

CALIBRATION CERTIFICATE

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Certificate No: 2605056
Issue Date: 02 June 2026
Calibration Date: 27 May 2026
Technician: R Moore

Description: A 50 N compression and tension strain gauged load cell, used with an associated digital indicator, both manufactured by Interface.

Identification: 1602377 on load cell. *TM0512*
17989275 on indicator.

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 ,	50 N down to 2 N
	Class 1.0 ,	50 N down to 1 N
Tension,	Class 0.5 ,	50 N down to 2 N
	Class 1.0 ,	50 N down to 1 N

Signed for and on behalf of Element Sheffield:

L Shenton



Force Calibration Supervisor



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The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k=2$, which for a normal distribution corresponds to a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements. The certificate and results within, relates only to the item calibrated as shown on the first page of the certificate.

When Element is making statements of conformity a simple acceptance rule has been applied.
Uncertainty budgets have been determined and are available on request.

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Method:

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

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 ball seating unit, provided by Element, placed centrally on the upper loading boss. In tension the forces were applied to the device through adaptors, also provided by Element.

Measurements:

- The bearing pad test, Clause B.2 of Annex B of BS EN ISO 376:2011, was carried out during this calibration. The force proving instrument satisfies the requirements of the bearing pad test for the following classification range(s):-

Class 0.5	50 N down to 2 N
Class 1.0	50 N down to 1 N

- The temperature during the calibration tests varied between 19.8°C and 20.2°C.
- 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	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Final Zero	-0.001	0.001	0.000	0.000	0.001	0.000	0.001	0.001

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



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5. 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.

6. 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:

<u>Required unit of force</u>	<u>Factor by which the force in newtons must be multiplied</u>
kilogram-force (kgf)	101.972×10^{-3}
pound-force (lbf)	224.809×10^{-3}
ton-force (tonf)	100.361×10^{-6}



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Results Table 1 : Compression

Test Number	1	2	5	6	Unbiased estimate of mean	Expanded Uncertainty N	Expanded Uncertainty %
Orientation	0°	0°	120°	240°			
Force (N)	Deflection (N)					±	
1	-1.000	-1.000	-1.000	-1.000	-1.000	0.00099	0.10%
2	-2.000	-2.000	-2.000	-2.000	-2.000	0.00102	0.05%
5	-5.001	-5.001	-5.001	-5.001	-5.001	0.00163	0.03%
10	-10.003	-10.003	-10.003	-10.003	-10.003	0.00271	0.03%
15	-15.005	-15.005	-15.005	-15.005	-15.005	0.00398	0.03%
20	-20.007	-20.006	-20.006	-20.006	-20.006	0.00508	0.03%
25	-25.007	-25.008	-25.007	-25.006	-25.007	0.00654	0.03%
30	-30.010	-30.010	-30.010	-30.009	-30.010	0.00784	0.03%
35	-35.010	-35.010	-35.010	-35.009	-35.010	0.00885	0.03%
40	-40.012	-40.011	-40.011	-40.010	-40.011	0.01023	0.03%
45	-45.012	-45.011	-45.011	-45.011	-45.011	0.01140	0.03%
50	-50.013	-50.012	-50.012	-50.012	-50.012	0.01259	0.03%

Maximum Relative Uncertainty = 0.10%

Coefficients

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

$$D = B_0 + B_1 F + B_2 F^2 + B_3 F^3$$

$$F = A_0 + A_1 D + A_2 D^2 + A_3 D^3$$

where:

$$B_0 = 6.16529E-04$$

$$A_0 = 6.16265E-04$$

$$B_1 = -1.00036E+00$$

$$A_1 = -9.99637E-01$$

$$B_2 = 6.16180E-07$$

$$A_2 = 6.14034E-07$$

$$B_3 = 3.05332E-08$$

$$A_3 = -3.05239E-08$$

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

$$U_{exp} = (C_0 + C_1 F + C_2 F^2) \times 2$$

where:

$$C_0 = 0.00000E+00$$

$$C_1 = 1.13615E-04$$

$$C_2 = 1.52032E-07$$

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Results Table 2 : Tension

Test Number	3	4	7	8	Unbiased estimate of mean	Expanded Uncertainty N	Expanded Uncertainty %
Orientation	0°	0°	120°	240°			
Force (N)	Deflection (N)					±	
1	1.000	1.000	1.000	1.000	1.000	0.00088	0.09%
2	2.001	2.000	2.000	2.000	2.000	0.00155	0.08%
5	5.002	5.001	5.001	5.000	5.001	0.00213	0.04%
10	10.004	10.003	10.003	10.002	10.003	0.00280	0.03%
15	15.006	15.005	15.005	15.004	15.005	0.00377	0.03%
20	20.007	20.006	20.007	20.006	20.006	0.00469	0.02%
25	25.009	25.007	25.007	25.006	25.008	0.00662	0.03%
30	30.011	30.008	30.009	30.007	30.009	0.00821	0.03%
35	35.013	35.009	35.011	35.009	35.011	0.00965	0.03%
40	40.015	40.010	40.013	40.011	40.013	0.01114	0.03%
45	45.016	45.011	45.014	45.012	45.014	0.01203	0.03%
50	50.018	50.013	50.016	50.014	50.016	0.01294	0.03%

Maximum Relative Uncertainty = 0.09%

Coefficients

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

$$D = B_0 + B_1 F + B_2 F^2 + B_3 F^3$$

$$F = A_0 + A_1 D + A_2 D^2 + A_3 D^3$$

where:

$$B_0 = -4.30112E-04$$

$$A_0 = 4.29992E-04$$

$$B_1 = 1.00030E+00$$

$$A_1 = 9.99697E-01$$

$$B_2 = 1.77360E-06$$

$$A_2 = -1.77168E-06$$

$$B_3 = -2.62170E-08$$

$$A_3 = 2.61807E-08$$

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

$$U_{exp} = (C_0 + C_1 F + C_2 F^2) \times 2$$

where:

$$C_0 = 0.00000E+00$$

$$C_1 = 1.07766E-04$$

$$C_2 = 3.82895E-07$$

End of Certificate