

TECHNICAL NOTES **(GENERAL SPECIFICATION)** **FOR** **SEAMLESS, ERW** **&** **EFSW PIPES**

	Prepared by	Checked by	Approved by
Signature			
Name/ Designation	A. K. Gupta, DGM(ES), PR Sajid Ansar, CMNM(M&I) S. K. Srivastava, SESM(MR) Devendra Kumar, SM(PDEC)	(A. K. Sarkar) DGM(M&I)	(C. S. Das) ED(M&I)
Date			

IOC/M&I/MECH/P/1/2011	Seamless ERW & ESW Pipes	Revision-4	Page 1 of 17
-----------------------	--------------------------	------------	--------------

1.0 GENERAL

1.1 All pipes and their dimensions, tolerances, chemical composition, physical properties, heat treatment, hydro-test and other testing and marking requirements shall conform to the latest codes and standards specified in the material description. This section contains certain additional & special requirements.

1.2 The offered pipes to various ASTM/ ASME standards shall also meet requirements of Metric unit system of relevant code e.g. ASTM A312 shall also meet requirements of ASTM A312M and ASME B36.10 shall also meet requirements of ASME B36.10M.

1.3 Testing:

1.3.1 Test reports shall be supplied for all mandatory tests as per the applicable material specification.

1.3.2 Material test certificates (physical property, chemical composition & heat treatment report) shall also be furnished for the pipes supplied. For alloy steel pipes Mill test certificate containing above information shall be furnished.

1.3.3 All C.S. pipes with wall thickness greater than 24.5 mm shall be impact tested. If welding is used in manufacture, impact test of Heat Affected Zone (HAZ) and weld material shall also be carried out. Testing shall be according to Para 323.3 of ASME B31.3.

1.3.4 Where the pipe material is specified as A312TP304/316L with suffix-RT the pipe shall be radiographed in accordance with A312 supplementary requirement S5.

1.3.5 Where the pipe material is specified as A312TP304/316L with suffix-'spot radiographed' the pipe shall be spot radiographed in accordance with requirement of ASME B31.3 para 341.5.1.

1.3.6 Pipes with a positive quality tolerance of maximum one random length shall be acceptable (no tolerance on negative side).

1.3.7 PMI test: Positive material specification to be performed at vendors works on alloy steel pipes and clad pipes. The extent of PMI examination as follows:

- 100% (for pipes procured from traders).
- 2 random samples drawn from each size/ heat/ lot (for pipes procured directly from Mills).

a) For welded pipes PMI shall be performed on base metal as well as weldments.

IOC/M&I/MECH/P/1/2011	Seamless ERW & ESFW Pipes	Revision-4	Page 2 of 17
-----------------------	---------------------------	------------	--------------

- b) Whenever any sample drawn to PMI test on the basis of percentage selection fails to meet specification requirements, 100% of items of lot shall be tested for PMI.

1.3.8 For Hydrocarbon service, EFSW pipes confirming to ASTM A 672 shall be 100% radiograph.

1.4 Manufacturing processes:

1.4.1 Steel made by acid Bessemer process shall not be acceptable.

1.4.2 Spirally welded pipes below 24 inch shall not be acceptable.

1.5 Pipes shall be supplied in single or double random lengths of 4 to 7 and 7 to 14 meters respectively.

1.6 Welding joints:

1.6.1 Seamless and E.R.W pipes shall not have any circumferential seam joint in a random length. However, in case of E.FS.W pipe, in one random length one welded circumferential seam of same quality as longitudinal weld is permitted. This weld shall be at least 2.0 m from either end. The longitudinal seams of the two portions shall be staggered by 90° single random length in such cases shall be 5 to 7M.

1.7 Unless otherwise mentioned in the respective material code, E. FS. W /SAW pipes < 36" shall not have more than one longitudinal seam joint and E.FS.W/SAW pipes ≥ 36" shall not have more than two longitudinal seam joints.

1.8 Pipe with screwed ends shall have NPT external taper pipe threads conforming to ASME/ ANSI B1.20.1/ IS554 for 2" to 6" NB.

1.9 Pipe shall be bevelled in accordance with ANSI B16.25, except for nominal sizes NPS ≤ 1½" shall be cut square/ plain end & dimensions as per ANSI B 36.10. Weld contours shall be as follows:

Material	Wall thickness	Weld contour
Carbon steel (Except low temp. carbon steel)	Upto 22mm	Figure 2 Type A
	> 22mm	Figure 3 Type A
Alloy steel, stainless steel & low temperature carbon steel	Upto 10mm	Figure 4
	> 10mm & upto 25mm	Figure 5 Type A
	> 25mm	Figure 6 Type A

1.10 Galvanized pipes shall be coated with zinc by hot dip process conforming to ASTM A123/ IS 4736.

1.11 All austenitic stainless steel pipes shall be supplied in solution annealed condition. All types of 321 or 347 stainless steel pipes shall

IOC/M&I/MECH/P/1/2011	Seamless ERW & ESW Pipes	Revision-4	Page 3 of 17
-----------------------	--------------------------	------------	--------------

be in a stabilized heat-treated condition. Stabilizing heat treatment shall be carried out subsequent to the normal solution annealing. Soaking time & holding temperature for stabilizing heat treatment shall be 900°C & 4 hrs respectively.

- 1.12 All the seamless carbon steel pipes of size 1½” NPS and under shall be Cold-drawn/ hot finished. Carbon steel seamless pipes of size 2” & over shall be furnished hot finished. Seamless pipes cold-drawn from higher thickness pipes are not acceptable.

1.13 I.G.C Test for Stainless Steels:

- 1.13.1 For all austenitic stainless steel pipes inter-granular corrosion test shall have to be conducted as per following:

ASTM A262 Practice “B” with acceptance criteria of 60 mils/year(max.)

Or

ASTM A262 Practice “E” with acceptance criteria of “No cracks as observed from 20X Magnification” & “Microscopic structure to be observed from 250X magnification”.

- 1.13.2 When specifically asked for high temperature application for some grades of austenitic stainless steel (e.g. SS309, 310, 316, 316H etc) ASTM A262 Practice “C” with acceptance criteria of “15 mils/year (max.)” shall have to be conducted.

- 1.13.3 For the IGC test as described as above, two sets of samples shall be drawn from each solution annealing lot; one set corresponding to highest carbon content and the other set corresponding to the highest pipe thickness. When testing is conducted as per Practice ‘E’ photograph of microscopic structure shall be submitted for record.

- 1.14 All welded pipes indicated as ‘CRYO’ & ‘LT’ shall be impact tested as per requirement and acceptance criteria of ASME B31.3. The impact test temperature shall be –196C & -45C for stainless steel and carbon steel respectively unless specifically mentioned otherwise.

- 1.15 Specified heat treatment for carbon steel and alloy steel and solution annealing for stainless steel pipes shall be carried out after weld repairs. Number of weld repairs at the same spot shall be restricted to maximum two by approved repair procedure.

- 1.16 For black or galvanised pipes to IS 1239, the minimum percentage of elongation shall be 20%.

- 1.17 All 1Cr-0.5 Mo and 1.25 Cr-0.5Mo seamless pipes shall be normalized and tempered.

IOC/M&I/MECH/P/1/2011	Seamless ERW & ESW Pipes	Revision-4	Page 4 of 17
-----------------------	--------------------------	------------	--------------

- 1.18 For all weld Alloy steel pipes with mandatory requirement of heat treatment and radiography, radiography shall be performed after heat treatment.

2.0 PIPES IN HYDROGEN SERVICES:

- 2.1 All Carbon Steel pipes having wall thickness 9.53 mm (0.375") and above shall be normalized. Cold drawn pipes shall be normalized after the final cold draw pass for all thickness.
- 2.2 All alloy steel (Cr-Mo) pipes shall be normalized and tempered. The normalizing and tempering shall be a separate heating operation and not a part of the hot forming operation. The maximum room temperature tensile strength shall be 100,000 psi.
- 2.3 All carbon steel pipes having wall thickness 19 mm (0.75") and above shall be post weld heat-treated.
- 2.4 All alloy steel (Cr-Mo) pipes shall be post weld heat treated irrespective of type or thickness of weld.
- 2.5 All austenitic stainless steel grades shall be solution annealed after welding. 100% radiography of welded joints shall be done both before and after PWHT.
- 2.6 For carbon steel pipes hardness of weld and HAZ shall be 200 BHN (max.). For alloy steel pipes, hardness of weld and HAZ shall be 225 BHN (max.).
- 2.7 For all austenitic stainless steel, the weld deposit shall be checked for Ferrite Content (FN). A FN not less than 3% and not more than 10% is required to avoid sigma phase embrittlement during heat treatment. FN shall be determined by Ferrite-scope prior to post weld heat treatment (PWHT).
- 2.8 For all Carbon Steel (CS) and Alloy Steel (AS) pipes with wall thickness over 19 mm, Charpy V- notch impact testing shall be carried out in accordance with paragraph UG-84 of ASME Section VIII, Div 1 for weld metal and base metal from the thickest item per heat of material and per heat treating batch. Impact test specimen shall be in complete heat treated condition and accordance with ASTM A 370. Impact energies at 0°C shall average greater than 27 J (20 ft-lb) per set of 3 specimen, with a minimum 19 J (15 ft-lb).
- 2.9 If welding is used in manufacture, impact test of Heat Affected Zone (HAZ) and weld metal shall also be carried out.

3.0 NACE CARBON STEEL PIPES:

IOC/M&I/MECH/P/1/2011	Seamless ERW & ESW Pipes	Revision-4	Page 5 of 17
-----------------------	--------------------------	------------	--------------

- 3.1 Pipes under this category shall meet the requirements given in NACE MR-0103-2007.
- 3.2 Steel must be fully killed carbon steel type and must have been produced by Vacuum Degassing process.
- 3.3 Steel shall be calcium treated for inclusion morphology control.
- 3.4 Ultimate strength of the steel shall be limited to maximum of 80,000 PSI. The yield versus UT strength shall be limited to maximum of 0.80.
- 3.5 Carbon equivalent in all CS material shall be calculated per the formula given below.

$$CE = C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15$$

- 3.6 The longitudinal seam of welded pipes shall be subjected to 100% radiography.
- 3.7 Only following American Specifications, as specified against each product are permitted:

ASTM A 106 Gr. B/API 5L GR-B Seamless
 API 5L Gr. B, SAW (LONGITUDINAL)
 ASTM A 333 GR 1 & 6 SEAMLESS

3.8 Chemistry Control

The chemical analysis shall be carried out on heat as well as on product as per relevant product material specifications and shall meet the requirements of Table-1.

SPECIFICATION			
	ASTM A 106 Gr.B/ API 5L Gr.B (Seamless)	API5L Gr. B (SAW)	ASTM A 333 GR 1 & 6
C	0.20% max.	0.20% max.	0.20% max
S	0.02% max.	0.003% max.	0.02% max
P	0.03% max.	0.02% max.	0.025% max
Ni	0.4 % max.	0.2 % max.	-
CE	0.42 max.	0.40 max.	0.42 max

- 3.9 Mechanical tests shall be as per specified material specification.

3.10 Hardness

- 3.10.1 Maximum hardness shall be limited to 200 BHN at all places including the weldments and measurement shall be as per ASTM E-18 or ASTM E-92 respectively.

IOC/M&I/MECH/P/1/2011	Seamless ERW & ESFW Pipes	Revision-4	Page 6 of 17
-----------------------	---------------------------	------------	--------------

3.10.2 Hardness test shall be conducted on a sample of each heat and on each finished product. Waiver may be given only for those products, which can get damaged due to hardness test. For small products which cannot be hardness tested individually, the manufacturer shall conduct test on a random basis by selecting components from production run or stores batches to ensure that the products complies fully with hardness requirements. The products for which hardness values are found in excess of specified value shall be rejected. If the hardness on the sample of a heat is more than the acceptable value, then the entire raw material from the heat shall be rejected.

3.10.3 For SS 316 material Moly% shall be 2.3% minimum.

4.0 IBR PIPES

4.1 Pipes under purview of IBR shall be accompanied with IBR certificate original in Form IIIA, duly approved and countersigned by IBR authority/ local authority/ manufacturer empowered by the central boiler board of India and issue inspection certificate in form-IIID. Photocopy of the original certificate duly attested by the local boiler inspector where the supplier is located is the minimum requirement for acceptance.

4.2 For materials 1¼ Cr- ½ Mo (ASTM A335 Gr. P11/ A691 Gr. 1¼ Cr) & 2¼ Cr - 1Mo (ASTM A335 Gr. P22/ A691 Gr. 2¼ Cr), Form III-A approved by IBR shall include the tabulation of E_t , S_c & S_r values for the entire temperature range given below. E_t , S_c & S_r values shall be such that throughout the temperature range

$$\begin{array}{l} E_t / 1.5 \geq \\ S_r / 1.5 \geq \\ S_c \geq \end{array} \quad \left| \quad S_A \right.$$

Where,

S_A : Allowable stress at the working metal temperature (As per latest addition of ASME B-31.3)

E_t : Yield pint (0.2% proof stress at the working metal temperature)

S_c : The average stress to produce elongation of 1%(creep) in 100000 hrs at the working metal temperature.

S_r : The average stress to produce rupture in 100000 hrs at the working metal temperature and in no case more than 1.33 times the lowest stress to produce rupture at this temperature.

4.3 For carbon steal pipes under IBR the chemical composition shall conform to the following:

Carbon (max)	:	0.25%
Others (S, P, Mn)	:	As prescribed in IBR regulation.

The chemical composition as indicated in this clause is not applicable

IOC/M&I/MECH/P/1/2011	Seamless ERW & ESW Pipes	Revision-4	Page 7 of 17
-----------------------	--------------------------	------------	--------------

for pipes other than IBR services.

4.4 No other third party inspection is required.

5.0 HYDROSTATIC TEST

- Irrespective of requirement specified in code all pipes shall be hydrostatically tested.
- The testing of A106, A333, A335, A358 & A672 shall be as per A530. A312 & A268 shall be as per A999.
- API5L shall be as per API5L.

5.1 Hydro-testing of pipes (at least one from each batch) shall be witnessed by TPI at vendor's shop. Hydro-testing of SS pipes shall be done with potable water with max. chloride content 250 ppmw (as per NACE RP-0170) where draining of test fluid is possible.

5.2 Calculation to establish hydro-test pressure shall be performed by vendor in accordance with the standards. Checking of calculation and witnessing of hydro-testing shall be performed by TPI agency.

6.0 SCOPE OF INSPECTION BY THIRD PARTY INSPECTION AGENCY

6.1 The scope of inspection shall be read with item description, codes stipulated in purchase requisition, requirement of test and inspection as per this technical specification.

6.2 Test to be witnessed:

- i) Testing for physical properties.
- ii) Visual Inspection & Dimensional check
 - a) 10% random basis for each heat. Minimum one length in case of pipe is procured from manufacture.
 - b) 100% in case the pipe is procured from stockiest/ traders.
- iii) Hydrostatic test
 - a) 10% random basis for each heat. Minimum one length in case the pipe is procured from manufacture.
 - b) 100% in case the pipe is procured from stockiest / traders.

6.3 Review of documents:

- i) Mill test certificate of raw materials.
- ii) Material identification reports.
- iii) Radiographs (if required).
- iv) Heat treatments (if required).
- v) Material composition as per NACE (if required).
- vi) Manufacturer's test certificate.
- vii) Hydro-test 100%
- viii) Supplementary test as required.

IOC/M&I/MECH/P/1/2011	Seamless ERW & ESFW Pipes	Revision-4	Page 8 of 17
-----------------------	---------------------------	------------	--------------

- ix) Manufacturer's test certificates for 100% visual & dimension check in case of manufacturer.
- 6.4 Third party inspection release note shall contain the information on test witnessed, documents reviewed, observations/ remarks, identifications, order status and date(s) of inspection. The original certificate shall be furnished with supply of material.
- 6.5 Third party inspector shall stamp each length of pipe based on the same performed by the manufacturer and shall mention the same in the inspection release note. For small bore i.e. 1½" and below, stamping on the bundle of pipes instead of each length may be considered.
- 6.6 The inspection and test plan for traders and manufacturer is enclosed as Annexure-I & II.

7.0 SPECIAL REQUIREMENT

- 7.1 Applicable in case bidder is not the manufacturer of the quoted pipe.
 - 7.1.1 If trader (vendor) directly supplies the pipes, inspection at its go-down/ stockyard shall be carried out by TPI as per the requirements of this provision specified earlier & hereunder.
 - a) TPI shall check the source of pipes. The pipes must be supplied by the manufacturers, which are enlisted in the approved list of M/s. EIL and certificate in this regard issued by M/s. EIL is to be presented to TPI. TPI shall go ahead with inspection only after being satisfied with the certificate and the certificate should be the part of inspection release note issued by TPI.
 - b) Any reputed national or international inspection agency should have inspected at the works of the pipe manufacturer all those pipes that are presented to TPI for certification at trader's stockyard. TPI shall first ensure availability of original certificate, issued by the reputed national or international inspection agency in the name of first customer, and shall correlate the same with the stamp-marks that pipes shall bear.
 - c) TPI shall endorse on the original certificate, which shall form part of his inspection report. In case original certificate cannot be surrendered by trader, TPI shall endorse on a photocopy of the original certificate and enclose the same with his report.

IOC/M&I/MECH/P/1/2011	Seamless ERW & ESFW Pipes	Revision-4	Page 9 of 17
-----------------------	---------------------------	------------	--------------

- d) Of each size of the finished pipe, the trader in presence of TPI shall draw one sample from each lot of 100 lengths (a lot shall consist of pipes of the same size and wall thickness and the identical heat of steel), and shall send to the TPI-approved test house for conduction of the following tests to the conformity of the relevant standard(s):
- i. Tensile test – for all MOC
 - ii. Product analysis – for all MOC
 - iii. Flattening test or bend test – for all MOC
 - iv. Hardness test – for NACE only
 - v. Impact test – for LTCS only
 - vi. IGC test – for SS only.
 - vii. PMI – for AS and SS only (carried out on every length of pipe).

In no case, however, shall the number of samples drawn for a size, having same wall thickness, be less than two.

- e) TPI shall witness/ review the test-results and endorse the certificates of the test house towards the conformity of the results to the standard.
- f) TPI shall thereafter stamp the pipes and issue inspection release note.
- g) The trader shall bear the cost for samples, tests and other incidental expenses, and shall include all such costs in the quoted rates of the pipes.
- h) The vendor shall be liable to furnish the Inspection Documents, in the specified form, along with the Dispatch Document without which the Purchaser shall not consider the material to have been delivered by the vendor. In other words, the material without proper inspection documents, shall not be considered delivered as per the interpretations of the contract, as the material cannot be used in execution even though they are physically available with the purchaser.

8.0 TECHNICAL SPECIFICATION AND SCOPE OF INSPECTION OF CLADDED PIPE

- 8.1 Acceptable method of fabrication of cladded pipe to be seamless or centrifugally cast CRA. The cladding should have metallurgical bond, mechanical bond will not be accepted.
- 8.2 Acceptable base material is A515 Gr 65 and 516 Gr 60/65/70 will be considered as equivalent.

IOC/M&I/MECH/P/1/2011	Seamless ERW & ESW Pipes	Revision-4	Page 10 of 17
-----------------------	--------------------------	------------	---------------

- 8.3 TPI to review material test certificates for chemical composition, tensile, guided bend and flattening test as per API 5LD.
- 8.4 Molybdenum in the cladding to be minimum 2.5%.
- 8.5 Diameter of the pipe to be measured and variation to be within 0.75%. TPI to review the same.
- 8.6 Minimum thickness tolerance for pipe thickness to be-12.5%.
- 8.7 Intergranular corrosion test to be carried out as per API 5LD and result reviewed by TPI.
- 8.8 Hydro-test to be done as per $S = 2\sigma_t/d$, limited to 3000 PSI and result to be witnessed by TPI.
- 8.9 Thickness of the cladding to be minimum 2.5mm, to be witnessed by TPI.
- 8.10 Pipe to be ultrasonically tested as per ASTM 578 level and results to be reviewed by TPI for acceptance.
- 8.11 PMI to be carried out and witnessed by TPI at least at both the ends at 180° apart.
- 8.12 Pipe to checked visually and to be free from any visible defects, scales, dents, marks etc and to be straight. TPI to witness.

9.0 MARKING & DESPATCH

- 9.1 All pipes shall be marked in accordance with the applicable codes, standards & specifications. In addition IOCL item code & special condition like “IBR”, “CRYO”, “NACE”, “H2” etc shall also be marked.
- 9.2 Pipes under “IBR”, “CRYO”, “NACE”, “H2” shall be painted in red strips, light purple brown stripes, canary yellow & sea green stripes respectively longitudinally throughout the length (25mm width) for easy identification. Marking of pipes circumferentially for sizes 1” and below at one metre interval along the length of pipes is also acceptable.
- 9.3 Paint or ink for marking shall not contain any harmful metal or metallic salts such as zinc, lead or copper which cause corrosive attack on heating.
- 9.4 Pipe shall be dry, clean and free from moisture, dirt, and loose foreign materials of any kind.
- 9.5 Pipes shall be protected from rust & corrosion.

IOC/M&I/MECH/P/1/2011	Seamless ERW & ESW Pipes	Revision-4	Page 11 of 17
-----------------------	--------------------------	------------	---------------

- 9.6 Rust preventive shall be applied. These when used on machined surfaces to be welded shall be easily removable with a petroleum solvent and the same shall not be harmful to welding.
- 9.7 Both ends of the pipe shall be protected with the following material:
- | | | |
|--------------|---|-------------------------------|
| Plain end | : | Plastic cap |
| Bevel end | : | Wood, Metal or plastic cover |
| Threaded end | : | Metal or plastic threaded cap |
- 9.8 Pipes may be provided with plastic pushfit type end caps/ steel caps without belt wire.
- 9.9 Steel end protectors to be used on galvanized pipes shall be galvanized. Plastic caps can also be used as end protectors for galvanized pipe ends.
- 9.10 All alloy materials tested by PMI shall be identified using either of the following methods by indicating "PMI OK"
- a) Bar Code/ Hologram Sticker
 - b) A low stress stamp marking

Annexure-I

		INDIAN OIL CORPORATION LTD.				INSPECTION AND TEST PLAN FOR PIPES (FOR MANUFACTURER)			SPECIFICATION		Rev.
											0
Applicable codes and specifications : ASTM/P.O Technical specification/ Pipe Specification Sheet									Scope of inspection		
Sl. No.	Stage	Component	Characteristics	Method of Check	Quantum of check	Reference Documents	Acceptance Norms	Records	Sub-Vendor	Vendor	TPI
1a	Raw material inspection	Bullet/ Mother hollow	Marking and correlation with TC	Review of records & visual	100%	Purchase requisition/ ASTM-STD/ P.O Technical Specification	Purchase requisition/ ASTM-STD/ P.O Technical Specification	Inspection report		R	
1b	Raw material inspection	Bullet/ Mother hollow	Chemical composition	Spectro	One sample per heat	Purchase requisition/ ASTM-STD/ P.O Technical Specification	Purchase requisition/ ASTM-STD/ P.O Technical Specification	Inspection report		R	
1c	Raw material inspection	Bullet/ Mother hollow	Internal soundness	Macro-etching	One sample per heat	Internal standard	Internal standard	Inspection report		R	
2	Pipe rolling heating, Hot rolling Straightening	Pipe	Process controls	As per internal QA plan	As per internal QA plan	Purchase requisition/ ASTM-STD/ P.O Technical Specification	Internal standard	Inspection report		W	
3	Heat treatment (if applicable)	Pipe	HT cycle (Time & temperature)	Furnace recorder	100%	Purchase requisition/ ASTM-STD/ P.O Technical Specification	Purchase requisition/ ASTM-STD/ P.O Technical Specification	Inspection report		W	R
4	Non destructive testing (if applicable)	Pipe	Surface & internal imperfections	UT, Eddy current, MPI or other specified	Purchase requisition/ ASTM-STD/ P.O Technical Specification	Purchase requisition/ ASTM-STD/ P.O Technical Specification	Purchase requisition/ ASTM-STD/ P.O Technical Specification	Inspection report, General record		W	R
5	Destructive testing (Note special impact hardness	Pipe	Chemical & Mechanical properties	Chemical tensile flattening bend,	Each HT lot/ each heat no/ size	Purchase requisition/ ASTM-STD/ P.O Technical	Purchase requisition/ ASTM-STD/ P.O Technical Specification	Lab report		W	H

IOC/M&I/MECH/P/1/2011	Seamless ERW & ESFW Pipes	Revision-4	Page 13 of 17
-----------------------	---------------------------	------------	---------------

	requirements for H ₂ service)			hardness impact		Specification					
6	Destructive Testing (For SS materials)	Pipe	Corrosion properties	IGC test	Highest thickness & highest carbon/ HT lot	Purchase requisition/ ASTM-STD/ P.O Technical Specification	Purchase requisition/ ASTM-STD/ P.O Technical Specification	Lab report		W	H
7	Hydrotesting	Pipe	Leak check	Visual	100% vendor by random by TPI	Purchase requisition/ ASTM-STD/ P.O Technical Specification	Purchase requisition/ ASTM-STD/ P.O Technical Specification	Inspection report, Hydro-graph		W	H
8	Final inspection	Pipe	Surface condition, straightness, End finish Bevel angle, Root face. Outer dia, Thickness Length, End finish, Coating, marking Colour coding, End caps.	Visual dimensional	100%	Purchase requisition/ ASTM-STD/ P.O Technical Specification	Purchase requisition/ ASTM-STD/ P.O Technical Specification	Inspection report		W	H
9	Weight checking	Pipe	Weight	Weight scale	100%	Purchase requisition/ ASTM-STD/ P.O Technical Specification	Purchase requisition/ ASTM-STD/ P.O Technical Specification	Inspection report		W	
10	Final inspection	Pipe	PMI check	X-ray Florescence/ Spectrometer	Purchase requisition/ ASTM-STD/ P.O Technical Specification	Purchase requisition/ ASTM-STD/ P.O Technical Specification	Purchase requisition/ ASTM-STD/ P.O Technical Specification	Inspection report		W	H

Legends: H- Hold(offer for witness & obtain clearance), W- Witness, R- Review, A- Approval, I- Information, X- submit PO-Purchase order, PR- Purchase Requisition

All the NDT/ Leak testing/ Heat treatment/ Special manufacturing procedures have to be specially approved or only previously approved procedures have to be used. In case of conflict between purchase specification, contract documents and QAP more stringent conditions shall be applicable. This document describes generally the requirements pertaining to all types of pipes. Requirements specific to the item are only applicable.

IOC/M&I/MECH/P/1/2011	Seamless ERW & ESFW Pipes	Revision-4	Page 14 of 17
-----------------------	---------------------------	------------	---------------

Annexure-II

		INDIAN OIL CORPORATION LTD.	Inspection and test plan for pipes (for Traders)			Specification	Rev
							0
Applicable codes and specifications: ASTM/ P.O Technical Specification/ Pipe Specification Sheet						SCOPE OF INSPECTION	
A. Review of manufacturer material test certificates and TPI certificates issued to manufacturer.							
Sl. No.	Type	Characteristics	Reference documents	Acceptance norms	Record	Trader	TPI (IOCL Representative)
1	Material testing	Chemical Composition	Purchase requisition/ ASTM-STD/P.O Technical specification	Purchase requisition/ ASTM-STD/P.O Technical specification	TPI certificates of materials at the manufacturer works	R	R & Endorse
2	Heat treatment (if applicable)	HT cycle (Time & temperature)	Purchase requisition/ ASTM-STD/P.O Technical specification	Purchase requisition/ ASTM-STD/P.O Technical specification	TPI certificates of materials at the manufacturer works	R	R & Endorse
3	Non destructive testing (if applicable)	Surface & internal imperfections	Purchase requisition/ ASTM-STD/P.O Technical specification	Purchase requisition/ ASTM-STD/P.O Technical specification	TPI certificates of materials at the manufacturer works	R	R & Endorse
4	Destructive Testing (Note special impact hardness requirements for H ₂ service	Chemical & Mechanical properties	Purchase requisition/ ASTM-STD/P.O Technical specification	Purchase requisition/ ASTM-STD/P.O Technical specification	TPI certificates of materials at the manufacturer works	R	R & Endorse
5	Destructive testing (for SS materials)	Corrosion properties	Purchase requisition/ ASTM-STD/P.O Technical specification	Purchase requisition/ ASTM-STD/P.O Technical specification	TPI certificates of materials at the manufacturer works	R	R & Endorse
6	Final inspection	Hydro-testing surface condition, dimension checking straightness, End finish. PMI check	Purchase requisition/ ASTM-STD/P.O Technical specification	Purchase requisition/ ASTM-STD/P.O Technical specification	TPI certificates of materials at the manufacturer works	R	R & Endorse

Legend: H- Hold (Offer for witness & obtain clearance), W- Witness, R- Review, A- Approval, I- Information, X- Submit, PO- Purchase Order, PR- Purchase Requisition.

IOC/M&I/MECH/P/1/2011	Seamless ERW & ESFW Pipes	Revision-4	Page 15 of 17
-----------------------	---------------------------	------------	---------------

		INDIAN OIL CORPORATION LTD.		Inspection and test plan for pipes (for Traders)			Specification	Rev	
								0	
Applicable codes and specifications: ASTM/ P.O Technical Specification/ Pipe Specification Sheet								SCOPE OF INSPECTION	
B. Review of manufacturer material test certificates and TPI certificates issued to manufacturer.									
Sl. No.	Type	Characteristics	Quantum of check	Reference documents	Acceptance norms	Record	Trader	TPI (IOCL Representative)	
1	Tensile test	Mechanical properties	One sample from each lot of 100 length having same size, thickness, material & heat	Purchase Requisition/ ASTM-STD/ P.O Technical specification	Purchase requisition/ ASTM-STD/P.O Technical specification	Testing results of TPI-approved test house	W	Sample drawing-W Test results-R	
2	Product Analysis	Chemical Properties	One sample from each lot of 100 length having same size, thickness, material & heat	Purchase Requisition/ ASTM-STD/ P.O Technical specification	Purchase requisition/ ASTM-STD/P.O Technical specification	Testing results of TPI-approved test house	W	Sample drawing-W Test results-R	
3	Flattening test or Bend test	Mechanical properties	One sample from each lot of 100 length having same size, thickness, material & heat	Purchase Requisition/ ASTM-STD/ P.O Technical specification	Purchase requisition/ ASTM-STD/P.O Technical specification	Testing results of TPI-approved test house	W	Sample drawing-W Test results-R	
4	Hardness Test	Mechanical properties	One sample from each lot of 100 length having same size, thickness, material & heat	Purchase Requisition/ ASTM-STD/ P.O Technical specification	Purchase requisition/ ASTM-STD/P.O Technical specification	Testing results of TPI-approved test house	W	Sample drawing-W Test results-R	
5	Impact test – for LTCS and H2 Service	Mechanical properties	One sample from each lot of 100 length having same size, thickness, material & heat	Purchase Requisition/ ASTM-STD/ P.O Technical specification	Purchase requisition/ ASTM-STD/P.O Technical specification	Testing results of TPI-approved test house	W	Sample drawing-W Test results-R	
6	IGC Test – for SS only	Corrosion Properties	One sample from each lot of 100 length having same size, thickness, material & heat	Purchase Requisition/ ASTM-STD/ P.O Technical specification	Purchase requisition/ ASTM-STD/P.O Technical specification	Testing results of TPI-approved test house	W	Sample drawing-W Test results-R	

IOC/M&I/MECH/P/1/2011	Seamless ERW & ESFW Pipes	Revision-4	Page 16 of 17
-----------------------	---------------------------	------------	---------------

7	Inspection - for AS & SS only	PMI Check	To be carried out on every length of pipe	Purchase Requisition/ ASTM-STD/ P.O Technical specification	Purchase requisition/ ASTM-STD/P.O Technical specification	Inspection Report	W	H
8	Final Inspection	Dimensional checking & Hydrotesting	100% for each type and size	Purchase Requisition/ ASTM-STD/ P.O Technical specification	Purchase requisition/ ASTM-STD/P.O Technical specification	Inspection Report	W	H
9	TPI Clearance	Stamping & Inspection release note	100%	---	---	Inspection Report	W	H

General Notes:

1. This is an indicative inspection and test plan for pipes. However, vendor has to develop their own inspection & test plan that will includes all the above and special requirement specific to the pipes, if any, and submit the same for approval after P.O placement.

All the NDT/ Leak testing/ Heat treatment/ Special manufacturing procedures have to be specially approved or only previously approved procedures have to be used. In case of conflict between purchase specification, contract documents and QAP more stringent conditions shall be applicable. This document describes generally the requirements pertaining to all types of pipes. Requirements specific to the item are only applicable.

TECHNICAL NOTES **(GENERAL SPECIFICATION)** **FOR** **BUTT WELDED, SOCKET** **WELDED AND SCREWED** **FITTINGS**

	Prepared by	Checked by	Approved by
Signature			
Name/ Designation	A. K. Gupta, DGM(ES), PR Sajid Ansar, CMNM(M&I) S. K. Srivastava, SESM(MR) Devendra Kumar, SM(PDEC)	(A. K. Sarkar) DGM(M&I)	(C. S. Das) ED(M&I)
Date			

TECHNICAL NOTES FOR BUTT WELDED, SOCKET WELDED AND SCREWED FITTINGS

1.0 GENERAL

- 1.1 Chemical composition, physical properties, tests, dimensions and tolerances, heat treatment and marking shall conform to the applicable latest codes / standards / specifications as specified. For any special requirement please refer material requisition sheet.
- 1.2 The offered fittings to various ASTM standards shall also meet requirements of Metric unit system of relevant code e.g. ASTM A234 shall also meet requirements of ASTM A234M.
- 1.3 Nipples made of seamless pipes of corresponding metallurgy shall also be acceptable as alternative to forged nipples.
- 1.4 Dimensions of all Butt Weld Fittings shall be maintained per the requirements of ANSI B 16.9/ ANSI B 16.28 latest edition. Dimensions of steel BW fittings for sizes not covered in ANSI B16.9/ ANSI B16.28 shall confirm to MSS-SP-48. The Butt Weld ends shall be prepared and finished in line with the requirements of ANSI B 16.25. Socket weld and threads for screwed fittings shall be in accordance with ANSI B16.11 and ANSI B1.20.1 respectively, unless otherwise specified.
- 1.5 All the Reducers, seamless as well as welded, concentric as well as eccentric, shall have knuckles and straight flanges at both the ends. Straight cone type reducers shall not be acceptable.

2.0 TESTING

- 2.1.1 Test reports shall be supplied for all mandatory tests as per the material specifications/ applicable code/ standards. Test reports shall also be furnished for any supplementary tests as specified. Material test certificates (physical properties, chemical composition & heat treatment report) shall also be furnished for fittings supplied. For alloy steel fittings Mill test certificate containing above information shall be furnished.
- 2.1.2 PMI test : Positive material identification test to be performed at vendors works on alloy steel fittings/ stainless steel and clad fittings. The extent of PMI examination will be 100%.
 - a) For welded fittings PMI shall be performed on base metal as well as weldments.
 - b) Whenever any sample drawn to PMI test on the basis of percentage selection fails to meet specification requirements, 100% of items of lot shall be tested for PMI.

IOC/M&I/MECH/P/2/ 2011	Butt Welded, Socket Welded and Screwed Fittings	Rev.-01	Page 2 of 10
------------------------	---	---------	--------------

- 2.2 All fittings shall be seamless in construction unless otherwise specified. If fittings are specified as welded, the same shall conform to clause 1.8. Seamless fittings are acceptable in place of welded fittings, however, welded fittings are not acceptable in place of seamless fittings.
- 2.3 Outside diameters and wall thickness (unless otherwise mentioned) of butt welded fittings shall be in accordance with ASME B36.10 and ASME B36.19 as applicable.
- 2.4 For reducing butt weld fittings having different wall thicknesses at each end, the greater wall thickness of the fitting shall be employed and inside bore at each end shall be matched with the specified inside diameter.
- 2.5 Beveled ends for all fittings shall conform to ASME B16.25. Contour of bevel shall be as follows:

Material	Wall Thickness	Weld Contour
Carbon steel (except low temperature carbon steel)	Upto 22 mm	Figure 2 Type A
	> 22 mm	Figure 3 Type A
Alloy steel, stainless steel and low temperature carbon steel	Upto 10 mm	Figure 4
	> 10 mm & upto 25 mm	Figure 5 Type A
	> 25 mm	Figure 6 Type A

2.6 Welded Fittings

- 2.6.1 All welded fittings shall be double welded. Inside weld projection shall not exceed 1.6 mm. Welds shall be ground smooth at least 25 mm from the ends.
- 2.6.2 For fittings made out of welded pipe, the welded pipe itself shall be double welded and shall be manufactured with the addition of filler metal.
- 2.6.3 Welded tees shall not be of fabricated (stub-in) type.
- 2.6.4 All welded fittings shall be normalized & all weld joints including parent material weld shall be 100% radiographed by X-ray by fittings manufacturer.
- 2.6.5 Welded pipes employed for manufacture of fittings shall be made by automatic welding only.
- 2.6.6 Specified heat treatment for carbon steel & alloy steel fittings shall be carried out again after weld repairs.
- 2.6.7 Irrespective of the material code requirement, all welded fittings indicated in specification as "Cryo" & "LT" shall meet impact test

requirements of ASME B31.3. The impact test temperature shall be (–) 196°C & (–) 45°C for stainless steel & carbon steel respectively unless specifically mentioned otherwise in the SPECIFICATION.

2.7 Welded fittings formed out of plate

- 2.7.1 The welded fittings (elbows, tees reducers) shall be manufactured in two-half construction; each half formed out of plate, followed by longitudinal weld on sides.
- 2.7.2 Steel plates used for production of welded fittings shall be normalized and ultrasonically examined as per the relevant codes/ standards.
- 2.7.3 The supplementary requirements S1 and S2 of A234/ A420 shall be fulfilled.
- 2.7.4 All welded fittings shall have maximum negative tolerance of 0.3mm.

2.8 Stainless Steel Fittings

- 2.8.1 All austenitic stainless steel fittings shall be pickled & passivated.
- 2.8.2 All stainless steel fittings shall be supplied in solution heat-treated condition.
- 2.8.3 Solution annealing for stainless steel fittings shall be carried out again after weld repairs.
- 2.8.4 For all stainless steel fittings Inter Granular Corrosion (IGC) test shall have to be conducted as per the following:

ASTM A262 Practice “B” with acceptance criteria of “60” mils/year (max.)”.

Or

ASTM A262 Practice “E” with acceptance criteria of “no cracks as observed from 20X magnification” & “microscopic structure to be observed from 250X magnification”.

- 2.8.5 When specifically asked for in specification for high temperature application of some grades of austenitic stainless steel (e.g. SS309, 310, 316, 316H etc.) ASTM A262 Practice “C” with acceptance criteria of “15 mils/year” shall have to be conducted.
- 2.8.6 For the IGC test as described in clauses as above, two sets of samples shall be drawn from each solution treatment lot, one set corresponding to the highest carbon content and other set to the highest fitting thickness. When testing is conducted as per ASTM A262 Practice “E”, photograph of microscopic structure shall be submitted for record.

- 2.9 Thickness/ schedule lower or higher than specified for the finished product shall not be accepted.

For manufacturing of elbows from pipes, same size of pipe as that of elbow shall be used and the normal wall thickness of the starting pipes shall have positive tolerance only. However, where the manufacturer has an established automatic/ semi-automatic process for the manufacturer of elbows, the starting pipe may be permitted to be of lower size with higher schedule as required. Starting pipe of higher size than that of the elbow shall not be permitted.

- 2.10 The gasket contact surfaces of stub ends shall be flat with face finish specified in the requisition. Interpretation on the specified face finish is as follows:

125 AARH : Serrations with 125 to 250 μ in AARH

- 2.11 Seamless stub ends shall not have any welds on the body. Stub ends shall be of long pattern type unless specified otherwise in the specification.
- 2.12 Galvanized fittings shall be coated with zinc by hot dip process conforming to ASTM A123 / IS4736. It is to be noted that ASTM A123 refers to ASTM 153 for galvanizing of threaded components. Hence, threaded galvanized fittings shall be coated with zinc by hot dip process conforming to ASTM A153.
- 2.13 Threaded ends shall have NPT taper threads in accordance with ASME/ ANSI B1.20.1 upto 1.5" NB & IS 554 from 2" to 6" NB.
- 2.14 Unless and otherwise specified in the specification, all socket welded and screwed fittings shall be in accordance with ASME B16.11 and ANSI B1.20.1 to the extent covered in the specification except for unions which shall be in accordance with MSS-SP-83.
- 2.15 Special fittings like nipplet, elbowlet, latrolet, bosset, sweep-o-let etc. which are not covered in ASME, MSS-SP standards shall be as per manufacturer's std. Contour of these fittings shall meet the requirements of ASME B31.3. Manufacturer shall submit drawings/ catalogues of these items along with the offer.
- 2.16 All swages shall be of seamless construction.
- 2.17 Nipplet length shall be 165 mm unless specified otherwise in the specification.
- 2.18 Length of all long half couplings shall be 100 mm unless otherwise specified in the SPECIFICATION.

- 2.19 All seamless & welded pipes employed for manufacturing of fittings shall be required to have undergone hydrotest. The testing of A53, A106, A333, A335, A358 and A672 shall be as per A530. A312, A268 as per A999. API5L shall be as per API5L. ASTM B series pipes e.g. B165, B167 shall be as per respective ASTM standard IS 3589, IS 1239 and others shall be as per respective IS Standards.
- 2.20 The bevel ends of all butt weld fittings shall undergo 100% MP/ DP test.
- 2.21 Abbreviations for ends of swages and nipples shall be as follows:
- | | | |
|-----|---|--------------------|
| PBE | : | Plain Both Ends |
| TBE | : | Threaded Both Ends |
| TOE | : | Threaded One End |
| TSE | : | Threaded Small End |
| TLE | : | Threaded Large End |
- 2.22 All types of SS321, SS347 or SS348 fittings shall be in stabilized heat treated condition. Stabilizing heat treatment shall be carried out subsequent to normal solution annealing. Soaking temperature and holding time for stabilizing heat treatment shall be 900°C and 4 hours respectively.

3.0 Hydrogen Service Fittings:

- a) All carbon steel fittings having wall thickness 9.53 mm (0.375") and above shall be normalized. Cold drawn fittings shall be normalized after the final cold draw pass for all thicknesses. In addition, fittings made from forgings shall have Carbon-0.35% max. and Silicon-0.35% max. The normalizing heat treatment shall be a separate heating operation and not a part of the hot forming operation.
- b) All alloy steel (Cr-Mo) fittings shall be normalized and tempered. The normalizing and tempering shall be a separate heating operation and not a part of the hot forming operation. The maximum room temperature tensile strength shall be 100,000 psi.
- c) All carbon steel fittings having wall thickness 19 mm (0.75") and above shall be post weld heat-treated.
- d) All alloy steel (Cr-Mo) fittings shall be post weld heat treated irrespective of type or thickness of weld.
- e) All austenitic stainless steel grades shall be solution annealed after welding. 100% radiography of welded joints shall be done both before and after PWHT.

- f) For carbon steel fittings, hardness of weld and HAZ shall be 200 BHN (max.) for alloy steel fittings, hardness of weld and HAZ shall be 225 BHN (max.).
 - g) For all austenitic stainless steels, the weld deposit shall be checked for ferrite content. A Ferrite No. (FN) not less than 3% and not more than 10% is required to avoid sigma phase embrittlement during heat treatment. FN shall be determined by Ferritescope prior to post weld heat treatment.
 - h) For all carbon steel and alloy steel fittings with wall thickness over 19 mm, Charpy-V Notch impact testing shall be carried out in accordance with paragraph UG-84 of ASME Section VIII, Div.-I for weld metal and base metal from the thickest item per heat of material and per heat treating batch. Impact test specimen shall be in complete heat treated condition and accordance with ASTM A370. Impact energies at 0°C shall average greater than 27J (20 ft-lb) per set of three specimens, with a minimum of 19J (15 ft-lb).
 - i) If welding is used in manufacture, impact test of Heat Affected Zone (HAZ) and weld metal shall also be carried out.
- 3.1 For all welded alloy steel fittings with mandatory requirements of heat treatment and radiography, radiography shall be performed after heat treatment.
 - 3.2 All 1Cr-0.5Mo & 1.25Cr-0.5Mo fittings shall be normalized and tempered. All 2.25Cr-1Mo, 5Cr-0.5Mo & 9Cr-1Mo welded fittings shall be normalized and tempered.
 - 3.3 Fitting material as per ASTM A234 Gr.WP5/WP9, wherever specified, shall be as per Clause-1, unless otherwise specified.
 - 3.4 Materials designated, as structural steel grades like IS 2062, SA 36 etc. or similar specification are not permitted for manufacture of fittings.

4.0 NACE CS FITTINGS

- 4.1 Fittings under “NACE” category shall meet the requirement of MR-01-03 and the special requirements as per purchase requisition specification.

5.0 IBR FITTINGS

- 5.1 Fittings under the purview of “IBR” (Indian Boiler Regulations) shall be accompanied with original IBR certificate in Form III-C duly approved and countersigned by IBR authority/ local authority/ manufacturer empowered by Central Boiler Board of India and issue inspection certificate. Photocopy of the original certificate duly attested by the

IOC/M&I/MECH/P/2/ 2011	Butt Welded, Socket Welded and Screwed Fittings	Rev.-01	Page 7 of 10
------------------------	---	---------	--------------

local boiler inspector where the supplier is located is the minimum requirement for acceptance.

- 5.2 For materials 1¼Cr – ½Mo (ASTM A234 Gr.WP11 & ASTM A234 Gr.WP11W) & 2¼ Cr-1Mo (ASTM A234 Gr.WP22 & ASTM A234 Gr.WP22W), where fittings are manufactured from pipe, Form III-C approved by IBR shall include the tabulation of E_t , S_c & S_r values for the entire temperature range given below. E_t , S_c & S_r values shall be such that throughout the temperature range.

$$\begin{array}{lcl} E_t/1.5 & \geq & \\ S_r/1.5 & \geq & S_A \\ S_c & \geq & \end{array}$$

- S_A : Allowable stress at the working metal temperature (as per latest addition of ASME B-31.3).
 E_t : Yield point (0.2% proof stress at the working metal temperature)
 S_c : The average stress to produce elongation of 1% (creep) in 100000 hrs at the working metal temperature.
 S_r : The average stress to produce rupture in 100000 hrs at the working metal temperature and in no case more than 1.33 times the lowest stress to produce rupture at this temperature.

- 5.3 For carbon steel fittings described “IBR” chemical composition shall conform to the following:

- Carbon (max.) : 0.25%
 Others (S, P, Mn) : As prescribed in IBR regulations

The above composition is not valid for non-IBR fittings.

- 5.4 No other third party inspection is required.

6.0 INSPECTION REQUIREMENT FOR FITTINGS

- 6.1 All fittings shall be made from seamless pipes unless otherwise specified in purchase order.
- 6.2 The seamless pipes shall be verified with certificate for chemical and physical properties, hydrotest requirement (as stipulated in technical spec) issued by the manufacturer's quality control section and will be endorsed by Third Party Inspection as identification of material.
- 6.3 All fittings shall be supplied in heat-treated condition as per ASTM Standard mentioned in Purchase Order.

- 6.4 Visual inspection and dimensional checking of 100% fittings as per relevant ANSI, ASTM Standards, shall be carried out by Third Party Inspection (This includes thickness checking of 100% fittings).
- 6.5 Manufacturer shall provide the following reports as per relevant standards mentioned in the technical specifications & fittings purchase order.
- a) Chemical analysis reports.
 - b) Tensile test results.
 - c) Type of heat treatment.
 - d) Hardness Test results.
 - e) Impact test reports, radiography report, IGC test report, hydrotest (if required in the specified standard).
- 6.6 All fittings shall be stamped as per specified ASTM standard specified in purchase order.

7.0 SCOPE OF INSPECTION FOR THIRD PARTY INSPECTION AGENCY

7.1 This scope of inspection shall be read with item description, codes stipulated in purchase requisition, requirement of test and inspection as per this technical specification/ note.

7.2 Tests to be witnessed:

- i. Testing for physical properties for dia. 2" and above.
- ii. Visual inspection : 100%
- iii. Dimensional check : 100%
- iv. Thickness check : 100%
- v. Impact test, if applicable
- vi. IGC test, if applicable
- vii. Hydrostatic test (if specifically mentioned)

7.3 Review of documents:

- i. Mill T.C. of raw materials
- ii. Materials identification reports
- iii. Radiographs
- iv. Heat Treatment Charts
- v. Manufacturers test certificates
- vi. Chemical analysis reports
- vii. Tensile test results
- viii. Hardness test results

7.4 Third party inspection shall issue a release note on their letterhead giving correlation-marking details. The third party inspection shall contain the information on tests witnessed, documents reviewed, observations/ remarks, identifications, order status and date(s) of

IOC/M&I/MECH/P/2/ 2011	Butt Welded, Socket Welded and Screwed Fittings	Rev.-01	Page 9 of 10
------------------------	---	---------	--------------

inspection. All the documents along with original certificate & release note shall be furnished with supplies.

8.0 MARKING AND DESPATCH

- 8.1 Each fitting shall be legibly and conspicuously stamped in accordance with MSS-SP-25 along with special condition like “IBR”, “Cryo”, “NACE” and “H₂” etc.
- 8.2 Steel die marking with round bottom punch may be permitted on body of butt weld CS and lower alloy steel fittings, but for SS & higher alloy steel fittings, the same should be marked by electro-etching only.
- 8.3 Paint or ink for marking shall not contain any harmful metals or metal salts such as Zinc, Lead or Copper which causes corrosive attack on heating.
- 8.4 Fittings shall be dry, clean and free of moisture, dirt and loose foreign materials of any kind.
- 8.5 Fittings shall be protected from rust, corrosion and mechanical damage during transportation, shipment and storage.
- 8.6 Rust preventive shall be applied. These when used on machined surfaces to be welded shall be easily removable with a petroleum solvent and the same shall not be harmful to welding.
- 8.7 Fittings under “IBR”, “Cryo”, “NACE” and “H₂” shall be painted in red, light purple, canary yellow and sea green stripes respectively for easy identification. Width of stripe shall be 25mm.
- 8.8 Each end of fitting shall be protected with a wood, metal or plastic cover/ sponge.
- 8.9 Each size of fitting shall be supplied in separate packaging marked with the purchase order number, item code number, material specification, size and schedule/ thickness/ rating. For small quantities, fittings of different sizes may be packed in separate packings size-wise and these packings may be packed in a bigger package/ container clearly identifying the contents.
- 8.10 All alloy materials tested by PMI shall be identified using either of the following methods by indicating “PMI OK”
 - a) Bar Code/ Hologram Sticker
 - b) A low stress stamp marking
 - c) Or by any other method

TECHNICAL NOTES (GENERAL SPECIFICATION) FOR VALVES (Gate, Globe, Check, Ball, Plug, Needle, Butterfly & Piston Valves)

	Prepared by	Checked by
Signature		
Name/ Designation	(Sajid Ansar) CMNM(M&I)	(S. G. Chaudhuri) DGM(M&I)
Date	18.12.13	18.12.13

TECHNICAL SPECIFICATION FOR VALVES

1.0 GENERAL

- 1.1 Vendor shall quote in strict accordance with the valves data/ specification sheets, subject technical notes and all other enclosures to the requisition. Any deviation to be highlighted clearly.
- 1.2 Vendor shall supply valves along with auxiliaries, if any, such as gear operator, bypasses, drains etc. wherever specified in the specification sheets, subject notes and other enclosures to the requisition.
- 1.3 All applicable codes and standards for manufacture, testing, inspection etc. shall be of latest editions.
- 1.4 All cast valves though specified as per various BS standards shall also meet pressure temperature conditions of respective class as per ASME B16.34 and vendor shall certify the same.
- 1.5 The offered valves to various ASTM/ ASME standards shall also meet requirements of Metric unit system of relevant code e.g. ASTM A105 shall also meet requirements of ASTM A105M.

2.0 DOCUMENTATION

- 2.1 Vendor shall submit the following with the offer:
 - 2.1.1 Detailed dimensional, cross section drawing with parts/ material lists, weight etc. for the gate, ball, plug, butterfly valves, diaphragm valves, check valves & valves to manufacturer's standard.
 - 2.1.2 One copy of Valve datasheet signed as accepted by the manufacturer with all deviations marked clearly, if taken.
 - 2.1.3 Drawings for valves with accessories like gear operator/ hydraulic/ pneumatic operator, extension bonnet; extended stems with stands bypass etc. giving major salient dimensions.
- 2.2 Vendor shall submit the following documents along with dispatch documents. :
 - 2.2.1 Test reports shall be supplied for all mandatory tests as per the applicable code. Test reports shall also be furnished for any supplementary tests.
 - 2.2.2 Material test certificates (physical property, chemical composition & heat treatment report) of the pressure containing parts shall be furnished for the valves supplied. Material test certificates for the other parts shall also be furnished for verification during inspection. For alloy

IOC/M&I/MECH/P/4/2013	Technical notes for Valves	Revision-4	Page 2 of 23
-----------------------	----------------------------	------------	--------------

steel valves mill test certification containing above information shall be furnished.

NDT test reports, PMI & any additional test as applicable.

3.0 DESIGN & CONSTRUCTION

3.1 Valve shall be designed, manufactured, tested, inspected and marked as per the manufacturing standards; design codes and standards (latest editions) indicated in the respective valve specification sheets.

3.2 Face to face and end to end dimension of steel valves of sizes up to 24" shall conform to ASME B16.10 to the extent covered under standard.

3.3 All flanged valves shall have flanges integral (except forged valves) with the valve body. Forged valves with flanged connection will be supplied by welding flanges along with nipple with 100% radiography/ DP/ MP whichever is applicable. Flange face finish shall be normally specified in the valve specification sheet as serrated finish, 125 AARH etc. The interpretation for range of face finish shall be as follows:

Stock Finish : 1000 μ in AARH max.
Serrated Finish / Smooth : Serrations with 125 to 250 μ in AARH
Finish / 125 AARH
Extra Smooth Finish / 63 : 32 TO 63 μ in AARH
AARH

3.4 PMI test: Positive material identification test to be performed at vendor's works on pressure containing parts i.e. body & bonnet / cover of alloy steel, stainless steel valves. However for stainless steel valves PMI test is to be performed on stem also. The extent of PMI examination will be 100%.

3.5 For all weld end valves with bevel ends as per ASME B 16.25, the contour of bevel shall be as follows:

Materials	Wall thickness	Weld contour
Carbon steel [except low temp carbon steel]	up to 22 mm	Fig 2 type A
	> 22 mm	Fig 3 type A
Alloy steel, SS & low temp carbon steel	up to 10 mm	Fig 4
	> 10 mm to 25 mm	Fig 5 type A
	> 25 mm	Fig 6 type A

Inside contour shall be sloped to in line with ANSI B16.25 i.e. when the thickness is greater than that of matching pipe.

- 3.6 For flanged valves with ring joint flange the hardness shall be as follows:

Flange material	Min. Hardness of Groove (BHN)
Carbon Steel	140
1% Cr to 5% Cr	150
Type 304, 316, 321, 347	160
Type 304L, 316L	140

- 3.7 Following requirements for check valves shall be met over and above the valve spec sheet requirements:

- 3.7.1 Unless specified otherwise in the data sheet all swing check valves 3" & above shall have a drain boss at location "G" (0.5" size for valve sizes 3" & 4" and 0.75" size for valves 6" & larger) (Refer Fig.No.1 of ASME B16.34). A tapped drain hole (except in CRYO valves and 900#, 1500# & 2500# rating valves where tapping shall not be done in boss) with plug shall be provided as per ASME B16.34. Threads shall be as per ASME B1.20.1 (Taper) NPT.
- 3.7.2 Swing check valves shall be provided with limit stops to prevent disc from remaining in open position.

Wherever check valve disc assembly is supported from the cover of the check valves the following shall be ascertained:

- i. Positive location/ positioning of cover must be provided to ensure correct alignment of the valve disc.
 - ii. Hinge pin design must permit accurate alignment of the disc and valve seat.
- 3.7.3 The check valves having disc assembly supported from the cover of the check valves are not acceptable.
- 3.7.4 For heavy check valves, provisions shall be available for lifting by way of lugs, eye bolts and other such standard devices.
- 3.8 If an overlay weld-deposit is used for the body seat ring seating surface, the corrosion resistance of the seat ring base material shall be at least equal to the corrosion resistance of the material of the shell. However, provision given in valve data sheet will supersede in case of any contradiction.

- 3.9 By-pass:**
For gate valves:

ANSI Class	Size
150 Class	26 inch and above
300 class	16 inch and above

IOC/M&I/MECH/P/4/2013	Technical notes for Valves	Revision-4	Page 4 of 23
-----------------------	----------------------------	------------	--------------

600 class	6 inch and above
900 class	4 inch and above
1500 class	4 inch and above
2500 class	3 inch and above

By- pass valve shall be globe valve. The sizes shall be :

On main valve < 4" or = 4" = ½" or more
>4" but <10" = ¾" or more
= 10" or >10" = 1" or more

- 3.9.1 Vendor shall supply the bypass valve duly tested and fitted to the main valve. Valves with bypass shall have the direction of flow marked on the main valve. Bypass attachment to the main valve body shall not be screwed. All fillet welds for bypass installation shall be 100% examined by DP/MP test.
- 3.9.2 The bypass piping arrangement shall be such that clearance between main valve body & bypass assembly shall be the minimum possible for layout reasons. Basic design of bypass shall be to MSS-SP-45 & ASME B16.34.
- 3.10 Valve body/ bonnet shall be forged/ cast as specified. Forgings are acceptable in place of casting but not vice versa.
- 3.11 Material of construction of yoke shall be minimum equivalent to body/ bonnet material.
- 3.12 Stem shall be forged or machined from forged/ rolled bar. No casting is permitted. However, integral stem of cast stainless steel ball valves is acceptable.
- 3.13 Butt welding and socket welding carbon steel valves shall have 0.25% maximum carbon content, free machining steel is not acceptable.
- 3.14 The valve packing shall meet type testing for fugitive emission as per API 622.
- 3.15 All Teflon packing, seats, seals, lining etc. shall be virgin Teflon-Top grade.
- 3.16 All forged chrome moly valves shall be furnished in normalized and tempered condition in accordance with ASTM A182.
- 3.17 Stellite/ hard-facing by deposition, shall be minimum 1.6mm. Finished thickness after final machine condition. In case of renewable seat rings the same shall be seal welded for valves of size 3" and above to prevent loosening in service.

3.18 For all Austenitic stainless steel valves, Inter Granular Corrosion (IGC) test shall have to be conducted as per following:

3.18.1 ASTM A 262 practice "B" with acceptance criteria of 60 mils/ year (max.) for all materials forged, rolled, wrought and casting.

Or

ASTM A262 practice "E" with acceptance criteria of "No cracks as observed from 20X magnification" for all materials other than castings. "Microscopic structure to be observed from 250X magnification" in addition.

3.18.1 When specifically asked for in MR for high temperature application of some grades of austenitic stainless steel (e.g. SS309, 310, 316, 316H etc.) ASTM A 262 practice "C" with acceptance criteria of '15 mils/ year (max)" shall be conducted.

3.18.2 For the IGC test as described in Clause as above two sets of samples shall be drawn from each solution annealing lot. One set shall correspond to the highest carbon content and the other to the highest pressure rating. When testing is conducted as per practice "E", photograph of the microscopic structure shall be submitted for record.

3.19 All types of 321 or 347 stainless steel valves shall be in a stabilized heat treated condition. Stabilising heat treatment shall be carried out subsequent to the normal solution annealing. Soaking temperature and holding time for stabilizing heat treatment shall be 900 C and 4 hours respectively.

3.20 Spiral wound bonnet gaskets are to be provided with inner/ outer ring except when encapsulated gaskets type body-bonnet joints are employed. In case of non-circular gasket used in 150# valve, the same will be either corrugated metal laminated with flexible graphite or tanged gasket with SS-316 inserts.

3.21 Body bonnet joint is to be design to ASME SECTION-VIII DIV-1 APPENDIX-2.

3.22 In case of gate valve, stem to gate connection shall be accommodated within Gate only.

3.23 Wear travel mentioned in API 600 has to be maintained and recordrd.

3.24 In case of gear operated globe valve, stem will be non rotating type and guides are to be provided to minimize wear & to maintain stem movement aligned in all valve orientations.

3.25 Ball/ Plug/ Butterfly Valves:

3.25.1 As a pre qualification fire safe test as per API-607/ API 6FA/ BS 6755 Part II shall be carried on all kinds of ball (soft seated or metal seated), plug, butterfly valves and also on lubricated plug valves. The test shall

IOC/M&I/MECH/P/4/2013	Technical notes for Valves	Revision-4	Page 6 of 23
-----------------------	----------------------------	------------	--------------

be witnessed & certified by third party inspection agency. The vendor has to submit test certificate for the particular design / type of the valve offered.

3.25.2 The operating levers or handles on ball valves shall indicate, by their position, whether the valve is open or closed. The open position shall be indicated when the lever or handle points in a direction parallel to the flow through the valve. In addition, it shall be impossible to reverse the indicating position inadvertently during reassembly of the valve.

3.25.3 Ball and plug valve shall be drilled to relieve pressure from plug port area to upstream of valve when valve is closed.

3.25.4 Each valve shall be supplied with a lever/wrench except for gear operated/motor operated valves.

3.25.5 All ball valves (soft seated or metal seated) shall be supplied with antistatic device.

3.25.6 Soft-seated BW/ SW end ball valves shall have a 100 mm long seamless pipe nipple (compatible to body material) welded to each end of the valve. Nipples are to be welded prior to assembling Teflon seats/seals. Schedule of nipple shall be indicated in the valve specification sheet.

3.25.7 Face to face dimension of all ball valves shall be same as those of the corresponding ANSI class of gate valves (except 10 inch onwards in class 150 where the face-to-face dimensions shall be as per API 6D long pattern).

3.25.8 The ball shall be solid and shall not protrude outside the end of flanges of the valves.

3.25.9 The ball valve shall be floating ball type/trunion mounted as per following:

Rating	Size	Type
150 #	8" & below	Floating ball
	10" & above	Trunion mounted
300 #	4" & below	Floating ball
	6" and above	Trunion mounted
600 # and above	1.5" & below	Floating ball
	2" & above	Trunion mounted

3.25.10 Unless otherwise specified in the data sheets, bore of all reduced bore ball valves shall be limited to one size lower than the nominal bore. If not specified in the data sheet the ball valve shall be supplied with full bore.

IOC/M&I/MECH/P/4/2013	Technical notes for Valves	Revision-4	Page 7 of 23
-----------------------	----------------------------	------------	--------------

3.25.11 Butterfly valves if specified/used in other than cooling water lines (Cat.'D' services) shall be high performance fire safe design to API-609.

3.25.12 Unless otherwise specifies, plug valve shall be pressure balance type.

3.25.13 Whenever the term STELLITE' is mentioned it mean facing of Seat and Disc or Wedge by Cobalt- Chromium-Tungsten alloy. Stelliting should be able to maintain hardness of 375 BHN at high temperatures. Whenever the term' HARD' is mentioned with reference to Seat or Disc of valve, it should be 350-500 BHN (min).

3.26 The MOVs are to be installed in an open area and the actuators shall be suitable for all weather conditions. The testing of complete assemblies of MOVs along with the actuators shall be done by the supplier at his works.

3.27 Ends of flanged valve of 22" size shall match corresponding flanges to MSS-SP44 unless otherwise specified.

4.0 OPERATION

4.1 Generally the valves are hand wheel or lever operated. Gear operation shall be provided as under:

VALVE TYPE	CLASS	SIZE REQUIRING GEAR-OFFER
Gate valve, globe valve	150 class	12" and larger
	300 class	10" and larger
	600 class	8" and larger
	900 class	6" and larger
	1500 class	3" and larger
	2500 class	3" and larger
Ball/ plug Valve (other than pressure balance plug valve)	150 class	6" and larger
	300 class	6" and larger
	600 class	4" and larger
	900 class	3" and larger
	1500 class	3" and larger
Butterfly Valve	150 class	10" and larger
	300 class	6" and larger

For sizes lower than these ranges, hand wheel/ lever/ wrench shall be provided.

For pressure balance plug valves the gear operator shall be as per manufacturers recommendation. For sizes lower than these ranges, hand wheel/ lever/ wrench shall be provided.

IOC/M&I/MECH/P/4/2013	Technical notes for Valves	Revision-4	Page 8 of 23
-----------------------	----------------------------	------------	--------------

- 4.2 Gear operator shall be as under, with position indicators for open/ close positions, with limit stops (limit stops are not applicable for gate and globe valves)

For gate/ globe/ diaphragm valves	Totally enclosed bevel gear in grease case with grease nipples/ plugs.
For ball/ plug/ butterfly valves	Totally enclosed helical worm or combination of helical and spur gear in grease case with grease nipples/ plugs.

- 4.3 Where gear operator is not called for as above but vendor recommends a gear operator, he shall highlight such case (s).
- 4.4 Gear operator shall be so designed to operate effectively with the differential pressure across the closed valve equal to the cold non-shock pressure rating.
- 4.5 Ball, plug and butterfly valves even with wrench or lever operators shall have “open” position indicators with limit stops.
- 4.6 Hand wheel diameter shall not exceed 750 mm and lever length shall not exceed 500mm on both sides. Effort for normal operation shall not exceed 35 kgs at hand wheel periphery but for opening & or closing, the effort shall be as per EN 12570 Clause 5.1. However failing to meet the above requirements vendor shall offer gear-operated valve and quote as above.

5.0 IBR CERTIFICATION

- 5.1 For valve described “IBR”, valves shall be in accordance with the latest IBR (Indian Boiler Regulation) including the requirements specified in the specification.
- 5.2 For SW / BW end carbon steel valves under IBR, the chemical composition shall conform to the following:

Carbon (max.)	:	0.25%
Others (S, P, Mn)	:	as per IBR regulations

The above composition is not valid for non-IBR valves.

- 5.3 Valves coming under the purview of “IBR” (Indian Boiler Regulations) shall each be individually accompanied by IBR certificate original in Form III-C duly approved by IBR authority/ local authority empowered by the central boiler board of India. Photocopy of original certificate

IOC/M&I/MECH/P/4/2013	Technical notes for Valves	Revision-4	Page 9 of 23
-----------------------	----------------------------	------------	--------------

duly attested by the local boiler inspector where the supplier is located is the minimum requirement for acceptance.

6.0 SPECIAL REQUIREMENT FOR VALVES IN HYDROGEN SERVICES:

6.1 GENERAL

- 6.1.1 All cast valve flanges & bodies with flange rating of Class 900 or greater shall be examined in accordance with paragraphs 7.2 through 7.5 of Appendix-VII of ASME SEC-VIII, DIV.1, regardless of casting quality factor.
- 6.1.2 All casting for body/bonnet shall be 100% radio-graphed irrespective of pressure, temperature, class & rating.
- 6.1.3 All Weld repairs shall be subjected to PWHT.
- 6.1.4 Body/bonnet/cover joints and stuffing box of all valves shall have low emission. One valve per metallurgy, per rating, per size shall be helium leak tested as per ASME Sec. V, Subsection A, Article 10 (Detector/Tracer Probe Technique), Appendix V at a minimum of 25% of the allowable (rated) cold working pressure. Selection of valves for helium leak test shall be at random. Test duration shall be as follows:

Test Duration in Minutes					
Normal size	Pressure Class				
	Upto 300	600	800&900	1500	2500
Upto 2"	3	6	9	12	12
3" to 6"	6	9	12	15	18
8" to 16"	9	9	12	15	18
18" to 24"	9	12	15	18	21

The valve shall show no leakage. No leakage is defined as a total leakage rate of less than **0.0001 ml/s of helium**.

- 6.1.5 Only normalized and tempered material shall be used in the following specifications:

Castings : A217 Gr. WC1, A217 Gr. WC4, A217 Gr. WC5, A217 Gr. WC6, A217 Gr. WC9, A217 Gr.C5, A217 Gr.C12

Forgings : A182 Gr. F11 Cl.2

6.2 CS & AS VALVES

- 6.2.1 Bend test and magnetic particle inspection of the entire surface of body and bonnet casting shall be in accordance with ASTM A 217. Supplementary requirement S3 & S4 evaluation of magnetic particle, inspection shall be in accordance with ANSI B16.34/ MSS-SP-53 **except that no linear discontinuities shall be allowed.**
- 6.2.2 The Brinell hardness of heat-treated casting shall not exceed 200 BHN for carbon steel & 225 for alloy steel.
- 6.2.3 Repair to defective casting shall be outlined in writing to the purchase before repair starts. Repair method to be approved prior to welding.
- 6.2.4 Casting shall be preheated to a minimum of 400 degree F prior to welding and all Chromium Molybdenum alloys shall be post weld heat treated after welding is complete. Stress relieving is essential for welds.
- 6.2.5 Carbon steel shall be normalized and alloy steels shall be normalized and tempered.
- 6.2.6 Dye Penetrant Test of welds shall be in accordance with ASTM B165 Procedure B-2. Interpretation as per Appendix-8 of ASME-VIII Div.1.
- 6.2.7 The tensile stress for AS shall be less than 100,000 PSI.
- 6.2.8 Charpy V-notch impact testing is to be done for valve material (average 20 ft-lb for set of 3 [minimum value 15 ft-lb] at 30°F) to be ensured.
- 6.2.9 For radiography and acceptance criteria for valve casting, clause no. 6.3.2 will be applicable.

6.3 SS VALVES

- 6.3.1 Valve casting shall be in solution heat treated and pickled condition.
- 6.3.2 Critical body and bonnet casing section typically defined by ASME B16.34 shall be radiographed and shall meet ASTM E446 (upto 2" thick) Category A, B & CA Level 2, Category CB, OC & CD Level 3, Category D, B & F Level 0. For wall thickness 2" to 4.5" comparable plates of ASTM E186 shall be used. ASTM E94 and ASTM E142 shall be used for recommended practice & controlling quality of radiography as guide. The entire surface of all castings shall be dye penetrant inspected after picking.
- 6.3.3 Welds shall be 100% radiographed and evaluated in accordance with paragraph 344.5 of ASME B31.3 with a minimum casting quality factor of 0.95. Dye penetration test shall be as per ASTM E165 Procedure B-2, interpretation as per Appendix-8 of ASME-VIII Div.1.

IOC/M&I/MECH/P/4/2013	Technical notes for Valves	Revision-4	Page 11 of 23
-----------------------	----------------------------	------------	---------------

7.0 VALVES IN NACE SERVICE

- 7.1 Valves under this category shall meet the requirements given in NACE MR-0103-2007 and the special requirements as per material requisition by the respective refineries.

8.0 LOW TEMPERATURE & CRYOGENIC VALVES

8.1 Scope

All valves of Low Temperature Carbon Steel (LTCS) and all grades of austenitic SS (CRYO) material are categorized as cryogenic valves. All these valves shall have extended bonnet as per BS 6364 except check valves. Valves shall be suitable for installation in position (on vertical, horizontal or skewed pipeline).

8.2 Qualification Criteria

Both cryogenic test and reference list together, as indicated herein, shall be considered for vendor qualification and vendor shall furnish the same, along with his offer of particular type / rating of valves. Cryogenic test certificates of Higher size of valves w.r.t MR submitted by the vendors, also qualifies the valves of lower size of valves.

Vendors whose current supply does not cover valves of all sizes, materials and ratings (cryogenic test and reference list) required by specification, should confirm/ furnish the following for consideration of their offer:

1. Evidence of having conducted successfully at least one cryogenic test as per BS 6364. Test certificate and reference list shall be furnished with the offer.
2. Vendor shall confirm to conduct cryogenic test as per clause 8.2.1 for the remaining valves not later than 12 weeks from the date of purchase order.

Offers of vendors who do not comply with above requirement would be rejected.

Cryogenic test need not to be conducted for every order. Test conducted previously of particular type/rating is acceptable but test certificates of particular type / rating to be furnished along with the offer. Also, IRN should include the reviewing of cryogenic test certificates by the third party inspection agency.

IOC/M&I/MECH/P/4/2013	Technical notes for Valves	Revision-4	Page 12 of 23
-----------------------	----------------------------	------------	---------------

8.2.1 Cryogenic Test:

Vendors to furnish copies of cryogenic test certificate for tests conducted as per details given below:

1. Shall be as per BS 6364.
2. Test temperature, unless specifically called for otherwise in the individual MR, shall be -45°C for LTCS and -196°C for all grades of austenitic stainless steel.
3. Tests carried out on a particular size of one type of valve, pressure rating and material shall qualify all sizes equal to and below the test valve size for the same type, pressure rating and material. In case of austenitic SS any one grade would qualify for all other grades of austenitic SS.
4. Tests shall have to be witnessed and certified by any one of the approved third party inspection agencies.

8.2.2 Reference List:

Vendor shall furnish reference list for valves supplied for cryogenic service indicating the name of client, year of supply, size, material, pressure rating, type of valve and quantity.

8.2.3 Post Order Testing Procedure:

1. Before conducting post order testing, vendor shall submit the following for approval.
 - a) Test procedure (as per BS 6364).
 - b) Cross-section drawing of the valve with material of construction.
 - c) Schematic of test rig (as per BS 6364) with complete details.
2. Test has to be conducted on largest size of order for each type of valve and for each material and class rating. Vendor shall offer one, two or three valves for selection of test valve by inspector depending upon whether quantity of largest valve in the order is one, two or three and more than three respectively.

In the event of failure of the test valve to meet the specification requirements, the vendor shall conduct test on two more valves. If the other two valves which pass test successfully, are of lower size, then the qualification will be valid only to sizes upto which test has been conducted successfully.

IOC/M&I/MECH/P/4/2013	Technical notes for Valves	Revision-4	Page 13 of 23
-----------------------	----------------------------	------------	---------------

3. In case of non-conductance of cryogenic test(s) within 12 weeks or failure in the test(s) conducted after receipt of order, the owner reserves the right to invoke any of the provisions of the purchase order including cancellation of the purchase order at the risk and cost of vendor.
- 8.3 Bonnet extension, wherever specified in the valve sheet to BS 6364 shall be for “non cold box application” unless otherwise specified in the MR. Even if not called for in valve sheet, valves indicated as “LT” or “CRYO” shall be supplied with bonnet extension.
- 8.4 Bonnet and Gland extension joints shall be of butt welded construction.
- 8.5 Repair welding procedure for austenitic stainless steel valves in “CRYO” service shall have to be qualified for impact test as per ASME B31.3. Minimum acceptable impact energy shall be 20J or lateral expansion of 0.38 mm at temperature of (-) 196°C.
- 8.6 Wherever impact test of CS studs/ nuts is called for in the data sheet, the impact value shall be 27J at the intended service temperature specified in the data sheets.
- 8.7 Repair welding procedure for low temperature carbon steel valves in “LT” service shall have to be qualified for impact test as per ASME B31.3.

9.0 SCOPE OF INSPECTION & TESTING OF TPI

Every valve shall be subjected to all the mandatory tests and checks called in the respective codes/ data sheets by TPI/ IBR agency.

9.1 Forged Valves

1. Visual and dimensional inspection.
2. Review of material test certificates.
3. Any mandatory or supplementary test.
4. Hydrostatic test on 10% valves selected on random basis.
5. Strip check is required for 1% of total order quantity of valves of each type, class & material of construction of body & bonnet irrespective of sizes (sample selection will be generally in highest sizes in the lot) in similar category. **However, strip check is not required for CS/ Brass/ Bronze material valves with 13% Cr/ Brass/ Bronze trims.**

9.2 Cast steel valves

1. Visual and dimensional inspection.
2. Review of material test certificates.

IOC/M&I/MECH/P/4/2013	Technical notes for Valves	Revision-4	Page 14 of 23
-----------------------	----------------------------	------------	---------------

3. Review of radiographs/ radiographic reports or any other NDT tests wherever applicable as per data sheet.
4. Any mandatory or supplementary test.
5. Hydrostatic test 100% for body, 10% other test.
6. Strip check is required for 1% of total order quantity of valves of each type, class & material of construction of body & bonnet irrespective of sizes (sample selection will be generally in highest sizes in the lot) in similar category. **However, strip check is not required for CS/ Brass/ Bronze material valves with 13% Cr/ Brass/ Bronze trims.**

9.3 In case of motor operated or actuator-operated valves, functional/ operational checks as per the requirements of the specifications shall be made on each valve.

9.4 **Third party inspection is also required for IBR valves which will be prior to IBR inspection, the TPI will verify the documents and dimensional check-up.**

10.0 RADIOGRAPHY OF CAST VALVES:

10.1 Valve castings shall undergo radiographic examination as specified in individual valve material spec sheet. Radiography specified as random 10% or 20% etc. in the respective **valve data sheet** implies 10% or 20% etc. of number of valves ordered against each item number with a minimum of one valve against each item.

Material	Rating	Size range	Radiography
All	150#	24" and below	NIL**
		26" and above*	100%
	300#	16" and below	NIL**
		18" and above*	100%
	600# & above	All sizes	100%

* No radiography is required for valves of size 26" in cooling water service (A3A).

**** For sizes 24" & below in 150# and 16" & below in 300#, radiography percentage if specifically mentioned in individual valve material spec sheet shall govern.**

10.2 Radiography procedure, areas of casting to be radiographed shall be as per ASME B16.34 and acceptance criteria shall be as per ASME B16.34 Annexure-B. However for areas of casting to be radiographed for types of valves not covered in ASME B16.34, vendor shall enclose details of areas to be radiographed in the line with ASME B16.34.

10.3 For random radiography wherever specified in individual data sheets, the sampling shall be per size of the quantity ordered for each foundry.

IOC/M&I/MECH/P/4/2013	Technical notes for Valves	Revision-4	Page 15 of 23
-----------------------	----------------------------	------------	---------------

10.4 Radiography wherever specified in the data sheets or as above shall be done by X-ray/ γ -ray to get the required sensitivity.

10.5 Over and above the stipulations laid down above all valve castings when sourced indigenously shall only be procured from approved & reputed foundries.

11.0 MARKING

11.1 Valve markings, symbols, abbreviations etc. shall be in accordance with MSS-SP-25 or the standard referred in specification sheet as applicable. Vendors name, valve rating, material designation, nominal size, direction of flow (if any) etc. shall be integral on the body.

11.2 Each valve shall have a corrosion resistant tag giving size, valve tag/ code no, securely attached on the valve body.

11.3 Paint or ink for marking shall not contain any harmful metal or metal salts such as zinc, lead or copper which causes corrosive attack on heating.

11.4 Carbon steel/ Alloy steel valves shall be painted with one coat of inorganic zinc silicate (minimum DFT 65 to 75 microns).

11.5 All alloy steel high temperature valves shall be painted with heat resistant silicone paint suitable for intended temperature.

11.6 All 3½ Ni steel/ LTCS valves shall be painted with one coat of inorganic zinc silicate coating.

11.7 Non –IBR CS valves shall be painted with two coats of Aluminum paint.

11.8 IBR valves shall be painted with two coats of Red paint in body bonnet/ body cover joint.

11.9 NACE valves shall be painted in yellow colour (synthetic enamel) in body bonnet/ body cover joint.

12.0 DESPATCH

12.1 After inspection valves shall be dry, clean and free from moisture, dirt and loose foreign material of any kind.

12.2 Valves shall be protected from rust, corrosion and any mechanical damage during transportation, shipment and storage.

12.3 Rust preventive on machined surfaces to be welded shall be easily removable with petroleum solvent or which shall not be harmful to welding.

IOC/M&I/MECH/P/4/2013	Technical notes for Valves	Revision-4	Page 16 of 23
-----------------------	----------------------------	------------	---------------

12.4 Each end of valves shall be protected with the following materials:

Flange Face	:	Wood, Metal or Plastic cover
Beveled End	:	Wood, Metal or Plastic cover
SW & SCRD End	:	Plastic Cap

12.5 For special service valve additional requirement (if any) of dispatch shall also be met.

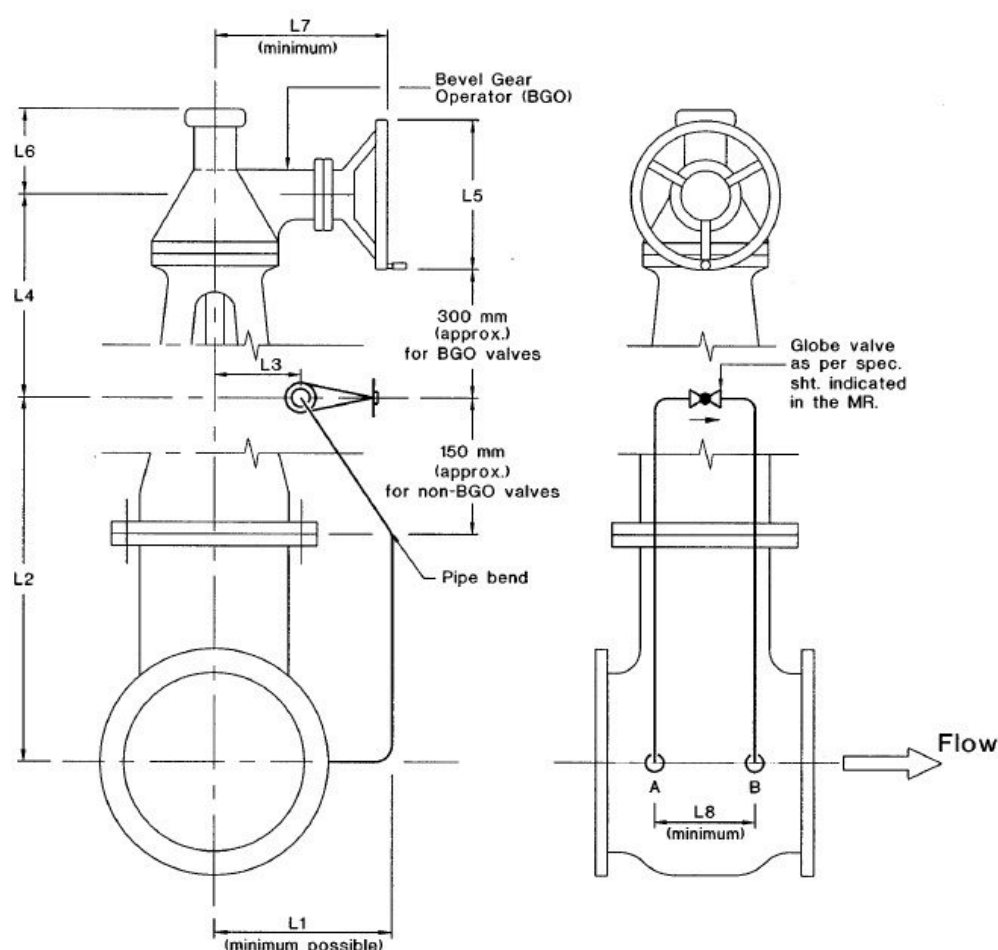
12.6 End protectors of wood/ plastic to be used on flange faces shall be attached by at least three bolts and shall not be smaller than the outside diameter of the flange. However, plastic caps for SW & SCRD end valves shall be press fit type.

12.7 End protectors to be used on beveled end shall be securely and tightly attached.

12.8 All alloy materials tested by PMI shall be identified using either of the following methods by indicating "PMI OK"

- a) Bar Code/ Hologram Sticker
- b) A low stress stamp marking
- c) Any other method

BYPASS PIPING ARRANGEMENT



NOTES:

1. The orientation & location of hand wheel of bevel gear operator & the bypass arrangement shall be strictly as per this sketch.
2. The bypass pipe ends shall be socket/ butt welded to the body wall of the main valve.
3. The bypass arrangement shall be properly clamped to & supported by the body of the main valve.
4. Basic design of bypass shall be to MSS-SP-45 & ASME B16.34.
5. The by-pass piping, fittings and valve shall be of compatible material and design w.r.t. requirement of piping classes wherein the by-pass is used. In case of pipe bend used for bypass piping, higher schedule pipe is to be used for the same and in case forged elbow, traceability of the same is to be ensured to clause no. 3.1 of EN 10204.
6. This sketch is applicable for both BGO & NON-BGO Valves.
7. Vendor shall furnish dimensions L1 to L8.

IOC/M&I/MECH/P/4/2013	Technical notes for Valves	Revision-4	Page 18 of 23
-----------------------	----------------------------	------------	---------------

INSPECTION AND TEST PLAN FOR VALVES

INSPECTION & TEST PLAN FOR VALVES

1.0 SCOPE

This Inspection and Test Plan covers the minimum testing requirements of Valves.

2.0 Reference Documents

PO/ PR/ Standards referred therein/ Job specifications/ Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS

SL. NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/ TPIA
1.0	Procedure						
1.1	Hydrostatic Test, Heat Treatment, NDT, Helium Leak Test and Other Procedures	Documented Procedures	100%	Procedure Documents	-	H	R
1.2	WPS, PQR & WPQ	Welding Parameters & Qualification Record	100%	WPS, PQR & WPQ	-	H	W-New R-Existing
1.3	Pre-Qualification Tests	Fire safe, Cryogenic & Other Test as applicable	As per PR/ Purchase Specification	Acceptance Report	-	H	H (If New)
2.0	Material Inspection						

IOC/M&I/MECH/P/4/2013	Technical notes for Valves	Revision-4	Page 20 of 23
-----------------------	----------------------------	------------	---------------

SL. NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/ TPIA
2.1	Castings & Forgings (Body, Bonnet, Disc, Stem, Body Ring)	Chemical, Mechanical, Heat Treatment, NDT, IGC & Other Properties as applicable	100%	Test Certificate	H	R	R
2.2	Castings & Forgings (Body, Bonnet, Disc, Stem, Body Ring)	Visual & Dimension	100%	Inspection Report	H	H	-
2.3	Body and Bonnet Castings	Radiography Examination	As per PR/ Purchase Specification	Films and report	H	R	R
2.4	Bars for Trim material	Chemical Analysis	Each Heat	Test Certificates & Lab Report	H	R	-
2.5	Gaskets, Gear units, Fasteners, Gland, Packings, etc.	Physical/ Chemical Properties	100%	Test Certificates & Lab Report	H	R	-
2.6	Actuators as applicable	Performance, Statutory as applicable	100%	Test Certificates, Inspection Report	H	H	R
3.0	In Process Inspection						
3.1	Welding	Welding Parameters	100%	Inspection	-	H	-

SL. NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/ TPIA
		as per WPS/ PQR		Reports			
3.2	Machining of components	Visual/ Dimension	100%	Inspection Reports	-	H	-
4.0	Final Inspection						
4.1	Hydrostatic/ Pneumatic Test and Helium Leak test as applicable	Leak Check	As per PR/ Purchase Specification	Test Report	-	H	RW (Note-1)
4.2	Visual/ Dimension	Surface & Dimension Check	100%	Test Report	-	H	RW (Note-1)
4.3	Functional Test for Actuator Operated Valves	Satisfactory Performance	100%	Test Report	-	H	RW
4.4	PMI Check	Chemical	As per EIL Spec. 6-81-0001	Inspection Report	-	H	RW
4.5	Strip Check (As applicable)	Verify Components & Differential hardness if applicable	As per PR/ Purchase Specification	Inspection Report	-	H	RW (Note-1)
4.6	Final Stamping	Stamping Of Accepted Valves	Stamping of Valves which are witnessed by EIL/ TPIA	Inspection Report	-	H	RW (Note-1)
5.0	Painting						
5.1	Painting and Color coding as	Visual/ DFT Check	100%	Inspection Report	-	H	-

SL. NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/ TPIA
	applicable						
6.0	Documentation & IC						
6.1	Documentation & Inspection Certificate (IC)	Review of Stage Inspection Reports/ Test Reports & Issue of IC	100%	Supplier TC & IC	-	H	H

Legend: H – Hold (Do not proceed without approval), P – Perform, RW – Random Witness (As specified or 10% (min. 1 no. of each size and type of Bulk item), R – Review, W – Witness (Give due notice, work may proceed after scheduled date).

NOTES (AS APPLICABLE):

1. For Non NACE & Non Hydrogen service Carbon Steel Valves up to size 12” will be accepted on review of Supplier Test Certificates. Supplier Test Certificate to be reviewed by EIL/ TPIA.
2. This document describes the generic test requirements. Any additional test or Inspection scope if specified in contract documents shall also be applicable (unless otherwise agreed upon).
3. Acceptance Norms for all the activities shall be as per PO/ PR/ Standards referred there in/ Job specification/ approved documents.

IOC/M&I/MECH/P/4/2013	Technical notes for Valves	Revision-4	Page 23 of 23
-----------------------	----------------------------	------------	---------------