

*Large Water Flow Laboratory*

**COMMERCIAL - IN - CONFIDENCE**

## **CERTIFICATE OF CALIBRATION**

**ELNBAR - Multiparameter Measurement Sensor  
of size 1200 mm NB From  
M/s. INDEXEL ENGINEERING PRIVATE LIMITED,  
GI-12, IT Park , Road No.4, IPIA  
Rajasthan - 324005**

**CERTIFICATE NUMBER**

**Certificate Number : C50/240632/012**

**ULR:CC239524500000012F**

**एफ.सी.आर.आई.**



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An ISO 17025 : 2017, 9001 : 2015 Establishment

An Autonomous R&D Organisation under Ministry of Heavy Industries, Govt. of India.

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| Date of Receipt | Date of Calibration | Date of Issue |
|-----------------|---------------------|---------------|
| 08.07.2024      | 10.07.2024          | 19.07.2024    |



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JC - FCRI2024-0632

SUMMARY

|                                    |                                                                                                                                                    |
|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| Test meter                         | ELNBAR - Multiparameter Measurement Sensor (refer section. 1 for details)                                                                          |
| Standard for Reference Flow meters | ISO TR 6817 Measurement of conductive liquid flow in closed conduits – Method using Electromagnetic flow meters.                                   |
| Laboratory                         | Large Water Flow Laboratory (LWFL)                                                                                                                 |
| Calibration Results                | The result of calibration is given in Table 1 and summary of result in Section 4.                                                                  |
| Traceability                       | All the Instruments / Reference flow meters used are traceable to national standards through reference standards and their calibrations are valid. |

Calibrated by

Manikandan S

Ashiq Rahiman N

Prepared by

Ashiq Rahiman N

Checked & Approved  
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*S. Muthu*



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1. Specification of Flow meter Calibrated.

|                       |                                              |
|-----------------------|----------------------------------------------|
| FLOW ELEMENT          | : ELNBAR - Multiparameter Measurement Sensor |
| SIZE                  | : 1200 mm NB                                 |
| MAKE                  | : Electronet Equipments Pvt Ltd              |
| MODEL NO.             | : Insertion EMF Meter                        |
| SERIAL NO             | : ELNBAR-M-2324-159                          |
| CALIBRATED FLOW RANGE | : 10000 m <sup>3</sup> /h                    |
| METER FACTOR          | : 1                                          |
| DATE OF CALIBRATION   | : 10.07.2024                                 |

2. Specification of Reference Instruments used

| REFERENCE METER      | RANGE                  | UNCERTAINTY | CALIB DUE DATE |
|----------------------|------------------------|-------------|----------------|
| EMF 1 (24")          | 5000 m <sup>3</sup> /h | 0.25 %      | 21/12/2024     |
| EMF 4 (24")          | 5000 m <sup>3</sup> /h | 0.22%       | 22/12/2024     |
| RTD                  | 0-60 °C                | 0.070 °C    | 17/04/2025     |
| DAS                  | 4-20 mA                | 0.010 mA    | 01/04/2025     |
| Pressure transmitter | 0-10 bar               | 0.034 mbar  | 31/10/2024     |

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### 3. Method of Calibration

The meter to be calibrated was installed in the test line of large water flow laboratory. The line was flooded and entrapped air cleared using circuit air bleeds. Combinations of pumps were used for attaining the required flow rate. The flow rate was adjusted using the downstream control valve. When flow conditions had stabilized, the actual flow rate was measured using reference flow meters (EMF). A high precision Data acquisition module was used to acquire and average the flow rate indicated by the reference flow meters. Temperature of water was determined using on line RTD's and line pressure was monitored using a precision pressure transmitter. Current output from the test flow meter was also averaged and recorded through DAS. Percentage error of the test meter with respect to reference meter is recorded at different flow rates.

### 4. Result

- The results are tabulated in Table 1.
- The expanded uncertainty in the measurement flow rate is estimated to be better than 0.45%
- The expanded uncertainty quoted are standard uncertainty multiplied by a coverage factor  $k = 2.87$  at a level of confidence of approximately 95 %.

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5. Table-1 Calibration Result

FLOW ELEMENT : ELNBAR - Multiparameter Measurement Sensor  
SIZE : 1200 mm NB  
MAKE : Electronet Equipments Pvt Ltd  
MODEL NO : Insertion EMF Meter  
SERIAL NO : ELNBAR-M-2324-159  
CALIBRATED FLOW RANGE : 10000 m<sup>3</sup>/h  
METER FACTOR : 1  
DATE OF CALIBRATION : 10.07.2024

| Sl No             | Pup bar | T deg C | p kg/m <sup>3</sup> | Qa m <sup>3</sup> /h | Va m/s | C mA   | Qc m <sup>3</sup> /h | Vi m/s | % Dev. in Qi |
|-------------------|---------|---------|---------------------|----------------------|--------|--------|----------------------|--------|--------------|
| 1                 | 0.589   | 28.20   | 996.673             | 2038.712             | 0.500  | 5.349  | 2059.67              | 0.51   | 0.086        |
| 2                 | 0.590   | 28.22   | 996.673             | 2028.165             | 0.497  | 5.290  | 1969.59              | 0.48   | -0.240       |
| 3                 | 0.590   | 28.22   | 996.673             | 2029.005             | 0.497  | 5.355  | 2068.83              | 0.51   | 0.163        |
| 4                 | 0.577   | 28.25   | 996.673             | 5048.255             | 1.238  | 7.256  | 4971.30              | 1.22   | -0.315       |
| 5                 | 0.577   | 28.25   | 996.673             | 5045.063             | 1.237  | 7.281  | 5009.47              | 1.23   | -0.146       |
| 6                 | 0.577   | 28.25   | 996.673             | 5040.864             | 1.236  | 7.287  | 5018.63              | 1.23   | -0.091       |
| 7                 | 0.577   | 28.25   | 996.673             | 5048.226             | 1.238  | 7.338  | 5096.50              | 1.25   | 0.198        |
| 8                 | 0.577   | 28.25   | 996.673             | 5051.275             | 1.239  | 7.357  | 5125.51              | 1.26   | 0.304        |
| 9                 | 0.572   | 28.26   | 996.673             | 3013.093             | 0.739  | 5.960  | 2992.55              | 0.73   | -0.084       |
| 10                | 0.572   | 28.26   | 996.673             | 3011.818             | 0.738  | 5.944  | 2968.12              | 0.73   | -0.179       |
| 11                | 0.572   | 28.26   | 996.673             | 3007.070             | 0.737  | 5.949  | 2975.76              | 0.73   | -0.128       |
| 12                | 0.467   | 28.30   | 996.644             | 6503.424             | 1.595  | 8.240  | 6473.69              | 1.59   | -0.122       |
| 13                | 0.467   | 28.30   | 996.644             | 6505.653             | 1.595  | 8.271  | 6521.02              | 1.60   | 0.063        |
| 11                | 0.467   | 28.30   | 996.644             | 6501.848             | 1.594  | 8.257  | 6499.64              | 1.59   | -0.009       |
| 12                | 0.594   | 28.29   | 996.673             | 8136.284             | 1.995  | 9.288  | 8073.78              | 1.98   | -0.256       |
| 13                | 0.594   | 28.29   | 996.673             | 8122.613             | 1.992  | 9.254  | 8021.87              | 1.97   | -0.412       |
| 14                | 0.594   | 28.29   | 996.673             | 8125.324             | 1.992  | 9.282  | 8064.62              | 1.98   | -0.248       |
| 15                | 0.859   | 28.34   | 996.644             | 9053.968             | 2.220  | 10.005 | 9168.51              | 2.25   | 0.469        |
| 16                | 0.859   | 28.34   | 996.644             | 9052.664             | 2.222  | 10.006 | 9170.04              | 2.25   | 0.440        |
| 17                | 0.859   | 28.34   | 996.644             | 9081.302             | 2.227  | 10.001 | 9162.40              | 2.25   | 0.332        |
| Repeatability (%) |         |         |                     |                      |        |        |                      |        | = 0.114      |

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## 6. Sample Calculation

$$\begin{aligned} Q_c &= \text{Flow rate obtained from current output } (m^3/h) \\ Q_a &= \text{Actual flow rate indicated by master reference meter } (m^3/h) \\ \% \text{ Dev in } Q_c &= \frac{(Q_c - Q_a) \times 100}{Q_a \text{ wrt FS}} \% \end{aligned}$$

For SI.No.3 in Table 1

$$\begin{aligned} P_{up} &= 0.590 \text{ bar} \\ T &= 28.22 \text{ deg C} \\ \rho &= 996.673 \text{ kg/m}^3 \\ Q_a &= 2029.005 \text{ m}^3/h \\ C &= 5.355 \text{ mA} \\ Q_c &= \frac{C - 4}{16} \times Q_{max} \text{ m}^3/h \\ Q_c &= 2068.831 \text{ m}^3/h \end{aligned}$$

### a) Percentage deviation in indicated flow rate

$$\begin{aligned} \% \text{ Dev in } Q_i &= \frac{(2068.831 - 2029.005) \times 100}{24429.000} \\ &= \underline{0.163} \% \end{aligned}$$

### b) Calculation of repeatability

The repeatability was determined for the operating range (Table 1 SI.No.4 to 8)

$$\begin{aligned} \% \text{ Repeatability} &= \frac{\sigma_{n-1}}{\sqrt{n}} \\ n &= 5 \\ \sigma_{n-1} &= 0.255 \% \\ \% \text{ Repeatability} &= \frac{0.255}{\sqrt{5}} \\ &= \underline{0.114} \% \end{aligned}$$

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## 7. Calibration Chart

|                       |                                              |
|-----------------------|----------------------------------------------|
| FLOW ELEMENT          | : ELNBAR - Multiparameter Measurement Sensor |
| SIZE                  | 1200 mm NB                                   |
| MAKE                  | Electronet Equipments Pvt Ltd                |
| MODEL NO.             | Insertion EMF Meter                          |
| SERIAL NO.            | ELNBAR-M-2324-159                            |
| CALIBRATED FLOW RANGE | : 10000 $m^3/h$                              |
| METER FACTOR          | 1                                            |
| DATE OF CALIBRATION   | 10.07.2024                                   |

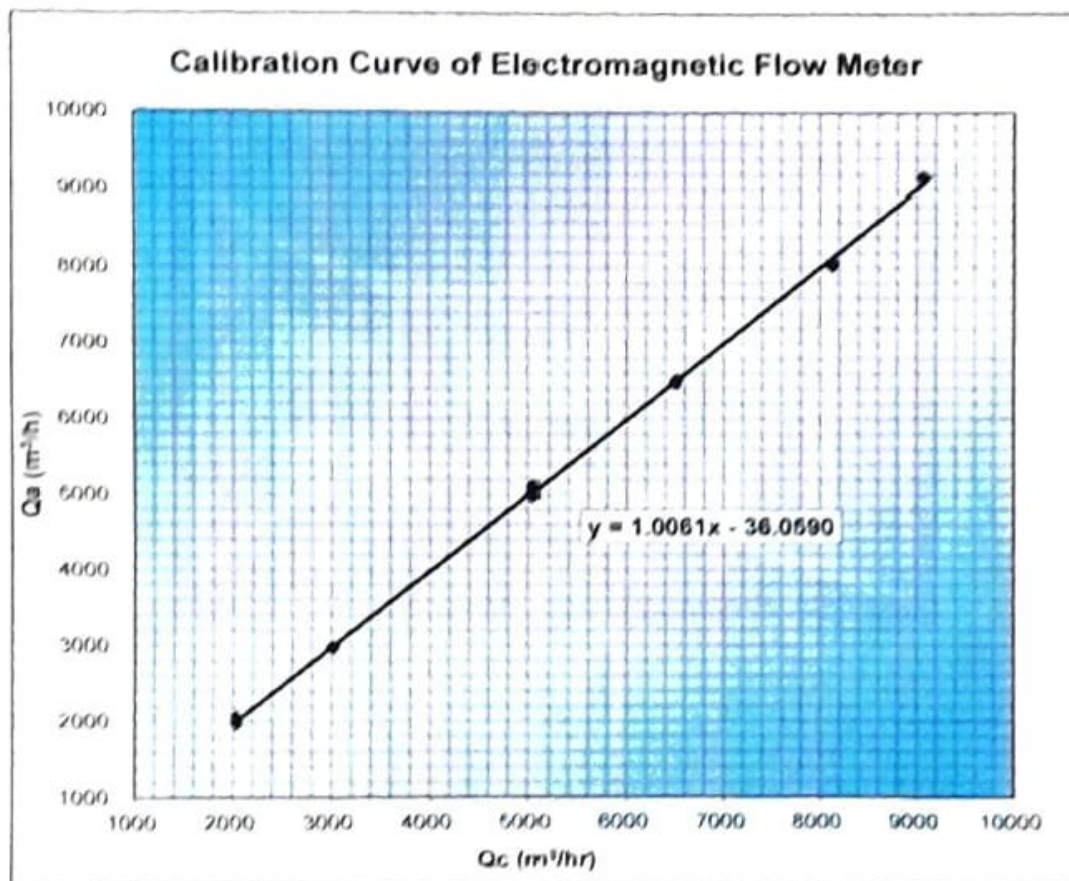


Fig 1