



सी एस आई आर – राष्ट्रीय भौतिक प्रयोगशाला
CSIR-NATIONAL PHYSICAL LABORATORY
 (वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद्)
 (Council of Scientific and Industrial Research)



(राष्ट्रीय मापकी संस्थान (एनएमआई), सदस्य बीआईपीएस एवं हस्ताक्षरकर्ता सीआईपीएम - एमआरए)
 (National Metrology Institute (NMI), Member BIPM and Signatory CIPM - MRA)

डॉ. के. एस. कृष्णन् मार्ग, नई दिल्ली-110012, भारत
 Dr. K. S. Krishnan Marg, New Delhi-110012 INDIA

दूरभाष/Phone : +91-11-4560, 8441, 8610, 9447, फैक्स/Fax : 91-11-4560 8448
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अंशांकन प्रमाण पत्र
CALIBRATION CERTIFICATE
FORCE PROVING INSTRUMENT

प्रमाण पत्र संख्या / Certificate No.

24050237/D1.05/C-135

दिनांक/ Date	अगले अंशांकन हेतु अनुशंसित तिथि Recommended date for next calibration	पृष्ठ / Page	पृष्ठों की संख्या / No. of Pages
10.07.2024	10.09.2026	1	2

1. Calibrated for:

M/s. National Centre for Quality Calibration
 4, Abhishree Corporate Park, Nr. Swagat Bunglow BRTS,
 Iskon-Ambli Road, Ambli,
 Ahmedabad-380058 (Gujarat).
Customer's Ref. No.: Letter Dated: Nil

2. Description & identification of instrument

Type: Load Cell
 Capacity: 1 kN
 Sr. No: 03475
 Manufacturer: Stark Embsys
 Model: SE-ST-H
 Connector Type: 4 Pin
 Digital Indicator Sr. No.: 03475
 Manufacturer: Stark Embsys
 Resolution: 1 div
 Model: SE-20L-H
 Cable length: 6.20 m
Accessories: Self-aligning compression pads.

3. Environmental conditions:

Temperature: $(23 \pm 1)^\circ \text{C}$ **Relative humidity:** $(50 \pm 10) \%$

4. Standards used with Associated uncertainty

5 kN dead weight force machine.
 $\pm 0.080\%$ ($k=2$)

5. Traceability of standard used:

The standard used for calibration is traceable to the National Standard, which realize the units of quantities according to the International System of Units (SI).

6. Principle/Methodology of calibration and Calibration procedure No.:

Sub-Div.#D1.05/Doc.#3/CP#FT/F-02 broadly based on IS 4169-2014(ISO:376-2011).

No load output: The digital indicator was switched on for 30 minutes to warm up and stabilized for no load output before the start of calibration. The no load output was noted (before taring) and the calibration signal was noted.

Preloading: Before the application of the calibration forces, the instrument was preloaded thrice to its maximum capacity and kept at full load for about 90 seconds.

Calibration: The sequence of the applied calibration force in Compression is given below:

At 0° : Two series of calibration forces in increasing values. At 120° and 240° positions: One series of calibration forces each in increasing values. Creep test is performed by calculating the difference in output i_{30} obtained at 30s and i_{300} obtained at 300s after the removal of the maximum calibration force and express this difference as percentage of maximum deflection.

The calibration was made by using Self-aligning compression pads provided along with the instrument to ensure axial application of the force.

Between each series, the instrument was rotated along its axis so as to occupy during the calibration three positions (0° , 120° & 240°) and the instrument was subjected to the full load once for about 90 seconds each time before starting in a new position and thrice the changed mode.

Between the loadings, readings corresponding to no load after waiting at least 30 seconds for the return to zero were noted.

अंशांकनकर्ता:

Calibrated by:

GOPAL JEE *Gopal Jee*

Vikram *Vikram*

जाँचकर्ता:

Checked by:

Dr. Rajesh Kumar *Rajesh Kumar*

जारीकर्ता:

Issued by:

श्रीनिवास राव रागम *Dr. Srinivasa Rao Ragam*

प्रभारी वैज्ञानिक:

Scientist-in-charge

Dr. Rajesh Kumar *Dr. Rajesh Kumar*



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10.07.2024	10.09.2026	2	2

7. Results: Compression

The calibration data obtained is valid for the following digital indicator setting only					
Calibration Signal: Nil			No Load Output: 0 div		
	(Indicator Reading in div.)				
Applied Force N	Position 0° series 1	Position 0° series 2	Position 120° series 3	Position 240° series 4	Average 1,3,4
0	0	0	0	0	0
50	9993	9992	9994	9996	9994
100	19994	19996	19988	20006	19996
200	39999	40001	39975	40012	39995
300	60005	60009	59969	60028	60001
400	80016	80017	79971	80045	80011
500	100027	100029	99971	100068	100022
600	120064	120063	119993	120085	120047
700	140079	140081	140008	140112	140066
800	160107	160109	160034	160132	160091
1000	200159	200161	200098	200206	200154
0	4	2	9	5	---

Interpolation Equation: (Compression)

$$F = 2.0425 \times 10^{-17} \cdot x^3 - 3.1388 \times 10^{-11} \cdot x^2 + 5.0016 \times 10^{-3} \cdot x + 1.0518 \times 10^{-2}$$

$$x = -3.2384 \times 10^{-8} \cdot F^3 + 2.5111 \times 10^{-4} \cdot F^2 + 199.9373 \cdot F - 2.1000$$

Where F = Force in N

x = Indicator reading in div.

Classification: The force proving instrument is found to comply with the requirements of IS:4169-2014 (ISO:376-2011) in respect of interpolated forces and classified as follows:

Class	Mode	From	To	Uncertainty of Measurement
Class 0.5	Compression	1000 N	50 N	± 0.07%

The reported uncertainty is at coverage factor $k=2$ which corresponds to a coverage probability of approximately 95% for a normal distribution, considering the relative deviation of different components such as zero, repeatability, reproducibility, resolution, creep, interpolation and combining with the uncertainty of the applied force.

8. Date of calibration: 09.07.2024

9. Remarks: Nil

अंशांकनकर्ता:
Calibrated by:
 GOPAL JEE *Gopal Jee*

जाँचकर्ता:
Checked by:
 Dr. Rajesh Kumar

प्रभारी वैज्ञानिक:
Scientist-in-charge:

Vikram

जारीकर्ता:
Issued by:



डा. श्रीनिवास राव
 Dr. Srinivasa Rao Ragam

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Digital Indicator Sr. No.: 03475
 Manufacturer: Stark Embsys
 Resolution: 1 div
 Model: SE-20L-H
 Cable length: 6.20 m

Accessories: Self-aligning tension shackles.

3. Environmental conditions:

Temperature: $(23 \pm 1)^\circ \text{C}$ **Relative humidity:** $(50 \pm 10) \%$

4. Standards used with

5 kN dead weight force machine.

Associated uncertainty

$\pm 0.080\% (k=2)$

5. Traceability of standard used:

The standard used for calibration is traceable to the National Standard, which realize the units of quantities according to the International System of Units (SI).

6. Principle/Methodology of calibration and Calibration procedure No.:

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Preloading: Before the application of the calibration forces, the instrument was preloaded thrice to its maximum capacity and kept at full load for about 90 seconds.

Calibration: The sequence of the applied calibration force in Tension is given below:

At 0° : Two series of calibration forces in increasing values. At 120° and 240° positions: One series of calibration forces each in increasing values. Creep test is performed by calculating the difference in output i_{30} obtained at 30s and i_{300} obtained at 300s after the removal of the maximum calibration force and express this difference as percentage of maximum deflection.

The calibration was made by using Self-aligning tension shackles provided along with the instrument to ensure axial application of the force.

Between each series, the instrument was rotated along its axis so as to occupy during the calibration three positions (0° , 120° & 240°) and the instrument was subjected to the full load once for about 90 seconds each time before starting in a new position and thrice the changed mode.

Between the loadings, readings corresponding to no load after waiting at least 30 seconds for the return to zero were noted.

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Calibrated by:

GOPAL JEE *Gopal Jee*

Vikram *Vikram*

जाँचकर्ता:

Checked by:

Dr. Rajesh Kumar *Rajesh Kumar*

जारीकर्ता:

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7. Results: Tension

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Calibration Signal: Nil			No Load Output: 0 div		
	(Indicator Reading in div.)				
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0	0	0	0	0	0
50	9991	9989	9982	9985	9986
100	20007	20016	19990	19992	19996
200	40008	40025	39972	39976	39985
300	60018	60036	59960	59962	59980
400	80031	80043	79950	79964	79982
500	100050	100055	99950	99966	99989
600	120052	120065	119930	119952	119978
700	140060	140068	139930	139947	139979
800	160080	160064	159932	159946	159986
1000	200102	200084	199920	199949	199990
0	8	3	2	2	---

Interpolation Equation: (Tension)

$$F = -1.2891 \times 10^{-17} \cdot x^3 - 7.8920 \times 10^{-13} \cdot x^2 + 5.0007 \times 10^{-3} \cdot x + 4.2093 \times 10^{-2}$$

$$x = 2.0621 \times 10^{-8} \cdot F^3 + 6.3199 \times 10^{-6} \cdot F^2 + 199.9717 \cdot F - 8.4156$$

Where F = Force in N

x = Indicator reading in div.

Classification: The force proving instrument is found to comply with the requirements of IS:4169-2014 (ISO:376-2011) in respect of interpolated forces and classified as follows:

Class	Mode	From	To	Uncertainty of Measurement
Class 0.5	Tension	1000 N	50 N	$\pm 0.07\%$

The reported uncertainty is at coverage factor $k=2$ which corresponds to a coverage probability of approximately 95% for a normal distribution, considering the relative deviation of different components such as zero, repeatability, reproducibility, resolution, creep, interpolation and combining with the uncertainty of the applied force.

8. Date of calibration: 10.07.2024

9. Remarks: Nil

अंशांकनकर्ता:

Calibrated by:

GOPAL JEE *Gopal Jee*

Vikram

जाँचकर्ता:

Checked by:

Dr. Rajesh Kumar

जारीकर्ता:

Issued by:

Dr. Srinivasa Rao Raghunath

प्रभारी वैज्ञानिक:

Scientist-in-charge:

Dr. Rajesh Kumar