1500 MW (NOMINAL) PRAGATI – III CCPP

VOLUME – II B & III

TECHNICAL SPECIFICATION
FOR MANDATORY SPARES OF
PRETREATMENT PLANT
CW TREATMENT PLANT
CHLORINE DIOXIDE SYSTEM
EFFLUENT TREATMENT PLANT
CHLORINATION PLANT
SIDE STREAM FILTRATION
&
SEWAGE TREATMENT PLANT

SPECIFICATION NO.: PE-TS-314-158-A001M

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

	TITLE: **1500 MW PRAGATI – III CCPP** **TECHNICAL SPECIFICATION FOR MANDATORY SPARES OF PRETREATMENT PLANT CW TREATMENT PLANT CHLORINE DIOXIDE SYSTEM EFFLUENT TREATMENT PLANT CHLORINATION PLANT SIDE STREAM FILTRATION & SEWAGE TREATMENT PLANT**	SPECIFICATION NO. PE-TS-314-158-A001M VOLUME - II B & III SECTION - REV.NO. 0 DATE :

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VOLUME-IIB

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SECTION - A
INTENT OF SPECIFICATION

1.0 SCOPE:

1.1 This specification is intended to cover supply and dispatch to power station site, of the mandatory spares for as specified here in after for **PRETREATMENT PLANT, CW TREATMENT PLANT, CHLORINE DIOXIDE SYSTEM, EFFLUENT TREATMENT PLANT, CHLORINATION PLANT, SIDE STREAM FILTRATION & SEWAGE TREATMENT PLANT for 1500 MW PRAGATI – III CCPP**.

1.2 It is not the intent to specify all the details of the design & manufacturer. However, the equipment shall conform in all respect to high standard of design, engineering & workmanship and shall be capable of performing the required duties in a manner acceptable to Engineer / Owner, who will interpret the meaning of drawing & the specification & shall be entitled to reject any work or material, which is not in full accordance herewith.

1.3 General terms & conditions, instructions to the bidder and other attachments referred to elsewhere, made part of tender specification. The bidder shall be responsible for all governed by requirements stipulated hereinafter.

1.4 The equipments covered under this specification shall not be dispatched unless the same have been finally inspected, accepted and shipping release issued by BHEL/Customer or BHEL & Customer.

1.5 In the event of any conflict between the various sections of the specification, bidder shall bring the same to the attention of the BHEL during pre-bid clarification stage before bid submission.

1.6 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under VOL-III of the specification. In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of BHEL / Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by BHEL/ Customer as and when brought to their notice either by the bidder or by BHEL/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication to BHEL / Customer.

1.7 Pre bid clarification regarding any ambiguity or missing information has to be raise by bidder before bid submission. After submission of bid, clarifications raised by bidder in their offer may be reply by BHEL but no price implication / impact (positive / negative) shall be entertain by BHEL / customer w.r.t. reply given by BHEL for said clarification.

1.8 Deviations along with cost of withdrawal (positive or negative), if any, should be very clearly brought out clause by clause in the enclosed schedule; otherwise, it will be presumed that the vendor's offer is strictly in line with tender specification & there is no deviation. (Price to be given in sealed envelope only.)

SECTION – B

PROJECT INFORMATION

Clause No.	PROJECT INFORMATION
1.03.00	**Land Availability** The land identifed for the project is in physical posession of PPCL Bidders are advised to visit the plant site for getting acquainted with the conditions prevailing at site.
1.04.00	**Fuel Availability** RLNG/Natural Gas would be used as the main fuel for the project.
1.04.01	**Natural Gas** Employer shall make RLNG / Natural Gas available at a pressure of about 40 Kg/ cm^2 at a terminal point near Plant Boundary. Expected composition of RLNG/ Natural Gas shall be as indicated at Annexure-I.
1.05.00	**Water Availability** Make up water for the plant shall be treated sewage water drawn from Rithala sewage treatment plant.
1.06.00	**Quality of Raw Water** Raw Water Analysis from above source is enclosed at Annexure - II.
1.07.00	**Meteorological Data** Important meteorological data as obtained from Safdarjund Obsevatory, Delhi based on observations from year 1951 to 1980 is enclosed at Annexure-III.
1.08.00	**Wind Design Criteria** Criteria for Wind resistant design of structures and equipment shall be as per Annexure-IV.
1.09.00	**Earthquake Design Criteria** Criteria for earthquake resistant design of structures and equipment shall be as per Annexure-V.

Clause No.	PROJECT INFORMATION

ANNEXURE - I
PAGE 1 OF 1

SPECIFICATION OF NATURAL GAS/RLNG :

S.N	PROPERTY	UNIT	VALUE
1.	COMPOSITION		
	a) Methane (C1)	% Molar	85 - 100
	b) Ethane (C2)	% Molar	0 - 10
	c) Propane (C3)	% Molar	0 - 5
	d) Butane (C4) & heavies	% Molar	0 - 3
	e) Pentane (C5) & heavies	% Molar	0 - 0.5
	f) Nitrogen	% Molar	0 - 1.25
	g) Oxygen (O_2)	% Molar	0 - 0.5
	h) Total non-hydro carbons	% Molar	0 - 2.0
2.	LOWER HEATING VALUE		
	- Minimum	Kcal/SCM	8100
	- Maximum	Kcal/SCM	9500
3	SUPPLY PRESSURE	Kg/cm^2	40
4	SUPPLY TEMPERATURE		
	a) Minimum	Degree C	5
	b) Normal	Degree C	30
	c) Maximum	Degree C	50
5	CONTAMINANTS		
	a) Trace Metals		
	i) Pb + Zn	ppm (wt)	0.5 (Max)
	ii) Na + K	ppm (wt)	0.3 (Max)
	iii) Vanadium	ppm (wt)	0.5 (Max)
	iv) Calcium	ppm (wt)	2.0 (Max)
	v) Magnesium	ppm (wt)	2.0 (Max)
	vi) Sum of Hevy Metals	ppm (wt)	1.0 (Max)
	b) Liquid	% (wt)	NIL
	c) Moisture	Kg/million SCM	112 (Max)
	d) Hydrogen Sulphide	ppm (wt)	5 (Max)
	e) Total Sulphur	ppm (wt)	15 (Max)

Clause No.	PROJECT INFORMATION

ANNEXURE - II
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RAW WATER ANALYSIS PRAGATI III CCPP

The raw water analysis shall be as follows:

Sl. No.	Parameters Description		Unit
1.	pH	7.4	
2.	Total Suspended solids	~~20-500~~	mg/ltr.
3.	Total dissolved Solids	961	mg/ltr.
4.	Conductivity at 25 deg C	1456	µS /cm
5.	Total Hardness (as $CaCO_3$)	250	mg/ltr.
6.	Calcium Hardness (as $CaCO_3$)	153	mg/ltr.
7.	Magnesium Hardness (as $CaCO_3$)	95	mg/ltr.
8.	Sodium (as Na)	200	mg/ltr.
9.	Potassium (as K)	20	mg/ltr.
10.	Phenolphthalein alkalinity (as $CaCO_3$),	Nil	mg/ltr.
11.	Methyl Orange alkalinity (as $CaCO_3$)	380	mg/ltr.
12.	Sulphate (as SO4)	104	mg/ltr.
13.	Chlorides (as Cl)	197	mg/ltr.
14.	Nitrates (as NO_3)	5	mg/ltr.
15.	Total Phosphate (as PO_4)	12	mg/ltr.
16.	Fluoride (as F)	1	mg/ltr.
17.	Barium (as Ba)	0.8	mg/ltr.
18.	Strontium (as Sr)	0.5	mg/ltr.
19.	Total Silica (as SiO_2)	14	mg/ltr.

Clause No.	PROJECT INFORMATION

ANNEXURE - II
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Sl. No.	Parameters Description		Unit
20.	Molybdate Reactive Silica (as SiO_2)	10.5	mg/ltr.
21.	Colloidal / Molybdate Unreactive Silica (as SiO_2)	1.0	mg/ltr.
22.	Biochemical Oxygen demand at 20^0 C for 5 days	20-45	mg/ltr.
23.	Chemical oxygen demand	100-120	mg/ltr.
24.	Total Kjeldhal Nitrogen (as N)	20-45	mg/ltr.
25.	Ammoniacal nitrogen (as N)	15-25	mg/ltr.
26.	Residual Chlorine (as Cl_2)	0.25	mg/ltr.

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ANNEXURE-III
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Climatological Table based on the Observations at SafdarJung Observatory (1951-1980)

		AIR TEMPERATURE									CLOUD Amount		RAIN FALL		
				Mean				Extreme		Relative Humidity					
		Dry bulb	Wet bulb	Daily max.	Daily min.	Highest in the month	Lowest in the month	High-est	Low-est		All cloud	Low cloud	Monthly total	No. of Rainy days	Mean Wind speed
		°C	°C	°C	°C	°C	°C	°C	°C	%	Octas		mm		Kmph
JAN	I	9.3	7.6	21.1	7.3	25.5	3.8	29.4	-0.6	77	2.5	0.7	20.3	1.7	8.3
	I	19	12.7							45	2.5	0.8			
FEB	I	12.8	9.9	24.2	10.1	29.7	5.7	33.3	1.7	68	2.2	0.6	15.0	1.3	10.1
	I	22.7	14.5							37	2.5	0.6			
MAR	I	19.3	14.3	30.0	15.4	35.5	9.9	40.6	4.4	56	2.2	0.5	15.8	1.2	10.7
	I	28.5	17.4							29	2.8	0.8			
APR	I	26.6	17.8	36.2	21.5	40.8	15.8	45.6	10.7	39	1.8	1.9	6.7	0.9	11.2
	I	34.9	19.8							37	1.4	1.6			
MAY	I	30.7	20.5	39.6	25.9	43.4	20.8	47.2	17.5	37	1.4	0.5	17.5	1.4	12.8
	I	38.2	21.9							21	2.1	1.1			
JUN	I	31.8	24	39.3	28.3	43.6	22.6	46.7	18.9	52	2.6	1.1	54.9	3.6	13.7
	I	37.6	24.6							35	3.1	1.9			
JUL	I	29.5	25.8	35.1	26.8	39.9	23.4	45.0	21.4	75	5.2	3.1	231.5	10.0	9.9
	I	33	26.6							61	5.4	3.4			
AUG	I	28.3	25.6	33.3	25.9	37.2	23.5	41.0	21.2	80	5.5	3.4	258.7	11.3	8.3
	I	31.4	26.4							68	5.5	3.4			
SEP	I	27.4	23.7	33.9	24.4	36.8	21.5	40.6	17.3	72	3.0	1.7	127.8	5.4	8.9
	I	31.8	24.7							58	3.3	2.2			
OCT	I	23.7	18.8	32.9	19.5	36.1	15.3	39.4	9.4	62	1.0	0.5	36.3	1.6	6.1
	I	30.2	20.9							41	1.2	0.7			
NOV	I	16.6	12.6	28.3	12.8	32.1	8.7	35.0	3.9	61	1.1	0.2	5.0	0.1	6.1
	I	24.6	16.4							40	1.4	0.3			
DEC	I	10.6	8.4	23.0	8.2	27.1	4.8	29.0	1.1	73	2.1	0.5	7.8	0.6	7.4
	I	19.8	13.5							47	2.2	0.4			

Note : Recent Meteorological data may be collected from Indian Meteorological Department

Clause No.	PROJECT INFORMATION

CRITERIA FOR WIND RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT

All structures shall be designed for wind forces in accordance with IS: 875 (Part-3) and as specified in this document. The various design parameters, as defined in IS: 875 (Part-3), to be adopted for the project site shall be as follows;

(a)	The basic wind speed "V_b" at ten metres above the mean ground level	:	47 metres/second
(b)	The risk coefficient "K_1"	:	1.07
(c)	Category of terrain	:	Category-1

Note: Notwithstanding the values of the above mentioned parameters, the design wind pressure so computed at any point shall not be taken less than 1500 N/Sq.. metre for all classes of structures, i.e A,B & C, as defined in IS : 875 (Part-3).

Along wind forces shall generally be computed by the Peak (i.e. 3 second gust) Wind speed method as defined in the standard.

Along wind forces on slender and wind sensitive structures and structural elements shall also be computed, for dynamic effects, using the Gust Factor or Gust Effectiveness Factor method as defined in the standard. The structures shall be designed for the higher of the forces obtained from Gust Factor method and the Peak Wind Speed method.

Analysis for dynamic effects of wind must be undertaken for any structure which has a height to minimum lateral dimension ratio greater than "5" and/or if the fundamental frequency of the structure is less than 1 Hz.

Susceptibility of structures to across-wind forces, galloping, flutter, ovalling etc. should be examined and designed/detailed accordingly following the recommendations of IS : 875 (Part-3) and other relevant Indian standards.

It should be estimated if size and relative position of other structures are likely to enhance the wind loading on the structure under consideration. Enhancement factor, if necessary, shall suitably be estimated and applied to the wind loading to account for the interference effects.

Damping in Structures

The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for:

(a)	Welded steel structures	:	1.0%
(b)	Bolted steel structures	:	2.0%
(c)	Reinforced concrete structures	:	1.6%
(d)	Steel stacks	:	As per IS :6533 & CICIND Model Code whichever is more critical

Clause No.	PROJECT INFORMATION

CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT FOR PRAGATI -III AT BAWANA

All structures shall be designed for seismic forces adopting the site specific seismic information provided in this document and using the other provisions in accordance with IS: 1893 (Part 1) - 2002 and IS: 1893 (Part 41) - 2005. Pending finalization of Partss 2, 3 and 5 of IS: 1893, provisions of part-1 shall be read along with the relevant clauses of IS: 1893 - 1984, for structures other than the buildings and industrial structures including stack like structures.

A site specific seismic study has been conducted for the project site. The site specific design acceleration spectra (in units of gravity acceleration 'g') for the various damping ratios are as given at Annexure-EQ1.

Vertical acceleration spectral values shall be taken as 2/3rd of the corresponding horizontal values.

The site specific design acceleration spectra shall be used in place of the response acceleration spectra, given at figure-2 in IS: 1893 (Part 1) and Annex B of IS: 1893 (Part 4). The site specific acceleration spectra specified in Annexure-EQ1 includes the effect of the zone factor (Z/2) for design basis earthquake (DBE). The importance factor (I) and response reduction factor (R) as used in the IS: 1893 (Part- 1 and Part- 4) are to be considered.

Damping in Structures

The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for:

(a) Steel structures : 2%

(b) Reinforced Concrete structures : 5%

(c) Steel stacks : 2%

Method of Analysis

Since most structures in a power plant are irregular in shape and have irregular distribution of mass and stiffness, dynamic analysis for obtaining the design seismic forces shall be carried out using the response spectrum method. The number of vibration modes used in the analysis should be such that the sum total of modal masses of all modes considered is at least 90 percent of the total seismic mass and shall also meet requirements of IS:1893 (Part-1). Modal combination of the peak response quantities shall be performed as per Complete Quadratic Combination (CQC) method or by an acceptable alternative as per IS:1893 (Part-1).

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	ANNEXURE - V **PAGE 2 OF 2** In general, seismic analysis shall be performed for the three orthogonal (two principle horizontal and one vertical) components of earthquake motion. The seismic response from the three components shall be combined as specified in IS: 1893 (Part-1). For buildings, If the design base shear (VB), obtained from modal combination, is less than the base shear (VB), computed using the approximate fundamental period (Ta) given in IS: 1893, Part-1 and using site specific acceleration spectra, the response quantities (e.g. member forces, displacements, storey shears and base reactions) shall be enhanced in the ratio of VB / VB. However, no reduction is permitted if VB is less than VB. For regular building less than 12m in height, design seismic base shear and its distribution to different floor levels along the height of the building may be carried out as specified under clause 7.5, 7.6 & 7.7 of IS: 1893 (Part-1) and using site specific design acceleration spectra. The design horizontal acceleration spectrum value (A_h) shall be computed for the fundamental natural period as per clause 7.6 of IS: 1893 (Part-1) using site specific spectral acceleration given in Annexure-EQ1. Further, the spectral acceleration coefficient shall get restricted to the peak spectral value if the fundamental natural period of the structure falls to the left of the peak in the spectral acceleration curve. Design/Detailing for Ductility Structures shall be engineered and detailed in accordance with relevant Indian/ International standards to achieve ductility.

Clause No.	PROJECT INFORMATION

APPENDIX-EQ1
TO ANNEXURE-V
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Recommended Design Spectral Acceleration Values for 2% and 5% damping

Period(sec)	Spectral acceleration (g) Damping ratio	
	2%	5%
0.01	0.165	0.165
0.02	0.171	0.171
0.03	0.182	0.181
0.04	0.200	0.196
0.05	0.226	0.215
0.06	0.258	0.236
0.07	0.291	0.255
0.08	0.319	0.272
0.09	0.341	0.287
0.10	0.366	0.304
0.11	0.397	0.327
0.12	0.431	0.354
0.13	0.457	0.380
0.14	0.474	0.401
0.15	0.481	0.412
0.16	0.483	0.414
0.17	0.485	0.412
0.18	0.483	0.408
0.19	0.481	0.404
0.20	0.477	0.393
0.21	0.472	0.383
0.22	0.464	0.372
0.23	0.456	0.362
0.24	0.447	0.353
0.25	0.439	0.345
0.26	0.431	0.337
0.27	0.424	0.331
0.28	0.419	0.326
0.29	0.415	0.322
0.30	0.412	0.319

Clause No.	PROJECT INFORMATION

APPENDIX-EQ1
TO ANNEXURE-V
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Recommended Design Spectral Acceleration Values for 2% and 5% damping

Period(sec)	Spectral acceleration (g) Damping ratio	
	2%	5%
0.31	0.409	0.316
0.32	0.406	0.314
0.33	0.403	0.312
0.34	0.400	0.310
0.35	0.395	0.309
0.36	0.391	0.307
0.37	0.386	0.306
0.38	0.380	0.304
0.39	0.374	0.303
0.40	0.368	0.302
0.41	0.362	0.302
0.42	0.356	0.301
0.43	0.349	0.301
0.44	0.344	0.300
0.45	0.339	0.300
0.46	0.334	0.300
0.47	0.330	0.300
0.48	0.326	0.300
0.49	0.323	0.300
0.50	0.320	0.300
0.51	0.318	0.300
0.52	0.316	0.300
0.53	0.315	0.300
0.54	0.315	0.299
0.55	0.315	0.299
0.56	0.315	0.298
0.57	0.315	0.298
0.58	0.316	0.296

Clause No.	PROJECT INFORMATION

APPENDIX-EQ1
TO ANNEXURE-V
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Recommended Design Spectral Acceleration Values for 2% and 5% damping

Period(sec)	Spectral acceleration (g) Damping ratio	
	2%	5%
0.60	0.316	0.295
0.62	0.317	0.293
0.64	0.317	0.290
0.66	0.316	0.287
0.68	0.314	0.283
0.70	0.311	0.279
0.72	0.306	0.274
0.74	0.301	0.269
0.76	0.295	0.264
0.78	0.288	0.258
0.80	0.281	0.252
0.82	0.274	0.246
0.84	0.268	0.241
0.86	0.262	0.235
0.88	0.256	0.229
0.90	0.251	0.224
0.92	0.246	0.218
0.94	0.242	0.213
0.96	0.238	0.207
0.98	0.236	0.202
1.00	0.233	0.197
1.05	0.232	0.192
1.10	0.231	0.188
1.15	0.230	0.184
1.20	0.230	0.180
1.25	0.231	0.177
1.30	0.231	0.175
1.35	0.232	0.173
1.40	0.232	0.171

Clause No.	PROJECT INFORMATION

APPENDIX-EQ1
TO ANNEXURE-V
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Recommended Design Spectral Acceleration Values for 2% and 5% damping

Period(sec)	Spectral acceleration (g) Damping ratio	
	2%	5%
1.45	0.232	0.170
1.50	0.232	0.169
1.55	0.231	0.167
1.60	0.230	0.166
1.65	0.228	0.164
1.70	0.225	0.162
1.75	0.222	0.159
1.80	0.218	0.156
1.85	0.213	0.152
1.90	0.207	0.147
1.95	0.201	0.143
2.00	0.194	0.137
2.05	0.187	0.132
2.10	0.179	0.126
2.15	0.172	0.121
2.20	0.163	0.115
2.25	0.154	0.109
2.30	0.146	0.103
2.35	0.138	0.098
2.40	0.130	0.093
2.50	0.122	0.088
2.60	0.115	0.084
2.70	0.109	0.080
2.80	0.102	0.076
2.90	0.097	0.072
3.00	0.091	0.069
3.10	0.086	0.067
3.20	0.081	0.064
3.30	0.077	0.062

Clause No.	PROJECT INFORMATION

APPENDIX-EQ1
TO ANNEXURE-V
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Recommended Design Spectral Acceleration Values for 2% and 5% damping

Period(sec)	Spectral acceleration (g) Damping ratio	
	2%	5%
3.40	0.073	0.060
3.50	0.069	0.058
3.60	0.065	0.056
3.70	0.062	0.055
3.80	0.059	0.053
3.90	0.057	0.052
4.00	0.054	0.051
4.10	0.052	0.049
4.20	0.050	0.048
4.30	0.049	0.047
4.40	0.047	0.046
4.50	0.046	0.045
4.60	0.044	0.044
4.70	0.043	0.043
4.80	0.042	0.042
4.90	0.041	0.041
5.00	0.040	0.040
5.10	0.039	0.039
5.20	0.038	0.038
5.40	0.037	0.037
5.60	0.036	0.036
5.80	0.035	0.035
6.00	0.034	0.034
6.20	0.033	0.033
6.40	0.031	0.031
6.60	0.030	0.030
6.80	0.029	0.029
7.00	0.028	0.028
7.30	0.027	0.027

Clause No.	PROJECT INFORMATION

Recommended Design Spectral Acceleration Values for 2% and 5% damping

Period(sec)	Spectral acceleration (g) Damping ratio	
	2%	5%
7.60	0.026	0.026
8.00	0.025	0.025
8.50	0.024	0.024
9.00	0.022	0.022
9.50	0.021	0.021
10.00	0.020	0.020

SECTION – C

SPECIFIC TECHNICAL REQUIREMENTS

1. INTRODUCTION

This document gives the description of the mandatory spares for **PRETREATMENT PLANT, CW TREATMENT PLANT, CHLORINE DIOXIDE SYSTEM, EFFLUENT TREATMENT PLANT, CHLORINATION PLANT, SIDE STREAM FILTRATION & SEWAGE TREATMENT PLANT for 1500 MW PRAGATI – III CCPP**.

2. SCOPE OF SUPPLY

2.1 The items to be supplied by bidder as described in the below list:

SL. NO.	INSTRUMENT / ITEM	TYPE	RANGE	UNIT	END CONNECTION	QTY	MODEL NO.	MAKE
1.	PG	DIRECT BOURDON	0-4	KG/CM2	1/2" NPT (M)	5	8A-BD	GLUCK
2.	FT	ULTRASONIC	0-2000	M3/HR	100 NB ANSI B 16.5, 150 # FF	4	3102HA 1FRCNAST	EMERSON
3.	FT	DIFF. PRESSURE TYPE	0-4300	M3/HR	25 NB,DIAPHRAGM VALVE	4	3051CD2A0 2A1AH2B1 M5Q4	EMERSON
4.	ORIFICE PLATE	ORIFICE	0-4300	M3/HR	TAP SIZE 1/2: NPT (F) LINE SIZE 800 MS	2	--	MICROPRE CISION
5.	COND ANALYSER	2 wire	0-1000	µS/Cm	Low flow cell suitable for 12 MM OD tube connection	1	TX :1181C-06-10-07-11 ELECTROD E :400-13-55	EMERSON
6.	ORIFICE PLATE	ORIFICE	0 -350	M3/HR	LINE SIZE 500 NB CS TAP SIZE -1/2: NPT (F)	1	--	MICROPRE CISION
7.	LI	FLOAT & BOARD	2600	MM	40 NB ANSI B 16.5, 150 # FF	5	MLI-166-2600	LEVCON
8.	LI	FLOAT & BOARD	4900	MM	40 NB ANSI B 16.5, 150 # FF	1	MLI-166-4900	LEVCON
9.	LG	REFLEX	1300	MM	25 NB ANSI B 16.5, 150 # FF	5	RS 446-1116	LEVCON
10.	LS	CAPACITANC E	--	--	100 NB ANSI B 16.5, 150 # FF	15	ALC 541	NIVO CONTROL
11.	LS	SIDE MOUNTED MAGNETIC FLOAT TYPE	--	--	65 NB ANSI B 16.5, 150 # FF	7	137EA 2 7 T SA 2 S000-	SBEM
12.	PH TRANSMITTER	2 - WIRE	0-14	pH	2" PIPE MOUNTING	3	1181 PH-06-07-11	EMERSON
13.	PH SENSOR	Flow Through PH Sensor	0-14	pH	SAMPLE IN/OUT CONNECTION 1/4" NPT (F)	3	399-01	EMERSON
14.	PG	CHEMICAL SEAL THRD	0-16	Kg/cm2	1/2"NPT(M)	5	CS-S-TH + 8 A-BD	GLUCK
15.	PS	DIRECT MOUNTING	0-10	Kg/cm2	40 NB , ANSI B 16.5, 150 # FF	5	GM-201-02-A7K-33-3-Z	SWITZER
16.	PS	DIRECT MOUNTING	1.6-16	Kg/cm2	40 NB , ANSI B 16.5, 150 # FF	2	GM-201-02-A8K-33-3-Z	SWITZER

17.	TEMP. ELEMENT	RTD (PT 100)	0-50	DEG. CEL	FLANGED 150#, 50 NB ANSI B 16.5 RF	1	--	TEPMSENS
18.	TEMPERATURE TRANSMITTER	2 wire	0-50	DEG. CEL	HEAD MOUNTED	1	644HANAJ8 M5C4Q4	EMERSON
19.	ORIFICE PLATE	FLANGED TAPPING	0 - 13	M3/HR	LINE SIZE 50 CS TAP SIZE 1/2: NPT (F)	1	--	MICRO PRECISION
20.	PG	CHEMICAL SEAL FLGD	0-10	KG/CM2	25 NB ANSI B 16.5, 150 #FF	22	CS-S-RF + 8 AG-BD	GLUCK
21.	LG	REFLEX	1600	MM	25 NB ANSI B 16.5, 150 #FF	5	RS519-1119	LEVCON
22.	LI	FLOAT & BOARD TYPE	TANK HEIGHT 2450 mm	MM	40 NB , ANSI B 16.5 150 # FF	1	131T L 1 2 3 3 4 1 3 0 H=2450mm	SBEM
23.	LS	TOP MOUNTED DISPLACER TYPE	ROPE LENGTH 2450 mm	MM	100 NB , ANSI B 16.5 150 # FF	2	137D 1 2 1 X 1 1 4 2 L=2450mm	SBEM
24.	LT	ULTRASONIC	2875	MM	100 NB ANSI B 16.5, 150 #FF	5	3102HA1FR CNAST	EMERSON
25.	FI	BY-PASS	44 -220	M3/HR	25 NB ANSI B 16.5, 150 #FF	2	BPD-CS-200-PG-3	EUREKA
26.	ACTUATOR MOTOR OPERATED	ELECTRIC	--	--	--	1	SA3 E22	AUMA
27.	DIGITAL INPUT CARDS	-	-	-	-	6	IC200MDL650	GE
28.	DIGITAL OUTPUT CARDS	-	-	-	-	5	IC200MDL750	GE
29.	ANALOG INPUT CARDS	-	-	-	-	2	IC200ALG264	GE
30.	ANALOG OUTPUT CARDS	-	-	-	-	2	IC200ALG328	GE
31.	PC (MONITOR, CPU, KEYBOARD & OPTICAL MOUSE) LOADED WITH SOFTWARE (OPERATING SYSTEM)	As per datasheet attached	--	--	--	1	--	DELL / HP
32.	POWER SUPPLY MODULE	As per datasheet attached	--	--	--	4	--	--
33.	TFT MONITOR	As per datasheet attached	--	--	--	1	--	--
34.	PRINTER	As per datasheet attached	--	--	--	1	--	--
35.	HDD	160 GB	--	--	--	2	--	DELL / HP
36.	KEY BOARD	104 keys standard keyboard	--	--	--	2	--	DELL / HP
37.	POWER SUPPLY FOR COMPUTER (SMPS)	For desktop PC	--	--	--	4	--	Reputed Make

3. PACKING

Bidder to note that proper packing shall be provided ensuring safety to the instruments.

4. DRAWINGS / DOCUMENTS AND OTHER REQUIREMENTS

4.1 Bidder to note that engineering documents like Technical Data sheet & Quality Plan needs not be submitted by bidder during detailed engineering. However, bidder to ensure supply of instruments / items as per actual already supplied items / equipment attached under Section – D.
4.2 Spares for which datasheet is not attached, bidder has to supply as per make and model number etc. given above.
4.3 In case, there are some comments marked in attached datasheets, bidder has to supply spares complying the comments.
4.4 That all spares supplied will be new and in accordance with the contract document and will be free from defects in design, material and workmanship and shall further guarantee as under.
4.5 Further in case of discontinuance of supply of spares by the vendors or his sub-vendors, the vendor will provide such spares with other equivalent makes and model that should be easily interchangeable.

4.6 INSPECTION & TESTING

Bidder to furnish the Certificate of Conformance & other test certificates as required by end customer during acceptance of material. Also, bidder to withstand the guarantees as specified in commercial part of specification.

4.7 SCOPE OF SERVICE

Nil.

4.8 CIVIL SCOPE

Nil.

4.9 TERMINAL POINT

Not applicable.

4.10 ABBREVIATION

PG	Pressure Gauge
FT	Flow Transmitter
LI	Level Indicator
LG	Level Gauge
LS	Level Switch
LT	Level Transmitter
FI	Flow Indicator
HDD	Hard disc drive (Internal)

SECTION – D

TECHNICAL DATASHEETS OF SPARES

CW II

PRE-TREATMENT PLANT

Salwan 19/1/10

— Please Indicate Manufacturers Name on data sheet.

Cat - II

CE-152

19.01.2010

0	8/10/2009	FOR APPROVAL	SKS	APU	AVS
Rev. No	Date	Description	Prepared By	Reviewed By	Released By

PROJECT	**PRAGATI-III COMBINED CYCLE POWER PROJECT 1500MW(NOMINAL).**
CUSTOMER:	**PRAGATI POWER CORPORTION LIMITED (PPCL)**
CONSULTANT:	**NTPC LIMITED, CONSUTANCY WING**
	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA
	THERMAX LIMITED PUNE

DATA SHEET FOR PRESSURE GAUGES

THERMAX DOC.NO.: WHJAA00066	BHEL DOC. NO. : PE-VO-314-158-A300	OC.NO. 630128 REV. NO : ~~00~~ 01

THERMAX

PROJECT: - PRAGATI-III COMBINED CYCLE POWER PROJECT 1500MW (NOMINAL).(PT PLANT)
OWNER: PRAGATI POWER CORPORARTION LIMITED (PPCL)
CLIENT:BHARAT HEAVY ELECTRICALS LTD
CONSULTANT: NTPC LIMITED, CONSULTANCY WING
CLIENT DOC NO: PE-VO-314-158-A300
THERMAX OC NO: 630128

REPLIES TO THE COMMENT ON DATA SHEET

PRESSURE GAUGE DOC NO. WHJAA00066

S.NO.	COMMENT	THERMAX REPLY	REMARKS
I	Chemical seal & gauge isolation valve to be provided	Chemical seal is considered as per process requirement. 3 way gauge cock for threaded connection & diaphragm valve for flanged connection is considered for isolation.	

Note: Same data sheet is attached for approval

PRESSURE GAUGES (CHEMICAL SEAL TYPE)

SPECIFICATION FOR PRESSURE GAUGE

1. TYPE	Direct	10 BEZEL RING	SCREWED
2. MOUNTING	Local	11. SOCKET MATERIAL	SS - 316
3. DIAL SIZE	150MM	12. MOVEMENT	SS - 304
4. DIAL COLOUR	White with black inscription	13. RUPTURE DISC	Yes
		14. OVERRANGE PROTECTION	130 % of FSD
5. CASE MAT & ENCLOSURE CLASS	DI-Cast AL Weatherproof & dust proof as per NEMA - 4	15. ACCESSORIES	A) Snubber 1/2" NPT(M) X 1/2" NPT(F)-SS-316 B)GLYCERINE FILLED CASING
6. PRESS. ELEMENT	Bourdon		
7. ELEMENT MAT.	SS316	16. GLASS	SHATTER PROOF TYPE
8. ACCURACY	± 1% of FSD	17. Max. working temp	50 Deg. Celcius.
9. ZERO ADJUST.	Micrometer Pointer with Epoxy coated Screw adj.		

SPECIFICATION FOR CHEMICAL SEAL

1.TOP CHAMBER	CARBON STEEL
2.BOTTOM CHAMBER	CS + PTFE
3.TRANSMITTING FLUID	SILICON OIL
4. PACKING MATERIAL- FIBRE ASBESTOS ACID PROOF	
5. DIAPHRAGM-SS316+PTFE	
6.PROCESS CONNECTION- 25 NB ANSI B 16.5, 150 # FF	

TAG NO	RANGE Kg/cm2	OPER. PRESS. Kg/cm2	OPER. TEMP. DEG. C	MEDIUM	LOCATION	MODEL NO	ACCESSORIES
PG - 101	0 - 2.5	1.5	AMB	LIME	DISCHARGE OF P-1010 A	CS-S-RF + 8 AG-BD	B
PG - 102	0 - 2.5	1.5	AMB	LIME	DISCHARGE OF P-1010 B	CS-S-RF + 8 AG-BD	B
PG-103	0 - 2.5	1.5	AMB	LIME	DISCHARGE OF P-1020 A	CS-S-RF + 8 AG-BD	B
PG-104	0 - 2.5	1.5	AMB	LIME	DISCHARGE OF P-1020 B	CS-S-RF + 8 AG-BD	B
PG-105	0 - 2.5	1.5	AMB	FeCL3	DISCHARGE OF P-1030 A	CS-S-RF + 8 AG-BD	B
PG-106	0 - 2.5	1.5	AMB	FeCL3	DISCHARGE OF P-1030 B	CS-S-RF + 8 AG-BD	B
PG-107	0 - 2.5	1.5	AMB	FeCL3	DISCHARGE OF P-1030 C	CS-S-RF + 8 AG-BD	B
PG-108	0 - 2.5	1.5	AMB	PE	DISCHARGE OF P-1040 A	CS-S-RF + 8 AG-BD	B
PG-109	0 - 2.5	1.5	AMB	PE	DISCHARGE OF P-1040 B	CS-S-RF + 8 AG-BD	B
PG-110	0 - 2.5	1.5	AMB	PE	DISCHARGE OF P-1040 C	CS-S-RF + 8 AG-BD	B

Name & Under - ?

NOTES : 1. The Tag plate should be in engraved phenolic laminated to be marked on the dial.

QTY :- 10 NOS	PROJECT:PRAGATI -III COMBINED CYCLE POWER PROJECT 1500 MW (NOMINAL) AT BAWANA,DELHI					
MAKE :- GLUCK		1	8/10/2009	SKS	APU	AVS
THERMAX LIMITED	O.C NO: 630128	0	17/08/2009	SKS	APU	AVS
Water & Waste Solutions	OWNER: PRAGATI POWER CORPORATION LTD, DELHI	Rev.	Date	Prepd by	Chkd by	App by
Sai Chambers, Wakadewadi	CLIENT : BHARAT HEAVY ELECTRICALS LTD	Specifcation No		Plant	SH NO	
Pune 411 003 (INDIA)	CONSULTANT :- NTPC - CONSULTANCY WING	WHJAA00066		PT	2 OF 3	

PRESSURE GAUGES (DIRECT BOURDON TYPE)

GENERAL INFORMATION

1. TYPE	Direct	10. BEZEL RING	SCREWED
2. MOUNTING	Local	11. SOCKET MATERIAL	SS-316
3. DIAL SIZE	150MM	12. CONNECTION	1/2" NPT (M) Bottom
4. DIAL COLOUR	White with black inscription	13. MOVEMENT	SS - 304
		14. RUPTURE DISC	Yes
5. CASE MAT & ENCLOSURE CLASS	DI-Cast AL Weatherproof & dust proof as per NEMA - 4	15. OVERRANGE PROTECTION	130 % of FSD
		16. ACCESSORIES	A) Snubber 1/2" NPT(M) X1/2" NPT(F) - SS-316
6. PRESS. ELEMENT	Bourdon		B)GLYCERINE FILLED CASING
7. ELEMENT MAT.	SS316		
8. ACCURACY	± 1% of FSD	17. GLASS	Shatter Proof Type
9. ZERO ADJUST.	Micrometer Pointer with Epoxy coated Screw adj.	18. MAX. WORKING TEMP	80 Deg. Celcius

TAG NO	RANGE Kg/cm2	OPER. PRESS. Kg/cm2	OPER. TEMP. DEG. C.	MEDIUM	LOCATION	MODEL NO	ACCESSORIES
PG-111	0 - 4	2.5	AMB	WATER	DISCHARGE OF P-1050 A	8A-BD	A
PG-112	0 - 4	2.5	AMB	WATER	DISCHARGE OF P-1050 B	8A-BD	A

NOTES : 1. The Tag plate should be in engraved phenolic laminated to be marked on the dial.
2. 3way gauge cock & Snubber shall be supplied separately by THERMAX.

QTY :- 02 NOS	PROJECT:PRAGATI -III COMBINED CYCLE POWER PROJECT 1500 MW (NOMINAL) AT BAWANA,DELHI					
MAKE :- GLUCK		1	8/10/2009	SKS	APU	AVS
THERMAX LIMITED	O.C NO: 630128	0	17/08/2009	SKS	APU	AVS
Water & Waste Solutions	OWNER: PRAGATI POWER CORPORATION LTD.,DELHI	Rev	Date	Prepd by	Chkd by	App by
Sai Chambers, Wakadewadi	CLIENT : BHARAT HEAVY ELECTRICALS LTD	Specification No		Plant	SH NO	
Pune 411 003 (INDIA)	CONSULTANT:- NTPC - CONSULTANCY WING	WHJAA00066		PT	3 OF 3	

When selecting a pressure gauge, it is important to consider following factors to insure safety, accuracy and utility.

- *Gauge Measuring Principles*

Bourdon tube pressure gauges

Most standard dial type pressure gauges use a 'C' shaped or helically wound elastic measuring element known as Bourdon Tube. Bourdon tubes are generally made of a copper alloy or stainless steel alloy which are soldered or welded to the socket; the free end being firmly closed with an adjusting nut. A change in pressure causes the measuring element in to deflection. This deflection of the free end of the bourdon tube is proportional to the applied pressure and is transmitted to a rotary geared movement. This movement carries the pointer and indicates the pressure on a dial with ~270° scale graduation. Bourdon tube gauges are used for the measurement of high pressure up to 1000 bar and vacuum to -1 bar of gases, steam and fluids except for those having a high viscosity, or which are liable to crystallize. Accuracy is between ± 0.1% and ± 2.5% of full scale deflection.

Diaphragm pressure gauges

A thin, concentrically corrugated diaphragm is clamped between two flanges. The diaphragm will be loaded with the process pressure on one side and elastically deflects from its normal position. This travel is proportional to the applied pressure and is transmitted to a rotary movement by a push/pull rod. This movement carries the pointer and indicates the pressure on a dial with ~270° scale graduation. Diaphragm pressure gauges are used for the measurement of pressure from as low as 100 MMWC up to 25 Bar and vacuum to -1 bar of gases gases, steam and fluids. Accuracy is ± 1.6% of full scale deflection. The diaphragm is made of copper alloy or stainless steel alloy and can be protected against aggressive medium using foils made of Tantalum, Hestalloy-C, and PTFE etc. The connecting part can be protected using suitable material i.e. stainless steel alloy, PP, PVC, PTFE, PVDF etc. Diaphragm pressure gauges with open measuring flange are perfectly suited for high viscous, crystallizing and solid matter containing medium. Diaphragm pressure gauges can be easily supplied with overload safety. (For details see General Information – Diaphragm Pressure Gauges)

Capsule pressure gauges

The capsule consist of two thin, concentrically corrugated diaphragm welded or soldered together. Pressure changes in capsule causes and elastic deformation on both the sides of the measuring element. The motion of the measuring element is proportional to the measured pressure. It is transmitted to the pointer by a movement and indicated on a dial with ~270° scale graduation. Capsule pressure gauges are used for measurement of low positive or negative values up to 600 mbar. Accuracy is between ± 1.6% and ± 2.5% of full scale deflection.

Bourdon tube pressure gauges with chemical seals

The bourdon tube gauge is screwed in to the seal. The seal consist of a defined cavity which will be closed with a thin, elastic diaphragm i.e. membrane. The volume between this diaphragm and the bourdon tube will be filled with a transmission fluid after total evacuation. When the process fluid exerts a pressure, the elastic diaphragm transmits it through the transmission fluid to bourdon tube pressure gauge. The bourdon tube transfers the measured pressure by a movement on a dial with ~270° scale graduation. Due to the transmission fluid filling, the connection between the seal and the gauge must remain closed. The seals can be made in various forms and types depending on criticality of end applications. Gauges with seals can be used for the measurement of pressure up to 1000 bar and vacuum to -1 bar. Accuracy is between ± 0.55 to ± 1.6% of full scale deflection. A gauge with connecting flange is suited for high viscous, crystallizing, corrosive and solid matter containing medium. Flat seals can be used for clearance-volume free pressure measurement. Connecting parts of the seals can be made of resistant material against aggressive medium. For particular application a flexible capillary tube is installed between chemical seal unit and bourdon tube pressure gauge i.e. Remote reading/mounting. The most current version is a diaphragm seal mounted to a bourdon tube pressure gauge; therefore we use this version as an example to describe construction and function. Otherwise this seal can be connected to pressure transmitter, switch or transducer. (For details see General Information – Chemical Seals)

- *Gauge Types*

General Purpose Gauges

These gauges often referred to as commercial or equipment gauge. Though general purpose gauges may have to be ruggedly constructed, the service conditions are not expected to be severe. Designed for low cost without refinements, they are frequently referred to as "throw away" gauges since it is not economical to attempt repairs on this type of gauges. Most general purpose gauges have a black ABS or painted steel case with brass internal parts and connection.

Industrial Gauges

These gauges are having heavy duty construction designs and typically used in more demanding applications. These gauges usually have a greater accuracy requirement than general purpose gauges. The industrial stainless steel type gauges are built for extended life and designed for harsh corrosive environments.

Process Gauges

Process gauges combine the heavy duty operating and construction requirement of industrial gauges with more exacting accuracy and service life which is demand of many process applications. Process gauges are designed for the chemical, petroleum and other process industries. The cases are made of corrosion resistant material like Stainless steel 304 or Aluminium or thermoplastics and if process requires, can offer a solid front / blow out back safety case design.

Precision & Test Gauges

Dial type test gauges are cost effective, extremely sensitive and highly accurate. These gauges are excellent for instrument shops, gauges manufacture, repair and calibration shops, testing laboratories and other application demanding precision and consistent results. Test gauges feature adjustable knife-edge pointer and mirror bands on the dial to assure precise readings.

Low Pressure Gauges

Low pressure gauges utilize a capsule & diaphragm sensing element design and accurately measure pressure between 100 up to 6000 MMWC. Typical measuring units are inches of water, mm of water, oz/sq. inch, mm of mercury, inch of mercury etc.

Specialty Pressure Gauges

Special gauges designed for specific applications

- *Gauge Size*

The gauge size is typically referring to the nominal diameter of the dial (ANSI) or case (DIN) for bourdon or capsule or diaphragm pressure gauges. The dial is the viewing area of the gauge that shows the pressure scale and needle pointer. Gauges are available in a wide range of sizes from 1-1/2" up to 10". Dial size is determined in two ways. First, a requirement for higher accuracy dictates that a larger dial size be available for display of small and readable pressure scale increments. Second, by a requirement that the pressure gauge user/operator be able to read the scale from a distance that physical circumstances may dictate.

- *Gauge Mounting and Connection*

Pressure gauges should have rigid mounting to protect it from mechanical vibration of the equipments or system lines and should be mounted in upright position. Equipment structure and system design presents a need for variable mounting requirements and case styles. Considering these parameters following mountings and process connections are available for most gauges type.

Entry & Mounting Styles (Our type abbreviation used in Model Nos.)

- Bottom Entry Direct Mounting (BD)
- Bottom Entry Surface Mounting (BS)
- Center Back Entry Direct Mounting (CBD)
- Center Back Entry Panel Mounting (CBP)
- Center Back Entry Bracket Mounting (CBB)
- Side Back Entry Direct Mounting (SBD)
- Side Back Entry Panel Mounting (SBP)
- Side Back Entry Bracket Mounting (SBB)

Process Connection

- 1/8", 1/4", 3/8", 1/2" NPT (M) or BSP (M) (For detail availability refer catalogue)
- For diaphragm and chemical seal gauges flanged process connection are available refer catalogue.
- Other specific process connections can be provided as per requirement.

- *Gauge Pressure Range*

A gauge range of twice the normal working pressure is generally selected. The maximum operating pressure in all cases should be limited to 75% of the gauge range. Where alternating pressure and pulsation are encountered, working pressure should be limited to 2/3 of the gauge range. Overlooking these criteria may result in to over pressure failure or loss of gauge accuracy.

- *Pressure fluid composition*

Copper alloy i.e. Brass or stainless steel is the standard wetted parts (material in contact with the pressure media) available on most pressure gauges. Since the sensing element of a pressure gauge be exposed directly to the measured medium, consider the characteristics of this media i.e. corrosiveness, Temperature, viscosity (May be varying with temperature), solid content, crystallizing nature etc. Ignoring this may result in to loss of accuracy, failure of elastic sensing element, explosion and can be further worst. For pressure fluids that will not solidify under normal/operating conditions or leave deposits a standard bourdon tube gauge may be acceptable. Otherwise, a diaphragm gauge or chemical seal attached to bourdon gauge should be used. For wetted parts selection refer chemical compatibility table or contact factory.

- *Gauge case/Housing*

Stainless steel, black ABS, painted steel, brass, aluminium, thermoplastic is standard case material. Select a material suitable to your application referring product catalogue and possible combination of case material for it. Stainless steel, ABS and aluminium cases are recommended for our door service. General purpose or most standard gauges have a dry case (No liquid fill), while industrial and process gauges have a liquid fill option available.

- *Gauge Front ring/Bezel and Window*

The front ring/bezel can be made of acrylic, stainless steel, brass, steel, aluminium or thermoplastic. The viewing window is held in place by the front ring/bezel. Some rings are permanent crimp design, while others can be removed providing access to dial/pointer for recalibration or repair. Widow materials are typically clear acrylic, polycarbonate, plain glass or safety glass.

- *Gauge Dial/Pointer*

The pressure scale is printed on the face of dial. The pointer typically moves clockwise to measure pressure and counter clockwise to measure vacuum. Some gauges offer adjustable pointer or mechanism for recalibration. Test gauges offer a mirrored band on the dial and a knife-edge pointer, making it easy to take very accurate readings.

- *Gauge Accuracy*

Gauges are available with the following accuracy as per ASME B40.1, EN-837-1, IS-3624 and BS-1780. Initial system engineered design requirements will dictate the required pressure gauge accuracy. System should be designed with cost and safety in mind. Generally, gauges with better accuracy are larger and more expensive.

Accuracy Grades as per ASME B40.100 1998			
Accuracy Grade	Permissible Error (± Percent of Span)		
	Lower ¼	Middle ½	Upper ¼
4A *	0.1	0.1	0.1
3A	0.25	0.25	0.25
2A	0.5	0.5	0.5
1A	1.0	1.0	1.0
A	2.0	1.0	2.0
B	3.0	2.0	3.0
C	4.0	3.0	4.0
D	5.0	5.0	5.0
* Grade 4A gauges must remain within specified tolerance before and after lightly tapped.			

Accuracy Classes as per EN-837-1:1996	
Accuracy Class	Permissible Error (± Percent of Span)
0,1	0.1
0,25	0.25
0,6	0.6
1	1.0
1,6	1.6
2,5	2.5
4	4
For gauges with pointer stop, the accuracy class will cover 10% to 100% of the range. For gauges with free zero, the accuracy class will cover 0% to 100% of the range and zero shall be used as an accuracy check point.	

Accuracy Class as per BS-1780:Part 2: 1971			
Accuracy Class	Permissible Error (± Percent of Span)		
	Below 10%	10 to 90%	Above 90%
Test Gauge	0.25	0.25	0.25
Class 1	1-1/2	1	1-1/2
Class 2	3	3	3

Accuracy Class as per IS-3624 1987			
Accuracy Class	Permissible Error (± Percent of Span)		
	Below 10%	10 to 90%	Above 90%
Test Gauge	0.25	0.25	0.25
Class 1A	1	1/2	1
Class 1B	1-1/2	1	1-1/2
Class II	3	3	3

- *Liquid Filled Option*

Liquid filled gauges help absorb vibration and pressure spikes/surges, increasing the service life of the gauge. The dampening action of the liquid reduces pointer flutter and lubricates the internal parts, dramatically reducing wear in the movement. Glycerine is the standard fill fluid and provides the best performance in most applications; Silicone has a low viscosity and works well when extreme temperature fluctuation or icing is expected. The fill liquid must be compatible with the gauge application.

Further, when gauges are filled with the glycerine for low temperatures a glycerine – water mixture in following ratios is used:

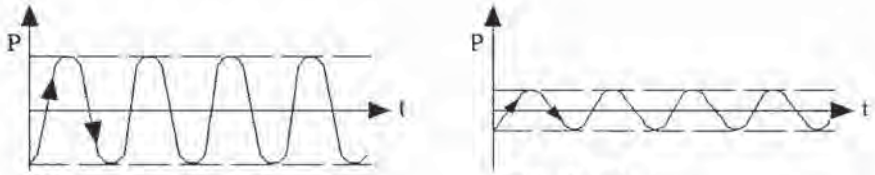
Up to 0° C 90 % Glycerine and 10 % water
Up to -20° C 80 % Glycerine and 20 % water
Up to -40° C 65 % Glycerine and 35 % water

When a glycerine-water mixture is used at ambient temperatures, the dampening effect is reduced with increased water ratio.

Operation

With applications incurring frequent pressure changes, pressure peaks and external vibration, general purpose or dry case pressure gauges are subjected to rapid wear. Under such conditions, the moving parts of the gauge suffer oscillations, the amplitude id often higher than the natural frequency of the acting forces. This may lead to a fracture of the measuring element. Simultaneously, transmission parts. bearings and gears are warmed up and abrased. An exact reading is usually impossible due to pointer oscillations. To provide effective protection against such conditions, pressure gauges are filled with glycerine. The dampening effect of the liquid, thus reduces the amplitude of the vibrations.

Principle of oscillation dampening



Without glycerine | With glycerine

The lubrication provided by the glycerine reduces the abrasion of pinion and shafts and considerably extends the gauge life. Additionally, the filling prevents the formation of condensed water within the case and the entry of unwanted aggressive gases. The equalization of pressure within the case is provided by a bleeder.

- *Shock, Vibration & Pulsation*

Consider liquid filled gauges to enhance the reliability and integrity of the measuring system when operating for long periods under extreme operating conditions. In addition pulsation snubbers are used to minimize effects from pulsation and pressure spikes/surges. The snubber helps keep accurate data flowing by dampening pulsation and spikes/surges. Gauge life is also extended by reducing gauge wear. Further, mounting option become an important consideration for elimination of mechanical vibration between mechanical equipment and the pressure gauge. In some application it may be appropriate to connect the pressure gauges to the mechanical device using flexible hose and tubing so that equipment's mechanical vibration is dampened by structural components. ***gluck*** offers a wide range of dial sizes, mounting options and case styles to fit customer's gauge mounting needs.

- *Operating Temperature & Ambient conditions*

The normal ambient temperature range for most standard dry or silicone filled gauges is -40 to +140° F. The normal temperature range for glycerine filled gauges is -4 to +140° F. Steam and other hot media raise the safe working limits of the gauge, such temperature change effects the stiffness of elastic element (Bourdon Tube) and change in stiffness of element will effect gauge accuracy. In these cases, siphons, cooling towers or chemical seals may be used to trap condensed steam or other vapor to isolate the gauge from the heat source I.e. making liquid seal in the line to the gauge for preventing high temperature reaching the gauge internals.

Gluck (India) Mfg. Co.

MODEL Decoding of Bourdon Type Gauges	**General Information**

For understanding the Model decoding please refer to an example of Model **8A-BD** where the alphabets is to be divided in to parameter **"8", "A-" & "BD"** and for values of each parameter refer table 1, 2 & 3 respectively as under.

Table – 1 : Specifies the dial size and general MOC of the wetted parts i.e. Bourdon tube & Shank (Socket or Process Connection)	
15	1-1/2" (40mm) Dial Size, Copper Alloy internals
5	2" (50mm) Dial size, Copper Alloy internals
9	2-1/2" (63mm) Dial size, Copper Alloy internals
1	4" (100mm) Dial size, Copper Alloy internals
2	6" (150mm) Dial size, Copper Alloy internals
4	10" (250mm) Dial size, Copper Alloy internals
3	2-1/2" (63mm) Dial size, Steel Alloy internals
7	4" (100mm) Dial size, Steel Alloy internals
8	6" (150mm) Dial size, Steel Alloy internals
6	10" (250mm) Dial size, Steel Alloy internals
Notes: *1) Copper Alloys : Brass, Ph. Bronze* *2) Steel Alloys : SS-304, SS-316, SS-316L, SS-316Ti, Monel*	

Table – 2 : Specifies utility, construction in general, case MOC and case option (Dry or filled case)	
-	General Purpose, Non Weather Proof
E-	General Purpose, Economic, Non Weather Proof
A-	Industrial Purpose, Weather Proof, Aluminium Black Coated Casing (Dry Case)
S-	Industrial Purpose, Weather Proof, SS Casing (Dry Case)
M-	Industrial Purpose, Weather Proof, Steel Black Coated Casing (Dry Case)
AG-	Industrial Purpose, Weather Proof, Aluminium Black Coated Casing (Filled Case)
SG-	Industrial Purpose, Weather Proof, SS Casing (Filled Case)
MG-	Industrial Purpose, Weather Proof, Steel Black Coated Casing (Filled Case)

Table – 3 : Specifies Mounting	
BD	Bottom Entry Direct Mounting
BS	Bottom Entry Surface Mounting
CBD	Center Back Entry Direct Mounting
CBP	Center Back Entry Panel Mounting
CBB	Center Back Entry Bracket Mounting
SBD	Side Back Entry Direct Mounting
SBP	Side Back Entry Panel Mounting
SBB	Side Back Entry Bracket Mounting

From the taken example of Model no. ***8A-BD*** gauge categories as under:

6" (150mm) Dial size Steel Alloy internals X Industrial Purpose, Weather Proof, Aluminium Black Coated Casing (Dry Case) X Bottom Entry Direct Mounting type Bourdon operated Gauge

Gluck (India) Mfg. Co.

Industrial Weather Proof SS Case Bourdon Gauge with Stainless Steel Alloys	PART – 6 Spec. Series : BTW-S XS – XXX : Dry Version XSG – XXX : Filled Version

Universal Stainless Steel Bourdon Type Gauge: Many applications require pressure gauges, which must remain fully functional under extreme operating condition such as aggressive fluids under pressure or aggressive environments. In this case the materials used for the pressure gauges components must be selected with particular care.
Gluck high quality pressure gauges are built with stainless, chrome- nickel steels (i.e. S.S.316). They can be used under all operational conditions, practically without limitations. Their concept combines sturdy design and high measuring accuracy.
The pressure gauges are suitable for extreme measuring conditions. Variable designs and materials enable them to meet the requirements of virtually all-international pressure gauge standards. The gauges can be used for all liquids and gases used in processes except for those having a high viscosity, or which are liable to crystallized.

Nominal Size
63, 100, 150 mm

Accuracy
63 mm: Class 1.6 / 2.5 as per EN-837-1 or Class II as per IS-3624
100 and 150 mm: Class 1 as per EN-837-1 or Class IB as per IS-3624

Scale Ranges
0...0.6 to 0...800 Kg/Cm² for 100 and 150 mm
0...1 to 0...400 Kg/Cm² for 63 mm
or equivalent other units of pressure or vacuum

Working Pressure
Steady: 3/4 of full scale value
Fluctuating: 2/3 of full scale value
Short Duration: Full scale value

Over Pressure Safety
1.25 X Full scale value. (Up to scale range 100 Kg/Cm²)
1.15 X Full scale value. (For scale range > 100 & ≤ 400 Kg/Cm²)
1.10 X Full scale value. (For scale range > 400 Kg/Cm²)

Enclosure or Weather Protection
IP 65 as per IS 13947 (Part-1)-1993

Operating Temperature
Ambient: -20...+60° C
Medium: +200° C

Temperature Error (Reference temperature +29° C)
Deviation of indication per 10° C about +0.3 % of indicated value for higher temperatures, about -0.3 % of indicated value for lower temperatures.
The temperature used for the correction of the indication is the temperature of the measuring system, and not the temperature of the fluid under pressure.

Standard Features

Pressure Connection (Shank)
Material: Stainless Steel 316
Thread Size: 1/8", 1/4" BSP(M) /BSPT(M) / NPT(M) , 14mm Flat for 63mm
1/4", 3/8", 1/2" BSP(M) /BSPT(M) / NPT(M) , 22mm Flat for 100, 150 & 250mm

Pressure Element
Material: Stainless Steel 316
< 100 Kg/Cm²: C-type
≥ 100 Kg/Cm² : Helical type

Movement
Stainless Steel 304

Dial
White Aluminium or ABS Plastic with black lettering

Pointer
Black Aluminium or Tin

Mounting
-) Bottom Entry Direct Mounting (BD)
-) Bottom Entry Surface Mounting (BS) for 100, 150 and 250mm
-) Side Back Entry Direct Mounting (SBD)
-) Side Back Entry Bracket Mounting (SBB)
-) Center Back Entry Direct Mounting (CBD)
-) Center Back Entry Bracket Mounting (CBB)

Case
Stainless Steel 304 Semi Glossy Finish

Bezel Ring
Stainless Steel 304 Bayonet lock type

Window
Laminated safety glass (Shatter Proof Glass) for 100 & 150mm
Clear plain glass for 63 mm

Blow Out Protection
Neoprene Disc at back of the case for 100 and 150 mm
Bleeder at top of the case for 63mm
(For filled version bleeder shall be provided on the top of the case for all dial sizes.)

Zero Adjustment
Provided on the pointer for 100 and 150 mm
Not available for 63 mm

Optional Features

-) Accuracy class 0.6 as per EN-837-1 or class IA as per IS 3624 for 150mm
-) Pressure connection and element material of Stainless Steel 316 L, Monel (Availability to be confirmed with factory)
-) Liquid filled version available. For 63 mm widow shall be acrylic glass. (For details on glycerine filling refer Pressure Gauges Selection)
-) Other process connection.
-) Metal Bush bearing movement, Stainless Steel 316 movement (available for 100 and 150 mm).
-) Scale graduation with °C for refrigerant R717 (NH_3) Ammonia Pressure Range -1-0-16 Kg/Cm² and -1-0-25 Kg/Cm².
-) Specific custom required scale.
-) Acrylic window, Toughened Glass window.

Nom. Size	Model No.		Mounting					
	Dry Version	Filled Version	Bottom Entry Direct	Bottom Entry Surface	Side Back Entry Direct	Side Back Entry Bracket	Center Back Entry Direct	Center Back Entry Bracket
63 mm	3S	3SG	BD	NA	NA	NA	CBD	CBB
100 mm	7S	7SG	BD	BS	SBD	SBB	NA	NA
150 mm	8S	8SG	BD	BS	SBD	SBB	NA	NA

NA: Not Available

Modern chemical processing and process manufacturing procedures demand ever greater accuracy and reliability from their pressure and level measuring instruments. In order to minimize costs, both rejection level and production down time must be kept to the absolute minimum.

In some applications it is necessary to isolate the pressure measuring instrument from the process medium in order to maintain these accuracy and reliability objectives; the ***Gluck*** range of Chemical Seals are specifically designed for this purpose.

If a particular instrument and/or chemical seal are needed, user should be aware of the material characteristics, operating conditions for the instrumentation and the method of installation.

The following general information about features, applications and function of our chemical seal is relevant all our Models/Types. Furthermore, you will find user instructions and our advice about how to order in this leaflet. ***Detailed information, dimensional data and drawings can be found on the separate data sheets of the individual models.***

- *Application*

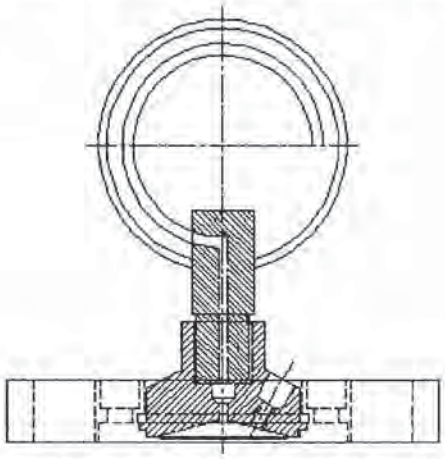
Chemical seals separate the measuring system from the process medium. This way they enlarge the possible applications for pressure gauges, pressure switches, pressure transducers and pressure transmitters a lot. Chemical seals are used and recommended as separators,

- When the process medium is corrosive and requires special corrosion resistance. Bourdon tubes are only available in certain standard materials. When none of these materials suits for the medium, a chemical seal made out of a suitable special material is a reasonable solution.
- When the process medium is thick or viscous fluid, pressure measuring element or bourdon tube shall be suitably protected.
- When process medium tends to crystallize, solidifies or polymerize causing the connection / inlet of the pressure instrument to be obstructed and can generate dead volumes in pressure measuring element.
- When process medium is Heterogeneous fluid with fibrous content, where deposits take place in dead zones.
- When process medium contains suspended solids it should be restricted to enter a measuring element such as bourdon tube.
- When process medium temperature or the ambient temperature at the measuring point is high this would affect the pressure instrument performance if in direct contact.
- For hygienic reasons often found in food or pharmaceutical where no dead space is allowed. Here bacteria zone conform which are sometimes difficult to clean.
- When measurement situations are difficult where either pressure instrument is difficult to read or install.
- For atmospheric or environmental contamination problem where adequate measurement must be made for safety reasons.
- When high over range protection is required.

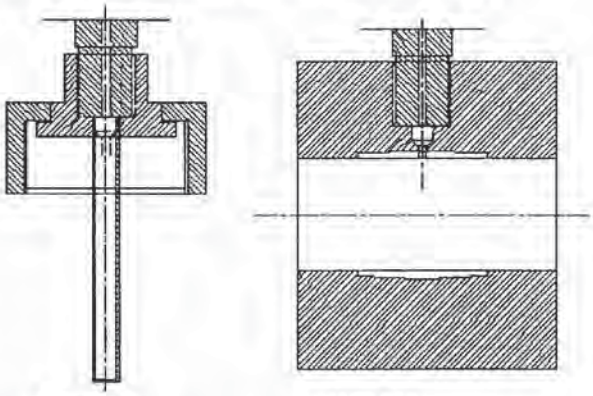
- *Function*

Chemical seals are mainly used on pressure gauges with Bourdon tubes, pressure switches, pressure transmitters or pressure transducers. They can be directly attached to measuring instrument, or through a capillary line or a cooling element can be mounted between measuring instrument and chemical seal.

The essential part of a chemical seal is a \the separating element. This can be a membrane (Diaphragm Seal), a tube (Inline seal) or an immersion tube shaft (Capsule seal), compare the simplified drawings of these three basic types below.



Diaphragm Seal Mounted to a Bourdon tube Pressure Gauge



Capsule Seal Inline Seal

The most current version is a diaphragm seal mounted to a Bourdon tube pressure gauge. Therefore we use this version as an example to describe construction and function:

The pressure element of the gauge and the space behind the membrane form a completely sealed system, evacuated and then filled with a suitable filling liquid. The process medium reaches the membrane which deflects under pressure and causes a volume change inside the system.

The membrane has to displace as much volume as the measuring element needs to indicate the pressure. The deflection of the membrane must stay below it's limit of elasticity which is determined by material, form, thickness and diameter of the membrane.

The volume displaced by the membrane is called "displacement volume" or "operation volume". The volume that is necessary to cause the element to indicate the pressure is called "control volume" or "driving volume".

- *Particulars*

The influence of a chemical seal on the measuring result should be as small as possible. Therefore it is important to take all operating conditions in to consideration when choosing a chemical seal, to find the most suitable version for an optimized measurement.

Temperature

The system is filled at ambient temperature, approx +27°C. A different temperature of the medium or the ambience at the measuring point causes a volume change, which changes the pressure inside of the filled system and may cause a significant indication error.

This influence can be minimized by using the best suitable filling fluid. The volume respectively the space behind the membrane of the chemical seal should be as small as possible to reduce temperature caused errors. Also the diameter of the membrane is important for the temperature effect. The bigger the diameter the better the compensation of temperature caused volume change.

For temperature higher than +100°C a capillary line or a cooling element between measuring instrument and chemical seal is recommended, so that the measuring instrument can stay remote from the measuring point. Cooling elements as well as capillary lines reduce temperature arriving at the measuring instrument.

Response Time

Generally a chemical seal retards the reading of the instrument. This can be desired for a better dampening effect on the indicating instrument.

The response time depends on the volume of the filling medium, the viscosity, the pressure range of the measuring instrument, the inner diameter and the length of a capillary line.

Height Difference

When the measuring instrument and the chemical seal are not mounted on the same level, this difference in height influences the measurement through the hydrostatic pressure of the fluid column. Please specify a level difference when ordering, so we can take this into consideration for the calibration.

Filling Fluid

The filling fluid has to be suitable for working and ambient temperature, namely as well as for the possible minimum temperature as for the possible maximum temperature. Furthermore the filling liquid has to be compatible to the medium, especially when the instrument is used for oxygen or chlorine services or in food and dairy industries. It can never be fully precluded that through a damaged membrane filling fluid might drip into the process medium.

Material

The standard and common special materials for chemical seals resp. wetted parts are specified in our data sheets. If you don't find the suitable material for your requirement, please contact us. We shall be pleased to offer individually on your specification.

Capillary Line

Capillary lines are made of stainless steel with protection at both the ends. Optionally the capillary line can be supplied with flexible armour (stainless steel). The maximum possible length of the capillary line depends upon the pressure range and the chemical seal model.

Attachment of outside bought Measuring Instruments

Upon request we also attach measuring instrument from other manufacturers to our seals. Therefore we need a detailed description and user instruction of the instrument, so we can verify the suitability of the displacement volume of the selected seal.

User Instruction

Unfortunately chemical seals are often damaged by incorrect handling. The repair of instruments with chemical seals is very time consuming and expensive. Measuring instruments with chemical seal should therefore be handled very carefully.

Please note especially the following notes:

- Avoid touching the membrane inexpert. It is very thin. Any contact with sharp instruments causes' damage. Chemical seal should never be cleaned with high pressure water or sharp instruments.
- Do not open any connection of the system.
- All those chemical seal supplied with filling screws which is sealed shall not be opened.
- When the capillary line is not welded but screwed to the chemical seal, this connection are also not allowed to be opened.
- Do not use capillary at all for carrying or moving the instrument. The welding connections are not allowed to be stressed. The capillary line may never be buckled or bended. Buckling or bending causes an increased response time or even a leak, this means to damage the complete system.
- Before you send an instrument back for repair service, please pay attention to clean all wetted parts carefully from the process medium, especially from any health effecting substances. You should state on the delivery notes for which medium the instrument was used.

- *How to Order*

Besides the specification of the required measuring instrument enquiry or order needs to contain the following information:

- Model/Type of chemical seal (If already chosen; otherwise we will be pleased to help you selecting the suitable model)
- Material of construction for wetted parts
- Process connection
- Required Transmitting fluid
- Operating and maximum pressure
- Temperature at the chemical seal; if changing: from ____ upto____ °C or °F
- Ambient temperature
- Minimum and maximum temperature in case of flush or other cleaning procedures
- When capillary extension is required, please specify further details as under;
  - Length of extension
  - Any difference in height between chemical seal and measuring instrument
  - Mounting of the measuring instrument
    - Bottom entry surface mounting i.e. Rear flange at the instrument
    - Bottom entry yoke mounting i.e. Pipe clamp mounted on back of the case
    - Back entry panel mounting i.e. Front flange at the instrument
    - Back entry bracket mounting i.e. Bracket at the instrument and Case MOC shall be Aluminium black only.

In our data sheets you find information about our standard models and configurations. Besides that we developed in close cooperation with our customer numerous INDIVIDUAL TECHNICAL SOLUTIONS for pressure measurements.

Please do not hesitate to contact us, it shall be our privilege to find the most suitable solution to your individual pressure measuring requirements.

Gluck chemical seals are basically designed and categorized as under:

- Sandwich Diaphragm Seals — Prefixed as CS-S
- Welded Diaphragm One Piece Design — Prefixed as CS-W1
- Welded Diaphragm Two Piece Design — Prefixed as CS-W2
- Welded Diaphragm Three Piece Design — Prefixed as CS-W3

Please refer decoding information on each type of above seals for the general available option for its selection parameters. For every selection's detailed information refer Data / Specification sheets.

Gluck (India) Mfg. Co.

MODEL & Item Code Decoding of Chemical Seals (Sandwich Diaphragm Seals)	**General Information**

Considering large permutation and combination of various parameters for chemical seals it is must to have MODEL reference for identifying type of chemical seal in ***general*** with respect to its construction & type of process connection. All the chemical seals under Sandwich Diaphragm Seals type are prefixed with **CS-S** i.e. **C**hemical **S**eal – **S**andwich type. Second parameter specifies construction & type of seal i.e. CS-S-XX where XX_1 has to be replaced as per Table-1 hereunder.

Table-1 : Specifies construction & Seal Type (XX_1)	
TH	Threaded Connection Seals (Male or Female)
RF	Regular Flanged Connection Seals
IF	I-Section Flanged Connection Seals
MT-TH	Most Tapper Threaded Connection Seals (For High Viscous Application)
TH-FL	Threaded Connection Seals with flushing arrangements (Male or Female)
OF	Open Type Flanged Connection Seals (Flush Diaphragm)
TGF	Tongue & Groove Flanged Connection (For High Pressure)

Further to MODEL reference it is must to identify the other parameters for the seal and the same are defined below which form the specific item code for the seal.

Item Code Generation: CS-S-XX_1-XX_2-XX_3-XX_4-XX_5-XX_6-XX_7-XX_8
Please refer Table-2 to 8 hereunder for values of each parameter to be replaced for $XX_{2\text{ to }8}$ respectively.

Table-2 : Specifies MOC of Top Housing (XX_2)	
MSB	Carbon Steel Black Coated
MSP	Carbon Steel Plated
S4	Stainless Steel 304
S6	Stainless Steel 316
FRG	Forged Flange (For the Forging grade data sheet is to be referred)

Table-3 : Specifies MOC of Bottom Housing (XX_3)	
MSB	Carbon Steel Black Coated
MSP	Carbon Steel Plated
S4	Stainless Steel 304
S4L	Stainless Steel 304L
S6	Stainless Steel 316
S6L	Stainless Steel 316L
MN	Monel
HC	Hestalloy 'C'

Table-4 : Specifies Protection on Bottom Housing (XX_4)	
NA	Not Applicable
PTC	PTFE Coated
PTL	PTFE Lined
PVC	PVC Coated
PVL	PVC Lined
RL	Rubber Lined

Table-5 : Specifies MOC of Diaphragm (XX_5)	
S6	Stainless Steel 316
S6L	Stainless Steel 316L
MN	Monel
HC	Hestalloy 'C'
IN	Inconnel
N2	Nickle-200
N4	Nickle-400
TA	Tantalum

Table-6 : Specifies Protection on Diaphragm (XX_6)	
NA	Not Applicable
PTC	PTFE Coated
PTL	PTFE Lined
ETL	Halar (High Grade Teflon – ECTFE) Lined

Table-7 : Specifies Gasket MOC / Grade (XX_7)	
A-GR	Asbestos of various Grade
T	Teflon
P	PVC
NR	Neoprene Rubber

Table-8 : Specifies Seal Range Note (XX_8)	
L	Low Pressure Range of 0.6 Kg/cm²
R	Regular Pressure 0-1 up to 25 Kg/cm²
M	Medium Pressure 0-30 up to 60 Kg/cm²
H	High Pressure 0-70 up to 160 Kg/cm²
VH	Very High Pressure 0-210 up to 400 Kg/cm²

For understanding item code refer an example of item code:

CS-S-TH-MSB-S6-NA-S6-PTC-A60-R

This specifies Chemical Seal Parameters as under:

- **CS : Chemical Seal**
- **S : Sandwich Diaphragm Type**
- **TH : Threaded Connection (For Size and Type Data/Specification sheet to refer)**
- **MSB : Top Housing CS Black Coated**
- **S6 : Bottom Housing Stainless Steel 316**
- **NA : Bottom Housing Protection not Applicable**
- **S6 : Diaphragm (Membrane) of Stainless Steel 316**
- **PTC : Diaphragm protected with Teflon Coating**
- **A54 : Asbestos Gasket of Grade-60 of Champion Make Acid Proof Temp. 210°C & Pressure 150 Kg/cm².**
- **R : Regular Pressure Range i.e. 0-1 up to 25 Kg/cm²**

In addition to above for filling fluid, mounting information, Bourdon Gauge type to be attached to the seal refer specific data sheet.

PRE-TREATMENT PLANT

Cat IV

CSI 254
6/5/10

Rev. No	Date	Description	Prepared By	Reviewed By	Released By
1	2/3/2010	REVISED AS PER NTPC COMMENT	SKS	APU	AVS
0	9/12/2009	FOR APPROVAL	SKS	APU	AVS

PROJECT	**PRAGATI-III COMBINED CYCLE POWER PROJECT 1500MW(NOMINAL).**
CUSTOMER:	**PRAGATI POWER CORPORTION LIMITED (PPCL)**
CONSULTANT:	**NTPC LIMITED, CONSUTANCY WING**
	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA
THERMAX	**THERMAX LIMITED** PUNE

DATA SHEET FOR ULTRASONIC FLOW TRANSMITTER

THERMAX DOC.NO.: WHJBE00006	BHEL DOC. NO. : PE-VO-314-158-A302	OC.NO. 630128 REV. NO : 01

THERMAX

PROJECT: - PRAGATI-III COMBINED CYCLE POWER PROJECT 1500MW (NOMINAL).(PT PLANT)
OWNER: PRAGATI POWER CORPORARTION LIMITED (PPCL)
CLIENT:BHARAT HEAVY ELECTRICALS LTD
CONSULTANT: NTPC LIMITED, CONSULTANCY WING
CLIENT DOC NO: PE-VO-314-158A302
THERMAX OC NO: 630128

REPLIES TO THE COMMENT ON DATA SHEET

ULTRASONIC FLOW TRANSMITTER DOC NO. WHJBE00006

S.NO.	COMMENT	THERMAX REPLY	REMARKS
1	Electrical connections / Conduit entry size shall be in Plug & socket type	Noted & confirmed, data sheet is revised accordingly	

INDEX SHEEET			
GENERAL INFORMATION			
ITEM	ULTRASONIC FLOW METER -PARSHALL FLUME		
TAG NO.	FT 503	FT 504	FT 505
LOCATION	T-1030 A	T-1030 B	T-1030 C
SERVICE	RAW WATER		
OPERATING CONDITIONS			
1. MEDIUM	RAW WATER		
2.PRESSURE (MAX)	BY GRAVITY		
3.TEMPERATURE	AMB		
4.LINE SIZE	N.A.		

NOTE

1]SS TAG PLATE SHALL BE PROVIDED

2]NICKEL PLATED BRASS DOUBLE COMPRESSION CABLE GLAND SHALL BE PROVIDED BY THERMAX AT SITE

3] 4" counter flange of 2" NPT(F) threaded connection for fitting the instrument shall be supplied (Thermax WWS scope)

TAG	FLOW NORMAL / MAX (m3/hr)	FLOW RANGE (m3/hr)	THROAT WIDTH (FEET)
FT 503	**1660 / 2000**	**0 -2200**	**2**
FT 504	**1660 / 2000**	**0 -2200**	**2**
FT 505	**1660 / 2000**	**0 -2200**	**2**

QTY :- 03	PROJECT:PRAGATI -III COMBINED CYCLE POWER PROJECT 1500 MW (NOMINAL) AT BAWANA,DELHI					
MAKE :- EMERSON		1	2/3/2010	SKS	APU	AVS
THERMAX LIMITED	O.C NO: 630128	0	9/12/2009	SKS	APU	AVS
Water & Waste Solutions	OWNER: PRAGATI POWER CORPORATION LTD.,DELHI	Rev	DATE	PREPD. BY	CHKD. BY	App by
Sai Chambers, Wakadewadi	CLIENT : BHARAT HEAVY ELECTRICALS LTD	Specification No		PLANT	SH NO	
Pune 411 003 (INDIA)	CONSULTANT:- NTPC - CONSULTANCY WING	WHJBE00006		PT	2 OF 6	

INDEX SHEEET

GENERAL INFORMATION

ITEM	ULTRASONIC FLOW METER - FLOW THROUGH RECTANGULAR OPEN CHANNEL
TAG NO	FT 506
LOCATION	CLARIFIED WATER STORAGE TANK
SERVICE	WATER

OPERATING CONDITIONS

1. MEDIUM	WATER
2.PRESSURE (MAX)	BY GRAVITY
3.TEMPERATURE	AMB
4.LINE SIZE	N.A.

NOTE

1]SS TAG PLATE SHALL BE PROVIDED

2]NICKEL PLATED BRASS DOUBLE COMPRESSION CABLE GLAND SHALL BE PROVIDED BY THERMAX AT SITE

3] 4" counter flange of 2" NPT(F) threaded connection for fitting the instrument shall be supplied (Thermax WWS scope)

TAG	FLOW NORMAL / MAX (m3/hr)	FLOW RANGE (m3/hr)
FT 506	3320 / 3600	0 - 3800

QTY :- 01	PROJECT:PRAGATI -III COMBINED CYCLE POWER PROJECT 1500 MW (NOMINAL) AT BAWANA,DELHI					
MAKE :- EMERSON		1	2/3/2010	SKS	APU	AVS
THERMAX LIMITED	O.C NO: 630128	0	9/12/2009	SKS	APU	AVS
Water & Waste Solutions	OWNER: PRAGATI POWER CORPORATION LTD.,DELHI	Rev	DATE	PREPD. BY	CHKD. BY	App by
Sai Chambers, Wakadewadi	CLIENT : BHARAT HEAVY ELECTRICALS LTD	Specification No		PLANT	SH NO	
Pune 411 003 (INDIA)	CONSULTANT:- NTPC - CONSULTANCY WING	WHJBE00006		PT	3 OF 6	

Ultrasonic Flow Transmitter Specification Sheet		
Sr	Identification	Specification
	General	
1	Make	EMERSON
2	Model Number	3102HA 1FRCNAST
	Type	Ultrasonic Type Flow Transmitter
		SMART with local indication - 2 wire
	Transmitter	
4	Accuracy	± 0.25 % Of Measured Distance for>1m,2.5mm<1m
5	Flow Range	Refer index sheet
6	Maximum Span Limit	0 to 11 m
7	Output	4-20 mA with HART Communication
8	Power Supply	12-30 V DC
9	Level Resolution	Better than 1 mm
10	Blanking Distance / Dead Zone	0.3 m
11	Process Pressure Rating	-0.25 to 3 bar
12	Process Temperature	-30 to 70 °C
13	Update Interval	1 second
14	Beam Angle	3°
15	Temperature Compensation	Automatic Integral. Optinal remote sensor for dynamic comp.
16	Local Indication	Digital LCD Indication in Engineering Unit
17	Process connections	2 "NPT Thread
18	Electrical connections / Conduit Entry Size	PLUG & SOCKET TYPE X 2Nos.
	Material Of Construction	
19	Sensing Element	PVDF
20	Cover Seal	Silicon Rubber
21	Sensor Body	EPDM
22	Enclosure / Housing	NEMA 4X ,IP66, Polyurethane-covered Aluminum
	Accessories	
23	Tag Plate	Stainless Steel engraved Tag Plate
	Cetificates	
24	Cetificates	No Certificates - Standard

PARSHALL FLUME HEIGHT Vs FLOW DETAILS

TAG NO: FT 503/504/505

Parshall Flume , Flow rate = 1660 m3 / hr

Throat Width : 2 feet

Q = 4WHa^1.522w0.026 (FPS UNIT)

W = 2 feet

Q = 1660 m3/hr=16.28399 cuft /sec

Q = 8H ^ 1.55 ft3/sec

ULTRASONIC FLOW METER TO BE CALIBRATED BASED ON FOLLOWING HEIGHT Vs FLOW DETAILS

Height (meter)	Height (feet)	Flow (ft3/sec)	Flow (m3/hr)	
0.2	0.66	4.16	424.43	
0.3	0.98	7.81	795.70	
0.35	1.15	9.91	1010.46	
0.4	1.31	12.19	1242.81	
0.45	1.48	14.63	1491.73	
0.46	1.51	15.14	1543.43	
0.47	1.54	15.65	1595.75	
0.475	1.56	15.91	1622.14	
0.476	1.56	15.96	1627.43	
0.477	1.56	16.02	1632.73	
0.478	1.57	16.07	1638.04	
0.479	1.57	16.12	1643.36	
0.48	1.57	16.17	1648.68	
0.481	1.58	16.23	1654.01	
				NORMAL FLOW RATE
0.483	1.58	16.33	1664.68	
0.488	1.60	16.59	1691.46	
0.49	1.61	16.70	1702.22	
0.492	1.61	16.80	1713.00	
0.494	1.62	16.91	1723.81	
0.496	1.63	17.02	1734.64	
0.498	1.63	17.12	1745.49	
0.5	1.64	17.23	1756.37	
0.51	1.67	17.77	1811.11	
0.52	1.71	18.31	1866.45	
0.53	1.74	18.86	1922.38	
0.54	1.77	19.41	1978.89	
0.55	1.80	19.97	2035.98	
0.56	1.84	20.54	2093.65	
0.58	1.90	21.69	2210.68	

HEIGHT Vs FLOW DETAILS

TAG NO: FT 506

MEASURING WEIR CALCULATION

For width(b) = 2000 mm

Q(m3/hr)	Q(m3/sec)	b (mtr)	h(mm)	
2000	0.55556	2	283.88	
2300	0.63889	2	311.57	
2500	0.69444	2	329.36	
2800	0.77778	2	355.19	
3000	0.83333	2	371.89	
3100	0.86111	2	380.10	
3125	0.86806	2	382.14	
3150	0.87500	2	384.17	
3175	0.88194	2	386.20	
3200	0.88889	2	388.22	
3225	**0.89583**	**2**	**390.24**	
3250	**0.90278**	**2**	**392.25**	
3275	**0.90972**	**2**	**394.26**	
3300	**0.91667**	**2**	**396.26**	
				NORAMAL FLOW
3350	**0.93056**	2	400.25	
3375	**0.93750**	2	402.23	
3400	**0.94444**	2	404.22	
3425	**0.95139**	2	406.19	
3450	0.95833	2	408.16	
3475	0.96528	2	410.13	
3500	0.97222	2	412.09	
3550	0.98611	2	416.01	
3600	1.00000	2	419.90	
3700	1.02778	2	427.63	
3800	1.05556	2	435.30	
3900	1.08333	2	442.89	
4000	1.11111	2	450.42	
4100	1.13889	2	457.89	
4200	1.16667	2	465.30	

Measuring flow range(0-3320M^3/hr)
Max.flow:(3800M3/hr)

	PROJECT:PRAGATI -III COMBINED CYCLE POWER PROJECT 1500 MW (NOMINAL) AT BAWANA,DELHI					
		1	2/3/2010	SKS	APU	AVS
THERMAX LIMITED	O.C NO: 630128	0	9/12/2009	SKS	APU	AVS
Water & Waste Solutions	OWNER: PRAGATI POWER CORPORATION LTD.,DELHI	Rev	DATE	PREPD. BY	CHKD. BY	App by
Sal Chambers, Wakadewadi	CLIENT : BHARAT HEAVY ELECTRICALS LTD	Specification No		PLANT	SH.NO	
Pune 411 003 (INDIA)	CONSULTANT:- NTPC - CONSULTANCY WING	WHJBE00006		PT	6 OF 6	

Product Data Sheet
00813-0100-4840, Rev. AB
August 2007

Rosemount 3100 Series Ultrasonic Level Transmitters

The Rosemount 3100 Series is a loop-powered ultrasonic transmitter designed for reliable continuous level measurement.

THE 3100 SERIES FEATURES:

- *Non-contacting measurement with no moving parts.*
- *Integral LCD and push-buttons as standard for on-site programming,*
- *Continuous measurement of level or distance-to-surface. Volume or open channel flow calculations for models 3102 and 3105.*
- *2 integral signal relays for model 3102.*
- *Easy to install and configure.*
- *Rugged aluminum housing and PVDF wetted material.*
- *2-wire dc loop-powered.*

HART® FIELD COMMUNICATIONS PROTOCOL

CE

Contents

Reliability in a Universal Package

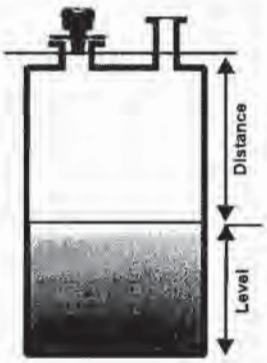
The Rosemount 3100 Series is a liquid level transmitter based on ultrasonic technology making it suitable for many liquid applications.

MEASUREMENT PRINCIPLE

Ultrasonic pulse signals are transmitted from the face of the transmitter, and are then reflected from the liquid surface. The transmitter 'listens' for these reflected signals (echoes) and measures the time-delay between transmitting and receiving.

The distance to the liquid surface is automatically calculated by using the computed time-delay.

*Distance = Speed of sound in air * (Time-delay / 2)*



An integral temperature sensor continuously measures the air temperature around the transmitter, and uses this to compute the *speed of sound in air*, thereby automatically compensating *Distance* for temperature effects.

Models 3102 and 3105 have the option of a Remote Temperature Sensor for dynamic temperature compensation.

The Distance measurement can be output through the 4-20mA or HART output.

Level Measurement

When programmed with the bottom reference of the application - usually the bottom of a tank - the transmitter will calculate the liquid depth (Level).

The calculated Level can be output through the 4-20mA or HART output.

Volume Measurement

Models 3102 and 3105 can also calculate the volume of liquid in a tank. The transmitter has a library of profile shapes for selection.

The calculated Volume can be output through the 4-20mA or HART output.

Open Channel Flow Measurement

Models 3102 and 3105 can also calculate the rate of liquid flow in an open channel. The transmitter has a library of standard open channel flow structure profiles, but can also support a user-defined flow profile that is plotted or calculated.

The calculated Flow Rate can be output through the 4-20mA or HART output.

It is possible to enter a 10-point strapping table for non-standard tank shapes and flow structures.

SPECIAL FEATURES

Advanced software features

- Learn routine (false echo registration)

  Manually teach the transmitter to ignore up to four false echoes, caused by the pulse signal reflecting off obstructions, until the actual level is seen.
- Empty tank mapping

  When a tank is empty, automatically teach the transmitter up to four false echoes, without the need for user interaction.
- Present depth

  When the tank is not empty, the bottom reference can be automatically reset to be the sum of a user-entered (known) present depth and the distance to the surface.
- Set as empty

  When the tank is known to be empty, the bottom reference can be automatically reset to be the measured distance.
- Distance offset

  The distance to the surface can be adjusted by a user-entered positive or negative offset value.
- Level offset

  The level can be adjusted by a user-entered positive or negative offset value.
- Bottom blanking

  If there is an obstruction on the bottom of a tank, the false echoes can be avoided by specifying an area to ignore.

Relays on model 3102

- Two integral relays for control functionality.

Integral display and push buttons (all models)

The central area of the display allows up to five alphanumeric characters to be displayed. This is either the measurement or data to assist when programming.

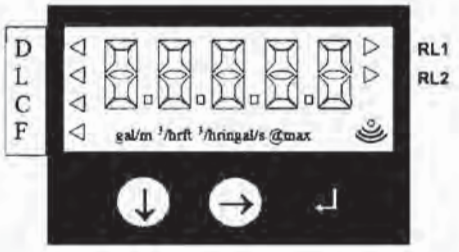
To the left of the central area, on Model 3102 and 3105 only, there are **four arrow icons**, only one of which will be illuminated at any one time to indicate the duty chosen by the user:

- D (Distance-to-surface)
- L (Level)
- C (Content / Volume)
- F (Flow)

To the right of the central area, on Model 3102 only, there are **two arrow icons** that indicate the status of the transmitter relay outputs RL1 and RL2. When illuminated, they indicate that the relay contact is closed.

Under the central area is a list of units of measurement. The transmitter will illuminate only those characters applicable to the units of measurement chosen.

To the right of the measurement units is an **echo received icon** made up of 3 arc segments that continuously indicate the strength of the echo received (minimum, average, and good).



Integral push-buttons and display

Selecting a Rosemount 3100 Series transmitter

Overview of models

Choose model 3101 for simple level or distance measurements over a range of 1 - 26 ft (0.3 - 8 m), and a 4-20mA signal output.

Choose model 3102, with 2 integral relays, for level or distance measurements over a range of 1 - 36 ft (0.3 - 11 m). Also features volume and open channel flow calculations, and a 4-20mA / HART output.

Choose the Intrinsically Safe certified model 3105 for level or distance measurements over a range of 1 - 36 ft (0.3 - 11 m) in hazardous areas. Also features volume and open channel flow calculations, and a 4-20mA / HART output.

Housing

The housing is available in aluminum, and has two ½-inch NPT cable/conduit entries.

Option of M20 x 1.5 conduit/cable adaptors.

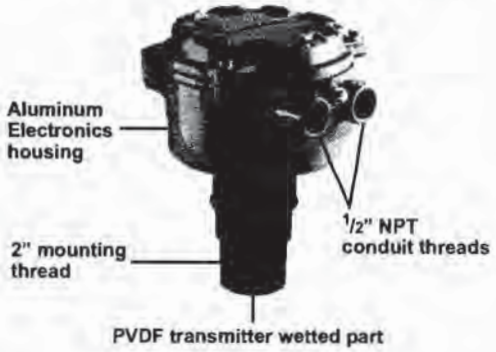
Wetted parts are made of corrosion resistant PVDF.

Process Connection

Threaded Connection

Threads: 2-inch BSPT or 2-inch NPT.

Optional flange accessories: See page 17.



Electrical connections

(For full specification, see page 8)

Power supply

The 3100 Series requires an external power supply:
3101: 12 - 30 Vdc
3102: 12 - 40 Vdc
3105: 12 - 40 Vdc, (12 - 30 Vdc in hazardous area).

Signal output

Model 3101 has an analog 4-20mA output, which is powered by the voltage supplied to the transmitter.

Models 3102 and 3105 have a 4-20mA output with HART® communication. This is powered by the voltage supply to the transmitter.

Relay outputs

Model 3102 has two relay outputs, which are powered by the voltage supply to the transmitter.

Remote temperature sensor

All models have an integrated temperature sensor for automatically compensating for temperature effects.

Models 3102 and 3105 have support for connecting a Rosemount Remote Temperature Sensor, which is an optional accessory (see page 17). When used, it automatically overrides the integral sensor and provides dynamic temperature compensation.

Measurements and Calculations

3101: Level, or distance to the surface.
3102: Level (or distance), volume, open channel flow.
3105: Level (or distance), volume, open channel flow.

Measurement range

3101: 1 - 26 ft (0.3 - 8 m)
3102: 1 - 36 ft (0.3 - 11 m)
3105: 1 - 36 ft (0.3 - 11 m)

Product certifications

(For a summary of certifications, see page 11.)

Non-hazardous area installation

3101 and 3102 are available for:

- FM and CSA Ordinary Location installation.

Hazardous area installation

3105 is available for:

- FM Intrinsically Safe/Non-incendive installation.
- CSA Intrinsically Safe/Non-incendive installation.
- ATEX and IECEx Intrinsically Safe installation.

NOTE:
Product certifications are selected using the Ordering Information (see page 14 onwards).

System Integration

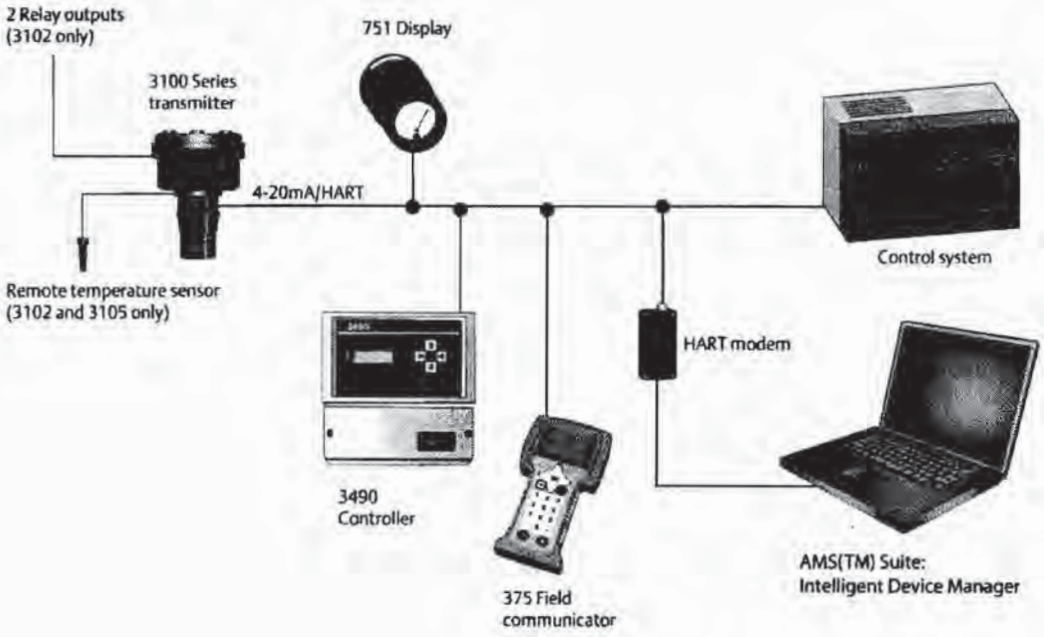
The Rosemount 3100 Series transmitter uses the same two wires for power supply and communication.

The 3100 Series requires an external power supply:

- 3101: 12 to 30 Vdc
- 3102: 12 to 40 Vdc
- 3105: 12 to 40 Vdc (30 Vdc in hazardous area).

Measurement data is transmitted as an analog 4-20mA signal as standard.

On models 3102 and 3105, a digital HART® signal superimposed on the 4-20mA signal.



The Rosemount 3100 Series transmitter powers PlantWeb® with easier configuration, lower installation costs, higher reliability and device diagnostics that enable predictive intelligence, reduce operating costs and improve plant availability.

Installation Best Practices

Correct location of the transmitter is essential for the reliable operation of any ultrasonic level measurement system.

NOTE:
The Rosemount 3100 Series is designed to be mounted in a *non-metallic fitting* or *flange*. Please check optional PVC flange accessories on page 17.

Mounting considerations

a) The transmitter should be mounted above the liquid surface using the 2-inch thread provided. To facilitate mounting, optional flanges are available as an accessory - see page 17.

b) Mount the transmitter as near vertical as possible to ensure a *good echo* from the liquid surface for *maximum echo size* received.

c) Obstructions within the beam angle generate strong "false-echoes"; wherever possible, the transmitter should be positioned such that false echoes are avoided.

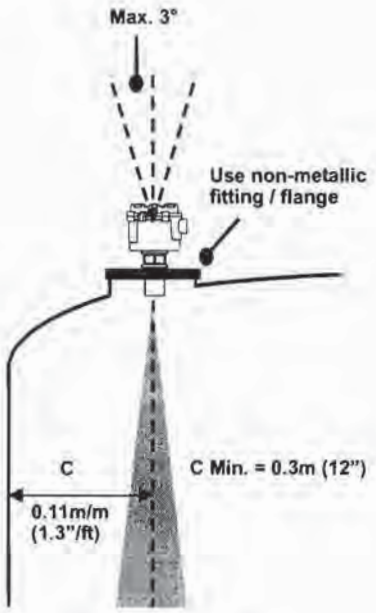
d) To avoid detecting unwanted objects in the tank or well, it is advisable to maintain a distance of at least 4.3 inches (0.11 metres) from the centre line of the transmitter for every metre range to the obstruction.

e) It is recommended not to mount the transmitter closer than 12 inches (0.3 metres) to the wall to avoid losing echo size.

f) Avoid applications where heavy condensation could form on the transducer face.

g) If the transmitter is mounted in a stand-off or nozzle, it is always preferable that the transmitter face protrudes at least 5mm into the tank. If this is not possible, see "Mounting in a nozzle" on page 7.

h) In environments where direct sunlight can cause high surface temperatures on exposed instruments, it is recommended to use a suitable sun-shade.



Liquid surface conditions

a) Foaming liquids can reduce the size of the returned echo as foam is a poor ultrasonic reflector. It is always preferable to mount an ultrasonic transmitter over an area of clear liquid.

b) Beware of mounting the transmitter directly over any inlet stream.

c) Liquid surface turbulence is not normally a problem unless it is excessive. In most cases, the effects of turbulence are minor, with excessive turbulence being catered for by fine-tuning the transmitter on site if necessary.

d) A still-pipe can be used to avoid foam and turbulence.

In-tank effects

a) Stirrers or agitators can cause a vortex. Always try to mount the transmitter off-centre of any vortex to maximise the return echo.

b) As stirrer blades become uncovered, they will create echoes as they pass through the ultrasonic beam. The transmitter can be tuned on-site to ignore these false echoes.

Mounting in a nozzle

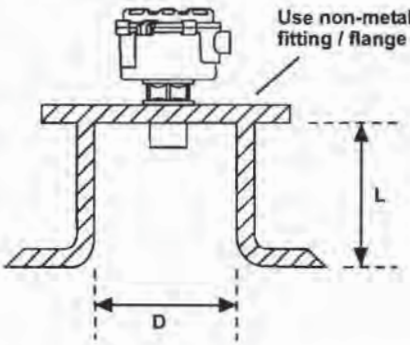


TABLE 1.

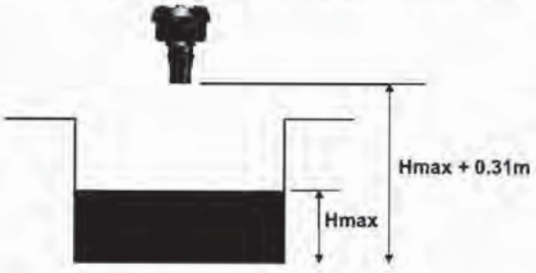
Nozzle Diameter Size (D)	Maximum Nozzle Length (L)
DN50 (2 inch)	18mm (3/4")
DN80 (3 inch)	100mm (4")
DN100 (4 inch)	100mm (4")
DN125 (5 inch)	200mm (8")
≥DN150 (6 inch)	350mm (14")

Open Channel Flow installations (Models 3102/3105)

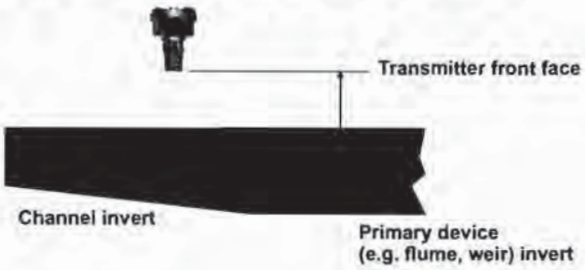
There are normally two distinct parts to an open channel flow measurement system; the primary element (flow structure) and the secondary element (head measurement instrumentation). For accurate open channel flow measurement, both parts of the system must be installed accurately.

The transmitter should be positioned at the correct distance upstream from the flow structure at a height that is at least equal to the maximum flow depth plus the blanking distance (dead zone) of the transmitter (see below).

A minimum distance of 0.31m is recommended.



It is important that the *bottom reference* of the transmitter is related to the centre of the invert of the primary device (see below), and NOT the distance to the channel bottom directly below the transmitter.



NOTES:

- The liquid surface at the point of measurement must have a stable, smooth surface and uniform approach velocity. It must not be affected by baffles, foam, hydraulic jumps or any other object likely to cause flow disruption.
- The primary element should be free from any situation where it is likely to 'drown' (refer to relevant Standard for further information)

Specifications

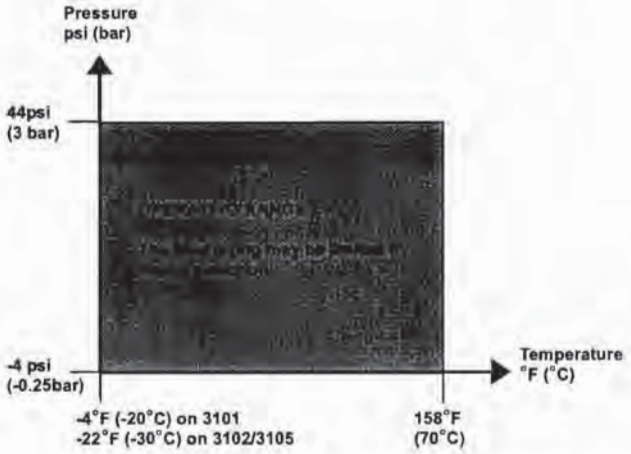
General	
Product	Rosemount 3100 Series level transmitters; Model 3101 for Level and Distance measurement. Model 3102 for Level, Distance, Volume, and Open channel flow measurement with 2 integral signal relays. Model 3105 for Level, Distance, Volume, and Open channel flow measurement for hazardous locations.
Measurement principle	Ultrasonic, time-of-flight.
Measuring performance	
Measurement range	Model 3101: 1 - 26 ft (0.3 - 8 m) Model 3102: 1 - 36 ft (0.3 - 11 m) Model 3105: 1 - 36 ft (0.3 - 11 m)
Level resolution	Better than $^1/_{16}$" (1 mm)
Level accuracy	Model 3101: ± 0.2 in. (5 mm) for <3.3 ft (1 m), ± 0.5% of measured distance for >3.3 ft (1 m) Models 3102 and 3105: ± 0.1 in. (2.5 mm) <3.3 ft (1 m), ±0.25% of measured distance for >3.3 ft (1 m) under reference conditions (1)
Blanking distance (Dead Zone)	12" (0.3m)
Update interval	1 second
Display / Configuration	
Integral Display	4/5 digit display for live measurement, and for configuration purposes.
Output Units	For Level or distance-to-surface: m, ft, in, or none For Contents: l, m^3, gal, or ft^3 For Flow: l/s, l/m, m^3/hr, gal/s, gal/m, ft^3/m (cfm), ft^3/hr, or none
Output Variables	Model 3101: Level, or distance-to-surface Model 3102: Level (or distance-to-surface), Content (Volume), and Flow. Model 3105: Level (or distance-to-surface), Content (Volume), and Flow.
Configuration tools	Standard integral push-buttons with LCD. Rosemount hand-held communicator Model 375. Rosemount 3490 Series Universal Control Unit. Rosemount AMS(TM) Suite
Electrical	
Power supply	Loop-powered (2-wire) Model 3101: 12 - 30 Vdc Model 3102: 12 - 40 Vdc Model 3105: 12 - 40 Vdc (non-hazardous area), 12 - 30 Vdc (hazardous area).
Earthing	None required.
Current Output	Model 3101: Analog 4-20 mA Model 3102: Analog 4-20 mA, HART®. Model 3105: Analog 4-20 mA, HART®.
Signal on alarm	Standard: Low = 3.75 mA. High = 21.75 mA. Namur NE43: Low = 3.6 mA. High = 22.5 mA
Saturation levels	Standard: Low = 3.9 mA. High=20.8 mA. Namur NE43: Low = 3.8 mA. High = 20.5 mA
Relay output (on 3102 model)	2 integral signal relays, SPST rated 1A @ 30VDC (inductive) and 2A @ 30VDC (resistive)
Electrical parameters	U_i = 30 V, I_i = 120 mA, P_i = 0.82 W, L_i = 108μH, C_i = 0 nF.
Cable entry	½" - 14 NPT conduit entries for cable glands. Option: M20 x 1.5 conduit/cable adaptor.
Output Cabling	Single twisted-pair and shielded, min. 0.22 mm^2 (24 AWG), max. 1.5 mm^2 (15 AWG).
Materials of construction	
Wet-side material	PVDF.
Body and cover material	Polyurethane-covered Aluminum.
Cover seal	Silicone rubber.
Cover screws	316 Stainless Steel.
Transducer body seal	EPDM.

Mechanical	
Mounting thread size	2" NPT, or 2" BSP. Optional flange accessories available.
Measuring	
Temperature compensation	Model 3101: Automatic Integral temperature compensation. Model 3102: Automatic Integral temperature compensation. Optional remote temperature sensor for dynamic temperature compensation. (2) Model 3105: Automatic Integral temperature compensation. Optional remote temperature sensor for dynamic temperature compensation. (2)
Environment	
Ambient temperature	Model 3101: -4 °F to +158 °F (-20 °C to +70 °C) Models 3102 and 3105: -40 °F to +158 °F (-40 °C to +70 °C) (3)
Process temperature	Model 3101: -4 °F to +158 °F (-20 °C to +70 °C) Models 3102 and 3105: -22 °F to +158 °F (-30 °C to +70 °C)
Process pressure	-4 to +44 psi (-0.25 to 3.0 bar)
Ingress protection	NEMA 4X, IP 66.
Electromagnetic compatibility	EN61326 (Class B)
Certifications	CE-mark, FM, CSA, ATEX, or IECEx - dependent on order code.

(1) Temperature: 20°C, Pressure: 101.3 kPa (atmospheric pressure), and Relative Humidity: 65%.
(2) See page 17 for optional accessories.
(3) See page 11 onwards for approval temperature ranges.

Temperature and Pressure Ratings

The process temperature/pressure rating depends on the design of the transmitter in combination with the flange materials.

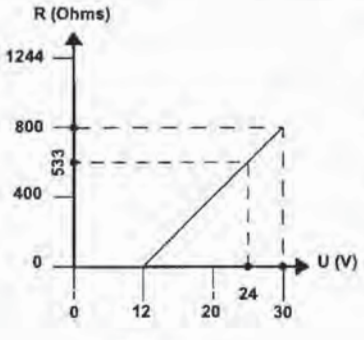


Process temperature and pressure diagram for Rosemount 3100 Series

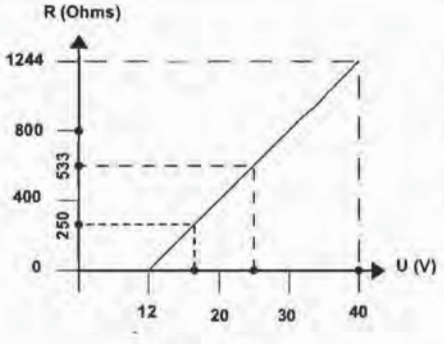
Load Limitations

A HART® Communicator requires a minimum load resistance of 250 Ohm within the loop in order to function properly. Communication with Rosemount 3490 Universal Controller does not require additional resistance. The maximum load resistance can be determined from these diagrams:

Non-Intrinsically Safe Installations

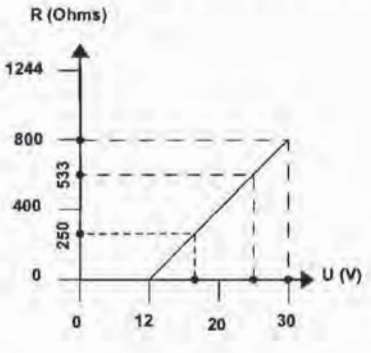


Model 3101



Models 3102 and 3105

Intrinsically Safe Installations



Model 3105

NOTE
R = Maximum Load Resistance
U = External Power Supply Voltage

Product Certifications

ORDINARY LOCATION CERTIFICATION FOR FM *(MODELS 3101/3102)*

G5 Project ID: 3024095
The transmitter has been examined and tested to determine that the design meets basic electrical, mechanical, and fire protection requirements by FM, a nationally recognized testing laboratory (NRTL) as accredited by the Federal Occupational Safety and Health Administration (OSHA).

ORDINARY LOCATION CERTIFICATION FOR CSA *(MODELS 3101/3102)*

G6 Project ID: 1878089
The transmitter has been examined and tested to determine that the design meets basic electrical, mechanical, and fire protection requirements by CSA, a nationally recognized testing laboratory as accredited by the Standards Council of Canada (SCC).

EUROPEAN DIRECTIVE INFORMATION

The EC declaration of conformity for all applicable European directives for this product can be found on the Rosemount website at www.rosemount.com. A hard copy may be obtained by contacting your local sales office.

ATEX Directive (94/9/EC)

Complies with the ATEX Directive.

Pressure Equipment Directive (PED) (97/23/EC)

3100 Series is outside the scope of PED Directive.

Electro Magnetic Compatibility (EMC) Directive

EN61326 (Class B)

CE-mark

Complies with applicable directives
3101, 3102 (EMC)
3105 (EMC, ATEX)

HAZARDOUS LOCATIONS CERTIFICATIONS *(MODEL 3105)*

Factory Mutual (FM) Approvals

Factory Mutual (FM) Intrinsically Safe Approval

I5 Project ID: 3024095
Intrinsically Safe for Class I, Div. 1, Groups A, B, C and D
Intrinsically Safe for Class I, Zone 0, AEx ia IIC
Temperature Code: T4 at +60°C, max ambient
Temperature Code: T6 at +55°C, max ambient

Control Drawing: 71097/1216
Ui = 30 V, Ii = 120 mA, Pi = 0.82 W, Li = 108 µH, Ci = 0 µF.

Factory Mutual (FM) Non-Incendive Approval

I5 Project ID: 3024095
Non-Incendive for Class I, Div. 2, Groups A, B, C and D
Non-Incendive for Class I, Zone 2, AEx nA IIC
Temperature Code: T4 at +60°C, max ambient
Temperature Code: T6 at +55°C, max ambient

Control Drawing: 71097/1216
Ui = 30 V, Ii = 120 mA, Pi = 0.82 W, Li = 108 µH, Ci = 0 µF

Canadian Standards Association (CSA) Approvals

Canadian Standards Association (CSA) Intrinsically Safe Approval

I6 Project ID: 07 CSA 1878089
Intrinsically Safe for Class I, Div. 1, Groups A, B, C, and D
Intrinsically Safe for Class 1, Zone 0, Ex ia IIC
Temperature Code:
T4 (T_{amb} -40°C to +60°C)
T6 (T_{amb} -40°C to +55°C)

Control Drawing: 71097/1218
Ui = 30 V, Ii = 120 mA, Pi = 0.82 W, Li = 108 µH, Ci = 0 µF

Canadian Standards Association (CSA) Non-Incendive Approval

I6 Project ID: 07 CSA 1878089
Non-Incendive for Class I, Div. 2, Groups A, B, C, and D
Non-Incendive for Class I, Zone 2, Ex nL IIC
Temperature Code:
T4 (T_{amb} -40°C to +60°C)
T6 (T_{amb} -40°C to +55°C)

Control Drawing: 71097/1218
Ui = 30 V, Ii = 120 mA, Pi = 0.82 W, Li = 108 µH, Ci = 0 µF

ATEX Intrinsically Safe Approval

I1 Certificate: Sira 06ATEX2260X
Intrinsically Safe for II 1 G, EEx ia IIC
Temperature Class:
T4 (T_{amb} -40°C to +60°C)
T6 (T_{amb} -40°C to +55°C)

Ui = 30 V, Ii = 120 mA, Pi = 0.82 W, Li = 108 µH, Ci = 0 µF

Special conditions for safe use:

1. All transmitter models have external plastic parts, which could present a risk of ignition due to electrostatic charge build-up. They shall not be directly installed in any process where its enclosure might be charged by the rapid flow of non-conductive media.
2. All transmitter models shall only be cleaned with a damp cloth.
3. When the transmitter housing uses aluminum alloy in its construction, this presents a risk of ignition due to impact and shall be taken into consideration on installation and use.

IECEx Approval

I7 Certificate: IECEx SIR 06.0068X
Intrinsically Safe for Zone 0, Ex ia IIC
Temperature Class:
T4 (T_{amb} -40°C to +60°C)
T6 (T_{amb} -40°C to +55°C)

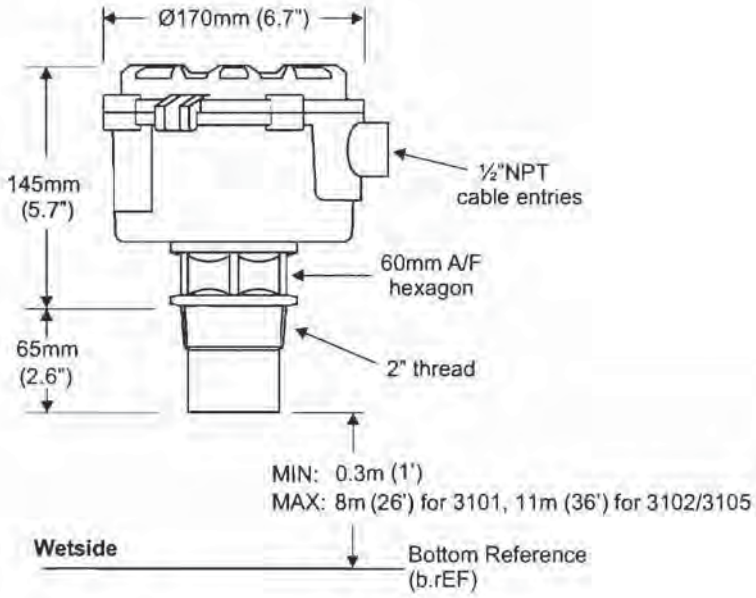
Ui = 30 V, Ii = 120 mA, Pi = 0.82 W, Li = 108 µH, Ci = 0 µF

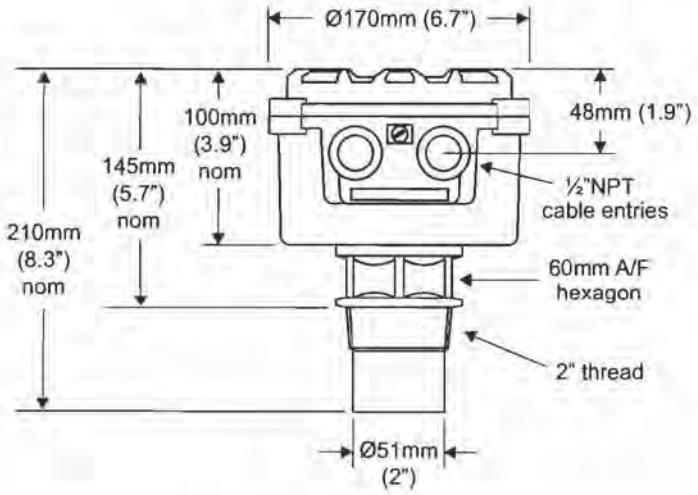
Special conditions for safe use:

1. All transmitter models have external plastic parts, which could present a risk of ignition due to electrostatic charge build-up. They shall not be directly installed in any process where its enclosure might be charged by the rapid flow of non-conductive media.
2. All transmitter models shall only be cleaned with a cloth.
3. When the transmitter housing uses aluminum alloy in its construction, this presents a risk of ignition due to impact and shall be taken into consideration on installation and use.

Dimensional Drawings

Threaded Mounting





Ordering Information

Model Code 3101, Level of liquids

Model	Product Description
3101	Ultrasonic level transmitter
Code	**Signal Output**
L	4-20 mA
Code	**Housing Material**
A	Polyurethane-covered Aluminum
Code	**Conduit / Cable Threads**
1	½ - 14 NPT
2	M20 x 1.5 adaptor
Code	**Wet-side material**
F	PVDF
Code	**Process Connection**
RC	2" NPT thread(1)
SC	2" BSPT thread(2)
Code	**Certificates**
NA	No certification
G5	FM Ordinary Location
G6	CSA Ordinary Location
Code	**Options**
Tag Plate	
ST	Stainless Steel engraved tag plate
WT	Laminated paper tag plate

(1) Choosing this option implies US (Imperial) units of measurement are required for the default configuration.
(2) Choosing this option implies Metric units of measurement are required for the default configuration.

Example model order code: 3101-L-A-1-F-RC-G5-ST

Model Code 3102, Level, Volume or Flow of liquids

Model	Product Description
3102	Ultrasonic level transmitter with 2 integral relays
Code	**Signal Output**
H	4-20 mA with HART® communication
Code	**Housing Material**
A	Polyurethane-covered Aluminum
Code	**Conduit / Cable Threads**
1	½ - 14 NPT
2	M20 x 1.5 adaptor
Code	**Wet-side material**
F	PVDF
Code	**Process Connection**
RC	2" NPT thread (1)
SC	2" BSPT thread (2)
Code	**Certificates**
NA	No certification
G5	FM Ordinary Location
G6	CSA Ordinary Location
Code	**Options**
Alarms	
C4	Namur alarm and saturation levels; high alarm.
C5	Namur alarm and saturation levels; low alarm.
C8	Low alarm setting with standard Rosemount alarm and saturation levels.
Tag Plate	
ST	Stainless Steel engraved tag plate
WT	Laminated paper tag plate

(1) Choosing this option implies US (Imperial) units of measurement are required for the default configuration.
(2) Choosing this option implies Metric units of measurement are required for the default configuration.

Example model order code: 3102-H-A-1-F-RC-G5-C4-ST

Model Code 3105, Level, Volume or Flow of liquids

Model	Product Description
3105	Ultrasonic level transmitter for hazardous areas
Code	**Signal Output**
H	4-20 mA with HART® communication
Code	**Housing Material**
A	Polyurethane-covered Aluminum
Code	**Conduit / Cable Threads**
1	½ - 14 NPT
2	M20 x 1.5 adaptor
Code	**Wet-side material**
F	PVDF
Code	**Process Connection**
RC	2" NPT thread(1)
SC	2" BSPT thread(2)
Code	**Certificates**
I1	ATEX Intrinsically Safe
I5	FM Intrinsically Safe and Non-Incendive
I6	CSA Intrinsically Safe and Non-Incendive
I7	IEC Ex Intrinsically Safe
Code	**Options**
Alarms	
C4	Namur alarm and saturation levels; high alarm.
C5	Namur alarm and saturation levels; low alarm.
C8	Low alarm setting with standard Rosemount alarm and saturation levels.
Tag Plate	
ST	Stainless Steel engraved tag plate
WT	Laminated paper tag plate

(1) Choosing this option implies US (Imperial) units of measurement are required for the default configuration.
(2) Choosing this option implies Metric units of measurement are required for the default configuration.

Example model order code: 3105-H-A-1-F-RC-I5-ST

Spare Parts and Accessories

Code	Accessory/Spare
Accessories	
03100-1001-0001	2" NPT to 2" ANSI #150 PVC Flange
03100-1001-0002	2" NPT to 3" ANSI #150 PVC Flange
03100-1001-0003	2" NPT to 4" ANSI #150 PVC Flange
03100-1001-0004	2" NPT to 6" ANSI #150 PVC Flange
03100-1002-0001	2" BSPT to DN50 PN16 PVC Flange
03100-1002-0003	2" BSPT to DN80 PN16 PVC Flange
03100-1002-0004	2" BSPT to DN100 PN16 PVC Flange
03100-1002-0005	2" BSPT to DN150 PN16 PVC Flange
03100-0001-0001	Remote Temperature Sensor (3102, 3105 only)
03100-0001-0002	1/2"NPT to M20 x 1.5 Conduit Adaptor (Pack of two)

NOTES:

NOTES:

Product Data Sheet
00809-0100-4840, Rev. AB
August 2007

Rosemount 3100 Series

Rosemount Level Solutions

Emerson provides a complete range of Rosemount products for level measurement applications.

Pressure – Level or Interface Measurement

Emerson has a complete line of Rosemount pressure transmitters and remote seals for measuring level or interfaces in liquid applications. Optimize performance with direct mount, Tuned Seal systems:

- Rosemount 3051S_L, 3051L, and 1151LT Liquid Level Transmitters
- Rosemount 1199 Remote Diaphragm Seals with direct mount or capillary connections

Vibrating Fork Switches – Point Level Detection

The Rosemount 2100 Series is developed for reliable point level detection of liquids and consists of:

- Rosemount 2110 Compact Vibrating Fork Liquid Level Switch
- Rosemount 2120 Full-featured Vibrating Fork Liquid Level Switch

Guided Wave Radar – Level and Interface Measurement

Multivariable, loop-powered Guided Wave Radar transmitters with a wide range of probe styles to fit different liquids and solids applications. The product line consists of:

- Rosemount 3300 Series – Versatile and easy-to-use transmitter with proven reliability
- Rosemount 5300 Series – Accurate, high performance transmitter with FOUNDATION™ fieldbus support

Non-contacting Radar – Level Measurement

The Rosemount non-contacting radar family consists of:

- Rosemount 5400 Series Transmitters – Loop-powered transmitter with a wide range of antennas, for liquid level measurement in most applications and process conditions
- Rosemount 5600 Series Transmitters – Transmitters with ultra-high sensitivity for measurement of level in liquids and solids, even for the most challenging applications

Non-contacting Ultrasonic – Level Measurement

The Rosemount 3100 Series ultrasonic level transmitters provide continuous non-contacting level measurement of liquids. The range consisits of:

- Rosemount 3101 for simple continuous level measurement
- Rosemount 3102 for continuous measurement with two integral relays for local control functionality
- Rosemount 3105 Intrinsically safe certified version for hazardous areas

Emerson Process Management, Rosemount Inc.

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Emerson Process Management
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Chanhassen, MN 55317 USA
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T (International) (952) 906-8888
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Fax 44 1243 867554

Asia Pacific
Emerson Process Management
Singapore Pte Ltd.
1 Pandan Crescent
Singapore 128461
Tel 65 6777 8211
Fax 65 6777 0947
AP.RMT-Specialist@emersonprocess.com

www.rosemount.com

EMERSON.
Process Management

PRE-TREATMENT PLANT

Cat II

CE-152

19.01.2010

Rev. No	Date	Description	Prepared By	Reviewed By	Released By
1	14/12/2009	REVISED AS PER BHEL COMMENTS	SKS	APU	AVS
0	8/10/2009	FOR APPROVAL	SKS	APU	AVS

PROJECT	**PRAGATI-III COMBINED CYCLE POWER PROJECT 1500MW(NOMINAL).**
CUSTOMER:	**PRAGATI POWER CORPORTION LIMITED (PPCL)**
CONSULTANT:	**NTPC LIMITED, CONSUTANCY WING**
	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA
THERMAX	**THERMAX LIMITED** PUNE

DATA SHEET FOR DIFF. PRESSURE FLOW TRANSMITTER

THERMAX DOC.NO.: WHJBC00009	BHEL DOC. NO. : PE-VO-314-158-A303	OC.NO. 630128 REV. NO : 01

INDEX FOR DIFF. PRESSURE FLOW TRANSMITTER

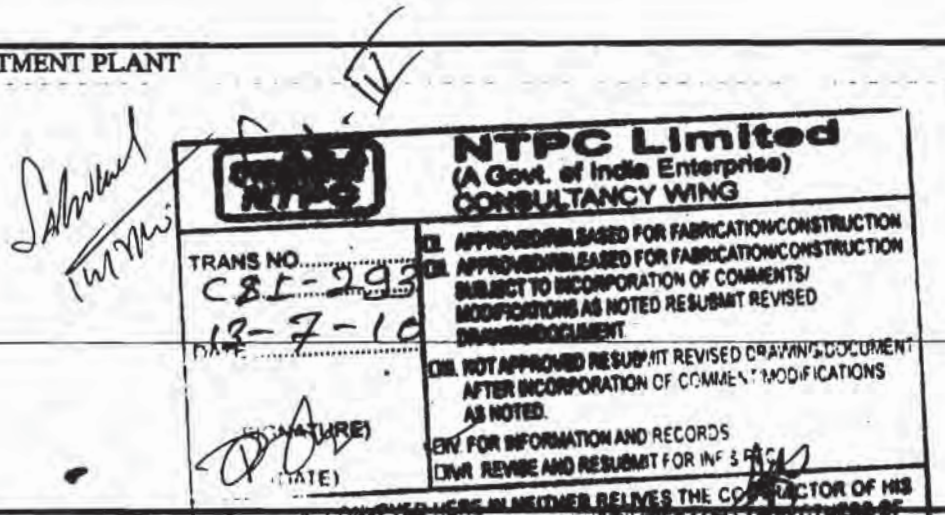
TAG NO	OPERATING CONDITIONS			DP RANGE mmWc	NORM/MAX M^3/HR	INSTRUMENT RANGE(METER MAX) M3/HR	LOCATION	REMARK
	MEDIUM	NORMAL PR. KG/CM2	TEMP					
FT-501	WATER	1.5	AMB	0-2500	3320/3650	0 - 4300	INLET TO CASCADE AERATOR	REFER SHEET NO.03
FT-502	WATER	1.5	AMB	0-2500	3320/3650	0-4300	INLET OF STALLING CHAMBER	REFER SHEET NO.03

QTY :- 02	PROJECT:PRAGATI -III COMBINED CYCLE POWER PROJECT 1500 MW (NOMINAL) AT BAWANA,DELHI	2	14/12/2009	SKS	APU	AVS
MAKE :- EMERSON		1	8/10/2009	SKS	APU	AVS
THERMAX LIMITED	O.C NO: 630128	0	19/08/2009	SKS	APU	AVS
Water & Waste Solutions	OWNER: PRAGATI POWER CORPORATION LTD.,DELHI	Rev	DATE	PREPD. BY	CHKD. BY	App by
Sai Chambers, Wakadewadi	CLIENT : BHARAT HEAVY ELECTRICALS LTD	Specification No		PLANT	SH NO	
Pune 411 003 (INDIA)	CONSULTANT:- NTPC - CONSULTANCY WING	WHJBC00009		PT	2 OF 3	

Differential Pressure Flow Transmitter Specification Sheet

Sr	Identification	Specification
	General	
1	Make	EMERSON
2	Model Number	3051CD2A02A1AH2B1M5Q4
3	Type	Capacitance Type Differential Pressure Transmitter
		SMART with local indication - 2 wire
	Transmitter	
4	Accuracy	± 0.065 % Of Span
5	Differential Pressure Calibration Range	0-2500 mmWC
6	Flow Range	Refer index sheet
7	Integral Square Rooting	Required
8	Maximum Span Limit	-250 to 250 in H2O
9	Output	4-20 mA with Digital Signal Based on HART Protocol
10	Power Supply	24 V DC from system
11	Accurate Turn Down Ratio	10 : 1
12	Maximum Turn Down Ratio	100 : 1
13	Static Pressure Rating	3696 psi
14	Stability	± 0.5 % Of URL fo 2 years
15	Time Constant	100 milliseconds
16	Local Indication	Digital LCD Indication in Engineering Unit
17	Process connections	1/2 "-14 NPT (F) with 3 VM
18	Electrical connections / Conduit Entry Size	1/2 "-14 NPT (F) X 2Nos.
	Material Of Construction	
19	Sensing Element	SS 316L
20	Other wetted Parts	SS 316
21	Sensor Body	SS 316
22	O-ring	Glass Filled PTFE
23	Fill Fluid	Silicon Oil
24	Enclosure / Housing	NEMA 4X ,IP66, Polyurethane-covered Aluminum
	Accessories	
25	Mounting Brackets	2 " Pipe Mounting
26	Manifold	5 VM Of SS 316 "T" Type

PRE-TREATMENT PLANT



Rev. No	Date	Description	Prepared By	Reviewed By	Released By
3	2/7/2010	ISSUED FOR APPROVAL	SKS	APU	AVS
2	31/3/2010	ISSUED FOR APPROVAL	SKS	APU	AVS
1	22/12/2009	REVISED AS PER NTPC COMMENT	SKS	APU	AVS
0	17/11/2009	FOR APPROVAL	SKS	APU	AVS

PROJECT	**PRAGATI-III COMBINED CYCLE POWER PROJECT 1500MW(NOMINAL).**
CUSTOMER:	**PRAGATI POWER CORPORTION LIMITED (PPCL)**
CONSULTANT:	**NTPC LIMITED, CONSUTANCY WING**
	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA
THERMAX	**THERMAX LIMITED** PUNE

DATA SHEET FOR ORIFICE PLATE

THERMAX DOC.NO.:	BHEL DOC. NO. :	SH.NO	OC.NO. 630128
WHJBB00009	PE-VO-314-158-A 305	1 OF 2	REV. NO : 03

PROJECT: - PRAGATI-III COMBINED CYCLE POWER PROJECT 1500MW (NOMINAL). (PT PLANT)
OWNER: PRAGATI POWER CORPORARTION LIMITED (PPCL)
CLIENT: BHARAT HEAVY ELECTRICALS LTD
CONSULTANT: NTPC LIMITED. CONSULTANCY WING
CLIENT DOC NO: PE-VO-314-158-A112 REV NO.03
THERMAX OC NO: 630128

REPLIES TO THE COMMENT ON DATA SHEET

ORIFICE PLATE DOC NO. WHJBB00009

S.NO.	COMMENT	THERMAX REPLY	REMARKS
I	Only two flow elements 501A, 501B are appearing in data sheet, however in flange assembly drawing there are 04 no.	Noted, flange assembly drawing is revised accordingly	
II	Beta ratio indicating in orifice sizing calculation is more than 0.7, where in data sheet it is mentioned as 0.4 to 0.7	Noted, data sheet note no.01 is revised for beta ratio range & supporting document ISO 5167 is attached.	

ORIFICE PLATES (F/E)

GENERAL	1	TAG NO	FE-501A	FE-501B
	2	SUPPLY	ORIFICE PLATE	
	3	MAKE TO	BS-1042 (LATEST REV.) / ISO-5167	
	4	PLATE MATERIAL	SS 316	
	5	PIPE MATERIAL	MS	MS
	6	TAP	FLANGED TAPPING	
	7	TAP SIZE	1/2: NPT (F)	
	8	LOCATION	OUTLET OF RAW WATER PUMP HOUSE	INLET OF STILLING CHAMBER
	9	LINE SIZE AND MATERIAL	800 MS	800 MS
OPERATING CONDITIONS	10	FLUID	WATER	
	11	MAX. FLOW M^3/HR	3650	3650
	12	NOR . FLOW M^3/HR	3320	3320
	13	METER MAX M^3/HR	4300	4300
	14	PRESS OPERATING KG/CM^2	1.5	1.5
	15	TEMP. OPERATING DEG. CEN	AMB	
	16	S.G. AT 15 DEG CEN	1	
	17	PROCESS MAX. PRESS. KG/CM^2	2.5	2.5
	18	PROCESS PIPE MATERIAL	IS:3589 GR 410, ERW,LATEST EDN,8 MM NOM.THK	
PLATE DETAILS	19	TYPE	CONCENTRIC.	
	20	ORIFICE BORE	560.07	
	21	PIPE OD mm & ID mm	812.8 / 796.8 mm.	812.8 / 796.8 mm.
	22	FLANGE SIZE AND RATING	ANSI-B-16.5-150#	
	23	INDICATOR TYPE	DIFFERENTIAL PRESSURE TYPE.	
	24	DIFF RANGEmm of WC	2500	2500
	25	VENT HOLE	YES.	
	26	PLATE THICKNESS	6.35 mm.	
	27	QUANTITY	2	

NOTES :-

(1) D/P. RANGE AS PER [redacted] 5

(2) TAG NO., PIPE ID / OD, ORIFICE BORE, D. P. RANGE, FLOW RANGE, MATERIAL OF CONSTRUCTION, SERVICES ARE TO BE ENGRAVED ON THE UPSTREAM SIDE OF INTEGRAL BAR HANDLE FOR ALL ORIFICE PLATES.

(3) COMPLETE ASSEMBLY i.e. ORIFICE PLATE WITH ANSI 300# WELD NECK FLANGES DULY TAPPED WILL BE IN THE SUPPLY OF INSTRUMENT VENDOR.

(4) NO.OF TAP HOLES - 2

(5) SS 316 ROOT VALVE SEPARATELY SUPPLIED BY THERMAX

Rev	DATE	PREPD. BY	CHKD. BY	App.by
5	2/7/2010	SKS	APU	AVS
4	30/3/2010	SKS	APU	AVS
3	22/12/2009	SKS	APU	AVS
2	16/12/2009	SKS	APU	AVS
1	17/11/2009	SKS	APU	AVS
0	19/08/2009	SKS	APU	AVS

QTY :- 02	PROJECT:PRAGATI -III COMBINED CYCLE POWER PROJECT 1500 MW (NOMINAL) AT BAWANA,DELHI	Specification No	PLANT	SH NO
MAKE :-MICROPRECISION				
THERMAX LIMITED	O.C NO: 630128	WHJBB00009	PT	2 OF 2
Water & Waste Solutions	OWNER: PRAGATI POWER CORPORATION LTD.,DELHI			
Sai Chambers, Wakadewadi	CLIENT : BHARAT HEAVY ELECTRICALS LTD			
Pune 411 003 (INDIA)	CONSULTANT:- NTPC - CONSULTANCY WING			

MICRO PRECISION PRODUCTS PVT. LTD. Faridabad

Bore Calculation as per ISO - 5167

CUSTOMER	M/S THERMAX LIMITED	
PROJECT/CONSULTANT	PRAGATI - III CCPP 1500MW (NOMINAL)	
P.O./Enq.No.	E-MAIL ENQUIRY DT 09.09.2009	
TAG/ITEM No.		FE-501A
MICRO Job No./ Quote No.		Q90741
Service		WATER
Flow Element and Type		O.PLATE, CONC.SQ.ED
Material of Flow Element		SS316
Material of Pipe		MS
Material of Flange		A105
Pipe Size	OD (mm) / ID (mm)	812.80 / 796.80
Type of Tapping		FLANGE TAPS
No. of Tapping		3 PAIRS
Maximum Flow	m3/Hr(Q)	3650.0000000
Normal Flow	m3/Hr(Qn)	3320.0000000
METER MAX (Design Flow)	m3/Hr(Qm)	4300.0000000
Temperature Operating	Celsius (t)	20.0000000
Upstream Pressure (Operating Condition)...	Kg/cm2 (P)abs	2.5332000
Density (Operating Condition)	Kg/m3 ROH (p)t	1000.0000000
Viscosity (Operating Condition)	(poise) Mu(u)	0.0100000
Diff Pressure at METER MAX	mm of WC (hm)	2500.0000000
Diff Pressure at Normal Flow	(hn)	1490.3190914
I.D. of Pipe at 20 deg. C	mm (D)	796.8000000
Coeff. of Expan.-Flow Element	mm/mm-C (a)pe	0.0000173
Coeff. of Expan.-Pipe	mm/mm-C (a)p	0.0000120
Correction Factor For Pipe I.D. at t deg C	(Fp)	1.0000000
Temp. Corr. Factor For Orifice Plate	(Fop)	1.0000000
Reynold Number	RD(n)	1473063.9730639
Therefore Approx. Beta = d/D	(Approx. Beta)(B)	0.7036645
Discharge Coefficient	(C)	0.6012567
Beta Updated	(Bi)	0.7031088
d(corrected) at 20 deg C dc=d/Fop	mm (dc)	560.2371053
Vent Hole Diameter	mm (G)	12.7000000
Vent Hole Location	mm (D-G)/2	392.0500000
d (After Vent Hole Correction)	mm (dv)	560.0787625
Pressure Loss at (METER MAX)	mm WC (w)	1225.9328055
Pressure Loss at (NORMAL FLOW)	mm WC(w1)	730.8124259
Pressure Loss at (MAXIMUM FLOW)	mm WC(w2)	883.3147540
DATE	10/09/09	
Revision no:	A, DT 21.12.2009;PIPE ID REVISED.TYPE & NO.OF TAPPINGS	
Reference no.	Q90741-D/FE-501A	

CROSS CHECK OF RESULTS USING CALCULATED VALUES BUT UNITS AS UNDER: -
Qv : 3.14/4*C*E*(di*di)*SQRT(2*DELTA(P)*(p)t) where (p)t in kg/m3
Qv in m3/sec : Delta(P) in Pa : di=(d/1000) in meters :E=1/SQR(1 -(Bi^4)
Qv (m3/sec) = 1.19335859 Qm (m3/Hr)= 4296.09091240

Calculation done by : SSV/SK Calculation checked by :

F/DoC/01 REV.00 dt. 01/12/2008

MICRO PRECISION PRODUCTS PVT. LTD. Faridabad

Bore Calculation as per ISO - 5167

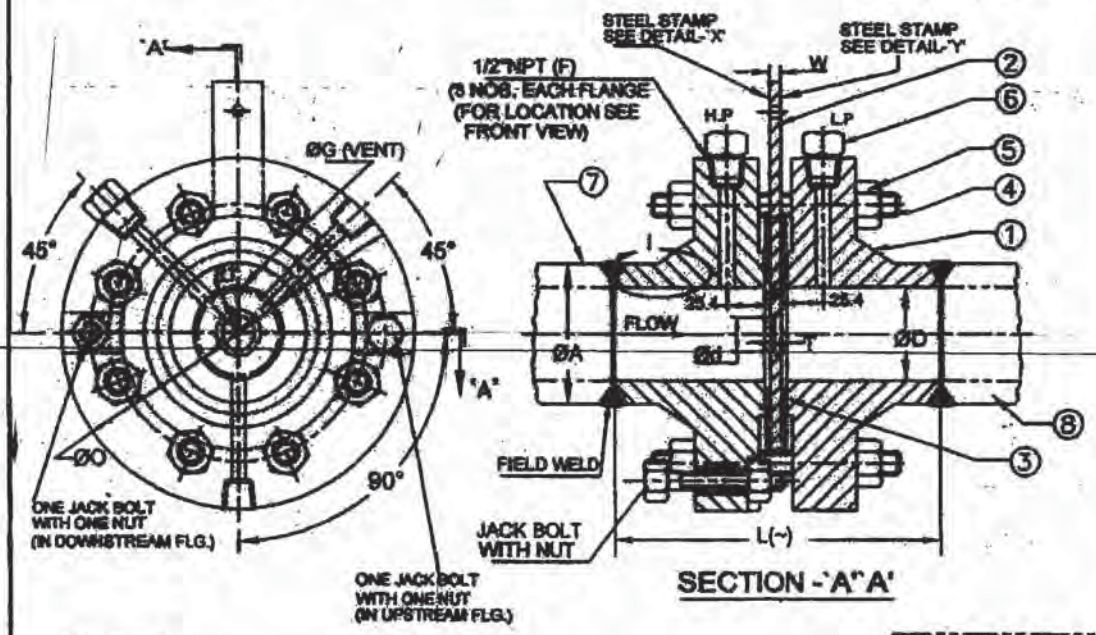
CUSTOMER	M/S THERMAX LIMITED	
PROJECT/CONSULTANT	PRAGATI - III CCPP 1500MW (NOMINAL)	
P.O./Enq.No.	E-MAIL ENQUIRY DT 09.09.2009	
TAG/ITEM No.		FE-501B
MICRO Job No./ Quote No.		Q90741
Service		WATER
Flow Element and Type		O.PLATE, CONC.SQ.EC
Material of Flow Element		SS316
Material of Pipe		MS
Material of Flange		A105
Pipe Size	OD (mm) / ID (mm)	812.80 / 796.80
Type of Tapping		FLANGE TAPS
No. of Tapping		3 PAIRS
Maximum Flow	m3/Hr(Q)	3650.0000000
Normal Flow	m3/Hr(Qn)	3320.0000000
METER MAX (Design Flow)	m3/Hr(Qm)	4300.0000000
Temperature Operating	Celsius (t)	20.0000000
Upstream Pressure (Operating Condition)	Kg/cm2 (P)abs	2.5332000
Density (Operating Condition)	Kg/m3 ROH (p)t	1000.0000000
Viscosity (Operating Condition)	(poise) Mu(u)	0.0100000
Diff Pressure at METER MAX	mm of WC (hm)	2500.0000000
Diff Pressure at Normal Flow	(hn)	1490.3190914
I.D. of Pipe at 20 deg. C	mm (D)	796.8000000
Coeff. of Expan.-Flow Element	mm/mm-C (a)pe	0.0000173
Coeff. of Expan.-Pipe	mm/mm-C (a)p	0.0000120
Correction Factor For Pipe I.D. at t deg C	(Fp)	1.0000000
Temp. Corr. Factor For Orifice Plate	(Fop)	1.0000000
Reynold Number	RD(n)	1473063.9730639
Therefore Approx. Beta = d/D	(Approx. Beta)(B)	0.7036645
Discharge Coefficient	(C)	0.6012567
Beta Updated	(Bi)	0.7031088
d(corrected) at 20 deg C dc=d/Fop	mm (dc)	560.2371053
Vent Hole Diameter	mm (G)	12.7000000
Vent Hole Location	mm (D-G)/2	392.0500000
d (After Vent Hole Correction)	mm (dv)	560.0787625
Pressure Loss at (METER MAX)	mm WC (w)	1225.9326055
Pressure Loss at (NORMAL FLOW)	mm WC(w1)	730.8124259
Pressure Loss at (MAXIMUM FLOW)	mm WC(w2)	883.3147540
DATE	10/09/09	
Revision no:	A, DT 21.12.2009;PIPE ID REVISED.TYPE & NO.OF TAPPINGS	
Reference no.	Q90741-D/FE-501B	

CROSS CHECK OF RESULTS USING CALCULATED VALUES BUT UNITS AS UNDER: -
Qv : 3.14/4*C*E*(di*di)*SQRT(2*DELTA(P)*(p)t) where (p)t in kg/m3
Qv in m3/sec : Delta(P) in Pa : di=(d/1000) in meters :E=1/SQR(1 -(Bi^4)
Qv (m3/sec) = 1.19335859 Qm (m3/Hr)= 4296.09091240

Calculation done by : SSV/SK

Calculation checked by :

REF:-D/DRG-1/JOB/OFA/MOFA10-4619



NOTES:-

1. ONE PAIR OF PRESSURE TAPPING WILL BE PROVIDED WITH 1/2"NPT(M) PLUG AND OTHER ONE PAIRS WITH PLASTIC CAPS.
2. 1 NO. JACK BOLT WITH NUT WILL BE PROVIDED IN EACH FLANGE AND BOTH LOCTED DIAMETRICALLY OPPOSITE.

S.NO.	TAG NO.	SIZE (NPS)	RATING (ANSI)	QTY. (SET)	Ød	ØD	ØA	ØO	L(~)	W	T	ØG	R1
2	FE-501B	600 mm	CLASS 300 ASME-B 16.47, SERIES B	1	560.07	796.80	812.8	1054.1	362	6.35	6.35	12.7 (VENT)	392.05
1	FE-501A	600 mm	CLASS 300 ASME-B 16.47, SERIES B	1	560.07	796.80	812.8	1054.1	362	6.35	6.35	12.7 (VENT)	392.05

PART NO.	DESCRIPTION	QTY. PER ASSY.	SPECIFICATION / MATERIAL	STOCK SIZE	REF. DRG. NO./STD.
8	DOWN STREAM PIPE	1	NOT IN OUR SCOPE		
7	UP STREAM PIPE	1	NOT IN OUR SCOPE		
6	PLUG (1/2" NPT (F))	2	C.S		
5	NUT	TO SUIT NO. OF HOLES	A194 GR.2H		
4	STUD		A193 GR.B7		
3	GASKET (4.5 mm THK.)	2	SS 304 SPIRAL WOUND+ GRAPHITE FILLER		ASME-B 16.20
2	ORIFICE PLATE (CONC. SQ. EDGE)	1	SS-304		
1	FLANGE (WNRF-FACE FINISH-125~250 AARH)	2	A105		

DATE	NO.	DESCRIPTION
REVISION		

PROJECT 1500 MW PRAGQTTI- III CCP PROJECT BAWANA
CUSTOMER M/S. THERMAX LIMITED
ENQ. NO. E MAIL ENQUIRY DT. 07.10.08.2009
JOB NO. _____

TITLE

ORIFICE FLANGE ASSY.

(MODEL NO. MOFA10)

GEN. TOL. EXCEPT AS NOTED
ALL DIMENSIONS ARE IN MM EXCEPT AS NOTED

	NAME	SIG.	DATE
APPROVED	S.L.S.		
CHECKED	S.PAL		
DRAWN	A.SINGH		10/12
DESIGNED			

DRAWING NO.

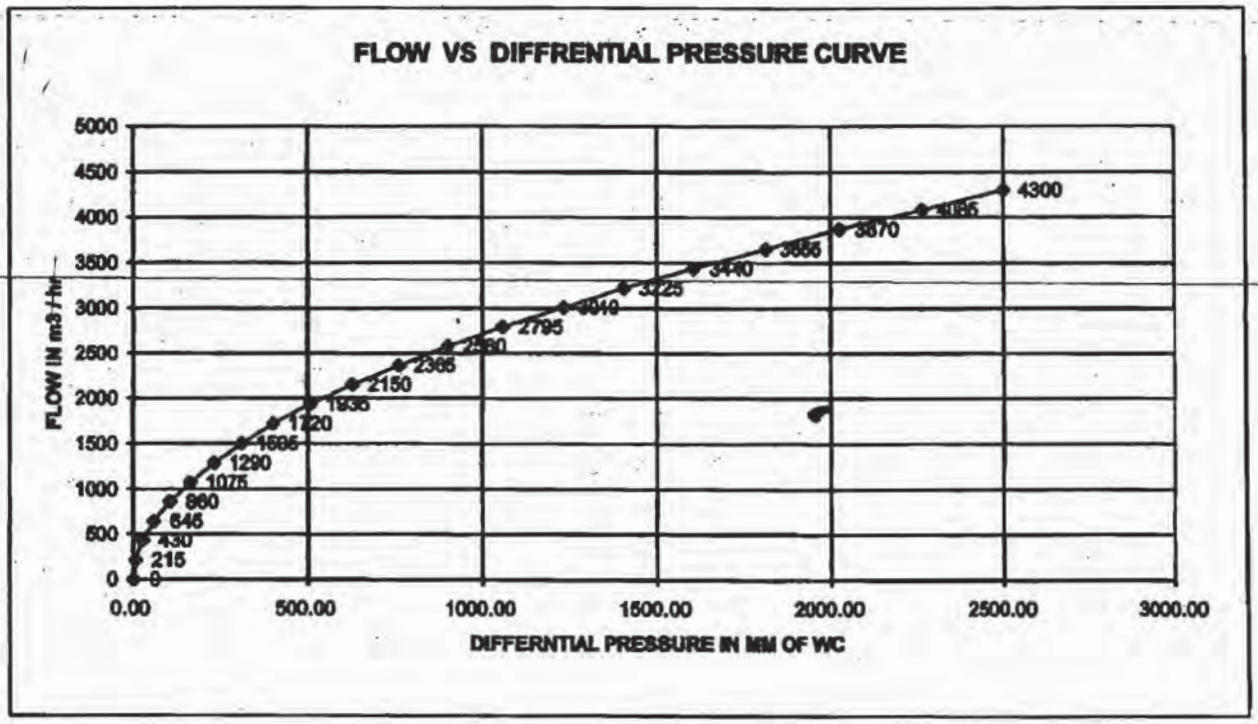
MOFA10/4619

SCALE N.T.S.

MICRO PRECISION PRODUCTS PVT. LTD.

3, LINK ROAD, SECTOR-28, FARIDABAD

SHEET 1 OF 1 REV. 0



1	CUSTOMER	:	M/S THERMAX LIMITED
2	P.O. NO.	:	E-MAIL ENQUIRY DT 09.09.2009
3	PROJECT	:	PRAGATI - III CCPP 1500 MW (NOMINAL)
4	JOB NO.	:	-
5	TAG NO.	:	FE-501A
6	SERVICE	:	WATER

7 O.PLATE I.D. 560.07 mm

8 FLOW EQUATION WITH CONSTANT DENSITY OF 1000.00 KG/M3

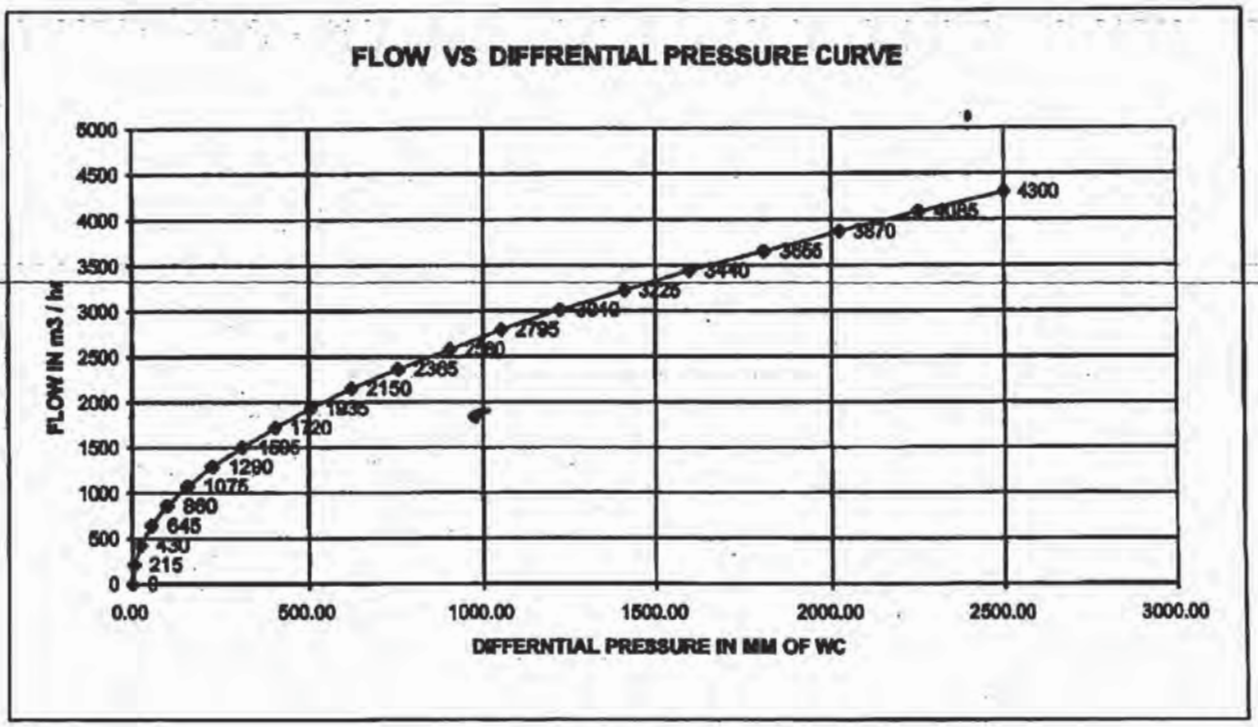
W = K x SQRT (DP) WHERE DP IS IN MM OF WC & FLOW IN M3/HR

= 86 x SQRT (DP)

9 FLOW EQUATION WITH CHANGE IN DENSITY

W = K x SQRT (DP) x SQRT (ROH) WHERE ROH IS IN KG/M3

= 2.719559 x SQRT (DP) x SQRT (ROH)



1	CUSTOMER	:	M/S THERMAX LIMITED
2	P.O. NO.	:	E-MAIL ENQUIRY DT 09.09.2009
3	PROJECT	:	PRAGATI - III CCPP 1500 MW (NOMINAL)
4	JOB NO.	:	-
5	TAG NO.	:	FE-501B
6	SERVICE	:	WATER

7 O.PLATE I.D. 560.07 mm

8 FLOW EQUATION WITH CONSTANT DENSITY OF 1000.00 KG/M3

W = K x SQRT (DP) WHERE DP IS IN MM OF WC & FLOW IN M3/HR

= 86 x SQRT (DP)

9 FLOW EQUATION WITH CHANGE IN DENSITY

W = K x SQRT (DP) x SQRT (ROH) WHERE ROH IS IN KG/M3

= 2.719559 x SQRT (DP) x SQRT (ROH)

5.2.3.10 The diameter of the pipe shall be measured as specified in 6.4.2, the ... as part of the primary device. This also applies to the distance requirement given in 6.4 measured from the upstream edge of the recess formed by the carrier ring.

5.3 Coefficients and corresponding uncertainties of orifice plates

5.3.1 Limits of use

Standard orifice plates shall only be used in accordance with this part of ISO 5167 under the following conditions.

For orifice plates with corner or with D and $D/2$ pressure tappings:

— $d \geq 12{,}5$ mm;

— $50 \text{ mm} \leq D \leq 1\,000$ mm;

— $0{,}1 \leq \beta \leq 0{,}75$;

— $Re_D \geq 5\,000$ for $0{,}1 \leq \beta \leq 0{,}56$;

— $Re_D \geq 16\,000\,\beta^2$ for $\beta > 0{,}56$.

For orifice plates with flange tappings:

— $d \geq 12{,}5$ mm;

— $50 \text{ mm} \leq D \leq 1\,000$ mm;

— $0{,}1 \leq \beta \leq 0{,}75$.

Both $Re_D \geq 5\,000$ and $Re_D \geq 170\beta^2 D$

where D is expressed in millimetres.

The pipe internal roughness shall satisfy the following specification if the uncertainty values in this ISO 5167 are to be met, i.e. the value of the arithmetical mean deviation of the roughness profile, Ra, is such that $10^4 Ra/D$ is less than the maximum value given in Table 1 and greater than the minimum value in Table 2. The discharge coefficient equation (see 5.3.2.1) was determined from a database collected [illegible]

which Tables 1 and 2 are based is [illegible]

Table 1 — Maximum value of $10^4 Ra/D$

≤ 0,20	15	15							
0,30	15	15	15	15	15	[illegible]	[illegible]		
0,40	15	15	10	7,2	5,2	4,1	3,5	3,1	2,7
								1,1	