (in N) OR For a given deflection D (in N), the applied force F (in kN) is calculated from the following:

$$D=B_0+B_1F+B_2F^2+B_3F^3 \qquad F=A_0+A_1D+A_2D^2+A_3D^3$$

where:

B_0 =	1.32044E-01	A_0 =	-1.31642E-04
B_1 =	9.98892E+02	A_1 =	1.00111E-03
B_2 =	6.24127E-02	A_2 =	-6.25083E-11
B_3 =	-5.98623E-04	A_3 =	6.01486E-16

If the expanded uncertainty is required for forces other than above it can be calculated from the following:

$$U_{exp}=(C_0+C_1F+C_2F^2)x2$$

where:

C_0 = 0.00000E+00
C_1 = 9.32504E-05
C_2 = 5.81198E-07

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Results Table 2 : Tension

Test Number	3	4	7	8	Unbiased estimate of mean	Expanded Uncertainty kN	Expanded Uncertainty %
Orientation	0°	0°	120°	240°			
Force (kN)	Deflection (N)					±	
0.5	-499.3	-499.4	-499.4	-499.5	-499.4	0.000513	0.00103
1	-998.3	-998.3	-998.2	-998.3	-998.2	0.000404	0.00040
2.5	-2496.1	-2496.5	-2495.8	-2496.8	-2496.3	0.000899	0.00036
5	-4993.3	-4993.9	-4993.3	-4993.6	-4993.4	0.001359	0.00027
7.5	-7491.5	-7491.7	-7491.3	-7491.7	-7491.5	0.001694	0.00023
10	-9990.6	-9990.6	-9989.9	-9990.3	-9990.2	0.002250	0.00023
12.5	-12489.7	-12489.7	-12489.1	-12489.5	-12489.5	0.002787	0.00022
15	-14989.4	-14989.7	-14988.8	-14989.4	-14989.2	0.003352	0.00022
17.5	-17489.3	-17489.5	-17488.9	-17489.5	-17489.2	0.003882	0.00022
20	-19989.5	-19989.9	-19989.3	-19989.9	-19989.5	0.004483	0.00022
22.5	-22490.9	-22490.4	-22490.5	-22490.3	-22490.6	0.005012	0.00022
25	-24992.1	-24991.3	-24990.9	-24991.3	-24991.4	0.005634	0.00023

Maximum Relative Uncertainty = 0.10%

Coefficients

For a given applied force F (in kN), the expected deflection D (in N) OR For a given deflection D (in N), the applied force F (in kN) is calculated from the following:

$D=B_0+B_1F+B_2F^2+B_3F^3$ $F=A_0+A_1D+A_2D^2+A_3D^3$

where:

$B_0 =$ 3.58822E-02 $A_0 =$ 3.68254E-05
$B_1 =$ -9.98368E+02 $A_1 =$ -1.00163E-03
$B_2 =$ -7.40510E-02 $A_2 =$ -7.42321E-11
$B_3 =$ 8.97719E-04 $A_3 =$ -9.01933E-16

If the expanded uncertainty is required for forces other than above it can be calculated from the following:

$U_{exp}=(C_0+C_1F+C_2F^2)x2$

where:

$C_0 =$ 0.00000E+00
$C_1 =$ 8.89617E-05
$C_2 =$ 6.60126E-07

End of Certificate

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