Water Flow Laboratory

COMMERCIAL - IN - CONFIDENCE

CERTIFICATE OF CALIBRATION

on

AN APT

of size 20" NB from

M/s. ENGINEERING SPECIALITIES PVT. LTD,
30F, FREE SCHOOL STREET,
WEST BENGAL - 700016

CERTIFICATE NUMBER
FCRI/WFL/C/2020/485
ULR - CC239520400000485F

एफ.सी.आर.आई.

FCRI

फ्लूइड कंट्रोल रिसर्च इंस्टिट्यूट, पालक्काड

FLUID CONTROL RESEARCH INSTITUTE, PALAKKAD

An ISO 17025-2017, ISO 9001-2015 Establishment
An Autonomous R&D Organisation under Ministry of Heavy Industries & Public Enterprises, Govt. of India.
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Water Flow Laboratory

Date of Receipt	Date of Calibration	Date of issue
19.08.2020	02.09.2020	07.09.2020

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JC - 2020 - 547

Approved Signatory

पि.के. सुरेष / P. K. SURESH
उप निदेशक / DEPUTY DIRECTOR

SUMMARY

Test Meter	APT
Standards Referred	ISO 4185-1980: "Measurements of Liquid flow in closed conduits using weighing method"
Laboratory	Water Flow Laboratory (WFL)
Calibration Results	The results of calibration is given in Table 1, the calibration chart is given in Fig. 2 and summary of result in Section 3.
Traceability	All the instruments /Reference flow meters used are traceable to national standards through reference standards and their calibrations are valid. NABL symbol on this certificate implies traceability of calibration data reported (Note 1, clause 5.6.2.1.1 of ISO 17025:2017).

Calibrated by
K.G.Jayesh
M Unnikrishnan

Prepared by
Fathima K A

Checked by
K Suresh, S.R.E

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1. Method of Calibration

The meter to be calibrated was installed in a standard test line of water flow laboratory as shown in figure 1, Schematic of Calibration Setup. The line was flooded and entrapped air cleared using circuit air bleeds. Constant Head Tank / Direct pumping was the flow source for the calibration. Flow rate was adjusted using the downstream control valve. When flow conditions had stabilised, the flow rate was determined by collecting water for a measured time interval in the weighing system. The method used was flying-start-and-finish technique where the flow was diverted in to the weighing system and diverted back at the end of test.

The time of collection was determined by a high precision timer, which was triggered by a photo switch-timer blade arrangement attached to the diverter. Differential pressure was measured using high precision differential pressure transmitter, where output is averaged using high speed data acquisition system. Water temperature and water pressure were also recorded. The actual flowrate, theoretical flowrate, coefficient of discharge, and Reynolds number were then calculated. This procedure was repeated for the other flow rates also.

2. Specification of Reference Instruments used

Instrument	*Range*	*unit*	*Uncertainty*	*Calibration Due*
Weighing System	20000	kg	2.90E+00 kg	02.12.2020
Timer	1000	sec	9.02E-03 sec	29.05.2021
Diverter System	1000	sec	8.10E-03 sec	20.08.2021
Densitymeter	1500	kg/m^3	2.60E-02 kg/m^3	06.09.2020
Data Acquisition System	4-20	mA	1.02E-02 mA	29.05.2021
DP Transmitter	2000	mbar	4.00E-04 mbar	15.01.2021
DP Transmitter	500	mbar	2.53E-01 mbar	12.12.2020

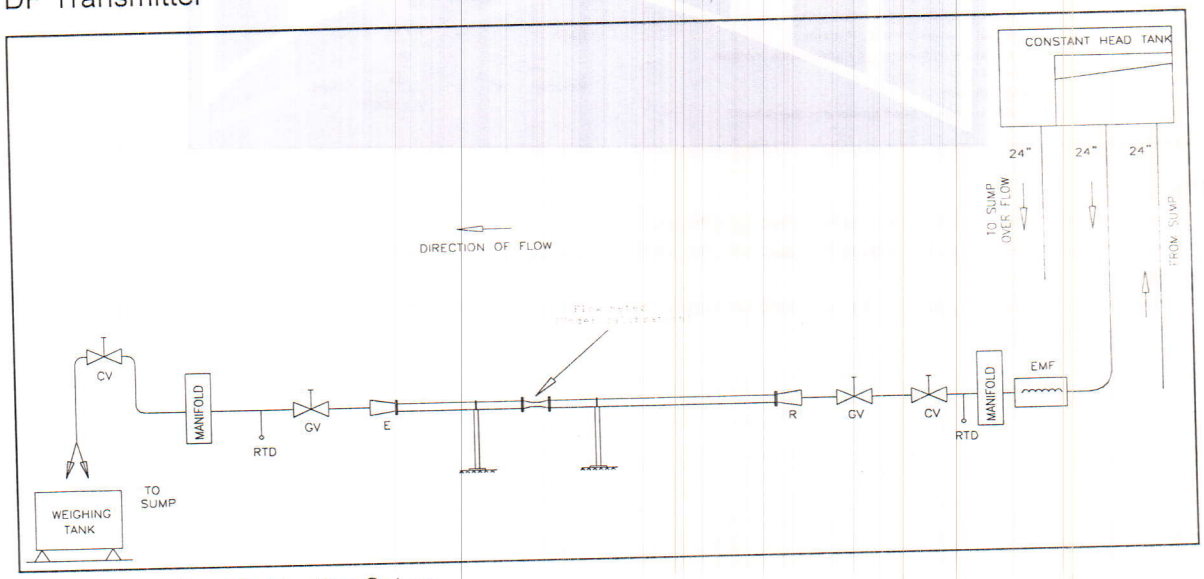

Fig 1. Schematic of Calibration Set-up

Checked

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Table. 1

Flow Element : APT
Size : 20" NB
Tag. No. : 01GDP01BP001
Probe Size : SPB-2NB

Sensor Material : SS316
Pipe ID : 500.00 mm
Medium of Calibration : Water
Date of calibration : 02.09.2020

Sl. No.	Pup bar	W_1 kg	W_2 kg	t sec.	T deg.C	Density kg/m^3	dp bar	Viscosity *10^{06} Pa.sec.	Qa m^3/h	K	V m/s	ReD
1	1.80	3860	18318	33.398248	29.33	996.640	0.0609	808.793	1565.341	0.63346	2.215	1364418
2	1.80	3136	18984	36.607870	29.34	996.630	0.0608	808.619	1565.412	0.63401	2.215	1364760
3	1.80	1914	18402	40.916562	29.36	996.620	0.0527	808.271	1457.142	0.63389	2.061	1270901
4	1.80	1224	18662	43.273866	29.37	996.620	0.0528	808.098	1457.149	0.63329	2.061	1271181
5	1.80	5212	18396	35.638563	29.37	996.620	0.0444	808.098	1337.704	0.63400	1.892	1166980
6	1.80	1142	18110	45.866000	29.38	996.610	0.0445	807.924	1337.757	0.63330	1.893	1167265
7	1.80	1076	17158	52.794260	29.38	996.610	0.0301	807.924	1101.516	0.63405	1.558	961132
8	1.80	1554	18448	60.772729	29.38	996.610	0.0251	807.924	1005.220	0.63364	1.422	877109
9	1.80	990	18896	27.384027	29.40	996.600	0.1385	807.577	2364.520	0.63450	3.345	2064037
10	1.80	1318	19522	30.497080	29.40	996.600	0.1155	807.577	2158.491	0.63427	3.054	1884191
11	1.80	1542	19224	31.487170	29.40	996.600	0.1020	807.577	2030.671	0.63497	2.873	1772613
12	1.80	1000	19662	29.845308	29.40	996.600	0.1268	807.577	2261.121	0.63413	3.199	1973778
13	1.80	1532	19022	33.037347	29.42	996.580	0.0906	807.230	1914.411	0.63515	2.708	1671812
14	1.80	2402	19228	31.779260	29.42	996.580	0.0910	807.230	1914.642	0.63383	2.709	1672014
15	1.80	1600	17962	32.879938	29.42	996.580	0.0802	807.230	1799.517	0.63457	2.546	1571478
16	1.80	1548	18820	34.716527	29.42	996.580	0.0800	807.230	1799.106	0.63521	2.545	1571120
17	1.80	1340	18996	37.623104	29.44	996.570	0.0713	806.883	1697.042	0.63468	2.401	1482611
18	1.80	1546	19002	37.196999	29.44	996.570	0.0712	806.883	1697.038	0.63512	2.401	1482608
19	1.80	2004	15320	39.372438	29.44	996.570	0.0371	806.883	1223.028	0.63410	1.730	1068491
20	1.80	3884	16678	37.839401	29.46	996.560	0.0372	806.537	1222.704	0.63307	1.730	1068656
21	1.80	4222	16742	49.795731	29.46	996.560	0.0206	806.537	909.225	0.63262	1.286	794672
22	1.80	4688	15742	49.891526	29.46	996.560	0.0160	806.537	801.220	0.63255	1.133	700275

Mean K = **0.63402**
Repeatability (%) = **0.062** %

Pup - Pressure at the upstream of the test meter
W_1 - Initial mass of the weigh tank
W_2 - Final mass of the weigh tank
B - Buoyancy correction factor = 1.00106
t - Time of collection of water
ρ - Density of water at line temperature
dP - Differential pressure across the meter.
μ - Dynamic viscosity of medium of calibration.
D - Diameter of conduit (m)
A - Area of cross-section of conduit (m^2)
Qt - Theoretical flow rate of the dP meter.
Qa - Actual flowrate determined by gravimetric method.
v - Velocity of flow.
K - Flow Coefficient.
ReD - Reynolds number based on conduit diameter.

$$Qa = \frac{(W_2 - W_1) \times 1.00106 \times 3600}{t \times \rho} \quad m^3/h$$

$$Qt = A \times \sqrt{\frac{2 \times dP}{\rho}} \times 3600 \quad m^3/h$$

$$K = \frac{Qa}{Qt}$$

$$ReD = \frac{\rho V D}{\mu}$$

$$\text{Velocity } V = \frac{Qa}{A \times 3600} \quad m/s$$

3. RESULT

i. The results are tabulated in Table 1 and shown graphically in fig. 2.
ii. The expanded uncertainty in K, taking into account the uncertainty of curve fit equation in Fig.2, is estimated to be better than 0.25 %
iii. The expanded uncertainty quoted are standard uncertainty multiplied by a coverage factor k = 2 at a level of confidance of approximately 95 %.

Checked

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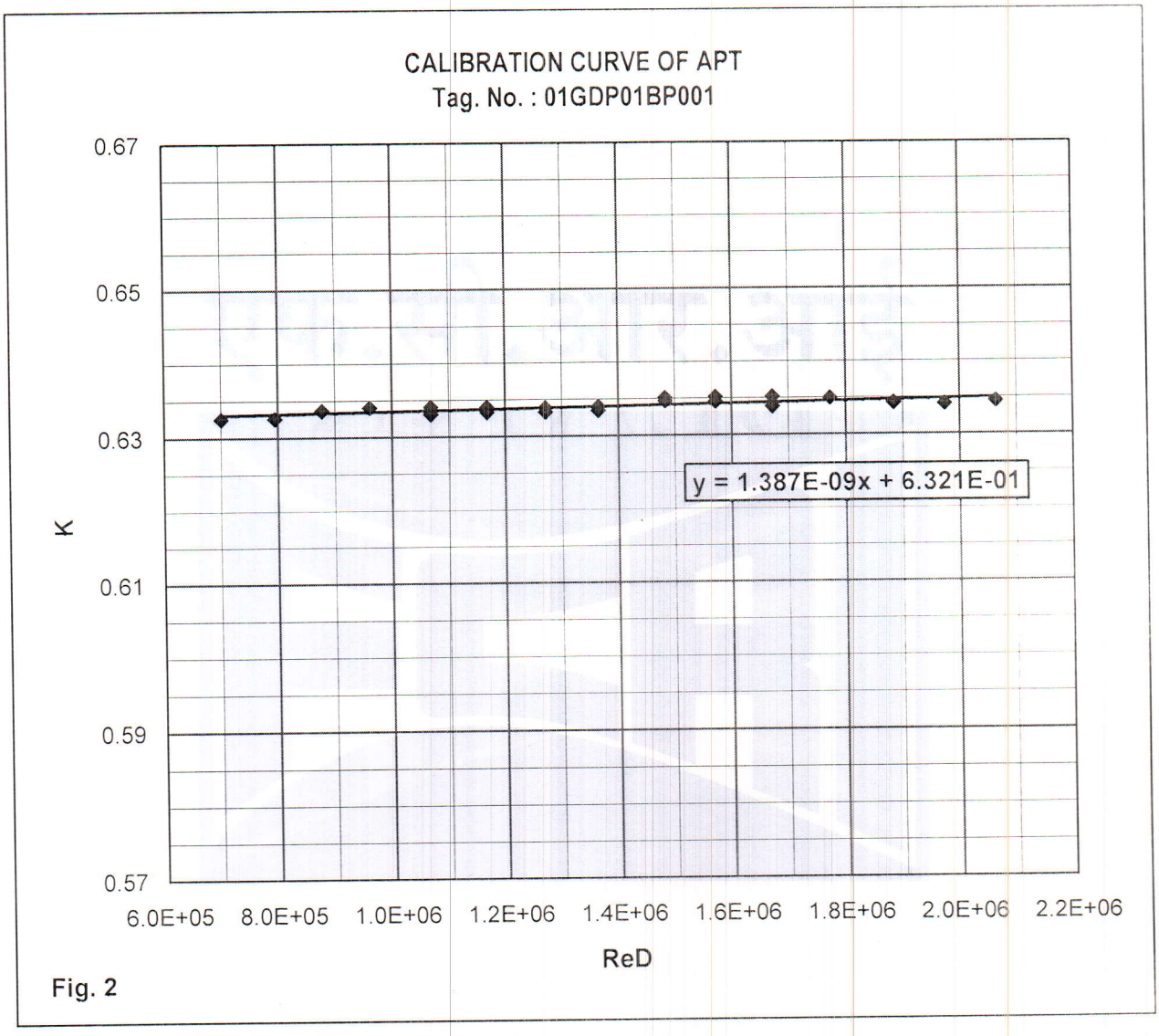

Fig. 2

Checked

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