पाइपिंग के निर्माण के लिए वेल्डिंग विनिर्देश

WELDING SPECIFICATION FOR FABRICATION OF PIPING

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ABBREVIATIONS

ASME	:	American Society of Mechanical Engineers
ASNT	:	American Society for Nondestructive Testing
AWS	:	American Welding Society
AUT	:	Automated Ultrasonic Testing
BPVC	:	Boiler & Pressure Vessel Code
CFH	:	Cubic Feet per Hour
DWDI	:	Double Wall Double Image
DWSI	:	Double Wall Single Image
GTA	:	Gas Tungsten Arc
GTAW	:	Gas Tungsten Arc Welding
IBR	:	Indian Boiler Regulations
IQI	:	Image Quality Indicator
NDT	:	Non Destructive Testing
PQR	:	Procedure Qualification Record
RT	:	Radiographic Testing
SMAW	:	Shielded Metal Arc Welding
SWSI	:	Single Wall Single Image
UTS	:	Ultimate Tensile Strength

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1.0 GENERAL

This specification shall be followed for the fabrication of all types of welded joints of piping system within the battery limits of the plant. This specification shall be used in conjunction with Welding Specification Charts for Piping.

The welded pipe joints shall include the following:

a) All pipe joints, longitudinal butt welds, circumferential butt welds and socket welds.

b) Attachments of forgings, flanges and other supports to pipes.

c) Welded manifold headers and other sub-assemblies.

d) Welded branch connections with or without reinforcing pads.

e) Joints in welded/fabricated piping components.

f) The attachments of smaller connections for vents, drain drips and other instrument tappings.

Any approval granted by the Engineer-in-Charge or Owner's inspector, shall not relieve the Contractor of his responsibilities and guarantee.

This specification shall not be applicable for welding of pipelines for transportation of liquid petroleum, gas and other similar products in onshore and offshore.

2.0 APPLICABLE CODES & STANDARDS

All welding work, equipment for welding, heat treatment, other auxiliary functions and the welding personnel shall meet the requirements of the latest editions of the following accepted standards and procedures unless otherwise specified in the EIL Standard Welding Specification Chart (6-77-0005) or Job Welding Specification Charts for Piping and the Technical Notes attached thereof. In the case of conflicting requirements, the requirements mentioned in Welding Specification Chart/Technical Notes shall be applicable.

i) ASME B31.3: Process Piping, ASME Code for Pressure Piping, B31

ii) ASME Boiler & Pressure Vessel Code, Sec II Part C: Specifications for Welding Rods, Electrodes and Filler metals.

iii) ASME Boiler & Pressure Vessel Code, Section V: Non destructive examination.

iv) ASME Boiler & Pressure Vessel Code, Section IX: Welding and Brazing Qualifications.

v) The Indian Boiler Regulations - I.B.R.

vi) 6-44-0016: Standard Specification for Non-Destructive Examination Requirements of Piping.

vii) 6-77-0005: Welding Specification charts for Piping Classes.

viii) API 582: Welding Guidelines for the Chemical, Oil, and Gas Industries.

ix) 5-1940-7040: Procedure for permitting Welding consumables.

In the event of any differences due to the additional requirements mentioned in this specification, over and above those obligatory as per codes, this specification shall be binding.

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3.0 BASE METAL

3.1 In general, use of carbon steel, alloy steel and stainless steel is envisaged. The details of the material specifications are given in the Welding Specification Chart.

3.2 The Contractor shall provide the manufacturer's test certificates for every batch of the materials supplied by him.

4.0 WELDING PROCESS

4.1 The welding processes to be employed are given in the Welding Specification Chart. In addition to Shielded Metal Arc Welding Process (SMAW) and Gas Tungsten Arc Welding Process (GTAW), Welding of various materials under this specification may be carried out using one or more of the following processes with the approval of the Engineer-in-Charge.

- Gas Metal Arc Welding (GMAW)
- Flux Cored Arc Welding (FCAW)
- Flux Cored Arc Welding (FCAW) - Orbital
- Submerged Arc Welding (SAW)

The limitations given in the API 582 for various welding processes shall be complied with.

4.3 The Welding procedure could be employed for a particular joint only after duly qualifying the welding procedure to be adopted. Previous qualified welding procedures may be permitted if agreed by the Engineer-in-charge.

4.4 FCAW with external gas shielding (FCAW-G) shall be used for pressure-retaining welds and structural welds. FCAW-G shall be used for filler and cap passes of butt welds.

4.5 GMAW process shall be used in Pulsed mode only for root pass welding of pipes.

5.0 WELDING CONSUMABLES

5.1 The Contractor shall provide, at his own expense, all the welding consumables necessary for the execution of the job such as electrodes, filler wires, argon etc. and these should bear the approval of the Engineer-in-Charge.

5.2 The welding electrodes and filler wires supplied by the Contractor shall conform to the class specified in the Welding Specification Chart. The materials shall be of the make approved by the Engineer-in-Charge. Usage of non-purge filler wires may be permitted only after taking approval in the Welding Specification Charts.

5.3 Electrode qualification test at site shall be done as per document number 5-1940-7040 and Welding specification chart for Piping, 6-77-0005. Electrode qualification test records should be submitted as per the Exhibit-A (attached) in respect of the electrodes tested by the Contractor, for obtaining the approval of the Engineer-in-Charge. It shall record the minimum test results required for classification of welding consumables as per ASME Section II part C.

5.4 The Contractor shall submit batch test certificates from the electrode manufacturers. All the test certificates shall be duly endorsed by the vendors/stockiest.

5.5 All electrodes shall be purchased in sealed containers and stored properly to prevent deterioration. Contractor shall use vacuum-packed electrodes for pressure-retaining welds for LTCS, Hydrogen, Amine, Caustic, NACE, Alloy steels, stainless steels, Non-ferrous alloys. The electrodes removed from the containers shall be kept in baking ovens at temperatures recommended by the electrode manufacturer. "Out of the oven time" of electrodes, before they are consumed, shall not exceed the limits recommended by the electrode manufacturer.

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The electrodes shall be handled with care to avoid any damage to the flux covering and proper records of both holding and baking time needs to be recorded by the Contractor.

5.6 All low hydrogen type of electrodes and others, shall be baked as per manufacturers recommendation and stored in holding ovens at temperature recommended by the manufacturer.

5.7 The electrodes, filler wires and flux used shall be free from rust, oil, grease, earth and other foreign matter which affect the quality of welding.

5.8 Tungsten electrodes used shall conform to ASME Sec.II C SFA 5.12 specification. Thoriated Tungsten electrodes shall not be permitted due to possible radiation hazard. Instead, ceriated Tungsten Electrodes (EWCe-2 or equivalent) shall be used for GTA Welding.

6.0 SHIELDING & PURGING GAS

6.1 Argon gas used in GTA welding shall be as per SFA 5.32 of ASME Section II part C. The purity of the gas shall be certified by the manufacturer. The rate of flow for shielding purposes shall be established through procedure qualification tests.

6.2 When GTAW process alone or a combination of GTAW and SMAW/FCAW/SAW processes is recommended for the production of a particular joint, the purging shall be maintained during the root pass and for the first filling pass to minimize oxidation on the inner side of the pipe, unless otherwise specified in Welding Specification Chart.

6.3 Initial purging shall be maintained for sufficient period of time so that at least 4-5 times the volume between the dams is displaced, in order to completely remove the entrapped air. In no case should the initial purging period be less than 10 minutes. High gas pressure should be avoided.

6.4 After initial purging, the flow of the backing gas should be reduced to a point where only a slight positive pressure prevails.

6.5 Gas backing (purging) is not required for socket type of welded joints.

6.6 Dams, used for conserving inert gas during purging, shall be removed after completion of the welding, and shall be accounted for. Wherever, removal of dams is not possible after welding, use of water-soluble dams should be made.

7.0 EQUIPMENTS & ACCESSORIES

7.1 All the equipment for performing the heat treatment, including transformers, thermocouples, pyro-meters, automatic temperature recorders (with suitable calibration arrangement etc.) shall be provided by the Contractor at his own expense along with certificate traceable to national /international standard.

7.2 Contractor shall make necessary arrangements at his own expense, for providing the radiographic equipment, radiographic films, processing equipment all other darkroom facilities and all the equipment/materials required for carrying out the dye-penetrant/magnetic particle test/ultrasonic testing.

7.3 Contractors shall use only calibrated panels and digital recorders for carrying out PWHT activities.

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8.0 EDGE PREPARATION

8.1 General

The edges to be welded shall be prepared to meet the joint design requirements by any of the following methods recommended:

(a) Carbon Steel
Gas cutting, machining or grinding methods shall be used. After gas cutting, oxides shall be removed by chipping or grinding.

(b) Low Alloy Steels (containing up to 5% Chromium).
Gas cutting, machining or grinding methods shall be used. After gas cutting, machining or grinding shall be carried out on the cut surface.

(c) High alloy steel (> 5% Chromium) and stainless steels, nickel alloys:
Plasma cutting, machining or grinding methods shall be used. After plasma cutting, cut surfaces shall be machined or ground smooth.

8.2 The beveled edges shall be masked with tape after fit-up. The welding shall preferably be completed within a week after fit-up.

8.3 Cleaning

(a) The ends to be welded shall be properly cleaned to remove paint, oil, grease, rust, oxides, sand, earth and other foreign matter. The ends shall be completely dry before the welding commences.

(b) On completion of each run, craters, welding irregularities, slag etc., shall be removed by grinding and chiseling. Wire brushes used for cleaning stainless steel joints shall have stainless steel wires and the grinding wheels used for grinding stainless steel shall be of a suitable type. Separate grinding wheels and wire brushes shall be used for carbon steels and stainless steels. Mixing of usage of carbon steel grinding wheels on stainless steels is not permitted.

9.0 ALIGNMENT & SPACING

9.1 Components to be welded shall be aligned and spaced as per the requirements laid down in applicable code. Special care must be taken to ensure proper fitting and alignment when the welding is performed by GTAW process. Flame heating for adjustment and correction of ends is not permitted unless specifically approved by the Engineer-in-Charge.

9.2 A wire spacer of suitable diameter may be used for maintaining the weld root opening while tacking, but it must be removed after tack welding and before laying the root bead.

9.3 For pipes of wall thickness 5 mm and above, the ends to be welded shall be secured in position with the aid of couplers, yokes and 'C' clamps, to maintain perfect alignment. Yokes shall be detached after the completion of weld, without causing any surface irregularity. Any irregularity caused on the pipe surface must be suitably repaired to the satisfaction of the Engineer-in-Charge.

9.4 Tack welds, for maintaining the alignment, of pipe joints shall be made only by qualified welders using approved WPS. Since the tack welds become part of the final weldment they shall be executed carefully and shall be free from defects. Defective tack welds must be removed prior to the actual welding of the joints.

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9.5 Tacks should be equally spaced. Minimum number of tacks shall be:

3 tacks - for 2 1/2" and smaller dia. pipes.
4 tacks - for 3" to 12" dia. pipes.
6 tacks - for 14" and larger dia. pipes.

9.6 Welding shall commence only after approval of fit-up by the Engineer-In-Charge.

10.0 WEATHER CONDITIONS

10.1 The parts being welded and the welding personnel should be adequately protected from rain and strong winds. In the absence of such a protection no welding shall be carried out.

10.2 During field welding, particular care shall be exercised to prevent any air current affecting the welding process.

11.0 WELDING TECHNIQUE

11.1 Root Pass

(a) Root pass shall be made with electrodes/filler wires recommended in the welding specification chart. For fillet welding, root welding shall be done with consumables recommended for filler passes. The preferred size of the electrodes is 2.5 mm diameter (12 SWG) but in any case not greater than 3.25 mm (10 SWG).

(b) Upward technique shall be adopted for welding pipe held fixed with its axis horizontal.

(c) The root pass of butt joints should be executed so as to achieve full penetration with complete fusion of the root edges. Weld projection inside the pipe shall be as per applicable code. It shall be limited 3mm max. when the applicable code does not place any restriction.

(d) Any deviation desired from the recommended welding technique and electrodes indicated in the welding specification chart should be adopted only after obtaining express approval of the Engineer-in-Charge.

(e) Root welding shall be uninterrupted. No joint shall be left alone after the root pass. Hot pass shall be deposited prior to stoppage of work.

(f) While the welding is in progress care should be taken to avoid any kind of movement of the components, shocks, vibrations and stresses to prevent occurrence of weld cracks.

(g) Peening shall not be used.

11.2 Joint Completion

(a) Joint shall be completed using the class of electrodes, recommended in the Welding Specification Chart. Size of the electrode shall not exceed 4 mm in diameter for stainless steels and alloy steels used for low temperature applications.

(b) Two weld beads shall not be started at the same point in different layers.

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(c) Butt joints shall be completed with a cover layer that would affect good fusion at the joint edges and a gradual notch free surface.

(d) Each weld joint shall have a workmanship like finish. Weld identification work shall be stamped clearly at each joint, just adjacent to the weld. Metal stamping shall not be used on thin pipe having wall thickness less than 3.5mm. Suitable paint shall be used on thin wall pipes for identification.

(e) Rust preventive/protective painting shall be done after the weld joint has been approved.

11.3 Dissimilar Welds

(a) Where welds are to be produced between carbon steels (P No. 1) and alloy steels (P No. 4, 5A, 5B), preheat and post weld heat treatment requirements shall be those specified for corresponding alloy steels. The preferred filler wire/electrodes shall correspond to ER70S-2 or E-7016/7018 type.

(b) For welds between two dissimilar Cr-Mo low alloy steels (P No. 4, 5A, 5B), preheat and post weld heat treatments shall be those specified for higher alloy steel and electrodes preferred shall match steel of lower alloy content. For dissimilar metal welds between 9Cr-1Mo-V (P No. 15E) and lower-alloy steel (e.g 2.25Cr-1Mo)/carbon steel, Cr-Mo (P No. 5B) to carbon steel (P No.1), consideration should be made to insert a small transition piece (e.g 2.25Cr-1Mo, 5Cr-0.5Mo) to allow a lesser gradient in the chemical composition.

(c) For carbon steel or alloy steel to stainless welds, use of filler wire/electrodes E/ER-309/ERNiCr-3/E Ni Cr Fe-3/ENiCrMo-3 shall be made. E/ER-309 shall not be used above design temperature of 315°C. The welding procedure, electrodes/filler wires to be used shall be approved by the Engineer-in-Charge.

(d) Dissimilar metal welds joining carbon steels and low alloy steel to stainless or nickel base alloys shall be avoided in the severe thermal cycling service and in sour services.

12.0 HEAT TREATMENT

12.1 Preheating and Interpass Temperature

a) No welding shall be performed without preheating the joint to 10°C (50°F) when the ambient temperature is below 10°C.

b) Preheating and Interpass temperature requirements for the various materials shall be as per the Welding Specification Chart attached.

c) Preheating shall be performed using resistance or induction heating methods. Preheating by gas burners, utilizing oxy-acetylene or oxy-propane gas mixtures, with neutral flame may also be carried when permitted by the Engineer-in-Charge.

However, preheating in lieu of PWHT carried out in carbon steel piping above 25 mm thickness shall be done using coil heating and monitored using thermocouples.

d) Preheating shall extend uniformly to at least three times the thickness of the joint, but not less than 50 mm, on each side of the weld.

e) Preheating temperature shall be maintained over the whole length of the joint during welding. Temperature recorders shall be provided by the Contractor to record the

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temperature during alloy steel welding. For carbon steel piping, preheat temperature shall be ensured by use of temperature indicating crayons, pyrometers or other suitable means. Digital hand-held contact thermocouples are preferred over crayons for austenitic stainless steels, DSS, and nickel alloys.

f) If a welding is interrupted for more than 3 minutes without maintenance of minimum preheat before a minimum of 10mm deposits or 25% of the total joint thickness is completed (whichever is less), surface NDE shall be performed before welding is restarted.

12.2 Post Heating

In case of alloy steel materials (P-Nos. 5B, 15E), if a weld joint is not completed on the same day or the postweld heat treatment is not performed immediately after welding, the weld joint and adjacent portion of pipe, at least 50 mm on either side of weld, shall be uniformly heated to 350°C for 1 hour per inch with 1 hour minimum and then wrapped with mineral wool before allowing it to cool to room temperature. Post-weld heat treatment as specified in the Welding Specification Chart shall be carried out later on.

12.3 Post-Weld Heat Treatment (PWHT)

a) Post-weld heat treatment, wherever required for joints between pipes, pipes and fittings, pipe body and supports shall be carried out as per the welding specification chart, applicable codes standards and the instructions of the Engineer-in-Charge. In this regard, procedure qualification shall be done before carrying out PWHT on production welds.

b) The Contractor shall submit for the approval of the Engineer-in-Charge, well before carrying out actual heat treatment, the details of the post-weld heat treatment procedure as per Exhibit B attached, that he proposes to adopt for each of the materials/assembly/part involved.

c) Post-weld heat treatment shall be done in a furnace or by using an electric resistance or induction-heating equipment, as decided by the Engineer-in-Charge.

d) While carrying out local post-weld heat treatment, technique of application of heat must ensure uniform temperature attainment at all points of the portion being heat-treated. Care shall be taken to ensure that width of heated band over which specified post-weld heat treatment temperature attained is at least that specified in the relevant applicable standards/codes. Control of temperature shall be done using microprocessor/computer-controlled system.

e) Throughout the cycle of heat treatment, the portion outside the heated band shall be suitably wrapped under insulation so as to avoid any harmful temperature gradient at the exposed surface of pipe. For this purpose, temperature at the exposed surface should not be allowed to exceed 50% of the peak temperature.

f) The temperature attained by the portion under heat treatment shall be recorded by means of thermocouple pyrometers. Adequate number of thermocouples should be attached to the pipe directly at equally spaced location along the periphery of the pipe joint. Minimum number of thermocouples required different pipe diameters is given in the table below. However, the Engineer-in-Charge can increase the required number of thermocouples to be attached if found necessary.

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Pipe outside diameter, inch	No. of thermocouples
Up to 6"	1
8" - 10"	2
12" - 20"	3
24" - 36"	4
42" - 54"	5
56" - 92"	8
104"	10

g) Automatic temperature recorders, which have been suitably calibrated, shall be employed for measuring & recording temperature. The time-temperature graph shall be submitted to Engineer-in-Charge immediately on completion of Stress Relieving Cycle. The calibration record of each recorder should be submitted to the Engineer-in-Charge prior to starting the heat treatment operations and his approval should be obtained.

h) Manufacturer's test certificate shall be submitted for the thermocouples materials and record shall be maintained by the Contractor.

i) Immediately on completion of the Heat Treatment, the Post-Weld Heat Treatment charts/records along with the hardness test results on the weld points, wherever required as per the Welding Specification Chart, shall be submitted to Engineer-in-Charge for his approval.

j) Each weld joint shall bear a unique identification number, which shall be maintained in the piping sketch to be prepared by the Contractor. The weld joint identification number should appear on the corresponding post weld heat treatment charts. The chart containing the identification numbers and piping sketch shall be submitted to the Engineer-in-Charge in suitable folders.

13.0 CLEANING OF THE WELD JOINT

All weld joints shall be free from adherent weld spatters, slag, swarf, dirt or foreign matter. This can be achieved by brushing. For stainless steels, brushes with only stainless-steel bristles shall be used.

14.0 INSPECTION AND TESTING

14.1 General

(a) The Owner's inspector shall have free access to all concerned areas, where the actual work is being performed. The contractor shall also accord the Owner's Inspector all means and facilities necessary to carry out inspection.

(b) The Owner is entitled to depute his own inspector to the shop or field where prefabrication and erection of pipe lines is in progress for (but not limited to) the following objectives:

i) To check the conformance to relevant standards and suitability of various welding equipments and the welding performance.

ii) To witness the welding procedure qualification.

iii) To witness the welder performance qualification.

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iv) To check whether shop/field welding being executed is in conformity with the relevant specifications and codes of practice followed in piping construction.

(c) Contractor shall intimate sufficiently in advance the commencement of qualification tests, welding works and acceptance tests, to enable the Owner's inspector to be present to supervise them, as decided by the Engineer-In-Charge.

14.2 Welding Procedure Qualification

(a) Welding procedure qualification shall be carried out in accordance with the applicable requirements of ASME Sec. IX latest edition and/or other applicable codes and the job requirements.

(b) The contractor shall submit the welding procedure specification in format as per Exhibit-C (attached) immediately after the receipt of the order. For shop/field welding, WPS format given in ASME Section IX may also be used.

(c) Owner's inspector will review, check and approve the welding procedure submitted and shall release the procedure for qualification tests. The procedure qualification test shall be carried out by the Contractor at his own expense. A complete set of test results in the format as per Exhibit-D (attached) or ASME Section IX shall be submitted to the Owner's inspector for his approval immediately after completing the procedure qualification test and at least 2 weeks before the commencement of actual work. For shop welding, PQR format given in ASME Section IX may also be used.

(d) Standard test as specified in the code shall be carried out in all cases. In addition to these tests, other tests like macro/micro examination, hardness tests, dye penetrant examination, Charpy V-notch, Corrosion tests etc. shall be carried out on specimens depending upon the type of base material, operating conditions and requirements laid down in the detailed drawings, specifications and welding charts. It shall be the responsibility of the Contractor to carry out all the tests required to the satisfaction of the Owner's inspector.

(e) Contractor may submit old PQR conducted at other sites under EIL supervision. Engineer-In-Charge may permit the use of old PQR if found acceptable.

14.3 Welder's Qualification

(a) Welders shall be qualified in accordance with the ASME Section-IX or other applicable codes. The Owners inspector reserves the right to witness the test and certify/approve the qualification of each welder separately. Only those welders who have been approved by the Owner's Inspector shall be employed for welding. Contractor shall submit the welder qualification test reports in the format as per Exhibit-E (attached) and obtain express approval before commencement of work. It shall be the responsibility of Contractor to carry out qualification tests of welders. For welding of the steam piping, falling under the purview of Indian Boiler Regulations, only those welders with IBR Certification, qualified by Boiler Inspectorate, and acceptable to the local Boiler Inspector authority shall be employed.

(b) The welders shall always have in their possession, an identification card containing information contained in Exhibit-G and shall produce it on demand by the Engineer-In-Charge or his representative. It shall be the responsibility of the Contractor to issue the identify cards after it has been duly certified by the, owner's Inspector.

(c) No welder shall be permitted to work without the possession of the identify card.

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(d) If a welder is found to perform a type of welding or in a position for which he is not qualified, he shall be debarred from doing any further work. All welds performed by an unqualified welder shall be cut and redone by a qualified welder at the expense of the Contractor

14.4 Visual Examination

Visual Examination of all welds shall be carried out as per the latest editions of the applicable codes and EIL Standard 6-44-0016. All finished welds shall be visually inspected for parallel and axial alignment of the work, excessive reinforcement, concavity of welds, shrinkage cracks, inadequate penetration, unrepaired burn-through, under cuts, dimensions of the weld, surface porosity and other surface defects. Undercutting adjacent to the completed weld shall not exceed the limits specified in the applicable standard/code.

14.5 Radiographic Examination

(a) Radiography shall be carried out by Conventional radiography or Close proximity radiography or Computed Radiography (CR) using Phosphor Imaging Plate (IP) as described in ASME Section V Article 2 Mandatory Appendix VIII. The details of the Computed Radiography is covered in Annexure J. Digital Radiography (DR) as described in ASME Section V Article 2 Mandatory Appendix IX may be permitted for vendor shop weld inspection after review and approval of the procedure by EIL Inspector or Owner's Third Party Inspector (TPI).

(b) The extent of Radiography shall be as per the EIL Standard NDT specifications (6-44-0016) or job specification given elsewhere in the Tender. For field weld joints, Contractor shall propose among suitable Radiographic methods given in clause 14.5 (a) depending on the actual field condition for approval of Engineer-in-charge. For welds between dissimilar materials, the extent of Radiographic Examination shall be the more stringent of the two recommended for the materials being welded. Wherever random Radiography is called for, in a particular piping class, the dissimilar materials weld joints shall essentially be included.

(c) The Radiographic Examination procedures shall be submitted by the contractor as per Exhibit-F for approval from the Owner's Inspector prior to employment. A person qualified to ASNT Level-II or ASNT Level-III in Radiographic testing shall prepare the procedure. The Radiography Procedure shall be established to demonstrate that the required sensitivity can be consistently achieved under the most unfavorable parameters (e.g. source to film distance, geometric unsharpness, thickness etc.). The radiographic technique and procedure adopted shall conform of the requirements mentioned in Article 2 as well as Article 22 of ASME Section V. The IQI sensitivity obtained shall be equal to or better than the requirements mentioned in Article 2 of ASME Section V. Source side penetrameter shall be used in establishing radiographic procedure/ technique. The acceptance criteria shall be as per the relevant codes of Fabrication and overriding requirements if mentioned elsewhere in the technical specifications of the contract. The Contractor shall be responsible for carrying out Radiography; rectification of defects and re-radiography of welds repaired/rectified at his cost.

(d) Depending on the site condition, decision to use close proximity radiography shall be taken by Engineer-in-charge. Close Proximity Radiography (CPR) with conventional film radiography or Computed Radiography shall be used. The cordoning distance for close proximity radiography shall be 4 to 5 meters maximum. The permissible maximum pipe thickness and minimum pipe size shall be 12 mm and 3" respectively for use of Close Proximity Radiography.

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(e) Type of Radiation source and film to be used shall be as per Exhibit-H for carrying out radiographic examination. However, if specifications (as given elsewhere in the contract) for some critical material require usage of X-Ray Radiation, then Radiography shall be done using X-Rays only.

(f) The Contractor shall fulfill all the statutory and owner's safety requirements while handling X-ray and Gamma-ray equipment.

(g) In case of random radiography, the joints for Radiography shall be selected by the Owner's Inspector and the Radiography shall be performed in his presence, if he instructs the contractor to do so. The contractor shall furnish all the radiographs, to the Owner's Inspector immediately after processing along with evaluation by a person qualified to ASNT Level-II in Radiographic testing, inline with Article 2 of ASME Section V. The certificate of ASNT/ISNT Level II qualification of the NDT personnel shall be submitted to owner's inspector for his approval prior to start of job.

(h) The Contractor shall provide the Owner's Inspector, all the necessary facilities at site such as a dark room with controlled temperature, illuminator (viewer) suitable for varying densities, a duly calibrated electronic densitometer with batteries, magnifying glass, tracing papers, ruler, marking pencils etc. to enable him to review the radiographs.

(i) For each weld performed by a welder found unacceptable, two additional checks shall be carried out on welds performed by the same welder. This operation is iterative and the of two additional welds for each weld deemed unsatisfactory shall be continued till such time that two consecutive welds of satisfactory quality are found for every defective weld.

(j) The Contractor shall carry out these additional radiographic testing at his own expense. To avoid the possibility of too many defective welds by a single welder remaining undetected for a long period to time, the Contractor shall promptly arrange for Radiographic Examination so that there is no accumulation of defective joints.

14.5.1 Check shots

(a) Owner / Engineer-in-charge or his representative shall select 5% of the total number of weld joints accepted in first attempt in radiography for check shots. CONTRACTOR shall take check shot in one segment instead of all segments of each selected joints if agreed by the Engineer-in-charge.

(b) Weld profiles of check shots shall be compared with weld profile observed in the earlier Radiographs. In the event of any one variation in the check shots and earlier Radiographs, contractor shall re-shoot the entire lot of joints radiographed by particular Radiography agency on the particular date. All the re-shot films shall be compared with the originally submitted films.

14.6 Liquid Penetrant and Magnetic Particle Examination

(a) Whenever such tests are specified, the tests shall be carried out on joints chosen by the Owner's inspector, as per ASME Section V article 6 and 7 respectively. The tests are to be performed by a person possessing a valid ISO/ASNT/ISNT Level-II qualification in the method being used.

(b) For austenitic stainless steels and other nonmagnetic materials, liquid (dye) penetrant test shall be carried out. For carrying out this test, the materials shall be brought within a temperature limit of 15^0 to 50^0C.

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14.7 Ultrasonic examination (UT)

(a) Ultrasonic testing (UT) can be used in place of radiographic examination when permitted by ASME B31.3 with prior approval of Engineer-in-charge.

(b) The Ultrasonic testing procedure to be adopted shall be submitted by the CONTRACTOR in line with EXHIBIT-I and get it approved from EIL/OWNER.

(c) The CONTRACTOR shall make all the arrangements for the Ultrasonic Testing of work at his expense. The CONTRACTOR shall furnish all the reports to the EIL/OWNER, immediately after examination together with the corresponding interpretation reports on the approved format. The details of the AUT reports along with the joint identification number shall be duly entered in a register and signed by the CONTRACTOR and submitted to the EIL/OWNER for approval. The EIL/OWNER will review all the Ultrasonic Testing records of welds and inform the CONTRACTOR to those welds, which are unacceptable. The decision of the COMPANY shall be final and binding in this regard.

(d) In addition, Radiography examination shall be carried out when in the opinion of EIL/OWNER, Radiography inspection is required to confirm or clarify defects indicated by Ultrasonic examination.

(e) The ultrasonic testing system used for inspecting welds shall be approved by EIL/OWNER.

14.8 Hardness Test

Hardness requirements for welds shall be as per the Welding Specification Chart/Non-Destructive Examination Specification attached elsewhere in the contract. Hardness testing shall be carried out by Vickers Hardness Tester during welding procedure qualification and shall be cross sectional. For production welds, hardness testing shall be carried out by portable digital hardness testers. Poldi hardness tester shall not be permitted. Contractor shall produce documentary evidence/calibration certificate to the Owner's Inspector and obtain approval of the hardness testing equipment. Contractor shall mobilize standardized test block with hardness value punch and calibration certificate. Digital hardness tester shall be checked prior to each shift using standardized test block.

14.9 Proof Tests

Hydrostatic and pneumatic tests shall be performed as per the requirements laid down by respective flushing and Testing specification/applicable codes to demonstrate the soundness of the welds. The tests shall be conducted after fulfilling the requirement of visual examinations, radiography etc., and after the entire work has been certified by the Owner's inspector to be fit for being subjected to such tests.

15.0 REPAIRS OF WELDS

(a) No repair shall be carried out without prior permission of the Owner's inspector.

(b) Repairs and/or work of defective welds shall be done in time to avoid difficulties in meeting the construction schedules.

(c) Defects ascertained through the inspection methods, which are beyond acceptable limits shall be removed after the joint is completely radiographed by the process of chipping and grinding. The repaired welds shall be subjected, as a minimum requirement to the same testing and inspection requirements as the original weld.

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(d) The number of times repair welding can be permitted for the same weld shall be governed by the standard specification, 6-44-0016.

(e) When the entire joint is judged unacceptable, the welding shall be completely cut and edges suitably prepared as per required alignment tolerances. The rewelded joint shall again be examined following standard practices.

(f) After attending repairs for alloy steel (P No.4, 5) joints, full joint to be re-radiographed after completion of PWHT.

16.0 DOCUMENTS TO BE SUBMITTED BY CONTRACTOR (4 COPIES EACH)

(a) Electrode and Welding Consumable Qualification Records as per Exhibit-A, for the Welding Consumables tested and approved for the work.

(b) Batch Test Certificates, for the Electrodes used, obtained from the Electrode Manufacturers.

(c) Proposed Heat Treatment Procedure as per Exhibit-B.

(d) Heat Treatment Charts.

(e) Weld joint hardness test results.

(f) Welding Procedure Specifications as per Exhibit-C immediately after receipt of the order.

(g) Welding Procedure Qualification records as per Exhibit-D.

(h) Welder Performance Qualification records as per Exhibit-E immediately after conducting Welder Qualification Tests.

(i) Radiography Procedure as per Exhibit-F and other NDT procedures.

(j) Radiographic test Report along with Radiographs and other NDT reports.

(k) Piping Sketch (Isometric) giving all the details regarding the pipe specifications, welded joints, joints radiographed magnetic particle, tested, ultrasonic tested, penetrant tested, joints heat treated, WPS used, welders identification number, etc.

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EXHIBIT – A: ELECTRODE QUALIFICATION TEST RECORD

Date:

Test started on:

Test completed on:

A: DETAILS

CONTRACTOR

Tested at (Site name)

Code of Reference (used for testing) :

Special Requirements (if any) :

Sl. No.	Classification of electrode	Size of electrode	Batch no.	Manufacturer name/brand/date of manufacture	Intended for welding in position	Remarks

B : All-weld Tensile Test

Base Material used :

Buttering used : Yes/No

Pre-heat temperature :

Inter-pass temperature :

Post weld heat treatment details :

Visual examination :

Radiographic examination results :

Tensile test results :

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Sl.No.	Batch no./ identification no.	Size of electrode	Current & polarity	UTS		YS		% elongation		Remarks
				As per code	Actual	As per code	Actual	As per code	Actual	

C. Impact Test Results

Test Temperature : Notch in :

Type of Specimens (Charpy) : Size of Specimens :

Sl.No.	Batch no./ identification no.	Size of electrode	Current & polarity	Impact value							Remarks
				As per code, max./avg.	1	2	3	4	5	Average	

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D. Chemical Analysis Results

Sl.No.	Batch no./ identification no.	Size of electrode	Current & polarity		% C	% Mn	% Si	% P	% S	% Cr	% Ni	% Mo	% V	others	Remarks
				As per code											
				Actual											
				As per code											
				Actual											

E. Fillet Weld Test Results :

Base Materials :

Sl. No.	Batch no./ identification no.	Size of electro de	Current & polarity	Welding position	Visual	Macro	Fracture	Remarks
				Horizontal				
				Vertical				
				Overhead				
				Horizontal				
				Vertical				
				Overhead				

F. Other Test Results :

1. Transverse tensile test :

In combination with :

Base material used :

Position of welding :

Preheat temperature :

Post weld heat treatment :

Radiography :

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	Identification No.	U.T.S.	Fracture in	Remarks

2. Guided Bend Test :

Position	Identification No.	Root, Face or Side Bend	Remarks
	1		
	2		
	3		
	4		
	5		

G. Any other tests :

H. Conclusions :

PREPARED BY	REVIEWED BY	APPROVED BY
(CONTRACTOR)	(CONTRACTOR)	(EIL/OWNER)

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EXHIBIT – B: STRESS RELIEF HEAT TREATMENT PROCEDURE

LSTK CONTRACTOR : _____

Name of the Heat treater : _____

Name of the Project : _____

Specification /Reference No. :

Line no./Joint No.

1. General Details — Other Details

Name of the Equipment : _____

Material : _____

Type of Heating : Elec. Res./ Induction (Tick mark applicable method)

Maximum Permissible Temp at Uncovered Parent Metal _____

Width of heated band _____
Width of Insulation _____

No. of Themo couples (dia wise) _____

Type of Thermo couples _____

3. Heat Treatment Cycle Details

Charging Temp °C _____
Rate of heating °C /Hr. _____
Soaking Temperature, °C _____
Soaking Time, Hrs. _____
Rate of Cooling °C /Hr. _____
Method of Cooling _____

4. Other details, if any _____

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EXHIBIT – C: FORMAT FOR WELDING PROCEDURE SPECIFICATION (WPS)

Company Name _____ By _____

Welding Procedure Specification No. _____ Date _____ Supporting PQR No. (S) _____

Revision No. _____ Date _____

Welding Process (es) _____ Type (s) _____
(Automatic, Manual, Machines or Semi Auto)

JOINTS

Joint Design _____
Backing (Yes) _____ (No) _____
Backing Material (Type) _____
Sketches Production Drawings. Weld Symbols Written
Description should show the general arrangement of the parts to be welded. Where applicable, the root specing and the details of weld groove may be specified.
(At the option of the Manufacturer sketches may be attached to illustrate joint design weld layers and bead sequence e.g. for notch toughness procedures, for multiple process procedures, etc.)

BASE METALS

P.No. _____ Group No. _____ to P. No. _____ Group No. _____

OR

Specification type and grade _____
to Specification type and grade _____

OR

Chem. Analysis and Mech. Prop. _____
to Chem. Analysis and Mech. Prop. _____
Thickness Range :
Base Metal : Groove _____ Fillet _____
Deposited Weld Metal : Groove _____ Fillet _____
Pipe Dia Range : Groove : _____ Fillet _____
Other _____

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FILLER METALS

F.No. _____ Other _____
A.No. _____ Other _____
Spec. No. (SFA) _____
AWS No. (Class) _____
Size of filler metals _____
_____
(Electrodes, Cold Wire, Hot Wire etc.)
Electrode-Flux (Class) _____
Flux Trade Name _____
Consumable Inset _____
Each base metal/filler metal combination should be recorded individually.

WPS NO. _____ Rev. _____

POSITIONS:	**POSTWELDED HEAT TREATMENT**
Position (s) of Groove _____ Welding Progression : UP ____ Down ____ Position (s) of Fillet _____	Temperature Range _____ Time Range _____
PREHEAT Preheat Temp. Min. _____ Interpass Temp. Max. _____ Preheat Maintenance _____	**GAS** Shielding Gas (es) _____ Percent Composition (mixtures) _____ _____ Flow Rate _____ Gas Backing _____ Trailing Shielding Gas Composition _____

ELECTRICAL CHARACTERISTICS

Current AC or DC _____ Polarity _____
Amps (Range) _____ Volts (Range) _____
(Amps and volts range should be recorded for each electrode size, position, and thickness, etc. This information may be listed in a tabular form similar to that shown below).

Tungsten Electrode Size and Type _____
(Pure Tungsten, 2% Ceriated, etc)
Mode of Metal Transfer for GMAW _____
(Spray arc, short circuiting arc, etc.)
Electrode Wire feed speed range _____
_____

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TECHNIQUE

String or Weave Bead _____

Orifice or Gas Cup Size _____

Initial and Interpass Cleaning (Brushing, Grinding, etc.) _____

_____

Method of Back Gouging _____

Oscillation _____

Contact Tube to Work Distance _____

Multiple or Single Pass (per side) _____

Multiple or Single Electrodes _____

Travel Speed (Range) _____

Peening _____

Other _____

Weld Layer(s)	Process	Filler Metal		Current		Volt Range	Travel Speed Range	Others
		Class.	Dia.	Type Polarity	Amp. Range			
								e.g. Remarks, Comments, Hot wire Addition, Technique Torch Angle, etc.

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EXHIBIT-D: FORMAT FOR PROCEDURE QUALIFICATION RECORD (PQR)

RECORD OF ACTUAL CONDITIONS USED TO WELD TEST COUPON

Company Name _____
Procedure Qualification Record No. _____ Date _____
WPS No. _____

Welding Process (es) _____
Types (Manual, Automatic, Semi-Auto) _____
_____

JOINTS

Groove Design of Test Coupon

(For combination qualification the deposited weld metal thickness shall be recorded for each Filler metal or process weld)

_____

BASE METALS Material Sepc. _____ Type of Grade _____ P.No. _____ to P.No. _____ Thickness of Test Coupon _____ Diameter of Test Coupon _____ Other _____	**POSTWELD HEAT TREATMENT** Temperature _____ Time _____ Other _____ _____ _____
FILLER METALS Weld Metal Analysis A No. _____ Size of Filler Metal _____ Filler Metal F.No. _____ SFA Specification _____ AWS Classification _____ Other _____	**GAS** Type of Gas/Gases _____ Composition of Gas Mixture _____ Other _____ _____ _____
POSITION Position of Groove _____ Weld Progression (Uphill, Downhill) _____ Other _____ _____	**ELECTRICAL CHARACTERISTICS** Current _____ Polarity _____ Amps. _____ Tungsten Electrode Size _____ Other _____
PREHEAT Phreheat Temp. _____ Interpass Temp. _____ _____	**TECHNIQUE** Travel Speed _____ String or Weave Bead _____ Oscillation _____ Multipass or Single Pass (per side) _____ Single or Multiple Electrodes _____ Other _____

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TENSILE TEST

Specimen No.	Width	Thickness	Area	Ultimate total force, kgf	Ultimate tensile stress, Kgf/mm^2	Type & location of failure

GUIDED BEND TESTS

Type of Figure No.	Result

TOUGHNESS TESTS

Specimen No.	Notch Location	Notch Type	Test Temp.	Impact Value	Lateral Exp.		Drop Weight	
					% Shear	Mils	Break	No Break

FILLET WELD TEST

Result - Satisfactory : Yes _____ No ____ Penetration into Parent Metal : Yes ___ No. ____

Marco - Results _____

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OTHER TESTS

Type of Test _____

Deposit Analysis _____

Other _____

_____

Welder's Name _____ Clock No. _____ Stamp No. _____

Test Conducted by _____ Laboratory Test No. _____

We certify that the statements in this record are correct and test welds were prepared, welded and tested in accordance with the requirements of Section IX of the ASME Code.

Date _____ Manufacturer _____

By _____

(Detail of record of tests are illustrative only and may be moulded to conform to the type and number of tests required by codes and specifications).

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EXHIBIT – E: FORMAT FOR MANUFACTURER'S RECORD FOR WELDER OR WELDING OPERATOR QUALIFICATION TESTS

Welder Name _____ Check No. _____ Stamp. No. _____

Using WPS No. _____ Rev. _____

The above welder is qualified for the following ranges

Variable	Record Actual Values Used in Qualification	Qualification Range
Process	_____	_____
Process Type	_____	_____
Backing (metal, Weld metal, flux, etc)	_____	_____
Material Spec.	_____ to _____	_____ to _____
Thickness		
Groove	_____	_____
Fillet	_____	_____
Diameter		
Groove	_____	_____
Fillet	_____	_____
Filler Metal		
Spec. No.	_____	_____
Class	_____	_____
F. No.	_____	_____
Position	_____	_____
Weld Progression	_____	_____
Gas Type	_____	_____
Electrical Characteristics	_____	_____
Current	_____	_____
Polarity	_____	_____

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Guided Bend Test Results

Type and Fig. No.	Result

Radiographic Test Results
For alternative qualification of groove welds by radiography

Radiographic Results _____

Fillet Weld Test Results

Fracture Test (Describe the location, nature and size of any crack or tearing of the specimen___
Length and Per Cent of Defects _____ inches _____ %
Macro Test - Fusion _____
Appearance - Fillet Size (ing) _____ x _____ Convexity or Concavity _____
_____

Test Conducted by _____ Laboratory - Test No. _____

We certify that the statements in this record are correct and that the test welds were prepared. Welded and tested in accordance with the requirements of Section IX of the ASME Code.

Date _____ Organization _____
By _____

(Details of record tests are illustrative only and may be modified to conformation to the type & number of tests required by the Code).

Note: Any essential variables in addition to those above shall be recorded.

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EXHIBIT – F: RADIOGRAPHIC PROCEDURE QUALIFICATION RECORD FOR PIPE WELDING

1. Location
2. Date of Testing
3. Name of the LSTK CONTRACTOR/Agency
4. Material: Carbon steel/Alloy Steel/Stainless Steel

4 A. Technique: DWSI/SWSI/DWDI

5. Diameter & Thickness:
6. Type of Weld Joint:
7. Radiation Source:
8. Intensifying Screens/Lead Screens:
9. Geometric Relationship:
10. Limit of Film Coverage:
11. Film Type and Make:
12. Exposure Time:
13. Processing:
14. Density:
15. Sensitivity:

16.* Type of penetrameter: (Source side)

17.* Type of penetrameter: (Film side)

Signature of LSTK CONTRACTOR/Agency with Seal

Approval of OWNER/ PMC's Inspector

* Ref. Para regarding recommended practice on placement of penetrameters Article 22, SE 142, ASME Sec. V.

* For "Random Radiography" lines placement of penetrameters as per Article 2, ASME, Sec. V is permitted.

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EXHIBIT – G: WELDER'S IDENTIFICATION CARD

1.	Name:
2.	Identification:
3.	Date of Testing:
4.	Process
5.	Thickness range
6.	Diameter range
7.	P. No.
8.	Date of approval of welding
9.	Position(s)

Photograph

Approved by:

Employer's Signature with Seal

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EXHIBIT – H: Type of Source and Films to be used for RADIOGRAPHY

NOMINAL WALL THICKNESS (T) IN mm		SHOP WELDED JOINTS		IN-SITU WELDS	
		SOURCE	FILM : CEN Class	SOURCE	FILM : CEN Class
T > 19	All Materials	Gamma Ray	C 5	Gamma Ray	C 5
8 ≤ T < 19	Carbon Steel	Gamma Ray	C 4	Gamma Ray	C 4
	All other materials	Gamma Ray	C3	Gamma Ray	C 3
< 8	Carbon Steel Other than Inspection Class IV *	Gamma Ray	C 3	Gamma Ray	C3/C1
	All other materials and Carbon Steel of Inspection Class IV *	X-Ray	C 4	X-ray with C4 or Equivalent to be used. Gamma Ray (Se 75 Source only) with C3/C2 Equivalent may be allowed only if in the assessment of the owner's inspector, Joints are inaccessible for X-ray equipment and radiographic sensitivity is achieved.	

Note: Integral to above table

1) Films slower than the above may have to be used, if required radiographic sensitivity is not achieved consistently.

* Piping classes where 100% RT is specified. Refer Std. Spec. No. 6-44-0016

COMPARISON OF FILMS FROM DIFFERENT MANUFACTURERS

CEN Classification	KODAK	AGFA	FUJI
---	CX	D8	---
C5	AA400	D7	IX100
C4	T200	D5	IX80
C3	MX125	D4	IX50
C2	M100	D3	---
C1	DR50	D2	IX25
---	SR**	---	---

** *Special films, extremely fine grain & very high resolution*

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EXHIBIT – I: ULTRASONIC TESTING (UT)

1.0 INTRODUCTION

2.0 REFERENCE DOCUMENTS

3.0 AUT SYSTEM

4.0 COUPLANTS

5.0 CALIBRATION/DEMONSTRATION BLOCK

6.0 CALIBRATIONS

7.0 PROCEDURE

8.0 TRAINING AND QUALIFICATION

9.0 EVALUATION AND ACCEPTANCE CRITERIA

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1.0 INTRODUCTION

The specification shall be applicable for Automated Ultrasonic Testing (AUT) system or Semi-Automated Ultrasonic Testing suitable for full penetration butt-welds of piping. The system shall incorporate Phased array probes and Time of Flight Diffraction (TOFD) probes plus pulse echo probes. The procedure shall evaluate the performance of Phased Array Ultrasonic examination instruments and system. This specification is intended to be used on thickness of 8.0 mm and greater. TOFD probes shall be used above 12mm thickness. Lesser thicknesses may be tested using the standard practice if the technique can be demonstrated to provide adequate protection on mockups of the same wall thickness and geometry.

2.0 REFERENCE DOCUMENTS

The latest edition with addendum of the following standards shall be referred here:

a) ASME B31.3 – Process piping
b) ASME Section V- Non Destructive Examination (Latest edition)
c) ASNT SNT-TC-1A - Recommended Practice for Personnel Qualification and Certification in Nondestructive Testing

3.0 AUT SYSTEM

3.1 Instrument Requirement

The ultrasonic examination shall be performed using a system employing automated/ semi-automated scanning with computer-based data and analysis abilities.

The instrument shall be capable of real-time sectorial scan (also called an S-scan) image during scanning to assure that proper data has been collected, generating and displaying sectorial-scan image, which can be stored and recall for subsequent review.

The system shall provide an adequate number of examination channels to ensure the complete volumetric examination of the weld through the thickness in one circumferential scan.
The instrument linearity should be such that the accuracy is within 5%.

Each examination channel should be selective for pulse-echo or through transmission mode gate position and length for a minimum of two gates and gain.

TOFD techniques & B-scan mapping should be available to improve characterization. Recording thresholds should be selectable to display signals between 0 and 100% of full screen height for simple amplitude and transit time recording and it should be from 0 to 100% for B-scan or mapping type recording of data. Two recordable signals output per gate should be available being either analog or digital and representative of signal height and time of flight. Measuring distance accuracy of circumferential weld shall be within 1.0 cm from zero (0) position.

Electronic noise shall be lower than acoustical noise in all channels for the probes and sensitivities to be used during inspection. The signal to noise ratio for each channel during examination shall be at least $\geq$ 20 dB for shear waved probes.

The Contractor shall provide the detail information of the equipment like model, trade name, software used to the OWNER/EIL.

3.2 Probes

The phased array search unit frequency shall be between 1 MHz and 10 MHz depending on material type and thickness. The Contractor shall provide the detail information of the probe frequency, no. of elements, size, pitch etc. to the OWNER/EIL.

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3.3 Wedge

Phased array wedges shall be of a design to accommodate phased array search unit. Nominal refracted-wedge angles shall be possible from 35 to 75 degrees to ensure 100 % coverage of the weld and heat affected zone. The Contractor shall provide the detail information of the wedge to the OWNER/EIL.

3.4 Encoder

The encoder shall be capable of permitting a scan resolution of 1.0mm as minimum.

4.0 COUPLANT

The couplant shall be obtained by using a medium suitable for the purpose. It shall be suitable for the temperature used. The couplant, including additives, shall not be detrimental to the material being examined. Couplants used on nickel base alloys shall not contain more than 250 ppm of sulfur. Couplants used on austenitic stainless steel shall not contain more than 50 ppm of halides (chlorides plus fluorides). A method should be employed to determine that constant coupling is achieved during examination. An examination of the test piece with its surface wiped dry should produce a record showing an absence of the couplant recording signal.

The same couplant shall be used during calibration and examination.

5.0 CALIBRATION/DEMONSTRATION BLOCK

5.1 Calibration/Demonstration Block Material

5.1.1 Material selection

The material from which the qualification and calibration blocks are fabricated shall be of the same product form and material specification or equivalent P-number grouping as one of the materials being examined.

5.1.2 Heat treatment

The calibration and qualification blocks shall receive at least the minimum tempering treatment required by the material specification for the type and grade. If the calibration and qualification blocks contains welds other than cladding, and the component weld at the time of the examination has been heat treated, the block shall receive the same heat treatment.

5.1.3 Reflectors

a) Calibration blocks reflectors: Side drilled holes shall be used to confirm adequate sensitivity settings.

b) Demonstration blocks reflectors: Surface and sub-surface notches

5.1.4 Quality of calibration and demonstration blocks

Prior to fabrication, the block material shall be completely examined with a straight beam search unit. Areas that contain an indication exceeding the remaining back-wall reflection shall be excluded from the beam paths required to reach the various calibration reflectors.

5.1.5 Cladding

When the component material is clad, the block shall be clad by the same welding procedure as the production part. It is desirable to have component materials, which have been clad before the dropouts, or prolongations are removed. When the cladding is deposited using an automatic welding process, and, if due to block size, the automatic welding process is impractical, deposition of clad may be by the manual method.

5.1.6 Surface roughness of calibration and demonstration blocks

The roughness of the Demonstration and calibration surfaces of the blocks shall be representative for the scanning surface of the components to be examined.

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5.2 Calibration Blocks

5.2.1 Standard block
IIW V1 calibration block or V2 or equivalent calibration block are a recognized test reference for sweep range scale, index point of shear wave transducer, and refracting angle.

5.2.2 Calibration reference block
Reference block shall be made with notch and side-drilled hole as per ASME Section V article 4, Fig.T-434.2.1 and Fig.T-434.3 and shall be used for gain calibration and construction of reference curves. The reference calibration block shall be a section of pipe of the same nominal and schedule and normally be manufactured from the actual material examined and have approved dimensions.

5.2.3 Non-piping Calibration block
The basic calibration block configuration and reflectors shall be as shown in ASME Section V article 4, Fig.T-434.2.1. The block size and reflector locations shall be adequate to perform calibrations for the beam angles used.

5.2.4 Piping Calibration block
The basic calibration block configuration and reflectors shall be as shown in ASME Section V article 4, Fig.T-434.3. The block size and reflector locations shall be adequate to perform calibration for the beam angles used.

5.2.5 Block Curvature
The block curvature shall be as per ASME Section V article 4.

5.3 Demonstration Block

5.3.1 Preparation
A demonstration block shall be prepared by welding or, provided the acoustic properties are similar, the hot isotactic process (HIP) may be used.

5.3.2 Thickness
The demonstration block shall be within 25% of the thickness to be examined. For welds joining two different thickness of material, demonstration block thickness shall be based on the thinner of the two materials.

5.3.3 Weld joint configuration
The demonstration blocks weld joint geometry shall be representative of the production joints details.

5.3.4 Flaw location
Unless specified otherwise by the referencing Code Section, the demonstration block which three EDM notches oriented and major groove faces. The flaws shall be located at or adjacent to the blocks groove faces as follows:

(a) One surface flaw on the side of the block representing the component O.D. surface
(b) One surface flaw on the side of the block representing the component I.D. surface
(c) One subsurface flaw

When the scan plan to be utilized subdivides a weld into multiple examination zones, a minimum of one flaw per zone is required.

5.3.5 Flaw Size
Demonstration block flaw sizes shall be based on the demonstration block thickness and shall be no larger than that specified by the referencing Code Section.

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(a) Maximum acceptable flaw height for material less than 1 in. (25 mm) thickness, or
(b) 0.25 aspect ratio acceptable flaw for material equal to or greater than 1 in. (25 mm) thickness based on the demonstration block

5.3.6 Single I.D. / O.D. flaw alternative
When the demonstration block can be scanned from both major surfaces during the qualification scan [e.g., joint I.D. and O.D. have a similar detail, diameter of curvature is greater than 20 in. (500 mm), no cladding or weld overlay present, etc.], then only one surface flaw is required.

5.3.7 One-sided exams
When, due to obstructions, the weld examination can only be performed from one side of the weld axis, the demonstration block shall contain two sets of flaws, one set on each side of the weld axis. When the demonstration block can be scanned from both sides of the weld axis during the qualification scan(e.g., similar joint detail and no obstructions), then only one set of flaws is required.

6.0 CALIBRATION

6.1 General Calibration Requirements

1) Ultrasonic system: Calibration
Calibration shall be performed for complete ultrasonic system and shall be done prior to examination in the desired thickness range.
2) The surface condition of the calibration block shall be similar to that on which production test will be performed with respect to the surface geometry and cladding.
3) Same couplant shall be used for calibration as well as production testing.
4) Contact wedges, if used, shall be same for the calibration as well as for the production testing.
5) Any control, which affects instrument linearity (e. g. Filters, reject, or clipping), shall be in the same position for calibration, calibration checks, instrument linearity checks and examination.
6) Focal-Law: The focal law to be used during the examination shall be used for calibration.
7) Beam Calibration
All individual beams used in the examination shall be calibrated to provide measurement of distance and amplitude correction over the sound path employed in the examination. This shall include applicable compensation for wedge sound path variations and wedge attenuation effects.
8) The maximum temperature difference between test blocks and examination surface shall not exceed 14°C.

6.2 PA Instrument Linearity

The following requirements shall be met at intervals not to exceed one year or prior to first use thereafter.

1) Screen height linearity: The PAUT equipment's screen height linearity shall be evaluated in accordance with Mandatory Appendix I of ASME Sect. V, Art.4.

2) Amplitude control linearity: The PAUT equipment's amplitude control linearity shall be evaluated in accordance with Mandatory Appendix II of ASME Sect. V, Art.4 for each pulse-receiver circuit
3) Equipment linearity shall be such that accuracy of indicated amplitude or time is ±5% of actual full scale amplitude or time.

6.3 Phased array system calibration

Calibration shall be performed from the surface of the calibration block which corresponds to the component surface to be examined. System calibration shall include the complete

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ultrasonic system. Screen distance calibration shall be at least 1-1/2 "veepaths"(also known as skip) for the minimum angle that will be used during the examination.

The system shall be calibrated for velocity and wedge delay calibration, sensitivity calibration, Time Corrected Gain (TCG) calibration. Encoder calibration and confirmation of sensitivity.

The system shall require re-calibration due any of the following conditions:
1) Search unit transducer or wedge change.
2) Search unit cable or length change.
3) Ultrasonic instrument change.
4) Change in examination personnel.
5) Change in type of power source.

7.0 PROCEDURE

7.1 Safety

At first, safety supervisor or technician should be confirmed regarding safety matters before starting examination. Those are included mainly of scaffolding, ladder, lighting, electric conditions and personnel safety equipments have been checked by themselves as followed Project Safety Regulation. If there is not clear for safety questions for personnel, equipment and examination, the technician has right to stop his job whenever.

7.2 A detailed Automated Ultrasonic examination procedure shall be prepared and qualified for each wall thickness and joint geometry to be examined prior to the start of any NDT work. Repair procedure shall be separately qualified for each joint geometry. The procedure as a minimum shall include the following:

Scope; equipment; probe type and details; surface preparation, cleaning and couplant; technique sheet for each technique specified (number of techniques to be sufficient to cover all type of joints to be covered by the procedures scope); material; weld material (if different); sketch showing joint configuration, beam coverage; extent of scan; scanning pattern; material thickness and curvature; calibrations and frequency; means of setting and scanning sensivity levels and DAC curves; flaw location and size evaluation; acceptance criteria; reporting format; operator qualifications.

7.3 Lamination Check

A-UT shall be performed using a device employing automatic computer based data acquisition. The straight beam material examination (T-472 of Section V, Article 4) for reflectors that could interfere with the angle beam examination shall be performed:
a) Manually,
b) As part of a previous manufacturing process, or
c) During the A-UT examination provided detection of these reflectors is demonstrated.
d) The coverage shall be included minimum 100mm from centerline of welding.

7.4 Examination Coverage

The required volume of the weld and base material to be examined shall be scanned using a linear scanning technique with an encoder. Each linear scan shall be parallel to the weld axis at a constant standoff distance with the beam oriented perpendicular to the weld axis.

The ultrasonic examination area shall include the volume of the weld, plus the lesser of 25mm (1 in.) or "t" on each side of the weld.

A documented examination strategy or scan plan shall be provided, showing transducer placement, movement, and component coverage, that provides a standardized and repeatable methodology for weld acceptance. The scan plan shall also include ultrasonic beam angle

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used, beam directions with respect to weld centerline, and pipe volume examined for each weld. The documentation shall be made available to the owner's Inspector.

7.5 Examination side

Basically shall be examined on the both sides of welding line axis but can be examined from one side in case of another side is not available access under full coverage volume condition.

7.6 Surface condition

The contact surface shall be cleaned of weld spatter, dirt, pitting, rust and/or any other impurities or roughness that will interfere with the free movement of the ultrasonic transducers or would prevent adequate transmission of ultrasound. Prior to inspection the NDT technician shall judge the suitability of the surface and when required remedial action shall be taken.

7.7 Scanning

1) The search unit shall be maintained at a fixed distance from the weld axis by a fixed guide or mechanical means.

2) The examination angle(s) for E-scan and range of angles for S-scan shall be appropriate for the joint to be examined.

3) Scanning speed shall be such that data drop-out is less than 2 data lines per inch (25mm) of the linear scan length and that there arr no adjacent data line skips.

4) For E-scan techniques, overlap between adjacent active apertures (i.e., aperture incremental change) shall be a minimum of 50% of the effective aperture height.

5) For S-scan techniques, the angular sweep incremental change shall be a maximum of 1 deg or sufficient to assure 50% beam overlap.

6) When multiple linear scan are required to cover the required volume of weld and base material, overlap between adjacent linear scans shall be a minimum of 10% of the effective aperture height for E-scan or bean width for S-scan

7) Each scan shall have an overlap of minimum 1 in. (25 mm) - (in case of re-acquisition of missing or poor data line etc.)

8) TOFD channel

The TOFD gate start will be set 1 µSec before the arrival of the lateral wave and should extend up to the first back wall echo to achieve full cover of wall thickness.

7.8 Data Recording

A-scan data shall be recorded in an unprocessed form with on threshold, at a minimum digitization rate of five times the examination frequency, and recording increments of a maximum of

a) 0.04 in. (1 mm) for material < 3 in. (75 mm) thick

b) 0.08 in. (2 mm) for material ≥ 3 in. (75 mm) thick

7.9 Reflectors Transverse to the Weld Seam

As an alternate to line scanning, a manual angle beam examination may be performed for reflectors transverse to the weld axis. Manual angle beam UT shall be accordance with manual ultrasonic examination procedure based on (T-472 of Article 4, ASME Sec V).

7.10 Re-examination

1) Re-examination for repaired welds shall follow the same condition (same examination method, same acceptance criteria) as for the original weld.

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2) The additional testing shall be extent a length at least equal to 1 in.(25 mm) from the both end of repaired area.

3) Additional NDT methods of UT and MT shall be carried out to make ensure for the repaired area

8.0 TRAINING AND QUALIFICATION

All Inspectors of the EIL/OWNER (EIL/OWNER) shall be imparted training at the CONTRACTOR's cost. The inspector shall be provided complete awareness and knowledge regarding the equipment, limitations, capabilities complete range, method of operation, calibration, scanning, including development of suitable procedure, training on variables effecting the system performance and interpretation of results.

The Ultrasonic lead operator performing the examination shall be qualified in accordance with the EIL/OWNER's written practice, ASNT-TC-1A, ASME B31 Case 181-1. The minimum qualification of person interpreting the collected data shall be a ASNT Level III.

Only qualified UT personnel trained in the use of the equipment and who have demonstrated the ability to properly acquire examination data, shall conduct production scan.

Scanner technician, Band setter, scribe line technician shall have sufficient experience and capabilities to perform their duties to the satisfaction of AUT operator.

9.0 EVALUATION AND ACCEPTANCE CRITERIA

9.1 Evaluation

9.1.1 Data analysis criteria

Reflectors exceeding the limits in either a) or b) below, as applicable, shall be investigated to determine whether the indications originates from a flaw or is a geometric indication in accordance with Para. 9.1.3 (Flaw sizing) below.

a) For amplitude-based techniques, the location, amplitude, and extent of all reflectors that produce response greater than 20% of the reference level shall be investigated.

b) For non-amplitude based techniques, the location and extent of all images that have an indicated length greater than the limits, as applicable, shall be investigated.

9.1.2 Geometric

Ultrasonic indications of geometric and metallurgical origin shall be classified as follows:

1) Indications that are determined to originate from the surface configurations(such as weld reinforcement or root geometry) or variations in metallurgical structure of materials (such as cladding to base metal interface) may be classified as geometric indications, and

a) Need not be characterized or sized.
b) Need not be compared
c) Location shall be recorded

2) The following steps shall be taken to classify an indication as geometric:

a) Interpret the area containing the indication;
b) Plot and verify the indication coordinate, provide a cross-sectional display showing the indication position and surface discontinuity such as root or counter bore; and
c) Review fabrication or weld preparation drawings.

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3) Alternatively other NDE methods or techniques may be applied to classify an indication as geometric (e.g. alternative UT beam angles, radiography, ID and/or OD profiling).

9.1.3 Flaw sizing

The dimensions of the flaw shall be determined by the rectangle that fully contains the area of the flaw.

Flaw Sizing - Reflectors determined to be flaws shall be sized in accordance with a procedure demonstrated to size similar flaws at similar material depths. A flaw may be sized by manually analysis the data using sizing techniques that have been demonstrated on the calibration block. The dimension of the flaw shall be determined by the size of the rectangle that fully contains the area of the flaw.

9.1.4 Flaw evaluation

Flaws shall be evaluated for acceptance using the applicable criteria of ASME B31.3 Appendix R.

9.2 Acceptance criteria

Weld quality shall be judged on the basis of the acceptability criteria mentioned in ASME B31.3 Appendix R.

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EXHIBIT – J: COMPUTED RADIOGRAPHY

1.0 DIGITAL RADIOGRAPHY- INTRODUCTION

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3.0 DIGITAL RADIOGRAPHY SYSTEM

4.0 SYSTEM CHARACTERIZATION

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8.0 PERSONNEL REQUIREMENTS

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1.0 COMPUTED RADIOGRAPHY- INTRODUCTION

The minimum requirements for Computed radiography using phosphor image plates (films) is covered here. It is the CONTRACTOR'S responsibility to arrange and maintain Computed Radiographic System as required by this specification.

2.0 REFERENCE DOCUMENTS

The latest edition with addendum of the following standards shall be referred here:

a) ASME Section V, Mandatory Appendix VIII- Non Destructive Examination, Radiography using Phosphor Imaging Plate.
b) ASTM E2446- Practice of classification of computed Radiography system.
c) EN 14784-1: Industrial COMPUTED Radiography with storage Phosphor imaging plate.
d) ASNT SNT-TC-1A - Recommended Practice for Personnel Qualification and Certification in Nondestructive Testing

3.0 COMPUTED RADIOGRAPHY SYSTEM

3.1 Integral Image plate scanner and eraser unit Image plate scanner and eraser are single unit and integral. Scanner will be able to scan different sizes of imaging plates. Scanner will be able to provide simultaneous multi-scanning feature. Scanning speed will be 100 plates per hour for 3 X 12 @ 50 microns or better. Scanner will be able to provide flat horizontal transport system.

3.2 Imaging Plates/Cassettes

3.2.1 Image plates/Cassettes should have electron beam cured protection layer. Certification shall be as per EN 14784-1. Image plates and scanner, eraser & cassettes will be suitable for Radiography using X-ray, Ir-192, Selenium and Cobalt-60.

3.2.4 Images obtained by computer Radiography will give equivalent or better results in terms of shape/size, geometrical unsharpness and back scattering.

3.2.5 The offered image plates will not get exposed/deteriorated due to exposure to sunlight, room light etc.

3.2.6 No dark room will be used for handling & removing image plates from covers/cassettes, scanning & erasing. All the work will be done under tube lights illuminated ventilated room. The image plates should not have effect of such use on quality/results produced.

3.2.7 Image plate sizes shall be as per weld joint size.

3.2.8 Normally 50, 60 and 100 micron of IP plates are used for inspection of weld joints depending on type of energy source. 50 microns is used for X-ray and selenium source, 60 microns for IR-192 and 100 microns for Co-60 energy source. Different combination of IP plate and energy source may be used as advised by the IP plate manufacturer depending upon the job thickness and achievement of sensitivity. CONTRACTOR shall consider this clause as guideline only and select right combination of IP plate and source type after establishing the Digital Radiography procedure.

3.3 Software & High performance Laptop (Computer)

3.3.1 Software shall be user friendly and rugged. Software should be powerful to acquire, review, report and archive inspection data which should be compatible with Windows XP/Vista operating systems.

Line Profile - Software for image assessment should be capable of generating a line profile. This should include the ability to generate a line profile of a variable width specified by the user in order to be able to perform the testing specified in ASTM E2737.

Bad Pixel Presentation – Software for image assessment should be capable of turning on and off the display of bad pixels on demand by the user.

Image Enhancements – Software should have the capability of display images without image enhancements and then allow the user to apply filters, edge enhancements or contrast enhancements as desired.

Preservation of Original Data – Software should retain the original data if image enhancements are applied.

It should have wall thickness measurement tools and software.

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3.3.2 Software should be capable of saving images in a DICONDE compliant file format in accordance with ASTM E2339.

3.3.4 Generation of reports in Microsoft word and excels formats. System should be capable of saving data in DVDs.

4.0 SYSTEM CHARACTERIZATION

4.1 Prior to the approval of any item specific techniques, the system should be characterized to establish the capabilities of the system and determine the baseline for system performance. If any key components of a system are replaced, such as IP type, scanner model, scanner settings, software, etc; then this system characterization testing should be repeated.

4.2 *System Performance Baseline* - This system characterization should utilize Image Quality Indicators (IQIs) for quantitative measurement of *key system performance parameters.* The IQIs and test articles for this testing should be selected based upon materials and geometries that are representative of the system's intended application. The level III radiographer is responsible for developing the testing procedures for determining the system performance baseline. Equipment manufacturer assistance may be taken if required.

4.3 *Multiple Focal Spots* - Systems which have multiple focal spots that will be used for inspection should test system performance for each focal spot that will be used.

5.0 QUALIFICATION PLANS

5.1 CONTRACTOR is responsible for development and documentation of the qualification plans.

5.2 The qualification plans should include the following minimum details:

System configuration: The qualification plan(s) should include a complete and accurate listing of the CR inspection equipment. This should be a detailed listing of the CR system components by manufacturer, model and serial numbers. The software list should include details of software which is being used as part of the inspection process and its version information. This listing should be updated when key components are replaced or the system is modified.

Procedures – The qualification plan(s) should include a listing of the procedures used for operation, calibration and maintenance of the equipment.

Range of Items – The qualification plan(s) should specify the items, devices, materials, components, etc. that are covered by the qualification plan. This listing should identify specific items that are covered by the plan

Defects Covered – The qualification plan(s) should specify the types of defects that will be covered by the inspection. Whenever possible, the defects should be described quantitatively such as specifying the minimum dimensions for length, width and depth of cracks for specific materials.

Technique Verification Requirements – The qualification plan(s) should include a description of how the technique or techniques will be verified and the frequency of the verification. This includes a description and the quantity of the samples used for the technique verification and what IQIs and/or RQIs will be used.

Data Format and its Storage – The qualification plan(s) should include and documented about data format and its storage along with integrity & retrievability.

Revision – A qualification plan should be revised whenever any component specified above is changed.

6.0 TECHNIQUES

6.1 All techniques should be covered by a qualification plan approved by the level III radiographer.

6.2 *Filters and Collimators* – The written technique should specify the thickness, material and location of any beam hardening filters. The technique should also specify if a collimator is used to tighten the beam spread and the setting or position of the collimator if adjustable.

6.3 *Representative Quality Indicators* - Image quality indicators used shall be similar to conventional radiography as per this document.

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6.4 Type of radiation source shall be as per EXHIBIT-H in this document. Other radiation source might be used in consultation of CR System manufacturer considering energy level.

6.5 Filter Screens - Filter screens should be in intimate contact with the imaging plate with the exception of a thin layer or coating to prevent direct contact between the lead and the imaging plate.

6.6 *Backscatter* - Back filter screens should be used for protection from backscattered radiation. Lead or other suitable material should be used behind the imaging plate to prevent scattered radiation.

6.7 Viewing Adjustments – Standard digital image viewing software allows adjustment of Window/Level and Zoom. The technique should specify if these parameters may be adjusted during image assessment and the allowable range of adjustment.

6.8 Image Enhancements – All automated and manually applied image enhancements which manipulate the digital data, including digital filters, contrast or edge enhancements, etc. should be specified in the written technique unless specified in a system's operation procedure that is approved by the level III radiographer. Any manually controlled image enhancements specified in the technique should include the range of adjustment that is allowed.

6.9 Gray Value Range – Techniques should specify an acceptable gray value range of the area of interest, similar to a film density value used in film radiography. In addition, the gray value on the IQI should be within +/- 15% of the gray value as the area of interest.

6.8 Image Storage – The format for file storage should be specified in the written technique unless specified in a systems operation procedure that is approved by the level III radiographer.

6.9 Technique Verification– All techniques should be verified prior to approval by the level III radiographer. The verification should simulate the inspection as closely as is practical. This verification should ensure that the technique and inspection process are capable of detecting all defects specified in the inspection criteria and should be witnessed by a CLIENT representative.

6.10 Verification Personnel – During the validation, the inspection process should be performed by the same personnel who will be performing the inspection once the technique has been approved. The level III radiographer should witness the validation.

6.11 Written Technique – The technique used for the verification should be documented prior to the start of the verification. Changes made to the technique during the verification process may require the verification to be restarted at the discretion of the level III radiographer and/or CLIENT representative.

6.12 Samples for Demonstration - The preferred method of verification utilizes real or simulated defects (RQIs) in a blind test. At a minimum, the verification should be done using production representative samples.

7.0 FILE FORMAT AND STORAGE

7.1 *DICONDE* - Software should be capable of saving images in a DICONDE compliant file format in accordance with ASTM E2339. The full bit depth of the image should be retained in the saved image. Images should be saved in a lossless format.

7.2 *DVD* - Systems should be capable of saving data to DVDs. CDs may be used for smaller inspections; however, any inspection that cannot fit onto a single CD should be submitted on a DVD. DVDs used for submittal of images to the CLIENT should be write-once (DVD-R or DVD+R).

7.3 *DICONDE Headers* - Information stored in the DICONDE headers should contain as a minimum:-

- Detector manufacturer and model
- Viewing software and version number
- Pixel pitch (in microns)
- Part Name, such as nomenclature
- Part Identification, such as DODIC or drawing number
- Lot Number
- Date of Inspection
- Inspecting Activity

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7.4 Data Archival - Data should be archived in a secure location for the minimum duration specified in the contract.

7.5 Digital Annotation - If digital labeling is used, it should not permanently alter the nature of the image or hinder interpretation of an area within the image.

8.0 PERSONNEL REQUIREMENTS

Personnel should be trained and certified in accordance with an approved as established by ASNT-TC-1A or NAS-410. As a minimum, Level II and III individuals shall have 40 hours of training and 1 month of practical experience in the digital imaging process technique.

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वैसल्स, पाइपिंग तथा इक्वीपमैंट्स के ऊष्ण इन्स्यूलेशन हेतु मानक विनिर्देश

STANDARD SPECIFICATION FOR HOT INSULATION OF VESSELS, PIPING AND EQUIPMENT

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
0	24-11-2020	ISSUED AS STANDARD SPEC.	PP	BS	PS	SM

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Abbreviations:

ASTM	:	American Society for Testing and Materials
CG	:	Cellular Glass
CUI	:	Corrosion Under Insulation
DFT	:	Dry Film Thickness
ESCC	:	External Stress Corrosion Cracking
GI	:	Galvanized Iron
IE	:	Insulation for Electrically traced surfaces
IH	:	Insulation for heat conservation
IJ	:	Insulation for Steam jacketed surfaces
IS	:	Insulation for Personnel safety
IS	:	Indian Standard
IT	:	Insulation for Steam traced surfaces
ITP	:	Inspection Test Plan
max	:	shall indicate a maximum limit value
min	:	shall indicate a minimum limit value
PIR	:	Poly Isocyanurate Foam
PUF	:	Poly Urethane Foam
SS	:	Stainless Steel
SWG	:	Standard Wire Gauge

Definitions:

Ambient temperature:	Unless otherwise mentioned, ambient temperature referred in this specification shall mean 30^0C
Hot service:	Operating temperature from ambient to 760 deg C is considered as Hot service
Dual service:	Operating temperature ranging from minus (-) 200 to + 350 deg C is considered as dual service

Refractory & Insulation Standards Committee

Convenor : Mr Prasenjit Saha

Members :
Mr Biswarup Sarkar
Mr Prasenjit Pal
Mr Udayan Chakravarty (Piping)
Mr Prag Goel (Fired Heaters)
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1.0 SCOPE

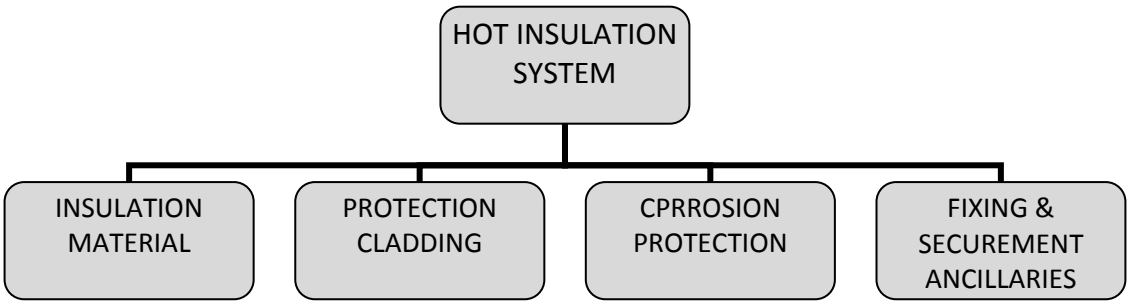
This specification covers the design and material aspects of external insulation of above ground piping, vessels and equipment having operating (process fluid) temperature from ambient to 760°C for the purpose of heat conservation, process stabilization, temperature maintenance, personnel protection and fire protection.

Insulation material and thickness for a project shall be as per Process design basis, BEDB Part-B agreed with client. Insulation system, material properties and specific design requirements are provided in this specification.

Exclusion:
Unless otherwise specified, this specification shall not be binding for insulation of incinerators, boilers, economizers, air pre-heater / ducting of fired heaters etc. for which requirements may be covered in respective package specification. This specification shall not apply to licensed units, where licensor's standard/ specification is applicable.

2.0 GENERAL

Main constituents of a hot insulation system are insulation material and weather protection cladding. Insulation can lead to corrosion to the substrate (commonly known as CUI), especially at low operating temperatures (below 175^{0}C), hence some CUI prevention measures are adopted. Several other materials are used for fixing and securement ancillaries.



2.1 Insulation materials generally used in the industry for hot insulation are given below. Service temperature of each material is different and some may overlap. Material for an application temperature range is selected based on specific advantage of the materials in that range with respect to CUI and other relevant aspects. Insulation material for a project shall be specified in the Process design basis BEDB Part-B.

Insulation Material	General Classification	Temperature limit
Rock wool	ASTM C-547/592/612 / IS 8183	550^{0}C
Calcium silicate	ASTM C-533 / IS 9428	760ºC
Moulded Perlite	ASTM C-610	649^{0}C
Ceramic fiber	ASTM C-892	760^{0}C
Cellular glass	ASTM C-552	427^{0}C
PUF/ PIR	ASTM C-591	100/125^{0}C
Glass wool	ASTM C-553	350ºC
Aerogel	ASTM C-1728	649ºC
Insulating cement	ASTM C-195	760ºC

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2.2 Insulation shall be covered with a weather protection jacket, commonly known as cladding. Unless otherwise specified, aluminium is to be used as default cladding material. Stainless steel / aluminized steel cladding shall be used at higher temperature (>550°C) or where fire protection is an intended service requirement and / or fire safe is a criteria. Non-metallic cladding like UV cured GRP and HDPE can also be used for specific purposes.

2.3 Water ingress into insulation is a major concern, especially at low operating temperature, which may remain into the system and can cause corrosion to the substrate. The risk of corrosion is maximum at operating temperature ≤175°C (hereinafter referred as CUI risk zone).

2.4 Painting is used for general corrosion protection for all temperature range and for all types of insulation. Additional corrosion protection measure is necessary at CUI risk zone particularly when insulation material is fibrous in nature (like rock wool, glass wool, calcium silicate) and metal cladding is used for weather protection.

2.5 In order to prevent / minimize moisture ingress into insulation, a layer of moisture barrier / breather mastic shall be used in CUI risk zone where insulation is designed with fibrous material and metal cladding. All insulation system designed with fibrous material and metal cladding, falling in CUI risk zone, irrespective of the purpose i.e. whether it is for heat conservation, acoustic, fire protection or any other service, shall use this barrier layer. This layer is however not necessary when insulation is designed with a closed cellular material like PUF, PIR, Cellular glass or a water repellent material like aerogel or moulded perlite and / or non-metallic cladding like UV cured GRP or HDPE is used for weather protection.

2.6 Inspection window shall be provided at specific intervals to facilitate periodic inspection for CUI.

3.0 DESIGN BASIS

Insulation type and thickness for a project is finalized in Process design basis, BEDB Part-B. Wherever insulation is provided for heat conservation, thickness is decided on the basis of thermal conductivity of the insulation material, allowable heat loss, max allowable surface temperature/ maintenance temperature, emissivity of cladding material and wind velocity.

3.1 Insulation is required to meet any (or combination of) of the following objectives, generally indicated in P&IDs and line lists:

- Heat conservation
- Process stabilization to assist process control.
- Heat tracing (Steam or Electric)
- Hot water or solvent tracing (liquid)
- Hot Oil tracing
- Steam jacketing
- Hot water or liquid or Oil jacketing
- Fire protection
- Personnel protection

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3.2 Insulation type and thickness shall normally be specified in project specification/ SOR and any of the following documents:

- Piping and Instrument Diagrams (P&IDs) and Line Lists.
- Piping General Arrangement Drawings & Isometrics.
- Instrument Piping Details and Schedules.
- Vessel, Exchanger, Storage Tank and sphere documents and Insulation Schedules.
- Equipment suppliers General Arrangement Drawings for equipment items in Package plant.

3.3 Typical details of any vessel part not covered in this specification, but needs insulation as per good engineering practice shall be submitted by the contractor for approval of owner/ engineer in charge. The details shall include the following as minimum:

- Removable insulation housings
- Flashing details
- Additional Insulation supports
- Vessel head insulation supports
- Expansion joints
- Vessel insulation details
- Exchanger removable housings
- Machinery removable housings etc.

3.4 Codes & Standards

This specification shall be used along with relevant standards / code of practice wherever specified. However, specific technical requirement mentioned in this specification shall prevail over standards/ code and in the event of any difference or conflicting requirement between the code and this specification, stringent of the two shall apply.

Latest issue of the codes/standards prevailing on last submission date of the tender shall be applicable.

3.5 Extent of Insulation

Internally refractory lined piping and equipment and any other items for which heat loss is essential shall not be insulated.

Insulation is not desired for piping and equipment for which heat loss is desired - excepting for personnel protection or to avoid thermal stress problems. Instruments and associated piping (other than impulse piping/tubing) subject to operating flow and/or temperature conditions prevailing in the connected piping or equipment shall be insulated to the same requirements as that of piping or equipment.

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3.5.1 Extent of insulation on piping system

a) Items requiring insulation

- Insulated piping systems shall have straight pipe, bends, tees and pipe-fittings completely insulated.
- Unless otherwise specified, all valves and flanged joints shall be completely insulated only in steam, condensate service, hot oil lines and in lines which are trace heated or jacketed to maintain temperatures.
- For bucket and float type traps the inlet piping and trap shall be insulated.
- Insulation on inlet piping to thermostatic and thermodynamic steam traps shall terminate at approximately 500mm before the trap.
- Steam trap outlet piping other than closed condensate recovery system shall not be insulated except for personnel protection reasons.
- Heat traced instrumentation shall be insulated. The fluid containing sections of such instruments and the associated piping shall be completely insulated. Indication length shall remain visible. Instrumentation other than heat traced shall not be insulated unless otherwise required by Instrumentation department.

b) Items NOT requiring insulation

- Piping which becomes hot intermittently, such as relief valves, vents, steam-out and snuffing steam systems, flare and blow down systems.
- Steam condensate lines downstream of steam traps discharging to drainage system, unless otherwise mentioned.
- Supports for piping, excluding pipe hangers to the extent covered by insulation.
- Steam Traps (except as noted above).
- Valves, including control valves and flanges in process piping systems (except as noted above). However, personnel protection insulation for these items shall be applied, as required.
- Pipe Union fittings.
- Thermowell bosses, temperature and pressure tappings.
- Expansion joints, hinged joints and hose assemblies
- Sight flow indicators.
- Flange joints in Hydrogen service.

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3.5.2 Extent of insulation on equipments

a) Items requiring insulation

- Support skirts of insulated vertical vessel greater than 1200mm diameter shall be insulated both internally and externally for a minimum distance of 600mm below the bottom tangent line. The insulation shall terminate not less than 300mm above the anchor chair.
- Support skirts of insulated vertical vessels of 1200mm and less shall be insulated externally.
- Bottom heads of insulated vertical vessels enclosed by a support skirt shall be insulated without finishing material and shall be insulated only when the vessel outside diameter is greater than 1200mm.
- Turbines shall be insulated for heat conservation.
- Liquid ends of pumps shall be insulated when heat traced and jacketed.

b) Items NOT requiring insulation

- Pumps with operating temperature below 200°C unless pumped fluid has a pour point above minimum design ambient temperature.
- Fans, compressors and blowers and Liquid ends of pumps as noted above
- Internally insulated or refractory lined equipment unless specially designed for metal temperature control.
- Heads of vessels enclosed by support skirts with vessel diameters 1200mm and less.
- Internal surfaces of insulated vessel support skirts with vessel diameter 1200mm or less.
- Turbine casings to be insulated shall exclude shaft seal caps, shaft bearing housings, throttle valves, governors and supports.
- Exchanger channel and covers; shell and channel flanges & Exp. Joints.
- Nozzles flanges, manholes, handholes and flanges of equipment.
- Surfaces of coolers and condensers, Thermowell bosses, temperature and pressure tappings.
- Nameplates of all equipment items.

3.6 Safety Insulation (Personnel Protection)

Exposed surfaces of piping, equipment/ vessels above 60°C in normal or even for a short-term operation, where insulation is not a requirement from heat conservation or process point of view, but in approachable range of operating and maintenance personnel, shall be protected from accidental touch for human safety by appropriate personnel protection. Extent of personnel protection may be decided by the field construction personnel using the criteria that exposed surfaces within 600mm

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horizontally and / or 2100mm vertically of a normal access of walkways or adjacent to handrails, platforms travelled by personnel shall be protected as minimum.

3.6.1 Insulation at low temperature carries a risk of CUI. Hence, insulation to the extent possible should be avoided in CUI risk zone and appropriate personnel protection shall be selected based on the criteria given below.

a) Metal cage / guards may be used for personnel protection for 61 to 175°C

b) Insulation shall be used for personnel protection for 176°C and above

c) Equipment / piping having internal refractory / other lining, shall not be insulated unless specifically required in the design. Personnel protection wherever applicable shall be provided by means of metal cage / guards only.

3.6.2 Requirement and type of personnel protection to be adopted in a project shall be specified in Process design basis BEDB Part-B.

3.6.3 The metal cage / guards, wherever used for personnel protection shall typically be placed at a gap from the surface as given below:

Pipe / Equipment dimension	Gap to be maintained from hot surface (mm)
Pipe diameter up to 6 inches	50
Pipe diameter greater than 6 inch but less than 10 inch	75
Pipe diameter greater than 10 inch	100
Equipment / vessels	100

3.7 Hot insulation in Acoustic service

In specific cases, where a line is to be provided both hot insulation as well as acoustic insulation, following shall be adopted:

3.7.1 Wherever, the material for hot and acoustic insulation are same (e.g. materials like rock wool, glass wool or ceramic fibre), higher of the insulation thickness shall be adopted, cladding shall be as per acoustic requirement.

3.7.2 If the material for hot insulation is different (for example, calcium silicate, PIR, perlite, Cellular glass etc.), hot insulation except the metal cladding shall be first installed over the pipe and then the complete acoustic system installed over it with cladding as per acoustic requirement.

3.7.3 EIL standard specification 6-79-0022 shall be referred for Acoustic insulation.

3.8 Hot & Fire safe insulation

Insulation system in certain service may require serving the purpose of heat conservation and meeting the fire safe criteria. In such cases, insulation thickness needs to be designed for heat conservation during normal operation as well as to limit heat gain in a fire situation, when surrounding is at a higher temperature due to high heat flux released in a hydrocarbon fire.

Wherever insulation material selected for heat conservation is suitable for the fire safe range (for example rock wool, calcium silicate, ceramic fibre etc.), higher of the

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thickness required for heat conservation and fire safe requirement shall be adopted. Cladding shall be of stainless steel / aluminized steel.

Wherever material for hot insulation is not fully fire resistant (for example, PIR, PUF etc.), insulation for heat conservation except the metal cladding shall be first installed over the pipe/equipment and then a layer of fire resistant insulation like rock wool / ceramic fibre etc. of appropriate thickness as applicable for fire safe criteria shall be installed over it with stainless steel / aluminized steel cladding.

3.9 EHT (Electrical heat trace) insulation

Unless otherwise specified, insulation system for the electrically heat traced piping shall consist of pre formed pipe sections of rock wool (LRB is acceptable for higher pipe diameter, refer 4.1.2) with an outer layer of preformed PUF/ PIR, wrapped with a multiplex foil, followed by metal cladding as weather barrier.

Wherever EHT system uses a heat tube, the rock wool pipe section shall be one inch higher size of the pipe diameter. The PUF pipe section shall be of appropriate diameter so that same is snugly fit over the rock wool layer.

Unless otherwise specified, a heat containment shall be created by wrapping a layer of 0.1-0.15mm aluminium foil over the tracing (along with heat tube wherever used) prior to installation of insulation.

3.10 Steam traced insulation

Unless otherwise specified, insulation system for steam traced piping / equipments and instruments shall consist of pre formed pipe sections of rock wool (LRB is acceptable for higher pipe diameter, refer 4.1.3) with a multiplex foil underneath metal cladding as weather barrier. In general, rock wool pipe section shall be one inch higher size of the pipe diameter to accommodate tracer pipes.

A heat containment shall be created by wrapping the tracer pipe (heat tube) along with the parent pipe with a layer of 0.1-0.15mm aluminium foil (or stainless steel foil for >400 deg C) prior to installation of insulation.

Steam tracing expansion loops or couplings extending outside of insulated pipe surfaces shall be insulated for heat conservation.

3.11 Impulse lines

Unless otherwise specified, for impulse lines of austenitic stainless steel, insulation material shall be sodium silicate inhibited ceramic fiber rope (min density 250 Kg/m^3). Ceramic fiber ropes shall comprise of ceramic fibres laid parallel and reinforced with stainless steel wire.

3.12 Removable Insulation

Part of equipment and piping requiring periodic inspection may be provided with a removable and reusable type insulation. Pumps or turbines requiring insulation should have removable insulation cover.

3.12.1 Removable insulation may consist of a fibrous insulation stitched into a quilt of glass cloth fabric envelope and tied with wire around the valve or flange connections. Insulation thickness / number of wraps shall provide equivalent insulation as that of adjacent piping/ equipment.

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3.12.2 Wherever box insulation is used, removable insulation shall be of the same type and thickness as adjacent pipe or equipment insulation.

3.12.3 Removable insulation cover box shall be fabricated from 1mm cladding sheet with insulation installed inside the box. Removable covers box for valves shall cover the body, bonnet, and flanges as applicable.

3.12.4 Insulation covers box shall fit tightly over fittings and protrusions and shall be held in place with straps and stainless-steel toggles. Box shall have an integral metal flashing extending at least 50 mm on adjacent pipe insulation and must be designed to prevent air movement behind insulating covers.

4.0 INSULATION MATERIALS

Insulation material shall be selected primarily based on range of service temperature and other parameters like desired thermal performance, fire protection requirement etc. All materials shall be of high quality and good appearance. Insulation materials shall be of low chloride content, chemically inert, non-sulphurous , rot proof, vermin proof, non-injurious to health and non-corrosive to steel and aluminium (even if soaked in water at ambient temperatures for extended periods), shall not disintegrate, settle, change its form of composition, in a detrimental way during service conditions. Typical details/ minimum technical specification of the major insulation materials and accessories are given in this specification as a guideline.

- Insulation materials in general shall conform to respective ASTM standard/ grade. Equivalent IS grade are acceptable.
- ASBESTOS in any form is NOT permitted. Insulation or finishing materials shall contain no asbestos.
- No inflammable material shall be attached to the insulation.
- Special attention shall be paid for use over austenitic stainless steel surfaces for max permissible chloride level and additional testing for respective material.
- Unless otherwise mentioned, dimensions and tolerances for pipe sections, mattresses & slabs shall generally be as per respective codes. Lesser the number of segments is better. The installed insulation shall fit snugly and shall have a tight joint.

4.1 Rock wool

Rock wool is a fibrous insulation made from molten rock, bonded with resin or suitable binder. The term rock wool shall mean fibrous insulation wool made from natural rock and does not refer to products manufactured from slag or glass. For application over austenitic stainless steel, the material shall be zinc free and shall be inhibited with sodium silicate as per ASTM C-795.

4.1.1 The material may be used up to 550^0C, but shall meet the general classification of respective standards and service temperature requirements as mentioned below:

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Form of Fibrous Material	Quality standard	Max service temperature
Preformed pipe sections	ASTM C547 TYPE-II / IS 9842	760^{0}C
Insulation blanket with wire net facing (details as per 4.1.4, 4.1.5 & 4.1.6)	ASTM C592 CLASS-III/ IS 8183	649^{0}C
Resin bonded mattress (max 2% resin)	ASTM C612/ IS 8183	760^{0}C

4.1.2 Rock wool shall meet following minimum properties:

Properties		Values	Remarks
Density (kg/m^3) as per IS 8183 / IS 3144 / ASTM C-167	Pipe sections	140	Note-1
	Resin bonded mattress / Insulation blanket (density is measured without metal facing)	128	
Linear Shrinkage (%) at 550°C/ 24 hours as per ASTM-C-356, max		2	
Non fibrous shot (%) as per ASTM C-1335 / 3144, max		15	
Compressive strength at 10% deformation (kg/m^2), min		120	
Alkalinity, pH as per ASTM C- 871 / IS 8183		7-10	
Leachable Chloride as per ASTM C-871, ppm, max		10	Note-1, 2
Thermal conductivity (W/mK) as per IS 3346 / ASTM C-177 / ASTM C-518 at mean temperature, max	(+) 100°C	0.052	Note-3
	(+) 200°C	0.068	
	(+) 250°C	0.080	
	(+) 300°C	0.090	
Test of incombustibility OR fire resistivity	Incombustibility as per IS 8183 / IS 3144	Pass	
	OR flame spread index as per ASTM E84, max	25	
Note-1: Supplier shall provide test certificate for each production Batch *Note-2: Max 20ppm allowed for application over carbon steel and low alloy steel* *Note-3: Supplier shall provide Type test certificate no older than 2 years*			

4.1.3 Forms of rock wool insulation

Nominal pipe diameter	Form of Fibrous Material
Up to 6 inch	Preformed pipe section is mandatory
> 6 inch to 14 inch	Preformed pipe section is desirable
>14 inch & equipments	Insulation blanket with wire net facing OR resin bonded mattress

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4.1.4 For operating temperature up to 175°C for application over carbon steel and low alloy steel pipe, insulation blanket wherever used shall have GI metal facing on one side with hexagonal shaped (25mm) wire-woven netting (0.88 to 0.73mm dia.) stitched with tie wires (0.41mm dia.). Galvanization shall be minimum 30gsm.

4.1.5 For operating temperature 176°C and above, for application over carbon steel and low alloy steel pipe, insulation blanket wherever used shall have metal facing as per ASTM A167 type SS 304 with 25mm mesh and 0.8mm wire diameter, stitched with 0.41mm dia. tie wires.

4.1.6 For austenitic stainless steel and alloy 20 piping, irrespective of operating temperature, insulation blanket wherever used shall have metal facing as per ASTM A167 type SS 304 with 25mm mesh and 0.8mm wire diameter, stitched with 0.41mm dia. tie wires.

4.2 Moulded Expanded Perlite

Perlite block and pipe sections shall be made of expanded perlite and sodium silicate or appropriate binder, shall be suitable for continuous service up to 649°C.

4.2.1 Material shall conform to the general classification of ASTM C-610 and meet the following minimum properties:

Properties		Values	Remarks
Density (kg/m^3) as per ASTM C-302/303, max		240	Note-1
Compressive strength at 5% deformation (kPa), min as per ASTM C 165 (for block)		483	
Linear Shrinkage (%) max at 649°C for 24hrs,	Length and width	2	
	thickness	8	
Water absorption after heat aging at 315°C & 48 hr water immersion, weight gain %		50	
Alkalinity, pH as per ASTM C- 871		6-10.5	
Flexural Strength as per ASTM C203, Proc-D (kPa), min		310	
Leachable Chloride as per ASTM C871, ppm, max		10	Note-1 & 2
Thermal conductivity (W/mK) ASTM C-177 / ASTM C-518 / ASTM C-335, at mean temperature	(+) 93 deg C, max	0.079	Note-3
	(+) 149 deg C, max	0.086	
	(+) 204 deg C, max	0.095	
	(+) 260 deg C, max	0.106	
	(+) 371 deg C, max	0.126	

Note-1: Batch test - Supplier shall provide test certificate for each production Batch
Note-2: Max 20ppm allowed for application over carbon steel and low alloy steel
Note-3: Type test - Supplier shall provide Type test certificate no older than 2 years

4.2.2 For application over austenitic stainless steel, perlite block and pipe sections shall also meet the requirements of ASTM C-692.

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4.2.3 Forms of moulded perlite

Nominal pipe diameter	Form of Fibrous Material
Up to 14 inch	Preformed pipe section
>14 inch & equipments	Pipe sections / Wedge cut from block

4.3 Calcium silicate

Calcium silicate block or pipe sections shall conform to general classification of IS 9428 (950 grade) or ASTM equivalent C533 TYPE II, shall be suitable for continuous service up to 927°C.

4.3.1 Material shall conform to the general classifications of respective ASTM / IS code and meet the following minimum properties:

Properties		Values	Remarks
Density (kg/m^3) as per IS 5688 / ASTM C302/303, min		240	Note-1
Linear shrinkage as per IS 5688 / ASTM C-356 at 927^{0}C for 24hrs, (%) max.		2	
Moisture content , by weight, max, %		20	
Compressive strength (of dry sample) at 5% deformation, kPa	IS 5688 OR	415	
	ASTM C165	688	
Heat resistance after exposure to 927^{0}C for 24hrs, as per IS 5688	(%) loss in weight, max	15	
	Compressive strength at 10% deformation, kPa, max	345	
Leachable Chloride as per ASTM C871, ppm, max		50	
Thermal conductivity (W/mK) at mean temperature as per IS 9490 / AST C-177	(+) 200 ^{0}C, max	0.072	Note-2
	(+) 300 ^{0}C, max	0.078	
	(+) 400 ^{0}C, max	0.084	
	(+) 500 ^{0}C, max	0.088	
Note-1: Batch test - Supplier shall provide test certificate for each production Batch *Note-2: Type test - Supplier shall provide Type test certificate no older than 2 years*			

4.3.2 Forms of calcium silicate insulation

Nominal pipe diameter	Form of Fibrous Material
Up to 14 inch	Preformed pipe section
>14 inch & equipments	Pipe sections / Wedge cut from block

4.4 Ceramic Fiber

Ceramic fiber is a fibrous insulation made from molten alumino-silicate compositions, fibers are mechanically interlocked through a needling process into blanket form

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without use of chemical binder, shall conform to general classification of ASTM C892 Type III, Grade 8 (1260°C Grade) and meet the following minimum properties:

Properties		Values	Remarks
Density (kg/m^3) as per ASTM C-167, min		128	
Linear Shrinkage (%) at 1200°C for 24hrs as per ASTM C-356, max		3	Note-1
Chemical composition	Al_2O_3, min	43	
	SiO_2, max	57	
	Fe_2O_3, max	0.1	
	TiO_2, max	0.3	
Mean fibre diameter (microns), 3% standard deviation		2.5-3.5	
Non fibrous shot (%) as per ASTM C-1335, max		20	
Tensile strength as per BS 1902 Part-6, kg/cm^2, max	Longitudinal	0.6	
	Transverse	0.5	
Leachable Chloride as per ASTM C871, ppm, max		50	
Thermal conductivity (W/mK) ASTM C-177 / IS 3346 at 600°C mean temperature, max		0.13	Note-2
Note-1: Batch test - Supplier shall provide test certificate for each production Batch *Note-2: Type test - Supplier shall provide Type test certificate no older than 2 years*			

4.5 Cellular Glass

Cellular glass is a closed cellular structured rigid insulation made from glass, a preferred material for cyclic service in the temperature range of (-) 200 to (+) 427 ^{0}C. The material conform to general classification of ASTM C552 Type-II, Grade-6, cut into pipe sections or profile of the substrate as per ASTM C1639 and meet the following minimum properties:

Characteristics		Values	Remarks
Density(kg/m^3), min. (ASTM C303)		98	Note-1
Closed cell content		100	
Compressive Strength (kPa) (ASTM C165), min.		414	
Flexural strength (kPa), ASTM C203, min.		283	
Water absorption (Volume %), max., (ASTM C240)		0.5	
Water Vapour Permeability, ng/Pa.s.m (ASTM E96)		0.007	
Thermal conductivity , w/mK (ASTM C518/ASTM C177)	(+)10°C, max	0.046	
	(-) 18°C, max	0.042	
	(-) 73°C, max	0.033	
	(-)101°C, max	0.030	
Surface burning characteristics as per ASTM E84	Flame spread index, max	5	Note-2

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	Smoked developed index, max.	0	
Note-1: Batch test - Supplier shall provide test certificate for each production Batch *Note-2: Type test - Supplier shall provide Type test certificate no older than 2 years*			

4.6 PIR / PUF Rigid Foam Insulation

Rigid PIR (polyisocyanurate) / PUF (polyurethane) is closed cellular structured plastic foam insulation. PUF is generally suitable for use up to 100^{0}C, whereas PIR can be used to little higher, up to 125^{0}C. Wherever in the specification PUF / PIR or PUF is specified, any of the two can be used, but wherever PIR is only specified, PUF shall not be used.

4.6.1 PIR shall be performed into free rise rigid buns using HCFC free chemicals and cut into pipe sections or required profile using a CNC machine. The material shall be chemically inert, moisture free, rot and vermin proof, shall not disintegrate, settle, change its form or composition in a detrimental way while in service, shall conform to general classification of ASTM C591 Grade-2 Type-II, suitable for application up to 125^{0}C and meet the following minimum properties:

Characteristics		Value	Remarks
Bulk density (kg/m3) ASTM-C302/ ASTM -D1622/ IS-11239, min		40	Note-1
Closed Cell content (%) ASTM D-6226 Procedure-2/ IS-11239 Part-5, min		95	
Chloride content (ppm) ASTM C 871, Procedure 2, max		60	
pH (ASTM C 871)		6-7	
Water vapour transmission (ng/Pa-s-m) ASTM E-96 method-A at 23°C & 50% RH, max		5.1	
Compressive strength at 10% deformation (kPa), ASTM D 1621, min		240.	
Flame spread Index as per ASTM E84 OR Horizontal burning as per equivalent BIS method, max		25	Note-1
Thermal conductivity of 180 days aged sample at mean temp (W/mK) ASTM C-177	(+)10 °C, max	0.024	
	(+)24 °C, max	0.024	
Note-1: Batch test - Supplier shall provide test certificate for each production Batch *Note-2: Type test - Supplier shall provide Type test certificate no older than 2 years*			

4.6.2 PUF shall generally be supplied in performed pipe sections or required profile using HCFC free chemicals from vendor shop. The material will have equivalent physical properties as of PIR except temperature limit shall be 100^{0}C and may exhibit higher horizontal burning characteristics compared to PIR.

4.6.3 In-situ foaming of polyuretnane (PUR)

Certain applications like tank may specify use in-situ polyurethane foam (PUR), where the insulation foam can be formed by in-situ injection of the chemicals into an enclosed volume that after curing will be converted into PUF. The quality of in-situ foaming can

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vary and depends on substrate temperature, ambient temperature, humidity etc. Every time the in-situ foaming going to be adopted, it requires demonstration through mock up for achievement of optimum quality. This shall only be used where in-situ PUR is specified and NOT to be used as replacement for preformed rigid PIR / PUF.

4.7 Flexible Aerogel Insulation

Flexible aerogel insulation is a composite of an amorphous silica-based aerogel, a fibrous carrying media, or reinforcements, or a combination thereof, that allow the construct to be flexible. The material shall be in accordance with ASTM C1728 Type-III, Gr.1A. The material shall have following general properties:

Characteristics		Value	Remarks
Temperature range (°C)		24 to 649	
Density (kg/m^3) ASTM C303, min		160	
Compressive Strength (kPa), min, at 10% deformation (ASTM C165)		20.7	
Linear shrinkage at maximum exposure temperature for 24h , max, % (ASTM C356) in length & width		2	
Water absorption, max, % by weight		8	
Water vapour sorption, by weight, max %, (ASTM C1104/C1104M)		5	
Flame spread index (ASTM E84) , max Smoke developed index (ASTM E84) , max		5 10	
Thermal conductivity (W/mK) at mean temperature (°C) (ASTM C177)	(+) 24 °C, max	0.021	
	(+) 149 °C, max	0.025	
	(+) 204 °C, max	0.029	
	(+) 260 °C, max	0.032	
	(+) 371 °C, max	0.043	
Note-1: Batch test - Supplier shall provide test certificate for each production Batch *Note-2: Type test - Supplier shall provide Type test certificate no older than 2 years*			

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4.8 Glass Wool

Glass wool is a fibrous insulation made from molten glass into fibrous form bonded with organic or inorganic binder and suitable for application up to 350°C. Glass wool blanket shall meet the requirements specified in ASTM C553 Type-I and meet the following minimum properties:

Characteristics		Values	Remarks
Density (kg/m^3) as per ASTM C-167, max		64	Note-1
Water vapor sorption % by weight, max, (ASTM C1104/C1104M)		5	
Chlorides, ppm, (ASTM C 871, procedure 2)		10	
pH values, (ASTM C 871)		6-10	
Thermal conductivity, W/mK (ASTM C518)	(+) 24 ^{0}C, max	0.030	Note-2
	(+) 50 ^{0}C, max	0.033	
	(+) 100 ^{0}C, max	0.040	
Note-1: Batch test - Supplier shall provide test certificate for each production Batch *Note-2: Type test - Supplier shall provide Type test certificate no older than 2 years*			

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4.9 Insulating Cement

Insulating cement is primarily composed of chopped rock wool and heat resistant cement and may contain inorganic fillers / suitable heat resistant binder. The material shall conform to general classification of ASTM C195 and shall be suitable up to 1038^0C.

Properties		Values	Remarks
Linear Shrinkage (%) (at 871°C) for 24hrs, max, ASTM C356		5	Supplier shall provide test certificate for each production Batch
Volume change (shrinkage) upon drying, max, ASTM C166		35	
Thermal conductivity, at mean temperature, ASTMC177	(+) 93 deg C, max	0.101	
	(+) 260 deg C, max	0.123	
	(+) 482 deg C, max	0.173	

4.10 Materials / Components for Specific Insulation System

Primary insulation type / combination and thickness shall be specified in Process design basis BEDB Part-B. Based on the insulation type and temperature range, additional components like moisture barrier mastic, foil etc. needs to be as per below guideline:

4.10.1 There is always a risk of water ingress into the insulation through joints of metal cladding. Hence, except specific applications were non-metallic cladding like UV cured GRP or HDPE are used, the risk of CUI needs to be addressed by appropriate material selection and moisture barrier system.

4.10.2 The risk of CUI is highest in the operating zone 50-175°C. Materials like Perlite, Cellular glass, PIR (up to 125°C) and PUF (up to 100°C) are preferable in this zone.

4.10.3 When a fibrous material like rock wool / glass wool is used in CUI risk zone (<175°C), a moisture barrier layer of breather mastic must be used underneath metal cladding.

4.10.4 A combination system with inner aerogel (5-10mm) + outer rock wool can provide good CUI prevention in low operating temperature (<175°C) and shall not require this breather mastic moisture barrier.

4.10.5 The breather mastic need not be used in CUI risk zone (<175°C) wherever moulded perlite or a closed cellular material like PIR/ PUF/ Cellular glass is used as insulation material and / or where a layer of aerogel is used in the innermost layer. The joints of the block insulations shall be sealed with appropriate joint sealant and a multiplex foil (commonly known as mylar foil) shall be used over the outermost insulation layer underneath cladding.

4.10.6 In general, the breather mastic and / or multiplex foil is not necessary above 175°C. However, for HP steam lines longer than 2km which uses rock wool as insulation, a layer of multiplex foil shall be used underneath the metal cladding. The multiplex foil need not be used where insulation is designed with perlite or rock wool in combination with a closed cellular material like PIR or aerogel on the outermost layer.

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4.10.7 Cellular glass be shall be chosen where any one of the following is a requirement:

a) Service is dual temperature, the lower range extents below ambient and upper limit of the exposure exceeds (+) 125 ^{0}C
b) The insulation requires fireproofing over it (epoxy intumescent or vermiculite)

4.11 Insulation thickness

Insulation thickness and thickness for inner and outer insulation for combination lining shall be specified in schedule of rate / equipment datasheet.

Unless otherwise specified, layering of insulation as given below shall be followed:

Insulation thickness (mm)	Number of layers
≤ 75	Single layer
76-150	Two layers
>150	Three layers

4.12 Form of Insulation

All the preformed insulation (Cellular glass, PIR, Calcium silicate, Perlite, Pipe section made from Rock wool etc.) should match the contour of pipe /surface profile of the equipment. Half sections or radial sections shall have longitudinal and circumferential faces flat and smooth so as to match with the other half/ section. Ends of the preformed half sections shall be flat and perpendicular to the center line.

Cellular glass shall be fabricated as per ASTM C1639.

Preformed rigid insulation blocks of PIR shall be cut from buns using CNC machine.

Application	Sections
Pipes up to 12 inch NB	Two half sections
>12 inch up to 20 inch NB	Max 3 radial sections
>20 inch NB	Max 4 radial sections
Equipments, Vessel shells	Machine cut radial sections in required contour of the substrate/ underneath layer
Vessel heads	Manually cut slabs contoured to the profile of vessel heads is acceptable

5.0 ANCILLARY MATERIALS

Hot insulation system shall have the following ancillary components:

Primary components	Secondary components	Other ancillaries
• Multiplex foil • Weather protection Jacket • Protection guard	• Heat transfer cement • Painting • Expansion joint • Sealing tapes • Adhesive	• Band • Sealant for cladding • Screw • Clips • Rivets • Compression spring

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5.1 Weather Protection Jacket (Cladding)

5.1.1. Insulation shall be protected with cladding. Type of cladding shall be as below:

a) Unless otherwise mentioned, aluminium jacketing shall be used as weather protection cladding up to temperature 550 deg C. Aluminium cladding shall be as per ASTM C1729, Class-A having polysurlyn lamination on inside surface and shall meet the requirements of ASTM B209 alloy 3003 H14. Equivalent IS code shall be acceptable for the metal sheet.

b) For temperature above 550 deg C and/ or for fire safe insulation (for all temperature range) cladding shall be stainless steel or aluminized steel as per ASTM A167 / A240 type 304 or aluminized steel as per ASTM A463, type 2, coating designation T2-100, with polysurlyn lamination on inside surface. Equivalent IS code shall be acceptable for the metal sheet.

c) For grade piping in offsites jacket material shall be galvanized steel. Galvanized jacketing shall not be used over insulation on or near austenitic stainless steel and/or austenitic nickel steel Piping & Equipment. Galvanized steel shall be as per ASTM A526 with 275 gsm of coating of Zinc Layer on both the surfaces. Equivalent IS code shall be acceptable for the metal sheet.

5.1.2. Thickness of metal cladding shall be as follows:

Application	Thickness for Aluminium cladding	Thickness for Stainless steel /Aluminized steel cladding
For shells of vertical storage Tanks & Vessels	0.7lmm (22 SWG) Corrugated; The profile of corrugated sheet shall be 32mm x 5mm	0.56mm (24 SWG) Corrugated; The profile of corrugated sheet shall be 32mm x 5mm
For tank Roofs	1.22mm (18 SWG) Flat	0.91mm (20 SWG) Flat
For Horton Spheres & Horizontal vessel shell and heads; vertical vessel heads	0.7lmm (22 SWG) Flat	0.56mm (24 SWG) Flat
For removable covers	1.22mm (18 SWG) Flat	1.22mm (18 SWG) Flat
For all piping, other than grade piping in offsites	0.7lmm (22 SWG) Flat	0.56mm (24 SWG) Flat
For grade piping in Offsites	0.56mm (24 SWG) Galvanized steel (Refer note below)	

Note: For grade piping in offsites the cladding material shall be Galvanized steel.

5.2 Securement Bands / Wires

1 If material is Aluminium, then specification shall be ASTM B209 Alloy 3003 H16, If Stainless Steel, it shall be 18/8.

2 For securing fibrous insulation

A On Piping
Band, 24 SWG thick x 12mm (min) wide, Stainless Steel.

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B On Equipments
Band, 24 SWG thick x 20 mm wide, Stainless Steel.

C On Vertical Storage Tanks
Band, Stainless Steel, 25mm wide x 24 SWG thick.

D Horton Sphere
16 SWG SS Wire & Band, Stainless Steel, 25mm wide x 0.8mm thk.

3 For Securing Rigid Insulation

A On Piping upto 16" OD
Wire, stainless steel, 16 SWG.

B On Piping 18" OD & Larger, Vertical and Horizontal equipments
Band, stainless steel. 20 wide x 24 SWG thick.

4 For Securing Cladding on Insulation (all types)

A For Piping
Band, SS 12mm (min) wide x 24 SWG thick.

B On Equipment
Band, SS, 20mm wide x 24 SWG thick.

C On Vertical Storage Tanks & Spheres
Band, Stainless Steel, 25mm wide x 24 SWG thick.

5.3 Compression Spring

Compression spring (commonly known as MITY spring) shall be used on jacketing over tank, pressure vessels and equipment. The compression springs shall be of 100mm length made of SS 302 / SS 304 stainless steel, shall not be stretched more than 13mm during installation.

Requirement for springs on banding to secure metal jacketing shall be as follows:

Equip. OD	Equip. Circ.	Number of Jacket Expansion Springs					
		Steel Temperature					
(m)	(m)	93°C	204°C	315°C	427°C	538°C	649°C
1	2.9	0	0	0	1	1	1
2	5.7	0	1	1	1	2	2
3	9.6	0	1	2	2	2	2
4.6	14.3	1	1	2	3	3	4
6	19.1	1	2	3	3	4	4
7.6	23.9	1	2	3	4	5	6

5.4 Rivets

Rivets required for metal jacket securement shall be the expanding Aluminium "POP" blind eye type/ Stainless Steel, 9.5mm long x 5mm diameter.

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5.5 Screws

Screws required for metal jacket securement shall be Stainless Steel/cadmium plated steel self tapping type A No.8 dia. x 12mm long to BS 4176 complete with neoprene washers under the head.

5.6 'S.' and 'J' Clips

Formed from 25mm wide stainless steel banding.

5.7 Heat Transfer Cement

Maximum Exposure Temperature: 677°C
Heat Transfer Coefficient to Equipment wall: 114-227 W/m^{2o}C
Bond Shear: 1.034 kPa
Electrical resistivity: 1.299 ohm/cm

5.8 Sealant for Cladding

Sealing materials which may either be in the form of a elastomeric sealing compound or fibre based bituminous felt strips.

The technical requirement and typical elastomeric material for joint sealant of metal cladding (aluminium and stainless steel) is specified below.

General Characteristics	Combustibility/ fire resistance	Water vapour permeance (max)
Average 52% volume solid as per ASTM C461	FSI (flame spread index) $\leq$ 20 as per ASTM E-84, tested on a 6.3mm inorganic reinforced cement board with DFT ~2mm	0.0092 metric perms (as per ASTM F-1249 with DFT 2.8mm)

5.9 Moisture Barrier (Breather Mastic)

When a fibrous material like rock wool / glass wool is used in CUI risk zone (<175°C), a moisture barrier layer of breather mastic must be used underneath metal cladding. The moisture barrier shall be a polymeric water based, breather type mastic (vapor under pressure will pass through it), fire resistive, flexible and be compatible with the type of insulation. Material shall be suitable for the range of temperature to which it is exposed.

Material shall be evaluated for fire resistance as per as per ASTM E-84 (flame spread index ~10) and water vapour permeability in accordance with ASTM E96, procedure-B >1perms for 1/16'' thickness. Average nonvolatile content: 60 to 64% by volume (64% by weight).

5.10 Multiplex Foil

Multiplex foil may be used as an alternative to mastic moisture barrier in specific applications (details shall be as per respective SOR). Multiplex foil shall consist of sandwiched sheets of aluminium and polyester be applied over the insulation prior to weather protection jacketing. It shall confirm to the following requirements:

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Foil composition:	12 µm polyester film
	25 µm aluminum foil
	12 µm polyester film
Tensile strength Yield strength Tear resistance	100 MPa 70 N / cm 400 g / mm
Temperature range	+120°C to -60°C
Volumetric mass	1.93 kg / dm³
Water vapour permeability in acc. with ASTM E 96, procedure E (37.8°C, 90% RH)	max. 10.10-6 g / (m².h.mmHg)

5.11 Sealing Tapes for Multiplex Foil

The sealing tape for joints in the multiplex foil shall meet the following requirements:

Foil composition	12 µm polyester film
	25 µm aluminium foil
	12 µm polyester film
	adhesive layer: polyacrylate
Total thickness exclusive of adhesive layer	50 µm
Temperature range	+120°C to -45°C
Volumetric mass	1.93 kg / dm³
Water vapour permeability in acc. with ASTM E 96, procedure E (37.8°C, 90% R.H.)	Max. 10.10-6 g / (m².h.mmHg)

5.12 Joint Sealant for Insulation Blocks

The joint sealant for joints between insulation blocks shall be compatible with the base insulation material and suitable for the temperature range to which it is exposed. Typical material and technical requirement for PUR/PIR insulation system is specified below. For cellular glass insulation, compatibility or specific products shall be recommended/ confirmed by the cellular glass supplier

General Characteristics	Combustibility/ fire resistance	Water vapour permeance (max)
Average 82% volume solid as per ASTM D2369	Flame spread ASTM E-84 and fuel contribution negligible when used as 3.2 mm wide sealant between joints of incombustible insulation blocks	Negligible when measured across 3.2 mm wide sealant between joints of impermeable insulation blocks

5.13 Protection Guard

Guards and their supports shall be manufactured from carbon steel, which may be galvanized or painted or with Stainless Steel (SS-304). (The mesh may be painted with yellow stripes, 50 mm wide, and shall include a hazard sign indicating ‘Hot surface’.).

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The guard mesh shall be of 2mm thick and 12 mm square. Guard shall be designed with end cap of 0.7 to 1mm thk from galvanized Al-Zn coated or Al coated carbon steel with recommended spacing of 450mm to 600mm. Care to be taken that end caps are fitted in an orientation that will allow water drainage. If the metal surface requires greater protection, a fibre glass insulation tape can be fitted to area where end caps make contact to protect pipe work and reduce heat transfer. Mesh shall be rolled to shape as per normal cladding and shall be provided with 50 mm of overlap, sharp edges of cut mesh to be filed. In case of removable guard, the same can be made from toggle clips.

In case of protection guard for small bore piping, perforated metal sheet may be used. Sheet thickness shall be 1mm.Perforation hole shall be minimum 5mm, with minimum 40% free passage. Steel sheet shall be stainless steel in accordance with ASTM A167, type 304.

6.0 APPLICATION

6.1 General Requirements

6.1.1 The application methods, given in this specification are general in nature. The Contractor is responsible for applying an insulating system that will give a satisfactory operational performance and the requirements given herein shall be regarded as the acceptable minimum. The Contractor shall carryout the work in accordance with the best practices of insulation application with the minimum of waste and debris and the final job shall have a neat, efficient and workmanlike appearance.

6.1.2 The insulation shall be so designed/ applied such that ingress of water is prevented, leaked product can drain off and vapour can escape.

6.1.3 All hydrostatic tests on piping and equipment, including steam tracing systems, shall be carried out before insulating material is applied. The insulation Contractor shall only insulate those sections of the plant that have been specifically released for such work by the engineer-in-charge. If insulation must be installed before pressure test, then all welds and flanged joints in the pipe shall be left uncovered till successful completion of pressure test. Then insulation shall be completed.

6.1.4 Co-ordination with Other Agencies

Contractor shall work in close co-ordination with the erection Contractor. Wherever temporary supports are provided the contractor shall remove these and provide necessary support as per standard or as specified in the bid package/tender.

6.1.5 Surfaces to be insulated shall be thoroughly cleaned, dried and made free from loose scale, oil or grease. It shall be the Contractor's responsibility to remove loosely adhering scale and dirt before applying insulation.

6.1.6 Under Insulation Painting

Equipments and piping shall be protected from corrosion by providing appropriate painting under insulation, as per applicable painting specification for the project. Austenitic stainless steel especially 300 and 400 series are susceptible for external stress corrosion cracking (ESCC). For to avoid ESCC in stainless steel, 0.1mm thick aluminium foil up to 550°C, above which stainless steel foil can be wrapped with an overlap of 50mm. Overlap joint shall be sealed with barium chromate sealer or self-

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adhesive (chloride free) aluminum tape at the edge of foil. Foil shall be secured in position either by pressure sensitive tape or aluminium band.

6.1.7 The insulation contractor shall not carry out any welding or drilling on plant equipment and piping.

6.1.8 Wet or Damaged Insulation shall not be used under any circumstances. Material awaiting its protective cover shall be adequately protected from damage, rain and contamination and shall be covered with cladding at a minimum loss of time.

6.1.9 Insulation shall be finished, bevelled and weatherproofed at all terminal points where it is required to remove bolts etc. without damage to the insulation.

6.1.10 Equipment nameplates shall remain visible after insulation has been applied by bevelling back the insulating material and carefully sealing the exposed edges to prevent ingress of moisture.

6.1.11 All projections, such as lifting lugs, trunnions and stiffeners on piping and equipment (i.e. vacuum rings) shall be insulated with the same thickness of insulation as specified for the equipment item or pipeline.

6.1.12 Thermowell bosses, pressure tappings and weephole nipples shall not be insulated in but left accessible.

6.1.13 A minimum clearance of 25mm between outside surface of any insulation finish and adjacent equipment, pipe or structural members shall be maintained.

6.1.14 Insulation supports shall not project out of the insulation outer surface and shall be given sufficient coverage of insulating material to avoid hot spots on the metallic cover at support positions.

6.1.15 Where insulated horizontal piping is supported on steel shoes, the height of the shoe shall be such that the underside of the insulation finishing material is clear of the supporting structure upon which the shoe rests by 25mm minimum.

6.1.16 Pieces of insulation with crushed and damaged ends shall not be used.

6.1.17 Packing and transport to site

Insulating materials should be packed in cartons, crates, bags or shrink film wrapping to minimize mechanical damage and to provide adequate weather-protection and to avoid contamination. Preferably, insulating materials should not be unpacked on site until required for immediate use.

All forms of packaging of insulating materials should be carefully marked. The marking should indicate the type of material and the size, thickness, quality, and quantity contained in each package.

6.1.18 Protection of Materials During Storage

Insulation materials must be protected against any damage, from delivery to finish cladding. Decking and covering with tarpaulins alone are not considered sufficient protection from weather for any length of time and shall not be permitted. Insulation material slabs, blankets and sections shall be stored on a flat surface in a horizontal

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position. Insulation material shall never be stacked directly on the ground. The contractor shall make own arrangement for covered storage for insulation materials as directed by the Engineer-in-Charge.

6.1.19 Protection of Partially Completed Jobs

Precautions must be taken to ensure that each day's work is adequately protected before being left over-night to prevent seepage of water. Unfinished / partially finished / ongoing insulation jobs shall be protected from water ingress by appropriate water shed / wrapping and other protective means.

6.2 Piping Applications

6.2.1 Horizontal Pipe

a) General

Insulation material shall be applied to fit snugly against the contours and shaped only where necessary to achieve this requirement

b) Pipe Section / Moulded Blocks / Segments

- End joints of adjacent blocks shall be staggered one half of the length of the block.

- Included angle between segments shall not be less than 30 deg. for both single and double layer insulation.

- Further, minimum arc length of segments should meet following staggering requirements.

When double layer is applied, both longitudinal and circumferential joints shall be staggered. The arc between the longitudinal seam lines of the inside and outside layers of insulation shall have an angle of over 15 deg. or the longitudinal joints staggered at least by one-layer thickness, whichever is more stringent. Circumferential seams of the inside and outside layers shall be at least 100mm apart.

c) Blankets (Fibrous insulation) shall be applied over the surface with joints tightly butted and laced together with stainless steel lacing wire.

d) Insulation Securement (All insulation materials)

Each layer of insulation shall be secured firmly in place with at least 3 loops of binding wire / band, one loop to be placed not more than 75 from each end and at least one loop to be equally spaced between end loops, for each section.
Binding wire shall be drawn about the insulation with ends tightly twisted together, bent under & pressed into the surface of insulation. Bands or wires in no case be spaced more than 200mm apart.

- For calcium silicate and moulded expanded perlite, all joints shall be sealed with insulating cement of same composition as the Moulded block.

- For Cellular glass, Polyurethane foam and polyisocyanurate, joints shall be sealed with suitable compatible material

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e) Frame work for supporting cladding fibrous insulation

This is not necessary for rigid materials. This is required only for horizontal pipe runs provided with fibrous insulation, in blanket forms; vertical piping provided with fibrous materials need not be provided with this. Piping provided with fibrous resin bonded pipe sections also need not be provided with this framework.

Spacer rings shall be fabricated out of 25x3 M.S. Flats. The outside diameter of these rings shall be equivalent to the outside diameter of the insulation. Spacer rings shall be riveted to 'Z' shaped stays fabricated from the same sized M.S. Flats. These rings shall be suitably painted for corrosion protection. Stays shall be provided at intervals of not more than 300 along the circumference of the insulation, subject to a minimum of 3 stays. Spacer rings shall be provided at every approx. 900. To minimize direct heat conduction through the stays, a packing of 2 sheets of 3 thick CF paper shall be provided at the joints of the stays and pipes. Joints between M.S. Spacer Ring and stays shall be riveted by 6 dia M.S. Rivets with 2 Sheets of 3 thick mill board interposed.

6.2.2 Vertical Pipe

Insulation on vertical or near vertical piping (i.e. greater than 45 deg. angle from horizontal) shall be supported by bolted on metal collars. Metal collars shall be of 6 thick M.S. or Alloy Steel bar (to suit piping material).

Outside diameter of collar shall be around 12 less than O.D. of insulation. Where multi-layer insulation is used, support collar shall be extended to provide for each layer.

Support positions shall be at no greater distance apart than the following:

Pipe operating Temp.(°C)	Support Spacing (mm)
Upto 400	4500
401 to 500	3500
501 to 550	2500
551 to 650	2000
651 to 760	1500

6.2.3 Expansion Joints (Both vertical and horizontal piping. Rigid insulation Materials)

Expansion joint shall be provided at regular intervals as below:

Temp.(°C)	Spacing (mm)
Upto 200	Not required
201 to 300	10
301 to 350	8
351 to 400	6
401 to 550	5
551 to 650	4
651 to 760	3

Expansion joint shall be formed by a 25mm space between the pipe insulation sections and the space shall be filled by compressed loose rock wool. Expansion joints in each layer shall be offset at least 150 from each other in case of multi-layer insulation.

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Expansion joint for first layer for vertical pipe shall preferably be just below insulation support collars.

6.2.4 Elbows and Bends (All insulation materials)

Insulation material shall be mitred and shall be same as that of pipe. Insulation securement bands/wire shall be same as that for equivalent dia pipe. Each mitred section shall be secured with minimum 2 wires/bands. For bends / elbows of nom. pipe size 6" & below, due to lack of space, for all insulation materials, insulation shall be secured by spirally wound 16 SWG SS wire for hard materials & 10 SWG SS wire for soft materials.

Insulation joint for calcium silicate shall be suitably sealed by insulating cement. Fittings below 50mm nom. dia, if insulated of calcium silicate shall be insulated with insulating cement build up in 6mm layers to the thickness of insulation of the adjacent piping. Each layer of insulation cement shall be reinforced with 25mm No. 20 SWG wire netting.

6.2.5 Tee (All Insulation Materials)

Preformed pipe sections or segments shall be carefully cut and shaped around "Tee,' junctions and the insulation material of the tangential pipe shall be carefully and neatly cut to mate upto the material applied to the parent pipe without the creation of voids or gaps, at the junction. Insulation shall be adequately secured by wire / bands of same specification as that of same size pipe.

6.2.6 Flanged Joints or Valves (all insulation materials)

Flanged Joints or Valves, if to be insulated, shall be insulated with removable type insulation.

6.2.7 Insulation Flashing (all insulation materials)

Insulation shall be stopped short of flanged joints and unions by a sufficient distance to permit easy removal of the flange nuts and bolts or breaking of the unions to take place without disturbance or damage to the insulating material. At these positions the insulation shall be beveled and sealed with a metal closure which in turn shall be sealed with waterproof sealing material.

6.2.8 Pipe Supports: (All insulation materials)

Insulation at solid welded or clamped supports shall be cut and shaped to fit around the support and banded securely to enable the insulation to be carried with the pipe movement. When the pipe hangers pass through insulation on piping outdoors, metal hoods packed with a waterproof sealing material shall be furnished and installed. Upper bolts of the hanger clamps are not to be covered with insulation.

6.2.9 Steam Traced Piping (All insulation materials)
Steam traced piping and fittings shall be installed with oversized sections to allow accommodation of both parent pipe and tracer without damage or deformation of the insulation. Traced instrument line and fittings shall be totally enclosed by the insulation in a similar manner and the designed warm air annulus maintained throughout the tracer pipe length. Insulation supports for vertical pipe shall have suitable clearance for tracer pipe. Composite box type insulation may be provided on the steam supply lead lines, in case they are routed together similarly this may be provided for the return lines to manifolds after the run of tracers.

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6.2.10 Electrical Traced Piping

Electrical traced piping shall be provided with the same size insulation as would be provided if the piping were not electrically traced, unless otherwise specified.

6.3 Horizontal Equipments

6.3.1 Application in horizontal vessel

a) The vessel fabricator shall provide insulation cladding support /securement as per fabrication drawing / standard. Insulation contractor shall verify the same before commencing.

- For vessels of diameter 2000mm and above are provided insulation support at horizontal centre line as also vertically at tangent lines. Ring support at tangent lines are provided with 6mm diameter holes. These are to be used for insulation securement.

- At vessel heads above 600mm outside diameter are provided flats having 6mm dia holes. The flats are for insulation support and holes provided in them are to be used for insulation securement.
  Also provided on either head is a central ring made of 10 dia stainless steel rod.

- Boot of vessel, if any, is provided with circular support ring with holes, as indicated in sketch.

b) Blanket shall be applied over the surface with joints tightly butted and laced together with 1mm dia stainless steel lacing wire.

Other block insulation shall be applied with the longer dimension parallel to the axis of the vessel or equipment. When blocks are applied in multiple layers, all joints in successive layers shall be parallel to the long axis, shall be staggered and sealed with suitable sealant.

6.3.2 Insulation Securement

Each layer of insulation on shells of equipment shall be secured by bands at every 300 centres. Each band shall be machine stretched and tensioned to remove slack only. Each layer of insulation on vessel heads shall be secured as follows:

Band shall be in radial direction connecting the head central floating ring and shell girth ring. The radial bands shall be placed at not more than 150 centres for rigid and 300 for fibrous insulation, measured at the girth ring. These bands shall be machine stretched and sealed. Outermost layer of insulation shall also be supported by drawing and securing 16 SWG annealed wire through the 6 diameter holes provided in the shell girth ring as also the flats provided on heads. The wire shall be drawn through every hole and it shall be secured to the ring with a knot.

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6.4 Vertical Equipments

6.4.1 Application in vertical vessel

Application details on shell, top and bottom heads shall be similar to that of horizontal equipment. Insulation shall be laid on insulation support rings provided by the fabricator.

6.4.2 Insulation Securement (For all insulation materials)

Bottom and Top Head insulation shall be supported by 16 SWG SS wire drawn through holes in the insulation supports provided by the fabricator.

Top head insulation shall be secured by floating ring/bands provided by vessel fabricator similar to head of horizontal vessel.Shell insulation shall be supported by bands at every 300 centres on the cylindrical portion and the bands shall be kept horizontal.

Insulation Securement for Bottom head for vessel supported on legs shall be identical to that of Top head.

For insulation securement of bottom heads inside skirt no floating rings/bands need be provided; Firm securement should be ensured just by 16 SWG annealed SS wire drawn over insulation tightly and through the holes on support rings provided by the fabricator.

6.4.3 Expansion Joints (For rigid insulation)

Expansion joints shall be provided every 4000mm (max.). The expansion joint shall be provided at insulation support rings. It shall be a 25mm space between the top of the insulation and the bottom of the support ring. The space shall be filled up by compressed rockwool fibre.

6.5 Flange, Nozzle, Channel Cover, Manway & Handhole Flanged Cover (For All Insulation Materials)

Where insulation is required, these shall be insulated with lined removable prefabricated covers secured with bands or quick release toggle clips.

Otherwise, insulation shall be stopped short of uninsulated flanges and nozzles etc., a sufficient distance to permit withdrawal of bolts without disturbing the insulation. Insulation shall be weatherproofed and sealed at these locations.

6.6 Application over Irregular Surfaces Such as Pumps, Compressors, Turbines etc.

a) Rockwool: This shall be prefabricated removable covers, lined with pipe sections / lags / slabs / mattresses.

b) Calcium silicate/ Moulded expanded perlite: Insulation material shall be loose fill insulating cement/block insulation cut and fitted.

Insulation shall be applied in maximum 25mm thick layers until the scheduled thickness is obtained.

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Each layer shall be covered with a layer of 25mm hex. 20 SWG galvanised iron wire mesh for other than SS surfaces and with SS wire mesh for SS surfaces. The final layers shall be trovelled to a smooth finish with a 6mm thick finishing cement.

Insulation shall be beveled back at 45 deg. from all casing flanges, shaft seal caps and bearing boxes.

6.7 Vertical Storage Tanks (Carbon Steel)

a) Supporting rings / spikes (rods) for supporting insulation / cladding

- Shell

The extent of insulation/ cladding support/ securement details shall be as per the relevant tank fabrication standard/ drawings. Insulation contractor shall check for its presence before insulation application work.

Water Shed

At the junction of shell and roof, a watershed is provided to act as top covering for the shell insulation. The details of water shedding shall be as per the relevant tank fabrication standard/ drawings. Insulation contractor shall check for its presence prior to insulation application work.

Insulation Support

Insulation support will consist of 5mm dia steel rods provided at 400mm dia diamond pitch. Length of these lugs is 3mm less than insulation thickness.

Cladding Support

From tank top, horizontal rings shall be provided at every 1175mm on tank shell.

- Tank Roof

Shall be provided as per relevant tank fabrication standard.

b) Insulation laying and securement

- Shell (Application of fibrous insulation)

Insulation shall be applied between rings in horizontal mode. Mattresses insulation shall be applied with joints tightly butted and laced together with 1mm dia. Stainless steel lacing wire. Matts shall be impaled to the 5mm rod and speed washers fixed and pressed home for intimate contact of the insulation. In the case of multiple layers, speed washers are necessary only over the final layers, (upto and including 150mms). Rods and speed washers of spring steel should be selected to suit each other. While rods are provided by tank fabricator, speed washers shall be furnished by insulation contractor. Insulation shall be further secured by bands spaced centrally between insulation supports.

- Shell (Application of Polyisocyanurate / Polyurethane foam)

Shall be foamed cast in-situ as per vendor's procedure (approved by Client/Client's representative) and to the satisfaction of Site-in-Charge. The

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minimum requirement for thermal conductivity, density, compressive strength, fire properties and water vapour permeability shall be as specified herein this specification. Contractor shall ensure that cladding & band thicknesses are capable of withstanding foaming pressures which are developed at the time of injection of foam. Contractor can use foamed cast in-situ insulation only after getting the approval to material specification and application procedure.

- Roof (For all materials)

  Application fibrous insulation, Polyisocyanurate / Polyurethane foam shall be similar to that as for shell. Insulation support from 5mm dia M.S. lugs shall be exactly same as in shell.

6.8 Horton Spheres

c) Structural members provided by spheres fabricator for insulation/cladding securement. Insulation & Cladding supports shall be as per relevant sphere fabrication standard

d) Insulation laying and securement

Insulation shall be applied between rings. Insulation shall be applied with joints tightly butted and laced together with 1mm dia galvanized lacing wire.

Insulation shall be secured by drawing and securing tightly 16 SWG stainless steel wire through the 6 dia holes, provided every 200 centres, in the horizontal leg of the insulation support angle ring. The wire shall be rightly drawn over the insulation and the insulation firmly secured. The wire shall be drawn through every single individual hole and it shall be secured with angle with a knot at every fourth hole.

6.9 Inspection Windows

Removable plug type inspection window shall be provided on the outside thermal insulation metal jacketing to facilitate the maintenance inspection of substrate. The removable plug shall be made of silicon rubber and secured with small chain or lanyard made of stainless steel. Sealing flange shall be made of stainless (SS-304). An O-ring made of rubber shall be placed for any metal seal flange for proper retrofit.

Plug flange shall be fixed by screws and washers to outside metal jacketing and same shall be silicon sealed for a perfect watertight assembly sealing.

When inspection window installed on corrugated metal jacketing, a neoprene transition gasket shall be installed between cladding and flange

6.9.1 Piping

Plug type inspection windows of ellipsoidal shape shall be provided on all the insulated pipelines having diameter 2” and above. The locations of inspection plugs shall be as follows:

- Straight section:

  Two inspection window at 0-6 o’clock position shall be provided at a distance of every 12 meters.

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- Bends/Elbows:

  There must be three inspection window shall be installed near the bends. In case of no supports are welded at the centre of the elbows, one inspection window at the centre of the outer arc and another two at 100 mm away from the above and downstream of the plug. In case of supports are welded at the centre of the elbows, one on side of the elbows and another two at 100 mm away from the support upstream and downstream.

- Tee joints:

  Two no. inspection window shall be installed, one at the Tee bottom and another at the side of Tee.

6.9.2 Exchangers

All the heads shall be provided with one inspection window each. Minimum two inspection windows shall be provided on the shell side.

6.9.3 Columns & Vessels

Heads shall be provided with one inspection window each. One inspection window shall be provided at every platform. Minimum two inspection windows shall be provided on shell portion.

6.9.4 Tanks

One inspection window shall be provided at each course of the tank and also at the top.

6.9.5 Dimension of Inspection window

Application	Size
Pipe dia 2''	35mm minor diameter x 120mm major diameter
Pipe dia 3"	45mm minor diameter x 120mm major diameter
Pipe dia 4"	75mm minor diameter x 120mm major diameter
Pipe dia 6"	100mm minor diameter x 120mm major diameter
Pipe dia 8"	100mm minor diameter x 120mm major diameter
Pipe dia > 8"	120mm minor diameter x 120mm major diameter
Exchangers, Columns& Vessels and Tanks	120mm minor diameter x 120mm major diameter

6.10 Impulse Lines for Heat Traced Lines

Wrap the impulse lines with insulation (Sodium Silicate inhibited Ceramic rope) of required thickness after cleaning the impulse lines from dust, rust, grease etc. Ensure that the rope(s) have been tightly wrapped without leaving any gaps. Apply two layers of self adhesive Aluminium foil tape of minimum 0.1 mm thick spirally bound over the fibre rope surface with the joints in two layers staggered. Ceramic rope shall have minimum density of 250 Kg/m^3, other property like maximum use temperature, tensile strength, linerar shrinkage, non-fibrous content etc. shall meet the requirement specified as per ASTM C892, Type III. A suitable sealant shall be provided to stop the water ingress at the termination points of insulation.

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Note: Impulse line insulation details shall be as follows:

Size of Impulse line (inch)	Temperature (°C)	No. of layers	Thickness of each layer (inch)
1/2	150	2	1/2
3/4	150	2	1/2
1/2	250	2	3/4
3/4	250	2	3/4

6.11 Impulse Lines for Hot Insulated Lines

Wrap impulse lines with sodium silicate inhibited ceramic fiber rope (SS-wire braided) with thickness of layer as 3/4" irrespective of temperature, after cleaning the impulse lines from dust, rust, grease etc. The wrapping of the rope around impulse line shall cover it completely without leaving any gap. Apply two layers of self adhesive Aluminum foil tape of minimum 0.1 mm thick spirally bound over the fiber rope surface with the joints. Ceramic rope shall have minimum density of 250 Kg/m³, other property like maximum use temperature, tensile strength, linerar shrinkage, non-fibrous content etc. shall meet the requirement specified as per ASTM C892, Type III. A suitable sealant shall be provided to stop the water ingress at the termination points of insulation

6.12 INSULATION FINISH

6.12.1 Multiplex vapor barrier

In case of closed cell material (Cellular glass, perlite etc.) in CUI risk zone and on PIR in case of electrical tracing and multiplex vapour barrier shall be applied over the outer surface of Insulation. The joints of the vapor barrier foil shall be overlapped by 50mm. The joints shall be sealed with a tape confirming to the specification as mentioned herein in this specification.

6.12.2 Moisture Barrier

(Applicable for application on outer surface of the fibrous insulation in CUI risk zone)

The mastic shall be applied in two coats with glass cloth reinforcement such that total dry thickness is ~ 3mm.

Immediately after the insulation, a 3mm thick coating of the mastic shall be applied to the surface and a glass cloth shall be laid over the surface and embedded in the mastic. Care shall be taken to ensure that the glass cloth is laid smooth and free from wrinkles and that no pockets of air are trapped beneath the surface. The glass cloth shall have min 75mm overlap at joint. A second coat of 3mm shall be applied after approximately 12 hrs. During the drying time, the insulation shall be protected from the weather by "Alkathene" film type tarpaulin or similar materials approved by engineer-in-charge.

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6.12.3 Insulation Finish with metal jacketing

The insulation finish shall provide a weatherproofed and covering over the whole of the insulated areas and be applied and fitted in such a manner as to provide a close fitting assembly without gaps.

a) Piping

- Straight pipe shall have metal jacketing cut and machine rolled, (approx. 1metre long) wrapped around, with 50mm minimum overlaps on both longitudinal and circumferential overlaps. All laps shall be arranged to shed water.

- A single bead shall be made on all overlaps to ensure tight metal to metal water tight arrangement. Self-tapping screws, at every 150, shall be provided at all longitudinal overlaps for both horizontal & vertical piping.
- At all operating temperatures the seams at overlap positions shall be rendered watertight to ensure that insulation remains dry and unwetted, whether the possible water impingement is from rain, hose or fire sprinklers.

- The metal coverings shall be secured tightly around the insulated pipe and held in place with bands on a maximum of 300mm centres. One band shall be located on each circumferential lap and the distance between laps divided at equal band spacings. The band securing seals shall be kept neatly in line and positioned away from viewing angles as much as is possible.

- Vertical overlaps on vertical or near vertical piping shall be staggered to provide overlaps at 'North,' and 'South' positions in alternate sections of covering.

- Each sections of metal covering on vertical piping with insulation OD's larger than 250mm shall be supported from the next lower section with two ‘S' clips, fabricated from banding material. The ‘S' clip shall be of sufficient length to allow the minimum overlap of 50mm.

- On vertical piping with OD's of 600mm and larger, the securing bands shall be supported by ‘J’ clips, fabricated from banding material. The ‘J’ clip spacing shall be a minimum of two per band. All ‘J’ clips shall be screwed into position and secured.

- Insulated bends and elbows in piping 80mm and larger, shall be metalled with 'lobster back' segments using 10mm minimum ball swage to assist shaping. The metal bands shall be screwed with self tapping screws and metal sealants are to be provided to get a completely waterproofed arrangement.

- Insulated bends and elbows in piping smaller than 80 mm may use complete pressed and humped back flat metal elbows or fabricated 'stove pipe' elbows.

- The practice of locating all joints in the top portion of elevated horizontal pipes for the sake of good appearance when looking up from grade shall be strongly discouraged. The joints shall be located to shed water.

b) Equipments

- The metal jacket over vertical vessel shells shall be constructed of sheet metal panels with the weight of the panel taken on the equipment insulation support rings, via angle brackets bolted to the panel.

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- The panels shall be applied commencing at the bottom of the vessel. Each circumferential ring of panels shall be tensioned by means of tensioning bands until the final joint is screwed tight. 'S' clips shall be used as sheeting support at unscrewed circumferential overlaps.

- The panels shall be held tight over the vessel insulation by means of circumferential bands and sealed. The bands shall be positioned on all horizontal overlaps and at 300mm centres. Bands shall be held in their relative positions with 'J' clips fastened to the jackets with screw. Each band shall have J-clips on 1.8m maximum centre but not less than four J-clips per band. Each band shall have compression spring as specified in this specification.

- The panels shall have a minimum overlap of one corrugation on vertical joints and 80mm on horizontal joints. The overlaps shall be arranged to shed water at all times.

- The vertical and horizontal overlaps shall be secured with self tapping screws at 150mm pitch except the horizontal overlaps pre-selected to act as expansion joints, these shall be constructed with a 150mm overlap and shall remain unscrewed and left free to permit expansion. All overlaps shall be rendered watertight.

- All equipment projections such as nozzles, shall have the jacketing sealed using a metal flashing, cut to fit the projection and extending above the jacket at least 80mm. The seal between the flashing and jacket shall be made watertight by use of self-tapping screws and sealing mastic.

- Horizontal cylindrical equipment shall be furnished with flat metal jacket arranged in circumferential bands with the edge of the sheets, with the longer dimension applied around the circumference of the equipment insulation.

- The panels shall have a minimum of 80mm overlap of both longitudinal and circumferential edges, both overlaps being finished with a simple ball swage and rendered watertight.

- Horizontal overlaps shall be secured with No. 8x12mm long self-tapping screws set in the overlap at 150mm intervals and shall be so arranged that staggered bands of panelling encircle the equipment. Vertical overlaps shall not be screwed for horizontal equipment.

- The metal finish shall be banded and sealed at 450mm centres.

- The insulated heads of vertical and horizontal equipment shall be fabricated from flat metal, an "Orange peel" construction with all radial seams overlapping a minimum of 50mm and secured with self-tapping screws at 150mm centres. All overlaps shall be ball swaged and be rendered watertight.

- Projections from the heads shall be sealed using metal flashings, neatly cut to fit around the projections and extending above the jacket for a minimum of 80mm. The seal between flashing and jacket shall be weatherproofed with self-tapping screws and mastics.

- Insulation at bottom heads of fully skirted equipments does not require weatherproofing.

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- Heads of equipments 24" OD and smaller shall be finished and waterproofed with square ended fabricated covers.

c) Vertical Storage Tanks

Cladding Applications and Securement

➢ Shell

Cladding is applied over the system of horizontal rings as follows :

- Overlaps in the vertical joints will be one corrugation.
- Overlaps in the horizontal joints shall be 50mm (min.).
- Cladding to cladding fastening, at both horizontal and vertical overlaps shall be alternately by "POP" Rivets & selftapping screws at 150mm pitch.
- Cladding shall be secured to support ring by bolting. Bolts are provided by tank fabricator at 300mm centres on angles provided at every 1175 centres vertically. Felt washer, aluminium washer and nut shall be supplied by insulation contractor for all bolted connections at shell, roof and curb angle.
- Insulation shall be tucked into the skirt portion of the curb angle. Shell cladding and extended roof cladding shall be secured to curb angle by bolting as per relevant fabrication standard.
- Horizontal stainless steel bands over-cladding to be provided every 800mm and also to coincide at every horizontal cladding overlaps. Bands shall be tightened, locked and lock fastened featuring stainless steel fastening systems. In order to prevent sliding of the bands downwards, the bands shall be secured to the cladding using POP rivets at horizontal pitch not over 2 metres .

➢ Roof

- All cladding joints shall be sealed by elastomeric metal sealants.
- Min. 75mm overlap shall be ensured at all joints.
- At all joints, cladding-to-cladding securement shall be provided by self-tapping screws and pop rivets alternately, every 150 centres.
- Cladding shall be secured by bolting at every 300 provided by tank fabricator.

d) Horton Sphere

➢ Cladding Support

Insulation contractor shall provide 25mm x 0.8mm S.S. Bands over insulation and install them longitudinally from top to bottom of the sphere in such numbers so as to afford a maximum spacing of 1175mm at the equator. The

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S.S. Bands are spanned between four floating rings, the one at the top and bottom of the sphere are provided by the sphere fabricator. Generally the other two rings and SS bands are provided after insulation is applied prior to application of cladding. Floating rings will be constructed of 10mm diameter rods of S.S.. Diameter of ring at the top and bottom, to be provided by sphere fabricator would be around 1.2m. Cladding support bands shall be tightened using mechanical tighteners and fastened to MS / AS angles using two S.S.Rivets or four Nos. of Aluminium POP rivets, per angle cleat.

- Cladding Application

While applying cladding, following shall be ensured

-Minimum overlap both horizontal and vertical shall be 50mm.

- Cladding Securement and Scaling of Joints

All joints to be sealed using elastomeric metal sealant.

Cladding to cladding securement of both vertical and horizontal overlaps shall be alternately by POP rivets and self-tapping screws, at every 150mm spacing.

Cladding shall be secured to the insulation angle support by bolting the cladding on the bolts provided at every 300 pitch.

Further cladding shall be secured by 25mm x 0.5mm S.S. bands, applied identical to those for insulation securement. The bands shall be provided between two floating rings, one at the top and one at the bottom and arrangement & details shall be identical to that of insulation securement. Bands shall be secured to cladding every 2M by one SS or two aluminium POP rivets. While providing floating rings, for both insulation and cladding securement, following points shall be taken care of:

- Floating rings shall clear nozzles / manholes etc.
- Exercise extreme care while installing floating rings regarding cut outs in cladding around projections,
- Cladding at interface between leg and the body of the sphere to be provided with care and suitably sealed to prevent water ingress.

7.0 QUALITY CONTROL

7.1 Incoming Material Control

7.1.1 Insulation materials and accessories shall be inspected by appropriate authority according to inspection categorization of the materials as per project execution philosophy.

7.1.2 Irrespective of the inspection performed by TPI / PMC / Owner's representative, contractor shall submit QAP (quality assurance plan) of the materials and internal test reports for every production batch and type test wherever specified in this specification.

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The QAP shall include every stage of manufacturing process starting from raw material stage to final stage of manufacturing. The QAP shall also include reference of purchase order number and date, the types of checks, methods of tests followed, frequency of checks, lot size & acceptable criteria with permissible deviations.

7.1.3 Besides the inspection performed at supplier premises and / certificate of conformance provided by supplier, at the discretion of engineer-in charge, random inspection may be performed on the supplied materials. Parameters and extent of testing shall be advised by engineer-in charge.

On the advice of engineer-in charge, the contractor shall organize the testing on representative sample selected at random from an independent NABL approved laboratory. In the event of non-conformance in testing, repeat test may be performed. Failure in repeat test may call of rejection of the batch.

7.2 Installation Quality Control

7.2.1 Insulation shall be installed after hydrostatic testing and inspection. Insulation shall be protected from weather before and during installation.

7.2.2 Insulation system should be applied as per approved drawings/sketches, installation procedure and quality plan.

7.2.3 Contractor shall prepare an inspection test plan (ITP) for installation of insulation identifying inspection / witness points, frequency etc. and submit for approval of owner / engineer in charge at construction site.

7.2.4 The engineer in-charge may finalize the same with consultation of HO specialist. If so desired by engineer-in charge, HO specialist may assist inspection of insulation work at critical stages.

7.3 Qualification of Application Crews

Prior to start for installation work, contractor's credential shall be approved by engineer in-charge of insulation work. The application crew must be fully trained work force. At the beginning of every installation, the application shall be demonstrated and quality checks shall be carried out at site and shall be certified by Owner/Engineer in charge.

7.4 Documentation

Insulation contractor shall submit Insulation Application Procedure for review and approval. Such procedure shall contain minimum following information:

- Product data sheet, material safety data sheet and compliance certificate of all the insulation and ancillaries material.
- Insulation detail drawings showing insulation system, expansion/contraction joints, insulation supports, terminations etc.
- Method statement for insulation system application and repair.
- Quality Control Plan for Insulation application (QCP)

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7.5 Safety

The insulation contractor shall provide adequate protective appliances like hand gloves, masks, glasses etc. to the workmen carrying out the insulation work, to protect them from inhaling and touching insulation dust and fibers.

7.6 Specification Deviation / Concession Control

The insulation contractor shall notify Owner/Engineer in charge of any apparent conflict between this specification, product data sheets, the codes and standards, and any other specification or document noted herein. Resolution and/or interpretation precedence shall be obtained from the Owner/Engineer in charge in writing before proceeding with application of any insulation material.
Any technical deviation to the purchase order/contract and its attachment including, but not limited to, the data sheets and specification shall be sought by the insulation contractor only through the concession request format. Concession requests require the Owner's/Engineer in charge's review and approval, prior to the proposed technical changes being implemented. Technical changes implemented prior to Owner's approval are subject to rejection.

7.7 Guarantee for Supply and Installation Quality

Contractor shall ensure supplied materials conform to the technical requirements of this specification and relevant standards / codes applicable for the job. The insulation and ancillary materials shall be procured fresh for the project. Use of excess material from other site which does not have proper traceability shall not be allowed. It is the responsibility of insulation contractor to ensure adequate precautions are taken against damage and deterioration during sourcing, transportation and storage of insulation materials. For major insulation materials like rock wool, Perlite, Ceramic fiber PIR, cellular glass, aerogel etc. batch and type test certificates as applicable shall be submitted. For ancillary materials like multiplex foil, band, sealant etc. and metal cladding may be accepted based on supplier's compliance certificate.

Any deviations shall be clearly stated, and work shall proceed only after the deviations are approved by competent authority. The workmanship in execution of the insulation works shall be in accordance with sound engineering practice.

8.0 REFERENCE CODES & STANDARDS

ASTM Standards and Specifications

ASTM A167	Specification for stainless and heat-resisting chromium nickel steel plate, sheet and strip
ASTM A240	Specification for heat-resisting chromium and chromium-nickel stainless steel plate, sheet and strip for Pressure Vessels
ASTM A463	Specification for steel sheet, aluminum coated, by hot-dip process
ASTM A526	Specification of steel sheet, zinc coated (galvanized) by the hot-dip process, commercial quality
ASTM B209	Aluminum - Alloy sheet and plate
ASTM C165	Measuring Compressive properties of thermal insulations

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ASTM C177	Standard test method for Steady-state heat flux measurements & thermal transmission properties by means of the 'guarded-hot-plate' apparatus
ASTM C240	Standard test methods of testing Cellular glass insulation block
ASTM C302	Standard test method for Density and dimensions of preformed pipe-covering-type thermal insulation
ASTM C303	Standard test method for Density and dimensions of preformed block and board type thermal insulation
ASTM C335	Standard test method for Steady-state heat transfer properties of horizontal pipe insulation
ASTM C356	Standard test method for Linear shrinkage of preformed high-temperature thermal insulation subjected to soaking heat
ASTM C390	Standard criteria for Sampling and acceptance of preformed thermal insulation lots
ASTM C446	Standard test method for Breaking load and calculated modulus of rupture of preformed insulation of pipes
ASTM C518	Standard test method for Steady-state thermal transmission properties by means of the heat flow meter apparatus
ASTM C533	Standard specification for Calcium silicate block and pipe thermal insulation
ASTM C547	Standard specification for Mineral fiber pipe insulation
ASTM C552	Standard specification for Cellular glass thermal insulation
ASTM C591	Standard specification for Unfaced preformed rigid cellular polyisocyanurate thermal insulation
ASTM C592	Standard specification for Mineral fiber blanket insulation and blanket-type pipe insulation (metal-mesh covered) (industrial type)
ASTM C610	Standard specification for block and pipe thermal insulation
ASTM C612	Standard specification for Mineral fiber block and board thermal insulation
ASTM C795	Standard specification for thermal insulation for use in contact with austenitic stainless steel
ASTM C871	Standard test methods for Chemical analysis of thermal insulation materials for leachable chloride, fluoride, silicate and sodium ions
ASTM C892	Standard specification for High temperature fiber blanket thermal insulation
ASTM D1622	Test method for apparent density of rigid cellular plastics
ASTM E96	Standard test methods for Water vapor transmission of materials

EIL Standards and Specifications

7-13-0003	Hot insulation supports for storage tanks
7-13-0015	Hot insulation supports for spheres
7-12-0025	Fireproofing and insulation supports
7-13-0033	Hot insulation supports for horizontal vessels

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6-79-0022	Standard specification for acoustic insulation
6-79-0027	Standard specification for cold insulation of vessels, piping and equipment

IS Standards and Specifications

IS 8183	Bonded mineral wool - Specification
IS 9428	Calcium silicate insulation blocks and pipe-coverings
IS 11239	Method of test for rigid cellular thermal insulation materials

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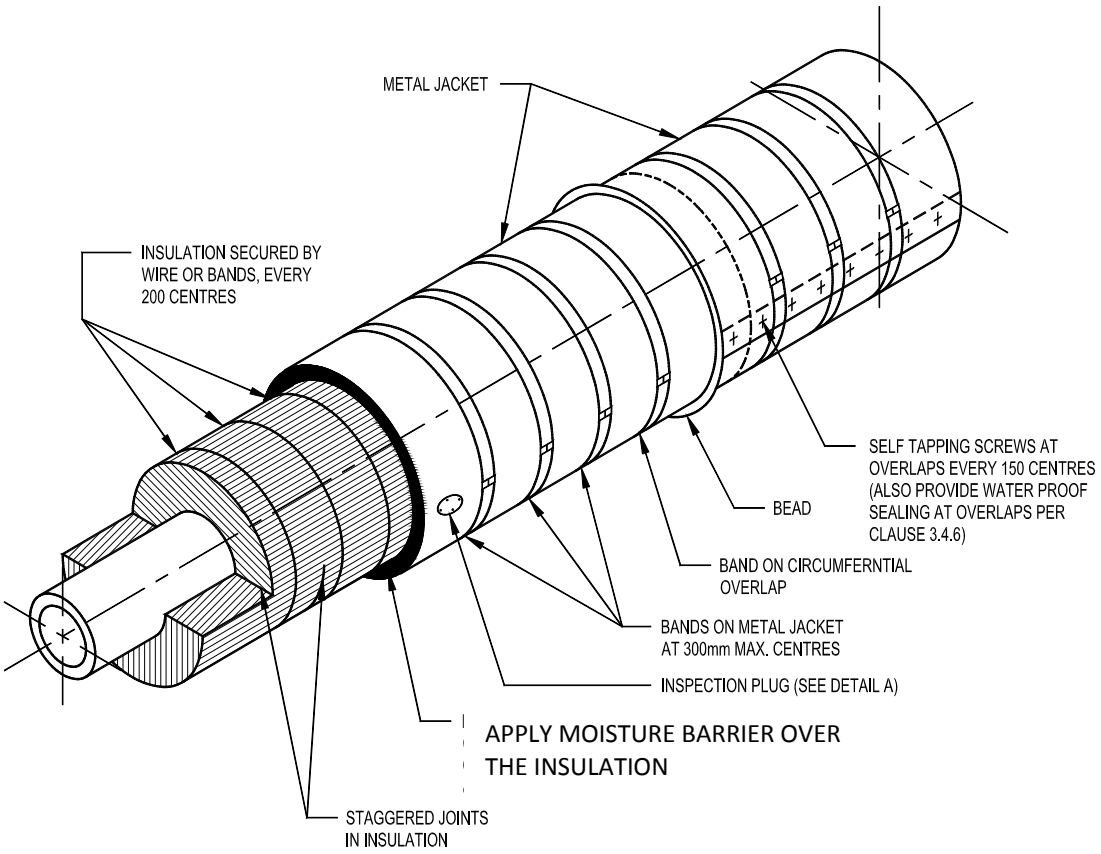
9.0 INSULATION DIAGRAMS

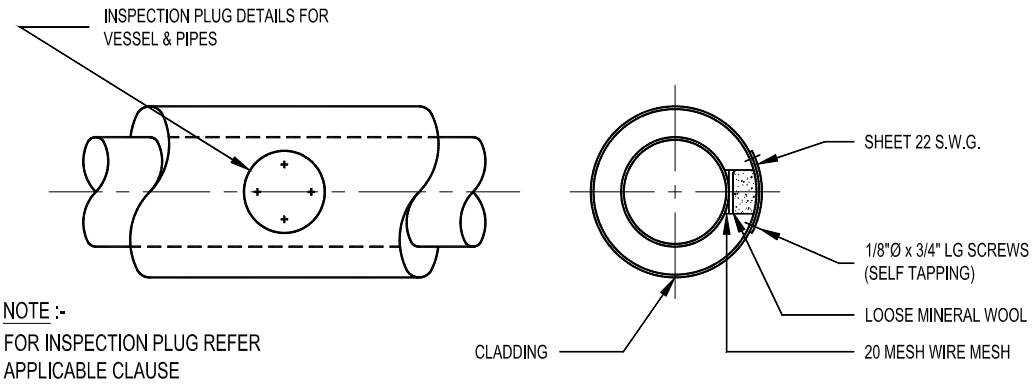
The drawings/ sketches are general in nature. Specific insulation system/ requirement if any from insulation manufacturer, shall be submitted by contractor for approval by owner/ Engineer in charge.

The attached sketches describe general arrangement of insulation material, ancillaries and cladding. Difference if any on material type & quality between sketch and the description elsewhere in this specification/ SOR, later shall apply.

S.No.	Description	Drawing
1	Pipe insulation details (fibrous &rigid insulation)	DRAWING. No. 01
2	Pipe insulation method of staggering of sections rigid & fibrous insulation (preformed pipe sections only)	DRAWING. No. 02
3	Horizontal pipe : fibrous insulation; detail of spacer rings for cladding support	DRAWING. No. 03
4.	Detail of spacer ring fibrous insulation (mattress)	DRAWING. No. 04
5.	Bolted on insulation support for vertical pipe	DRAWING. No. 05
6.	Insulation details for bends / elbows	DRAWING. No. 06
7.	Insulation details : pipe bends & elbows	DRAWING. No. 07
8.	Insulation details: pipe branched & reducer	DRAWING. No. 08
9.	Example of removable flange box, horizontal	DRAWING. No. 09
10.	Removable flange box, vertical	DRAWING. No. 10
11.	Insulation details pipe supports	DRAWING. No. 11
12.	Insulation of traced piping	DRAWING. No. 12
13.	Horizontal equipment insulation	DRAWING. No. 13
14.	Horizontal equipment heads	DRAWING. No. 14
15.	Use of flexible insulation in combination with rigid insulation to compensate for vessel expansion	DRAWING. No. 15
16.	Insulation details : vertical vessel	DRAWING. No. 16
17.	Insulation details vertical vessel heads	DRAWING. No. 17
18.	Insulation details : vertical vessels	DRAWING. No. 18
19.	Insulation details : vertical storage tank	DRAWING. No. 19
20.	Insulation details : sphere	DRAWING. No. 20
21.	Non- insulated flanges, horizontal and vertical	DRAWING. No. 21
22.	Removable valve box, "T" connection, horizontal	DRAWING. No. 22
23.	Removable valve box, "T" connection, vertical	DRAWING. No. 23
24.	Hanger support	DRAWING. No. 24
25.	Personal protection	DRAWING. No. 25
26.	Details of lifting lugs	DRAWING. No. 26
27.	Removable box for pump	DRAWING. No. 27

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DETAIL 'A'

FIGURE – 01
PIPE INSULATION DETAILS
(FIBROUS &RIGID INSULATION)

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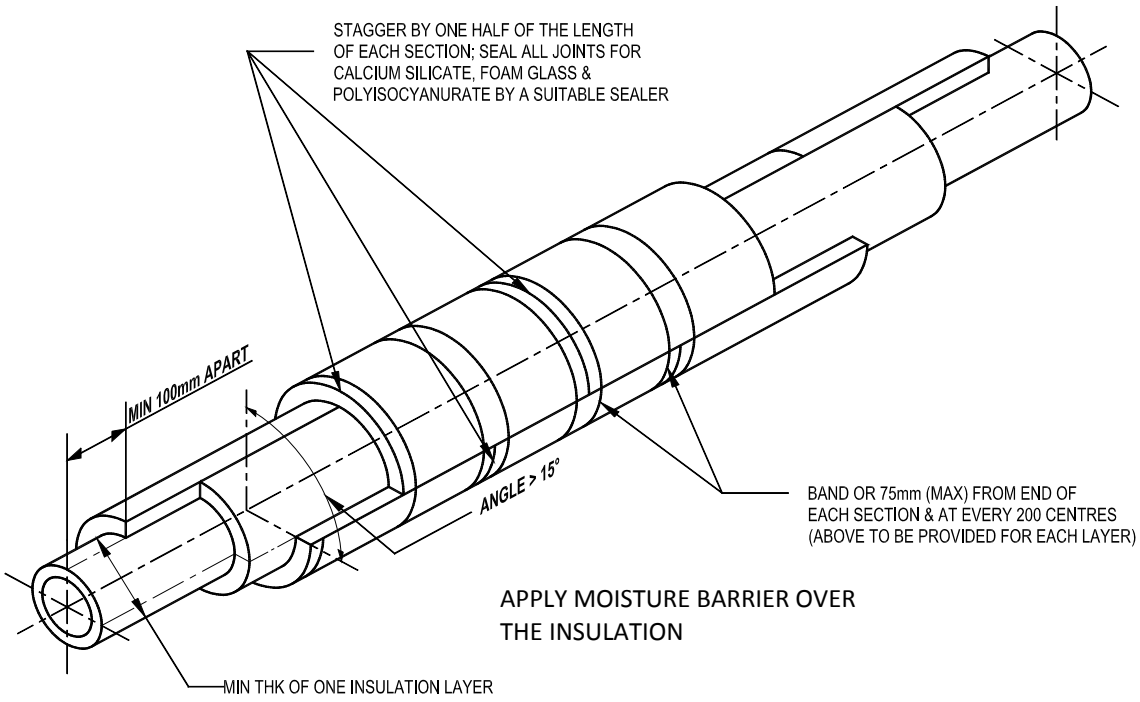


FIGURE – 02
PIPE INSULATION METHOD OF STAGGERING OF SECTIONS
RIGID & FIBROUS INSULATION (PREFORMED PIPE SECTIONS ONLY)

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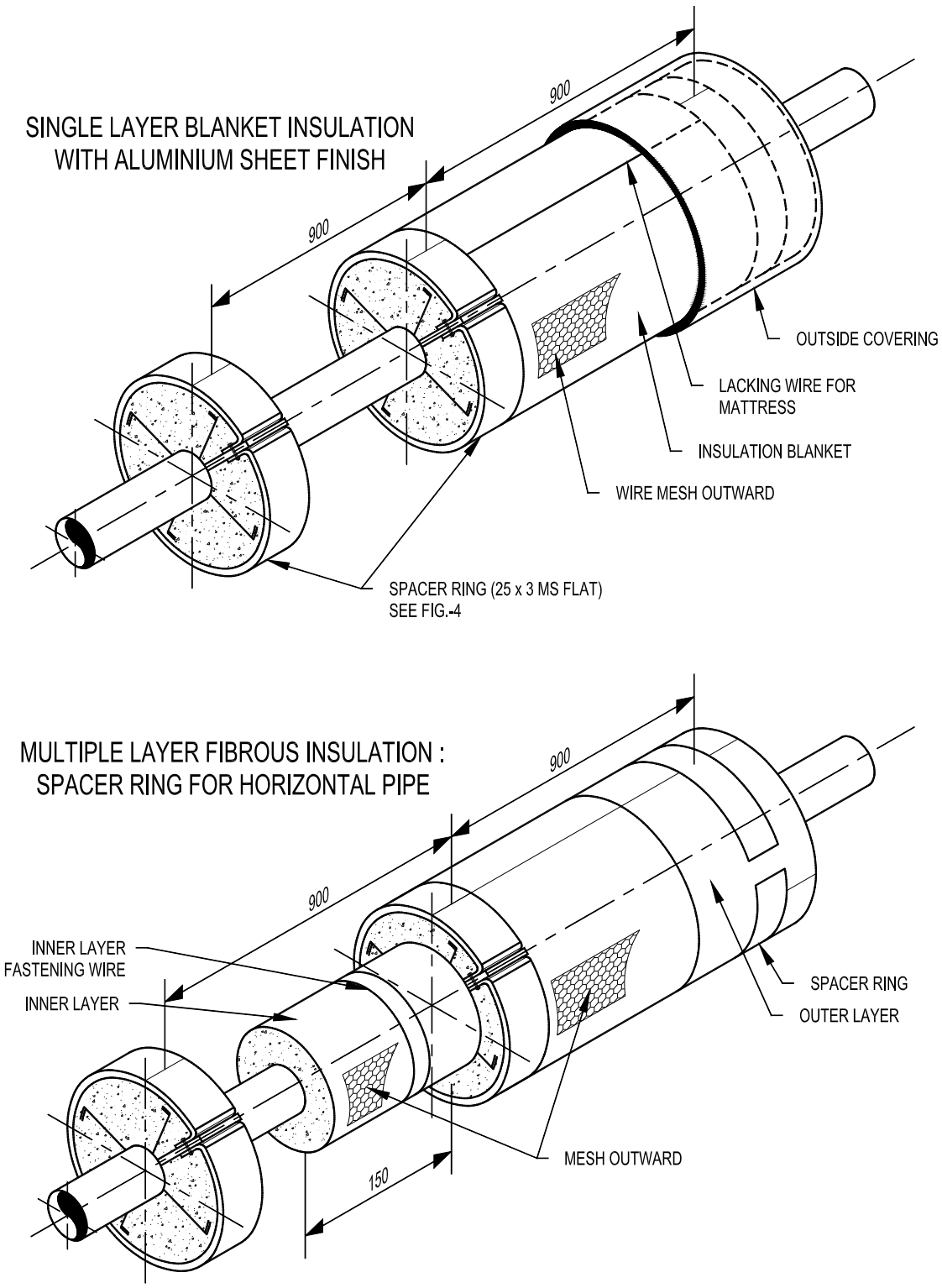


FIGURE – 03
HORIZONTAL PIPE : FIBROUS INSULATION; DETAIL OF SPACER RINGS FOR CLADDING SUPPORT

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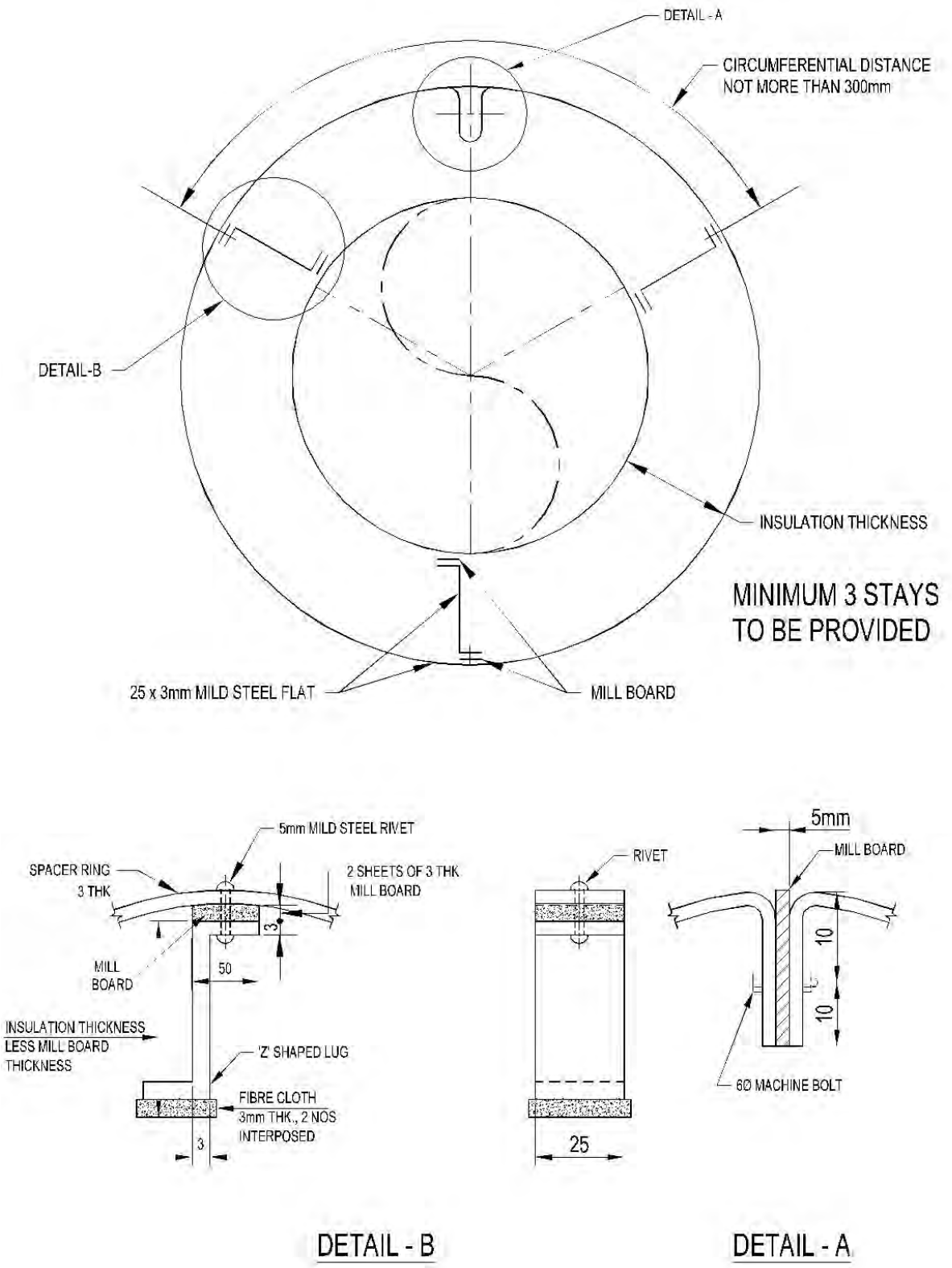
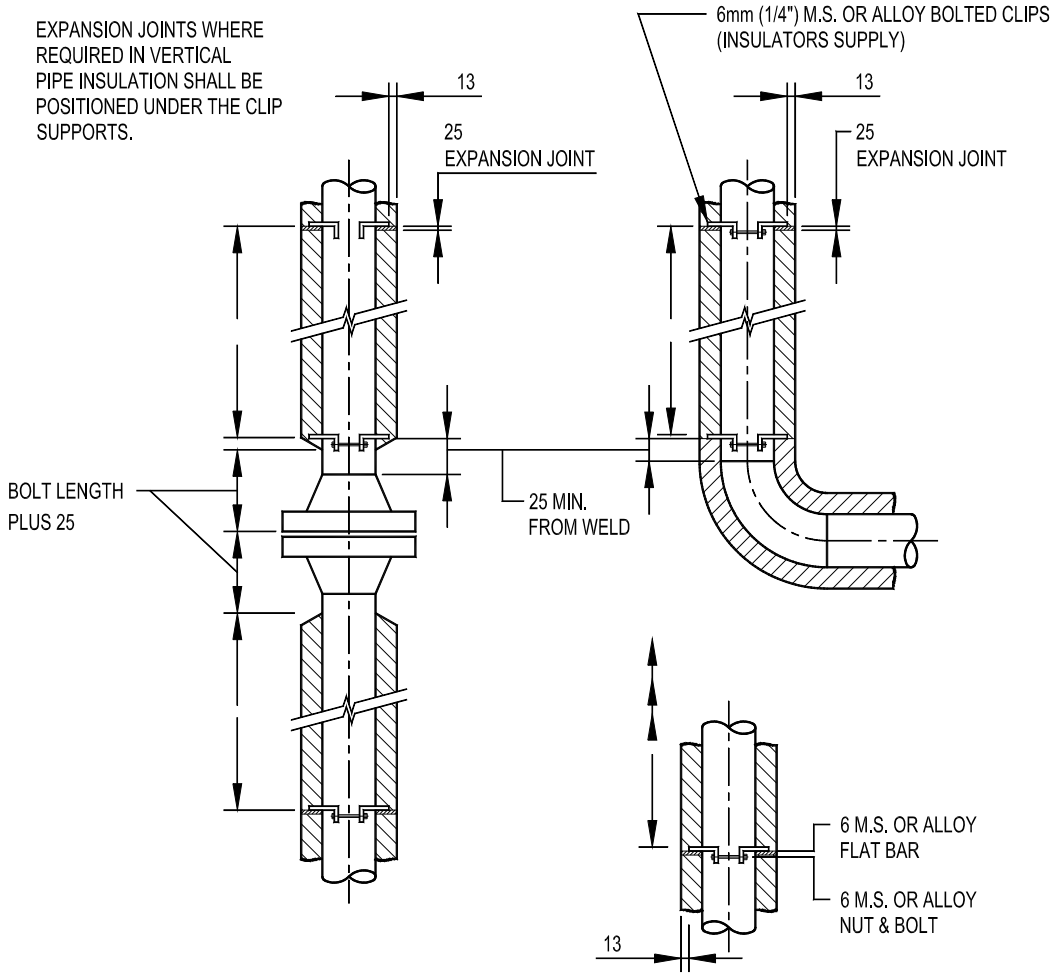


FIGURE – 04
DETAIL OF SPACER RING FIBROUS INSLUATION (MATTRESS)

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CLIP SPACING

PIPE TEMP. °C	MAX. SPACING 'D' MM
UPTO 400	4500
400 TO 500	3500
500 TO 550	2500

* CIRCUMFERENTIAL EXPANSION SHALL BE CONSIDERED AT THESE OPERATING TEMPERATURES.

FIGURE – 05
BOLTED ON INSULATION SUPPORT FOR VERTICAL PIPE

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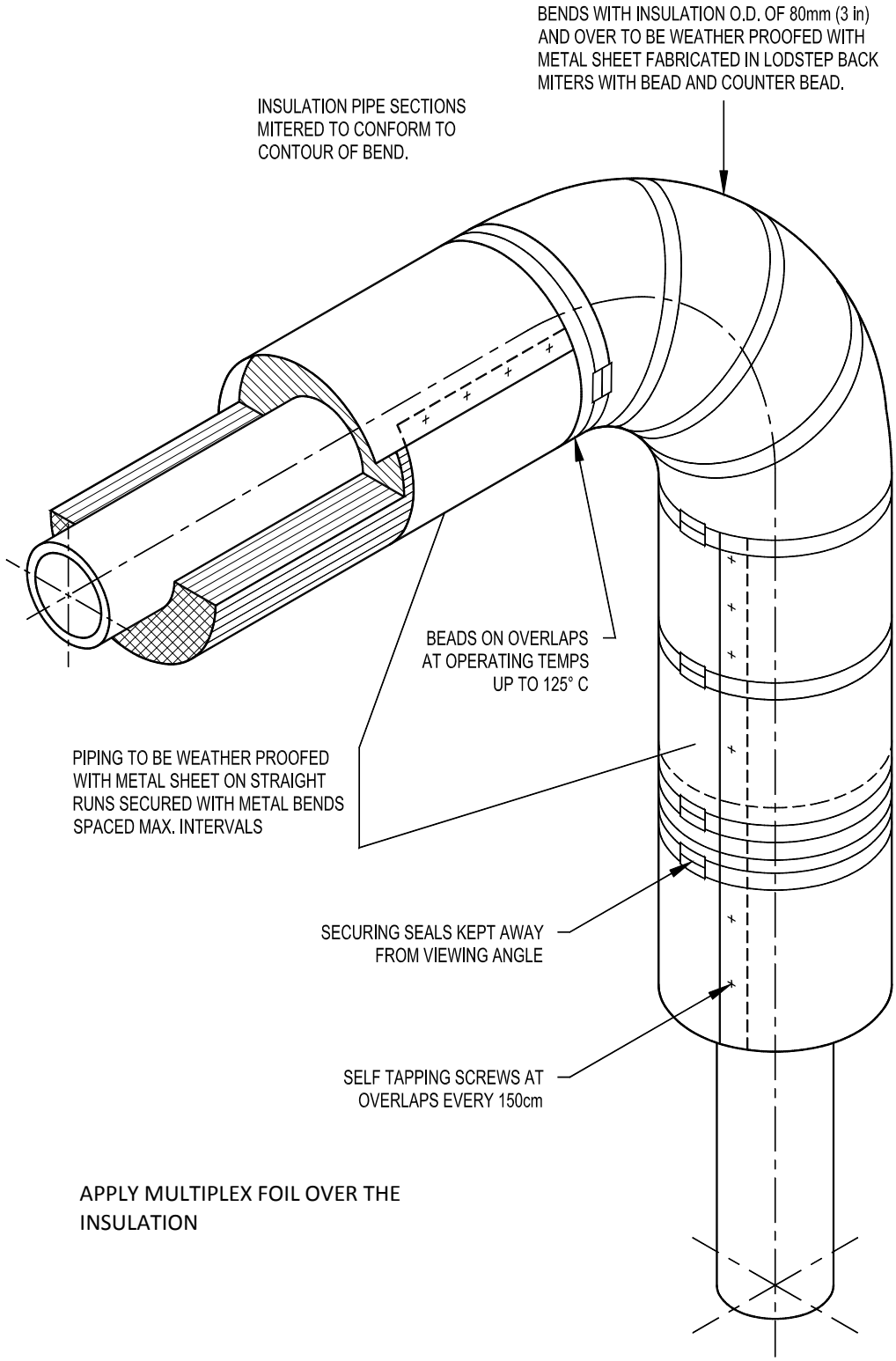


FIGURE – 06
INSULATION DETAILS FOR BENDS / ELBOWS

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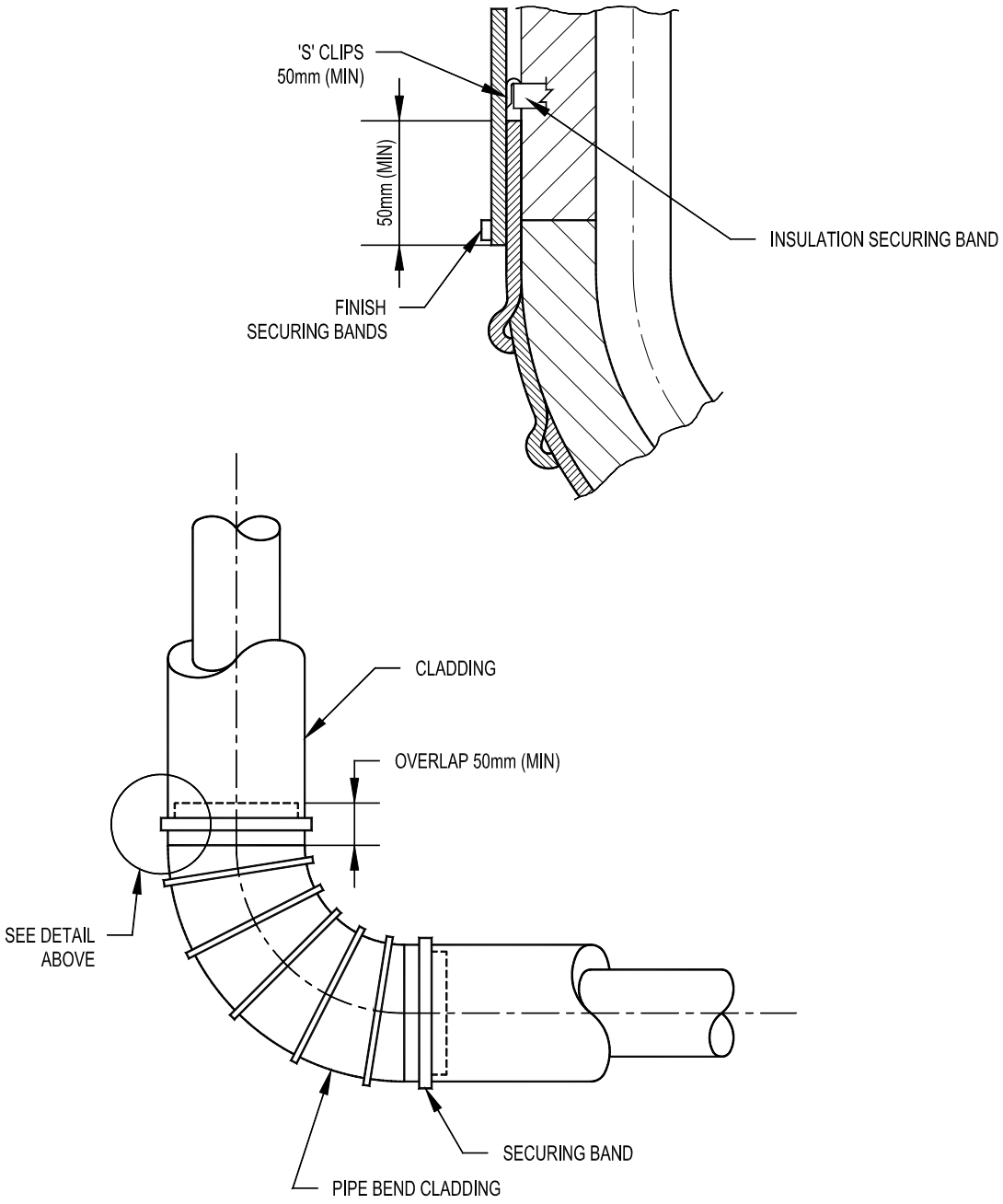


FIGURE – 07
INSULATION DETAILS : PIPE BENDS & ELBOWS

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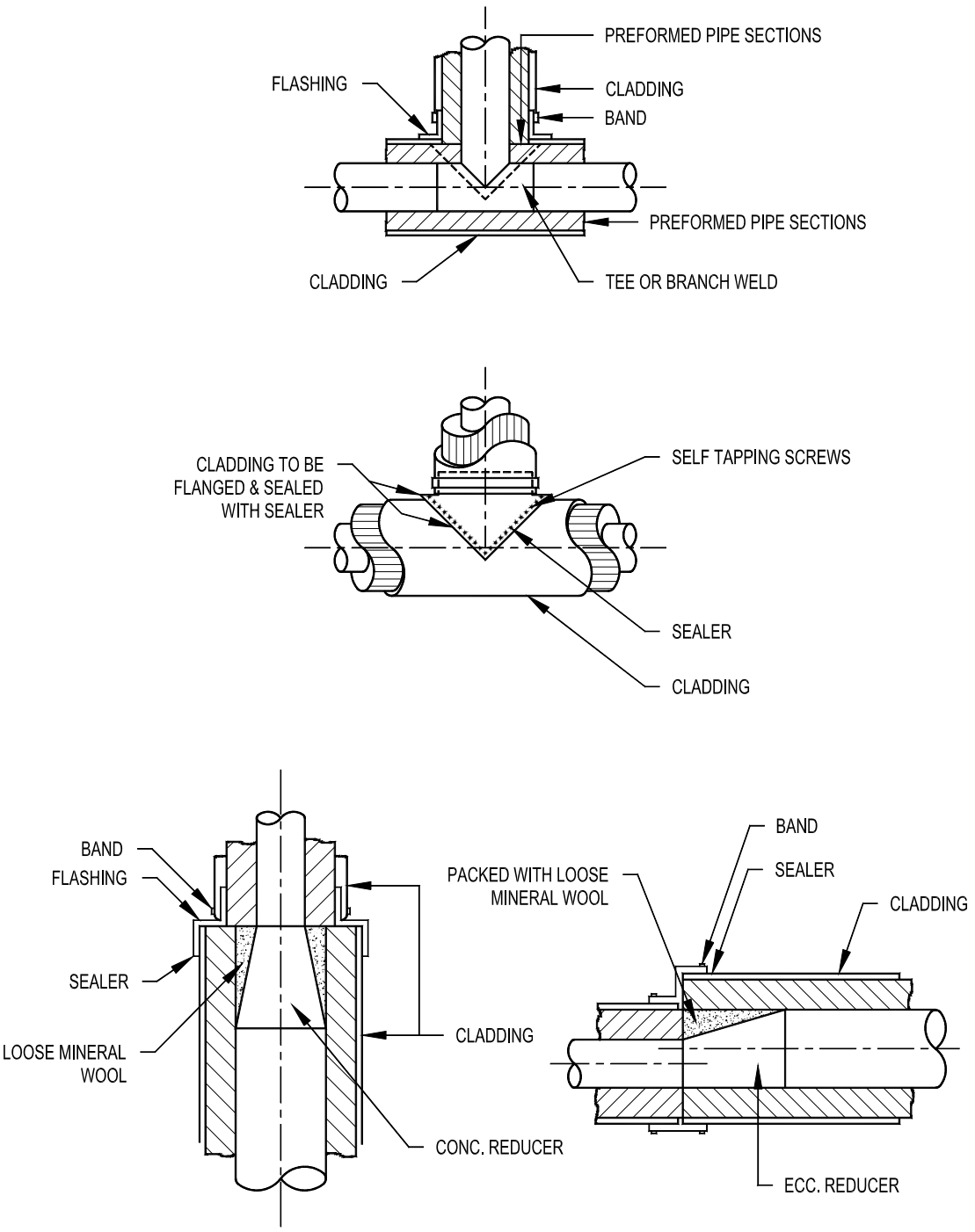
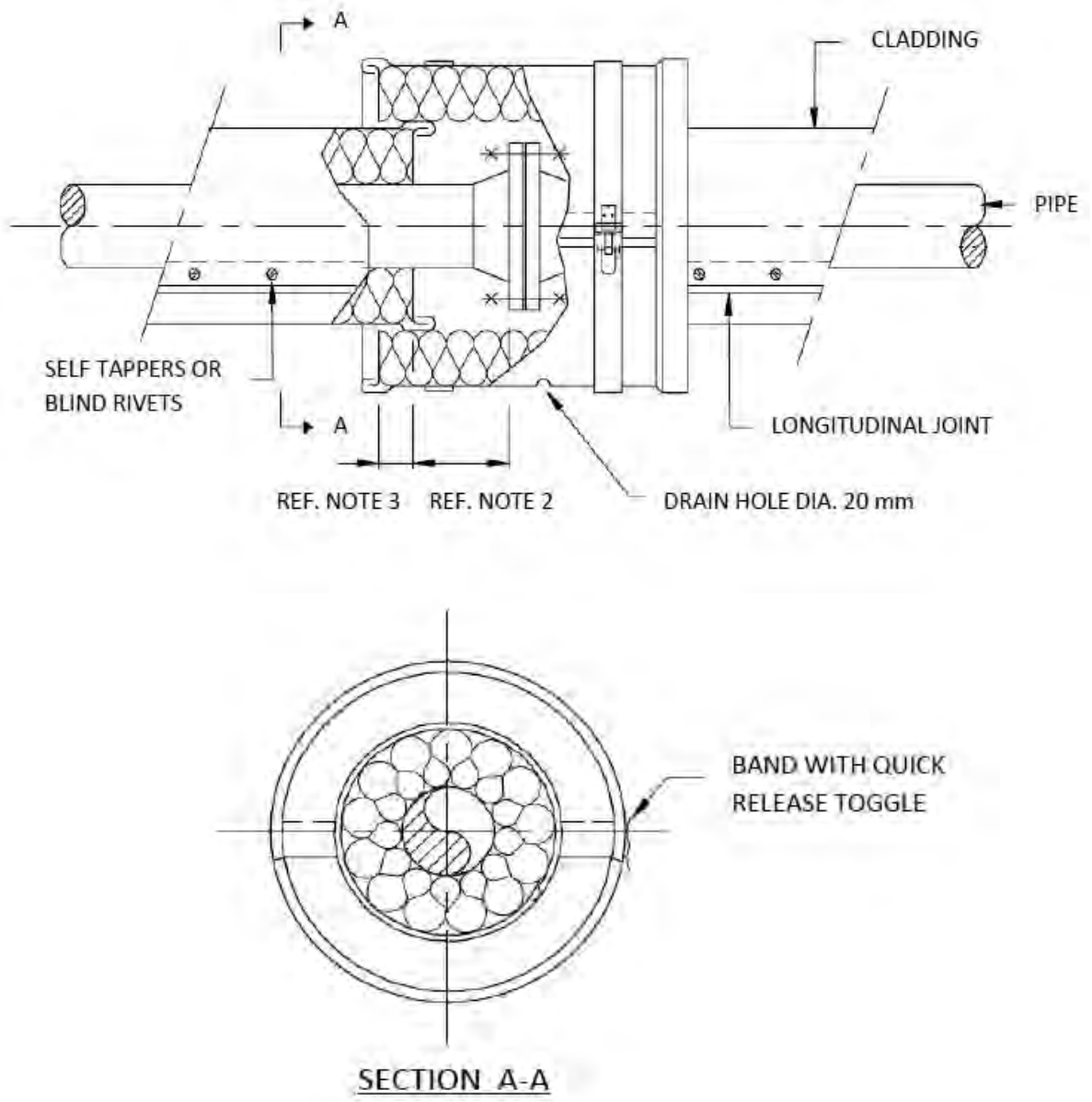


FIGURE – 08
INSULATION DETAILS: PIPE BRANCHED & REDUCER

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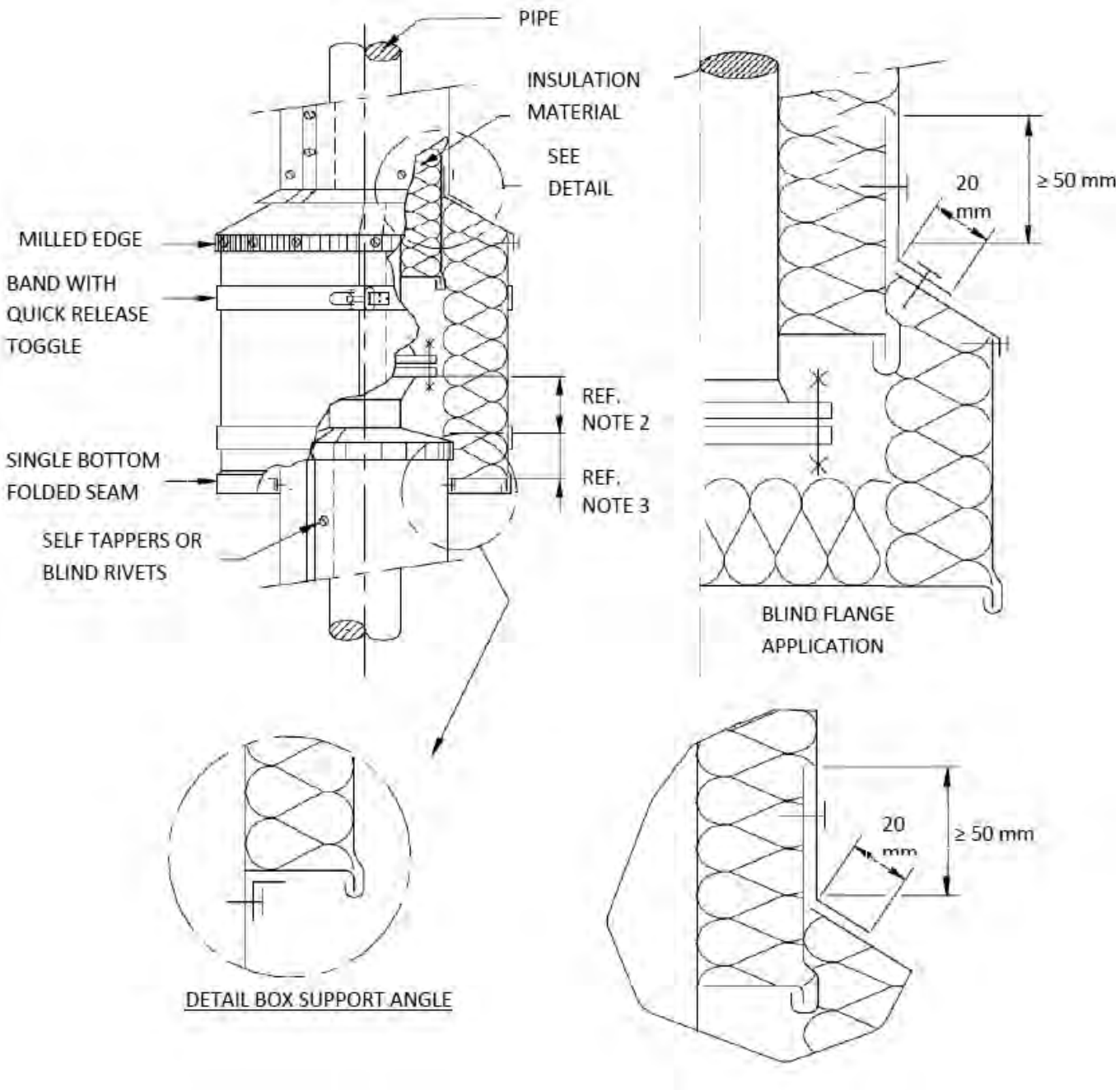


NOTE

1. MATERIAL AND FINSHING IN ACCORDANCE WITH INSTALLATION INSTRUCTIONS AND SPECIFICATION
2. DISTANCE BETWEEN INSULATION AND FLANGE TO BE BOLT LENGTH + 30 mm
3. INSULATION THICKNESS

FIGURE – 09
EXAMPLE OF REMOVABLE FLANGE BOX, HORIZONTAL

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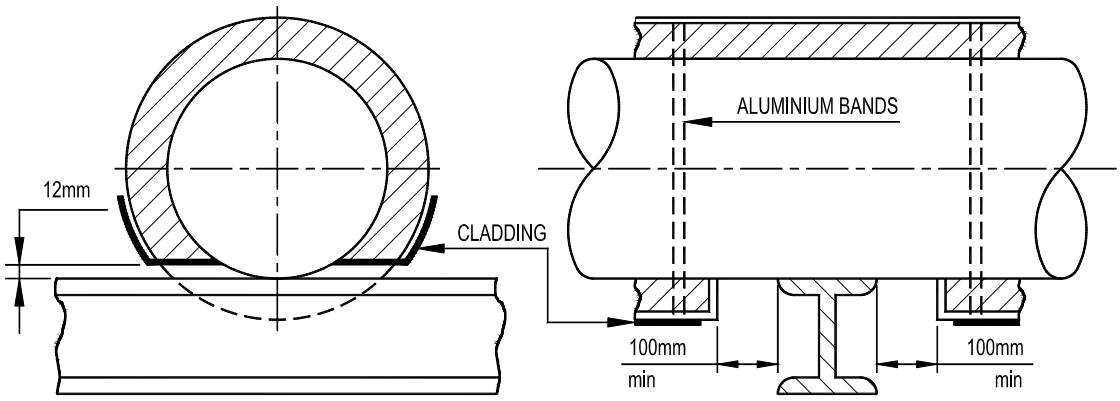


NOTE

1. MATERIAL AND FINSHING IN ACCORDANCE WITH INSTALLATION INSTRUCTIONS AND SPECIFICATION
2. DISTANCE BETWEEN INSULATION AND FLANGE TO BE BOLT LENGTH + 30 mm
3. INSULATION THICKNESS

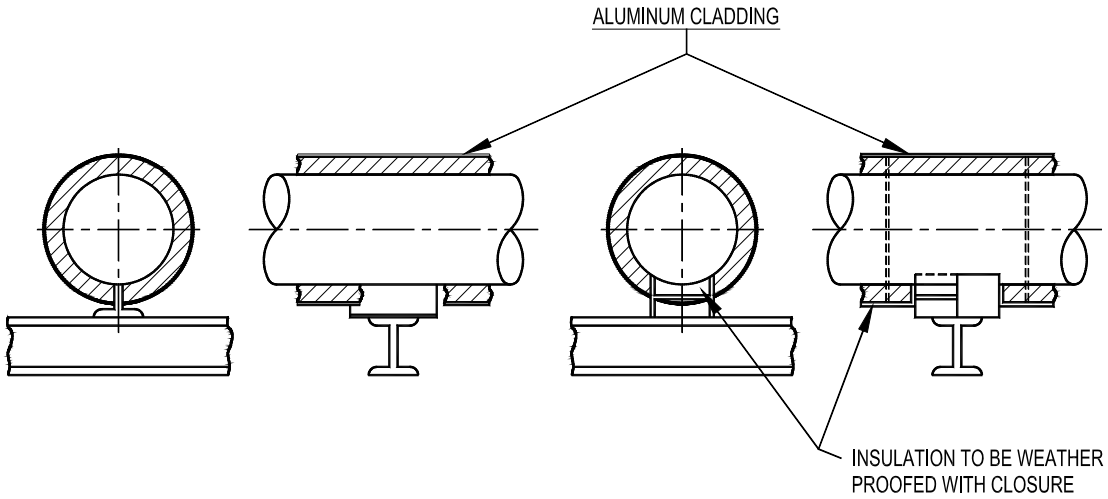
FIGURE – 10
REMOVABLE FLANGE BOX, VERTICAL

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WHERE CLADDING IS TO BE CUT AWAY IT SHALL FIT CLOSELY TO THE PIPE AND TO BE COMPLETELY WEATHERPROOF

INSULATION DETAIL AT LINES WITHOUT SHOES
(THIS SHOULD ONLY BE REQUIRED IN EXCEPTIONAL CIRCUMSTANCES)



INSULATION OF LINE ON SHOES

FIGURE – 11
INSULATION DETAILS PIPE SUPPORTS

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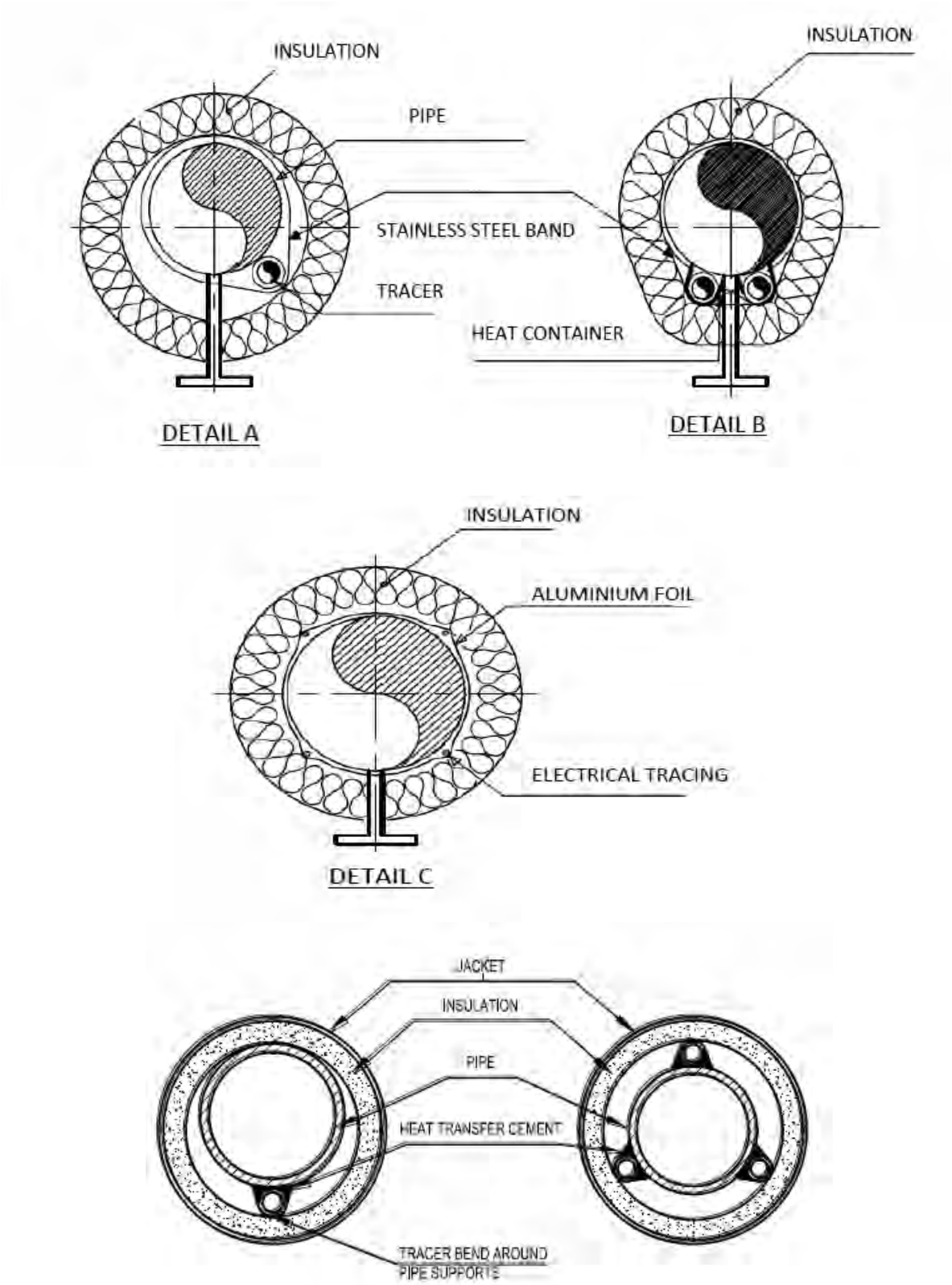
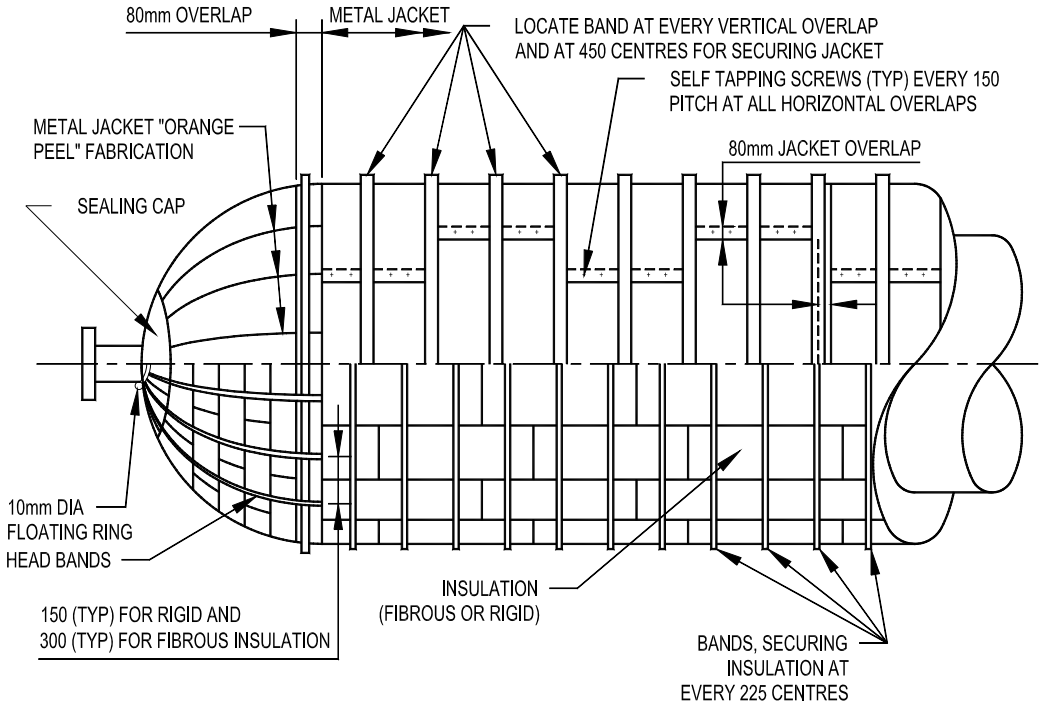


FIGURE – 12
INSULATION OF TRACED PIPING

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NOTES :-

1. SADDLE SUPPORTS FOR HORIZONTAL EQUIPMENT TOGETHER WITH SHOE AND ANCHOR SUPPORTS FOR HORIZONTAL PIPNG SHALL BE DESIGNED TO INCLUDE ELONGATED CUT-OUTS IN THE SUPPORT AT SUCH A DISTANCE FROM THE SUPPORTED EQUIPMENT AND PIPING TO ALLOW THE PASSAGE OF INSULATION SECURING BANDS AND TIES AROUND THE OUTSIDE FACE OF THE INSULATING AND FINISHING MATERIAL.

FIGURE – 13
HORIZONTAL EQUIPMENT INSULATION

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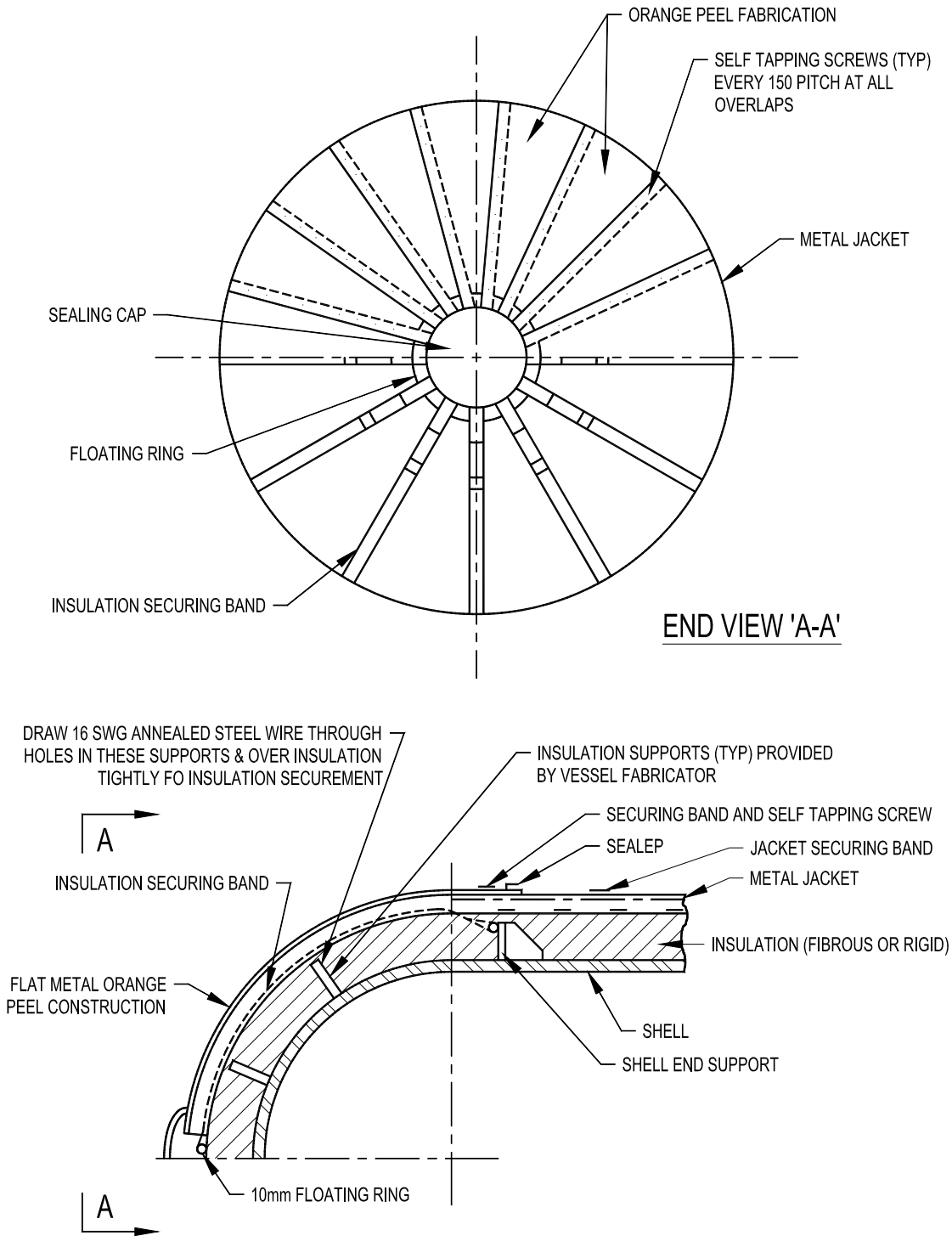


FIGURE – 14
HORIZONTAL EQUIPMENT HEADS

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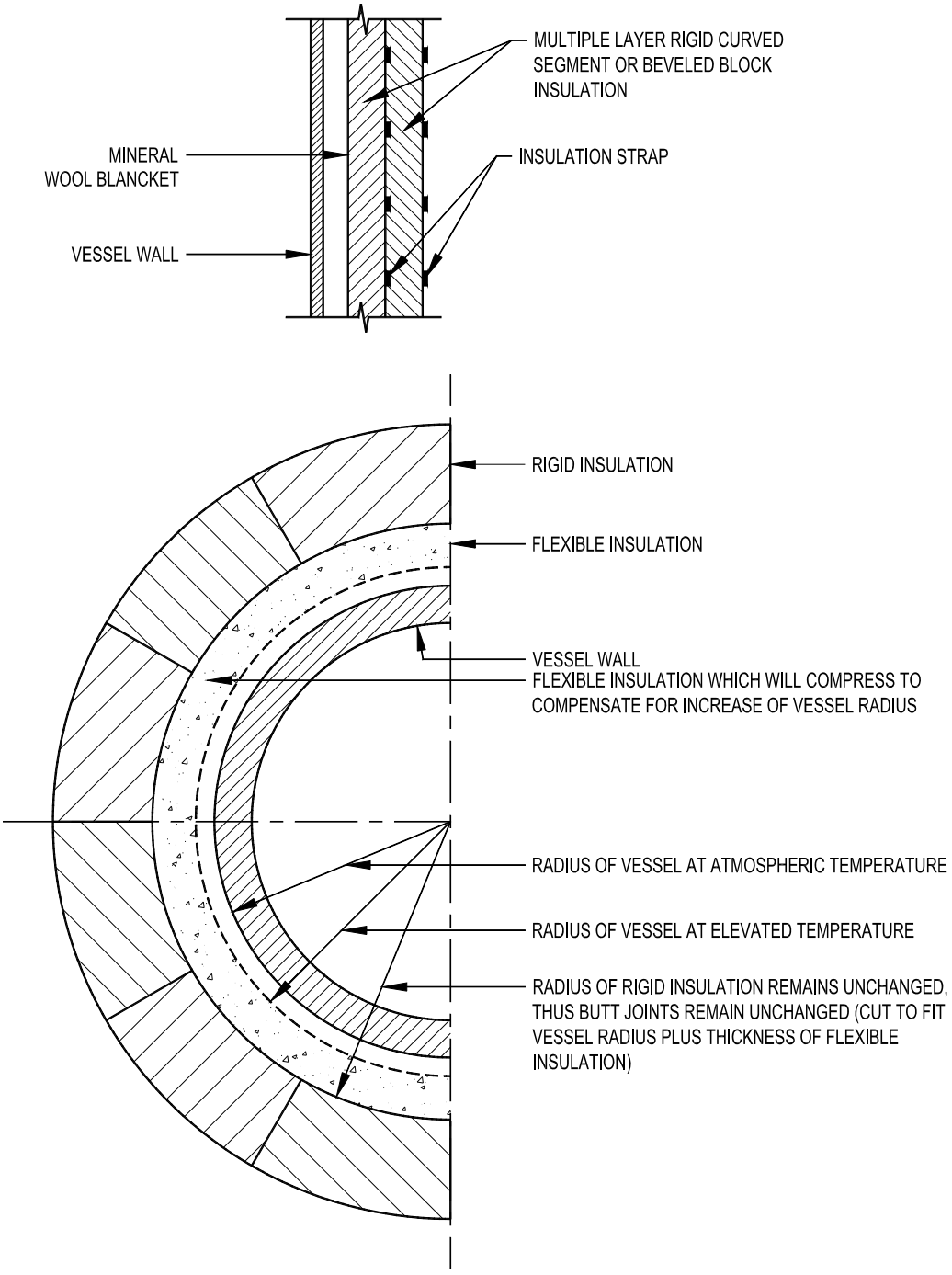


FIGURE – 15
USE OF FLEXIBLE INSULATION IN COMBINATION WITH RIGID INSULATION TO COMPENSATE FOR VESSEL EXPANSION

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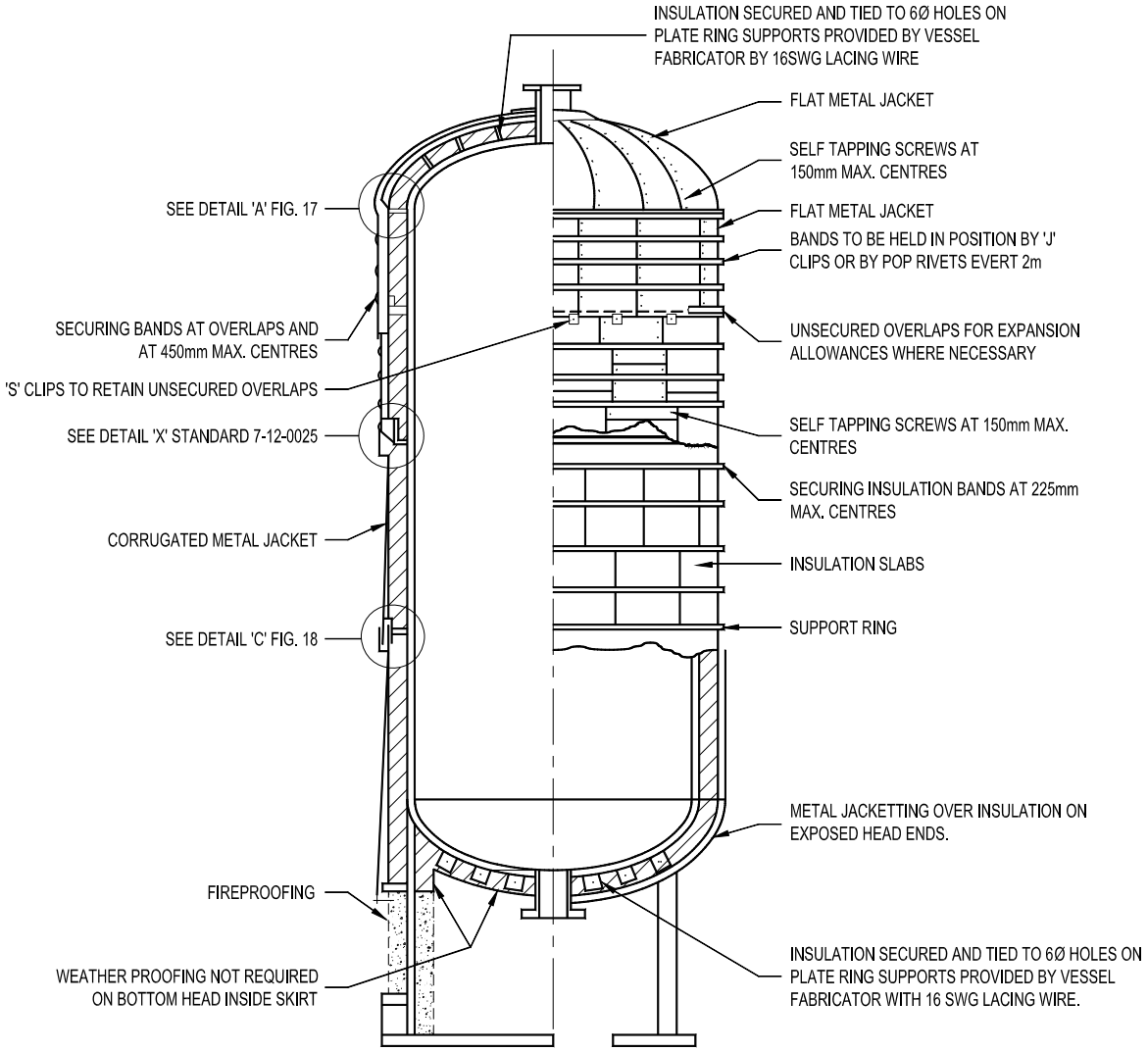
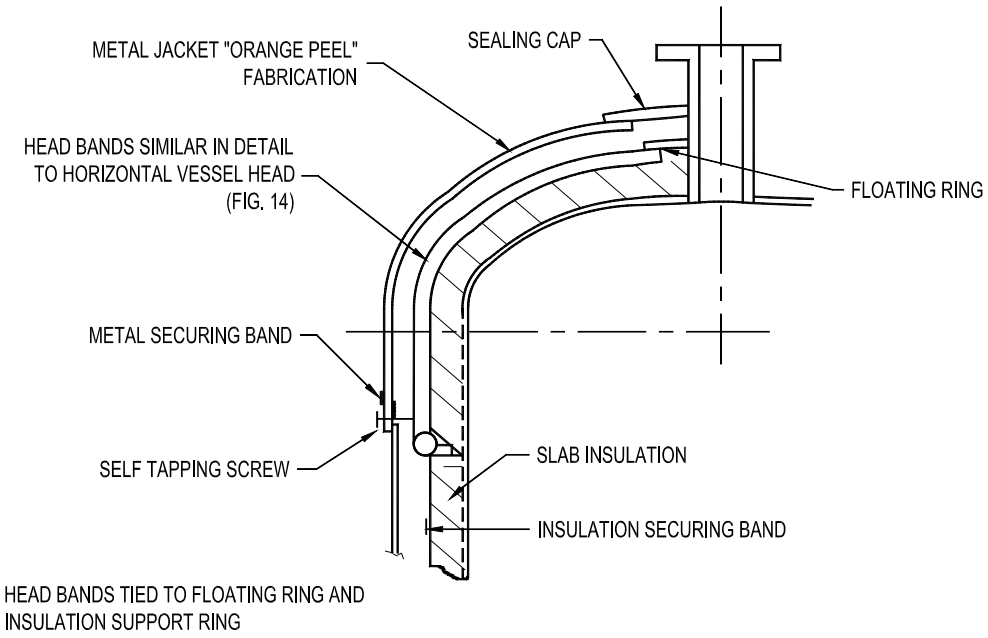


FIGURE – 16
INSULATION DETAILS : VERTICAL VESSEL

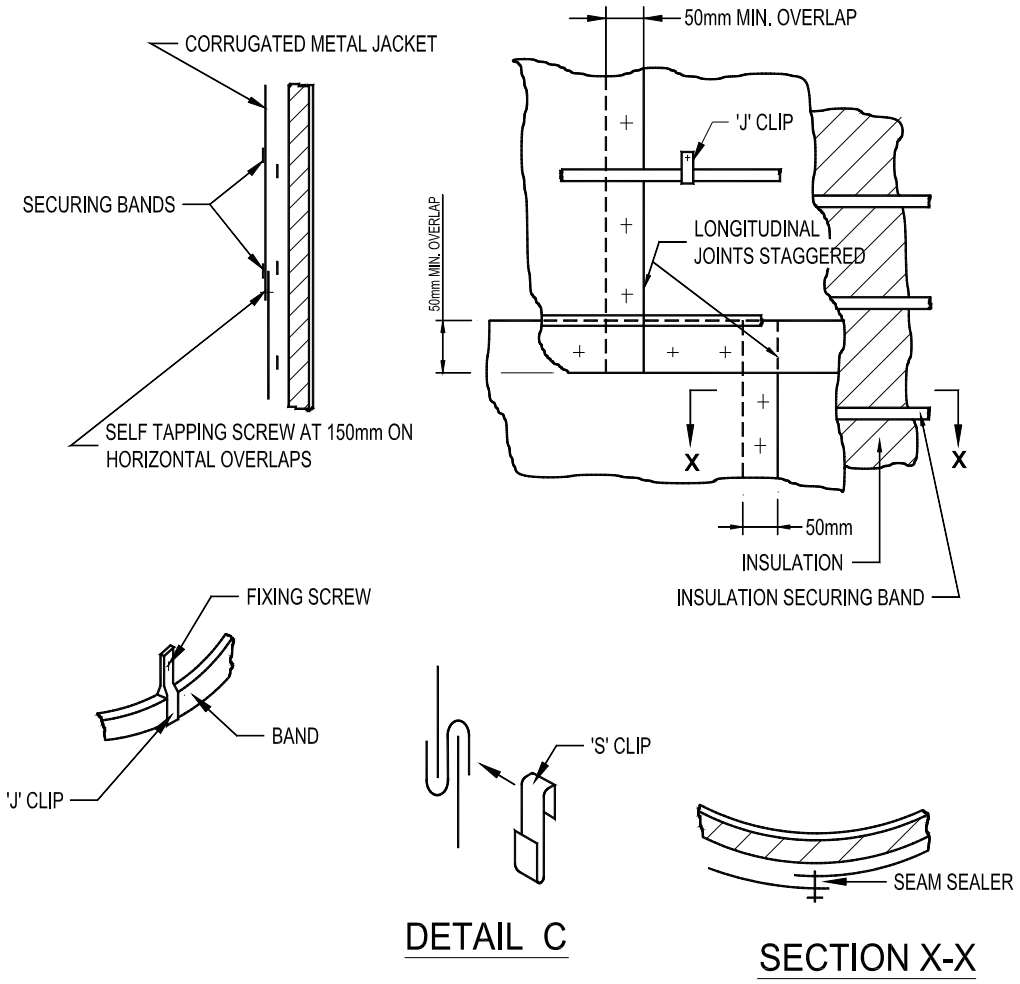
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DETAIL 'A'

FIGURE – 17
INSULATION DETAILS VERTICAL VESSEL HEADS

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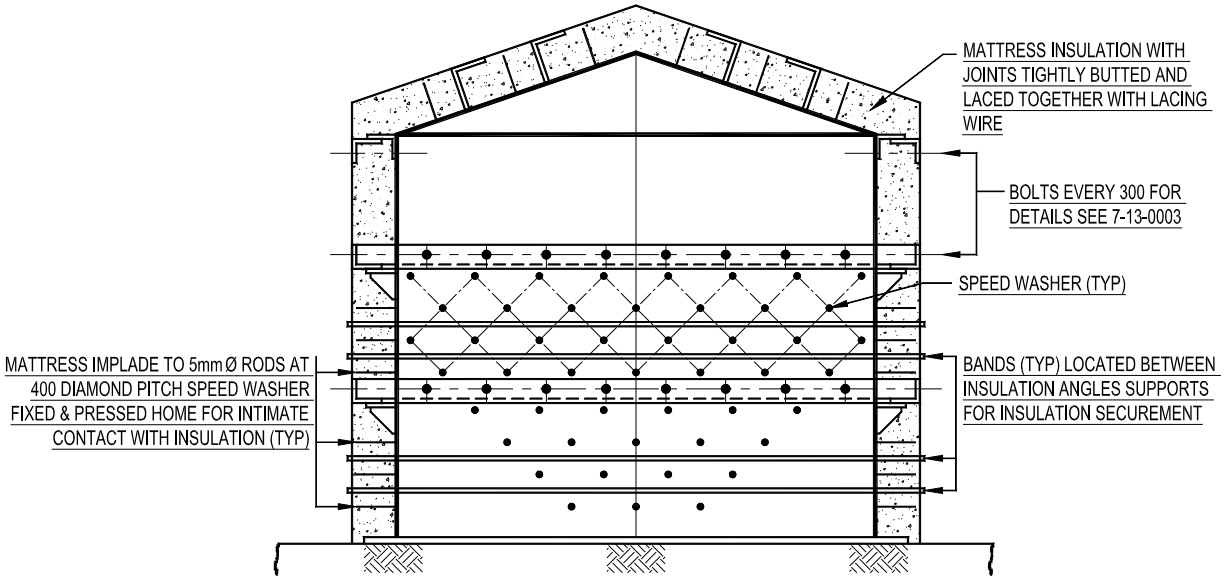


NOTE:

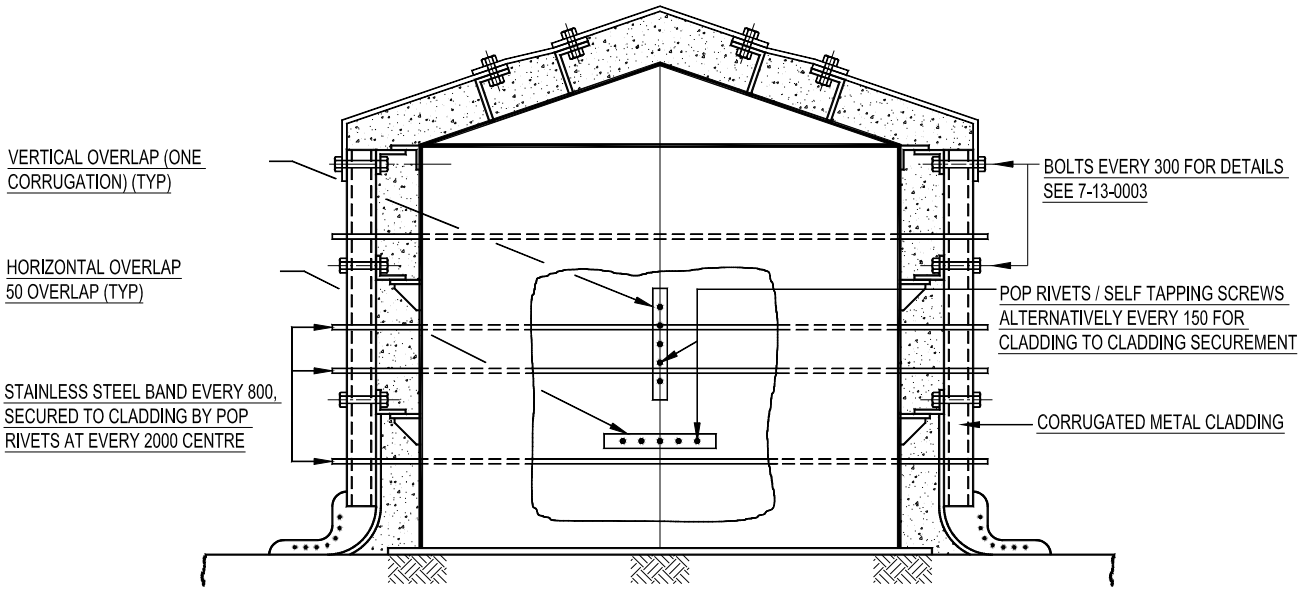
FINISHING SHEETING TO BE BANDED AND SCREWED. HORIZONTAL OVERLAPS LEFT UNSCREWED FOR EXPANSION PURPOSES SHALL BE SECURED AND SUPPORTED WITH 'S' CLIPS.

FIGURE – 18
INSULATION DETAILS : VERTICAL VESSELS

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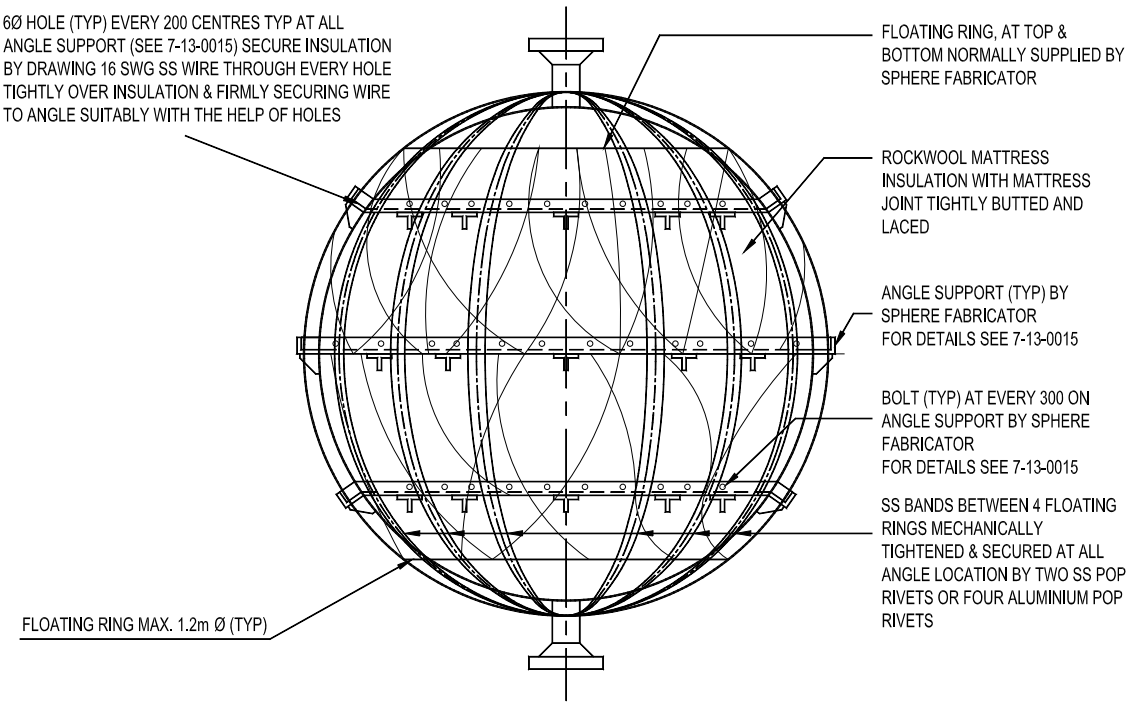
INSULATION SECUREMENT DETAIL



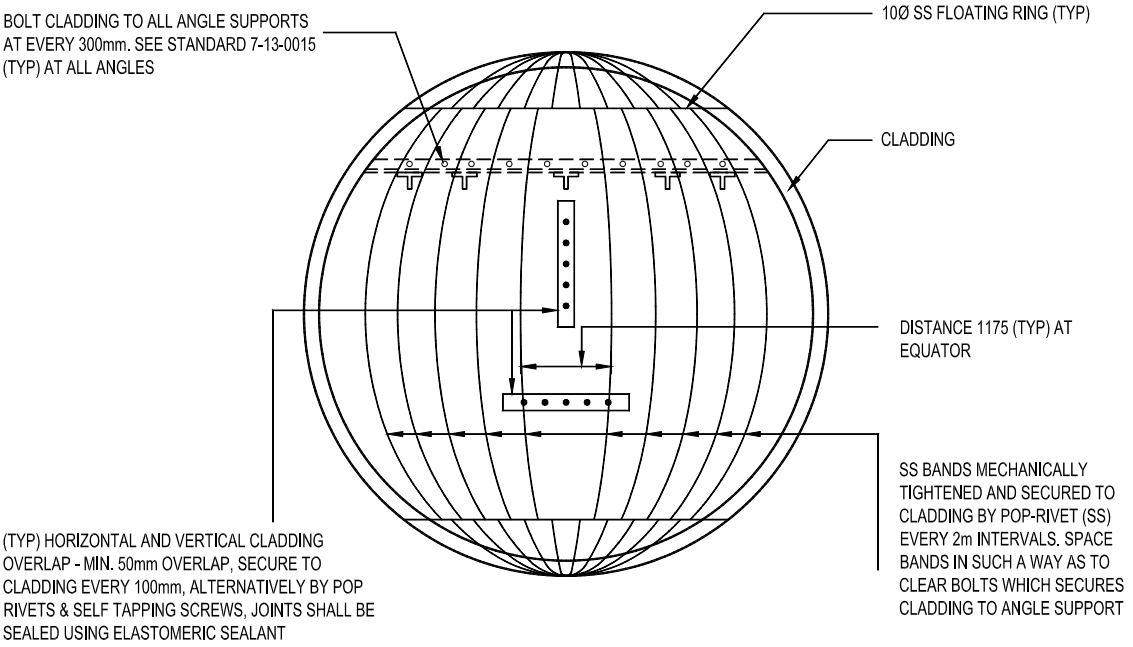
CLADDING SECUREMENT DETAIL

FIGURE – 19
INSULATION DETAILS : VERTICAL STORAGE TANK

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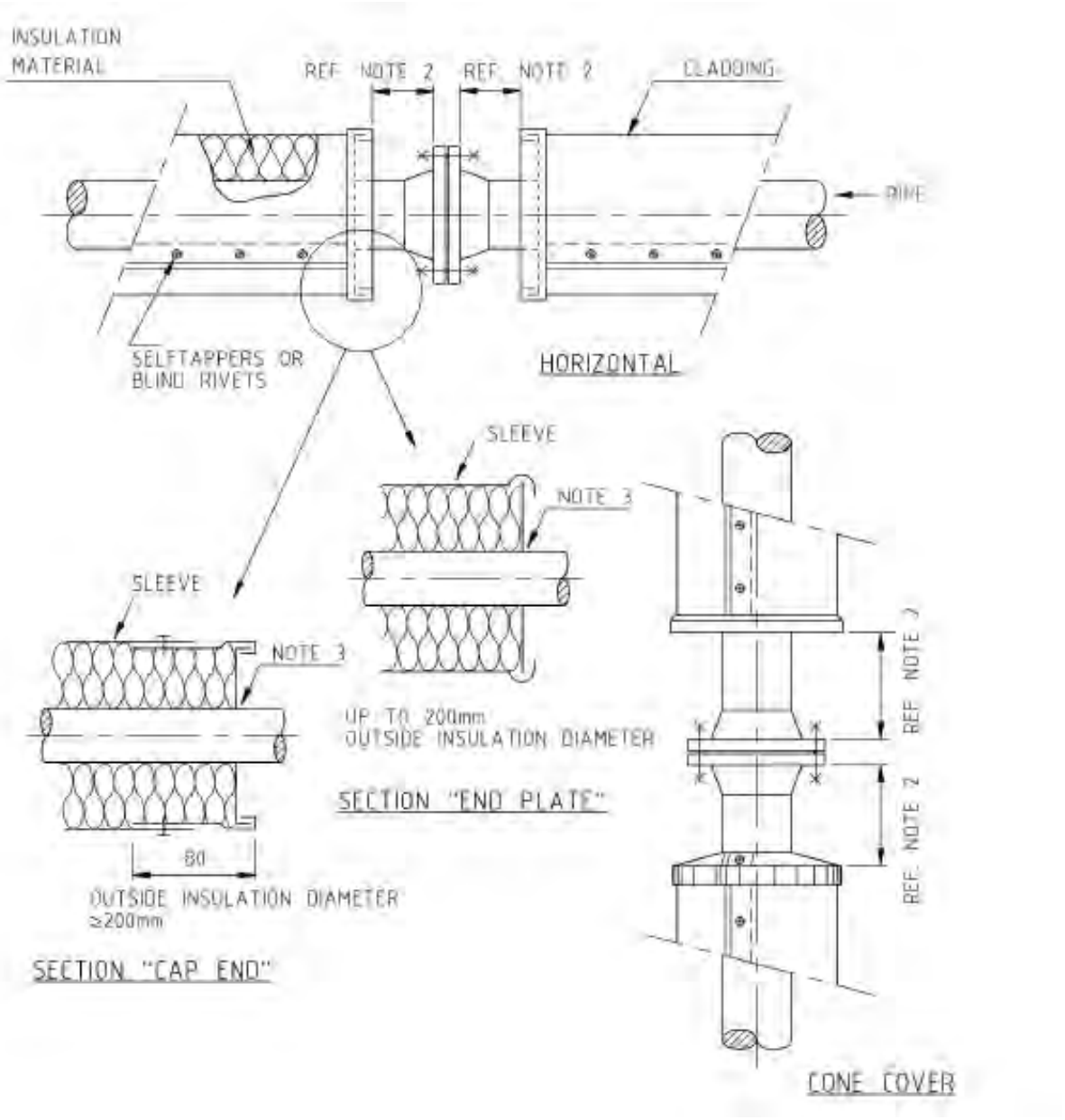
INSULATION SECUREMENT DETAILS



CLADDING SECUREMENT DETAILS

FIGURE – 20
INSULATION DETAILS : SPHERE

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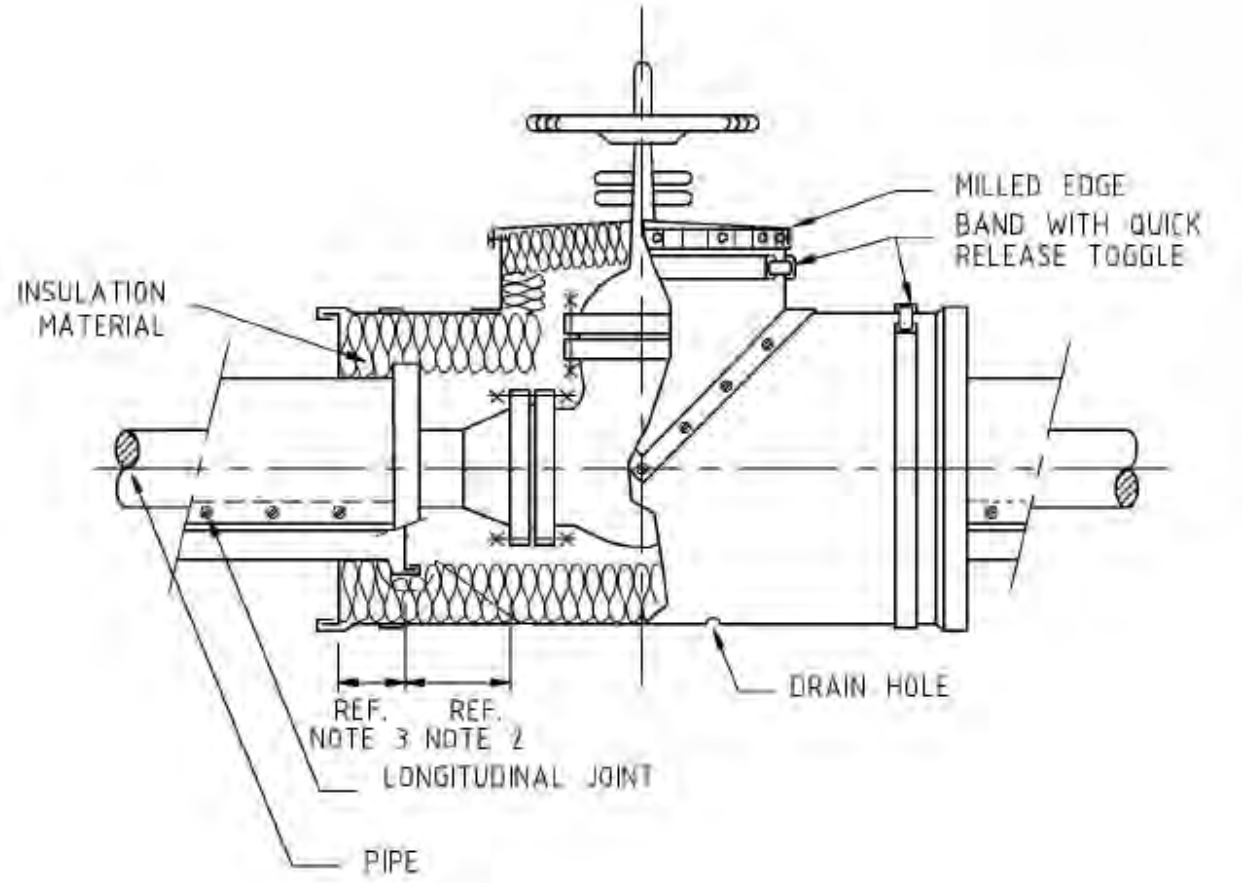


Note

1. Materials and finishing in accordance with installation instructions and specification.
2. Distance between insulation and flange to be bolt length+30mm
3. In case a end plate/cap end may damage the pipe, a heat resistant tape or gasket material to be installed between pipe and plate.

FIGURE – 21
NON- INSULATED FLANGES, HORIZONTAL AND VERTICAL

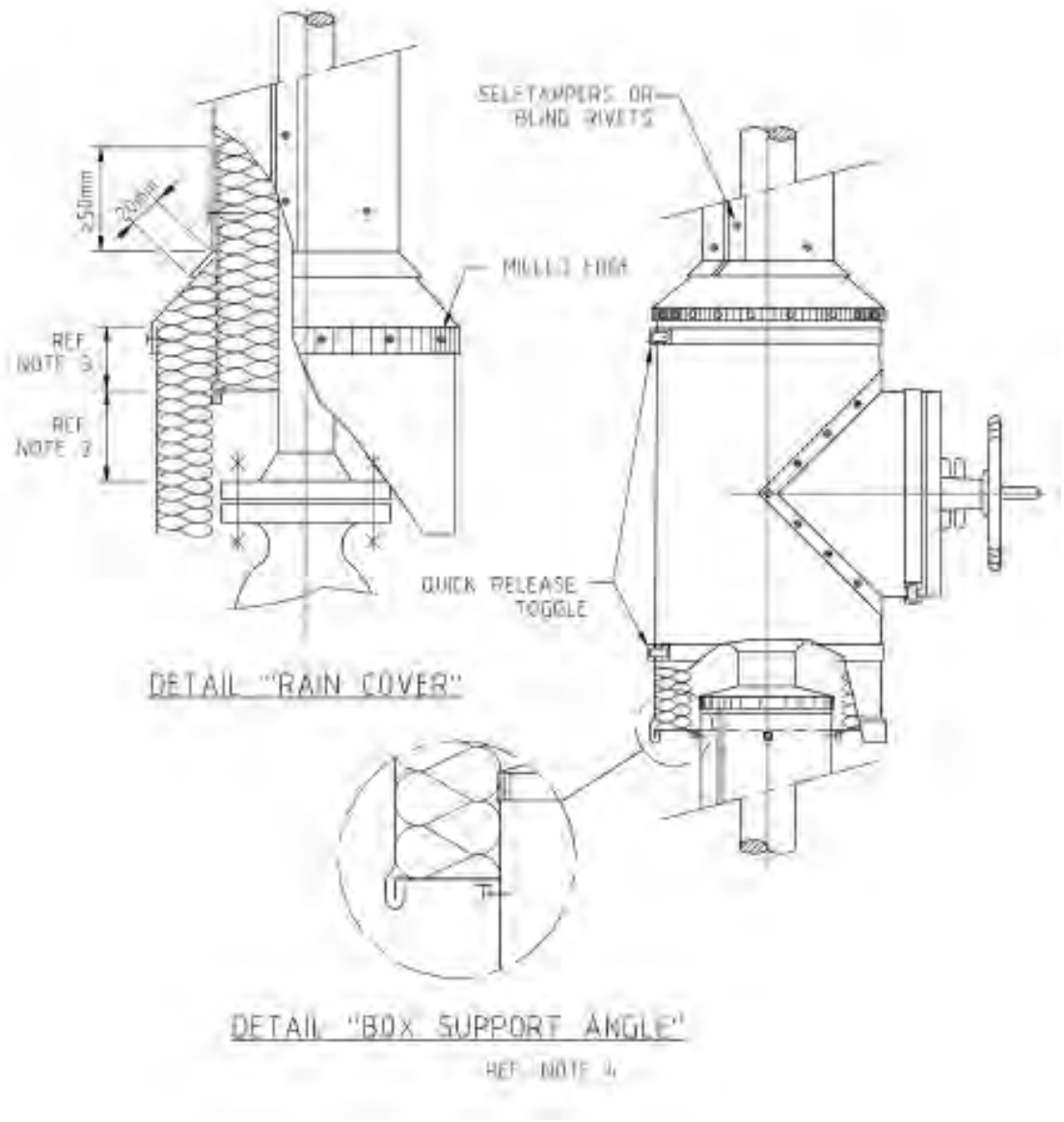
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Note
1. Materials and Finishing in accordance with installation instructions and specification
2. Distance between insulation and flange to be bolt length + 30mm
3. Insulation Thickness

FIGURE – 22
REMOVABLE VALVE BOX, "T" CONNECTION, HORIZONTAL
Applicable only valves which needs to be insulated as per applicable specification

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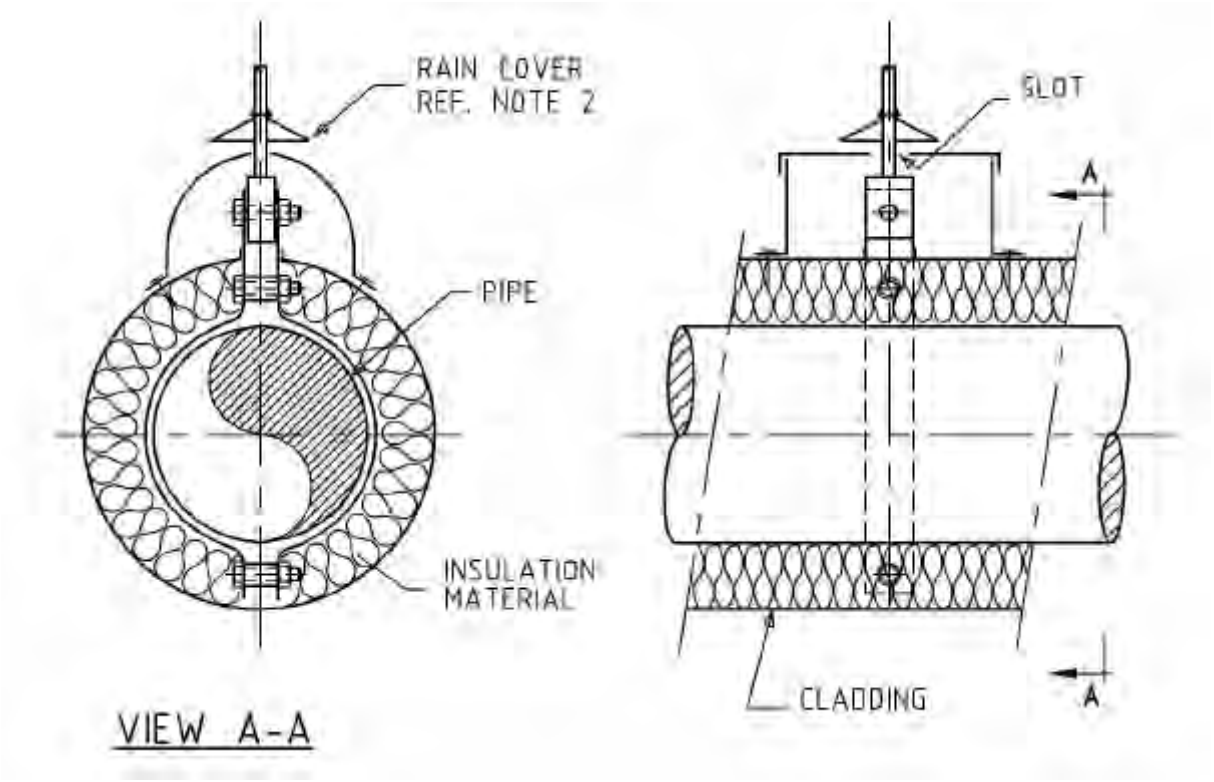


Note

1. Materials and Finishing in accordance with installation instructions and specification
2. Distance between insulation and flange to be bolt length + 30mm
3. Insulation Thickness
4. Per box minimal 4 support angles ≥ 30mm wide ≥ 0.8mm thick

FIGURE – 23
REMOVABLE VALVE BOX, "T" CONNECTION, VERTICAL
Applicable only valves which needs to be insulated as per applicable specification

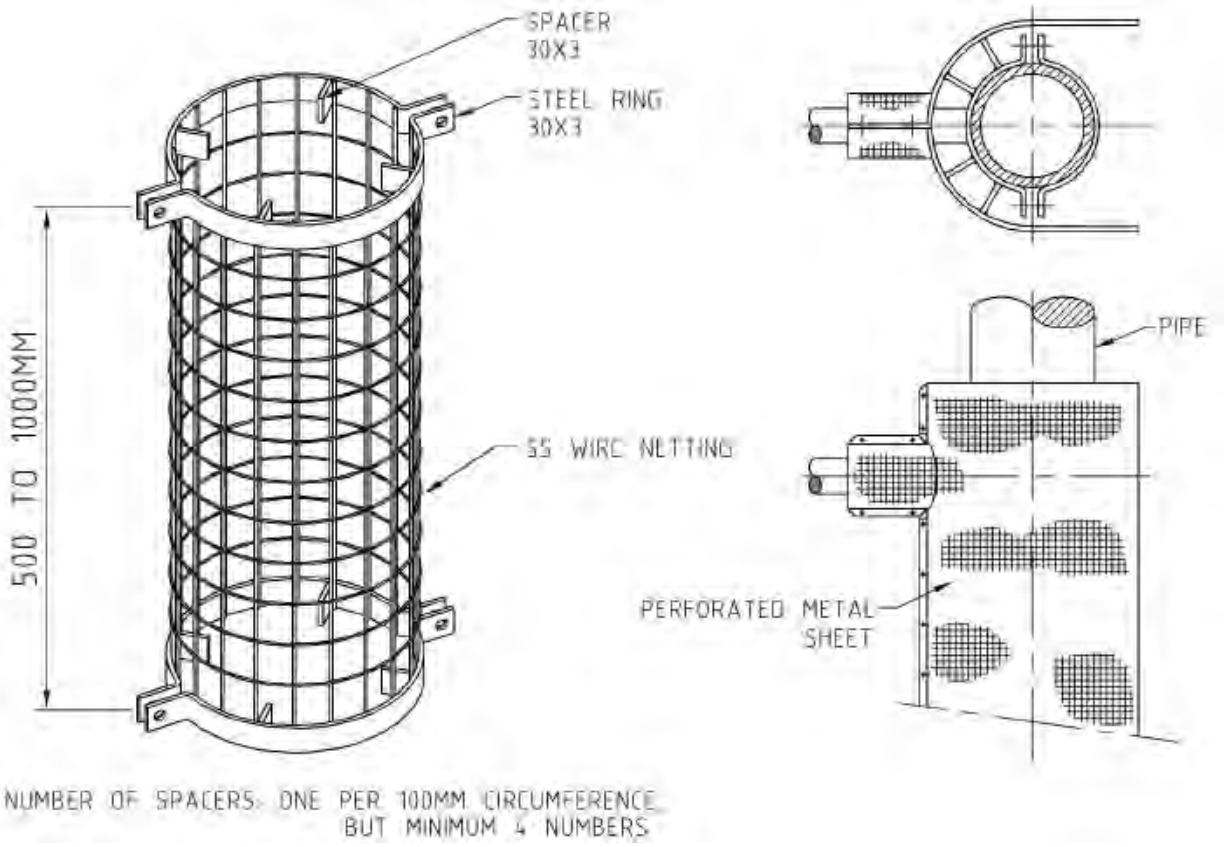
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Note
1. Materials and finishing in accordance with installation instructions and specifications
2. Rain cover is a part of the bracket

FIGURE – 24
HANGER SUPPORT

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WIRE NETTING



PERFORATED METAL SHEET



Note

1. Materials and finishing in accordance with installation instructions and specifications

FIGURE – 25
PERSONAL PROTECTION

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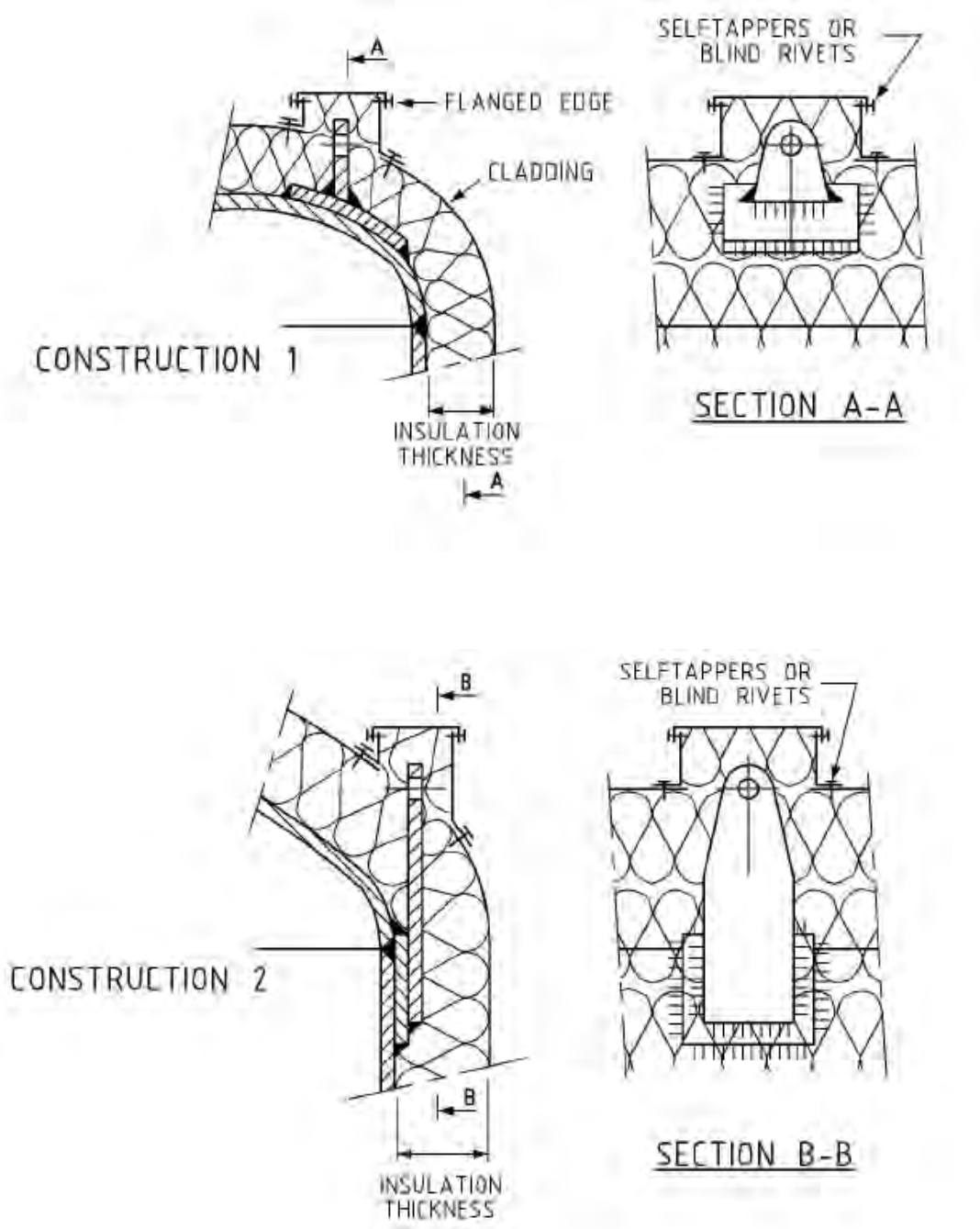
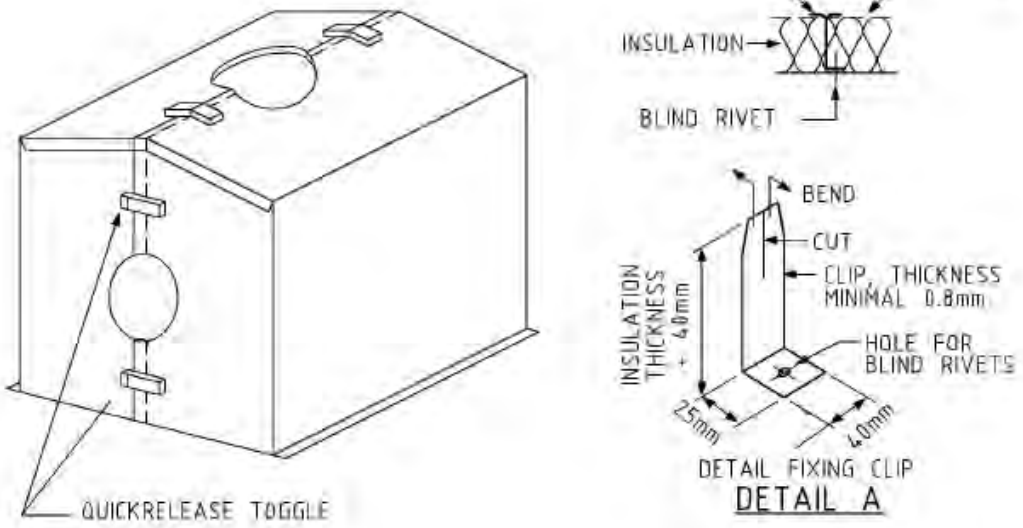
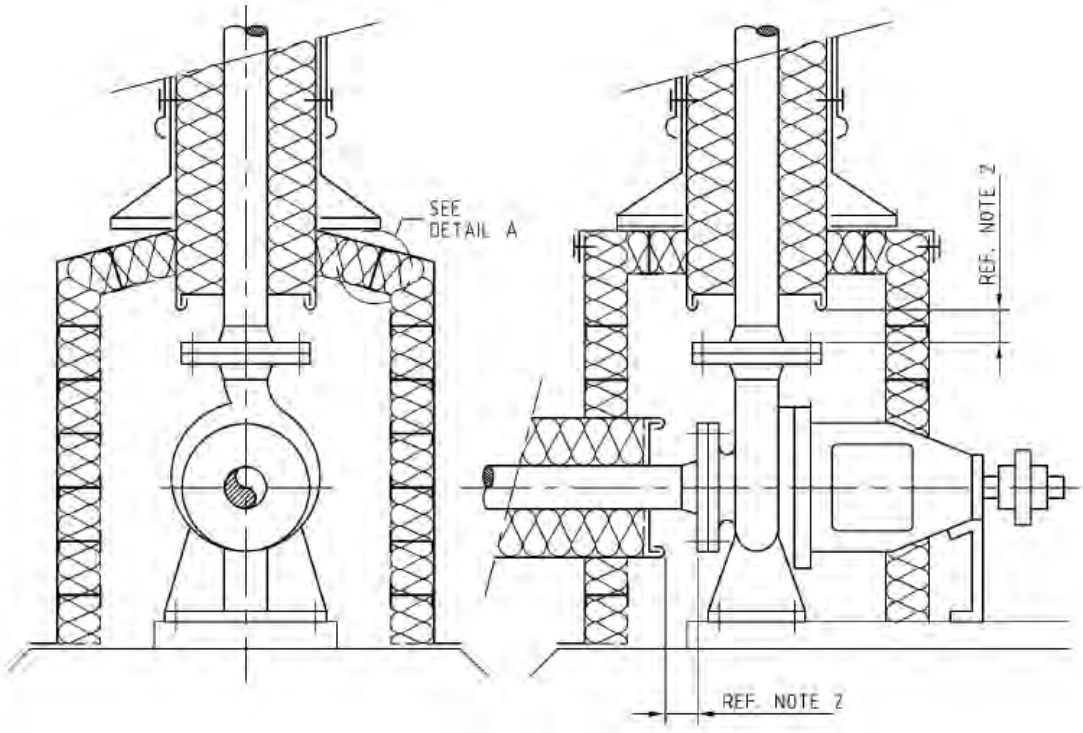


FIGURE – 26
DETAILS OF LIFTING LUGS

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Note
1. Materials and Finishing in accordance with installation instructions and specification
2. Distance between insulation and flange to be bolt length + 30mm

FIGURE – 27
REMOVABLE BOX FOR PUMP

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विक्रेता कार्यशाला में सकारात्मक सामग्री पहचान के लिए मानक विनिर्देश

STANDARD SPECIFICATION FOR POSITIVE MATERIAL IDENTIFICATION (PMI) AT SUPPLIER'S WORKS

Rev. No	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
4	23.12.21	REVISED AND RE-ISSUED	HKM	CS	RK	S Majumdar
3	19.09.16.	REVISED AND RE-ISSUED	TKK	HP	RKS	RN
2	20.10.11	REVISED AND RE-ISSUED	RKS	SCG	AKC	DM
1	15.07.08	REVISED AND RE-ISSUED	NKR	SSL	SKP	VC
0	07.12.00	ISSUED AS STANDARD SPECIFICATION	AKC	AKB	AKB	MI

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Abbreviations:

API	:	American Petroleum Institute
AS	:	Alloy Steel
HIC	:	Hydrogen Induced Cracking
LSTK	:	Lump Sum Turn Key
NACE	:	National Association of Corrosion Engineers
PMI	:	Positive Material Identification
RTJ	:	Ring Type Joint
Sch	:	Schedule
SS	:	Stainless Steel
TPI or TPIA	:	Third Party Inspection Agency

Inspection Standards Committee

Convenor: Mr. Rajeev Kumar

Members: Mr. Rajesh Sinha
Mr. Himangshu Pal
Mr. R. Muthuramalingam (RPO Representative)
Mr. Chandrashekhar
Mr. Avdhesh Agrawal
Mr. P V Satyanarayana (Engg. Representative)
Mr. Mahendra Mittal

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1.0 SCOPE

1.1 This specification applies to the requirements for Positive Material Identification (PMI) to be performed at the Supplier's works on Metallic Materials procured either directly by the Owner/EIL/ LSTK contractor or indirectly through the sub-Suppliers.

1.2 This specification covers the procedures and methodology to be adopted to assure that the chemical composition of the material is consistent with the material specifications as specified in purchase documents using 'Alloy Analyzer' at the time of final inspection before dispatch.

1.3 The scope of this specification shall include but shall not be limited to Positive Material Identification (PMI) to be performed on Materials listed below:

1.3.1 For alloy Steel materials as below:

- Alloy Steel Pipes including Clad Pipes
- Alloy Steel Flanges & Forgings
- Alloy Steel Fittings including Clad Fittings
- Alloy Steel Fasteners
- Alloy Cast & Forged steel valves
- Alloy Steel Instrumentation Items (Control Valves, Safety Valves etc.)
- Longitudinal Pipe & Fittings Welds.
- Gaskets (for Ring Type Joints)

1.3.2 For Carbon Steel materials as below:

- All Carbon Steel Piping items under NACE or HIC or H2 or Wet Hydrogen Sulfide (H_2S), Hydrofluoric acid (HF), Sulfuric acid (H_2SO_4) services etc.
- Carbon Steel flanges and valves (Rating 900# and above)
- LTCS items

Following items shall be excluded from scope of PMI examination.

- Gaskets other than for Ring Type Joints
- Internal Components of Valves

1.4 All grades of material supplies including Stainless Steels shall be liable for PMI test at site. In case of any defective materials being found at site, the Supplier shall be responsible to effect replacement of such defective materials at project site without any delays to the satisfaction of EIL site RCM (Resident Construction Manager).

2.0 REFERENCE DOCUMENTS

2.1 API Recommended Practice 578 (Third Edition, Feb 2018) - Material Verification Program for New and Existing Alloy Piping Systems.

3.0 DEFINITIONS

3.1 **Supplier:** Any Supplier or Manufacturer on whom an order is placed for the supply of referred items. This definition shall also include any sub-Supplier or manufacturer on whom a sub-order is placed by the Supplier.

3.2 **Inspection Lot:** A group of items offered for inspection covered under same size, Heat and Heat treatment lot.

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3.3 **Alloy Material:** Any metallic material (including welding filler materials) that contains alloying elements such as Chromium, Nickel, Molybdenum or Vanadium, which are intentionally added to enhance mechanical or physical properties and/or corrosion resistance.

4.0 PMI EXAMINATION

4.1 The Supplier shall submit a procedure of PMI to comply with the requirements of this Specification. Approval of PMI Procedure shall be obtained from Owner / EIL / TPIA prior to commencing manufacture / inspection of product.

4.2 PMI examination of materials is independent of any certification, markings or colour coding that may exist and is aimed at verifying that the alloy used are as per specified grades.

4.3 The Supplier shall identify all incoming alloy materials and maintain full traceability of all alloy
materials, including all off-cuts. Transfer of identification marks shall be undertaken prior to cutting to ensure maintenance of identification on off-cuts.

4.4 The Supplier shall ensure that all alloy materials are segregated and stored in separately identified locations to prevent the mix up of materials of different alloy specifications or alloy material with carbon steel. Non ferro-magnetic materials shall be segregated at all times from ferro-magnetic materials.

4.5 PMI examination is subject to surveillance inspection by Owner / EIL / TPIA.

5.0 ACCEPTABLE METHODS FOR PMI

5.1 The method used for PMI examination shall provide a quantitative determination of the alloying elements like Chromium, Nickel, Molybdenum or Vanadium in Alloy Steel items.

5.2 Instruments or methods used for PMI examination shall be able to provide quantitative, recordable, elemental composition results for positive identification of alloying elements present.

5.3 The acceptable instruments for alloy analyzer shall be either "Portable X-Ray fluorescence" or "Optical Emission" type each capable of verifying the percentage of alloy elements within specified range.

5.4 Chemical spot testing, magnets, alloy sorters and other methods using eddy current or triboelectric testing methods are not acceptable for PMI examination.

5.5 The PMI instrument used shall have the sensitivity to detect the alloying elements in the specified range.

5.6 All PMI instruments shall have been serviced within a 6 month period of the time of use to verify the suitability of batteries, sources etc., and the data of the last service shall be stated on the PMI Report Form (Sample enclosed).

5.7 Each analyzer must be calibrated according to the manufacturer's specification at the beginning and end of each shift. Instrument must be checked against known standard for each alloy type to be inspected during the shift.

5.8 Certified samples, with full traceability, of a known alloy materials shall be available for use as a random spot check on the instrument calibration.

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5.9 The surfaces to be examined shall be prepared by light grinding or abrasive paper and solvent cleaner. Evidence of Arc burn resulting from examination shall be removed by light grinding or abrasive paper. No permanent marks, which are injurious to the usage of product in service, are acceptable.

5.10 Alloy Steel ring type joint Gaskets shall be inspected by using portable X-Ray fluorescence instrument.

5.11 Testing shall be done as per the procedures outlined by the manufactures of alloy analyzer being used. Modification of these procedures if any must be approved by Owner/EIL.

5.12 The persons performing PMI shall demonstrate their capabilities to the satisfaction of Owner/EIL/TPIA visiting engineer. If the Supplier has qualified operator on their rolls, he may perform the examination. Otherwise PMI examination shall be sub-contracted to an independent testing agency approved by EIL.

5.13 Whenever material is identified as not meeting requirements by the visiting engineer a rejection note shall be issued.

6.0 EXTENT OF PMI EXAMINATION

Following sampling plans shall be applicable for PMI examination of various items.

A. Flanges, Fittings Valves, RTJ Gaskets - 100% by Supplier and 10% @ random witness by EIL/TPIA

B. Pipes - 100% (for pipes procured from traders)
2 random samples drawn from each Size/Heat/Lot (for pipes procured directly from mills)

C. Fasteners -

Lot Size	**Sample Size for** EIL/TPIA	Sample size for Supplier
Upto 100	2% (Min 2)	Min 10%
101 to 500	1% (Min 3)	Min 10%
501 and above	0.5% (Min 5)	Min 10%

Note:

a. For Welded Pipes and Fittings and flanges like Fig 8, Spacer and blinds etc. PMI shall be performed on Base Metal as well as weldments.

7.0 ACCEPTANCE CRITERIA

7.1 Base Metal

PMI test results showing presence of characteristic elements upto 10% less than the minimum specified value in the material specification and upto 10% more than the maximum specified value in the material specification shall be acceptable.

7.2 Deposited Weld Metal

For deposited weld metal using welding consumables matching with base metals, the recorded presence of characteristic elements upto 12.5% less than the minimum specified value in the

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welding consumable specification and upto 12.5% more than the maximum specified value in the welding consumable specification shall be acceptable.

8.0 REJECTION CRITERIA

8.1 If PMI test results fall outside the acceptable range as specified in 7.0 above, the supplier shall obtain a quantitative check analysis performed by a laboratory acceptable to Owner / EIL / TPIA for a complete chemical analysis. Alternatively, the item can be tested with a spark analyser for verification. Results of this analysis shall be submitted to Owner / EIL / TPIA for final decision.

Decision of Owner / EIL / TPIA shall be final in this regard.

8.2 If any sample drawn to PMI test on the basis of percentage selection as per 6.0 above, fails to meet specification requirements, 100% of items of lot shall be tested for PMI by supplier. Any failure thereafter during sample check shall mean rejection of whole lot.

9.0 RECORDING AND DOCUMENTATION

The results of PMI examination shall be recorded in a Report Format as enclosed with this specification.

10.0 MARKING

10.1 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

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	POSITIVE MATERIAL IDENTIFICATION REPORT BULK MATERIALS							Page of
Project:		Client						Job No.
PMI Report No.		Supplier/Sub-Supplier						
Purchase Order No.		Testing Agency						
Purchase Requisition No:		PMI Location						
Bulk Item Type (as per Requisition)								
Material Specification/Grade Number of items in Lot								
Requisition Item No./ Description		Major content, Weight Percent						Remarks Accept/Reject
Element	Cr	Ni	Mo	V	Ti *	Cb/ Nb **	Mn ***	
Specified Range								
Actual observations 1.								
2.								
3.								
4.								
5.								
6.								
7.								
8.								
Instrument Type / ID Last Service Date		Inspection Agency						Witnessed By

* To be reported in case of SS321 Material
** To be reported in case of SS347 Material
*** To be reported in case of LTCS Material

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वैल्डेड पाइपों के लिए
निरीक्षण एवं परीक्षण योजना

INSPECTION AND TEST PLAN
FOR
WELDED PIPES

Rev. No.	Date	Purpose	Prepared By	Checked By	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
6	23.12.2021	REVISED AND RE-ISSUED	HKM	CS	RK	S Mazumdar
5	19.09.2016	REVISED AND RE-ISSUED	TKK	HP	RKS	RN
4	17.06.2013	REVISED AND RE-ISSUED	TKK	RKS	SCG	DM
3	15.07.2011	REVISED AND RE-ISSUED	TKK	SCG	AKC	DM
2	30.06.2010	REVISED AND RE-ISSUED	RKB	VKJ	SKP	ND

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Abbreviations:

CEIL	:	Certification Engineers International Limited	MRT	:	Mechanical Run Test
CIMFR	:	Central Institute of Mining & Fuel Research	NDT	:	Non Destructive Testing
CE	:	Carbon Equivalent	NPSH	:	Net Positive Suction Head
DFT	:	Dry Film Thickness	PO	:	Purchase Order
DPT	:	Dye Penetrant Testing	PESO	:	Petroleum Explosive Safety Organization
DHT	:	De-hydrogen Heat Treatment	PQR	:	Procedure Qualification Record
ERTL	:	Electronics Regional Test Laboratory	PR	:	Purchase Requisition
FCRI	:	Fluid Control Research Institute	PMI	:	Positive Material Identification
HT	:	Heat Treatment	RT	:	Radiography Testing
HIC	:	Hydrogen Induced Cracking	SSCC	:	Sulphide Stress Corrosion Cracking
ITP	:	Inspection and Test Plan	TC	:	Test Certificate
IP	:	Ingress Protection	TPI or TPIA	:	Third Party Inspection Agency
IHT	:	Intermediate Heat Treatment	UT	:	Ultrasonic Testing
IC	:	Inspection Certificate	VDR	:	Vendor Data Requirement
IGC	:	Inter Granular Corrosion	WPS	:	Welding Procedure Specification
MPT/MT	:	Magnetic Particle Testing	WPQ	:	Welders Performance Qualification
MTC	:	Material Test Certificate			

Inspection Standards Committee

Convenor : Mr. Rajeev Kumar

Members:

Mr. Rajesh Sinha
Mr. Chandrashekhar
Mr. Mahendra Mittal
Mr. Himangshu Pal
Mr. Avdhesh Agrawal
Mr. R. Muthuramalingam (RPO Representative)
Mr. P V Satyanarayana (Engg. Representative)

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1.0 SCOPE

This Inspection and Test Plan covers the minimum testing requirements for Welded Pipes.

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 and Other Procedures	Documented Procedures	100%	Procedure Documents	-	H	R
1.2	WPS,PQR & WPQ (Approved under EIL/Reputed TPIA)	Welding Parameters & Qualification Record	100%	WPS,PQR &WPQ	-	H	W- New R- Existing (Qualified under reputed TPIA)
2.0	**Material Inspection**						
2.1	Raw Material Inspection	Review of MTC for Chemical & Mechanical Properties	100%	Test Certificates	-	H	R

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
3.0	**In Process Inspection**						
3.1	Welding	Welding Parameters as per WPS / PQR	100%	Inspection Reports	-	H	-
3.2	Heat Treatment	Stress Relieving, Normalizing, Tempering, Solution Annealing, Stabilization Heat Treatment etc. as applicable	100%	HT chart	-	H	R
3.3	Ferrite Check of SS Pipes (as Applicable) Before HT	% Ferrite Check	Random On Weld	Inspection Report	-	H	R
3.4	UT / RT As applicable	Surface & Internal Imperfections	PR / Purchase Specification	RT Films, Reports & UT Reports	-	H	R (Film review for RT)
3.5	TPM (Identification of Test Samples)	Product analysis, Tensile, Hardness, Impact, IGC and Other test as applicable	Lot as per specification.	Test Reports	-	H	H
3.6	Product Analysis	Chemical Composition	PR / Purchase Specification	Test Reports	-	H	R
3.7	Destructive Testing	Tensile (0.2 Offset/0.5% extension under load), Hardness, Impact, IGC and Other test as applicable	Lot as per specification.	Test Reports	-	H	H

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
3.8	Galvanizing (If Applicable)	Integrity Of Galvanized Coating	100%	Inspection Report	-	H	R
4.0	**Final Inspection**						
4.1	Hydrostatic Testing	Leak Check	100%	Test Report	-	H	RW (Min.5%)
4.2	Visual and Dimensional Inspection (VDI)	Surface Condition, Straightness, End Finish, Bevel Angle, Root Face, Outer Dia., Profile Thickness, Length, End Finish, Marking etc	100%	Inspection Report	-	H	RW (Min.5%)
4.3	Weight Checking as applicable	Weight	100%	Inspection Report	-	H	-
4.4	PMI Check	Chemical Check	As Per EIL Spec. 6-81-0001	Inspection report	-	H	RW
4.5	Final Stamping	Stamping of Accepted Pipes	Stamping of Pipes which are witnessed by EIL/TPIA.	Inspection Report	-	H	H

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
5.0	**Painting**						
5.1	Rust Preventive Coating & Color Coding (As applicable)	Visual & Color Coding as applicable	100%	Inspection Report	-	H	-
6.0	**Documentation & IC**						
6.1	Documentation & Inspection Certificate (IC)	Review of Stage Inspection Reports / Test Reports & Issue of IC	100%	Manufacturer 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. 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).
2. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred therein /Job Specification /Approved Documents.
3. For orders placed on stockist, items shall be accepted based on manufacturer's TC with EN10204 type 3.2 certification from EIL approved suppliers.

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निरीक्षण एवं परीक्षण योजना

INSPECTION AND TEST PLAN
FOR
SEAMLESS PIPES

Rev. No.	Date	Purpose	Prepared By	Checked By	Standards Committee Convenor	Standards Bureau Chairman
					Approved By	
6	23.12.2021	REVISED AND RE-ISSUED	HKM	CS	RK	S Majumdar
5	19.09..2016	REVISED AND RE-ISSUED	TKK	HP	RKS	RN
4	17.06..2013	REVISED AND RE-ISSUED	TKK	RKS	SCG	DM
3	15.07.2011	REVISED AND RE-ISSUED	TKK	SCG	AKC	DM
2	30.06.2010	REVISED AND RE-ISSUED	RK	VKJ	SKP	ND

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Abbreviations:

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DFT	:	Dry Film Thickness	PO	:	Purchase Order
DPT	:	Dye Penetrant Testing	PESO	:	Petroleum Explosive Safety Organization
DHT	:	De-hydrogen Heat Treatment	PQR	:	Procedure Qualification Record
ERTL	:	Electronics Regional Test Laboratory	PR	:	Purchase Requisition
FCRI	:	Fluid Control Research Institute	PMI	:	Positive Material Identification
HT	:	Heat Treatment	RT	:	Radiography Testing
HIC	:	Hydrogen Induced Cracking	SSCC	:	Sulphide Stress Corrosion Cracking
ITP	:	Inspection and Test Plan	TC	:	Test Certificate
IP	:	Ingress Protection	TPI or TPIA	:	Third Party Inspection Agency
IHT	:	Intermediate Heat Treatment	UT	:	Ultrasonic Testing
IC	:	Inspection Certificate	VDR	:	Vendor Data Requirement
IGC	:	Inter Granular Corrosion	WPS	:	Welding Procedure Specification
MPT/MT	:	Magnetic Particle Testing	WPQ	:	Welders Performance Qualification
MTC	:	Material Test Certificate			

Inspection Standards Committee

Convenor : Mr. Rajeev Kumar

Members:

Mr. Rajesh Sinha	Mr. Himangshu Pal	Mr. R. Muthuramalingam (RPO Representative)
Mr. Chandrashekhar	Mr. Avdhesh Agrawal	Mr. P V Satyanarayana (Engg. Representative)
Mr. Mahendra Mittal		

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1.0 SCOPE

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

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 and Other Procedures	Documented Procedures	100%	Procedure Documents	-	H	R
2.0	**Material Inspection**						
2.1	Raw Material Inspection	Review of MTC for Chemical, Mechanical Properties, size & steel making process, etc.	100%	Test Certificates	-	H	R
3.0	**In Process Inspection**						

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SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/ TPIA
3.1	Heat Treatment	Normalizing, Tempering, Solution Annealing, Stabilization Heat Treatment etc. as applicable	100%	HT chart	-	H	R
3.2	NDT As applicable	Surface & Internal Imperfections	PR / Purchase Specification	NDT Reports	-	H	R
3.3	TPM (Identification of Test Samples)	Product analysis, Tensile ((0.2 Offset/0.5% extension under load),), Hardness, Impact, IGC and Other test as applicable	Lot as per specification	Test Reports	-	H	H (Note-1)
3.4	Product Analysis	Chemical Composition	Lot as per specification	Test Reports	-	H	R
3.5	Destructive Testing	Tensile, Hardness, Impact, IGC and Other test as applicable	Lot as per specification	Test Reports	-	H	H (Note-1)
3.6	Galvanizing (If Applicable)	Integrity of Galvanised Coating	100%	Inspection Report	-	H	R
4.0	**Final Inspection**						
4.1	Hydrostatic Testing	Leak Check	100%	Test Report	-	H	RW (Note 1)

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SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/ TPIA
4.2	Visual and Dimensional Inspection (VDI)	Surface Condition, Straightness, End Finish, Bevel Angle, Root Face, Outer Dia., Thickness, Length, End Finish, Marking, End Caps etc	100%	Inspection Report	-	H	RW (Note 1)
4.3	Weight Checking as applicable	Weight	100% By Supplier	Inspection Report	-	H	-
4.4	PMI Check	Chemical Check	As Per EIL Spec. 6-81-0001	Inspection report	-	H	RW
4.5	Final Stamping	Stamping of Accepted Pipes	Stamping of Pipes which are witnessed by EIL/TPIA..Other pipes to have suppliers identification	Inspection Report	-	H	H

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SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/ TPIA
5.0	**Painting**						
5.1	Rust Preventive Coating & Color Coding (As applicable)	Visual & Color Coding as applicable	100%	Inspection Report	-	W	-
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. Carbon Steel Pipes (Other than LTCS & Pipes for special services like NACE, H2, HIC, etc.) 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 therein /Job Specification /Approved Documents.
4. For orders placed on stockist, items shall be accepted based on manufacturer's TC with EN10204 type 3.2 certification from EIL approved suppliers.

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वाल्वों के लिए
निरीक्षण एवं परीक्षण योजना

INSPECTION AND TEST PLAN
FOR
VALVES

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
7	08.05..2023	REVISED AND RE-ISSUED	NK	AK	RK	SM
6	14.11.2018	REVISED AND RE-ISSUED	KC	NM	RKS	RKT
5	17.06.2013	REVISED AND RE-ISSUED	TKK	RKS	SCG	DM
4	15.07.2011	REVISED AND RE-ISSUED	TKK	SCG	AKC	DM
3	30.06.2010	REVISED AND RE-ISSUED	RKB	VKJ	SKP	ND
2	31.01.2008	REVISED AND RE-ISSUED	CS	SS	MVKK	VC

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Abbreviations:

CEIL	:	Certification Engineers International Limited	MRT	:	Mechanical Run Test
CIMFR	:	Central Institute of Mining & Fuel Research	NDT	:	Non Destructive Testing
CE	:	Carbon Equivalent	NPSH	:	Net Positive Suction Head
DFT	:	Dry Film Thickness	PO	:	Purchase Order
DPT	:	Dye Penetrant Testing	PESO	:	Petroleum Explosive Safety Organization
DHT	:	De-hydrogen Heat Treatment	PQR	:	Procedure Qualification Record
ERTL	:	Electronics Regional Test Laboratory	PR	:	Purchase Requisition
FCRI	:	Fluid Control Research Institute	PMI	:	Positive Material Identification
HT	:	Heat Treatment	RT	:	Radiography Testing
HIC	:	Hydrogen Induced Cracking	SSCC	:	Sulphide Stress Corrosion Cracking
ITP	:	Inspection and Test Plan	TC	:	Test Certificate
IP	:	Ingress Protection	TPI or TPIA	:	Third Party Inspection Agency
IHT	:	Intermediate Heat Treatment	UT	:	Ultrasonic Testing
IC	:	Inspection Certificate	VDR	:	Vendor Data Requirement
IGC	:	Inter Granular Corrosion	WPS	:	Welding Procedure Specification
MPT/MT	:	Magnetic Particle Testing	WPQ	:	Welders Performance Qualification
MTC	:	Material Test Certificate			

Inspection Standards Committee

Convenor : Mr. Rajeev Kumar

Members:

Mr. Rajesh Sinha	Mr. Himangshu Pal	Mr. Chandrashekhar	Mr. R Muthu Ramalingam (RPO Rep.)
Mr. Avdhesh Agrawal	Mr. Mahendra Mittal	Ms Sulakshna Hundekari (Piping)	

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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, Fugitive Emission Test, Internal/ External Coating Procedures & Other Procedures (Wherever applicable as per MR/ PR)	NDT Level III Approved Documented Procedures	100%	NDT Level III Approved Procedure Documents	-	H	R
1.2	WPS, PQR & WPQ and NDT operator Qualification Record	Welding Parameters & Qualification Record	100%	WPS, PQR &WPQ	-	H	W- New R- Existing

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SL NO	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.3	Pre-Qualification Tests	Fire safe, Cryogenic, Fugitive Emission Test, Internal Epoxy Coating, Glass Lined Coating & Other Test as applicable	As per PR / Purchase Specification	Acceptance Report	-	H	H (If new)
2.0	**Material Inspection**						
2.1	Castings & Forgings (Body, Bonnet, Disc, Stem, Body ring)	Chemical, Mechanical (Tensile, Hardness, Impact Test etc.), Heat Treatment, NDT, IGC & Other Properties as applicable	100%	Test Certificates	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 after Heat Treatment	As per PR / Purchase Specification	RT Films and NDT reports	H	R	R
2.4	Bars for Trim material	Chemical Analysis	Each Heat	Test Certificates & Lab Report	H	R	-

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SL NO	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
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 Certificates etc. As per EIL ITP. 6-81-1091	100%	Test Certificates, Inspection report	H	H	R
3.0	**In Process Inspection**						
3.1	Welding, Weld Overlay, Stelliting, Hardfacing (As applicable)	Welding Parameters as per WPS / PQR	100%	Inspection Reports	-	H	-
3.2	Machining of components	Visual / Dimension	100%	Inspection Reports	-	H	-
3.3	DP Test for all weld joints, Bevel Ends & Bypass (as applicable)	Dye Penetrant Test	100%	NDT Report	-	H	RW
3.4	Hardness Check	Heat Treat Castings, Weld Joints, Grove Joints etc.	100%	Inspection Reports	-	H	R
4.0	**Final Inspection**						

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SL NO	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.1	a. Shell Hydrotest b. Seat Hydro Test (Both Sides) c. Backseat Hydrotest (Gate & Globe Valves) d. Seat Pneumatic/ Air Test	Leak Check	100%	Pressure Test Report, Water quality Report		H	RW (Note 1)
4.2	Helium Leak test / Vacuum Test (as applicable)	Leak Check	As per PR / Purchase Specification	Test Report	-	H	RW (Note 1)
4.3	Visual & Dimensional Check	Surface Verification & Dimension Measurement	100%	Test Report	-	H	RW (Note 1)
4.4	Functional Test for Motor/ Actuator Operated Valves	Satisfactory Performance	100%	Test Report	-	H	RW
4.5	Marking Verification	Verification of Marking, Valve Tagging & Name Plate Checking	100%	Marking & Tagging Report		H	RW (Note-1)
4.6	PMI Check	Chemical Check	As per EIL Spec. 6-81-0001	PMI Report	-	H	RW

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SL NO	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.7	Strip Check (As applicable)	Verify Components for wear, damage , harmful defects & Differential hardness as applicable	As per PR / Purchase Specification	Inspection Report	-	H	RW (Note-1)
4.8	Final Stamping	Stamping of Accepted Valves	Stamping of Valves which are witnessed by EIL/TPIA.	Inspection Report	-	H	H (Note-1)
5.0	**Painting**						
5.1	Painting/ Pickling & Passivation and Color coding as applicable	Visual / DFT Check	100%	Inspection Report	-	H	-
6.0	**PACKING & PROTECTION**						
6.1	Packing & Protection	Dispatch Instructions as per Technical Notes for Valves	100%	Compliance Report with photographs		H	RW
7.0	**Documentation & Inspection Certificate**						

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SL NO	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
7.1	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. Non NACE & Non Hydrogen service Carbon Steel Cast Valves up to size 12"-300ANSI Class and Carbon Steel Forged Valves up to size 1.5"- 800 ANSI Class will be accepted on review of Supplier Test Certificates.
   Supplier Test Certificate along with back up reports 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 therein /Job Specification /Approved Documents.

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निरीक्षण व परीक्षण योजना

INSPECTION AND TEST PLAN FOR FORGED, SEAMLESS & WELDED FITTINGS

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convener	Standards Bureau Chairman
					Approved by	
9	26.12.2024	REVISED AND RE-ISSUED	AA	CS	RK	MN
8.	01.06.2019	REVISED AND RE-ISSUED	AA	RS	RKS	RKT

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Abbreviations:

CEIL	:	Certification Engineers International Limited	MRT	:	Mechanical Run Test
CIMFR	:	Central Institute of Mining & Fuel Research	NDT	:	Non Destructive Testing
CE	:	Carbon Equivalent	NPSH	:	Net Positive Suction Head
DFT	:	Dry Film Thickness	PO	:	Purchase Order
DPT	:	Dye Penetrant Testing	PESO	:	Petroleum Explosive Safety Organization
DHT	:	De-hydrogen Heat Treatment	PQR	:	Procedure Qualification Record
ERTL	:	Electronics Regional Test Laboratory	PR	:	Purchase Requisition
FCRI	:	Fluid Control Research Institute	PMI	:	Positive Material Identification
HT	:	Heat Treatment	RT	:	Radiography Testing
HIC	:	Hydrogen Induced Cracking	SSCC	:	Sulphide Stress Corrosion Cracking
ITP	:	Inspection and Test Plan	TC	:	Test Certificate
IP	:	Ingress Protection	TPI or TPIA	:	Third Party Inspection Agency
IHT	:	Intermediate Heat Treatment	UT	:	Ultrasonic Testing
IC	:	Inspection Certificate	VDR	:	Vendor Data Requirement
IGC	:	Inter Granular Corrosion	WPS	:	Welding Procedure Specification
MPT/MT	:	Magnetic Particle Testing	WPQ	:	Welders Performance Qualification
MTC	:	Material Test Certificate			

Inspection Standards Committee

Convener: Mr. Rajeev Kumar

Members:

Mr. Suresh G
Mr. Muthuramalingam
Mr. Mahendra Mittal
Mr. Himangshu Pal
Mr. Avdhesh Agrawal
Ms. Sulakshana Hundeikari
Mr. Chandrashekhar
Mr. Anil Kumar

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1.0 SCOPE

This Inspection and Test Plan covers the minimum testing requirements of Forged, Seamless & Welded Fittings.

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	Heat Treatment / NDT	Documented Procedures	100%	Procedure Documents	-	H	R
1.2	WPS, PQR, WPQ	Welding Parameters & Welding &	100%	WPS, PQR &WPQ	-	H	W- New R- Existing
1.3	NDE Operator Qualification records & Calibration records of measuring instruments & testing equipment	NDE operator qualification certificates & calibration certificates	100%	NDE & Calibration summery	-	H	R
2.0	**Material Inspection**						

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
2.1	Raw Material Identification (Billets, Rounds, Pipes, Coil, Plates, etc.) (*For pipes, coils & plates of Alloy steels and Special services like NACE, H2, HIC, Wet H2S, LTCS, UOP, AXEN etc.)	Chemical and Mechanical Properties, Size & Steel making practice etc.	100%	Mill test certificate, Supplier's Inspection Report	-	H	W* / R
3.0	**In Process Inspection**						
3.1	Forming &Welding	Forming & Welding Parameters	100%	Supplier's records	-	H	-
3.2	Ferrite Check of SS Welds (If Applicable)	% Ferrite Check	100%	Inspection Report	-	H	R
3.3	Heat Treatment	Stress Reliving, Normalizing, Tempering, Solution Annealing, Stabilization Heat Treatment etc. as applicable	100%	HT chart / Report	-	H	R
3.4	NDT-RT As Applicable	Surface & Internal Imperfections	As per PR/Purchase Specification	RT Films & Reports	-	H	R (Films Review)

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
3.5	NDT – UT (as applicable)	Surface & Internal Imperfections	As per PR/Purchase Specification	UT Report	-	H	R
3.6	NDT – DPT/MPT on Bevel Ends (as applicable)	Surface & Internal Imperfections	100%	Test Report	-	H	RW
3.7	Identification of Test Samples	Product Chemical, Mechanical, Impact, IGC and another test as applicable	Per heat, per heat treatment lot (Note-4)	Test Reports	-	H	H
3.8	Product Analysis	Chemical Composition	As per PR/Purchase Specification	Test Reports	-	H	R
3.9	Destructive Testing	Mechanical, Impact, IGC, Hardness and Other test as applicable	100%	Test Reports	-	H	H
3.10	Galvanizing (If Applicable)	Integrity Of Galvanized Coating	100%	Inspection Report	-	H	R
4.0	**Final Inspection**						
4.1	Visual and Dimension	Size, Thickness / Schedule, Dimensions, Surface quality, Marking, etc.	100%	Inspection Report	-	H	RW

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.2	Hardness testing on finished fittings of Alloy steels and Special services (like NACE, H2, HIC, Wet H2S, UOP, AXEN etc.) & any other services as applicable.	Hardness value of Base metal & Welds/HAZ.	Random 10%	Test Report	-	H	RW
4.3	PMI Check	Chemical Check	As Per EIL Spec. 6-81-0001	Inspection report	-	H	RW
4.4	Final Stamping	Stamping Of Accepted Fittings	Stamping of Fittings which are witnessed by EIL/TPIA.	Inspection Report	-	H	H
5.0	**Painting**						
5.1	Rust Preventive Coating & Color Coding	Visual & Color Coding as applicable	100%	Inspection Report	-	W	-
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).

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NOTES (As applicable):

1. 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).
2. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred there in /Job Specification /Approved Documents.
3. For orders placed on stockiest, items shall be accepted based on manufacturer's TC with EN10204 type 3.2 certification from EIL approved suppliers.
4. Test piece marking shall be carried out from the product for each heat of raw material and for each heat treatment batch at shop floor.

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फ्लैंजो, स्पैक्टेकल ब्लांइडों एवं ड्रिप रिंगों के लिये निरीक्षण व परीक्षण योजना

INSPECTION AND TEST PLAN FOR FLANGES, SPECTACLE BLINDS & DRIP RINGS

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
6	22.02.2024	REVISED AND RE-ISSUED	BBK	PW	RK	MN
5	14.11.2018	REVISED AND RE-ISSUED	KC	NM	RKS	RKT
4	17.06.2013	REVISED AND RE-ISSUED	TKK	RKS	SCG	DM
3	15.07.2011	REVISED AND RE-ISSUED	TKK	SCG	AKC	DM

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Abbreviations:

CEIL	:	Certification Engineers International Limited	MRT	:	Mechanical Run Test
CIMFR	:	Central Institute of Mining & Fuel Research	NDT	:	Non Destructive Testing
CE	:	Carbon Equivalent	NPSH	:	Net Positive Suction Head
DFT	:	Dry Film Thickness	PO	:	Purchase Order
DPT	:	Dye Penetrant Testing	PESO	:	Petroleum Explosive Safety Organization
DHT	:	De-hydrogen Heat Treatment	PQR	:	Procedure Qualification Record
ERTL	:	Electronics Regional Test Laboratory	PR	:	Purchase Requisition
FCRI	:	Fluid Control Research Institute	PMI	:	Positive Material Identification
HT	:	Heat Treatment	RT	:	Radiography Testing
HIC	:	Hydrogen Induced Cracking	SSCC	:	Sulphide Stress Corrosion Cracking
ITP	:	Inspection and Test Plan	TC	:	Test Certificate
IP	:	Ingress Protection	TPI or TPIA	:	Third Party Inspection Agency
IHT	:	Intermediate Heat Treatment	UT	:	Ultrasonic Testing
IC	:	Inspection Certificate	VDR	:	Vendor Data Requirement
IGC	:	Inter Granular Corrosion	WPS	:	Welding Procedure Specification
MPT/MT	:	Magnetic Particle Testing	WPQ	:	Welders Performance Qualification
MTC	:	Material Test Certificate			

Inspection Standards Committee

Convenor: Mr. Rajeev Kumar

Members:

Mr. Chandrashekar	Mr. G Suresh	Mr. Himangshu Pal	Mr. R Muthu Ramalingam (RPO Rep.)
Mr. Avdhesh Agrawal	Mr. Mahendra Mittal	Ms. Sulakshna Hundekari (Engg.)	Mr. Anil Kumar

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1.0 SCOPE

This Inspection and Test Plan covers the minimum testing requirements of Flanges, Spectacle Blinds & Drip Rings.

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	Heat Treatment, NDT, PMI , IGC, Mechanical, Chemical testing 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
2.0	**Material Inspection**						
2.1	Raw Material Inspection	Chemical & Mechanical Properties	100%	Test Certificates	-	H	R

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SL NO.	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
3.0	**In Process Inspection**						
3.1	Welding / Forging	Forging /Welding Parameters	100%	Inspection Reports	-	H	-
3.2	Heat Treatment	Stress Relieving, Normalising, Tempering, Solution Annealing, Stabilization Heat Treatment etc., as applicable	100%	HT chart	-	H	R
3.3	Identification of Test Samples	Product Chemical, Mechanical, Impact, IGC (Per heat/ Heat Treatment lot) and Other tests, as applicable	100%	Test Reports	-	H	H
3.4	Product Analysis (As applicable)	Chemical Composition	As per PR/Purchase Specification	Test Reports	-	H	R
3.5	Destructive Testing	Mechanical, Impact, IGC and Other tests, as applicable	100%	Test Reports	-	H	H
3.6	NDT as applicable	Surface & Internal Imperfections	As per PR/Purchase Specification	NDT Reports	-	H	R

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SL NO.	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
3.7	Galvanizing (If Applicable)	Integrity of Galvanised Coating	100%	Inspection Report	-	H	R
4.0	**Final Inspection**						
4.1	Final Inspection	1. Visual 2. Dimensions 3. Hardness 4. Marking etc.,	100%	Inspection Report	-	H	H (Note-1,2)
4.2	PMI Check	Chemical Check	As Per EIL Spec. 6-81-0001	Inspection report	-	H	RW
4.3	Review of Calibration Records	Summary of Calibration Reports of all Equipments, tools and instruments used during inspection and testing	100%	Calibration Reports	-	H	R
4.4	NDE Operator Qualification records	ASNT / ISNT Level I/II/III certifications	100%	Summery	H	H	R
4.5	Final Stamping	Stamping of Accepted Items	Stamping of Items which are witnessed by EIL/TPIA.	Inspection Report	-	H	H (Note-1,2)

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SL NO.	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
5.0	**Painting**						
5.1	Rust Preventive Coating & Color Coding	Visual & Color Coding as applicable	100%	Inspection Report	-	H	-
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. Non-NACE/HIC, Non-Hydrogen service & Non-LTCS, Carbon Steel (CS) Flanges, Spectacle Blinds and drip Rings up to size 24"-300 ANSI Class will be accepted based on the review of the Manufacturer's Test Certificates. Manufacturer's Test Certificate shall be as per EN 10204 Type 3.1. MTC along with backup reports to be reviewed by EIL/TPIA.

2. For cases apart from Note-1, Manufacturer's Test Certificate shall be as per EN 10204 Type 3.2 Certification, unless otherwise specified.

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3. 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)

4. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred therein /Job Specification /Approved Documents.

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निरीक्षण एवं परीक्षण योजना

INSPECTION AND TEST PLAN
FOR
BOLTING MATERIAL

Rev. No.	Date	Purpose	Prepared by	Checked by	Convenor Standards Committee	Chairman Standards Bureau
					Approved by	
5	23.12.2021	REVISED AND RE-ISSUED	HKM	CS	RK	S Mazumdar
4	19.09.2016	REVISED AND RE-ISSUED	TKK	HP	RKS	RN
3	17.06.2013	REVISED AND RE-ISSUED	TKK	RKS	SCG	DM
2	15.07.2011	REVISED AND RE-ISSUED	TKK	SCG	AKC	DM
1	28.09.2007	REVISED AND RE-ISSUED	PD	RB	MVKK	VC

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Abbreviations:

CEIL	:	Certification Engineers International Limited	MRT	:	Mechanical Run Test
CIMFR	:	Central Institute of Mining & Fuel Research	NDT	:	Non Destructive Testing
CE	:	Carbon Equivalent	NPSH	:	Net Positive Suction Head
DFT	:	Dry Film Thickness	PO	:	Purchase Order
DPT	:	Dye Penetrant Testing	PESO	:	Petroleum Explosive Safety Organization
DHT	:	De-hydrogen Heat Treatment	PQR	:	Procedure Qualification Record
ERTL	:	Electronics Regional Test Laboratory	PR	:	Purchase Requisition
FCRI	:	Fluid Control Research Institute	PMI	:	Positive Material Identification
HT	:	Heat Treatment	RT	:	Radiography Testing
HIC	:	Hydrogen Induced Cracking	SSCC	:	Sulphide Stress Corrosion Cracking
ITP	:	Inspection and Test Plan	TC	:	Test Certificate
IP	:	Ingress Protection	TPI or TPIA	:	Third Party Inspection Agency
IHT	:	Intermediate Heat Treatment	UT	:	Ultrasonic Testing
IC	:	Inspection Certificate	VDR	:	Vendor Data Requirement
IGC	:	Inter Granular Corrosion	WPS	:	Welding Procedure Specification
MPT/MT	:	Magnetic Particle Testing	WPQ	:	Welders Performance Qualification
MTC	:	Material Test Certificate			

Inspection Standards Committee

Convenor Mr. Rajeev Kumar

Members:

Mr. Rajesh Sinha	Mr. Himangshu Pal	Mr. R. Muthuramalingam (RPO Representative)
Mr. Chandrashekhar	Mr. Avdhesh Agrawal	Mr. P V Satyanarayana (Engg. Representative)
Mr. Mahendra Mittal		

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1.0 SCOPE

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

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	Heat Treatment & NDT Procedures	Documented Procedures	100%	Procedure Documents	-	H	R
2.0	**Material Inspection**						
2.1	Raw Material Inspection	Chemical, Mechanical properties, Steel making process, Macro Etch, etc.	100% one no. per heat per size	Mill Test Certificates/ Lab Reports	H	H	R
3.0	**In Process Inspection**						

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
3.1	Thread Rolling, Hot forging of Nuts/Bolt Heads, Machining	Process Parameters	100%	Inspection Report	-	H	-
3.2	Heat Treatment	Normalising & Tempering, Quenching & Tempering Solution Annealing, Stabilization Heat Treatment, Strain Hardening, Nitriding etc. as applicable	100%	Heat treatment process records /charts	-	H	R
3.3	NDT (as applicable)	Defects detection	100%	Test Reports	-	H	R
3.4	TPM Identification of Test Samples	Product Analysis, Proof Load Test , Stress Rupture, Tensile, Hardness, Impact, and Other test as applicable	Lot as per specification.	Test Reports	-	H	H
3.5	Chemical Testing	Chemical analysis	Lot as per specification.	Test Reports		H	H

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
3.6	Mechanical Testing	Mechanical (0.2 Offset/0.5% extension under load), Hardness, Proof Load Test for Nuts (as applicable) , Stress Rupture (As Applicable), Impact and Other test as applicable	Lot as per specification.	Test Reports	-	H	H
3.7	Galvanizing (If Applicable)	Integrity of Galvanised Coating	100%	Inspection Report	-	H	R
4.0	**Final Inspection**						
4.1	Visual & Dimension	Visual Marking & Dimensions	100% by supplier & Random by EIL/ TPIA	Inspection Report	-	H	RW (Note-3)
4.2	Final Stamping	Stamping of Accepted Bolting Material	Stamping of bolting material which are witnessed by EIL/TPIA. Others to have supplier's identification.	Inspection Report	-	H	RW (Note 3)

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.3	PMI Check	Chemical Check	As Per EIL Spec. 6-81-0001	Inspection report	-	H	RW (Note 3)
5.0	**Painting**						
5.1	Rust Preventive & Color Coding (as applicable)	Visual & Color Coding as applicable	100%	Inspection Report	-	H	-
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 NOTE 3), R-Review, W-Witness (Give due notice, work may proceed after scheduled date).

Notes (as applicable):

1. 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).
2. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred therein /Job Specification /Approved Documents.
3. Final visual and dimension And PMI Check shall be checked as per below sampling plan:

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Lot Size (Nos.)	Sample Size (Minimum) for EIL/TPIA	Sample size (Min) for Supplier
Upto 100	2% (Min. 2 Nos.)	10%
101 to 500	1% (Min. 3 Nos.)	10%
501 and above	0.5% (Min. 5Nos.)	10%

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निरीक्षण व परीक्षण योजना

INSPECTION AND TEST PLAN
FOR
GASKETS

Rev. No.	Date	Purpose	Prepared By	Checked By	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
5	28.09.2022	REVISED AND RE-ISSUED	TKK	PTM	RK	SM
4	14.11.2018	REVISED AND RE-ISSUED	KC	NM	RKS	RKT
3	17.06.2013	REVISED AND RE-ISSUED	TKK	RKS	SCG	DM
2	15.07.2011	REVISED AND RE-ISSUED	TKK	SCG	AKC	DM
1	02.01.2008	REVISED AND RE-ISSUED	AM	SS	MVKK	VC

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Abbreviations:

CEIL	:	Certification Engineers International Limited	MRT	:	Mechanical Run Test
CIMFR	:	Central Institute of Mining & Fuel Research	NDT	:	Non Destructive Testing
CE	:	Carbon Equivalent	NPSH	:	Net Positive Suction Head
DFT	:	Dry Film Thickness	PO	:	Purchase Order
DPT	:	Dye Penetrant Testing	PESO	:	Petroleum Explosive Safety Organization
DHT	:	De-hydrogen Heat Treatment	PQR	:	Procedure Qualification Record
ERTL	:	Electronics Regional Test Laboratory	PR	:	Purchase Requisition
FCRI	:	Fluid Control Research Institute	PMI	:	Positive Material Identification
HT	:	Heat Treatment	RT	:	Radiography Testing
HIC	:	Hydrogen Induced Cracking	SSCC	:	Sulphide Stress Corrosion Cracking
ITP	:	Inspection and Test Plan	TC	:	Test Certificate
IP	:	Ingress Protection	TPI or TPIA	:	Third Party Inspection Agency
IHT	:	Intermediate Heat Treatment	UT	:	Ultrasonic Testing
IC	:	Inspection Certificate	VDR	:	Vendor Data Requirement
IGC	:	Inter Granular Corrosion	WPS	:	Welding Procedure Specification
MPT/MT	:	Magnetic Particle Testing	WPQ	:	Welders Performance Qualification
MTC	:	Material Test Certificate			

Inspection Standards Committee

Convenor : Mr. Rajeev Kumar

Members:

Mr. Rajesh Sinha	Mr. Chandrashekhar	Mr. Himangshu Pal	Mr. R Muthu Ramalingam (RPO Rep.)
Mr. Avdhesh Agrawal	Mr. Mahendra Mittal	Miss Sulakshana Hundekari	

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1.0 SCOPE

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

2.0 REFERENCE DOCUMENTS

PO/PR/ Standards referred there in/ 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	HT & Test Procedures, as applicable	Documented Procedures	100%	Procedure Documents	-	H	R
2.0	**Material Inspection**						
2.1	Raw Material Inspection	Chemical, Physical and other properties as per applicable material specification	100%	Test Certificates	H	H	-
3.0	**In Process Inspection**						
3.1	Punching & Finishing	Finish & Dimension	100%	Inspection Report	-	H	-

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SL NO.	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
3.2	Heat Treatment for RTJ Gaskets (As applicable)	Time & Temperature	100%	HT Chart		H	R
3.3	Marking	Size, Rating, Material, Color Coding etc., as applicable	100%	Test Record	-	H	-
4.0	**Final Inspection**						
	Final Visual, Dimension & Testing	• Visual checks including marking check • Dimension check	100%	Inspection Report	-	H	R
4.1	Hardness test for RTJ Gaskets	Ring Hardness	10% (Per size/Rating/Heat /Heat treatment lot)	Test report	-	H	R
	Compressibility, Recovery, Sealability tests for Spiral Wound Gaskets	Compressibility, Recovery, Sealability	One per size/rating/lot	Test report	-	H	R

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SL NO.	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.2	PMI Check (as applicable)	Chemical Check	As per EIL Spec: 6-81-001	Inspection Report	-	H	R
4.3	Submission of Documents/ Certificate	Performance Qualification Test (applicable for Spiral wound Gaskets)	As per ASME B16.20	Type test report	-	H	R (Note-3)
5.0	**Painting**						
5.1	Rust Preventive & Color Coding as applicable	Visual & Color Coding as applicable	100%	Inspection Report	-	H	-
6.0	**Documentation & IC**						
6.1	Documentation & IC	Review of test reports, Inspection documents & Issue of IC	100%	Supplier Records / 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. 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)
2. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred therein /Job Specification /Approved Documents.
3. Performance qualification test of Spiral wound gaskets shall be carried out under reputed Third Party Inspection Agency(TPIA) arranged by the supplier

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INSPECTION AND TEST PLAN FOR PRESSURE VESSELS/ COLUMNS CARBON STEEL

Rev. No.	Date	Purpose	Prepared by	Checked by	Convenor Standards Committee	Chairman Standards Bureau
					Approved by	
4	14.05.2020	REVISED AND RE-ISSUED	SK	CS	RKS	SKS
3	09.09.2013	REVISED AND RE-ISSUED	TKK	RKS	SCG	DM
2	15.07.2011	REVISED AND RE-ISSUED	HP	SCG	AKC	DM
1	28.09.2007	REVISED AND RE-ISSUED	PD	RB	MVKK	VC
0	10.12.2002	ISSUED FOR IMLEMENTATION	NKN	SPS	AKB	GRR

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Abbreviations:

AS / CS / SS		Alloy Steel / Carbon Steel / Stainless Steel	MRT	:	Mechanical Run Test
CEIL	:	Certification Engineers International Limited	NDT	:	Non Destructive Testing
CIMFR	:	Central Institute of Mining & Fuel Research	NPSH	:	Net Positive Suction Head
CE	:	Carbon Equivalent	PO	:	Purchase Order
DFT	:	Dry Film Thickness	PESO	:	Petroleum Explosive Safety Organization
DPT	:	Dye Penetrant Testing	PQR	:	Procedure Qualification Record
DHT	:	De-hydrogen Heat Treatment	PR	:	Purchase Requisition
ERTL	:	Electronics Regional Test Laboratory	PMI	:	Positive Material Identification
FCRI	:	Fluid Control Research Institute	PWHT	:	Post Weld Heat Treatment
HT	:	Heat Treatment	RT	:	Radiography Testing
HIC	:	Hydrogen Induced Cracking	SSCC	:	Sulphide Stress Corrosion Cracking
ITP	:	Inspection and Test Plan	TC	:	Test Certificate
IP	:	Ingress Protection	TPI or TPIA	:	Third Party Inspection Agency
IHT	:	Intermediate Heat Treatment	UT	:	Ultrasonic Testing
IC	:	Inspection Certificate	VDR	:	Vendor Data Requirement
IGC	:	Inter Granular Corrosion	WPS	:	Welding Procedure Specification
MPT/MT	:	Magnetic Particle Testing	WPQ	:	Welders Performance Qualification
MTC	:	Material Test Certificate			
				:	

Inspection Standards Committee

Convenor : Mr. R K Singh

Members:

Mr. Rajesh Sinha
Mr. Chandrashekhar
Mr. Mahendra Mittal
Mr. Himangshu Pal
Mr. Avdhesh Agrawal
Mr. R. Muthuramalingam (RPO Representative)
Mr. P V Satyanarayana (Engg. Representative)

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1.0 SCOPE

This Inspection and test plan covers the minimum testing requirements of Pressure vessels/ Columns carbon steel

2.0 REFERENCE DOCUMENTS

PO/PR/ Standards referred there in/ 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	**Procedures**						
1.1	Hydro test, heat treatment, NDT, hot forming and other Procedures	Documented procedures.	100%	Procedure documents	-	H	R
1.2	Weld Plan & NDT Plan	As per PR/ Purchase Specification/ Applicable codes	100%	Procedure documents	-	H	R
1.3	WPS/ PQR /WPQ	Documented procedures.	100%	Procedure documents	-	H	R-Existing W-New
2.0	**Materials Procurement**						

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
2.1	Plates, pipes, Forgings, Expansion Bellows, Fittings, Fasteners, Gaskets, etc (As applicable) (Note-3)	As per PR/Purchase Specification	100%	Mill TC	H	H	R
2.2	Internals like Demister, Johnson screen, support grid etc (As applicable) (Note-4)	As per PR/Purchase Specification	100%	Mill TC	H	H	R
3.0	**In process inspection**						
3.1	Materials identification for plates, pipes (pressure parts)	Review of test certificates, markings visual & dimensional inspection, identity correlation & transfer of identity	100%	Material clearance record	-	H	H
3.2	Material identification _for forgings, fittings, fasteners, gaskets (pressure parts)	Review of test certificates, markings Identity correlation.	100%	Material clearance record	-	H	R
3.3	Non pressure parts (including internals, supports etc.)	Review of test certificates	100%	Material test certificate	W	R	R
3.4	Inspection of formed components (cold or hot formed)	NDT of weld seam as applicable	100%	NDT Reports / Films	H	H	R
		NDT (dished ends and tori-cone) on inside & outside surfaces in knuckle zone and edges.	100%	Inspection report	H	H	R

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
		HT chart review as applicable	100%	HT Chart	W	W	R
		Test coupon as applicable	100%	Inspection report	H	H	W
		Visual & dimensional (min. thickness, profile, ovality etc) inspection	100%	Inspection report	H	H	H
3.5	Welding consumable	Chemical & mechanical properties	100%	Batch test certificates	W	R	R
3.6	Weld edge preparation & set up of pressure parts	Visual & dimensional inspection, weld edge, root gap, offset, alignment, cleanliness etc	100%	Inspection check list	-	W	-
		NDT of weld edges, as applicable	100%	NDT Reports	-	W	R
3.7	Intermediate inspection of welds	Visual, Welding Parameters, NDT	100%	Inspection report	-	W	-
4.0	**Final inspection**						
4.1	Visual and dimensional inspection (internals & externals) including welds (before PWHT as applicable)	Visual, dimensions, completeness of assembly and weld visual for reinforcement, undercuts, Surface defects, etc.	100%	Inspection report	-	H	H

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.2	PMI (AS/SS components)	Chemical check	Each component	Inspection report		W	RW
4.3	Pneumatic test of RF pads	Leak check	100%	Test report	-	W	R
4.4	Trial assembly of internals and column/vessel sections as applicable	Dimensions, completeness of assembly and alignment	100%	Inspection report	-	H	W
4.5	Inspection of completed welds	PWHT as applicable	100%	HT chart		W	R
		NDT as applicable	100%	NDT Reports / RT Films	-	W	R
4.6	Hardness check on all welds, HAZ as applicable	Hardness	100%	Inspection report	-	W	RW
4.7	Production test coupon as applicable	Production test coupon testing	As per spec/drg.	Inspection report	-	H	H
4.8	Hydrostatic test	Leak check	100%	Test report	-	H	H
5.0	**Template Inspection**						
5.1	Foundation Template & Gauge plate inspection	Visual & Dimensions, Orientation markings	100%	Inspection report	-	H	H
6.0	**Painting**						

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
6.1	Final painting	Visual inspection (after surface preparation and final painting for workmanship, uniformity) DFT check	100%	Inspection report	-	H	-
7.0	**Documentation and IC**						
7.1	Final stamping, review of inspection documents and issue of IC	Verifying stamping details and review of inspection documents	100%	IC / Inspection reports	-	H	H
7.2	Final documents as per PR	Verification & compilation of inspection & test records for submission to customer	100%	Final dossier	-	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. 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)
2. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred there in /Job Specification /Approved Documents.
3. Third Party Certifications shall be as per EN 10204 Type 3.2 for CS Plates (NACE/H2/HIC), Forgings, Fittings and Expansion Bellows and TPIA shall be arranged by supplier. Certifications shall be as per EN 10204 Type 3.1 for Pipes, CS Plates (non-NACE/H2/HIC), Gaskets and Fasteners.
4. Inspection of Internals shall be as per EIL Std ITP no. 6-81-0060.
5. For EPC jobs, all inspection shall be carried out by TPIA, unless notified otherwise.

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अपकेंद्रीय क्षैतिज पम्प के लिए निरीक्षण और परीक्षण योजना

(विशेष प्रयोजन प्रक्रिया)

INSPECTION AND TEST PLAN FOR PUMP CENTRIFUGAL HORIZONTAL (SPECIAL PURPOSE PROCESS)

Rev. No.	Date	Purpose	Prepared by	Checked by	Convener Standards Committee	Chairman Standards Bureau
					Approved by	
4	23.05.20	REVISED AND RE-ISSUED	TV	RMR	RKS	SKS
3	20.03.14	REVISED AND RE-ISSUED	TKK	RKS	SCG	SC
2	18.06.13	REVISED AND RE-ISSUED	TKK	RKS	SCG	DM
1	21.01.08	REVISED AND RE-ISSUED	SMG	SS	MVKK	VC
0	23.07.02	ISSUED FOR IMPLEMENTATION	VKJ	TVD	AKB	GRR

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Abbreviations:

AS	:	Alloy Steel	NPSH	:	Net Positive Suction Head
COC	:	Certificate of Compliance	PESO	:	Petroleum and Explosives Safety Organization
DFT	:	Dry Film Thickness	PMI	:	Positive Material Identification
EIL	:	Engineers India Limited	PO	:	Purchase Order
EPC	:	Engineering Procurement Construction	PQR	:	Procedure Qualification Record
EN	:	European Norms	PR	:	Purchase Requisition
HT	:	Heat Treatment	QAP	:	Quality Assurance Plan
HV	:	High Voltage	RT	:	Radiography Testing
IC	:	Inspection Certificate	Specs.	:	Specifications
IRN	:	Inspection Release Note	SQT	:	Seal Qualification Test
ITP	:	Inspection and Test Plan	SS	:	Stainless Steel
LCP	:	Local Control Panel	Temp	:	Temperature
MOM	:	Minutes of Meeting	TPI or TPIA	:	Third Party Inspection Agency
KW	:	Kilo Watt	UCP	:	Unit Control Panel
MRT	:	Mechanical Run Test	UT	:	Ultrasonic Testing
MTC	:	Material Test Certificate	VDR	:	Vendor Data Requirement
MV	:	Medium Voltage	VFD	:	Variable Frequency Drive
NDT	:	Non Destructive Testing	WPS	:	Welding Procedure Specification
			WPQ	:	Welders Performance Qualification

Inspection Standards Committee

Convener: Mr. R.K. Singh

Members:

Mr. Rajesh Sinha	Mr. Himangshu Pal	Mr. Chandrashekhar	Mr. Avdhesh Agrawal
Mr. Mahendra Mittal	Mr. R Muthuramalingam (RPO Representative)	Mr. Tarun Kumar / Mr. Mahesh Gupta, Eqpt Div	

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1.0 SCOPE:

This Inspection and Test Plan covers the minimum testing requirements of Pump Centrifugal Horizontal (Special Purpose Process)

2.0 REFERENCE DOCUMENTS:

PO/PR/ Standards referred there in/ 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	**Procedures / Documents**						
1.1	Pressure test, MRT, Performance test, NPSH tests, NDT as applicable, Heat Treatment as applicable, Dynamic Balancing Test of Impeller, Nozzle load test, String Test as applicable and other procedure as applicable	Documented Procedures	100%	Procedures	-	H	R
1.2	WPS, PQR,WPQ - 1) Qualification for Overlay 2) Repair welding procedures	Welding procedure Qualification, Welder parameters	100%	WPS/PQR/ WPQ Records	-	H	W- New, R – Existing (Note-3)
1.3	Pre-Inspection meeting	Verification of technical requirements as per PR/contract	100%	MOM	-	H	W/R (For <160KW) H (For >160KW)

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SL. NO	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
2.0	**Material Inspection**						
2.1	Incoming Material Casing, Stuffing Box, Impeller, Shaft Material, Wear rings & Bearing Housing (As applicable)	Visual & Dimensions, Chemical Properties / Physical Properties, Heat Treatment as per Specs UT for Shaft & Other Forgings and (#)Wear ring differential hardness	100%	MTC , HT Chart, Inspection Report, COC for #	H	H	R (Note-4)
2.2	Accessories- Buffer Liquid Reservoir, Barrier/Buffer Liquid Cooler, Mechanical Seal, Seal Plan Cooling (As applicable)	Pressure Test & Seal Qualification test (As applicable) for Mechanical seal, Reservoir, coolers Dynamic balancing of seal and coupling.	100%	MTC/ Inspection & Test Record, Pressure test report and COC/ SQT (if applicable) for Mechanical Seal	H	H	R (Note-4)
2.3	Piping & Hardware Items- Valves, Flanges, Pipes, Fittings, Gaskets, Fasteners, Instruments etc (As applicable)	Visual & Other Requirement as per purchase specification / Approved Documents	100%	MTC & Inspection Report	H	H	R (Note-4)
2.4	Motor / VFD (As applicable) *(supplier/sub supplier to arrange TPIA certification)	1) Type test/ Routine test of Motor, VFD & Other test requirement as per purchase specification / Approved Documents 2) MTC review 3) PESO Certificate review (As applicable)	100%	MTC & Inspection Report	H	H*	W (Note-7)
2.4.1	Combined testing of motor & VFD (As applicable) *(supplier/sub supplier to arrange TPIA certification)	1) Routine Test & Type Test 2) PESO requirement (As applicable)	100%	MTC & Inspection / Test Records	H	H*	W (Note-7)

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SL. NO	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
2.5	Steam Turbine (As applicable)	MRT of Turbine & & Other checks as per approved QAP (Note-8)	100%	MTC & Inspection Report / Test Records	H	H	W (Note-6)
2.6	Gear box (As applicable)	MRT of gear box & Other checks as per approved QAP (Note-8)	100%	MTC & Inspection Report	H	H	W (Note-6)
2.7	Lube Oil system (As applicable)	Functional test & Other checks as per approved QAP (Note-8)	100%	MTC & Inspection Report	H	H	W (Note-6)
2.8	LCP/UCP (As applicable)	Functional Test & Other checks as per approved QAP (Note-8)	100%	MTC & Inspection Report	H	H	W (Note-6)
3.0	**In Process Inspection**						
3.1	NDT (As applicable) for Casing, Impeller, Stuffing Box, Shaft Casing to Nozzle butt weld	Surface and Internal imperfections	100%	Test Reports, RT films & NDT report	-	H	R
3.2	Pressure test before Assembly of Pump casing (In un-painted condition) & stuffing box	Leak Tightness Check	Each Set	Inspection and Test Records	-	H	R
3.3	Impeller / Rotor assembly	Dynamic Balancing	Each Impeller / Rotor assembly	Inspection and Test Records	-	H	W - 1 per Tag R - Spare

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SL. NO	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
3.4	Nozzle Load test (As applicable if specified in PR)	Stiffness of base-plate and Suction/Discharge Nozzles	100%	Inspection Report	-	H	R - For existing, reports as per quoted model W - 1 per model if reports are not available
4.0	**FINAL INSPECTION**						
4.1	Testing of Pumps	1) Performance test 2) NPSH (R) (As applicable) 3) MRT for 4 hours duration (To measure Vibration Limits, Noise level, Bearing Temp Rise)	Each Pump	Inspection and Test Records, Calibration records of driver	-	H	H
4.2	Dismantle inspection of pump after performance test / MRT (4 hours)	1) Visual insp. of casing inside surface 2) Wear ring area visual Check 3) Clearance measurement 4) Examination of Mechanical seal	Each Pump	Inspection and Test Records	-	H	W
4.3	Unitization of Pump with job driver on a common job base Frame	Alignment of pump with driver and Check Direction of Rotation	Each Set	Inspection and Test Records	-	H	W

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SL. NO	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.4	Complete Unit String Test along with all accessories (As applicable)	Mechanical Performance of the Train (Vibration Limits, bearing/oil temperature, Driver parameters and controls)	Each Set	Inspection and Test Records	-	H	H
4.5	Testing of auxiliary piping (If applicable)	Leak Tightness	Each Set	Inspection and Test Records	-	H	R
4.6	Job Instruments if applicable	Compliance to PR requirements	100%	MTC & Statutory certification (As applicable)	W	H	R
4.7	Testing and Measuring Instruments	Validity of calibration & accuracy	100%	Calibration Report	W	H	R
4.8	Final Pump skid Assembly & Spares verification	Visual, Nozzle dimensions including foundation dimensions of base frame, Battery Limits Check, Overall skid completeness check and PMI Check of all SS & AS components and welds on Skid	100%	Inspection Report	-	H	H
5.0	**Painting**						
5.1	Surface Preparation & Painting of all Carbon Steel Parts of Skid	Visual Inspection for workmanship, Panting Scheme, Paint Shade, Painting DFT Check	100%	Inspection Report	-	H	R
5.2	Pickling & Passivation for Stainless Steel Parts (As applicable)	Visual Inspection for workmanship	100%	Inspection Report	-	H	R

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SL. NO	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
5.3	Packing & Preservation	Visual Inspection for workmanship	100%	Inspection Report	-	H	-
6.0	**Documentation & IC/IRN**						
6.1	Stamping and review of inspection documents, issue of IC	Review of documents for compliance as per PR.	100%	Inspection Certificate (IC)	-	-	H
6.2	Review of final documentation of supplier	Compilation of documents as per VDR attached with PR	100%	Dossier / Completion certificate	-	H	H

Legend: H- Hold (Do not proceed without approval), P-Perform, RW - Random Witness (As specified or 10% (minimum 1 number 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. 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)
2. Acceptance Norms for all the activities shall be as per PO/PR/Standards referred there in /Job Specification /Approved Documents.
3. WPS/PQR/WPQ Shall be qualified & certified by a reputed TPIA.
4. Certifications shall be as per EN 10204 Type 3.1 except for Mechanical seal & wear ring hardness.
5. Bought out items to be procured from EIL/Client approved suppliers.
6. Third Party Inspection Certifications shall be as per EN 10204 Type 3.2 and TPIA shall be arranged by supplier.
7. Inspection Test Requirements of Motors shall be as per EIL ITP 6-81-1064 (MV Motors), 6-81-1031 (HV Motors), 6-81-1038 (MV VFDs), 6-81-1050 (HV VFDs).
8. Separate QAPs for Steam Turbine, Gear Box, Lube Oil System & Local Control Panel (LCP/UCP) and all other bought out / sub-ordered items (As applicable) shall be submitted for EIL/ TPIA review / approval.
9. For EPC jobs, all inspection shall be carried out by TPIA, unless notified otherwise.

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चेन पुली ब्लॉक / विंच के लिए
निरीक्षण व परीक्षण योजना

INSPECTION AND TEST PLAN
FOR
CHAIN PULLEY BLOCK / WINCH

Rev. No.	Date	Purpose	Prepared by	Checked by	Convenor Standards Committee	Chairman Standards Bureau
					Approved by	
4	14.05.2020	REVISED AND RE-ISSUED	SK	CS	RKS	SKS
3	09.09.13	REVISED AND RE-ISSUED	TKK	RKS	SCG	DM
2	10.04.12	REVISED AND RE-ISSUED	SK	SCG	AKC	DM
1	31.01.08	REVISED AND RE-ISSUED	CS	RB	MVKK	VC
0	23.07.02	ISSUED FOR IMPLEMENTATION	SKT	NKN	AKB	GRR

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Abbreviations:

BIS	:	Bureau of Indian Standards	MTC	:	Material Test Certificate
CEIL	:	Certification Engineers International Limited	MRT	:	Mechanical Run Test
CIMFR	:	Central Institute of Mining & Fuel Research	NDT	:	Non Destructive Testing
CE	:	Carbon Equivalent	NPSH	:	Net Positive Suction Head
DFT	:	Dry Film Thickness	PO	:	Purchase Order
DPT	:	Dye Penetrant Testing	PESO	:	Petroleum Explosive Safety Organization
DHT	:	De-hydrogen Heat Treatment	PQR	:	Procedure Qualification Record
ERTL	:	Electronics Regional Test Laboratory	PR	:	Purchase Requisition
FCRI	:	Fluid Control Research Institute	PMI	:	Positive Material Identification
HT	:	Heat Treatment	RT	:	Radiography Testing
HIC	:	Hydrogen Induced Cracking	SSCC	:	Sulphide Stress Corrosion Cracking
ITP	:	Inspection and Test Plan	TC	:	Test Certificate
IP	:	Ingress Protection	TPI or TPIA	:	Third Party Inspection Agency
IHT	:	Intermediate Heat Treatment	UT	:	Ultrasonic Testing
IC	:	Inspection Certificate	VDR	:	Vendor Data Requirement
IGC	:	Inter Granular Corrosion	WPS	:	Welding Procedure Specification
MPT/MT	:	Magnetic Particle Testing	WPQ	:	Welders Performance Qualification

Inspection Standards Committee

Convenor: Mr. R.K. Singh

Members:

Mr. Rajesh Sinha
Mr. Chandrashekhar
Mr. Mahendra Mittal
Mr. Himangshu Pal
Mr. Avdhesh Agrawal
Mr. R. Muthuramalingam (RPO Representative)
Mr. Shishupal Choudhary (Engg. Representative)

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1.0 SCOPE:

This Inspection Test Plan covers the minimum testing requirements of Chain Pulley Block / Winch

2.0 REFERENCE DOCUMENTS:

PO/PR/ Standards referred there in/ Job specifications /Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS:

S. NO	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	FORMAT OF REPORT	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	**Material Procurement**						
1.1	Trolley & Chain Pulley Block Plates	Chemical & Physical	One Sample Per Lot/Heat	Test Certificates	H	R	R
1.2	Wire rope	Strand configuration, size & tensile strength	Per drum / length	Manufacturer's Test Certificate	H	R	R
1.3	Hook	Load & Proof load test, Chemical, Physical, HT & NDT	100%	Manufacturer's Test Certificate	H	R	R
1.4	Gears/Ratchet Pawl/ Wheel	Chemical Composition	One Sample Per Lot/Heat	Manufacturer's Test Certificates	H	R	R
2.0	**In-process Inspection**						

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S. NO	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	FORMAT OF REPORT	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
2.1	Hooks	Proof load	100%	Manufacturer's Test Certificates	-	H	-
2.2	Load Chain / Wire Rope	Proof load	100%	Manufacturer's Test Certificates	-	H	-
2.3	Ratchet Pawl	Hardness	100%	Inspection Report	-	H	-
3.0	**Final Inspection**						
3.1	Complete Assembly	Load & Proof Load test	100%	Inspection Report	-	H	RW
		Operational Effort	100%	Inspection Report	-	H	RW
		Lift	100%	Inspection Report	-	H	RW
		Statutory certification / BIS License, if any	100%	Test Certificate/ License	-	R	R
4.0	**Painting**						
4.1	Panting (As applicable)	Visual & Dry Film Thickness	100%	Inspection Report	-	W	-
5.0	**Documentation and IC**						

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S. NO	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	FORMAT OF REPORT	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
5.1	Final stamping, review of inspection documents and issue of IC	Verifying stamping details and review of inspection documents	100%	IC / Inspection reports	-	H	H
5.2	Final documents as per PR	Verification & compilation of inspection & test records for submission to customer	100%	Final dossier	-	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. 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)
2. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred there in /Job Specification /Approved Documents.
3. For EPC jobs, all inspection shall be carried out by TPIA, unless notified otherwise.

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अपकेंद्रीय क्षैतिज पम्पों के लिए निरीक्षण और परीक्षण योजना

(सामान्य प्रयोजन प्रक्रिया)

INSPECTION AND TEST PLAN FOR PUMP CENTRIFUGAL HORIZONTAL (GENERAL PURPOSE PROCESS)

Rev. No.	Date	Purpose	Prepared by	Checked by	Convener Standards Committee	Chairman Standards Bureau
					Approved by	
5	23.05.20	REVISED AND RE-ISSUED	TV	RMR	RKS	SKS
4	20.03.14	REVISED AND RE-ISSUED	TKK	RKS	SCG	SC
3	19.08.13	REVISED AND RE-ISSUED	TKK	RKS	SCG	DM
2	15.07.11	REVISED AND RE-ISSUED	RMR	SCG	AKC	DM
1	21.01.08	REVISED AND RE-ISSUED	SMG	SS	MVKK	VC
0	23.07.02	ISSUED FOR IMPLEMENTATION	VKJ	TVD	AKB	GRR

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Abbreviations:

AS	:	Alloy Steel	NPSH	:	Net Positive Suction Head
COC	:	Certificate of Compliance	PESO	:	Petroleum and Explosives Safety Organization
DFT	:	Dry Film Thickness	PMI	:	Positive Material Identification
EIL	:	Engineers India Limited	PO	:	Purchase Order
EPC	:	Engineering Procurement Construction	PQR	:	Procedure Qualification Record
EN	:	European Norms	PR	:	Purchase Requisition
HT	:	Heat Treatment	QAP	:	Quality Assurance Plan
HV	:	High Voltage	RT	:	Radiography Testing
IC	:	Inspection Certificate	Specs.	:	Specifications
IRN	:	Inspection Release Note	SS	:	Stainless Steel
ITP	:	Inspection and Test Plan	Temp	:	Temperature
LCP	:	Local Control Panel	TPI or TPIA	:	Third Party Inspection Agency
MOM	:	Minutes of Meeting	UCP	:	Unit Control Panel
KW	:	Kilo Watt	UT	:	Ultrasonic Testing
MRT	:	Mechanical Run Test	VDR	:	Vendor Data Requirement
MTC	:	Material Test Certificate	VFD	:	Variable Frequency Drive
MV	:	Medium Voltage	WPS	:	Welding Procedure Specification
NDT	:	Non Destructive Testing	WPQ	:	Welders Performance Qualification

Inspection Standards Committee

Convener: Mr. R.K.Singh

Members:

Mr. Rajesh Sinha
Mr. Mahendra Mittal
Mr. Himangshu Pal
Mr. R Muthuramalingam (RPO Representative)
Mr. Chandrashekhar
Mr. Tarun Kumar / Mr. Mahesh Gupta, Eqpt Div
Mr. Avdhesh Agrawal

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1.0 SCOPE:

This inspection and test plan covers the minimum testing requirements of Pump Centrifugal Horizontal (General Purpose Process).

2.0 REFERENCE DOCUMENTS:

PO/PR/ Standards referred there in/ 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	**Procedures / Documents**						
1.1	Pressure test, MRT, Performance test, NPSH tests, NDT as applicable, Heat Treatment as applicable, Dynamic Balancing Test of Impeller, String Test as applicable and other procedure as applicable	Documented Procedures	100%	Procedures	-	H	R
1.2	WPS, PQR,WPQ : 1) Qualification for Overlay 2) Repair welding procedures	Welding procedure Qualification, Welder parameters	100%	WPS/PQR/ WPQ Records	-	H	W – New, R – Existing (Note-3)
1.3	Pre-Inspection meeting	Verification of technical requirements as per PR/Contract	100%	MOM	-	H	W/R (For <160KW) H (For >160KW)

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
2.0	**Material Inspection**						
2.1	Incoming Material (As applicable) : Casing, Stuffing Box, Impeller, Shaft Material, Wear rings & Bearing Housing	Visual & Dimensions, Chemical Properties, Physical Properties, Heat Treatment as per Specs., UT for Shaft & Other Forgings and (#)Wear ring differential hardness	100%	MTC, HT Chart, Inspection Report, COC for (#)	H	H	R (Note-4)
2.2	Accessories (As applicable) : Mechanical Seal, Coupling	Pressure Test of Mechanical Seal, Dynamic balancing of seal and Coupling	100%	MTC/ Inspection & Test Record, pressure test report and COC for Mechanical Seal	H	H	R (Note-4)
2.3	Piping & Hardware Items : Valves, Flanges, Pipes, Fittings, Gaskets, Fasteners, Instruments etc (As applicable)	Visual & Other Requirement as per purchase specification / Approved Documents	100%	MTC & Inspection Report	H	H	R (Note-4)
2.4	Motor / VFD (As applicable) : *(supplier/sub supplier to arrange TPIA certification)	1) Type test/ Routine test of Motor, VFD & Other test requirement as per purchase specification / Approved Documents 2) MTC review 3) PESO Certificate review (As applicable)	100%	MTC & Inspection Report	H	H*	W / R (Note-7)
2.4.1	Combined testing of motor & VFD (As applicable) *(supplier/sub supplier to arrange TPIA certification)	1) Routine Test & Type Test 2) PESO requirement (As applicable)	100%	MTC & Inspection / Test Records	H	H*	W (Note-7)

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
2.5	Steam Turbine (As applicable)	MRT of Turbine & & Other checks as per approved QAP	100%	MTC & Inspection Report	H	H	W (Note-6,9)
2.6	Diesel Engine with governor & accessories (As applicable)	MRT of Diesel Engine & Other checks as per approved QAP	100%	MTC & Inspection Report	H	H	R (Note- 8,9)
2.7	Gear box (As applicable)	MRT of gear box & Other checks as per approved QAP	100%	MTC & Inspection Report	H	H	W (Note-6,9)
2.8	Lube Oil system (As applicable)	Functional test & Other checks as per approved QAP	100%	Inspection Report	H	H	W (Note-6,9)
2.9	LCP/UCP (As applicable)	Functional Test & Other checks as per approved QAP	100%	MTC & Inspection Report	H	H	W (Note-6,9)
3.0	In Process Inspection						
3.1	NDT (As applicable) for Casing, Impeller, Stuffing Box, Shaft Casing to Nozzle butt weld	Surface and Internal imperfections	100%	Test Reports, RT films & NDT report	-	H	R
3.2	Pressure test before Assembly of Pump casing (In un-painted condition) & stuffing box	Leak Tightness check	Each Set	Inspection and Test Records	-	H	R
3.3	Impeller / Rotor assembly	Dynamic Balancing	Each Impeller / Rotor assembly	Inspection and Test Records	-	H	W - 1 per Tag R - Spare

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.0	**FINAL INSPECTION**						
4.1	Testing of Pumps	1) Performance test 2) NPSH (R) (As applicable) 3) MRT for 4 hours duration (To measure Vibration Limits, Noise level, Bearing Temp Rise)	Each Pump	Inspection and Test Records, Calibration records of Driver	-	H	H (Note-10)
4.2	Dismantle inspection of pump after performance test / MRT (4 Hours)	1) Visual inspection of casing inside surface 2) Wear ring area visual Check 3) Clearance measurement 4) Examination of Mechanical seal	Each Pump	Inspection and Test Records	-	H	W (Note-11)
4.3	Unitization of Pump with job driver on a common job base Frame	Alignment of pump with driver and Check Direction of Rotation	Each Set	Inspection and Test Records	-	H	W
4.4	Complete Unit test / String Test (As applicable)	Mechanical Performance of train (Vibration Limits, bearing/oil temperature, Driver parameters and controls)	Each Set	Inspection and Test Records	-	H	H
4.5	Testing of auxiliary piping (As applicable)	Leak Tightness	Each Set	Inspection and Test Records	-	H	R
4.6	Job Instruments (As applicable)	Compliance to PR requirements	100%	MTC & Statutory certification (As applicable)	W	H	R
4.7	Testing and Measuring Instruments	Validity of calibration & accuracy	100%	Calibration Report	W	H	R

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.8	Final Pump skid Assembly & Spares verification	Visual, Nozzles dimensions including foundation dimensions of base frame, Battery Limits Check, Overall skid completeness check and PMI Check of all SS & AS components and Welds on Skid	100%	Inspection Report	-	H	H
5.0	**Painting**						
5.1	Surface Preparation & Painting of all Carbon Steel Parts of Skid	Visual Inspection for Workmanship, Panting Scheme, Paint Shade, Painting DFT Check	100%	Inspection Report	-	H	R
5.2	Pickling & Passivation for Stainless Steel Parts (As applicable)	Visual Inspection for Workmanship	100%	Inspection Report	-	H	R
5.3	Packing & Preservation	Visual Inspection for Workmanship	100%	Inspection Report	-	H	-
6.0	**Documentation & IC / IRN**						
6.1	Stamping and review of inspection documents, issue of IC	Review of documents for compliance as per PR.	100%	Inspection Certificate (IC)	-	-	H
6.2	Review of final documentation of supplier	Compilation of documents as per VDR attached with PR.	100%	Dossier / Completion certificate	-	H	H

Legend: H- Hold (Do not proceed without approval), P-Perform, RW - Random Witness (As specified or 10% (minimum 1 number of each size and type of Bulk item)), R-Review, W-Witness (Give due notice, work may proceed after scheduled date).

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NOTES (As applicable):

1. 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)
2. Acceptance Norms for all the activities shall be as per PO/PR/Standards referred there in /Job Specification /Approved Documents.
3. WPS/PQR/WPQ Shall be qualified & certified by a reputed TPIA.
4. Certifications shall be as per EN 10204 Type 3.1 except for Mechanical seal & wear ring hardness.
5. Bought out items to be procured from EIL/Client approved suppliers.
6. Third Party Inspection Certifications shall be as per EN 10204 Type 3.2 and TPIA shall be arranged by supplier.
7. Inspection Test Requirements of Motors shall be as per EIL ITP 6-81-1064 (MV Motors), 6-81-1031 (HV Motors), 6-81-1038 (MV VFDs), 6-81-1050 (HV VFDs).
8. Inspection Test Requirements Diesel Engine Starting Battery shall be as per EIL ITP 6-81-1046 (For Lead Acid Battery Type).
9. Separate QAP/ITP of bought out items like Steam Turbine, Diesel Engine, Gear Box, Lube Oil System and LCP/UCP shall be submitted for approval of TPIA/EIL.
10. For Pump up to 55KW, Performance test, Mechanical Run Test, NPSH tests (As applicable) and dismantling inspection shall be reviewed by EIL/TPIA. Pump above 55KW and up to 160KW, Performance test, Mechanical Run Test and NPSH test (As applicable) shall be witnessed by EIL/TPIA and shall be limited to one per PR Sr. No. excluding engine driven pump. Engine driven pump & Pump above 160KW, Performance test, Mechanical Run Test and NPSH (R) test (As applicable) for each pump shall be witnessed by EIL/TPIA.
11. Dismantle inspection of pump after performance test shall be applicable only in case of abnormality in mechanical behavior (such as excessive noise & vibration, bearing temperature rise etc) during performance test.
12. For EPC jobs, all inspection shall be carried out by TPIA, unless notified otherwise.

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अपकेंद्रीय क्षैतिज पम्प के लिए निरीक्षण और परीक्षण योजना

(सामान्य जल सेवा)

INSPECTION AND TEST PLAN FOR PUMP CENTRIFUGAL HORIZONTAL (GENERAL WATER SERVICE)

Rev. No.	Date	Purpose	Prepared by	Checked by	Convener Standards Committee	Chairman Standards Bureau
					Approved by	
5	23.05.20	REVISED AND RE-ISSUED	TV	RMR	RKS	SKS
4	20.03.14	REVISED AND RE-ISSUED	TKK	RKS	SCG	SC
3	19.08.13	REVISED AND RE-ISSUED	TKK	RKS	SCG	DM
2	15.07.11	REVISED AND RE-ISSUED	RMR	SCG	AKC	DM
1	21.01.08	REVISED AND RE-ISSUED	SMG	SS	MVKK	VC
0	23..07.02	ISSUED FOR IMPLEMENTATION	VKJ	TVD	AKB	GRR

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Abbreviations:

AS	:	Alloy Steel	NPSH	:	Net Positive Suction Head
COC	:	Certificate of Compliance	PESO	:	Petroleum and Explosives Safety Organization
DFT	:	Dry Film Thickness	PMI	:	Positive Material Identification
EIL	:	Engineers India Limited	PO	:	Purchase Order
EPC	:	Engineering Procurement Construction	PQR	:	Procedure Qualification Record
EN	:	European Norms	PR	:	Purchase Requisition
HT	:	Heat Treatment	QAP	:	Quality Assurance Plan
HV	:	High Voltage	RT	:	Radiography Testing
IC	:	Inspection Certificate	Specs.	:	Specifications
IRN	:	Inspection Release Note	SS	:	Stainless Steel
ITP	:	Inspection and Test Plan	Temp	:	Temperature
LCP	:	Local Control Panel	TPI or TPIA	:	Third Party Inspection Agency
MOM	:	Minutes of Meeting	UCP	:	Unit Control Panel
KW	:	Kilo Watt	UT	:	Ultrasonic Testing
MRT	:	Mechanical Run Test	VDR	:	Vendor Data Requirement
MTC	:	Material Test Certificate	VFD	:	Variable Frequency Drive
MV	:	Medium Voltage	WPS	:	Welding Procedure Specification
NDT	:	Non Destructive Testing	WPQ	:	Welders Performance Qualification

Inspection Standards Committee

Convener: Mr. R.K. Singh

Members:

Mr. Rajesh Sinha	Mr. Himangshu Pal	Mr. Chandrashekhar	Mr. Avdhesh Agrawal
Mr. Mahendra Mittal	Mr. R Muthuramalingam (RPO Representative)	Mr. Tarun Kumar / Mr. Mahesh Gupta, Eqpt Div	

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1.0 SCOPE:

This Inspection Test Plan covers the minimum testing requirements of Pump Centrifugal Horizontal (General Water Service).

2.0 REFERENCE DOCUMENTS:

PO/PR/ Standards referred there in/ 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	**Procedures / Documents**						
1.1	Pressure test, MRT, Performance test, NPSH tests, NDT as applicable, Heat Treatment as applicable, Dynamic Balancing Test of Impeller, String Test as applicable and other procedure as applicable	Documented Procedures	100%	Procedures	-	H	R
1.2	WPS, PQR,WPQ - 1) Qualification for Overlay 2) Repair welding procedures	Welding procedure Qualification, Welder parameters	100%	WPS/PQR/ WPQ Records	-	H	W- New, R – Existing (Note-3)
1.3	Pre-Inspection meeting	Verification of technical requirements as per PR/contract	100%	MOM	-	H	W/R (For <160KW) H (For >160KW)

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
2.0	**Material Inspection**						
2.1	Incoming Material Casing, Stuffing Box, Impeller, Shaft Material, Wear rings & Bearing Housing (As applicable)	Visual & Dimensions, Chemical Properties / Physical Properties, Heat Treatment as per Specs, UT for Shaft & Other Forgings and (#)Wear ring differential hardness	100%	MTC, HT Chart, Inspection Report, COC for #	H	H	R (Note-4)
2.2	Accessories- Mechanical Seal, Coupling (As applicable)	Pressure Test of Mechanical Seal, Dynamic balancing of seal and coupling	100%	MTC/ Inspection & Test Record, Pressure test report and COC for Mechanical Seal	H	H	R (Note-4)
2.3	Piping & Hardware Items- Valves, Flanges, Pipes, Fittings, Gaskets, Fasteners etc (As applicable)	Visual & Other Requirement as per purchase specification / Approved Documents	100%	MTC & Inspection Report	H	H	R (Note-4)
2.4	Motor / VFD (As applicable) *(supplier/sub supplier to arrange TPIA certification)	1) Type test/ Routine test of Motor, VFD & Other test requirement as per purchase specification / Approved Documents 2) MTC review 3) PESO certificate review (As applicable)	100%	MTC & Inspection Report	H	H*	W / R (Note-7)
2.4.1	Combined testing of motor & VFD (As applicable) *(supplier/sub supplier to arrange TPIA certification)	1) Routine Test & Type Test 2) PESO requirement (As applicable)	100%	MTC & Inspection / Test Records	H	H*	W (Note-7)

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
2.5	Steam Turbine (As applicable)	MRT of Turbine & & Other checks as per approved QAP	100%	MTC & Inspection Report / Test Records	H	H	W (Note-6,9)
2.6	Diesel Engine with governor & accessories (As applicable)	MRT of Diesel Engine & Other checks as per approved QAP	100%	MTC & Inspection Report	H	H	R (Note-8,9)
2.7	Gear box (As applicable)	MRT of gear box & Other checks as per approved QAP	100%	MTC & Inspection Report	H	H	W (Note-6,9)
2.8	Lube Oil system (As applicable)	Functional test & Other checks as per approved QAP	100%	MTC & Inspection Report	H	H	W (Note-6,9)
2.9	LCP/UCP (As applicable)	Functional Test & Other checks as per approved QAP	100%	MTC & Inspection Report	H	H	W (Note-6,9)
3.0	**In Process Inspection**						
3.1	NDT (As applicable) for Casing, Impeller, Stuffing Box, Shaft Casing to Nozzle butt weld	Surface and Internal imperfections	100%	Test Reports, RT films & NDT report	-	H	R
3.2	Pressure test before Assembly of Pump casing (In un-painted condition) & stuffing box	Leak Tightness check	Each Set	Inspection and Test Records	-	H	R
3.3	Impeller / Rotor assembly	Dynamic Balancing	Each Impeller / Rotor assembly	Inspection and Test Records	-	H	W - 1 per Tag R - Spare (Note – 10)

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.0	**FINAL INSPECTION**						
4.1	Testing of Pumps	1) Performance test 2) NPSH (R) (As applicable) 3) MRT for 4 hours duration (To measure Vibration Limits, Noise level, Bearing Temp Rise)	Each Pump	Inspection and Test Records, Calibration records of Driver	-	H	H (Note-11)
4.2	Dismantle inspection of pump after performance test / MRT (4 Hours)	1) Visual insp. of casing inside surface 2) Wear ring area visual Check 3) Clearance measurement 4) Examination of Mechanical seal	Each Pump	Inspection and Test Records	-	H	W (Note-12)
4.3	Performance testing of pump after corro-coating (As applicable if specified in PR/pump datasheets)	Performance /Power consumption	One / Tag	Inspection and Test Records	-	H	W (One / Tag)
4.4	Unitization of Pump with job driver on a common job base Frame	Alignment of pump with driver and Check Direction of Rotation	Each Set	Inspection and Test Records	-	H	W
4.5	Complete Unit String Test along with all accessories (If applicable as per PR)	Mechanical Performance of the Train (Vibration Limits, bearing / Oil temperature, driver parameters and controls)	Each Set	Inspection and Test Records	-	H	H
4.6	Testing of auxiliary piping (As applicable)	Leak Tightness	Each Set	Inspection and Test Records	-	H	R

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.7	Job Instruments if applicable	Compliance to PR requirements	100%	MTC & Statutory certification (As applicable)	W	H	R
4.8	Testing and Measuring Instruments	Validity of calibration & accuracy	100%	Calibration Report	W	H	R
4.9	Final Pump skid Assembly & Spares verification	Visual, Nozzle dimensions including foundation dimensions of base frame, Battery Limits Check, Overall skid completeness check and PMI check of all SS & AS components and welds on skid	100%	Inspection Report	-	H	H
5.0	**Painting**						
5.1	Surface Preparation & Painting of all Carbon Steel Parts of Skid	Visual Inspection for workmanship, Panting Scheme, Paint Shade, Painting DFT Check	100%	Inspection Report	-	H	R
5.2	Pickling & Passivation for Stainless Steel Parts(As applicable)	Visual Inspection for workmanship	100%	Inspection Report	-	H	R
5.3	Packing & Preservation	Visual Inspection for workmanship	100%	Inspection Report	-	H	-
6.0	**Documentation & IC / IRN**						
6.1	Stamping and review of inspection documents, issue of IC	Review of documents for compliance as per PR.	100%	Inspection Certificate (IC)	-	-	H
6.2	Review of final documentation of supplier	Compilation of documents as per VDR attached with PR.	100%	Dossier / Completion certificate	-	H	H

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Legend: H- Hold (Do not proceed without approval), P-Perform, RW - Random Witness (As specified or 10% (minimum 1 number 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. 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)
2. Acceptance Norms for all the activities shall be as per PO/PR/Standards referred there in /Job Specification /Approved Documents.
3. WPS/PQR/WPQ Shall be qualified & certified by a reputed TPIA.
4. Certifications shall be as per EN 10204 Type 3.1 except for Mechanical seal & wear ring hardness.
5. Bought out items to be procured from EIL/Client approved suppliers.
6. Third Party Inspection Certifications shall be as per EN 10204 Type 3.2 and TPIA shall be arranged by supplier.
7. Inspection Test Requirements of Motors shall be as per EIL ITP 6-81-1064 (MV Motors), 6-81-1031 (HV Motors), 6-81-1038 (MV VFDs), 6-81-1050 (HV VFDs).
8. Inspection Test Requirements Diesel Engine Starting Battery shall be as per EIL ITP 6-81-1046 (For Lead Acid Battery Type).
9. Separate QAP/ITP of bought out items like Steam turbine, Diesel engine, Gear box, Lube Oil System & LCP/UCP shall be submitted for approval of TPIA/EIL.
10. Final balancing of impeller/shaft shall be done after corro-coating if applicable & specified in PR/datasheets.
11. For Pump up to 55KW, Performance test, Mechanical Run Test, NPSH tests (As applicable) and dismantling inspection shall be reviewed by EIL/TPIA. Pump above 55KW and up to 160KW, Performance test, Mechanical Run Test and NPSH test (As applicable) shall be witnessed by EIL/TPIA and shall be limited to one per PR Sr. No. excluding engine driven pump. Engine driven pump & Pump above 160KW, Performance test, Mechanical Run Test and NPSH test (As applicable) for each pump shall be witnessed by EIL/TPIA.
12. Dismantle inspection of pump after performance test shall be applicable only in case of abnormality in mechanical behavior (such as excessive noise & vibration, bearing temperature rise etc.) during performance test.
13. For EPC jobs, all inspection shall be carried out by TPIA, unless notified otherwise.

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अपकेंद्रीय क्षैतिज पम्प के लिए निरीक्षण और परीक्षण योजना

(विशाल क्षमता जल सेवा)

INSPECTION AND TEST PLAN FOR PUMP CENTRIFUGAL HORIZONTAL (LARGE CAPACITY WATER SERVICE)

Rev. No.	Date	Purpose	Prepared by	Checked by	Convener Standards Committee	Chairman Standards Bureau
					Approved by	
5	23.05.20	REVISED AND RE-ISSUED	TV	RMR	RKS	SKS
4	20.03.14	REVISED AND RE-ISSUED	TKK	RKS	SCG	SC
3	19.08.13	REVISED AND RE-ISSUED	TKK	RKS	SCG	DM
2	15.07.11	REVISED AND RE-ISSUED	RMR	SCG	AKC	DM
1	21.01.08	REVISED AND RE-ISSUED	SMG	SS	MVKK	VC
0	23.07.02	ISSUED FOR IMPLEMENTATION	VKJ	TVD	AKB	SB

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Abbreviations:

AS	:	Alloy Steel	NPSH	:	Net Positive Suction Head
COC	:	Certificate of Compliance	PESO	:	Petroleum and Explosives Safety Organization
DFT	:	Dry Film Thickness	PMI	:	Positive Material Identification
EIL	:	Engineers India Limited	PO	:	Purchase Order
EPC	:	Engineering Procurement Construction	PQR	:	Procedure Qualification Record
EN	:	European Norms	PR	:	Purchase Requisition
HT	:	Heat Treatment	QAP	:	Quality Assurance Plan
HV	:	High Voltage	RT	:	Radiography Testing
IC	:	Inspection Certificate	Specs.	:	Specifications
IRN	:	Inspection Release Note	SS	:	Stainless Steel
ITP	:	Inspection and Test Plan	Temp	:	Temperature
LCP	:	Local Control Panel	TPI or TPIA	:	Third Party Inspection Agency
MOM	:	Minutes of Meeting	UCP	:	Unit Control Panel
KW	:	Kilo Watt	UT	:	Ultrasonic Testing
MRT	:	Mechanical Run Test	VDR	:	Vendor Data Requirement
MTC	:	Material Test Certificate	VFD	:	Variable Frequency Drive
MV	:	Medium Voltage	WPS	:	Welding Procedure Specification
NDT	:	Non Destructive Testing	WPQ	:	Welders Performance Qualification

Inspection Standards Committee

Convener : Mr. R.K. Singh

Members:

Mr. Rajesh Sinha
Mr. Mahendra Mittal
Mr. Himangshu Pal
Mr. R Muthuramalingam (RPO Representative)
Mr. Chandrashekhar
Mr.Tarun Kumar / Mr. Mahesh Gupta, Eqpt Div
Mr. Avdhesh Agrawal

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1.0 SCOPE:

This inspection and test plan covers the minimum testing requirements of Pump Centrifugal Horizontal (Large capacity water service).

2.0 REFERENCE DOCUMENTS:

PO/PR/ Standards referred there in/ 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	**Procedures / Documents**						
1.1	Pressure test, MRT, Performance test, NPSH tests, NDT as applicable, Heat Treatment as applicable, Dynamic Balancing Test of Impeller, String Test as applicable and other procedure as applicable	Documented Procedures	100%	Procedures	-	H	R
1.2	WPS, PQR,WPQ – 1) Qualification for Overlay 2) Repair welding procedures	Welding procedure Qualification, Welder parameters	100%	WPS/PQR/ WPQ Records	-	H	W- New, R – Existing (Note-3)
1.3	Pre-Inspection meeting	Verification of technical requirements as per PR/contract	100%	MOM	-	H	W/R (For <160KW) H (For >160KW)

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
2.0	**Material Inspection**						
2.1	Incoming Material Casing, Stuffing Box, Impeller, Shaft Material, Wear rings & Bearing Housing (As applicable)	Visual & Dimensions, Chemical Properties / Physical Properties, Heat Treatment as per Specs UT for Shaft & Other Forgings and (#)Wear ring differential hardness	100%	MTC , HT Chart, Inspection Report, COC for #	H	H	R (Note-4)
2.2	Accessories- Mechanical Seal, Coupling (As applicable)	Pressure Test of Mechanical Seal, Dynamic balancing of seal and coupling	100%	MTC/ Inspection & Test Record, Pressure test report and COC for Mechanical Seal	H	H	R (Note-4)
2.3	Piping & Hardware Items- Valves, Flanges, Pipes, Fittings, Gaskets, Fasteners, Instruments etc (As applicable)	Visual & Other Requirement as per purchase specification / Approved Documents	100%	MTC & Inspection Report	H	H	R (Note-4)
2.4	Motor / VFD (As applicable) *(supplier/sub supplier to arrange TPIA certification)	1) Type test/ Routine test of Motor, VFD & Other test requirement as per purchase specification / Approved Documents 2) MTC review 3) PESO Certificate review (As applicable)	100%	MTC & Inspection Report	H	H*	W / R (Note-7)

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
2.4.1	Combined testing of motor & VFD (As applicable) *(supplier/sub supplier to arrange TPIA certification)	1) Routine Test & Type Test 2) PESO requirement (As applicable)	100%	MTC & Inspection / Test Records	H	H*	W (Note-7)
2.5	Steam Turbine (As applicable)	MRT of Turbine & & Other checks as per approved QAP	100%	MTC & Inspection Report / Test Records	H	H	W (Note-6,9)
2.6	Diesel Engine with governor & accessories (As applicable)	MRT of Diesel Engine & Other checks as per approved QAP	100%	MTC & Inspection Report	H	H	R (Note-8,9)
2.7	Gear box (As applicable)	MRT of gear box & Other checks as per approved QAP	100%	MTC & Inspection Report	H	H	W (Note-6,9)
2.8	Lube Oil system (As applicable)	Functional test & Other checks as per approved QAP	100%	MTC & Inspection Report	H	H	W (Note-6,9)
2.9	LCP/UCP (As applicable)	Functional Test & Other checks as per approved QAP	100%	MTC & Inspection Report	H	H	W (Note-6,9)
3.0	**In Process Inspection**						
3.1	NDT (As applicable) for Casing, Impeller, Stuffing Box, Shaft Casing to Nozzle butt weld	Surface and Internal imperfections	100%	Test Reports, RT films & NDT report	-	H	R

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
3.2	Pressure test before Assembly of Pump casing (In un-painted condition) & stuffing box	Leak Tightness check	Each Set	Inspection and Test Records	-	H	R
3.3	Impeller / Rotor assembly	Dynamic Balancing	Each Impeller / Rotor assembly	Inspection and Test Records	-	H	W - 1 per Tag R - Spare (Note-10)
4.0	**Final Inspection**						
4.1	Testing of Pumps	1) Performance test 2) NPSH(R)(As applicable) 3) MRT for 4 hours duration (To measure Vibration Limits, Noise level, Bearing Temp Rise)	Each Pump	Inspection and Test Records, Calibration records of Driver	-	H	H (Note-11)
4.2	Dismantle inspection of pump after performance test / MRT (4 Hours)	1) Visual insp. of casing inside surface 2) Wear ring area visual Check 3) Clearance measurement 4) Examination of Mechanical seal	Each Pump	Inspection and Test Records	-	H	W (Note-12)
4.3	Performance testing of pump after corro-coating (As applicable if specified in PR/pump datasheets)	Performance /Power consumption	One / Tag	Inspection and Test Records	-	H	W (One / Tag)
4.4	Unitization of Pump with job driver on a common job base Frame	Alignment of pump with driver and Check Direction of Rotation	Each Set	Inspection and Test Records	-	H	W

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.5	Complete Unit String Test (In case of Diesel Engine Driver)	Mechanical Performance of the Train (Vibration Limits, bearing/oil temperature, engine parameters and controls)	Each Set	Inspection and Test Records	-	H	H
4.6	Testing of auxiliary piping (As applicable)	Leak Tightness	Each Set	Inspection and Test Records	-	H	R
4.7	Job Instruments if applicable	Compliance to PR requirements	100%	MTC & Statutory certification (As applicable)	W	H	R
4.8	Testing and Measuring Instruments	Validity of calibration & accuracy	100%	Calibration Report	W	H	R
4.9	Final Pump skid Assembly	Visual, Nozzle dimensions including foundation dimensions of base frame, Battery Limits Check, Overall skid completeness check and PMI Check of all SS & AS components and Welds on Skid	100%	Inspection Report	-	H	H
5.0	**Painting**						
5.1	Surface Preparation & Painting of all Carbon Steel Parts of Skid	Visual Inspection for workmanship, Panting Scheme, Paint Shade, Painting DFT Check	100%	Inspection Report	-	H	R
5.2	Pickling & Passivation for Stainless Steel Parts (As applicable)	Visual Inspection for workmanship	100%	Inspection Report	-	H	R

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
5.3	Packing & Preservation	Visual Inspection for workmanship	100%	Inspection Report	-	H	-
6.0	**Documentation & IC/ IRN**						
6.1	Stamping and review of inspection documents, issue of IC	Review of documents for compliance as per PR.	100%	Inspection Certificate (IC)	-	-	H
6.2	Review of final documentation of supplier	Compilation of documents as per VDR attached with PR.	100%	Dossier / Completion certificate	-	H	H

Legend: H- Hold (Do not proceed without approval), P-Perform, RW - Random Witness (As specified or 10% (minimum 1 number 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. 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)
2. Acceptance Norms for all the activities shall be as per PO/PR/Standards referred there in /Job Specification /Approved Documents.
3. WPS/PQR/WPQ Shall be qualified & certified by a reputed TPIA.
4. Certifications shall be as per EN 10204 Type 3.1 except for Mechanical seal & wear ring hardness.
5. Bought out items to be procured from EIL/Client approved suppliers.
6. Third Party Inspection Certifications shall be as per EN 10204 Type 3.2 and TPIA shall be arranged by supplier.
7. Inspection Test Requirements of Motors shall be as per EIL ITP 6-81-1064 (MV Motors), 6-81-1031 (HV Motors), 6-81-1038 (MV VFDs), 6-81-1050 (HV VFDs).
8. Inspection Test Requirements Diesel Engine Starting Battery shall be as per EIL ITP 6-81-1046 (For Lead Acid Battery Type).
9. Separate QAP/ITP of bought out items like Steam turbine, Diesel engine, Gear box, Lube Oil System & LCP/UCP shall be submitted for approval of TPI/EIL.
10. Final balancing of impeller/shaft shall be done after corrosion-coating if applicable & specified in PR/datasheets.

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11. For Pump up to 55KW, Performance test, Mechanical Run Test, NPSH tests (As applicable) and dismantling inspection shall be reviewed by EIL/TPIA. Pump above 55KW and up to 160KW, Performance test, Mechanical Run Test and NPSH test (As applicable) shall be witnessed by EIL/TPIA and shall be limited to one per PR Sr. No. excluding engine driven pump. Engine driven pump & Pump above 160KW, Performance test, Mechanical Run Test and NPSH test (As applicable) for each pump shall be witnessed by EIL/TPIA.
12. Dismantle inspection of pump after performance test shall be applicable only in case of abnormality in mechanical behavior (such as excessive noise & vibration, bearing temperature rise etc.) during performance test.
13. For EPC jobs, all inspection shall be carried out by TPIA, unless notified otherwise.

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अपकेंद्रीय अधोलंब पम्प के लिए निरीक्षण और परीक्षण योजना

(सामान्य प्रयोजन प्रक्रिया)

INSPECTION AND TEST PLAN FOR PUMP CENTRIFUGAL VERTICAL (GENERAL PURPOSE PROCESS)

Rev. No.	Date	Purpose	Prepared by	Checked by	Convener Standards Committee	Chairman Standards Bureau
					Approved by	
4	23.05.20	REVISED AND RE-ISSUED	TV	RMR	RKS	SKS
3	20.03.14	REVISED AND RE-ISSUED	TKK	RKS	SCG	SC
2	19.08.13	REVISED AND RE-ISSUED	TKK	RKS	SCG	DM
1	21.01.08	REVISED AND RE-ISSUED	SMG	SS	MVKK	VC
0	23.07.02	ISSUED FOR IMPLEMENTATION	VKJ	TVD	AKB	GRR

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Abbreviations:

AS	:	Alloy Steel	NPSH	:	Net Positive Suction Head
COC	:	Certificate of Compliance	PESO	:	Petroleum and Explosives Safety Organization
DFT	:	Dry Film Thickness	PMI	:	Positive Material Identification
EIL	:	Engineers India Limited	PO	:	Purchase Order
EPC	:	Engineering Procurement Construction	PQR	:	Procedure Qualification Record
EN	:	European Norms	PR	:	Purchase Requisition
HT	:	Heat Treatment	QAP	:	Quality Assurance Plan
HV	:	High Voltage	RT	:	Radiography Testing
IC	:	Inspection Certificate	Specs.	:	Specifications
IRN	:	Inspection Release Note	SS	:	Stainless Steel
ITP	:	Inspection and Test Plan	Temp	:	Temperature
LCP	:	Local Control Panel	TPI or TPIA	:	Third Party Inspection Agency
MOM	:	Minutes of Meeting	UCP	:	Unit Control Panel
KW	:	Kilo Watt	UT	:	Ultrasonic Testing
MRT	:	Mechanical Run Test	VDR	:	Vendor Data Requirement
MTC	:	Material Test Certificate	VFD	:	Variable Frequency Drive
MV	:	Medium Voltage	WPS	:	Welding Procedure Specification
NDT	:	Non Destructive Testing	WPQ	:	Welders Performance Qualification

Inspection Standards Committee

Convener: Mr. R.K. Singh

Members:

Mr. Rajesh Sinha	Mr. Himangshu Pal	Mr. Chandrashekhar	Mr. Avdhesh Agrawal
Mr. Mahendra Mittal	Mr. R Muthuramalingam (RPO Representative)	Mr. Tarun Kumar / Mr. Mahesh Gupta, Eqpt Div	

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1.0 SCOPE:

This inspection and test plan covers the minimum testing requirements of Pump Centrifugal Vertical (General Purpose Process).

2.0 REFERENCE DOCUMENTS:

PO/PR/ Standards referred there in/ 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	**Procedures / Documents**						
1.1	Pressure test, MRT, Performance test, Minimum Submergence test, NDT as applicable, Heat Treatment as applicable, Dynamic Balancing Test of Impeller, String Test as applicable and other procedure as applicable	Documented Procedures	100%	Procedures	-	H	R
1.2	WPS, PQR,WPQ - 1) Qualification for Overlay 2) Repair welding procedures	Welding procedure Qualification, Welder parameters	100%	WPS/PQR/ WPQ Records	-	H	W- New, R – Existing (Note-3)
1.3	Pre-Inspection meeting	Verification of technical requirements as per PR/contract	100%	MOM	-	H	W/R (For <160KW) H (For >160KW)

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
2.0	**Material Inspection**						
2.1	Incoming Material Casing, Stuffing Box, Impeller, Shaft Material, Wear rings & Bearing Housing (As applicable)	Visual & Dimensions, Chemical Properties / Physical Properties, Heat Treatment as per Specs, UT for Shaft & Other Forgings and (#)Wear ring differential hardness	100%	MTC , HT Chart, Inspection Report, COC for #	H	H	R (Note-4)
2.2	Accessories- Mechanical Seal, Coupling (As applicable)	Pressure Test of Mechanical Seal, Dynamic balancing of seal and coupling	100%	MTC/ Inspection & Test Record, Pressure test, report and COC for Mechanical Seal	H	H	R (Note-4)
2.3	Piping & Hardware Items- Valves, Flanges, Pipes, Fittings, Gaskets, Fasteners, Instruments etc (As applicable)	Visual & Other Requirement as per purchase specification / Approved Documents	100%	MTC & Inspection Report	H	H	R (Note-4)
2.4	Motor / VFD (As applicable) *(supplier/sub supplier to arrange TPIA certification)	1) Type test/ Routine test of Motor, VFD & Other test requirement as per purchase specification / Approved Documents 2) MTC review 3) PESO Certificate review (As applicable)	100%	MTC & Inspection Report	H	H*	W (Note-7)
2.4.1	Combined testing of motor & VFD (As applicable) *(supplier/sub supplier to arrange TPIA certification)	1) Routine Test & Type Test 2) PESO requirement (As applicable)	100%	MTC & Inspection / Test Records	H	H*	W (Note-7)

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
2.5	Diesel Engine with governor & accessories (As applicable)	MRT of Diesel Engine & Other checks as per approved QAP	100%	MTC & Inspection Report	H	H	R (Note-8,9)
2.6	Gear box (As applicable)	MRT of gear box & Other checks as per approved QAP	100%	MTC & Inspection Report	H	H	W (Note-6,9)
2.7	Lube Oil system (As applicable)	Functional test & Other checks as per approved QAP	100%	Inspection Report	H	H	W (Note-6,9)
3.0	**In Process Inspection**						
3.1	NDT (As applicable) for Casing, Impeller, Stuffing Box Shaft & Casing to Nozzle butt weld	Surface and Internal imperfections	100%	Test Reports RT Films & NDT Report	-	H	R
3.2	Pressure test before Assembly of Pump casing (In un-painted condition) & stuffing box	Leak Tightness check	Each Set	Inspection and Test Records	-	H	R
3.3	Impeller / Rotor assembly	Dynamic Balancing	Each Impeller / Rotor assembly	Inspection and Test Records	-	H	W - 1 per Tag R - Spare
4.0	**FINAL INSPECTION**						

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.1	Testing of Pumps	1) Performance test 2) Minimum submergence test (If required) (Testing till end of curve to be done if specified in datasheet or job specification) 3) MRT for 4 hours duration (To measure Vibration Limits, Noise level, Bearing Temp Rise)	Each Pump	Inspection and Test Records, Calibration records of Driver	-	H	H (Note-10)
4.2	Dismantle inspection of pump after performance test / MRT (4 Hours)	1) Visual insp. of casing inside surface 2) Wear ring area visual Check 3) Clearance measurement 4) Examination of Mechanical seal	Each Pump	Inspection and Test Records	-	H	W (Note-11)
4.3	Unitization of Pump with job driver on a common job base Frame	Alignment of pump with driver and Check Direction of Rotation	Each Set	Inspection and Test Records	-	H	W
4.4	Complete Unit String Test (In case of Diesel Engine Driver)	Mechanical Performance of the Train (Vibration Limits, bearing/oil temperature, engine parameters and controls)	Each Set	Inspection and Test Records	-	H	H
4.5	Testing of auxiliary piping if applicable	Leak Tightness	Each Set	Inspection and Test Records	-	H	R
4.6	Job Instruments if applicable	Compliance to PR requirements	100%	MTC & Statutory certification (As applicable)	W	H	R

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.7	Testing and Measuring Instruments	Validity of calibration & accuracy	100%	Calibration Report	W	H	R
4.8	Final Pump skid Assembly	Visual, Nozzle dimensions including Mounting Plate dimensions, Battery Limits Check Overall skid completeness check and PMI Check of all SS & AS components and welds on Skid	100%	Inspection Report	-	H	H
5.0	**Painting**						
5.1	Surface Preparation & Painting of all Carbon Steel Parts of Skid	Visual Inspection for workmanship, Panting Scheme, Paint Shade, Painting DFT Check	100%	Inspection Report	-	H	R
5.2	Pickling & Passivation for Stainless Steel Parts (As applicable)	Visual Inspection for workmanship	100%	Inspection Report	-	H	R
5.3	Packing & Preservation	Visual Inspection for workmanship	100%	Inspection Report	-	H	-
6.0	**Documentation & IC / IRN**						
6.1	Stamping and review of inspection documents, issue of IC	Review of documents for compliance as per PR.	100%	Inspection Certificate (IC)	-	-	H
6.2	Review of final documentation of supplier	Compilation of documents as per VDR attached with PR.	100%	Dossier / Completion certificate	-	H	H

Legend: H- Hold (Do not proceed without approval), P-Perform, RW - Random Witness (As specified or 10% (minimum 1 number of each size and type of Bulk item)), R-Review, W-Witness (Give due notice, work may proceed after scheduled date).

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NOTES (As applicable):

1. 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)
2. Acceptance Norms for all the activities shall be as per PO/PR/Standards referred there in /Job Specification /Approved Documents.
3. WPS/PQR/WPQ Shall be qualified & certified by a reputed TPIA.
4. Certifications shall be as per EN 10204 Type 3.1 except for Mechanical seal & wear ring hardness.
5. Bought out items to be procured from EIL/Client approved suppliers.
6. Third Party Inspection Certifications shall be as per EN 10204 Type 3.2 and TPIA shall be arranged by supplier.
7. Inspection Test Requirements of Motors shall be as per EIL ITP 6-81-1064 (MV Motors), 6-81-1031 (HV Motors), 6-81-1038 (MV VFDs), 6-81-1050 (HV VFDs).
8. Inspection Test Requirements Diesel Engine Starting Battery shall be as per EIL ITP 6-81-1046 (For Lead Acid Battery Type).
9. Separate QAP/ITP of bought out items like Diesel engine, Gear box & LCP/UCP shall be submitted for approval of TPI/EIL.
10. For Pump up to 55KW, Performance test, Mechanical Run Test, Minimum submergence test (As applicable) and dismantling inspection shall be reviewed by EIL/TPIA. Pump above 55KW and up to 160KW, Performance test, Mechanical Run Test and Minimum submergence test (As applicable) shall be witnessed by EIL/TPIA and shall be limited to one per PR Sr. No. excluding engine driven pump. Engine driven pump & Pump above 160KW, Performance test, Mechanical Run Test and Minimum submergence test (As applicable) for each pump shall be witnessed by EIL/TPIA.
11. Dismantle inspection of pump after performance test shall be applicable only in case of abnormality in mechanical behavior (such as excessive noise & vibration, bearing temperature rise etc.) during performance test.
12. For EPC jobs, all inspection shall be carried out by TPIA, unless notified otherwise.

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अपकेंद्रीय अधोलंब पम्प के लिए निरीक्षण और परीक्षण योजना

(सामान्य जल सेवा)

INSPECTION AND TEST PLAN FOR PUMP CENTRIFUGAL VERTICAL (GENERAL WATER SERVICE)

Rev. No.	Date	Purpose	Prepared by	Checked by	Convener Standards Committee	Chairman Standards Bureau
					Approved by	
5	23.05.20	REVISED AND RE-ISSUED	TV	RMR	RKS	SKS
4	20.03.14	REVISED AND RE-ISSUED	TKK	RKS	SCG	SC
3	19.08.13	REVISED AND RE-ISSUED	TKK	RKS	SCG	DM
2	15.07.11	REVISED AND RE-ISSUED	RMR	SCG	AKC	DM
1	21.01.08	REVISED AND RE-ISSUED	SMG	SS	MVKK	VC
0	23.07.02	ISSUED FOR IMPLEMENTATION	VKJ	TVD	AKB	SB

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Abbreviations:

AS	:	Alloy Steel	NPSH	:	Net Positive Suction Head
COC	:	Certificate of Compliance	PESO	:	Petroleum and Explosives Safety Organization
DFT	:	Dry Film Thickness	PMI	:	Positive Material Identification
EIL	:	Engineers India Limited	PO	:	Purchase Order
EPC	:	Engineering Procurement Construction	PQR	:	Procedure Qualification Record
EN	:	European Norms	PR	:	Purchase Requisition
HT	:	Heat Treatment	QAP	:	Quality Assurance Plan
HV	:	High Voltage	RT	:	Radiography Testing
IC	:	Inspection Certificate	Specs.	:	Specifications
IRN	:	Inspection Release Note	SS	:	Stainless Steel
ITP	:	Inspection and Test Plan	Temp	:	Temperature
LCP	:	Local Control Panel	TPI or TPIA	:	Third Party Inspection Agency
MOM	:	Minutes of Meeting	UCP	:	Unit Control Panel
KW	:	Kilo Watt	UT	:	Ultrasonic Testing
MRT	:	Mechanical Run Test	VDR	:	Vendor Data Requirement
MTC	:	Material Test Certificate	VFD	:	Variable Frequency Drive
MV	:	Medium Voltage	WPS	:	Welding Procedure Specification
NDT	:	Non Destructive Testing	WPQ	:	Welders Performance Qualification

Inspection Standards Committee

Convener: Mr. R.K. Singh

Members:

Mr. Rajesh Sinha
Mr. Mahendra Mittal
Mr. Himangshu Pal
Mr. R Muthuramalingam (RPO Representative)
Mr. Chandrashekhar
Mr. Tarun Kumar / Mr. Mahesh Gupta, Eqpt Div
Mr. Avdhesh Agrawal

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1.0 SCOPE:

This inspection and test plan covers the minimum testing requirements of Pump Centrifugal Vertical (General Water Service).

2.0 REFERENCE DOCUMENTS:

PO/PR/ Standards referred there in/ 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	**Procedures / Documents**						
1.1	Pressure test, MRT, Performance test, Minimum Submergence test, NDT as applicable, Heat Treatment as applicable, Dynamic Balancing Test of Impeller, String Test as applicable and other procedure as applicable	Documented Procedures	100%	Procedures	-	H	R
1.2	WPS, PQR,WPQ - 1) Qualification for Overlay 2) Repair welding procedures	Welding procedure Qualification, Welder parameters	100%	WPS/PQR/ WPQ Records	-	H	W- New, R – Existing (Note-3)
1.3	Pre-Inspection meeting	Verification of technical requirements as per PR/contract	100%	MOM	-	H	W/R (For <160KW) H (For >160KW)

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
2.0	**Material Inspection**						
2.1	Incoming Material Casing, Stuffing Box, Impeller, Shaft Material, Wear rings & Bearing Housing (As applicable)	Visual & Dimensions, Chemical Properties / Physical Properties, Heat Treatment as per Specs, UT for Shaft & Other Forgings and (#)Wear ring differential hardness	100%	MTC , HT Chart, Inspection Report, COC for #	H	H	R (Note-4)
2.2	Accessories - Buffer Liquid Reservoir Barrier/Buffer Liquid Cooler, Mechanical Seal, Seal Plan, Coupling (As applicable)	Pressure Test & Seal Qualification test (As applicable) for Mechanical seal, Reservoir, coolers	100%	MTC/ Inspection & Test Record	H	H	R (Note-4)
2.3	Piping & Hardware Items- Valves, Flanges, Pipes, Fittings, Gaskets, Fasteners, Instruments etc (As applicable)	Visual & Other Requirement as per purchase specification / Approved Documents	100%	MTC & Inspection Report	H	H	R (Note-4)
2.4	Motor / VFD (As applicable) *(supplier/sub supplier to arrange TPIA certification)	1) Type test/ Routine test of Motor, VFD & Other test requirement as per purchase specification/ Approved Documents 2) MTC review 3) PESO Certificate review (As applicable)	100%	MTC & Inspection Report	H	H*	W / R (Note-7)
2.4.1	Combined testing of motor & VFD (As applicable) *(supplier/sub supplier to arrange TPIA certification)	1) Routine Test & Type test 2) PESO requirement (As applicable)	100%	MTC & Inspection / Test Records	H	H*	W (Note-7)
2.5	Diesel Engine with governor & accessories (As applicable)	MRT of Diesel Engine & Other checks as per approved QAP	100%	MTC & Inspection Report	H	H	R (Note-8,9)

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
2.6	Gear box (As applicable)	MRT of gear box & Other checks as per approved QAP	100%	MTC & Inspection Report	H	H	W (Note-6,9)
2.7	Lube Oil system (As applicable)	Functional test & Other checks as per approved QAP	100%	Inspection Report	H	H	W (Note-6,9)
3.0	**In Process Inspection**						
3.1	NDT (As applicable) for Casing, Impeller, Stuffing Box Shaft & Casing to Nozzle butt weld	Surface and Internal imperfections	100%	Test Reports RT Films & NDT Report	-	H	R
3.2	Pressure test before Assembly of Pump casing (In un-painted condition) & stuffing box	Leak Tightness check	Each Set	Inspection and Test Records	-	H	R
3.3	Impeller / Rotor assembly	Dynamic Balancing	Each Impeller / Rotor assembly	Inspection and Test Records	-	H	W - 1 per Tag R - Spare (Note-10)
4.0	**Final Inspection**						
4.1	Testing of Pumps	1) Performance test 2) Minimum submergence test (If required) (Testing till end of curve to be done if specified in data sheet or job specification) 3)MRT for 4 hours duration (To measure Vibration Limits, Noise level, Bearing Temp Rise)	Each Pump	Inspection and Test Records, Calibration records of Driver	-	H	H (Note-11)

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.2	Dismantle inspection of pump after performance test / MRT (4 Hours)	1) Visual insp. of casing inside surface 2) Wear ring area visual Check 3) Clearance measurement 4) Examination of Mechanical seal	Each Pump	Inspection and Test Records	-	H	W (Note-12)
4.3	Performance testing of pump after corro-coating (As applicable if specified in PR/pump datasheets)	Performance /Power consumption	One / Tag	Inspection and Test Records	-	H	W (One / Tag)
4.4	Unitization of Pump with job driver on a common job base Frame	Alignment of pump with driver and Check Direction of Rotation	Each Set	Inspection and Test Records	-	H	W
4.5	Complete Unit String Test (In case of Diesel Engine Driver)	Mechanical Performance of the Train (Vibration Limits, bearing/oil temperature, engine parameters and controls)	Each Set	Inspection and Test Records	-	H	H
4.6	Job Instruments if applicable	Compliance to PR requirements	100%	MTC &Statutory certification (As applicable)	W	H	R
4.7	Testing and Measuring Instruments	Validity of calibration & accuracy	100%	Calibration Report	W	H	R

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.8	Final Pump skid Assembly	Visual, Nozzle dimensions including Mounting Plate dimensions, Battery Limits Check, Overall skid completeness check and PMI Check of all SS & AS components and welds on skid	100%	Inspection Report	-	H	H
5.0	**Painting**						
5.1	Surface Preparation & Painting of all Carbon Steel Parts of Skid	Visual Inspection for workmanship, Panting Scheme, Paint Shade, Painting DFT Check	100%	Inspection Report	-	H	R
5.2	Pickling & Passivation for Stainless Steel Parts (As applicable)	Visual Inspection for workmanship	100%	Inspection Report	-	H	R
5.3	Packing & Preservation	Visual Inspection for workmanship	100%	Inspection Report	-	H	-
6.0	**Documentation & IC / IRN**						
6.1	Stamping and review of inspection documents, issue of IC	Review of documents for compliance as per PR.	100%	Inspection Certificate (IC)	-	-	H
6.2	Review of final documentation of supplier	Compilation of documents as per VDR attached with PR	100%	Dossier / Completion certificate	-	H	H

Legend: H- Hold (Do not proceed without approval), P-Perform, RW - Random Witness (As specified or 10% (minimum 1 number of each size and type of Bulk item)), R-Review, W-Witness (Give due notice, work may proceed after scheduled date).

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NOTES (As applicable):

1. 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)
2. Acceptance Norms for all the activities shall be as per PO/PR/Standards referred there in /Job Specification /Approved Documents.
3. WPS/PQR/WPQ Shall be qualified & certified by a reputed TPIA.
4. Certifications shall be as per EN 10204 Type 3.1 except for Mechanical seal & wear ring hardness.
5. Bought out items to be procured from EIL/Client approved suppliers.
6. Third Party Inspection Certifications shall be as per EN 10204 Type 3.2 and TPIA shall be arranged by supplier.
7. Inspection Test Requirements of Motors shall be as per EIL ITP 6-81-1064 (MV Motors), 6-81-1031 (HV Motors), 6-81-1038 (MV VFDs), 6-81-1050 (HV VFDs).
8. Inspection Test Requirements Diesel Engine Starting Battery shall be as per EIL ITP 6-81-1046 (For Lead Acid Battery Type).
9. Separate QAP/ITP of bought out items like Diesel engine, Gear box & LCP/UCP shall be submitted for approval of TPI/EIL.
10. Final balancing of impeller/shaft shall be done after corro-coating if applicable & specified in PR/datasheets.
11. For Pump up to 55KW, Performance test, Mechanical Run Test, Minimum Submergence test (As applicable) and dismantling inspection shall be reviewed by EIL/TPIA. Pump above 55KW and up to 160KW, Performance test, Mechanical Run Test and Minimum Submergence test (As applicable) shall be witnessed by EIL/TPIA and shall be limited to one per PR Sr. No. excluding engine driven pump. Engine driven pump & Pump above 160KW, Performance test, Mechanical Run Test and Minimum Submergence test (As applicable) for each pump shall be witnessed by EIL/TPIA.
12. Dismantle inspection of pump after performance test shall be applicable only in case of abnormality in mechanical behavior (such as excessive noise & vibration, bearing temperature rise etc.) during performance test.
13. For EPC jobs, all inspection shall be carried out by TPIA, unless notified otherwise

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नियन्त्रित आयतन हेतु रेसीप्रोकेटिंग पम्प के लिये निरीक्षण व परीक्षण योजना

INSPECTION AND TEST PLAN FOR PUMP RECIPROCATING (CONROLLED VOLUME)

Rev. No.	Date	Purpose	Prepared by	Checked by	Convenor Standards Committee	Chairman Standards Bureau
					Approved by	
5	23.08.24	REVISED AND RE-ISSUED	KBR	TV	RK	MN
4	12.06.19	REVISED AND RE-ISSUED	RMR	TV	RKS	RKT
3	19.08.13	REVISED AND RE-ISSUED	TKK	RKS	SCG	DM
2	15.07.11	REVISED AND RE-ISSUED	RMR	SCG	AKC	DM
1	21.01.08	REVISED AND RE-ISSUED	SMG	SS	MVKK	VC
0	19.08.-02	ISSUED FOR IMPLEMENTATION	VKJ	TVD	AKB	GRR

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Abbreviations:

CEIL	:	Certification Engineers International Limited	MRT	:	Mechanical Run Test
CIMFR	:	Central Institute of Mining & Fuel Research	NDT	:	Non-Destructive Testing
CE	:	Carbon Equivalent	NPSH	:	Net Positive Suction Head
DFT	:	Dry Film Thickness	PO	:	Purchase Order
DPT	:	Dye Penetrant Testing	PESO	:	Petroleum Explosive Safety Organization
DHT	:	De-hydrogen Heat Treatment	PQR	:	Procedure Qualification Record
ERTL	:	Electronics Regional Test Laboratory	PR	:	Purchase Requisition
FCRI	:	Fluid Control Research Institute	PMI	:	Positive Material Identification
HT	:	Heat Treatment	RT	:	Radiography Testing
HIC	:	Hydrogen Induced Cracking	SSCC	:	Sulphide Stress Corrosion Cracking
ITP	:	Inspection and Test Plan	TC	:	Test Certificate
IP	:	Ingress Protection	TPI or TPIA	:	Third Party Inspection Agency
IHT	:	Intermediate Heat Treatment	UT	:	Ultrasonic Testing
IC	:	Inspection Certificate	VDR	:	Vendor Data Requirement
IGC	:	Inter Granular Corrosion	WPS	:	Welding Procedure Specification
MPT/MT	:	Magnetic Particle Testing	WPQ	:	Welders Performance Qualification
MTC	:	Material Test Certificate			

Inspection Standards Committee

Convenor: Mr. Rajeev Kumar

Members:

Mr. Suresh G	Mr. Himangshu Pal	Mr. R Muthu Ramalingam (RPO Rep.)	Mr Mahendra Mittal
Mr. Chandrashekhar	Mr. Avdhesh Agrawal	Mr. Tarun Kumar /Mr Mahesh Gupta (Rotating)	Mr Anil Kumar

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1.0 SCOPE:

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

2.0 REFERENCE DOCUMENTS:

PO/PR/ Standards referred there in/ Job specifications /Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS:

SL NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	FORMAT OF REPORT	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	**Procedures**						
1.1	Hydro test, MRT/Performance, NDT and Other Procedure (As applicable)	Documented Procedures	100%	Procedures	-	H	R
1.2	WPS, PQR & WPQ - 1. Qualification for Overlay 2. Repair welding procedures	Welding procedures, Qualification	100%	WPS/PQR/ WPQ Records	-	H	W- New R – Existing (Note 4)
2.0	**Material Inspection**						

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SL NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	FORMAT OF REPORT	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
2.1	Incoming Material Frame, Cross Head, Fluid End Stuffing Box, Crank shaft, Connecting Rod, Extension Rod, Plunger and Gear Packing (As applicable)	Visual & Dimensions, Chemical Properties/Physical Properties, Heat Treatment as per Specs	100%	MTC, HT Chart, Inspection Report	W	H	R
2.2	Hard Ware items- Gaskets, Fasteners, Bearings Gland-Packing	Visual	As per Sampling Plan	MTC & Inspection Report	W	H	R
2.3	Motor / VFD (As applicable) *(supplier/sub supplier to arrange TPIA certification)	Type test/Routine test of Motor	100%	MTC & Inspection Report	H	H*	W (Note-3)
2.4	Gear box (As applicable) *(supplier/sub supplier to arrange TPIA certification)	MRT of gear box	100%	MTC & Inspection Report	H	H*	R
2.5	Accessories- Volume Bottles, Calibration Pot, Strainer & Piping items like pipes, pipe fittings, forgings etc (As applicable)	1. Visual & Dimension check. 2. Hydro test.	100%	Inspection and Test Records & MTC	W	H	R
2.6	Accessories- Coupling	Dimensions & Dynamic Balancing	100%	Inspection and Test Records	W	H	R

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SL NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	FORMAT OF REPORT	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
3.0	**In Process Inspection**						
3.1	All pump components	Visual & Dimension check	100%	Inspection and Test Records	-	H	R
3.2	In Process Crank Shaft, Connecting & Extension. Rods, Gear Blanks Plunger, Fluid end & St. Box	Internal Defects Ultrasonic Test (Pre-Machining Stage) (As applicable)	100%	Inspection and Test Records	-	H	R
3.3	In Process Frame	Leak Test	100% Oil Sump	Inspection and Test Records	-	H	R
3.4	Test before assembly of Fluid End, St. Box 1. Inside 2. Jacket Side 3. Volume Bottle 4. Piping	Leak tightness / Hydro test	Each set	Inspection and Test Records	-	H	R
4.0	**Final Inspection**						

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SL NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	FORMAT OF REPORT	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.1	Testing of pump	1) Performance (Flow repeatability, linearity and steady state accuracy) 2) Vibration 3) Noise Measurement 4) Bearing Temp. Rise 5) Mech Run 6) Relief Valve Set Pressure Function Test	Each Pump	Inspection and Test Records	-	H	H (One per PR Sr.No.)
4.2	Dismantling inspection of Pump	Strip Examination Visual check of Valve Assembly & Exposed Portion of Plunger	Each Pump	Inspection and Test Records	-	H	W (One per PR Sr.No.)
4.3	Job Instruments, if applicable	Compliance to PR requirements	100%	MTC & Statutory certification	H	H	R
4.4	Testing of auxiliary piping (As applicable)	Leak Tightness	Each Set	Inspection and Test Records	-	H	R
4.5	Final Pump skid Assembly	Visual, dimension and skid completeness check	100%	Inspection Report	-	H	H

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SL NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	FORMAT OF REPORT	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
5.0	**Painting**						
5.1	Painting of pump skid & associated parts (As applicable), preservation of internal machine parts.	Paint Scheme , Visual & Paint thickness check	100%	Inspection Report	-	H	R
6.0	**Documentation**						
6.1	Stamping and review of inspection documents, issue of IC	Review of documents for compliance as per PR.	100%	IC	-	-	H
6.2	Review of final documentation of supplier	Compilation of documents as per VDR attached with PR.	100%	Dossier / Completion certificate	-	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. 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)
2. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred there in /Job Specification /Approved Documents.
3. Inspection Test Requirements of Motors shall be as per EIL ITP 6-81-1031 (HV Motors), 6-81-1032 (MV Motors), 6-81-1038 (VFDs). TPIA wherever required as per above EIL ITP of motors shall be arranged by Main Vendor. Integration testing of Motor + VFD wherever required as per PR shall be witnessed by EIL/TPI (As applicable).
4. WPS/PQR/WPQ shall be qualified under TPI.

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इंडयूसड ड्राफ्ट फैन एंड फोर्सड ड्राफ्ट फैन के लिये
निरीक्षण व परीक्षण योजना

INSPECTION AND TEST PLAN
FOR
INDUCED DRAFT FAN & FORCED DRAFT FAN

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
5	23.08.24	REVISED AND REISSUED	KBR	TV	RK	MN
4	12.06.19	REVISED AND REISSUED	RMR	TV	RKS	RKT
3	18.06.13	REVISED AND REISSUED	TKK	RKS	SCG	DM
2	10.04.12	REVISED AND REISSUED	TKK	SCG	AKC	DM
1	21.01.08	REVISED AND REISSUED	SMG	RB	MVKK	VC
0	06.08.2002	ISSUED FOR IMPLEMENTATION	VKJ	TVD	AKB	GRR

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Abbreviations:

CEIL	:	Certification Engineers International Limited	MRT	:	Mechanical Run Test
CIMFR	:	Central Institute of Mining & Fuel Research	NDT	:	Non-Destructive Testing
CE	:	Carbon Equivalent	NPSH	:	Net Positive Suction Head
DFT	:	Dry Film Thickness	PO	:	Purchase Order
DPT	:	Dye Penetrant Testing	PESO	:	Petroleum Explosive Safety Organization
DHT	:	De-hydrogen Heat Treatment	PQR	:	Procedure Qualification Record
ERTL	:	Electronics Regional Test Laboratory	PR	:	Purchase Requisition
FCRI	:	Fluid Control Research Institute	PMI	:	Positive Material Identification
HT	:	Heat Treatment	RT	:	Radiography Testing
HIC	:	Hydrogen Induced Cracking	SSCC	:	Sulphide Stress Corrosion Cracking
ITP	:	Inspection and Test Plan	TC	:	Test Certificate
IP	:	Ingress Protection	TPI or TPIA	:	Third Party Inspection Agency
IHT	:	Intermediate Heat Treatment	UT	:	Ultrasonic Testing
IC	:	Inspection Certificate	VDR	:	Vendor Data Requirement
IGC	:	Inter Granular Corrosion	WPS	:	Welding Procedure Specification
MPT/MT	:	Magnetic Particle Testing	WPQ	:	Welders Performance Qualification
MTC	:	Material Test Certificate			

Inspection Standards Committee

Convenor: Mr. Rajeev Kumar

Members:

Mr. Suresh G	Mr. Himangshu Pal	Mr. R Muthu Ramalingam (RPO Rep.)	Mr Mahendra Mittal
Mr. Chandrashekhar	Mr. Avdhesh Agrawal	Mr. Tarun Kumar /Mr Mahesh Gupta (Rotating)	Mr Anil Kumar

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1.0 SCOPE:

This Inspection and Test Plan covers the minimum testing requirements of Induced Draft Fan & Forced Draft Fan

2.0 REFERENCE DOCUMENTS:

1) PO/PR/ Standards referred there in/ 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	**Procedures**						
1.1	WPS/PQR/WPQ, MRT / Performance test, NDT and other procedures	Documented Procedures	100%	Procedure Record	-	H	H- New / R- Already approved (Note -4)
2.0	**Material Inspection**						
2.1	Motor / VFD (As applicable) *(supplier/sub supplier to arrange TPIA certification)	Type test/Routine test of Motor	100%	MTC & Inspection Report	H	H*	W (Note-3)
2.2	Turbine (As applicable) *(supplier/sub supplier to arrange TPIA certification)	MRT of Turbine	100%	MTC & Inspection Report	H	H*	W
2.3	Fluid Coupling (As applicable) *(supplier/sub supplier to arrange TPIA certification)	Functional Test	100%	MTC & Inspection Report	H	H*	R

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SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
2.4	Local Control Panel (As applicable) *(supplier/sub supplier to arrange TPIA certification)	Functional Test	100%	MTC & Inspection Report	H	H*	R
3.0	**In process inspection**						
3.1	Material Identification Plate, Coil, Round Bar Forgings, Casing, Impeller, Coupling, Pulley, Gear Box., shaft, damper, etc. (As applicable)	1) Chemical Properties & Physical Properties 2) Surface Quality	100%	Mill /Mfg TC, OR Check Test Reports	-	H	-
3.2	Fabrication (Casing, Impeller etc.)	1) Welding parameters 2) Dimension / workmanship 3) RT / DPT as applicable	100%	Inspection Records	-	H	-
3.3	Shaft	Soundness (Ultrasonic Test)	100%	Ultrasonic test report	-	W	R
3.4	Rotor Assembly	Dynamic Balancing	100%	Inspection and Test Report	-	W	R
4.0	**Final inspection**						

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SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.1	Mechanical run test (MRT) & Performance test	1) No load Mech. Run test 2) Bearing Temperature Rise 3) Vibration 4) Noise Measurement 5) Performance	100%	Test Records	-	H	H
4.2	Final assembly Inspection (Unitized Fan with Driver, Coupling OR Pulley Belt Base Frame)	Conformity of Dimensions and Accessories	100%	Test Records	-	H	W
5.0	**Painting**						
5.1	Final painting (As applicable) and preservation of internal machined parts.	workmanship, uniformity & DFT check	100%	Inspection report	-	H	R
6.0	**Documentation and IC**						
6.1	Final stamping, review of inspection documents and issue of IC	Verification & compilation of inspection & test records	100%	Inspection record / IC	-	H	H
6.2	Final documents as per PR	Verification & compilation of inspection & test records for submission to customer	100%	Final dossier	-	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).

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NOTES (As applicable):

1. 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)
2. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred there in /Job Specification /Approved Documents.
3. Inspection Test Requirements of Motors shall be as per EIL ITP 6-81-1031 (HV Motors), 6-81-1032 (MV Motors), 6-81-1038 (VFDs). TPIA wherever required as per above EIL ITP of motors shall be arranged by Main Vendor. Integration testing of Motor + VFD wherever required as per PR shall be witnessed by EIL/TPI (as applicable).
4. WPS/PQR/WPQ shall be qualified under TPI.

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के लिए
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INSPECTION AND TEST PLAN
FOR
STRAINERS

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
4	14.02.2024	REVISED AND RE-ISSUED	NK	AK	RK	MN
3	14.11.2018	REVISED AND RE-ISSUED	KC	NM	RKS	RKT
2	17.06.2013	REVISED AND RE-ISSUED	TKK	RKS	SCG	DM
1	15.07.2011	REVISED AND RE-ISSUED	TKK	SCG	AKC	DM
0	28.09.2007	ISSUED FOR IMPLEMENTATION	PD	RB	MVKK	VC

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Abbreviations:

CEIL	:	Certification Engineers International Limited	MRT	:	Mechanical Run Test
CIMFR	:	Central Institute of Mining & Fuel Research	NDT	:	Non Destructive Testing
CE	:	Carbon Equivalent	NPSH	:	Net Positive Suction Head
DFT	:	Dry Film Thickness	PO	:	Purchase Order
DPT	:	Dye Penetrant Testing	PESO	:	Petroleum Explosive Safety Organization
DHT	:	De-hydrogen Heat Treatment	PQR	:	Procedure Qualification Record
ERTL	:	Electronics Regional Test Laboratory	PR	:	Purchase Requisition
FCRI	:	Fluid Control Research Institute	PMI	:	Positive Material Identification
HT	:	Heat Treatment	RT	:	Radiography Testing
HIC	:	Hydrogen Induced Cracking	SSCC	:	Sulphide Stress Corrosion Cracking
ITP	:	Inspection and Test Plan	TC	:	Test Certificate
IP	:	Ingress Protection	TPI or TPIA	:	Third Party Inspection Agency
IHT	:	Intermediate Heat Treatment	UT	:	Ultrasonic Testing
IC	:	Inspection Certificate	VDR	:	Vendor Data Requirement
IGC	:	Inter Granular Corrosion	WPS	:	Welding Procedure Specification
MPT/MT	:	Magnetic Particle Testing	WPQ	:	Welders Performance Qualification
MTC	:	Material Test Certificate			

Inspection Standards Committee

Convenor : Mr. Rajeev Kumar

Members:

Mr. Suresh G	Mr. Avdhesh Agrawal	Mr. Himangshu Pal	Mr. R Muthu Ramalingam (RPO Rep.)
Mr. Anil Kumar	Mr. Mahendra Mittal	Ms. Sulakshana Hundaikari (Engg)	Mr. Chandrashakhar

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1.0 SCOPE

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

2.0 REFERENCE DOCUMENTS

PO/PR/ Standards referred there in/ 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	NDT (DPT, MT, RT), Hydro test, Heat treatment (Normalizing, Nor & Temp, Solution Annealing, Stabilizing as applicable), Picking, Shot blasting & Painting procedure	Documented Procedures	100%	Procedure Documents	-	H	R
1.2	Weld Plan (WPS/ PQR/WPQ) & NDE Plan	Applicability of welding process (welding parameters) & NDE methods	100%	Weld & NDE Plan	-	H	W- New R- Existing
2.0	**Material Inspection**						

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SL. NO.	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
2.1	Raw Material Inspection	Chemical , Mechanical, Impact, IGC, Heat Treatment, NDT, Hardness and other properties as applicable	100%	Test Certificates	H	H	R
3.0	**In Process Inspection**						
3.1	Welding	Welding Parameters as per WPS / PQR	100%	Inspection Reports	-	H	-
3.2	Heat Treatment	PWHT as applicable	100%	HT chart	-	H	R
3.3	Radiography as Applicable	Weld Defects	100%	RT films & Reports	-	H	R
3.4	NDT As applicable	Surface & Internal Imperfections	100%	Test Reports	-	H	R
4.0	**Final Inspection**						
4.1	Hydrostatic Testing	Neither pressure drop nor leakage	100%	Test Report	-	H	RW (Note-1)
4.2	Visual and Dimensional Inspection (VDI)	Filter element fitment, Surface Condition & Dimensions	100%	Inspection Report	-	H	RW (Note-1)
4.3	PMI Check (External body, fasteners, internal filter element etc)	Chemical Check	As Per EIL Spec. 6-81-0001	Inspection Report	-	H	RW (Note-1)

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SL. NO.	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.4	Final Stamping	Stamping of Accepted Strainers	Stamping of Strainers which are witnessed by EIL/TPIA.	Inspection Report	-	H	H (Note-1)
5.0	**Picking passivation and Painting**						
5.1	Final shot blasting, surface preparation & painting (As applicable)	Visual inspection (after surface preparation and final painting for workmanship, uniformity) DFT check, color coding	100%	Inspection Report	-	H	R
5.2	Pickling & Passivation (SS strainers) as applicable	As per procedure	100%	Inspection Report	H	H	R
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 Strainers up to size 6" 300# ANSI will be accepted on review of Supplier Test Certificates duly reviewed by EIL/TPIA.

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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 therein /Job Specification /Approved Documents.

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निरक्षण एवं परीक्षणयोजना

INSPECTION AND TEST PLAN
FOR
HOSE PIPES AND COUPLING

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
4	11.12.2023	REVISED AND RE-ISSUED	SS	CS	RK	
3	14.11.2018	REVISED AND RE-ISSUED	KC	NM	RKS	RKT
2	17.06.2013	REVISED AND RE-ISSUED	TKK	RKS	SCG	DM
1	13.07.2011	REVISED AND RE-ISSUED	TKK	SCG	AKC	DM
0	28.09.2007	Issued for implementation	PD	RB	MVKK	VC

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Abbreviations:

CEIL	:	Certification Engineers International Limited	MRT	:	Mechanical Run Test
CIMFR	:	Central Institute of Mining & Fuel Research	NDT	:	Non Destructive Testing
CE	:	Carbon Equivalent	NPSH	:	Net Positive Suction Head
DFT	:	Dry Film Thickness	PO	:	Purchase Order
DPT	:	Dye Penetrant Testing	PESO	:	Petroleum Explosive Safety Organization
DHT	:	De-hydrogen Heat Treatment	PQR	:	Procedure Qualification Record
ERTL	:	Electronics Regional Test Laboratory	PR	:	Purchase Requisition
FCRI	:	Fluid Control Research Institute	PMI	:	Positive Material Identification
HT	:	Heat Treatment	RT	:	Radiography Testing
HIC	:	Hydrogen Induced Cracking	SSCC	:	Sulphide Stress Corrosion Cracking
ITP	:	Inspection and Test Plan	TC	:	Test Certificate
IP	:	Ingress Protection	TPI or TPIA	:	Third Party Inspection Agency
IHT	:	Intermediate Heat Treatment	UT	:	Ultrasonic Testing
IC	:	Inspection Certificate	VDR	:	Vendor Data Requirement
IGC	:	Inter Granular Corrosion	WPS	:	Welding Procedure Specification
MPT/MT	:	Magnetic Particle Testing	WPQ	:	Welders Performance Qualification
MTC	:	Material Test Certificate			

Inspection Standards Committee

Convenor : Mr. Rajeev Kumar

Members:

Mr. Chandrashekhar	Mr. Rajesh Sinha	Mr. Himangshu Pal	Mr. R Muthu Ramalingam (RPO Rep.)
Mr. Avdhesh Agrawal	Mr. Mahendra Mittal	Mr. Shishupal Chaudhary (Engg)	

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1.0 SCOPE

This Inspection and Test Plan covers the minimum testing requirements of Hose pipes and Couplings

2.0 REFERENCE DOCUMENTS

PO/PR/ Standards referred there in/ 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	NDT and other Procedures.	Documented Procedures	100%	Procedure Documents	-	H	R
1.1 (a)	NDT Plan with operator qualification	Requirement of NDT stages (PT, MT, UT, RT etc) & operator certificates	100%	NDT reports and Plan with Qualification records	-	H	R
1.2	Weld plan with WPS, PQR & WPQ	Welding Parameters & Qualification Record	100%	Weld plan with WPS, PQR & WPQ	-	H	R- Existing W-For New
2.0	**Material Inspection**						

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SL. NO.	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
2.1	Incoming materials (Rubber hose/ SS pipe/SS wire braiding/ Flanges/ coupling)	Chemical & Mechanical Properties. & IGC (For SS Items if applicable.)	100%	Test certificates	H	H	R
3.0	**In Process Inspection**						
3.1	Welding	Welding Parameters as per WPS / PQR	100%	Inspection Reports	-	H	R
3.2	NDT as applicable	Weld soundness	100%	Test Reports	-	H	R
4.0	**Final Inspection**						
4.1	Hydrostatic/Pneumatic Testing	Leak Check	100%	Test Report	-	H	R
4.2	Vacuum test, Steam Resistance, Electrical Continuity and other tests as applicable	Leak & Soundness Check	100%	Test Report	-	H	R
4.3	Visual and Dimensional Inspection	Surface Condition & Dimensions	100%	Inspection Report	-	H	R
4.4	PMI Check	Chemical Check	As Per EIL Spec. 6-81-0001	Inspection report	-	H	R
4.5	Final Stamping	Stamping of Accepted Items	100%	Inspection Report	-	H	R

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SL. NO.	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
5.0	**Painting**						
5.1	Painting & Color Coding	Visual, DFT & Color Coding as applicable	100%	Inspection Report	-	H	R- For Record only
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. 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)
2. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred therein /Job Specification /Approved Documents.

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के लिए
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INSPECTION AND TEST PLAN
FOR
SPRING SUPPORT ASSEMBLIES

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
3	11.12.2023	REVISED AND RE-ISSUED	SD	CS	RK	MN
2	14.11.2018	REVISED AND RE-ISSUED	KC	NM	RKS	RKT
1	20.11.2013	REVISED AND RE-ISSUED	TKK	RKS	SCG	SC
0	22.03.2012	Issued for Implementation	AM	SCG	AKC	DM

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Abbreviations:

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CE	:	Carbon Equivalent	NPSH	:	Net Positive Suction Head
DFT	:	Dry Film Thickness	PO	:	Purchase Order
DPT	:	Dye Penetrant Testing	PESO	:	Petroleum Explosive Safety Organization
DHT	:	De-hydrogen Heat Treatment	PQR	:	Procedure Qualification Record
ERTL	:	Electronics Regional Test Laboratory	PR	:	Purchase Requisition
FCRI	:	Fluid Control Research Institute	PMI	:	Positive Material Identification
HT	:	Heat Treatment	RT	:	Radiography Testing
HIC	:	Hydrogen Induced Cracking	SSCC	:	Sulphide Stress Corrosion Cracking
ITP	:	Inspection and Test Plan	TC	:	Test Certificate
IP	:	Ingress Protection	TPI or TPIA	:	Third Party Inspection Agency
IHT	:	Intermediate Heat Treatment	UT	:	Ultrasonic Testing
IC	:	Inspection Certificate	VDR	:	Vendor Data Requirement
IGC	:	Inter Granular Corrosion	WPS	:	Welding Procedure Specification
MPT/MT	:	Magnetic Particle Testing	WPQ	:	Welders Performance Qualification
MTC	:	Material Test Certificate			

Inspection Standards Committee

Convenor : Mr. Rajeev Kumar

Members:

Mr. Chandrashekhar	Mr. Rajesh Sinha	Mr. Himangshu Pal	Mr. R Muthu Ramalingam (RPO Rep.)
Mr. Avdhesh Agrawal	Mr. Mahendra Mittal	Ms. Sulakshna Hundekari (Engg)	

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1.0 SCOPE

This Inspection and Test Plan covers the minimum testing requirements of Spring Support Assemblies

2.0 REFERENCE DOCUMENTS

PO/PR/ Standards referred there in/ Job specifications /Approved documents.

3.0 INPECTION 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	Load Test and Non-Destructive Examination (as applicable)	- Magnetic Particle Test for all Alloy Steel Springs - Test Procedure	100%	Supplier's Test Procedure	-	W	R
1.1(a)	NDT Plan with operator qualification	Requirement of NDT stages (PT, MT, RT, UT etc) and operator certificates	100%	NDT reports and Plan with Qualification records	-	H	R
1.2	Weld plan with WPS, PQR & WPQ	Welding Parameters & Qualification Record	100%	Weld plan & Procedure documents	-	H	W- New R- Existing
2.0	**Material Inspection**						
2.1	Clamps, Lugs, Eye Rods, Hanger Rods, Turn Buckle, Plates, Teflon/Graphite Pad, Casing etc	• Visual Inspection • Mechanical Properties • Chemical Properties	100%	Material Test Certificates / Lab Test Reports	H	H	R

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SL. NO.	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/ TPIA
2.2	Bought Out Components • Spring Coil • Fasteners	• Chemical & Physical properties • Compression Test, Scragging & Cramp test for Springs	100%	Sub Supplier Test Certificates	H	H	R
3.0	**In Process Inspection**						
3.1	Machining of Components	• Visual & Dimensional	100%	Suppliers Test Records	-	H	R
4.0	**Final Inspection**						
4.1	Acceptance tests on Spring Support Assemblies	• Visual Inspection • Dimensional Inspection • Load /Travel Test • Scragging Test/ Compression Test, Cramp test for Springs • Stamping of accepted assemblies	100%	Inspection Witness Record	-	H	RW
5.0	**Painting**						
5.1	Painting (as applicable)	• Painting Scheme • Visual Check • Final DFT Check	100%	Supplier Test Records	-	H	R- For Record Only
6.0	**Documentation & IC**						
6.1	Documentation & Inspection Certificate (IC)	Review of Stage Inspection Reports / Test Reports & Issue of IC	100%	Manufacturer TC & IC	-	H	H

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SL. NO.	STAGE / ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/ TPIA
6.2	Final documents as per PR	Verification & compilation of inspection & test records for submission to customer	100%	Final dossier / Completeness certificate	-	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. 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)
2. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred therein /Job Specification /Approved Documents.

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निरीक्षण व परीक्षण योजना

INSPECTION AND TEST PLAN
FOR
H.O.T. CRANE

Rev. No.	Date	Purpose	Prepared by	Checked by	Convenor Standards Committee	Chairman Standards Bureau
					Approved by	
2	15.05.2020	REVISED AND RE-ISSUED	SK	CS	RKS	SKS
1	20.11.13	REVISED AND RE-ISSUED	TKK	RKS	SCG	SC
0	**22.03.12**	**Issued for Implementation**	**NM**	**SCG**	**AKC**	**DM**

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Abbreviations:

BIS	:	Bureau of Indian Standards	MTC	:	Material Test Certificate
CEIL	:	Certification Engineers International Limited	MRT	:	Mechanical Run Test
CIMFR	:	Central Institute of Mining & Fuel Research	NDT	:	Non Destructive Testing
CE	:	Carbon Equivalent	NPSH	:	Net Positive Suction Head
DFT	:	Dry Film Thickness	PO	:	Purchase Order
DPT	:	Dye Penetrant Testing	PESO	:	Petroleum Explosive Safety Organization
DHT	:	De-hydrogen Heat Treatment	PQR	:	Procedure Qualification Record
ERTL	:	Electronics Regional Test Laboratory	PR	:	Purchase Requisition
FCRI	:	Fluid Control Research Institute	PMI	:	Positive Material Identification
HT	:	Heat Treatment	RT	:	Radiography Testing
HIC	:	Hydrogen Induced Cracking	SSCC	:	Sulphide Stress Corrosion Cracking
H.O.T.	:	Hand-operated Overhead Travelling	TC	:	Test Certificate
ITP	:	Inspection and Test Plan	TPI or TPIA	:	Third Party Inspection Agency
IP	:	Ingress Protection	UT	:	Ultrasonic Testing
IHT	:	Intermediate Heat Treatment	VDR	:	Vendor Data Requirement
IC	:	Inspection Certificate	WPS	:	Welding Procedure Specification
IGC	:	Inter Granular Corrosion	WPQ	:	Welders Performance Qualification
MPT/MT	:	Magnetic Particle Testing			

Inspection Standards Committee

Convenor : Mr. RK Singh

Members:

Mr. Rajesh Sinha
Mr. Chandrashekhar
Mr. Mahendra Mittal
Mr. Himangshu Pal
Mr. Avdhesh Agrawal
Mr. R. Muthuramalingam (RPO Representative)
Mr. Shishupal Choudhary (Engg. Representative)

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1.0 SCOPE

This Inspection and Test Plan covers the minimum testing requirements of H O T Crane.

2.0 REFERENCE DOCUMENTS

PO/PR/ Standards referred there in/ 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	Load Test and NDT Procedure (as applicable)	Documented Procedures	100%	Procedure Documents	H	W	R
1.2	WPS/ PQR /WPQ	Documented procedures.	100%	Procedure documents	-	H	R-Existing W-New
2.0	**Material Procurement**						
2.1	Material Certification • Wheels, Shafts, Gear & Pinions • Girder , Trolley & End Carriage	• Visual Inspection • Mechanical Properties • Chemical Properties	100%	Material Test Certificates / Lab Test Reports	H	H	R
2.2	Bought Out Components • Chain Pulley Block • Long Travel Chain	Chemical & Physical properties, proof Load test, BIS License (as applicable)	100%	Sub Supplier Test Certificates	H	R	R

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SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/ TPIA
3.0	**In Process Inspection**						
3.1	Machining of Components	• Visual & Dimensional • Hardness check for Gears, Pinions & Wheels	100%	Suppliers Test Records	H	W	-
3.2	Inspection of Weld	• Visual • Applicable NDT	As per spec.	NDT report & RT Film	-	H	R (Review of RT Films)
4.0	**Final Inspection**						
4.1	Acceptance Tests of H. O. T. Crane	• Visual Inspection • Dimensional Inspection • Full Load Test • Overload Test • Deflection Test • Height of Lift • Travel speed • Current measurements • Stamping	100%	Inspection Report	-	H	H
5.0	**Painting**						
5.1	Final Painting (as applicable)	• Painting Scheme • Visual Check • Final DFT Check	Random	Supplier Test Records	-	H	-
6.0	**Documentation & IC**						

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SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/ TPIA
6.1	Stamping and review of Inspection documents, issue of IC	• Review of documents for compliance as per PR	100%	IC	-	H	H
6.2	Review of final documentation of supplier	• Completion of documents as per VDR attached with PR	100%	Dossier/ Completion certificate	-	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. 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)
2. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred there in /Job Specification /Approved Documents.
3. For EPC jobs, all inspection shall be carried out by TPIA, unless notified otherwise.

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निरीक्षण व परीक्षण योजना

INSPECTION AND TEST PLAN
FOR
ELECTRIC HOIST

Rev. No.	Date	Purpose	Prepared by	Checked by	Convenor Standards Committee	Chairman Standards Bureau
					Approved by	
2	15.05.2020	REVISED AND RE-ISSUED	SK	CS	RKS	SKS
1.	20.11.13	REVISED AND RE-ISSUED	TKK	RKS	SCG	SC
0	22.03.12	Issued for Implementation	AM	SCG	AKC	DM

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Abbreviations:

BIS	:	Bureau of Indian Standards	MTC	:	Material Test Certificate
CEIL	:	Certification Engineers International Limited	MRT	:	Mechanical Run Test
CIMFR	:	Central Institute of Mining & Fuel Research	NDT	:	Non Destructive Testing
CE	:	Carbon Equivalent	NPSH	:	Net Positive Suction Head
DFT	:	Dry Film Thickness	PO	:	Purchase Order
DPT	:	Dye Penetrant Testing	PESO	:	Petroleum Explosive Safety Organization
DHT	:	De-hydrogen Heat Treatment	PQR	:	Procedure Qualification Record
ERTL	:	Electronics Regional Test Laboratory	PR	:	Purchase Requisition
FCRI	:	Fluid Control Research Institute	PMI	:	Positive Material Identification
HT	:	Heat Treatment	RT	:	Radiography Testing
HIC	:	Hydrogen Induced Cracking	SSCC	:	Sulphide Stress Corrosion Cracking
ITP	:	Inspection and Test Plan	TC	:	Test Certificate
IP	:	Ingress Protection	TPI or TPIA	:	Third Party Inspection Agency
IHT	:	Intermediate Heat Treatment	UT	:	Ultrasonic Testing
IC	:	Inspection Certificate	VDR	:	Vendor Data Requirement
IGC	:	Inter Granular Corrosion	WPS	:	Welding Procedure Specification
MPT/MT	:	Magnetic Particle Testing	WPQ	:	Welders Performance Qualification

Inspection Standards Committee

Convenor: Mr. R.K. Singh

Members:

Mr. Rajesh Sinha
Mr. Chandrashekhar
Mr. Mahendra Mittal
Mr. Himangshu Pal
Mr. Avdhesh Agrawal
Mr. R. Muthuramalingam (RPO Representative)
Mr. Shishupal Choudhary (Engg. Representative)

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1.0 SCOPE

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

2.0 REFERENCE DOCUMENTS

PO/PR/ Standards referred there in/ 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	Load Test and NDT Procedure, as applicable	Documented Procedure	100%	Procedure Documents	-	H	R
1.2	WPS/PQR/WPQ	Documented Procedure	100%	Procedure Documents	-	H	R
2.0	**Material Procurement**						
2.1	Gears, Pinions, Wheels, Bearings, Plates for Drums & Trolley etc.	• Visual Inspection • Mechanical Properties • Chemical Properties	100%	Material Test Certificates / Lab Test Reports	H	R	-
2.2	Bought Out Components • Wire Rope • Hook	• Visual & Dimensional • Mechanical Properties • Chemical Properties • Proof Load Test • Sub Supplier Certification	100%	Sub Supplier Test Certificates	H	H	R
2.3	Motor	• Routine & Type Test	100%	Manufacturer Test Certificates	H	W	R

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SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/ TPIA
2.4	Control Panel and Pendant Wiring, Input / Output sequence operations	• Visual & Dimensional • Component Layout arrangement • High Voltage & Insulation Resistance Test • Wiring Colour code, size, insulation, ferruling & continuity check • Functional check for all shut down & interlock system by simulation • Earthing arrangement check	100%	Inspection Record	H	W	R
2.5	Other Electrical Components (Brakes, Limit Switches, Push Button Pendant Switches etc.)	• Visual & Dimensional • Performance Test	100%	Manufacturer Test Certificate, Inspection Record	H	W	R
3.0	**In Process Inspection**						
3.1	Fabrication	Set up, Welding, NDT , Assembly	100%	Inspection Report	-	H	-
4.0	**Final Inspection**						
4.1	Final Inspection	• Visual Inspection • Dimensional Inspection • Alignment & completeness • Load/Overload Test • Hoisting • Travel Speed & Current measurement • Stamping	100%	Inspection Record	-	H	H
5.0	**Painting**						

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SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/ TPIA
5.1	Final Painting (as applicable)	• Painting Scheme • Visual Check • Final DFT Check	Random	Painting Report	-	H	-
6.0	**Documentation & IC**						
6.1	Submission of Certificates (as applicable)	• Certificate of Statutory testing agency for suitability of area classification • Certificate of Statutory approval authority like PESO • Valid BIS License • Degree of protection certificate	Each Model	Certificates from Statutory Bodies	R	R	R
6.2	Documentation & Inspection Certificate(IC)	Compilation of Inspection and test records & Issue of IC	100%	Inspection Certificate	-	H	H
6.3	Final documentation	Compilation of Inspection & test records Data Requirements	100%	Final dossier / Completeness certificate	-	W	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. 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)
2. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred there in /Job Specification /Approved Documents.
3. For EPC jobs, all inspection shall be carried out by TPIA, unless notified otherwise.

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निरीक्षण व परीक्षण योजना

INSPECTION AND TEST PLAN
FOR
PIPING SPOOLS

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
1	14.12.2020	REVISED & RE-ISSUED	SK	CS	RKS	SM
0.	02.07.2015	ISSUED FOR IMPLEMENTATION	TKK	RKS	RKM	SC

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Abbreviations:

AS/CS/SS	:	Alloy Steel/ Carbon Steel/ Stainless Steel	PAUT	:	Phased Array Ultrasonic Testing
ANSI	:	American National Standards Institute	PO	:	Purchase Order
ASTM	:	American Society for Testing & Materials	PESO	:	Petroleum Explosive Safety Organization
DFT	:	Dry Film Thickness	PMI	:	Positive Material Identification
DPT /PT	:	Dye Penetrant Testing	PQR	:	Procedure Qualification Record
EIL	:	Engineers India Limited	PR	:	Purchase Requisition
EN	:	European Standard	PWHT	:	Post Weld Heat Treatment
EPC	:	Engineering, Procurement & Construction	RF Pad	:	Reinforcement Pad
HAZ	:	Heat Affected Zone	RT	:	Radiography Testing
HT	:	Heat Treatment	SSCC	:	Sulphide Stress Corrosion Cracking
ITP	:	Inspection and Test Plan	TC	:	Test Certificate
IC	:	Inspection Certificate	TPI or TPIA	:	Third Party Inspection Agency
IGC	:	Inter Granular Corrosion	TOFD	:	Time of Flight Diffraction
MPT/MT	:	Magnetic Particle Testing	UT	:	Ultrasonic Testing
MTC	:	Material Test Certificate	VDR	:	Vendor Data Requirement
MRT	:	Mechanical Run Test	WPS	:	Welding Procedure Specification
NDT	:	Non Destructive Testing	WPQ	:	Welders Performance Qualification
NPSH	:	Net Positive Suction Head			

Inspection Standards Committee

Convenor : Mr. R.K. Singh

Members:

Mr. Rajesh Sinha	Mr. Himangshu Pal	Mr. R. Muthuramalingam (RPO Representative)
Mr . Chandrashekhar	Mr. Avdhesh Agrawal	Ms. Sulakshna Hundekari (Engg. Representative)
Mr. Mahendra Mittal		

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1.0 SCOPE

This Inspection and Test Plan covers the minimum Inspection and testing for requirements Piping Spools.

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	Heat Treatment, NDT, Pressure test, PMI, Painting procedures etc. (as applicable)	Documented Procedures	100%	Procedure Documents	-	H	R
1.2	Weld Plan and NDT Plan	As per PR/ Purchase Specification/ Applicable codes	100%	Procedure documents	-	H	R – CS A-AS/SS/ CLAD
1.3	WPS, PQR & WPQ	Welding Parameters & Qualification	100%	WPS, PQR & WPQ	-	H	W- New R- Existing

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
2.0	**Material Procurement**						
2.1	Procurement of Materials Pipes, Fittings, Flanges, Valves, Hot induction bends etc. as required [NOTE- 1]	Chemical Properties, Mechanical properties, NDT, Heat treatment, IGC test, Impact test, Hardness test and other applicable tests as per material specification and purchase specification	100%	Mill test certificate, Supplier's Inspection Report	H	H	R
3.0	**In Process Inspection**						
3.1	Identification of materials & Transfer of marking	Verification of markings, correlation with manufacturer test certificates & Transfer of Heat number in individual pieces.	100%	Inspection Reports	-	H	H
3.2	Set-up of butt weld connections & Welding	Alignment, root gap, weld edge preparation, NDT & Welding Parameters	100%	Inspection Reports	-	H	-
3.3	Set-up and welding of Branch connections	Alignment, root gap, weld edge preparation, NDT & welding parameters	100%	Inspection Reports	-	H	RW

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
3.4	Pneumatic test of RF pad (as applicable)	Leak check	100%	Inspection Report	-	H	R
3.5	Ferrite Check of SS Welds (If applicable)	% Ferrite Check	100%	Inspection Report	-	H	RW
3.6	Radiographic Test (RT) before PWHT as Applicable	Welding Imperfections	As per PR/Purchase Specification	RT Reports	-	H	R (Review of RT Films)
3.7	Heat Treatment	Stress Relieving, Normalizing, Tempering, Solution Annealing, Stabilization Heat Treatment etc. (as applicable)	100%	HT chart / Report	-	H	R
3.8	Hardness check (as applicable)	Hardness for weld /HAZ, as applicable	As per spec.	Inspection report		H	RW
3.9	Radiographic Test (RT) after PWHT, as applicable	Welding Imperfections	As per PR/Purchase Specification	RT Reports	-	H	R (Review of Films)
3.10	Other NDT (UT, PT & MT as applicable)	Imperfections	As per PR/Purchase Specification	Test Report	-	H	R- for CS RW – for SS/AS
3.11	TOFD/PAUT (As applicable)	Imperfections	As per PR/Purchase Specification	Test Report	-	H	W

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.0	**Final Inspection**						
4.1	Visual and Dimension	Dimensions, Welding quality, Surface quality, root penetration, Marking, verification of match marking for site joints.	100%	Inspection Report	-	H	RW
4.2	Pressure Test (If applicable)	Leak Check	100%	Test Report	-	H	H
4.3	PMI Check for AS and SS spools	Chemical Check of base materials and welding	100%	Inspection report	-	H	RW
4.4	Final Stamping	Stamping of Accepted spools	Stamping of spools which are witnessed by EIL/TPIA. Other spools to have suppliers identification	Inspection Report	-	H	H
5.0	**Dispatch Preparation**						
5.1	Surface Preparation for painting	Visual, surface roughness & texture, cleanliness, dust level etc.	As per PR/Purchase Specification	Inspection Report	-	H	R
5.2	Painting & Color Coding (As applicable)	Visual, DFT Check & Color Coding check	100%	Inspection Report	-	H	R

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
5.3	Pickling/ passivation of SS spools, (as applicable)	Visual inspection for cleanliness	100%	Inspection report	-	W	R
5.4	Nitrogen Filling (if applicable)	Corrosion protection	100%	Inspection Report		H	R
5.5	Packing	Packing as per specification requirement	100%	Inspection Report		H	-
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: A-Approval, H- Hold (Do not proceed without approval), P-Perform, RW - Random Witness (As specified or 10% (minimum1 no. of each size and type of spool item), R-Review, W-Witness (Give due notice, work may proceed after scheduled date).

NOTES (As applicable):

1. All materials to be procured from EIL approved suppliers/ stockist under EN 10204 Type 3.2 certification. For Non NACE & Non Hydrogen service, following items shall be procured with EN 10204 type 3.1 certification.

Items	Dimensions	Material
Seamless Pipes	Size Upto 12"	Carbon Steel
Seamless Fittings	Size upto 14" and Socket welded fittings of all sizes	Carbon Steel
Flanges	Size Upto 24" 300 – ANSI Class & Socket Welded Flanges of all rating.	Carbon Steel
Valves	Size Upto 12" – 300 ANSI Class & All Forged Valves with socket welded ends upto 1500 ANSI Class (other than Jacketed Valves)	Carbon Steel

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Fasteners	All sizes	All material except Fasteners as per ASTM A453
Gaskets	All sizes	All material

All other pressure containing materials which are not covered above shall be procured with EN10204 type 3.2 certification. Inspection of Hot induction bends shall be carried out as per EIL Std ITP no. 6-81-0088.

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.
4. For EPC jobs, all inspection shall be carried out by TPIA, unless notified otherwise.

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ऐजीटेटर / मिक्सर के लिए
निरीक्षण और परीक्षण योजना

INSPECTION AND TEST PLAN
FOR
AGITATOR / MIXERS

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
0	30-03-2021	Issued for Implementation	AA	CS	RKS	S Mazumdar

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Abbreviations

AS/CS/SS	:	Alloy Steel/Carbon steel/Stainless steel	NDT	:	Non Destructive Testing
DT	:	Destructive Testing	PESO	:	Petroleum Explosive Safety Organization
HT	:	Heat Treatment	PO	:	Purchase Order
IC	:	Inspection Certification	PQR	:	Procedure Qualification Record
IGC	:	Inter Granular Corrosion	PR	:	Purchase Requisition
ITP	:	Inspection and Test Plan	TC	:	Test Certificate
MPT/MT	:	Magnetic Particle Testing	TPI or TPIA	:	Third Party Inspection Agency
MTC	:	Material Test Certificate	UT	:	Ultrasonic Testing

Inspection Standards Committee

Convenor : Mr. R K Singh

Members:

Mr. Rajesh Sinha
Mr. Chandrashekhar
Mr. Mahendra Mittal
Mr. Himangshu Pal
Mr. Avdhesh Agrawal
Mr. R. Muthuramalingam (RPO Representative)
Mr. P V Satyanarayana (Engg. Representative)

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1.0 SCOPE

This Inspection Test Plan covers the minimum testing requirements for Mechanical Top / Side / Bottom entry and Swivel Joint Agitators & Mixers (Liquid Jet mixers are excluded).

2.0 REFERENCE DOCUMENTS

PO / PR / Standards referred there in/ Job specifications /Approved Agitator / Mixer data sheet /Assembly drawings/Motor/Instruments Data Sheet

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	WPS, PQR and WPQ	As per PR, ASME, Standards & Specifications.	100%	WPS/PQR/WPQ	--	H	R – Old W – New
1.2	MRT procedure, Balancing, NDT Surface preparation / Painting	Procedures	100%	Procedure	--	H	R
2.0	**Material Inspection**						
2.1	Material Identification/ Review of Test certificates of critical components & bought out items (Wetted Parts) a. Top Shaft b. Bottom Shaft / Agitator Shaft c. Impeller/ Propeller Blades d. Impeller Boss / Liner	Mechanical Component: As per material specification Chemical, Mechanical, Visual, Dimensional, Special requirements Heat Treatment, Micro test, Hardness, IGC-Practice-E, UT, Impact (as applicable)	100%	Manufacturer's Test Certificate, Inspection Records/Reports	H	W/R	R

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SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/ TPIA
2.2	Bought out and electrical / Instrumentation Items a. Coupling b. Stuffing Box c. Gear Box d. Driver Motor e. Instruments f. Bearings g. Mounting Assembly	As per drawings/ PR.	100%	Material Test Certificate	-	R	R
3.0	**In Process Inspection**						
3.1	Visual, Dimensional check, Correlation of Bought out components	Visual, Dimensional check	100%	Inspection Report	--	H	R
3.2	Balancing of shaft and blades.	Allowable Residual unbalance	100%	Test Report	P	H	R
3.3	Gear Box	Testing - Torque/Kw, Temperature rise and efficiency as per approved data sheet	100%	Test Report	P	R	R
3.4	Coupling	As per approved data sheet/API 671,Torque and Balancing	100%	Test Report	P	R	R
3.5	Stuffing Box	As per approved data sheet/manufacturer's standard	100%	Test Report	P	R	R
3.6	Bearings	As per approved data sheet/manufacturer's standard	100%	Test Report	P	R	R
3.7	Motor Refer Note	As per PR, Datasheets /Approved drgs, relevant IS / NEMA standards	100%	Routine Test Cert./ Test reports	P	H	R

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SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/ TPIA
3.8	Instruments Pressure Transmitters, Level Transmitter, Pressure Switch, Level Switch, Pressure gauge, temperature Gauge, Vibration switches etc	As per approved IDS	100%	Calibration reports and Test Reports, Statutory certifications as applicable	P	H	R
3.9	Seal Cooling Plan (If applicable)	As per PR, Datasheets /Approved drgs.	100%	Test Report	P	H	W / R
3.10	Pressure test of seals.	Approved Datasheet / Drawing / Mfg Std.	100%	Test Report	P	H	R
3.12	Assembly and wiring	Balancing of shaft along with impeller / propeller. Overall dimension / wiring schematic as per approved Drg / SLD	100%	Inspection Report	--	H	R

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SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/ TPIA
4.0	**Final Inspection**						
4.1	a. Visual b. Dimension c. MRT (Load / No-load (Air) test min 4 Hrs) MRT with water if applicable MRT with both (air & water) if specified in contract i. Measurement of Current and Power ii. Swivel angle / rotation check in case of swivel joint agitator / mixer iii. Vibration / Noise Levels iv. Temperature rise of Motor / Gear box / Bearings. v. Overall Dimension vi. Direction of Rotation vii. Output RPM viii. Installation inside the vessel, uniform clearances check between blade tip and vessel ID & shaft deflection shall be measured. ix. Job mechanical seals and seal cooling plan shall be used during MRT d. PMI check where applicable	Suitability / Mechanical integrity as per PR, Datasheets /Approved drgs.	100%	Inspection Report	--	H	H

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SL. NO.	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/ TPIA
4.2	Mandatory and Commissioning Spare Verification	Approved Datasheet / Drawing / Mfg Std./Approved Spare List	100%	Suitability Certificate	--	H	W/R
5.0	**Painting**						
5.1	Surface Preparation & Painting	• Painting Scheme • Visual Check • Final DFT Check	Random	Painting Report	-	H	R
6.0	**Documentation & Issue of Inspection Release Note**						
6.1	Stamping and review of inspection documents, issue of IRN	Review of documents for compliance as per PR.	100%	IRN	-	-	H
6.2	Review of final documentation of supplier	Compilation of documents as per VDR attached with PR.	100%	Dossier / Completion certificate	-	H	H

Legend: H- Hold (Do not proceed without approval), P-Perform, Random -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), A-Approve

NOTES (As applicable):

1. Wherever W/R or H/W is indicated, Inspection Engineer shall decide the option to be exercised for the particular stage and supplier
2. Supplier's inhouse procedures may be accepted in case TPI/EIL is satisfied with adequacy of procedures to comply with Purchase Order/Specifications requirements, in case of non availability of suitable procedures fresh procedures may be qualified under TPI/EIL witness.
3. In case of conflict between purchase specification, contract documents and ITP more stringent conditions shall be applicable.
4. This document describes generally the requirements pertaining to all types of the item. Requirements specific to PO and the item are only applicable.
5. In case VFD is required, combined test of motor and VFD is to be performed.
6. For EPC jobs, all inspection shall be carried out by TPIA, unless notified otherwise.

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डोसिंग पैकेज के लिये
निरीक्षण व परीक्षण योजना

INSPECTION AND TEST PLAN
FOR DOSING PACKAGE

Rev. No.	Date	Purpose	Prepared by	Checked by	Convener Standards Committee	Chairman Standards Bureau
					Approved by	
0	26.10.2023	ISSUED FOR IMPLEMENTATION	SK	RMR	RK	MN

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Abbreviations:

CEIL	:	Certification Engineers International Limited	MRT	:	Mechanical Run Test
CIMFR	:	Central Institute of Mining & Fuel Research	NDT	:	Non Destructive Testing
CE	:	Carbon Equivalent	NPSH	:	Net Positive Suction Head
DFT	:	Dry Film Thickness	PO	:	Purchase Order
DPT	:	Dye Penetrant Testing	PESO	:	Petroleum Explosive Safety Organization
DHT	:	De-hydrogen Heat Treatment	PQR	:	Procedure Qualification Record
ERTL	:	Electronics Regional Test Laboratory	PR	:	Purchase Requisition
FCRI	:	Fluid Control Research Institute	PMI	:	Positive Material Identification
HT	:	Heat Treatment	RT	:	Radiography Testing
HIC	:	Hydrogen Induced Cracking	SSCC	:	Sulphide Stress Corrosion Cracking
ITP	:	Inspection and Test Plan	TC	:	Test Certificate
IP	:	Ingress Protection	TPI or TPIA	:	Third Party Inspection Agency
IHT	:	Intermediate Heat Treatment	UT	:	Ultrasonic Testing
IC	:	Inspection Certificate	VDR	:	Vendor Data Requirement
IGC	:	Inter Granular Corrosion	WPS	:	Welding Procedure Specification
MPT/MT	:	Magnetic Particle Testing	WPQ	:	Welders Performance Qualification
MTC	:	Material Test Certificate			

Inspection Standards Committee

Convenor : Mr. Rajeev Kumar

Members:

Mr. Rajesh Sinha	Mr. Himangshu Pal	Mr. Chandrashekhar	Mr.Avdhesh Agrawal
Mr. Mahendra Mittal	Mr.RMuthuramalingam (RPO Representative)	Mr.Tarun Kumar / Mr.Mahesh Gupta, Eqpt Div	

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1.0 SCOPE:

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

2.0 REFERENCE DOCUMENTS:

PO/PR/ Standards referred there in/ Job specifications /Approved documents.

3.0 INPECTION AND TEST REQUIREMENTS:

SL. NO	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	**Procedures/Documents**						
1.1	Hydro test , Functional Test Procedures, MRT/Performance test, NPSH Test, NDT as applicable, Heat Treatment as applicable, Dynamic Balancing Test of Impeller/ Rotor Assembly	Documented Procedures	100%	Procedures	-	H	R
1.2	WPS, PQR,WPQ - 1. Qualification for Overlay 2. Repair welding procedures 3. Wear ring hardness 4. Impact Test requirements	Welding procedures, hardness qualifications, Welder Parameters	100%	WPS/PQR/ WPQ Records	-	H	W- New, R – Existing (Note-7)
1.3	Pre Inspection meeting	Verification of technical requirements as per PR/contract	100%	MOM	-	H	R
2.0	Tanks/ Pressure Vessels						

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SL. NO	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
2.1	**Raw Material**						
2.1.1	Plate	Chemical Properties/ Physical Properties, IGC, Micro structure, conformity of materials, Hardness check	1/Plate/HT batch	MTC/Lab TC	P	H	H
2.1.2	Pipe for Nozzle	Chemical Properties/ Physical Properties, IGC, Micro structure	1/size/HT batch	MTC/Lab TC	P	H	R
2.2	In Process						
2.2.1	Dished Ends	Dimensions, surface defects on welding, NDT	100%	MTC/Lab TC/NDT reports	P	H	R
2.2.2	Welding	Visual Inspection of welds, NDT, Hardness check	100%	MTC & Inspection / Test Records	P	H	R
2.2.3	Visual & dimension	Measurements as per approved drgs & documents	100%	Inspection report	P	H	W
2.2.4	Hydrostatic Test	Leakage, Pressure drop	100%	MTC/Inspection report	P	H	W
3.0	**Stirrer / Mixer /Agitator**	Make,Model, Type, Dimensions, Visual & Painting, Mechanical seal check	100%	Verification as per datasheets & drgs	P	H	-
3.1	Raw Material for Shaft	Chemical Properties/ Physical Properties, IGC, Micro structure	1/bar	MTC/Lab TC/NDT reports	P	H	R

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SL. NO	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
3.2	Impeller	Chemical Properties/ Physical Properties, IGC	1/plate	MTC/Lab TC/NDT reports	P	H	R
3.3	Rotor Balancing	Static balancing, dynamic balancing, Visual & measurement	100%	MTC/Report	P	H	R
3.4	Complete Stirrer/ Mixer/ Agitator with Motor	Performance test in water/Air ,Vibration, Temp rise, Noise, Wobbling	100%	MTC	P	H	W
4.0	**Motors**						
4.1	Motor / VFD (As applicable) *(supplier/sub supplier to arrange TPIA certification)	1) Type test/Routine test of Motor . 2) MTC review , Degree of protection 3) PESO /CCEO certificate review 4) Other test requirement as per purchase specification / Approved Documents 5) Statutory certificate	100%	MTC & Inspection Report	H	H*	W (Note-3)
4.2	Combined testing of motor & VFD (As applicable) *(supplier/sub supplier to arrange TPIA certification)	Routine Test & Type Test, PESO/CCEO requirement , Statutory certificate	100%	MTC & Inspection / Test Records	H	H	W (Note-3)
5.0	**Metering Pump/ Dosing Pump/Unloading Pump**	Make, Model, Type, Dimensions, Visual & Painting	100%	Verification as per datasheets & drgs	P	H	-
5.1	Material-Pump Body	Chemical Properties/ Physical Properties	100%	MTC/Lab reports	P	H	R

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SL. NO	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
5.2	Wetted Parts	Chemical Properties/ Physical Properties	1/bar	MTC/Lab reports	P	H	R
		Surface Test – NDT for Shafts/Bars	100%	MTC	P	H	R
5.3	Hydrostatic Pressure test	Leakage, Pressure drop	100%	MTC/Inspection report	P	H	W
5.4	Final Inspection						
5.4.1	Pump with Motor 4 hrs Performance &MRT	Cap/Stroke ,Accuracy, Repeatability, Power/BKW @100% stroke, Leakage, dimensions, Noise, Vibration, Temp rise	100%	Inspection report	P	H	H
5.4.2	Visual & Dimension check	Measurement as per approved drgs	100%	Inspection report	P	H	H
5.4.3	Calibration Pot/Graduated cylinder	Visual & measurement check as per approved drgs	100%	Inspection report	P	H	H
6.0	**Pulsation Dampeners**						
6.1	Material Certificates-Plates	Chemical, Mechanical, IGC, Impact,bend. NDT					
6.2	Pipe for Nozzle	Chemical Properties/ Physical Properties, IGC, Micro structure	1/size/HT batch	MTC/Lab TC	P	H	R
6.3	In Process						
6.4	Dished Ends	Dimensions, surface defects on welding, NDT	100%	MTC/Lab TC/NDT reports	P	H	R

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SL. NO	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
6.5	Visual & dimension	Measurements as per approved drgs & documents	100%	Inspection report	P	H	W
6.6	Hydrostatic Test	Leakage, Pressure drop	100%	MTC/Inspection report	P	H	W
7.0	**Pressure Relief Valve**	Set & Reset Pressure ,Dimension ,Leakage during performance test	100%	MTC	P	H	R
7.1	PRV-check	Verification of make, model, type, visual & painting	100%	Verification as per datasheets & drgs	P	H	-
7.2	Raw Material- Casing/Body	Chemical Properties/ Physical Properties					
7.3	Visual & Dimension check	Measurement as per approved drgs	100%	Inspection report	P	H	H
7.4	Hydrostatic Pressure test	Leakage, Pressure drop	100%	Inspection report	P	R	W
7.5	Functional test	Check of Set & Reset Pressure	100%	Inspection report	P	R	W
7.6	PMI test for SS/AS/CS	Grade Confirmation	100%	MTC/Inspection reports	P	W	W
8.0	**Valve(Gate/Globe/Check/Ball)**						
8.1	Raw Material						
8.2	Body , Bonnet Cover	Chemical Properties/ Physical Properties, HT	1/Heat /Batch	MTC/Lab reports	P	H	R
8.3	Trim Material	Chemical Properties/ Physical Properties	1/bar/size	MTC/Lab reports	P	H	R

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SL. NO	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
8.4	Assembly	Leakage (Body/seat) –Hydro test	100%	MTC/Lab reports	P	H	R
		Leakage (seat)-Pneumatic	100%	MTC/Lab reports	P	H	R
		Dimension	100%	MTC/Lab reports	P	H	R
8.5	PMI test for SS/AS/CS	Grade Confirmation	100%	MTC/Inspection reports	P	W	W
9.0	**Fittings/Flanges**						
9.1	Raw Material	Chemical Properties/ Physical Properties/HT /IGC test	100%	MTC/Lab reports	P	H	R
10.0	**Strainers/Air dryer/ Air filter**						
10.1	Raw Material for body	Chemical Properties/ Physical Properties	1/Heat/Bar/Size	MTC/Lab reports	P	H	R
10.2	Screen/Cartilage candle/ Sieves	Chemical /Mesh Size	1/Size	MTC/Lab reports	P	H	R
10.3	Final Dimensions	Dimensions	100%	MTC/Inspection reports	P	H	R
10.4	Pressure Testing	Leakage	100%	MTC/Inspection reports	P	H	R
11.0	**Pipes**						
11.1	Material	Chemical, Mechanical Test, Micro Structure , IGC Test	1/HT Batch/Size	MTC	P	H	R

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SL. NO	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
11.2	Pressure testing	Hydro test –Leakage Test	100%	MTC/Inspection reports	P	H	R
12.0	**Instrument (LG/PG/LT/PT/DPG/DPT)**	Verification of make, model, type, visual & painting	100%	Verification as per datasheets & drgs	P	H	-
12.1	Raw Material for wetted parts	Chemical properties	1/HT Batch	MTC	P	H	R
12.2	Final Inspection	Dimension	100%	MTC/Inspection reports	P	H	R
12.3	Testing	Accuracy , Calibration	100%	MTC/Inspection reports	P	H	R
12.4	Certification	Degree of Protection	100%	MTC/Inspection reports	P	H	R
12.5	Job Instruments (as applicable)	Compliance to PR requirements	100%	MTC & Statutory certification	H	H	R
13.0	**Control Panel**	Dimensions	100%	MTC/Inspection reports	P	H	R
	Testing	Continuity , IR-HV-IR	100%	MTC/Inspection reports	P	H	R
		Verification of make	100%	MTC/Inspection reports	P	H	R
		Rating of components	100%	MTC/Inspection reports	P	H	R
		Paint shades, Thickness	100%	MTC/Inspection reports	P	H	R

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SL. NO	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
		Adhesion	100%	MTC/Inspection reports	P	H	R
		Degree of Protection	100%	MTC/Inspection reports	P	H	R
13.7	LCP/UCP (As applicable) *(supplier/sub supplier to arrange TPIA certification)	Inspection & Functional test of LCP / UCP	100%	MTC & Inspection Report	H	H	W (Note-5)
14.0	**Junction Box**	Verification of make, model, type, visual & painting	100%	Verification as per datasheets & drgs	P	H	-
		Certificates/ Statutory certification	100%	MTC/Inspection reports	P	H	R
15.0	**Complete Skid Assembly**	Dimensions & Orientation	100%	MTC/Inspection reports	P	W	W
		Leakage, Check on weldments, Hardness check	100%	MTC/Inspection reports	P	W	W
		Cleanliness/Functional test /Operation check for 4 hrs run with check for Interlocks	100%	MTC/Inspection reports	P	W	W
		Leakage in tank (Hydro test/Pneumatic leak test)	100%	MTC/Inspection reports	P	W	W
15.1	PMI test for SS/AS/CS	Grade Confirmation	100%	MTC/Inspection reports	P	W	W
15.2	Testing and Measuring Instruments	Validity of calibration & accuracy	100%	Calibration Report	W	H	R

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SL. NO	STAGE/ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
15.3	Final skid Assembly & Spares verification	Visual and Nozzle dimensions including foundation dimensions of base frame, Battery Limits Check, Overall skid completeness check, PID & Tagging check.	100%	Inspection Report	-	H	W
16.0	**Painting**						
16.1	Surface Preparation & Painting of all Carbon Steel Parts of skid & associated parts (As applicable)	Visual Inspection for Workmanship, Paint Scheme, Paint Shade, Visual & Paint thickness check	100%	Inspection Report	-	H	R
16.2	Pickling & Passivation of Stainless Steel Parts (as applicable)	Visual Inspection for Workmanship	100%	Inspection Report	---	H	R
16.3	Packing & Preservation	Visual Inspection for Workmanship	100%	Inspection Report	---	H	-
17.0	**Documentation & IC**						
17.1	Stamping and review of inspection documents, issue of IC	Review of documents for compliance as per PR	100%	Inspection Certificate(IC)	-	-	H
17.2	Review of final documentation of supplier	Compilation of documents as per VDR attached with PR.	100%	Dossier / Completeness on certificate	-	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. 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)
2. Acceptance Norms for all the activities shall be as per PO/PR/STANDARDS referred there in /Job Specification /Approved Documents.

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3. Inspection Test Requirements of Motors shall be as per EIL ITP 6-81-1031 (HV Motors), 6-81-1064 (MV Motors), 6-81-1038 (MV VFDs) & 6-81-1050 (HV VFD).
4. Separate QAP/ITP of bought out items like Motor/ VFD, LCP / UCP shall be submitted for approval of TPI/EIL.
5. Vibration limits, Noise & temperature rise shall be as per job specification /approved datasheet.
6. Bought out items to be procured from EIL/Client approved suppliers
7. WPS/PQR/WPQ Shall be qualified & certified by a reputed TPIA.
8. For EPC jobs, all inspection shall be carried out by TPIA, unless notified otherwise.

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अग्निरोधक नियंत्रण स्टेशनों के लिए निरीक्षण एवं परीक्षण योजना

INSPECTION AND TEST PLAN FOR FLAMEPROOF CONTROL STATIONS

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
5.	28.08.2024	Revised and Reissued	RP	GS	RK	MN
4.	14.01.2020	Revised and Reissued	MM	RS	RKS	RKT
3.	21.11.2013	Revised and Reissued	MJ	RS	SCG	SC
2	29.06.2012	Revised and Reissued	AB	HVJ	AKC	DM
1	28.09.2007	Revised and Re-issued	AKG	PPM	MVKK	VC
0	30.04.2002	Issued for implementation	RG	AKC	AKB	GRR

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Abbreviations

BIS	:	Bureau of Indian Standard
CIMFR	:	Central Institute of Mining & Fuel Research
DFT	:	Dry Film Thickness
ERTL	:	Electronics Regional Test Laboratory
FM	:	Factory Mutual
FLP	:	Flame Proof
IL	:	Indicating Lamps
ITP	:	Inspection and Test Plan
IP	:	Ingress Protection
IC	:	Inspection Certification
IS	:	Indian Standard
IEC	:	International Electro technical Commission
JEC	:	Japanese Electro technical Committee
MTC	:	Material Test Certificate
NEMA	:	National Electrical Manufacturers Association
PB	:	Push Button
PO	:	Purchase Order
PESO	:	Petroleum Explosive Safety Organization
PR	:	Purchase Requisition
PVC	:	Poly Vinyl Chloride
QC	:	Quality Control
TC	:	Test Certificate
TPI or TPIA	:	Third Party Inspection Agency
VDR	:	Vendor Data Requirement
XLPE	:	Cross Linked Poly Ethylene

Inspection Standards Committee

Convenor : Mr. R K Singh

Members:

Mr. G Suresh	Mr. Himangshu Pal	Mr. Chandrashekhar	Mr. R Muthu Ramalingam
Mr. Mahendra Mittal	Mr. Avdesh Agrawal	Mr. Anil Kumar	Mr. Arvind NP Singh (Engg)

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1.0 SCOPE

This Inspection and Test Plan covers the minimum testing requirements of Flameproof Control Stations.

2.0 REFERENCE DOCUMENTS

PO/PR/ Standards referred there in/Job specifications/Approved documents/Relevant IS/IEC Standards.

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	**Procedures**	--	--	--	--	--	--
2.0	**Material Inspection**						
2.1	Incoming material like castings, glass, meters, PBs, ILs, Fasteners etc	Visual, Dimensional, Chemical, Physical and Operational checks, (as applicable)	100%	MTC / Lab test records	H	H	R
3.0	**In process Inspection**						
3.1	Machining, Joints, Sealing methods	As per Test Lab Certified Drawings for Hazardous Area Applications	100%	Test Certificates	-	H	-
3.2	Assembly and Wiring Checks	Visual, Dimensional, Bill of Material, Rating of Components, Tightness of wiring terminations, Size, Type (FR/FRLS), continuity, color coding.	100%	Test Certificates	-	H	-

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
3.3	Flameproof enclosure without components	Routine Over-Pressure test	100%	Test Certificates	-	H	R
4.0	**Final Inspection**						
4.1	Flameproof Control Station (Routine tests)	• Visual/Dimensional/BOM Checks • Nameplate and Tag Number checks • Adherence of panels to Hazardous Area Certification conditions including Flame Path, Flame Gap, Thread Check, Thickness of Enclosure, No. of Cable Entries, Rating of mounted components, Maximum number of door/ cover mounted components, Joints, Sealing etc. • Wiring Checks/Electrical/ Functional Checks • High voltage test • IR test before and after High voltage Test • Paint Shade, Thickness and Adhesion check.	100% by Supplier 10% by EIL/TPIA	Test Records / Inspection Witness Record	-	H	H
4.2	Submission of Certificates & Documents	• Test Certificate of testing agency (CIMFR/ KLPL etc) for suitability of model to intended Hazardous area classification as per latest IS/IEC standards. • Certificate of Statutory authority (PESO). • Valid BIS License.	For each Type/Model	Certificates from test agencies	-	H	R

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
5.0	**Painting**						
5.1	Painting and Packing	• Visual checks for compliance to Painting requirements as per contract. • Suitable protection to prevent entry of foreign material. • Proper packing to prevent any damage during transportation and storage, as per contract.	100%	Packing list / Supplier's Records	-	H	-
6.0	**Documentation and IC**						
6.1	Documentation and IC	• Review of Internal Test Reports & MTC • IC Issuance	100%	Supplier's Test Records / Inspection Certificate	-	H	H

Legends: H- Hold (Do not proceed without approval), Random 10% , R-Review, RW-Random witness, W- Witness (Give due notice, work may proceed after scheduled date).

NOTES :-

1. 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).
2. Acceptance Norms shall be as per PO/PR/ Standards referred there in/ Job specifications /Approved documents/ Hazardous Area certifications.
3. Supplier has to furnish internal test reports before scheduled inspection date.

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अग्निरोधक लाइटिंग एवं पावर पैनलों के लिए निरीक्षण एवं परीक्षण योजना

INSPECTION AND TEST PLAN FOR FLAMEPROOF LIGHTING AND POWER PANELS

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convener	Standards Bureau Chairman
			Approved by			
4.	28.08.2024	Revised and Reissued	RP	GS	RK	MN
3.	14.01.2020	Revised and Reissued	MM	RS	RKS	RKT
2.	21.11.2013	Revised and Reissued	MJ	RS	SCG	SC
1	15.07.2011	Revised and Reissued	GS	SA	AKC	DM
0	07.10.2008	Issued for implementation	SA	SKD	SKP	VC

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Abbreviations

BIS	:	Bureau of Indian Standard	MTC	:	Material Test Certificate
CIMFR	:	Central Institute of Mining & Fuel Research	NEMA	:	National Electrical Manufacturers Association
DFT	:	Dry Film Thickness	PO	:	Purchase Order
ERTL	:	Electronics Regional Test Laboratory	PESO	:	Petroleum Explosive Safety Organization
FM	:	Factory Mutual	PQR	:	Procedure Qualification Record
FLP	:	Flame Proof	PR	:	Purchase Requisition
FRLS	:	Flame retardant low smoke	PVC	:	Poly Vinyl Chloride
ITP	:	Inspection and Test Plan	QC	:	Quality Control
IP	:	Ingress Protection	TC	:	Test Certificate
IS	:	Indian Standard	TPI or TPIA	:	Third Party Inspection Agency
IC	:	Inspection Certification	VDR	:	Vendor Data Requirement
IEC	:	International Electro technical Commission	XLPE	:	Cross Linked Poly Ethylene
JEC	:	Japanese Electro technical Committee			

Inspection Standards Committee

Convenor : Mr. Rajeev Kumar

Members:

Mr. G Suresh	Mr. Himangshu Pal	Mr. Chandrashekhar	Mr. R Muthu Ramalingam
Mr. Mahendra Mittal	Mr. Avdesh Agrawal	Mr. Anil Kumar	Mr. Arvind NP Singh (Engg)

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1.0 SCOPE

This Inspection and Test Plan covers the minimum inspection and testing requirements for Flameproof Lighting And Power panels.

2.0 REFERENCE DOCUMENTS

PO/PR / Standards referred there in /Job specifications / Approved documents/Relevant IS/IEC Standards.

3.0 INSPECTION AND TEST REQUIREMENT:

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	**Procedures**	---	---	---	---	---	---
2.0	**Material Inspection**						
2.1	Incoming Materials like Castings, Glass, Meters, Wires/ Cables, Bus-Bars, Gaskets, Isolators, MCBs, MCCBs, RCCBs, CTs/ PTs etc (As applicable)	Visual, Dimensional, Physical, chemical & functional checks (as applicable)	100%	Material test certificates / Manufacturer's Test records/	H	H	R
3.0	**In process Inspection**						
3.1	Machining, Joints, Sealing methods	As per Test Lab Certified Drawings for Hazardous Area Applications	100%	Test records	-	H	---
3.2	Panel assembly	Visual, Dimensional, Bill of Material, Rating of Components.	100%	Test Records	-	H	---
3.3	Wiring Checks	Size, type (FR/FRLS), make, termination tightness, ferruling, continuity, color coding	100%	Test Records	-	H	----
3.4	Pressure Check	Over Pressure test on individual enclosures as per relevant standard	100%	Test Records	-	H	R

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.0	**Final Inspection**						
4.1	Final Inspection	• Visual and Dimensional check • Adherence of panels to Hazardous Area Certification conditions including Flame Path, Flame Gap, Thread Check, Thickness of Enclosure, No. of Cable Entries, Rating of mounted components, Maximum number of door/ cover mounted components, Joints, Sealing etc. • Bill of material. • Wiring checks • Paint shade, adhesion and thickness. • Verification of mechanical and electrical operations • Dielectric test (High Voltage) • Insulation check before & after High Voltage • Correctness of nameplate • Annunciation/ Indication Checks	100%	Test Records	-	H	H
4.2	Submission of Certificates & Documents	• Test Certificate of testing agency (CIMFR/ KLPL etc) for suitability of model to intended Hazardous area classification as per latest IS/IEC standards. • Certificate of Statutory authority (PESO). • Valid BIS License.	For each Type/Model	Certificates from Test Labs/ Agencies	-	H	R

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
5.0	**Painting**						
5.1	Painting and Packing	• Visual checks for compliance to Painting requirements as per contract. • Suitable protection to prevent entry of foreign material. • Proper packing to prevent any damage during transportation and storage as per contract.	100%	Packing list / Supplier's Records	-	H	-
6.0	**Documentation and IC**						
6.1	Documentation and IC	• Review of Internal Test Reports & MTC • IC Issuance	100%	Supplier's Test Records / Inspection Certificate	-	H	H

Legends: H- Hold (Do not proceed without approval), Random -10%, R-Review, RW-Random witness, W- Witness (Give due notice, work may proceed after scheduled date).

NOTES :-

1. 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).
2. Acceptance Norms for all the activities shall be as per PO/PR/ Standards referred there in/ Job specifications /Approved documents/ Hazardous Area certifications.
3. Supplier has to furnish internal test reports before scheduled inspection date.

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पैकेज उपस्कर के मध्यम वोल्टेज वाले फिक्स किस्म के स्विचबोर्ड के लिए निरीक्षण एवं परीक्षण योजना

INSPECTION AND TEST PLAN FOR MV FIXED TYPE SWITCHBOARD FOR PACKAGE EQUIPMENT

Abbreviations

Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
					Approved by	
3	09.06.2020	Revised and Reissued	SA	RS	RKS	SKS
2	21.11.2013	Revised and Reissued	MJ	RS	SCG	SC
1	29.06.2012	Revised and Reissued	RKP	RJD	AKC	DM
0	01.12.2008	Issued for implementation	SA	SKD	SKP	VC

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BIS	:	Bureau of Indian Standards	MTC	:	Material Test Certificate
EIL	:	Engineers India Limited	MV	:	Medium Voltage
EPC	:	Engineering Procurement Construction	No	:	Number
FLP	:	Flame Proof	PO	:	Purchase Order
HV	:	High Voltage	PR	:	Purchase Requisition
ITP	:	Inspection and Test Plan	QC	:	Quality Control
IC	:	Inspection Certification	TC	:	Test Certificate
IP	:	Ingress Protection	TPI or TPIA	:	Third Party Inspection Agency
IR	:	Insulation Resistance	XLPE	:	Cross Linked Poly Ethylene
Min	:	Minimum			

Inspection Standards Committee

Convenor : Mr. R.K. Singh

Members: Mr. Rajesh Sinha, Mr. Himangshu Pal, Mr. Chandrasekhar, Mrs. Arvind NP Singh (Electrical), Mr. R Muthuramalingam, Mr Avdhesh Agrawal, Mr. Mahendra Mittal

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1.0 SCOPE

This Inspection and Test Plan covers the minimum testing requirements of MV fixed type switchboard for package equipment.

2.0 REFERENCE DOCUMENTS

PO/PR/ Standards referred there in/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	**Procedures**	--	--	--	--	--	--
2.0	**Material Inspection**						
2.1	Incoming Material like Insulators, Bus Bars, Fabricated items, Bus bar sleeves and supports, Instrument Transformers, Relays, Indicating Instruments, Switches, Breakers, Contactors etc.	Visual, Dimensional, operational checks, Manufacturer's test certificates etc. as applicable	100%	Material Test Certificates / Test Records	H	H	R
3.0	**In process Inspection**						
3.1	Switch board assembly	Visual, Dimensions, Bill of Material.	100%	Suppliers Test Records	--	H	-

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
3.2	Wiring checks	Size, termination, ferruling, continuity, Functional checks/ Scheme checking, HV and IR	100%	Suppliers Test Records	--	H	-
4.0	**Final Inspection**						
4.1	Switchgear Assembly	• Physical and Dimensional Verification, Verification of Bill of material. • Checking of the schemes and simulating them. • Operation check/Functional checks. • Power frequency voltage test. • Insulation resistance test before and after the HV test. • Current injection test. • Verification of Safety Features/Electrical and Mechanical Interlocks • Tests on Breakers(if applicable). • Interchangeability of Identical Modules.	100% by Supplier and on Random Basis by EIL/TPIA	Test Records / Inspection Witness Record	-	H	H
4.2	Submission of Cerificates/Documents	• Type Test Reports • Enclosure TC • Fault Level Certificate • Temperature Rise Certificate • Short Circuit Making and Breaking capacity of Isolators/Breakers (if Applicable)	1 No. of Sample/Rating	Inspection test records	-	H	R

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
5.0	**Painting**						
5.1	Painting and Packing	• Visual • Suitable protection to prevent entry of foreign material. • Proper packing to prevent any damage during transportation and storage.	100%	Packing list / Supplier's Records	-	H	-
6.0	**Documentation and IC**						
6.1	Documentation and IC	• Review of Internal Test Reports • IC Issuance	100%	Supplier's Test Records / Inspection Certificate	-	H	H

Legends: H- Hold (Do not proceed without approval), Random 10% , R-Review, RW-Random witness, W- Witness (Give due notice, work may proceed after scheduled date).

NOTES :-

1. 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).
2. Acceptance Norms for all the activities shall be as per PO/PR/ Standards referred there in/ Job specifications /Approved documents.
3. For EPC jobs scope of inspection shall be under TPIA, unless specified otherwise.

Signature Not Verified
Digitally signed by MD MAZHER ALI
Date: 2026.04.09 18:07:02 IST
Location: eProcure-EPROC

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