Water Flow Laboratory

CR-7 SPB-6 BGR OPGGL 800 NB

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CERTIFICATE OF CALIBRATION

on

A SELF AVERAGING PITOT BAR

of size 32" NB from

M/s. ENGINEERING SPECIALITIES PVT. LTD.,

KOLKATA

CERTIFICATE NUMBER

FCRI/WFL/C/2016/444

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CERTIFICATE OF CALIBRATION

ON A SELF AVERAGING PITOT BAR of size 32" NB from M/s. ENGINEERING SPECIALITIES PVT. LTD., KOLKATA

NABL C- 0026

Water Flow Laboratory

Date of Receipt	Date of Calibration	Date of issue
15.06.2016	18.06.2016	22.06.2016

P.K. SURESH
Chief Research Engineer
Approved Signatory

CERTIFICATE NUMBER : FCRI/WFL/C/2016/444

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SUMMARY

Test Meter	SELF AVERAGING PITOT BAR
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 17025:2005).

Calibrated by	Prepared by	Checked by
K.G.Jayesh	K.G.Jayesh	K.Suresh , R.E
Fazil		

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 reference meter was used to measure flowrates above 2500 m^3/h.

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	3.53E+00 kg	02.12.2016
Timer	1000	sec	1.05E-03 sec	14.10.2016
Diverter System	1000	sec	9.44E-03 sec	21.08.2018
Pressure Gauge	16	bar	5.92E-02 bar	06.11.2016
Temperature	10.2-49.5	°C	7.10E-02 °C	06.05.2017
Densitometer	1500	kg/m^3	2.00E-02 kg/m^3	08.09.2016
Data Acquisition System	4 -20	mA	1.02E-02 mA	22.09.2016
DP Transmitter	100	mbar	5.00E-02 mbar	31.03.2017
DP Transmitter	20	mbar	8.20E-03 mbar	12.10.2016
Electomagnetic flowmeter	5000	m^3/h	4.10E+00 m^3/h	12.01.2017

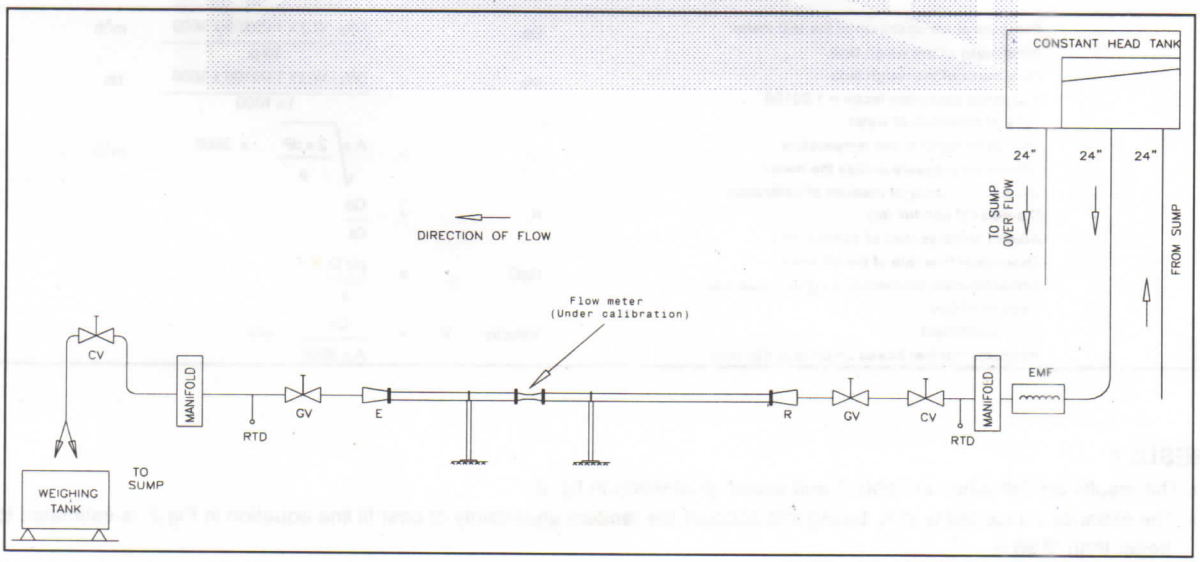

Fig 1. Schematic of Calibration Set-up

Checked

Table. 1

Flow Element	: **SELF AVERAGING PITOT BAR**	Pipe ID	: 793.00 mm
Size	: 32" NB	Medium of Calibration	: Water
Make	: M/s. BGR Energy Systems Ltd.	Date of calibration	: 18.06.2016
Tag No.	: 34GAF06CF200		
SAP Bar Model	: SPB-2NB		
Project	: ODISHA POWER GENERATION CORPORATION LTD		

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	1.68	908	16194	61.426813	30.43	995.255	0.002368	790.022	901.082	**0.73466**	0.507	506283
2	1.68	1020	18820	71.529350	30.43	995.255	0.002368	790.022	901.081	**0.73460**	0.507	506283
3	1.68	1230	17792	35.236179	30.43	995.255	0.008572	802.399	1701.971	**0.72934**	0.957	941522
4	1.68	3398	18480	32.087469	30.43	995.255	0.008492	802.399	1701.969	**0.73276**	0.957	941521
5	1.68	2112	18954	29.001388	30.43	995.255	0.012896	802.399	2102.825	**0.73466**	1.183	116327
6	1.68	1084	19334	31.425818	30.43	995.255	0.012923	802.399	2102.832	**0.73390**	1.183	116327
7	1.68	1022	17842	46.735960	30.44	995.251	0.004975	802.399	1303.181	**0.73302**	0.733	720911
8	1.68	980	18666	49.142130	30.44	995.251	0.004992	802.399	1303.184	**0.73178**	0.733	720912
9	1.54	-	-	-	30.44	995.251	0.018468	802.399	2501.336	**0.73025**	1.407	1383721
10	1.54	-	-	-	30.44	995.251	0.018456	800.685	2501.338	**0.73049**	1.407	1386684
11	1.46	-	-	-	30.44	995.251	0.024663	800.685	2903.319	**0.73347**	1.633	1609533
12	1.46	-	-	-	30.44	995.251	0.024785	800.685	2903.315	**0.73166**	1.633	1609531
13	1.35	-	-	-	30.46	995.248	0.031952	800.685	3301.319	**0.73274**	1.857	1830170
14	1.35	-	-	-	30.46	995.248	0.031810	800.685	3301.324	**0.73438**	1.857	1830173
15	1.26	-	-	-	30.46	995.248	0.040312	800.685	3706.951	**0.73251**	2.085	2055042
16	1.26	-	-	-	30.46	995.248	0.040289	800.685	3706.949	**0.73272**	2.085	2055041
17	1.21	-	-	-	30.49	995.239	0.052396	800.685	4198.642	**0.72773**	2.361	2327602
18	1.21	-	-	-	30.49	995.239	0.051860	800.685	4198.633	**0.73148**	2.361	2327597
19	1.21	-	-	-	30.49	995.239	0.051871	800.685	4198.726	**0.73142**	2.361	2327649
20	1.21	-	-	-	30.49	995.239	0.052131	800.685	4198.655	**0.72958**	2.361	2327610
21	1.21	-	-	-	30.49	995.239	0.052012	800.685	4198.665	**0.73041**	2.361	2327615
22	1.13	-	-	-	30.53	995.227	0.058960	800.685	4487.892	**0.73328**	2.524	2487924
23	1.13	-	-	-	30.53	995.227	0.059033	800.685	4487.897	**0.73283**	2.524	2487927

Mean Cd = **0.73216**
Repeatability = **0.095** %

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.
u - 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.

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

$$Ma = \frac{(W_2 - W_1) \times 1.00106 \times 3600}{t \times 1000} \quad T/h$$

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

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

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

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

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 random uncertainty of best fit line equation in Fig.2, is estimated to be better than 0.36%

iii. The expanded uncertainty quoted are standard uncertainty multiplied by a coverage factor k = 2 at a level of confidance of approximately 95 %.

CALIBRATION CURVE OF SELF AVERAGING PITOT BAR
SAP Bar Model : SPB-2NB

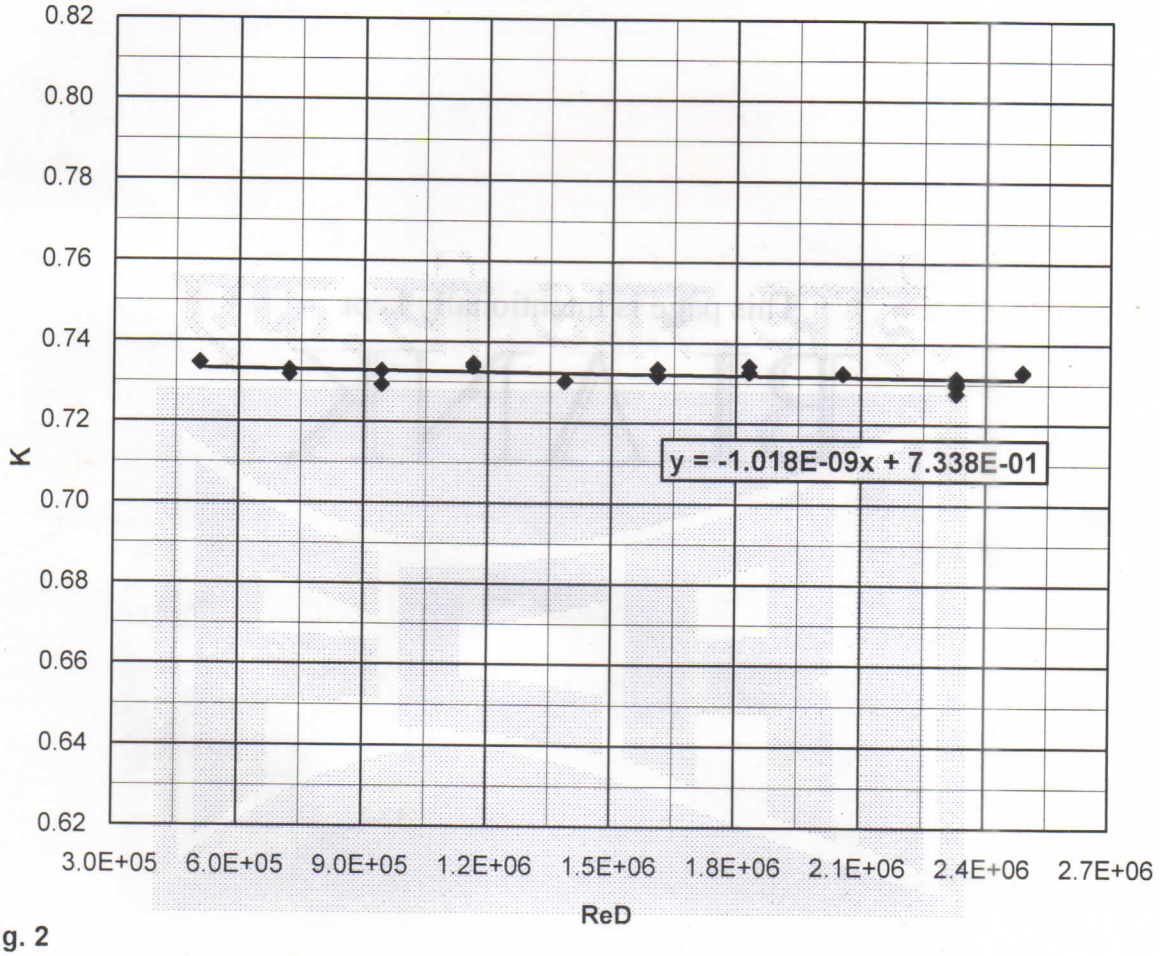

Fig. 2

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