



Offshore Design Section  
Engineering Services  
ISO – 9001:2008

FUNCTIONAL  
SPECIFICATION FOR  
TEMPERATURE  
TRANSMITTER  
(ELECTRONIC)

Spec. No. 3302

Rev. No. 6

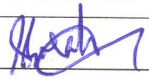

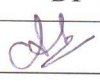
Discipline Instt.

Page: 1 OF 12

# FUNCTIONAL SPECIFICATION

## FOR

# TEMPERATURE TRANSMITTER (ELECTRONIC)

PREPARED / REVISED BY	REVIEWED BY	APPROVED BY	TOTAL No. OF PAGES	DATE	REV. No.
			12	14.12.2017	6
SBB	ARD	AS			
MD	ARD	KM	12	25.01.2016	5
MD	ARD	AKR	11	10.09.2012	4
MD	ARD	AKR	10	16.07.2010	3
VS	SRS	GRP	8	18.02.2008	2
AK	RS	GRP	10	28.03.2007	1
AK	MC	AC	10	25.08.2003	0

FORMAT No. ODS/SOF/004	Ref. PROCEDURE No. ODS/SOP/023	ISSUE No. 02	REV. No. 00	REV. DATE: 21.07.2010
---------------------------	-----------------------------------	-----------------	----------------	--------------------------



**Offshore Design Section**  
**Engineering Services**  
**ISO – 9001:2008**

**FUNCTIONAL  
SPECIFICATION FOR  
TEMPERATURE  
TRANSMITTER  
(ELECTRONIC)**

**Spec. No. 3302**


**Rev. No. 6**

**Discipline Instt.**

**Page: 2 OF 12**

**CONTENTS**

<b>Clause No.</b>	<b>ITEM</b>	<b>Page No.</b>
1.0	Scope of This Document	3
2.0	Reference Documents and Specifications	3
3.0	Scope of Supply	3
4.0	Temperature Transmitter	3
4.1	General	3
4.2	RTD	4
4.3	Thermocouple	5
4.4	Thermowell	6
4.5	Other Details of Temperature Transmitter	7
4.6	Material	7
4.7	Enclosure class	7
Annexure I	Material Selection Chart for Thermowell	8
Annexure II	Hook-up drawing-Thermowell	9-10
Annexure III	Temperature Transmitter without Thermowell	11
Annexure IV	Data Sheet Format	12

	<b>Offshore Design Section Engineering Services ISO – 9001:2008</b>	<b>FUNCTIONAL SPECIFICATION FOR <u>TEMPERATURE TRANSMITTER (ELECTRONIC)</u></b>	<b>Spec. No.</b>	<b>3302</b>
			<b>Rev. No.</b>	<b>6</b>
			<b>Discipline</b>	<b>Instt.</b>
			<b>Page: 3 OF 12</b>	

## 1.0 SCOPE OF THIS DOCUMENT:

This functional specification describes the essential design considerations for the selection of Temperature Transmitter (Electronic) for the intended service.

## 2.0 REFERENCE DOCUMENTS AND SPECIFICATIONS:

- a) Instrumentation/ Process Design Criteria
- b) Basic Bid Work
- c) Project P & IDs
- d) Instrument / Process Data Sheets

## 3.0 SCOPE OF SUPPLY:


- 3.1 The quantity to be supplied and installed shall be as per the requirements indicated in the Basic Bid Work, Design Criteria and the P & IDs.
- 3.2 The vendor shall be responsible for the selection of the Temperature Transmitter suitable for measurement range, accuracy, MOC & standard accessories for its intended application.
- 3.3 The procurement, tagging, packing, testing & calibration, preparation for shipment, along with accessories, spares, and assistance where required for its installation & commissioning at site shall be under vendor's responsibility.

## 4.0 TEMPERATURE TRANSMITTER

### 4.1 GENERAL:

- 4.1.1 Temperature transmitters shall be integral with the sensing element.
- 4.1.2 The sensing element shall be RTD 3-wire type or Thermocouple, complete with flanged thermowell.
- 4.1.3 For temperatures upto 350 °C, measurement shall be by means of Pt-100 RTD as per BS 1904.
- 4.1.4 Thermocouples shall only be used for measurement of temperatures above 350 °C, or whenever it can be suitably demonstrated that the mechanical construction of an item does not permit the installation of an RTD.
- 4.1.5 Surface metal temperatures shall be measured by thermocouples secured to the surface.
- 4.1.6 Transmitters shall include a Digital indicator scaled in engineering units, and shall be mounted integrally in the head of the detecting element where access permits, otherwise remotely mounted. Where the transmitter indicator is not readily visible a separate loop-powered indicator shall be provided. The output meter shall be suitable for use in the hazardous area.
- 4.1.7 Transmitters shall be SIL-2 certified "SMART" type and use HART protocol (latest edition) for communication. △

FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004	ODS/SOP/023	02	00	21.07.2010


	<b>Offshore Design Section</b> <b>Engineering Services</b> <b>ISO – 9001:2008</b>	<b>FUNCTIONAL</b> <b>SPECIFICATION FOR</b> <b><u>TEMPERATURE</u></b> <b><u>TRANSMITTER</u></b> <b><u>(ELECTRONIC)</u></b>	<b>Spec. No.</b>	<b>3302</b>
			<b>Rev. No.</b>	<b>6</b>
			<b>Discipline</b>	<b>Instt.</b>
			<b>Page: 4 OF 12</b>	

- 4.1.8 Transmitters shall be immune to Radio frequency interference due to walkie-talkie, paging system, communication system etc. All electronic modules shall be designed for short circuit protection. Electromagnetic Compliance/Conformity shall be as per EN 61326. △
- 4.1.9 Span shall be continuously adjustable over the transmitter range.
- 4.1.10 The TT shall be provided with ½"NPT (F) cable entries.
- 4.1.11 The range shall be selected so that the normal operating temperature shall fall in the middle third of the span.
- 4.1.12 TT shall have adjustable zero & span facility.
- 4.1.13 Transmitter instrument shall be Direct mount type or as close as possible to sensing point. Mountings and accessories required for Temperature Instrument shall be 316SS or better.
- 4.1.14 Temperature Transmitter shall be intrinsically safe and certified by statutory body like UL/FM/BASEEFA/ATEX/CCOE/ PESO or equivalent. The certificate for the same shall be provided with the Purchase Specification. △
- 4.1.15 TT Housing shall be Dual Compartment Type. The terminals shall be accessible without having to expose the sensor electronics portion to the environment.
- 4.1.16 Instrument parts shall be resistant to the corrosive properties of the process fluid and ambient conditions to which they are exposed.

## **4.2 RTD:**

- 4.2.1 Supply of the RTD shall be the responsibility of the Transmitter Vendor. The transmitter data sheet shall be containing the RTD details as an attachment and shall be signed by the transmitter vendor.
- 4.2.2 RTD shall be Pt-100 conforming to relevant standards. △
- 4.2.3 The RTD element length shall be selected to suit the Thermowell insertion length. RTD shall be as per SAMA/IEC-751/DN-43760/ JIS C1604/ BS 1904 standard. △
- 4.2.4 RTD bulb shall be with mechanism suitable for the absorption of vibrations in thermowell / piping. Shall be suitable for vibration resistance upto 3g. Where it is exposed to the vibrations of greater than 3g (Compressor discharge lines, bearing temperatures etc.), the RTD shall pass the Vibration test as per IEC 60751. Vendor shall submit the third party certificates for the Vibration tests performed at the accredited labs. △
- 4.2.5 Transmitter vendor shall certify the transmitter - sensor matching capability and provide the "alpha" value & CVD constants in the data sheet.
- 4.2.6 RTD shall be mineral insulated to the industry standards, and Sheath material shall be minimum SS 316 or better to suit the conditions. (S.S.braided for critical machinery application)
- 4.2.7 Sensor shall have spring loaded adaptor for better connectivity to the circuitry. Wiring shall be multi-strand, enamelled and insulated.

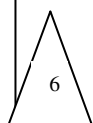
FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004	ODS/SOP/023	02	00	21.07.2010

	<b>Offshore Design Section</b> <b>Engineering Services</b> <b>ISO – 9001:2008</b>	<b>FUNCTIONAL</b> <b>SPECIFICATION FOR</b> <b><u>TEMPERATURE</u></b> <b><u>TRANSMITTER</u></b> <b><u>(ELECTRONIC)</u></b>	Spec. No.	3302
			Rev. No.	6
			Discipline	Instt.
			Page: 5 OF 12	


- 4.2.8 RTD Calibration certificate shall be submitted and Calibration test equipment shall have valid Calibration Certificate from accredited Labs traceable to National/International standards like NIST/NPL/UKAS/NAMAS/JCSS.
- 4.2.8 Insulation Resistance for thermometer at ambient temperature shall be >100 Mega-Ohms with a test voltage at minimum 100 Volt DC.  $\triangle$
- 4.2.9 Thermometers shall be supplied along with Type Test Certificates from reputed 3rd party agencies for 'Insulation resistance at elevated temperatures', 'Thermal Response Time' and 'Self-Heating' tests as per IEC 60751.  $\triangle$
- 4.2.10 Resistors shall be supplied along with Type Test Certificates from reputed 3rd party agencies for 'Tolerance', 'Stability at Upper Temperature Limit' and 'Self-Heating' tests as per IEC 60751.
- 4.2.11 Sensor heads shall be IP65 or Better. Connection Head Enclosure wherever provided shall be Ex-Proof to Class I Div II GR C&D or Zone 2 or equivalent.
- 4.2.12 Accuracy shall be within + 0.2% of reading. For Custody Transfer applications, it shall be 0.1% of the reading.
- 4.2.13 Lead wire shall be silver coated Cu wire 28 AWG or thicker, with PTFE insulation.
- 4.2.14 Vendor shall fill in the CVD values / IEC 751 'A, B, C' values for each of the RTD in the Data sheet.
- 4.2.15 RTD supplied shall meet the above specifications. RTD has to be sourced from reputed manufacturers, like Rosemount (Emerson), Gayesco (USA), Honeywell Automation, Burns Engineering, Yamari Singapore PTE Ltd., TSS PTE Pvt. Ltd. Singapore, Yokogawa(Japan/India), ABB-Kent (UK), Honeywell Automation, India Ltd.(India), Fuji (Japan), Ashcroft (USA), Nagano Kelki (Japan), Wika Alexander Weigand SE& Co. KG (Germany), Wika Instruments India Pvt. Limited (India), Baumer Technologies India Pvt. Ltd.(India), Goa Instruments Industries Pvt. Ltd. (India), Gauges Bourdon (I) Pvt. Ltd (India), Thermal Instrument India Pvt. Ltd (India), Pyro Electric Instruments Goa Pvt. Ltd, (India).  $\triangle$

### 4.3 THERMOCOUPLE:

- 4.3.1 Supply of thermocouple shall be the responsibility of the Transmitter Vendor. The transmitter data sheet shall contain the thermocouple details as an attachment and shall be signed by the transmitter vendor.
- 4.3.2 The thermocouple characteristics shall conform to IEC 584-1.
- 4.3.3 Thermocouples shall normally be the mineral-insulated metal- sheathed type, isolated from earth. Characteristic of mV versus temperature shall conform to BS-4937.
- 4.3.4 Thermocouples shall be Type K (Chromel-Alumel) for the temperature range –20 °C to 1000 °C. For temperature above 1000 °C, Type R (Platinum/13 % Rhodium-Platinum) shall be used.



FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004	ODS/SOP/023	02	00	21.07.2010


	<b>Offshore Design Section Engineering Services ISO – 9001:2008</b>	<b>FUNCTIONAL SPECIFICATION FOR <u>TEMPERATURE TRANSMITTER (ELECTRONIC)</u></b>	<b>Spec. No.</b>	<b>3302</b>
			<b>Rev. No.</b>	<b>6</b>
			<b>Discipline</b>	<b>Instt.</b>
			<b>Page: 6 OF 12</b>	

#### 4.4 THERMOWELL:

- 4.4.1 Thermowell shall be installed for all temperature-sensing elements installed on process lines or vessels.
- 4.4.2 The thermowell shall be suitable for the process media, generally 316 SS, or other material as required by the project piping specification. The thermowell shall be machined from drilled bar stock with minimum wall thickness of 4.8mm, and 6mm bore. Bore shall be concentric with the outside diameter to within 10% of wall thickness. The thermowell shall be provided with hexagonal head as applicable.
- 4.4.3 MOC for thermowell shall be as per the Annexure-I attached.
- 4.4.4 Thermowell flanges shall be of minimum # 300.
- 4.4.5 Welding of flange well shall be full penetration type. Weld shall be dye penetrate checked as per BS 5500.
- 4.4.6 Material and finish of gasket should be suitable for RTJ flanges having 63 µinch AARH (max) surface finish and shall conform to ANSI B16.5.  $\triangle$
- 4.4.7 Thermometer well shall have ½” NPT female thread for element and 1½” flanged for vessel or piping connection.
- 4.4.8 Thermowells to be used as test wells shall be provided with a stainless steel screwed plug and chain.
- 4.4.9 Wells for insulated vessels and lines shall have extension necks.
- 4.4.10 The thermowell tip shall be at centerline of pipe but immersion length shall not exceed 400 mm for higher size pipes.
- 4.4.11 Thermowell shall be designed to withstand vibration stresses caused by stream velocity. Also, the Natural Frequency of the thermowell shall be calculated applying all the factors like fluid mass, added sensor mass, non-uniform profile beam, and mounting compliance. After all the correction factors are applied, the “in-situ”, or installed natural frequency,  $f_n^c$ , is calculated and used for the rest of the frequency analysis. The steady state frequency (Wake frequency at maximum flow velocity),  $f_s$ , shall be less than 40% of the corrected natural frequency of the Thermowell or shall satisfy the condition  $0.6f_n^c < f_s(\text{steady state}) < 0.8f_n^c$ . The Contractor shall provide calculations as per ASME PTC 19.3 TW-2016/latest, and the justification for the final selection of the thermowell.  $\triangle$
- 4.4.12 Thermowell welding shall be full penetration type with ‘U’ length as follows:
- |                |   |   |
|----------------|---|---|
| 2” Pipeline    | - | Approx. 200 mm (with Expander & Wake Freq. 80%) |
| 4” to 6” lines | - | 280 mm  |
| Above 6”       | - | 320 mm  |
| Vessels        | - | 400 mm  |
- 4.4.13 The typical thermowell installation shall be as per Annexure – II & III of this specification.

FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004	ODS/SOP/023	02	00	21.07.2010



	<b>Offshore Design Section</b> <b>Engineering Services</b> <b>ISO – 9001:2008</b>	<b>FUNCTIONAL</b> <b>SPECIFICATION FOR</b> <b><u>TEMPERATURE</u></b> <b><u>TRANSMITTER</u></b> <b><u>(ELECTRONIC)</u></b>	<b>Spec. No.</b>	<b>3302</b>
			<b>Rev. No.</b>	<b>6</b>
			<b>Discipline</b>	<b>Instt.</b>
			<b>Page: 7 OF 12</b>	

- 4.4.14 TT Vendor shall be responsible for the supply of Thermowell (from any of the TG or TT vendors enlisted in ONGC Suggested Vendor List) along with the wake frequency calculation. Datasheet and wake frequency calculation sheet shall be signed and stamped by the TT Vendor. △

#### **4.5 OTHER DETAILS OF TEMPERATURE TRANSMITTER**

4.5.1 **Accuracy:** Digital accuracy of the transmitter shall be  $\pm 0.1\%$  of FSD.

4.5.2 **Repeatability:**  $\pm 0.1\%$ .

4.5.3 **Output Signal:** Output signal shall be 2 wired 4-20 mA DC, and capable of delivering the rated current signal into external load of around 600 ohms when powered with 24V DC (negative earthed).

#### **4.6 MATERIAL**

4.6.1 The material requirements for TT shall in general be according to clause 3.6.4.5 of Instrumentation Design Criteria

4.6.2 Transmitter body studs shall be high tensile stainless steel, or other corrosion-resistant material for higher stress levels.

4.6.3 Instrument parts shall be resistant to the corrosive properties of the process fluid and ambient conditions to which they are exposed.

#### **4.7 ENCLOSURE CLASS**

The transmitter shall be weatherproof (IP 65 or better). Housing for TT shall be constructed from 316SS/Epoxy coated Copper-free (i.e. less than 0.4% copper by mass) die-cast Aluminium, suitable for harsh offshore environment. △

FORMAT No.	Ref. PROCEDURE No.	ISSUE No.	REV. No.	REV. DATE:
ODS/SOF/004	ODS/SOP/023	02	00	21.07.2010



Offshore Design Section  
Engineering Services  
ISO – 9001:2008

**FUNCTIONAL  
SPECIFICATION FOR  
TEMPERATURE  
TRANSMITTER  
(ELECTRONIC)**

**Spec. No. 3302**

**Rev. No. 6**

**Discipline Instt.**

**Page: 8 OF 12**

**ANNEXURE – I**

**Material Selection Chart for Thermowell**

S. No.	Piping Class	Well	Flange
1	A1, B1, D1, E1, F1, XF1, F1, PA1, PB1, PD1, PE1, PXF1, PF1, A2, B2, D2, E2, XG1, A1H, A3, B3, A8	SS316	SS316
2	Sea Water / Untreated Produced Water	MONEL	MONEL
3	A4, A6, A9, B9, D9, E9	SS316	SS316
4	A5	MONEL	MONEL
5	A7	TITANUM	TITANUM
6	** A1N, B1N, D1N, E1N, F1N, XF1N, PA1N, PB1N, PD1N, PF1N, XG1N	SS316L	SS316L
7	A10, B10, D10, E10, F10	SS316L	SS316L
8	A11, B11, D11, E11, F11, PA11, PB11, PD11, PE11, PF11	HAST-C	HAST-C

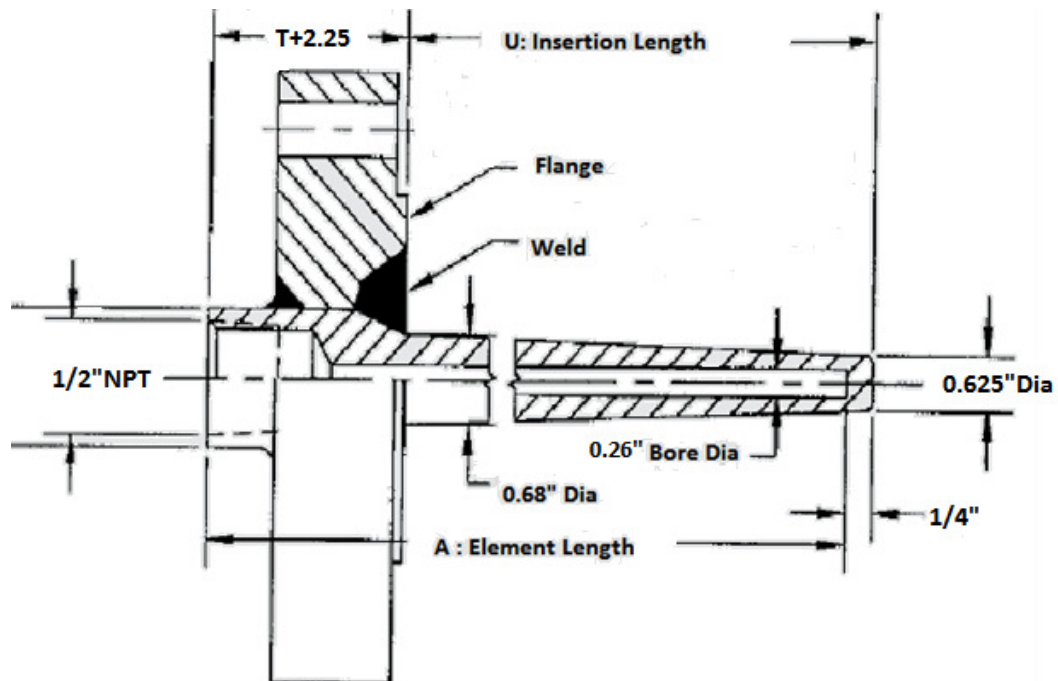
[\*\* All wetted parts of Thermowell shall conform to NACE MR-01-75 (Latest edition).]



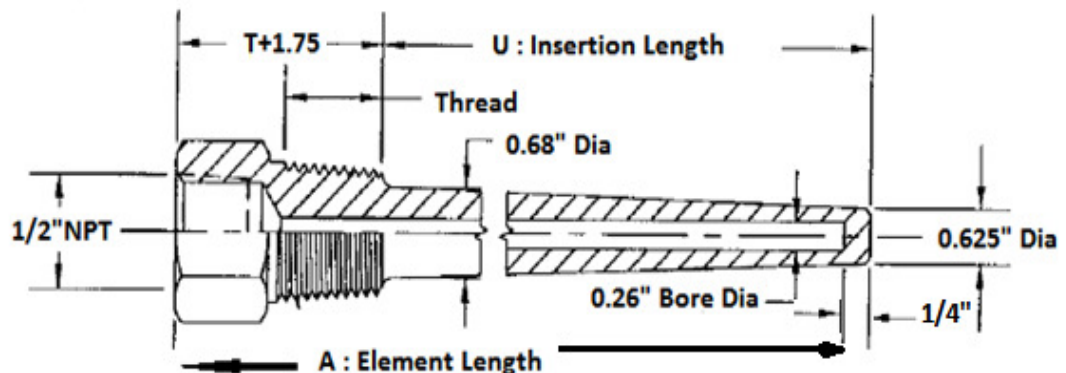


**ANNEXURE – II**  
**HOOK UP DRAWING – THERMOWELL for RTD**

**FLANGED TYPE**



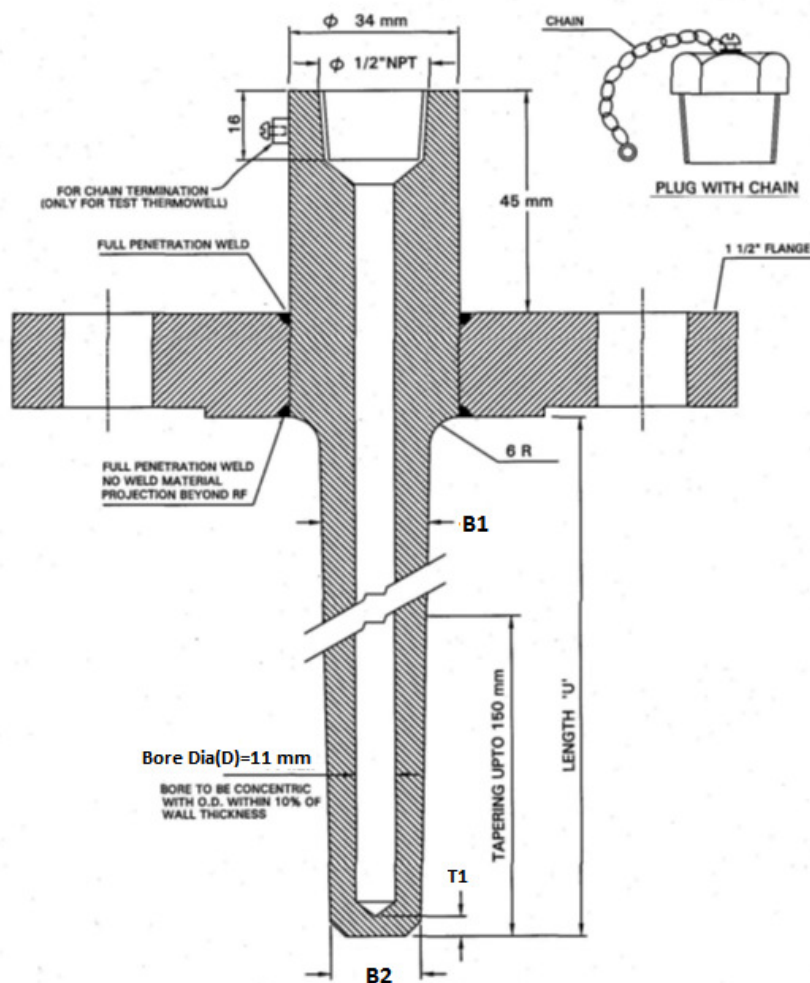
**THREADED TYPE**



**T= Lag Length**



**Thermowell Drawing for Thermocouple**



**Note:**

- 1) This Drawing is applicable for:
  - (a) 5 Van Stone Thermowell shall be used for 1500#ANSI Rating or equivalent
  - (b) Type shall be RTJ type for ANSI rating  $\geq 600\#$
  - (c) DP Test shall be carried out for all weld joints.
  - (d) Chain and plug shall be applicable only for test thermowells

Flange Rating	B1 (mm)	B2 (mm)	T1 (mm)	Test Pr. (Kg/cm <sup>2</sup> )
Upto 600#	22	18	4	200
Above 600#	25±0.2	18	6.5	400

**Note:** Thermowells shall be of tapered design in general. If there is any special requirement of straight or stepped thermo-well for any specific process requirement, then prior approval shall be taken by vendor.



Offshore Design Section  
Engineering Services  
ISO – 9001:2008

FUNCTIONAL  
SPECIFICATION FOR  
TEMPERATURE  
TRANSMITTER  
(ELECTRONIC)

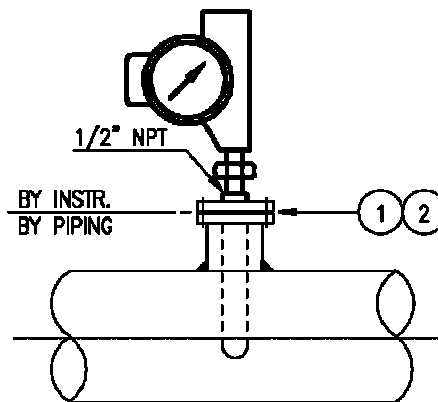
Spec. No. 3302

Rev. No. 6

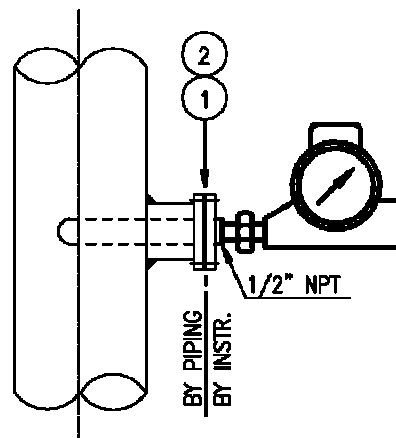
Discipline Instt.

Page: 11 OF 12

**Annexure-III**  
**Temperature Transmitter without Thermowell**



VERTICAL MOUNTING



HORIZONTAL MOUNTING

- (1)- FLANGE WITH GASKET (RF /RTJ) AS PER PIPING STANDARD
- (2)- STUD BOLTS & NUTS ASTM A320 GR.L7M/A194 GR.7M WITH HOT DIP GALVANIZED TO ASTM A153, AS PER THE REQUIREMENT



**Offshore Design Section**  
Engineering Services  
ISO – 9001:2008

**FUNCTIONAL  
SPECIFICATION FOR  
TEMPERATURE  
TRANSMITTER  
(ELECTRONIC)**

**Spec. No. 3302**



**Rev. No. 6**

**Discipline Instt.**

**Page: 12 OF 12**

**ANNEXURE – IV**

**TYPICAL DATA SHEET – TEMPERATURE TRANSMITTER**

TEMPERATURE TRANSMITTERS									
UNITS :- Flow Liquid – M3/HR Gas – NM3/HR Steam – Kg/hr Pressure – kg/cm2 Temperature – deg C Level/length -mm									
1	Function				<b>MEASURING UNIT</b>				
2	Type				15	SAMA Class			
3	Case				15.1	Compensation			
4	Mounting				16	Bulb Type			
5	Enclosure				16.1	Bulb Material			
	Enclosure Class				16.2	Bulb Union Thread			
6	Elec. Area Class				16.3	Bulb Extension Type			
7	Intrinsically Safe				16.4	Bulb Dia			
8	Power Supply				17	Capillary Materials			
9	Power Supply for Transmitter				18	Armour flexible			
10	Cable Entry				19	Armour Material			
11	Accuracy				20	Capillary Length			
12	Repeatability				21	Over Range protection			
					<b>THERMOWELL</b>				
<b>TRANSMITTER</b>					22	Material			
13	Output				23	Construction			
14	Trans Power Supply				24	Process Connection			
					25	Gauge Connection			
					26	Thermowell as per Drawing			
<b>RTD/ Thermocouple</b> 					<b>OPTIONS</b>				
Make & Model No./Type 									
<b>Thermowell</b>									
Make & Model No.									
<b>TAG No.</b>	<b>RANGE</b>	<b>TEMPERAT</b>		<b>WELL DIM</b>		<b>FLANGE</b>		<b>SERVICE</b>	<b>OPTIONS</b>
		<b>NOR.</b>	<b>MAX.</b>	<b>U</b>	<b>T</b>	<b>MATERIAL</b>	<b>RATING, FACE, FINISH</b>		
AS PER									
P& ID									
NOTE:-									
VENDOR SEAL AND SIGNATURE									