FUNCTIONAL SPECIFICATION

FOR

TEMPERATURE GAUGE AND THERMOWELL

PREPARED / REVISED BY	REVIEWED BY	APPROVED BY	TOTAL No. OF PAGES	DATE	REV. No.
AV	ARD	ARD	12	26.03.2018	6
ET	ARD	AKR	10	09.11.2012	5
VS	SRS	GRP	8	18.02.2008	4
AK	BK	GRP	9	28.03.2007	3
AK	BK	GRP	9	31.09.2006	2
AK	MC	RK	9	31.09.2006	1
ET	MC	AC	9	25.08.2003	0

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1.0 SCOPE OF THIS DOCUMENT:

1.1 This functional specification describes the essential design considerations for the selection of Temperature Gauge for the intended service.

2.0 CODES & STANDARDS:

2.1 **Reference Standards (Latest editions):**

a) EN 13190
b) ASME B 40.3, B 40.4, B 40.8 & B 40.9

2.2 **Reference Documents and Specifications:**

a) Instrumentation Design Criteria
b) Basic Bid Work
c) Project P & IDs
d) Process Design Criteria / 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 gauge suitable for its intended application, its procurement, tagging, packing, testing & calibration, preparation for shipment, along with accessories, spares, and assistance where required for its installation & commissioning at site.

4.0 TEMPERATURE GAUGE:

4.1 GENERAL:

4.1.1 The temperature gauges shall be used for local indication. These local temperature indicators shall in general be heavy duty; weatherproof, dial type bi-metal thermometers with 100 mm to 150 mm dial size, external adjustment, every angle rotatable and rigid stems. Liquid filled casing shall be provided for dial thermometers.

4.1.2 Filled system dial thermometers shall be used when the operating temperature is between 0^{o}C (32^{o}F) and – 45^{o}C (- 50^{o}F).

4.1.3 The Bi-metal shall be adjustable union stem type with SS 316 material for the stem. The Union size shall be ½" NPT and the diameter shall suit the well diameters.

4.1.4 Dial Thermometers shall be provided with separable stainless steel thermowells.

4.1.5 Filled capillary instruments shall be compensated for ambient temperature and shall not be used for measurements above 420^{o}C.The armor for the capillary instruments shall be flexible. The length of the capillary shall not be more than 5 m per gauge.

4.2 **MATERIAL:**

4.2.1 The material requirements for temperature gauges and thermowell shall in general be according to clause 3.6.4.5 of Instrumentation Design Criteria and as per Annexure I of this document, with NACE compliance as required.

4.2.2 Case material for all temperature gauges shall be SS 316. Capillary and Armour shall be of stainless steel. Movement shall be minimum SS.

4.2.3 The Window material shall be Shatter proof glass / Acrylic.

4.3 **RANGE:**

The range shall be selected such that the normal operating temperature shall fall in the middle third of the span.

4.4 **ACCURACY:**

Accuracy shall be as per EN 13190 Class 1.

4.5 **READING SCALES:**

Indicating scales shall read out in Degrees Celsius unless otherwise specified.

4.6 **THERMOWELL:**

4.6.1 Thermowell shall be installed for all temperature-sensing elements installed on process lines or vessels.

4.6.2 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. In package equipment, for smaller diameter pipe, threaded type thermowell shall be provided with hexagonal head as applicable. △6

4.6.3 MOC for Thermowells and Thermowells flanges shall be as per Annexure - I attached and shall be rated one piping class higher than the pipe to which it is connected. △6

4.6.4 Thermowells shall have ½" NPT female thread for element and 1½" flanged for vessel or piping connection.

4.6.5 Where Thermowells are provided without gauges (i.e., those that are to be used as test wells) shall be provided with a stainless steel 316 screwed plugs and chain.

4.6.6 The Thermowell tip shall be at centerline of pipe but immersion length shall not exceed 400 mm for higher size pipes.

4.6.7 Wells for Insulated Vessels and lines shall have Extension Necks. △6

4.6.8 A Thermowell, when required shall be installed adjacent to flow recorder, temperature recorder and controller measuring elements as per installation requirement. 6

4.6.9 Thermowell Welding shall be dye Penetrated Checked as per BS 5500.Thermowells welding shall be full penetration type with 'U' length as follows: 6

Upto 4"	-	280 mm by blowing pipe to 4"
4" to 6" lines	-	280 mm
Above 6"	-	320 mm
Vessels	-	400 mm

4.6.10 The typical thermo-well drawing is shown at Annexure – II of this specification.

4.7 EQUIPMENT PROTECTION:

The following protection requirements shall be read in conjunction with clause no. 3.6.4.4 of Instrumentation Design Criteria.

4.7.1 Temperature Gauges: 130% of measuring range shall be provided as Over-range protection for the temperature gauge. The temperature gauge shall be weather proof to NEMA 4X / IP 65 or better.

4.7.2 Thermowells: Thermowells shall be designed to withstand vibration stresses caused by stream velocity. Also, the natural frequency of the Thermowells 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 c n is calculated and used for the rest of the frequency analysis. The steady state frequency (wake frequency at maximum velocity), f s shall be less than 40% of the corrected natural frequency of the thermo well or shall satisfy the condition 0.6 f c n < f s (steady state) < 0.8 f c n .The Contractor shall submit wake frequency calculation as per ASME PTC 19.3 TW 2016/ latest for review and the justification for the final selection of the thermo well. 6

4.8 MISCELLANEOUS:

Thermowells shall not be installed in elbows. Lagging extensions shall be provided on insulated piping and insulated vessels. Thermowells shall be oriented so that gauge dials are clearly visible and readable from the deck or the appropriate access platform. Where a thermowell location causes poor access or visibility, the Contractor shall provide a remote-mounted capillary-gauge, located in an accessible and readily visible location.

4.9 THERMOWELL TESTING:

4.9.1 Thermowells shall be pressure tested with hydraulic fluid as per ASTM BS1560. Relevant test certificates shall be submitted along with the supply.

4.9.2 Ultrasonic test for bore concentricity of Thermowells shall be carried out.

4.9.3 Thermowell material test certificates shall be submitted along with the supply.

4.9.4 Temperature gauge calibration shall be as per EN 13190.

4.10 Temperature Gauge Testing Requirements:

4.10.1 The following tests shall be carried out for Temperature Gauges:

A) Test Requirement of Temperature Gauges according to DIN EN 13190:
   a) Accuracy and Hysteresis
   b) Influence of Mounting Position

B) Inspection / Acceptance Test at Factory / Manufacturer Premises for Temperature Gauges:
   a) Visual Inspection
   b) Dimensional Verification
   c) Accuracy
   d) Degree of Protection

4.10.2 Tests indicated in (A) shall be Type Tests for Temperature Gauge. Type Tests for each model/range shall be witnessed by DNV/LLOYDS/BV/TUV/NABL/Govt. Laboratory etc. Valid type test certificates shall be provided along-with the supply. Tests indicated in (B) are for Inspection/Acceptance at Factory/Manufacturer Premises.

4.10.3 Each type test certificate should indicate its validity period (Normally 5 years). The same has to be seen at the time of delivery/supply.

4.10.4 Inspection/Acceptance Test will be 10% of each model/range of the total quantity shall be carried out.

ANNEXURE – I

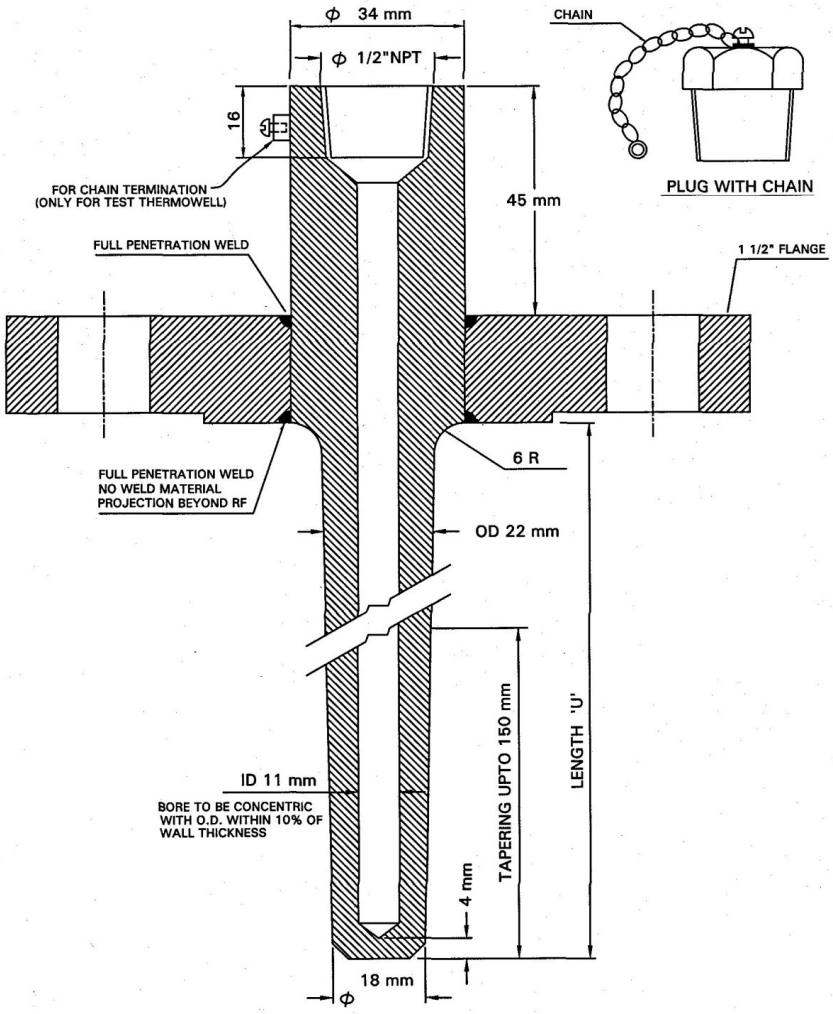
Material Selection Chart for Thermowell 6

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	TITANIUM	TITANIUM
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 A

(Hook Up Drawing)



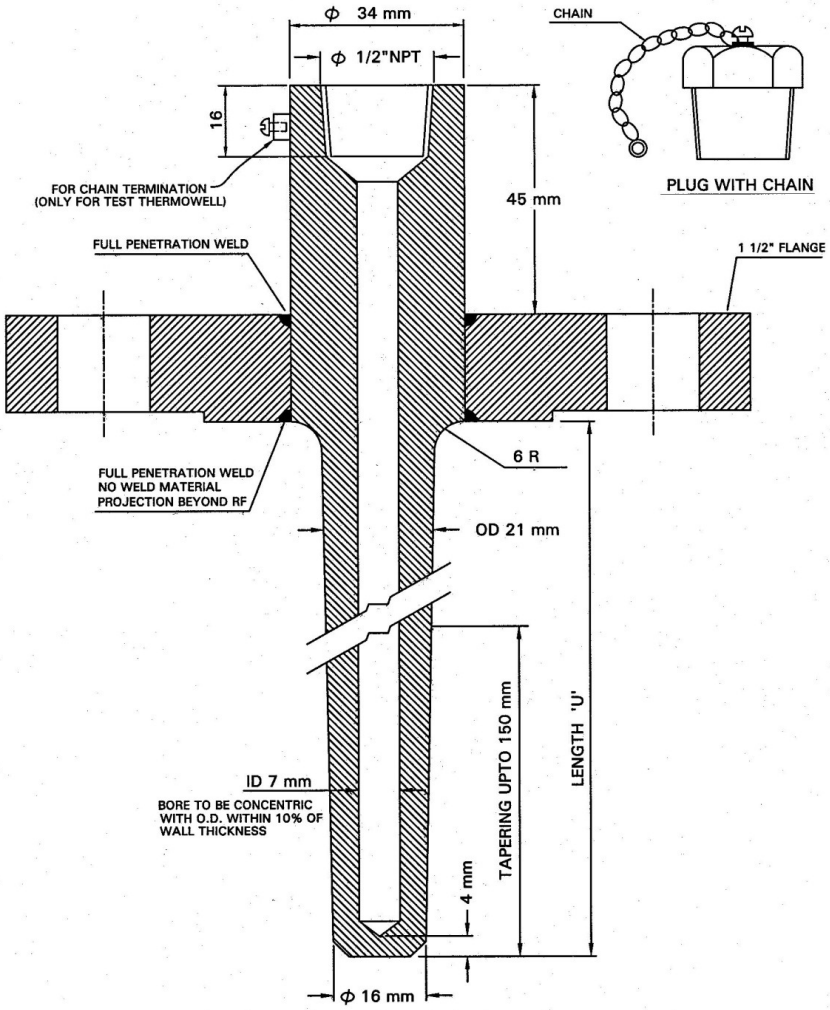
[** All wetted parts of Thermowell shall conform to NACE MR-01-75 (Latest edition).]

Note:

1) This standard is applicable for:
   (a) Temperature gauges and duplex temperature elements
   (b) Thermowell upto 1500# ANSI Rating or equivalent
2) Type shall be RTJ type for ANSI rating >= 600#
3) DP Test shall be carried out for all weld joints.
4) Chain and plug shall be applicable only for test thermowells.

ANNEXURE – II B

(Hook Up Drawing)

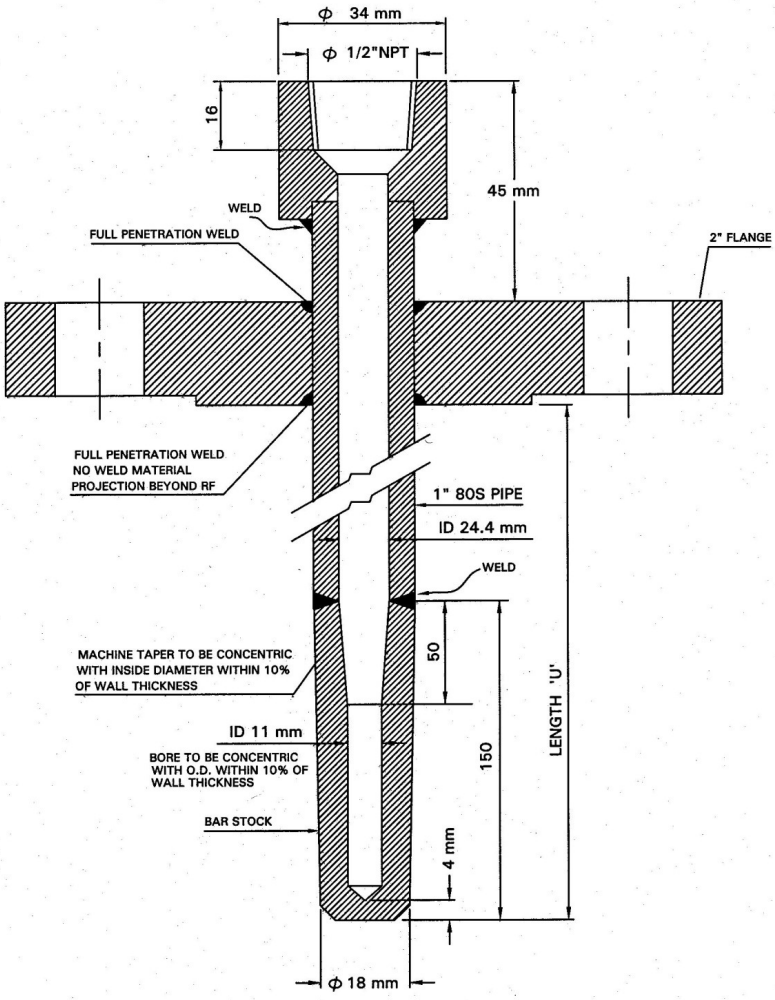


Note:

1) This standard is applicable for:
   (a) Single Temperature element
   (b) Thermowell upto 1500# ANSI Rating or equivalent
2) Type shall be RTJ type for ANSI rating >= 600#
3) DP Test shall be carried out for all weld joints.
4) Chain and plug shall be applicable only for test thermowells.

ANNEXURE – II C

(Hook Up Drawing)



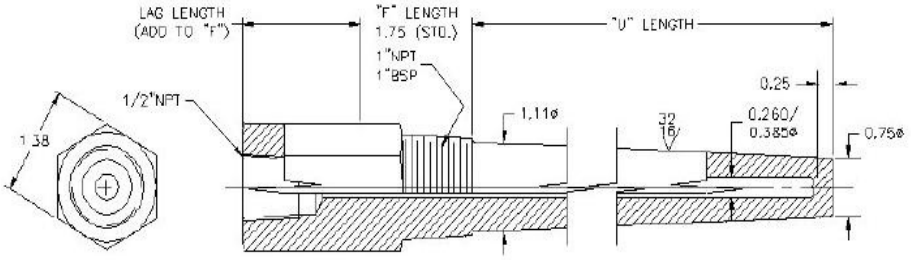
Note:

1) DP Test shall be carried out for all weld joints.
2) Type shall be RTJ type for ANSI rating >= 600#.

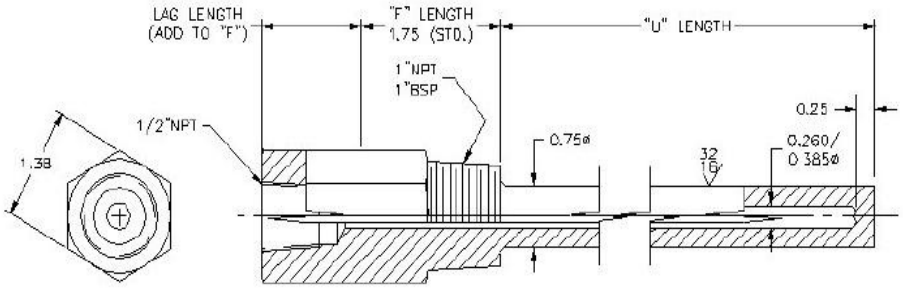
ANNEXURE – II D

HEXAGONAL HEAD THREADED TYPE

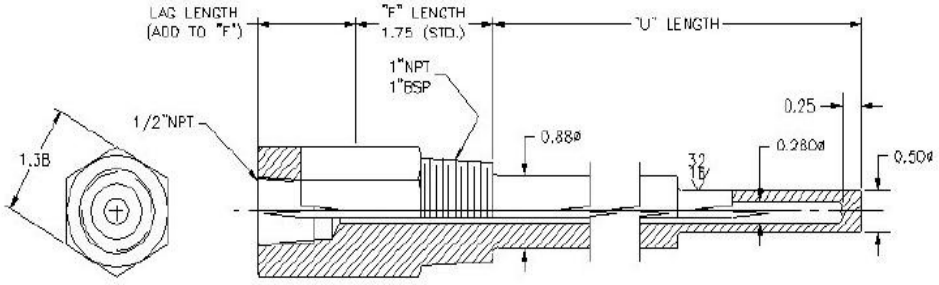
T Tapered Design



S Straight Design



P Stepped Design



"F" Length= Wrench and Thread Allowance
"U" Length= Immersion length into process

ANNEXURE – III Typical Data Sheet for Temperature Gauge

TEMPERATURE GAUGE

Units : Flow → Liquid-M^3/Hr, Gas → Kg/Hr, Steam → Kg/Hr, Pressure → Kg/Cm^2 G, Temperature → Deg C, Level/ Length → mm

1	Type :- Bimetal : Filled : Other :		FILLED SYSTEM		
2	Well :- Required : Not required :		14	SAMA Class :	
3	Mounting :- Local : Surface : Flush :			Compensation : Case :	Full :
4	Dial Size :- 150 mm : Other :		15	Bulb type :	
5	Colour :- White : With Black letters:			Bulb Material :	
6	Case Material :- : Other :		16	Bulb Union Threaded To :	1/2" NPT(M) : Other :
7	Window Material :- Glass : Acrylic : Other :		17	Extension Type :- Rigid : Bendable: Angle :	
8	Conn. Location :- Back : Bottom : Back Adjustable : All Angles Adjustable :		18	Bulb Dia :- Mfr. Std. : To suit well : Other :	
			19	Capillary Material :	
9	Accuracy :			Armour Flexible :	
10	Enclosure :			Armour Material :	
	Enclosure Class :		20	Capillary Length :	
11	Zero adj. : -			Over range Protection :-	

BIMETAL				**THERMOWELL**		
12	Stem :			21	Material :	Other :
	Type :	Adj. Union :	Threaded :	22	Construction :	Driller bar Stock / Built up :
	Material :					Other :
	Other :			23	Process Connection :	11/2" flanged : / 1" NPT(M) :
13	Stem Dia :- Mfr. Std. : Other : To suit well :					Other :
				24	Gauge Connection	1/2" NPT(F) : / Other :

13(b)	Temperature Gauge	Make	25	Thermowell As Per Drawing. :
		Model		

Tag No.	Temp Deg C		Range Deg C	Well Dim Mm		Flange		Service	Options
	Nor	Max		U	T	Material	Rating, face/fin.		

NOTES :

1. Immersion lengths of thermo-wells on vessels to be confirmed by respective vessel vendors.

□ VENDOR'S SIGNATURE WITH SEAL