सी एस आई आर - राष्ट्रीय भौतिक प्रयोगशाला
CSIR-NATIONAL PHYSICAL LABORATORY
(वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद)
(Council of Scientific and Industrial Research)
राष्ट्रीय मापिकी संस्थान (एनएमआई), सदस्य बीआईपीएम एवं हस्ताक्षरकर्ता सीआईपीएम – एमआरए)
(National Metrology Institute (NMI), Member BIPM and Signatory CIPM - MRA)
डॉ. के. एस. कृष्णन मार्ग, नई दिल्ली-110012, भारत
Dr. K. S. Krishnan Marg, New Delhi-110012, INDIA
दूरभाष/Phone : 91-11- 4560 8441, 8589, 8610, 9447, फैक्स/ Fax : 91-11- 4560 8448
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# अंशांकन प्रमाण पत्र
# CALIBRATION CERTIFICATE
## FORCE PROVING INSTRUME

प्रमाण पत्र संख्या/ Certificate No.

2202142O/D1.05/C-464

| दिनांक /Date | अगले अंशांकन हेतु अनुशंसित तिथि Recommended date for the next calibration | पृष्ठ /Page | पृष्ठों की संख्या /No. of Pages |
|---|---|---|---|
| 25.02.2022 | 25.04.2024 | 1 | 2 |

**1. Calibrated for:** M/s National Centre for Quality Calibration,
4, Abhishree Corporate Park, Nr. Swagat Bunglow BRTS,
Iskcon-Ambli Road, Ambli, Ahmedabad – 380058.
**Customer's Ref. No. & Dt.:** Letter Dated Nil.

**2. Description & identification of instrument:**
Type: Load cell
Capacity: 3000 kN
Sr. No: 14626
Digital indicator Sr. No.: 14626
Manufacturer: Star Embedded Systems (P) L
Resolutions: 1 div.
Model: LED-SD1
Connector type: 4 pin
Cable length = 11.63 m
Make : Star Embedded Systems (P) Ltd.
**Accessories:** Self-aligning compression pads.

**3. Environmental conditions:** **Temperature:** ( 23 ± 1 )° C **Relative humidity**: (50 ± 10) %

**4. Standards used:** 3000 kN force machine
**Associated uncertainty:** ±0.05% (*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 number:** NPL Calibration procedure No.: Sub-Div.#D1.05/Doc.#3/CP#FT/F-02 broadly based on IS 4169-2014.

**No load output:** The digital indicator was switched on for 30 minutes to warm up and stabilize for no load outpu before the start of the 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 calibratio forces each in increasing values. Creep test is performed by calculating the difference in output $i_{30}$ obtained at 30s an $i_{300}$ obtained at 300s after the removal of the maximum calibration force and express this difference as percentage o maximum deflection.

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

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

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

NCQC Valid up to 25-04-2024 Reviewed

NCQC System Certificate No. 241/1

| अंशांकनकर्ता: Calibrated by : | जाँचकर्ता: Checked by : | प्रभारी वैज्ञानिक: Scientist-in-charge: |
|---|---|---|
| SURYA | Dr. RAJESH KUMAR | |
| VIKRAM | जारीकर्ता: Issued by: | Dr.S.S.K.TITUS |

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अंशांकन प्रमाण पत्र
CALIBRATION CERTIFICATE
FORCE PROVING INSTRUMENT

प्रमाण पत्र संख्या/ Certificate No.
2202142/D1.05/C-464

| दिनांक /Date | अगले अंशांकन हेतु अनुशंसित तिथि Recommended date for the next calibration | पृष्ठ /Page | पृष्ठों की संख्या /No. of Pages |
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| 25.02.2022 | 25.04.2024 | 2 | 2 |

**7. Results:** Compression

| The calibration data obtained is valid for the following digital indicator setting only | | | | | |
|---|---|---|---|---|---|
| Calibration Signal: Nil | | | No load output: 32 div. | | |
| | (Digital Indicator Reading in Div) | | | | |
| Applied Force ( kN ) | 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 | --- |
| 150 | 10038 | 10033 | 10032 | 10029 | 10033 |
| 300 | 20060 | 20056 | 20052 | 20049 | 20054 |
| 600 | 40104 | 40100 | 40093 | 40092 | 40096 |
| 900 | 60132 | 60126 | 60123 | 60121 | 60125 |
| 1200 | 80149 | 80141 | 80145 | 80144 | 80146 |
| 1500 | 100160 | 100154 | 100168 | 100156 | 100161 |
| 1800 | 120168 | 120159 | 120173 | 120165 | 120169 |
| 2100 | 140165 | 140155 | 140171 | 140167 | 140168 |
| 2400 | 160162 | 160148 | 160175 | 160158 | 160165 |
| 3000 | 200119 | 200115 | 200147 | 200120 | 200129 |
| 0 | 14 | 11 | 10 | 10 | -- |

**Interpolation Equation: (Compression)**

$F = -7.6908 \times 10^{-17}.X^3 + 1.6198\times10^{-10}.X^2 + 1.4962\times10^{-2}.X - 0.1244$

$X = 1.5719\times10^{-9}.F^3 - 4.8297\times10^{-5}.F^2 + 66.8378.F + 8.3265$

Where F = Force in kN

X = Indicator reading in div.

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

| Class | Mode | From | To | Uncertainty of Measurement |
|---|---|---|---|---|
| Class 1 | Compression | 3000 kN | 150 kN | ± 0.12% |

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, zero, creep, interpolation and combining with the uncertainty of the applied force.

**8. Date of calibration:** 25.02.2022

**9. Remarks:** Nil

अंशांकनकर्त्ता:
**Calibrated by :**
SURYA
VIKRAM

जाँचकर्त्ता:
**Checked by :**
Dr. RAJESH KUMAR

जारीकर्त्ता:
**Issued by:**

प्रभारी वैज्ञानिक:
**Scientist-in-charge:**
Dr.S.S.K.TITUS