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/2020/486

ULR - CC239520400000486F

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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Certificate No: CC-2395

Water Flow Laboratory

Date of Receipt	Date of Calibration	Date of issue
02.09.2020	03.09.2020	07.09.2020

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J C - 2020 - 629

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	Prepared by	Checked by
K.G.Jayesh	Fathima K A	K Suresh, S.R.E
M Unnikrishnan		

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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

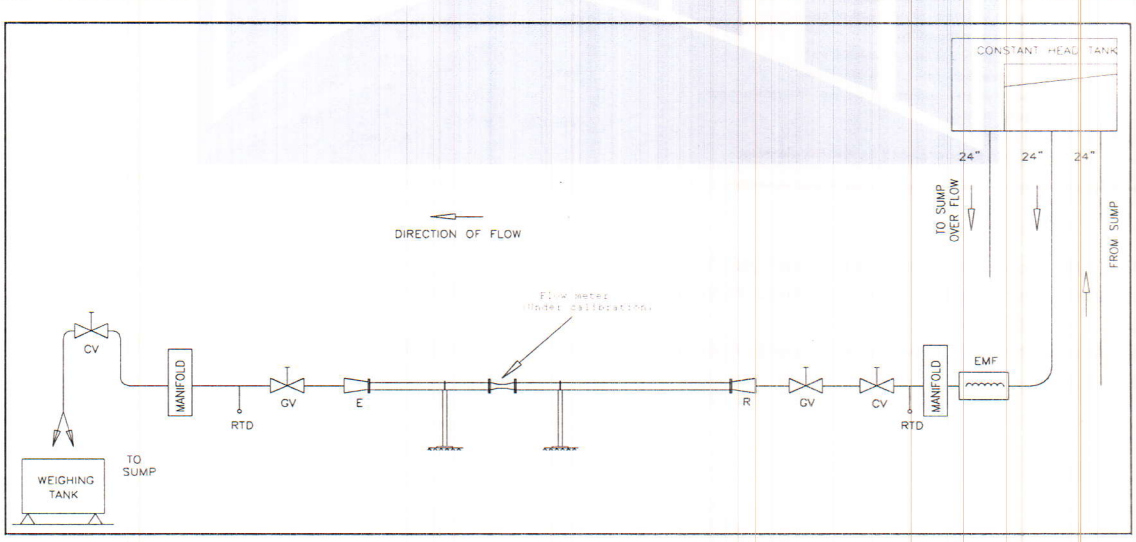

Fig 1. Schematic of Calibration Set-up

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Table. 1

Flow Element	: APT	Sensor Material	: SS316
Size	: 20" NB	Pipe ID	: 500.00 mm
Tag. No.	: 01GDP01BP001	Medium of Calibration	: Water
Probe Size	: SPB-2NB	Date of calibration	: 03.09.2020

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	2722	14948	28.916758	29.52	996.600	0.0572	805.499	1528.891	0.63840	2.163	1338042
2	1.80	9142	19190	23.753970	29.53	996.590	0.0574	805.327	1529.641	0.63759	2.164	1338972
3	1.80	8044	17288	27.807532	29.54	996.590	0.0354	805.154	1202.108	0.63805	1.701	1052492
4	1.80	6330	17184	32.608589	29.55	996.590	0.0355	804.981	1203.660	0.63797	1.703	1054077
5	1.80	1338	15300	54.559981	29.59	996.580	0.0210	804.291	925.388	0.63771	1.309	811073
6	1.80	3574	15080	30.989937	29.60	996.580	0.0572	804.119	1342.623	0.63781	1.899	1177019
7	1.80	7518	17482	26.878200	29.62	996.570	0.0441	803.775	1340.566	0.63749	1.897	1175708
8	1.80	9406	18170	27.036251	29.62	996.560	0.0337	803.775	1172.236	0.63768	1.658	1028068
9	1.80	7580	18032	32.348751	29.63	996.560	0.0335	803.603	1168.426	0.63750	1.653	1024946
10	1.80	1690	18702	25.160442	29.64	996.550	0.1461	803.430	2445.123	0.63882	3.459	2145305
11	1.80	2044	19346	25.977662	29.64	996.540	0.1418	803.430	2408.597	0.63874	3.407	2113237
12	1.80	2568	18350	28.332486	29.65	996.530	0.0994	803.258	2014.418	0.63805	2.850	1767756
13	1.80	3208	19336	28.614448	29.66	996.520	0.1014	803.086	2038.317	0.63922	2.884	1789094
14	1.80	3612	17458	26.102631	29.68	996.500	0.0903	802.743	1918.339	0.63749	2.714	1684472
15	1.80	2338	17290	28.199088	29.69	996.480	0.0902	802.571	1917.601	0.63759	2.713	1684151
16	1.80	3786	16510	26.168708	29.69	996.480	0.0758	802.571	1758.472	0.63780	2.488	1544394
17	1.80	2518	17318	30.451585	29.70	996.470	0.0756	802.399	1757.722	0.63837	2.487	1544051
18	1.80	4630	18534	35.588272	29.71	996.470	0.0489	802.228	1412.964	0.63806	1.999	1241468
19	1.80	2558	17466	38.193779	29.72	996.460	0.0489	802.056	1411.658	0.63747	1.997	1240573
20	1.80	3836	18034	30.127933	29.72	996.460	0.0713	802.056	1704.357	0.63738	2.411	1497798
21	1.80	2308	16538	30.202040	29.74	996.450	0.0712	801.713	1704.024	0.63770	2.411	1498132
22	1.80	6258	15196	40.123008	29.74	996.450	0.0159	801.713	805.664	0.63802	1.140	708318

Mean K = **0.63795**

Repeatability (%) = **0.029** %

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 0.22 %

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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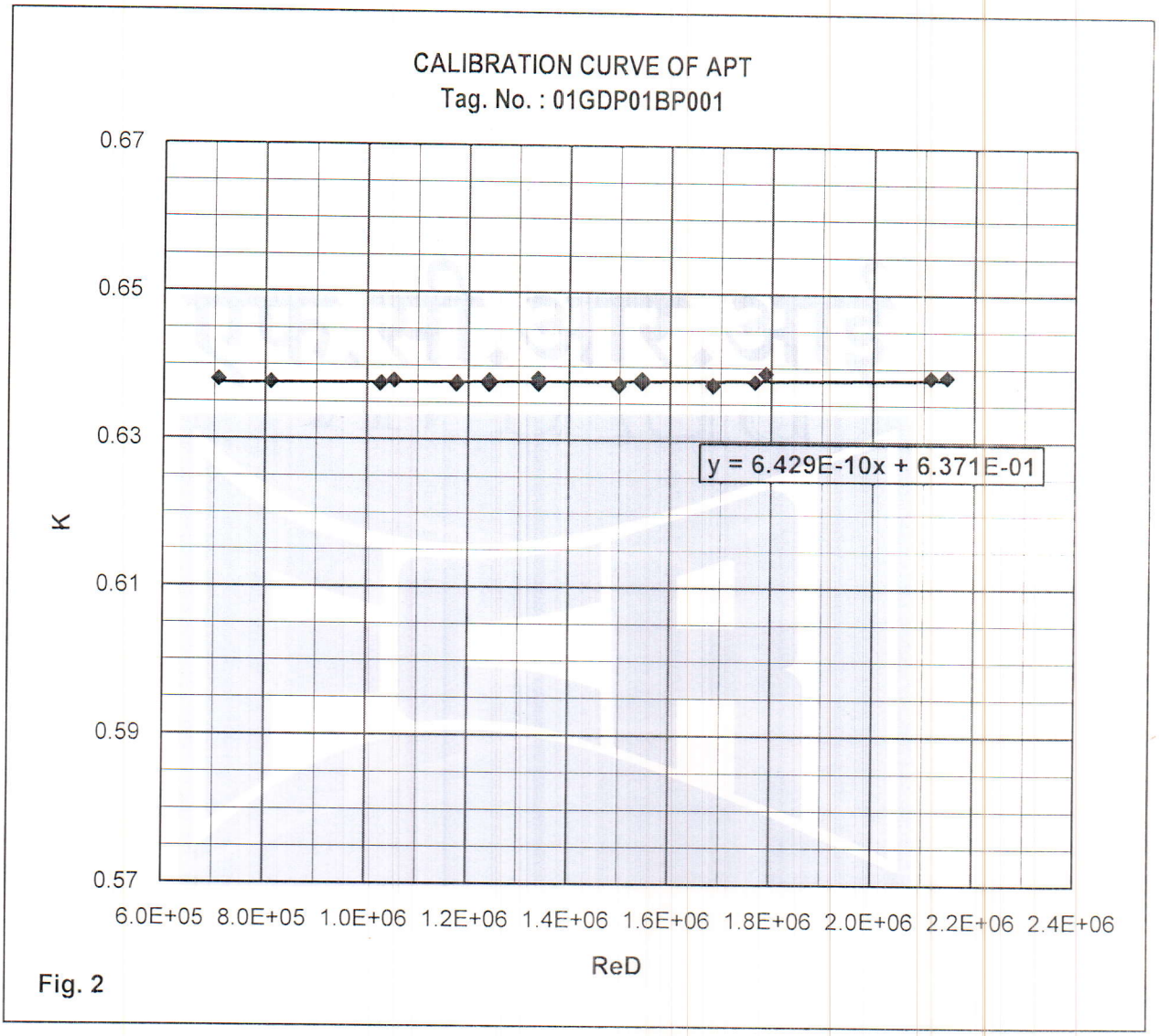

Fig. 2

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