# TECHNICAL CONDITIONS OF CONTRACT (TCC)

BHARAT HEAVY ELECTRICALS LIMITED

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## VOLUME - IA PART – I CHAPTER – I
## PROJECT INFORMATION

| | | | |
|---|---|---|---|
| 1.1 | Project Title | : | 2 x 660 MW Udangudi Super critical Thermal Power Project |
| 1.2 | Plant capacity | : | 2x 660 MW |
| 1.3 | Type of project | : | Green Field |
| 1.4 | Owner | : | Tamil Nadu Generation and Distribution Corporation Limited (TANGEDCO) |
| 1.5 | Plant site location | : | Kallamoli-628203,Thiruchedur Taluk,Tuticorin District,TamilNadu |
| 1.6 | Nearest Village | : | Udangudi |
| 1.7 | Nearest Town & City | : | 41 Km Tuticorin |
| 1.8 | State Capital | : | Chennai (481 Km) |
| 1.9 | Nearest Railway Station | : | Thiruchendur at 8 km |
| 1.10 | Nearest Airport | : | Tuticorin Domestic AirPort @41km |
| 1.11 | Nearest Seaport | : | Tuticorin Port (45 KM) |
| 2.0 | Meteorological Condition | | |
| 2.1 | Climate | : | Tropical, very dry and hot summer, dry and cold winter and good rain-fall in monsoon accompanied with strong wind |
| 2.2 | Site Elevation | : | + 2.8 m above MSL |
| 2.3 | Ambient Temperature | | |
| a. | Annual Maximum Mean Temperature | : | 41°C |
| b. | Annual Minimum Mean Temperature | : | 22.3°C |
| c. | Dry Bulb Temperature (DBT) for Design Purpose | : | Max 41°C 7 Min 17°C |
| 2.4 | Relative Humidity for Design Purpose | : | 62-84 % |
| 2.5 | Annual Rainfall | | |
| | Average | : | 384.4 mm to 718.2 mm |
| 2.6 | Basic Design Wind Pressure | : | As per IS: 875 (Latest Edition) |
| 2.7 | Wind Speed | : | 11.8 kmph (Avg), 50 m/s (max) |
| 2.7 | Seismic zone | : | Zone-II as per IS- 1893-2002 (Part-IV) |

## VOLUME-IA PART-I CHAPTER – II
## SCOPE OF WORKS

**The scope of works shall comprise of but not limited to the following:**

(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified)

1.2.1 Erection, Testing and Commissioning of **Balance Power Cycle Piping and all associated Piping & Insulation works** including handling at site stores / storage yard, transporting to site, inspection, pre-assembly, erection, alignment, welding, NDT, fixing of hangers & supports, chemical cleaning / pickling, oil flushing, water flushing, hydro testing & steam blowing, surface finish, supply & application of primer & finish paints and application of refractory & insulation works as per requirement / as given in the drawings including labeling & flow direction on the piping / over insulation & hangers and supports, pre-commissioning, commissioning, trial operation & handing over to customer and supply & application of final painting, etc. for **Unit-1 of 2 X 660 MW Udangudi Supercritical Thermal Power Project at Tuticorin District, Tamil Nadu**

1.2.2 The terminal points decided by BHEL are final and binding on the contractor for deciding the scope of work and effecting the payment for the work done up to the terminals.

1.2.3 Receipt of materials from all the BHEL Stores/ any other location at site and Transportation to Erection site, stacking, storage and preservation.

1.2.4 The scope of works also includes Erection and Commissioning of piping including pipes, valves, flanges, fittings, fasteners etc. as required, making the system complete in all respects.

1.2.5 Erection, testing and commissioning of Flash Tanks and other miscellaneous tanks as per the shipping list provided.

1.2.6 Pre assembly, installation, testing and commissioning Trial operation of the erected equipment along with accessories.

1.2.7 Lifting, laying, bolt tensioning, bolt torque tightening, supporting and installation, pre and post weld heat treatment, inspection, non-destructive testing including radiography and hydro test, water/steam flushing, card board blasting, air drying, argon / nitrogen purging and other testing of piping installations, above and below ground.

1.2.8 Fabrication and installation, setting and commissioning of pipe supports, guides, anchors and spring supports as required.

1.2.9 Obtain Necessary Statutory clearances and approvals, co-ordination with all applicable statutory / Government agencies e.g. IBR, Electrical Inspectorate, Labour Inspectorate etc.

1.2.10 Installation and Dismantling of temporary piping.

1.2.10.1 Temporary lines for **Detergent flushing of Boiler Feed Lines, Condensate line, Drips and Drains of heaters and any other associated piping systems shall** be erected as per the instructions of BHEL Engineer. Necessary pipes and other items will be supplied by BHEL free of cost. All arrangements for erection including welding has to be arranged by the contractor at the rates specifically quoted / accepted for this work. After the successful completion of chemical cleaning, all temporary piping, fittings of tanks etc., checking all the valves for any accumulation of foreign materials, welding the valves, pipes which were cut and cleaning, re-fixing as per BHEL Engineer's instructions is within the scope of work/specification. After completion of the activity, all the temporary lines to be dismantled, returned to BHEL Stores and restoration of piping to be carried out, within the quoted rates.

1.2.10.2 Temporary lines for **Steam blowing** of Power Cycle piping shall be erected as per the instructions of BHEL Engineer. Necessary pipes and other items will be supplied by BHEL free of cost. All arrangements for erection including welding has to be arranged by the contractor at the rates specifically quoted / accepted for this work. After completion of steam blowing, all the temporary lines to be dismantled and restoration of piping to be carried out, within the quoted rates.

1.2.10.3 Apart from 1.2.10.1 & 1.2.10.2 any temporary piping to be carried for commissioning of any equipment is within the quoted rates.

1.2.11 Installation of any necessary blind or additional valves to isolate lines to facilitate phased commissioning and start-up is covered under the scope within the quoted rates.

1.2.12 Execute all mechanical jobs identified during owner / Licensors check list, Technical audits, pre-commissioning and commissioning, including additional supports required to restrain pipe movement avoiding interference with nearby structural / piping.

1.2.13 Installation of all valves and other miscellaneous in line / on line items is also included. Open ends of piping valves shall be protected with wooden blanking plates securely fastened with wire or by plastic insert plugs.

1.2.14 Cleaning, pickling, if required, water / steam flushing, air drying disposal of fluids offsite, reinstatement, preservation of piping and miscellaneous items following hydro test, nitrogen purging, cleaning, chemical cleaning,

painting, insulation, as per specifications is covered under the scope within the quoted rates.

1.2.15 Insulation of TDBFP Drive turbine piping only (drains, vent lines, seal steam pipelines, etc.), Heat exchangers (HP Heaters, LP Heaters, Dearator, Drain cooler, etc.), Flash tanks, MDBFP, TDBFP pumps, etc along with associated piping and insulation of all the piping covered under this scope of works are also included in the scope of this work within the quoted rates.

1.2.16 Testing of welds/flanged joints.

1.2.17 Execute final painting and labelling including supply of paints, painting of all equipment, piping (including small bore piping), and structures like platform, supports etc.

1.2.18 Preparation of As-Built Drawings.

**Note:**

i) The following materials that will go as a part of the permanent system of the plant will be supplied by BHEL at free of any charges:

Pipes, valves, flanges, fittings, fasteners.

ii) The number of joints indicated in the welding schedules is approximate only and liable for variation, as per site conditions and also design consideration of manufacturing unit.

iii) The welding process, weld joint and material specification indicated in the welding schedules may change to suit site requirement.

iv) Consumables are within the scope of contractor for both temporary and main piping except those which are in BHEL scope. Please refer to SCC Rev-01-Clause 4.1.1 for further details.

FOR FURTHER DETAILED SCOPE OF WORKS REFER RELEVANT CHAPTERS IN THIS BOOK.

**VOLUME IA PART – I CHAPTER – III**
**FACILITIES IN THE SCOPE OF CONTRACTOR / BHEL**
**(SCOPE MATRIX)**

| Sl No. | Description | Scope to be taken care by | | Remarks |
|---|---|---|---|---|
| | | BHEL | Bidder | |
| **1.3.1** | **PART I** | | | |
| **1.3.1.1** | **ESTABLISHMENT** | | | |
| ***1.3.1.1.1*** | ***FOR CONSTRUCTION PURPOSE:*** | | | |
| 1.3.1.1.1.1 | Open space for office | Yes | | Free |
| 1.3.1.1.1.2 | Open space for storage | Yes | | Free |
| 1.3.1.1.1.3 | Construction of bidder's office, canteen and storage building including supply of materials and other services | | Yes | |
| 1.3.1.1.1.4 | Bidder's all office equipment, office / store / canteen consumables | | Yes | |
| 1.3.1.1.1.5 | Canteen facilities for the bidder's staff, supervisors and engineers etc | | Yes | |
| 1.3.1.1.1.6 | Firefighting equipment like buckets, extinguishers etc | | Yes | |
| 1.3.1.1.1.7 | Fencing of storage area, office, canteen etc of the bidder | | Yes | |
| ***1.3.1.1.2*** | **FOR LIVING PURPOSES OF THE BIDDER** | | | |
| 1.3.1.1.2.1 | Open space | Yes | | |
| 1.3.1.1.2.2 | Living accommodation | | Yes | |
| **1.3.1.2** | **ELECTRICITY** | | | |
| **1.3.1.2.1** | Electricity of Voltage 415 / 440 V For construction purposes | | Yes | Chargeable |
| 1.3.1.2.1.1 | Single point source | Yes | | Refer clause 1.3.4 |
| 1.3.1.2.1.2 | Further distribution for the work to be done which include supply of materials and execution | | Yes | |
| 1.3.1.2.2 | Electricity for the office, stores, canteen etc of the bidder which include: | | Yes | |

| Sl No. | Description | Scope to be taken care by | | Remarks |
|---|---|---|---|---|
| | | BHEL | Bidder | |
| 1.3.1.2.2.1 | Distribution from single point including supply of materials and service | | Yes | |
| 1.3.1.2.2.2 | Supply, installation and connection of material of energy meter including operation and maintenance | | Yes | Calibration certificate to be provided |
| 1.3.1.2.2.3 | Duties and deposits including statutory clearances for the above | | Yes | |
| 1.3.1.2.2.4 | Living facilities for office use including charges | | Yes | |
| 1.3.1.2.2.5 | Demobilization of the facilities after completion of works | | Yes | |
| 1.3.1.2.3 | Electricity for living accommodation of the bidder's staff, engineers, supervisors etc on the above lines.(in case BHEL provides this facility, the scope should be given without ambiguity) | | Yes | Refer the relevant clauses elsewhere in this tender |
| **1.3.1.3** | **WATER SUPPLY** | | | |
| ***1.3.1.3.1*** | ***For construction purposes:*** | | | |
| 1.3.1.3.1.1 | Making the water available at single point | | Yes | |
| 1.3.1.3.1.2 | Further distribution as per the requirement of work including supply of materials and execution | | Yes | |
| ***1.3.1.3.2*** | ***Water supply for bidder's office, stores, canteen etc*** | | | |
| 1.3.1.3.2.1 | Making the water available at single point | Yes | | |
| 1.3.1.3.2.2 | Further distribution as per the requirement of work including supply of materials and execution | | Yes | |
| **1.3.1.4** | **LIGHTING** | | | |
| 1.3.1.4.1 | For construction work (supply of all the necessary materials)<br>At office storage area<br>At the preassembly area<br>At the construction site /area | | Yes | |

| Sl No. | Description | Scope to be taken care by | | Remarks |
|---|---|---|---|---|
| | | BHEL | Bidder | |
| 1.3.1.4.2 | For construction work (Execution of the lighting work / arrangements)<br>At office storage area<br>At the preassembly area<br>At the construction site /area | | Yes | |
| **1.3.1.5** | **COMMUNICATION FACILITIES for site operations of the bidder** | | | |
| 1.3.1.5.1 | Telephone, Fax, internet, intranet, email etc | | Yes | |
| **1.3.1.6** | **COMPRESSED AIR SUPPLY** | | | |
| 1.3.1.6.1 | Supply of Compressor and all other equipment required for compressor & compressed air system including pipes, valves, storage systems etc | - | Yes | |
| 1.3.1.6.2 | Installation of above system and operation & maintenance of the same | - | Yes | |
| 1.3.1.6.3 | Supply of the all the consumables for the above system during the contract period | - | Yes | |

| Sl No. | Description | Scope to be taken care by | | Remarks |
|---|---|---|---|---|
| | | BHEL | Bidder | |
| **1.3.2** | **PART II** | | | |
| **1.3.2.1** | **ERECTION FACILITIES** | | | |
| 1.3.2.1.0 | Engineering works for construction | Yes | | |
| 1.3.2.1.1 | Providing the erection drawings for all the equipment covered under this scope | Yes | | |
| 1.3.2.1.2 | Drawings for construction methods | | Yes | |
| 1.3.2.1.3 | As-built drawings – wherever deviations observed and executed and also based on the decisions taken at site- example – routing of small bore pipes | | Yes | |
| 1.3.2.1.4 | Shipping lists etc for reference and planning the activities | Yes | | In consultation with BHEL |
| 1.3.2.1.5 | Preparation of site erection schedules and other input requirements | | Yes | |
| 1.3.2.1.6 | Review of performance and revision of site erection schedules in order to achieve the end dates and other commitments | | Yes | In consultation with BHEL |
| 1.3.2.1.7 | Weekly erection schedules based on Sl No 1.3.2.1.5 | | Yes | |
| 1.3.2.1.8 | Daily erection / work plan based on Sl No 1.3.2.1.7 | | Yes | |
| 1.3.2.1.9 | Periodic visit of the senior official of the bidder to site to review the progress so that works is completed as per schedule. It is suggested this review by the senior official of the bidder should be done once in every two months. | | Yes | In consultation with BHEL |
| 1.3.2.1.10 | Preparation of preassembly bay | | Yes | |
| 1.3.2.1.11 | Laying of racks for gantry crane if provided by BHEL or brought by the contractor / bidder himself | | | Not applicable |

### 1.3.3 OPEN SPACE:

1.3.3.1 Minimum Open space will be provided at free of charges to the contractor within the plant premises or adjacent to the plant boundary for construction of temporary office shed, contractor's stores shed(s). Contractor shall adopt pre-engineered / pre-fabricated constructions made of steel with single / double skin, insulated for un- insulated roof and wall coverings (fabricated out of permanently color coated metal sheets) for his site office, covered store or any other temporary building. Alternatively, contractor can adopt readymade 'porta cabin" or similar construction.

1.3.3.2 BHEL shall not provide to the contractor any residential accommodation to any of his staff and the contractor has to make his own arrangements. Contractor has to make his own arrangements for labour colony.

1.3.3.3 Location and area requirement for office/storage sheds/ fabrication yard shall be discussed and mutually agreed to.

### 1.3.4 ELECTRICITY:

1.3.4.1 Construction power will be provided to the contractor at one point within plant area by BHEL on chargeable basis at the applicable rate of TANGEDCO under LT tariff VI at the nearest substation. The present LT tariff VI rate of TANGEDCO is

a) Consumption charges at Rs.12.00 per unit
b) Fixed MD (Maximum Demand) charges as applicable per month
c) Electricity Tax on total amount

1.3.4.2 The TANGEDCO tariff and tax may vary from time to time. The required Energy meter for measuring the consumption shall be provided and installed by the contractor. Any dispute regarding consumption, the BHEL engineer's decision is final. The contractor shall make his own arrangement for further distribution with necessary isolator/LCB etc.

1.3.4.3 Provision of distribution of electrical power from the given points to the required places with proper distribution boards, approved cables and cable laying including supply of all materials like cables, switch boards, pipes etc., observing the safety rules laid down by electrical authority of the State/ BHEL / their customer with appropriate statutory requirements shall be the responsibility of the tenderer / contractor.

1.3.4.4 The required energy meter for measuring power consumption shall be arranged by the contractor and taken care by the contractor.

1.3.4.5 Necessary "Capacitor Banks" to improve the Power factor to a minimum of 0.9 shall be provided by the contractor at his cost. Penalty if any levied by customer on this account will be recovered from contractor's bills.

1.3.4.6 Contractor has to make his own arrangements for his electricity requirement for his labour colony at his cost.

1.3.4.7 BHEL is not responsible for any loss or damage to the contractor's equipment as a result of variations in voltage / frequency or interruptions in power supply.

### 1.3.5 CONSTRUCTION WATER

1.3.5.1 The contractor shall make his own arrangements of water suitable for construction purpose to have uninterrupted work. No separate payment shall be made for any contingency arrangement made by contractor, due to delay / failure for providing water supply. Contractor has to make his own arrangements for his water requirement for his labour colony at his cost. DM Water required for hydro testing shall be provided by BHEL free of cost.

### 1.3.6 DRINKING WATER

1.3.6.1 Bidder shall provide drinking water at the work spot at their cost.

### 1.3.7 ONLINE SITE CONSTRUCTION MANAGEMENT SYSTEM [SCMS]:

1.3.7.1 Contractor has to provide minimum 2 computers [along with one operator per PC] for online material management, reporting of daily progress, billing and other similar activities, within the quoted rate. BHEL reserves the right to make alternative arrangement at the risk and cost of the contractor, if the required nos of PCs are not deployed by the contractor.

### 1.3.8 CONSUMABLES:

1.3.8.1 Any special welding electrodes / consumables as provided by manufacturing units for Power Cycle Piping, will be supplied by BHEL free of cost. All other electrodes including stainless steel electrodes required shall be arranged by the contractor at his cost. The Contractor shall use the BHEL / Customer approved quality electrodes only. The utilization of the welding electrodes issued by BHEL shall be duly accounted for exercising maximum care and ensuring economical usage for minimum wastage. If during erection, it is found that the consumption of electrodes

is more than the actual requirement by improper usage, the cost for the additional quantity so consumed shall be recovered from the contractor

1.3.8.2 The contractor shall provide within finally accepted price / rates, all consumables like welding electrodes (including alloy steel and stainless steel), all gases (inert, welding, and cutting), soldering material, dye penetrants, radiography films. Other erection consumables such as wrap cloth, tapes, jointing compound, grease, lubricants, M-seal, Araldite, petrol, CTC / other cleaning agents, grinding and cutting wheels are to be provided by the contractor. Steel, H&S, packers, shims, wooden planks, scaffolding and pre-assembly materials, hardware items etc required for temporary works such as supports, scaffoldings, bed are to be arranged by him. Sealing compounds, gaskets, gland packing, wooden sleepers, for temporary work, required for completion of work except those which are specifically supplied by manufacturing unit are also to be arranged by him.

1.3.8.3 All consumables to be used for the job shall have to be approved by BHEL prior to use.

1.3.8.4 All the shims, gaskets and packing, which go finally as part of equipment, shall be supplied by BHEL free of cost.

1.3.8.5 In the event of failure of contractor to bring necessary and sufficient consumables, BHEL shall arrange for the same at the risk and cost of the contractor. The entire cost towards this along with standard BHEL overhead shall be deducted from the contractor's immediate due bills.

**1.3.9 GASES:**

1.3.9.1 All the required gases like Oxygen / Acetylene / Argon / Nitrogen required for work shall be supplied by the Contractor at his cost. It shall be the responsibility of the contractor to plan the activities and store sufficient quantity of these gases. Non availability of gases cannot be considered as reason for not attaining the required progress.

1.3.9.2 BHEL reserves the right to reject the use of any gas in case required purity is not maintained.

1.3.9.3 The contractor shall submit weekly / fortnightly / monthly statement report regarding consumption of all consumables for cost analysis purposes.

1.3.9.4 The contractor shall ensure safe keeping of the inflammable cylinder at a separate place away from normal habit with proper security etc.

**1.3.10 ELECTRODES SUPPLY AND STORAGE:**

1.3.10.1 It shall be the responsibility of the contractor to obtain prior approval of BHEL, before procurement, regarding suppliers, type of electrodes etc. On receipt of the electrodes at site, it shall be subject to inspection and approval by BHEL. The contractor shall inform BHEL details regarding type of electrodes, batch number and date of expiry etc. Test certificates for electrodes and other consumables should be submitted to BHEL Engineer as per requirement.

1.3.10.2 Shortage of any of the electrodes or the equivalent suggested by BHEL shall not be quoted as reason for deficiency in progress or for additional rate. Contractor shall submit weekly/ fortnightly/ monthly statement/ report regarding consumption and available stock of all types of electrodes for avoiding stoppage of work on consumable scarcity.

1.3.10.3 Storage of electrodes shall be done in an air conditioned / controlled humidity room as per requirement, at his own cost by the contractor.

1.3.10.4 All low hydrogen electrodes shall be baked / dried in the electrode drying oven (range 375 deg. C - 425 deg. C) to the temperature and period specified by the BHEL Engineer before they are used in erection work and each welder should be provided with one portable electrode drying oven at the work spot. Electrode drying oven and portable drying ovens shall be provided by contractor at his cost.

1.3.10.5 In case of improper arrangement of procurement of above electrodes BHEL reserves the right to procure the same from any source and recover the cost from the contractor's first subsequent bills at market value plus departmental charges of BHEL communicated from time to time. Postponement of such recovery is not permitted.

1.3.10.6 BHEL reserves the right to reject the use of any electrodes at any stage, if found defective because of bad quality, improper storage, date of expiry, unapproved type of electrodes etc. It shall be the responsibility of the contractor to replace at his cost without loss of time.

### 1.3.11 MATERIAL SUPPLY:

1.3.11.1 BHEL will supply the materials/equipment indicated in the weight schedule from their respective manufacturing units which are to be executed/incorporated in the permanent system. In addition, the material such as lube oil, grease, required for commissioning the erected equipment and chemicals required for chemical cleaning/detergent flushing of equipment will be supplied free of cost by BHEL.

### 1.3.12 POSSESSION OF GENERATORS

1.3.12.1 As there are bound to be interruptions in regular power supply, power cut/ load shedding in any construction sites, suitable extension of time, if found necessary only be given and contractor is not entitled for any compensation. It shall be the responsibility of the tenderer / contractor to provide, and maintain the complete installation on the load side of the supply with due regard to safety requirements at site. It shall be responsibility of the contractor to have at least 2 diesel operated welding generator sets to get urgent and important work to go on without interruptions. The consumables required to operate the generators are to be provided by tenderers. This may also be noted while quoting.

### 1.3.13 LIGHTING FACILITY:

1.3.13.1 Adequate lighting facilities such as flood lamps, hand lamps and area lighting shall be arranged by the contractor at the site of construction, pre assembly yard and contractor's material storage area etc. at his cost.

### 1.3.14 Other Facilities

1.3.14.1 Adequate water less urinals [at least 2 nos per level] shall be arranged by the contractor within quoted rates, with proper disposal arrangement.

### 1.3.15 BID DRAWINGS

1.3.15.1 Bid drawings published in this tender specification are for information and this may get revised during execution.

### 1.3.16 CONTRACTOR'S OBLIGATION ON COMPLETION

1.3.16.1 On completion of work, all the temporary buildings, structures, pipe lines, cables etc. shall be dismantled and leveled and debris shall be removed as per instructions of BHEL by the contractor at his cost. In the event of his failure to do so, the expenditure towards clearance of the same will be recovered from the contractor. The decision of BHEL Engineer in this regard is final.

## VOLUME-IA PART-I CHAPTER – IV

## T&Ps and MMEs TO BE DEPLOYED BY CONTRACTOR

1.4.1 The following minimum major Tools & Plants (T&P) shall be arranged by the Contractor within the quoted rate for execution of the scope of works covered under this contract.

| Sl. No. | Description | Qty |
|---|---|---|
| 01 | Trailer ( 20 T/ 30 T) | As required |
| 02 | Diesel Generator (2 numbers as mentioned below) providing a rated capacity of 500 KVA as standby for P91 welding) | 2 Nos ** |
| 03 | Fill pump | As required |
| 04 | HT pump for hydro test ( up to 50 Kg/Sq.cm) of LP piping | 2 Nos |
| 05 | Ultrasonic Hardness Testing Machine [ Ultrasonic Contact Impedance (UCI) ] | As Required |

**Back-up power capacity as mentioned in Sl. No.2 above can be achieved by deploying either a single DG set of 500 KVA capacity or a combination of 250 KVA or above capacity machines

1.4.2 All the T&Ps required for this scope of work, except the Tools & Plants provided by BHEL are to be arrange by the contractor within the quoted rates.

1.4.3 T&Ps mentioned above is tentative requirement considering parallel working in all areas mentioned in scope of work. However, mobilization schedule and quantity / numbers as mutually agreed at site for major T&Ps, have to be adhered to. Numbers / time of requirement of T&Ps will be reviewed time to time by BHEL site and contractor will provide required T&Ps / equipment to ensure completion of entire work within schedule / target date of completion without any additional financial implication to BHEL. Vendor will give advance intimation and certification regarding capacity etc. prior to dispatch of heavy equipment. Also on completion of the respective activity, demobilization of T&P in total or in part can be done with the due approval of engineer in charge. Retaining of the T&P's during the contract period will be mutually agreed in line with construction requirement.

### 1.4.4 Facility to be provided by Contractor for P 91 Welding

1.4.4.1 Diesel Generator, as standby supply for P91 Welding (along with required cables, switches, fuel and operator) has to be arranged by the contractor within the quoted rates. In the eventuality of contractor not making necessary arrangements to ensure availability of DG set as per requirement at site, BHEL will arrange the same at the contractor's risk and cost. All the necessary certificates and licenses required to operate the DG set are to be arranged by the contractor then and there at his cost.

1.4.4.2 Required number of operators / Technician / Electrician for installation, Commissioning & Operating continuously.

1.4.4.3 Ultrasonic Flaw Detector with recording device & complete accessories (Digital Type-Krautkramer model USN 50 or equivalent capable of storing calibration Data. All recordable indications will be stored in memory of digital Flaw detector and in PC (to be provided by the contractor) for review at later period.

1.4.4.4 GE or Kraut Kramer or Microdur make or reputed branded ultrasonic hardness testing machine (Ultrasonic Contact Impedance (UCI))

1.4.4.5 MPI / LPI kits with consumables.

1.4.4.6 Only One set of Annealing cable (2 nos) will be supplied by BHEL irrespective of number of Induction Heating Equipment deployed by BHEL. Additional sets of annealing cables have to be arranged by the contractor within the quoted rates.

1.4.4.7 Gas Burners arrangement with required gas for maintaining temperature in the event of power failure.

1.4.4.8 Digital Temperature Indicator.

1.4.4.9 Consumables

a) Glass Fibre Cloth -1mmx1000mm–Temp Rating 1260ºC.
b) Glass fibre cord Dia 3mm (twisted)- Temp Rating 1260ºC.
c) Ceramic Fibre Blanket -RT Grade, density 96 kg/$m^3$ –Temperature rating 1260ºC.
d) Ceramic fibre rope- Fibre Glass Braided, Dia 12 mm –Temperature rating 1260ºC.
e) K Type Thermocouple- 0.5 mm Dia Single Strand individual fibre glass insulated.
f) Heavy Duty TC connectors for K Type Thermocouple.
g) All other consumables / equipment to carry out the work.

1.4.5 The contractor to furnish a list of Tools and plants including cranes, tractors / trailers / trucks etc. which contractor proposed to deploy for this work.

1.4.6 Fill pumps shall be arranged by the contractor, wherever required.

1.4.7 For testing LP lines necessary Hydraulic Test pumps/ Hand pumps are to be arranged by the contractor.

1.4.8 For handling at store and transportation, contractor shall make his own arrangement.

1.4.9 For transportation, material handling, loading & unloading of all components / equipment, the contractor has to make his own arrangements at his own cost. BHEL will not provide any crane / T&Ps for unloading the above components. All necessary T&P such as, Trailers, Cranes Winches, Welding generators, Slings, Jacks, Sleepers, Rails etc. are to be arranged by the contractor.

1.4.10 All the T & P, lifting tackles including wire ropes, slings, shackles and electrically operated equipment shall be got approved by BHEL Engineer before they are actually put on use. Test certificates obtained from the statutory authority should be submitted before their usage.

1.4.11 New Generation Hydra Cranes are only permited. Any mention of hydra cranes elsewhere in the contract refers to “New Generation Hydra Cranes” only. Required Mobile Crane for completion of piping system has to be arranged by contractor. The age of the contractor deployed cranes up to 150 T should be within 15 years as on date of deployment. Contractor has to provide documentary proof for the age of the crane at the time of deployment to the BHEL Engineer.

1.4.12 In the event of non-mobilization of Tools, Plants, Machinery, Equipment, Material or non-availability of the same owing to breakdown and as a result progress of work suffered, BHEL reserves the right to make alternative arrangement at the risk and cost of the contractor.

**Case 1: BHEL provides its own Capital T&P:** If BHEL provides owned T&P then BHEL, hire charges (as per BHEL norms) will be recovered from the contractor as per the prevailing BHEL Corporate hire charges

- In case the T&P is specifically listed in “T&Ps to be deployed by Contractor”, ‘Rates of hire charges applicable to outside agencies other than contractors working for BHEL’ will apply.

- In case the T&P is not specifically listed in "T&Ps to be deployed by Contractor", 'Rates of hire charges applicable to contractors working for BHEL' will apply.

The hire charges of Capital Tools & Plants are exclusive of operating expenses e.g., Operator, fuel & Consumables and the same shall be arranged by the contractor at his cost.

**Case 2: BHEL provides hired T&P:** In all cases other than that specified in Sl No. 1 above, actual expenses incurred by BHEL along with applicable overheads will be back-charged to the contractor.
The present rates of BHEL's Corporate Crane hire charge, are enclosed. This may get revised further as per the BHEL corporate guidelines. The prevailing rates as on date of execution shall be applicable.

1.4.13 All the T & P arranged by contractor including electrical connections wherein required shall be reliable / proven / tested with necessary test certificate.

1.4.14 All instruments, measuring tools etc. are to be calibrated periodically as per the requirement of BHEL and necessary calibration certificates are to be submitted to BHEL before use.

1.4.15 Crane operators deployed by the contractor shall be tested by BHEL before he is allowed to operate the cranes.

1.4.16 Also Refer clause no 1.5.6 to 1.5.8 in connection with BHEL T&Ps in chapter V of this booklet.

1.4.17 Other Relevant clauses shall be referred in Special Conditions of Contract (SCC) published in Volume IB of Book II.

1.4.18 Also refer clause 1.3.7 on providing computers in chapter-III of Technical Conditions of Contract (VOLUME-IA PART- II) of this booklet.

**Note to Chapter-IV:**

**i.** The induction heating equipment and other equipment shall be drawn from BHEL stores, transported and installed & commissioned wherever required. For routine maintenance & attending all type of break-down maintenance, contractor shall deploy sufficient manpower, tools and plant within the quoted rate.

**ii.** The contractor shall provide electrical cables & switches required for extending power supply to the induction heating equipment. All the equipment shall be protected by providing covers or sheds at site by the contractor with in the quoted rate.

## VOLUME-IA PART-I CHAPTER - V

## T&Ps & MMEs TO BE DEPLOYED BY BHEL ON SHARING BASIS

1.5.1 List of Tools & Plants to be made available by BHEL to contractor on free of hire charges on sharable basis for execution of works within the scope of this tender for each unit are as below.

| Sl. No. | Description | Qty. |
|---|---|---|
| 01 | EOT Crane at TG Hall without operator | 1 No. |
| 02 | Induction Heating Machines | As Required |
| 03 | Spot Welding Machine | 1 No. |
| 04 | Chemical Cleaning Pumps with accessories | As Required |
| 05 | Suitable capacity Hydro Test pump for HP lines | 1 No. |

1.5.2 All the T&Ps mentioned in clause 1.5.1 above shall be issued to contractor on shareable basis and the allotment is made by BHEL on need basis for erection / pre-commissioning activities only.

1.5.3 Apart from the above mentioned T&Ps, any other Tools & Plants required for satisfactory completion of the work has to be arranged by the contractor.

1.5.4 EOT Crane – Allotment will be made only on need basis. Trained operators are to be arranged by the contractor within the quoted rates. Contractor has to plan the activities on item wise where the EOT crane is required to be used and submit to BHEL site for approval. In case the erection can be carried out by using other T&Ps, contractor shall make his own arrangement. The decision of BHEL Site I/c on this will be final and binding.

1.5.5 Providing manpower assistance required for free movement of trailing cable of EOT Crane is included in the scope of this contract.

1.5.6 BHEL will not provide crane operators for EOT cranes. Trained operators for EOT crane to be arranged by the contractor at his cost.

**1.5.7 P91 WELDING**

1.5.7.1 Facility and Consumables to be provided by BHEL for P91 Welding free of any charges:

a) Required no. of Induction heating machine.
b) Spot Welding machine for fixing thermocouple
c) Compensating cables.
d) Only One set of Annealing cable (2 nos) will be supplied by BHEL irrespective of number of Induction Heating Equipment deployed by BHEL. Additional sets of annealing cables have to be arranged by the contractor within the quoted rates.
e) Filler wire and Welding Electrodes for P91 Welding as supplied by manufacturing units. In case of additional requirements of the Filler Wire and Welding electrodes, the same shall be arranged by Bidder at own cost. BHEL will provide the Filler Wire and Electrodes as per the shipping list only.

1.5.7.2 For P91 welding, BHEL will only provide the facility and Consumables as indicated in TCC. Other consumables and facility required to complete the work shall be arranged by the contractor with in the quoted rate.

1.5.8 The contractor at his cost shall arrange for grouting of anchor points of T&Ps issued to him. Necessary grout materials are to be arranged by the contractor at his cost

1.5.9 Necessary electrical / water / air connection required for operation of any of the above equipment shall be Contractor's account.

1.5.10 The Contractor shall be responsible for the safe and proper use of the above equipment issued to him. Day-to-day maintenance and operation of equipment's shall be the contractor's responsibility and shall be as per instructions / standard practice of BHEL Engineer

1.5.11 In case of non-availability of the above, due to any unavoidable reason, like breakdown, overhaul etc., the contractor shall make arrangement at his own cost to meet the erection schedules. No extra claim will be admitted due to the non-availability of any of the above equipment. No delay in execution of work shall be accepted on this account.

1.5.12 The contractor shall return the T & P issued to him by BHEL in good working condition as and when so desired by BHEL. (Completion or reduction in work load) for diversion for other work. If such return is delayed by contractor due to his fault without written consent of BHEL, hire charges as applicable

according to BHEL policy will be levied from such time it was requisitioned by BHEL to the time of actual return and the amount so decided and arrived at, will be recovered from the contractor's bill.

1.5.13 Contractor shall have at all times experienced operators and technicians for routine and breakdown maintenance of the equipment. Any delay in rectification of defects will warrant BHEL rectifying the defect and charging the cost to the contractor.

1.5.14 If at any time it is noticed that contractor is not using any of the T & P or equipment properly according to the instructions of BHEL, BHEL will have the right to withdraw any and all such equipment and any cost due to this shall be contractor's account.

1.5.15 All the T&P would be issued only at BHEL stores and it shall be the responsibility of the contractor to take delivery from BHEL stores, transport the same to site and return the same to BHEL stores in good condition after use.

1.5.16 Contractor shall make good any loss or damage to the equipment supplied to him and day to day maintenance and operations of equipment shall be borne by the contractor including all consumables like petrol, oil and air filters etc.

1.5.17 Any Loss / Damage of tools by the contractor, the same shall have to be replaced by the contractor or otherwise cost thereof shall be recovered from the contractor.

1.5.18 Any loss / damage to any or part of the above equipment shall be to contractor's account and the expenditures on these account will be recovered from contractor's bills in case contractor fails to make good the loss.

## VOLUME-IA PART-I CHAPTER - VI
## TIME SCHEDULE

### 1.6.1. TIME SCHEDULE

1.6.1.1. The entire work of erection, testing and commissioning of Power Cycle Piping and all associated Piping & Insulation works for Unit-1 as detailed elsewhere in the Tender Specification shall be completed within **Twelve (12) months** from the date of commencement of work at site..

1.6.1.2. During the total period of contract, the contractor has to carry out the activities in a phased manner as required by BHEL and the program of milestone events.

1.6.1.3. The erection work shall be commenced on the mutually agreed date between the bidder and BHEL engineer and shall be deemed as completed in all respect only when both units are in operation. The decision of BHEL in this regard shall be final and binding of the contractor. The scope of work under this contract is deemed to be completed only when so certified by the site Engineer.

1.6.1.4. The contractor is required to refer Form 15 in Volume-I Book-II for all the instructions to be taken immediately after receipt of LOI.

### 1.6.3. COMMENCEMENT OF CONTRACT PERIOD

The date of commencement of contract period shall be the mutually agreed date between the bidder and BHEL engineer at site to start the work. In case of discrepancy, the decision of BHEL engineer is final.

### 1.6.4. MOBILISATION FOR ERECTION, TESTING, ASSISTANCE FOR COMMISSIONING ETC.,

1.6.3.1. The activities for erection, testing etc. shall be started as per directions of Construction Manager of BHEL.

1.6.3.2. The contractor has to augment his resources in such a manner that following major milestones of erection & commissioning are achieved on specified schedules mentioned below.

1.6.3.3. **TENTATIVE MILESTONES:**

| **Milestone Activity** | **Milestone Month Unit-1** |
|---|---|
| Start of Erection | 1st Month (Mar'24) |
| Readiness for Boiler Light Up | 3rd Month |
| Readiness for Steam Blowing | 6th Month |
| Readiness for Synchronisation | 7th Month |
| Readiness for Full Load & Trial Operation | 8th Month |
| Completion of Contractual Obligations | 12th Month |

1.6.3.4. In order to meet the schedule in general, and any other intermediate targets set, to meet customer/ project schedule requirements, Contractor shall arrange & augment all necessary resources from time to time on the instructions of BHEL Engineer.

### 1.6.4 CONTRACT PERIOD

The contract period for completion of entire work under scope for Unit-1 shall be **Twelve (12) months** from the "COMMENCEMENT OF CONTRACT PERIOD" as specified earlier for completion of the entire work.

### 1.6.5 MAJOR INTERMEDIATE MILESTONES:

| **Sl. No.** | **Description** | **Month** | **Intermediate Milestone for each unit** |
|---|---|---|---|
| 1 | Readiness for Boiler Light Up | 3rd Month | M1 |
| 2 | Readiness for Synchronisation | 7th Month | M2 |

**Penalty for Intermediate Milestones**

1. M1 and M2 shall be intermediate Milestones for each unit of this work.
2. In case of slippage of these identified Intermediate Milestones, Delay Analysis shall be carried out on achievement of each of these two Intermediate Milestones in reference to Form 14.
3. In case delay in achieving M1 milestone is solely attributable to the contractor,0.5% per week of executable contract value* limited to Maximum 2% of executable contract value will be withheld.
4. In case delay in achieving M2 milestone is solely attributable to the contractor,0.5% per week of executable contract value* limited to maximum 3% of executable contract value will be withheld.
5. Amount already withheld, if any, against slippage of M1 milestone, shall be released only if there is no delay attributable to contractor in achievement of M2 milestone.
6. Amount required to be withheld on account of slippage of identified intermediate milestone(s) shall be withheld out of respective milestone payment and balance amount (if any) shall be withheld @10% of RA Bill amount from subsequent RA bills.
7. Final deduction towards LD (if applicable), on account of delay attributable to contractor shall be based on final delay analysis on completion / closure of contract. Withheld amount, if any due to slippage of intermediate milestones shall be adjusted against LD or released as the case may be.
8. In case of termination of contract due to any reason attributable to contractor before completion of work, the amount already withheld against slippage of intermediate milestones shall not be released and be converted in to recovery.

Note: *Executable contract value-value of work for which inputs/fronts were made available to contractor and were scheduled for execution till the date of achievement of that milestone.

### 1.6.6 GUARANTEE PERIOD FOR UNIT

The guarantee period of **Twenty-Four Months** shall commence from the date of handing over of each Unit to Customer or six months from the date of first synchronization of the set, whichever is earlier (Provided all erection, testing, and commissioning works are completed in all respects).

## VOLUME-IA PART – I CHAPTER-VII
## TERMS OF PAYMENT

**Terms of payment**

1.7.1 The progressive payment for erection, testing and commissioning on accepted price of contract value will be released as mentioned below.

1.7.2 Progressive payment against monthly running bills will be made up to 85% of the value of the erected tonnage pro rata as per Cl. 1.7.2.1 to 1.7.2.13 of the following table.

| Cl. No. | Description | Piping | | | Insulation |
|---|---|---|---|---|---|
| | | 1) P91<br>2) HP<br>3) LP<br>4) SS | 1) H&S<br>2) Others/ Tanks | 1) Temp Piping Steam blowing/ Chemical cleaning | 1) Fixing componen ts<br>2) Mineral wool<br>3) Aluminum<br>4) Sealing compound |
| | | | | | |
| 1.7.2.1 | On pre assembly where ever applicable (if not applicable this portion shall be clubbed with placement in position) | 20 | 15 | - | - |
| 1.7.2.2 | Placement in position | 20 | 25 | - | 50 |
| 1.7.2.3 | Alignment | 10 | 15 | - | 15 |
| 1.7.2.4 | Welding/ Bolting/ Fixing | 15 | 30 | - | 20 |
| 1.7.2.5 | Completion of NDT (if not applicable , then this portion to be paid along with welding) | 5 | - | - | - |
| 1.7.2.6 | Installation of temp. piping | - | - | 60 | - |
| 1.7.2.7 | Dismantling of temp. piping, edge preparation and return to BHEL stores, area cleaning | - | - | 25 | - |
| 1.7.2.8 | Hangers & Supports etc. wherever necessary as per drawing | 10 | - | - | - |
| 1.7.2.9 | Hydraulic test / Pneumatic test | 3 | - | - | - |
| 1.7.2.10 | Floating of lines, final adjustment of supports for | 2 | - | - | - |

| Cl. No. | Description | Piping | | | Insulation |
|---|---|---|---|---|---|
| | | 1) P91<br>2) HP<br>3) LP<br>4) SS | 1) H&S<br>2) Others/ Tanks | 1) Temp Piping Steam blowing/ Chemical cleaning | 1) Fixing components<br>2) Mineral wool<br>3) Aluminum<br>4) Sealing compound |
| | cold & hot values (if not applicable, this portion to be clubbed along with hydraulic test/ pneumatic test) | | | | |
| 1.7.2.11 | Erection of tanks and vent silencers | - | - | - | - |
| 1.7.2.12 | Alignment of tanks & vent , silencers and their associated approach plat form with ladders etc. | - | - | - | - |
| 1.7.2.13 | Testing & commissioning of Tanks & Vent silencers | - | - | - | - |
| | Total for pro rata payments (85%) | **85** | **85** | **85** | **85** |

1.7.3 Further 15% payment on pro-rata basis common to all PG shall be released on achievement of the following stage/mile stones events in each unit (as per the following table) for the tonnage erected

| Cl. No. | Description | Piping | | | Insulation |
|---|---|---|---|---|---|
| | | 1) P91<br>2) HP<br>3) LP<br>4) SS | 1) H&S<br>2) Others /Tanks | 1) Temp Piping Steam blowing/ Chemical cleaning | 1) Fixing components<br>2) Mineral wool<br>3) Aluminum<br>4) Sealing compound |
| | | | | | |
| 1.7.3.1 | Boiler light up | 1 | 1 | - | 1 |
| 1.7.3.2 | ABO/Chemical cleaning | - | - | - | - |
| 1.7.3.3 | Steam blowing (Wherever Steam Blowing is not | 1 | 1 | - | 1 |

| | | | | | |
|---|---|---|---|---|---|
| | applicable, this may be payable for Chemical /detergent cleaning as applicable) | | | | |
| 1.7.3.4 | Safety Valve Floating | 1 | 1 | - | 1 |
| 1.7.3.5 | Rolling and synchronization | 1 | 1 | - | 1 |
| 1.7.3.6 | Coal firing | - | 1 | - | 1 |
| 1.7.3.7 | Full load | 1 | 1 | - | 1 |
| 1.7.3.8 | Trial operation of Unit | 1 | 1 | - | 2 |
| 1.7.3.9 | Completion of all drains and vents to respective locations and placement of instrument sensors after steam blowing | 2 | - | - | - |
| 1.7.3.10 | Painting | 2 | 2 | - | - |
| 1.7.3.11 | Area cleaning, temporary structures cutting/removal and return of scrap | 1 | 2 | - | 3 |
| 1.7.3.12 | Punch list points/pending points liquidation | 1 | 1 | - | 1 |
| 1.7.3.13 | Submission of as built drawings | 1 | 1 | - | - |
| 1.7.3.14 | Material reconciliation | 1 | 1 | 15 | 2 |
| 1.7.3.15 | Completion of contractual obligation | 1 | 1 | - | 1 |
| | **Total for stage/ milestone payments (15%)** | **15** | **15** | **15** | **15** |

**Notes to Terms of payment:**

Please Refer other relevant clauses for PVC, Retention amount and Performance Security Deposit.

## VOLUME-IA PART-I CHAPTER - VIII

## TAXES AND OTHER DUTIES

1.8.1 Goods and service Tax (GST) & Cess

1.8.1.1 The successful bidder shall furnish proof of GST registration with GSTN Portal in the State in which the Project is being executed, covering the services under this contract. Registration should also bear endorsement for the premises from where the billing shall be done by the successful bidder on BHEL for this project/ work.

1.8.1.2 Contractor's price/rates shall be exclusive of GST & Cess (if applicable) (herein after termed as GST). Contractor shall submit to BHEL the GST compliant tax invoice/debit note/revised tax invoice on the basis of which BHEL will claim the input tax credit in its return. Since this is a works contract, the applicable rate shall be @ 18% GST, as applicable presently

1.8.1.3 Bidder shall note that the GST Tax Invoice complying with GST Invoice Rules wherein the 'Bill To' details will as below:

BHEL GSTN- 33AAACB4146P2ZL

NAME - BHARAT HEAVY ELECTRICALS LIMITED

ADDRESS - 2X660MW UDANGUDI SUPERCRITICAL THERMAL POWER STATION, KALLAMOLI VILLAGE, THIRUCHENDUR TALUK, THOOTHUKUDI DISTRICT, TAMIL NADU- 628203

1.8.1.4 GST charged in the tax invoice/debit note/revised tax invoice by the contractor shall be released separately to the contractor only after contractor files the outward supply details in GSTR-1 on GSTN portal and input tax credit of such invoice is matched with corresponding details of outward supply of the contractor and has paid the GST at the time of filing the monthly return.

1.8.1.5 Incase BHEL has to incur any liability (like interest / penalty etc.) due to denial/reversal/ delay of input tax credit in respect of the invoice submitted by the contractor, for the reasons attributable to the contractor, the same shall be recovered from the contractor.

1.8.1.6 Further, in case BHEL is deprived of the Input tax credit due to any reason attributable to contractor, the same shall not be paid or Recovered if already paid to the contractor.

1.8.1.7 Tax invoice/debit Note/revised tax invoice shall contain all such particulars as prescribed in GST law and comply to the timelines for issue of the same. Invoices shall be submitted on time to the concerned BHEL Engineer In Charge.

1.8.1.8 TDS under GST (if/ as & when applicable) shall be deducted at prevailing rates on gross invoice value from the running bills.

1.8.1.9 E-way bills // Transit passes / Road Permits, if required for materials / T&P etc., bought into the project site is to be arranged by the Contractor only

1.8.1.10 BHEL shall not reimburse any amounts towards any interest / penalty etc., incurred by contractor Any additional claim at a later date due to issues such as wrong rates / wrong classification by contractor shall not be paid by BHEL

### 1.8.2 All taxes and duty other than GST & Cess

The contractor shall pay all (except the specific exclusion viz GST & Cess) taxes, fees, license charges, deposits, duties, tools, royalty, commissions, Stamp Duties, or other charges / levies, which may be levied on the input goods & services consumed and output goods & services delivered in course of his operations in executing the contract and the same shall not be reimbursed by BHEL. In case BHEL is forced to pay any of such taxes, BHEL shall have the right to recover the same from his bills or otherwise as deemed fit.

### 1.8.3 Statutory Variations

Statutory variations are applicable under the GST Acts, against production of proof. The changes implemented by the Central / State Government during the tenure of the contract viz. increase / decrease in the rate of taxes, applicability, etc. and its impact on upward revision / downward revision are to be suitably paid/ adjusted from the date of respective variation. The bidder shall give the benefit of downward revision in favour of BHEL. No other variations shall be allowed during the tenure of the contract.

### 1.8.4 New Taxes/Levies

In case Government imposes any new levy / tax after submission of bid during the tenure of the contract, BHEL shall reimburse the same at actual on submission of documentary proof of payment subject to the satisfaction of BHEL that such new levy / tax is applicable to this contract.

### 1.8.5 Direct Tax

BHEL shall not be liable towards Income Tax of whatever nature including variations thereof arising out of this contract as well as tax liability of the bidder and their personnel. Deduction of tax at source at the prevailing rates shall be effected by BHEL before release of payment as a statutory obligation, unless exemption certificate is produced by the bidder. TDS certificate will be issued by BHEL as per the provisions of Income Tax Act.

**VOLUME-IA PART-I CHAPTER - IX**

**BILL OF QUANTITY**

## 1.9.1 WEIGHT SCHEDULE - SUMMARY

| S.NO. | DESCRIPTION | APPROX PLACEMENT WT (In MT) (UNIT-1) | Rate Schedule |
|---|---|---|---|
| 1 | P91 Piping | 287.507 | 1.1 |
| 2 | HP Piping | 1240.192 | 1.2 |
| 3 | LP Piping | 704.176 | 1.3 |
| 4 | SS Piping | 20.639 | 1.4 |
| 5 | Hangers and Supports including Tanks, Vessels, Pumps, etc | 831.596 | 1.5 |
| 6 | Temporary Piping – Acid Cleaning | 124.000 | 1.6 |
| 7 | Temporary Piping – Steam Blowing | 118.000 | 1.7 |
| 8 | Mineral wool | 400.000 | 1.8 |
| 9 | Fixing components | 37.825 | 1.9 |
| 10 | Aluminium Sheets | 74.699 | 1.10 |
| **TOTAL WEIGHT (in MT)** | | **3838.634** | |

**Note:** The weight mentioned above is tentative balance placement weight. In addition to this tonnage, the contractor is responsible for completing the remaining balance of work that has already been undertaken.

## 1.9.2 WEIGHT SCHEDULE – PGMA DETAILS

## UNIT 1

| PGMA | WBS Description | Weight (kgs) | CATEGORY | MFG UNIT | RATE SCH |
|---|---|---|---|---|---|
| 80-300 | MS FROM SUPERHEATER TO BOILER STOP VALVE | 2467.869 | P91 | PC | 1.1 |
| 80-301 | MS FROM BOILER STOP VALVE TO ESV | 129490.136 | P91 | PC | 1.1 |
| 80-303 | MS HEADER TO AUX PRDS | 573.026 | P91 | PC | 1.1 |
| 80-304 | MS HEADER TO HPBP VALVE | 0.000 | P91 | PC | 1.1 |
| 80-307 | HP AND LP BYPASS WARM UP | 55.482 | P91 | PC | 1.1 |
| 80-310 | HRH FROM REHEATER TO INTERCEPTOR VALVE | 58297.370 | P91 | PC | 1.1 |
| 80-312 | LPBP VALVE UPSTREAM AND DOWNSTREAM | 78282.998 | P91 | PC | 1.1 |
| 80-320 | CRH FROM TURBINE TO REHEATER | 103047.200 | HP | PC | 1.2 |
| 80-321 | HPBP VALVE TO CRH PIPING | 12187.186 | HP | PC | 1.2 |
| 80-322 | CRH PIPING TO DEAERATING HEATER | 8284.391 | HP | PC | 1.2 |
| 80-323 | STEAM TO BFP DRIVE TURBINE | 5741.302 | HP | PC | 1.2 |
| 80-324 | CRH HEADER TO AUX.PRDS | 1320.450 | HP | PC | 1.2 |
| 80-329 | EXTRACTION STEAM TO BFP DRIVE TURBINE | 10592.384 | HP | PC | 1.2 |
| 80-331 | EXTRACTION STEAM TO LP HEATER-2 | 9401.432 | HP | PC | 1.2 |
| 80-332 | EXTRACTION STEAM TO LP HEATER-3 | 9997.908 | HP | PC | 1.2 |
| 80-334 | EXTRACTION STEAM TO LP HEATER-5 | 10868.783 | HP | PC | 1.2 |
| 80-335 | EXTRACTION STEAM TO DEAERATING HEATER | 16449.471 | HP | PC | 1.2 |
| 80-336 | EXTRACTION STEAM TO HP HEATER NO.1 | 7903.527 | HP | PC | 1.2 |
| 80-337 | EXTRACTION STEAM TO HP HEATER-2 | 3328.865 | HP | PC | 1.2 |
| 80-338 | EXTRACTION STEAM TO HP HEATER-3 | 5496.424 | HP | PC | 1.2 |
| 80-339 | AUX STEAM TO BFD TURBINE | 1630.103 | HP | PC | 1.2 |
| 80-340 | AUX STEAM HEADER | 271.522 | HP | PC | 1.2 |
| 80-341 | AUX STEAM HEADER INTERCONN BETWEEN UNITS | 12256.854 | HP | PC | 1.2 |
| 80-342 | AUX STEAM TO SCAPH | 10741.774 | HP | PC | 1.2 |
| 80-343 | AUX STEAM TO AH SOOT BLOWERS | 4750.498 | HP | PC | 1.2 |
| 80-344 | AUX STEAM TO FO SYSTEM TP | 46,100.270 | HP | PC | 1.2 |
| 80-345 | AUX STEAM TO DEAERATING HEATER | 3622.133 | HP | PC | 1.2 |
| 80-349 | AUX STEAM TO GLAND SEALS - TG SCOPE | 741.209 | HP | PC | 1.2 |
| 80-351 | AUX STEAM TO UNLISTED USERS - SG SCOPE | 22883.775 | HP | PC | 1.2 |
| 80-363 | EXHAUST STEAM FROM PRIME MOVERS-TG SCOPE | 35135.367 | HP | PC | 1.2 |
| 80-420 | BOILER FEED PUMP SUCTION | 21900.031 | HP | PC | 1.2 |
| 80-421 | BOILER FEED PUMP RECIRCULATION | 15007.497 | HP | PC | 1.2 |
| 80-423 | BOILER FEED PUMP TO HPH INCLUDING BYPASS | 104069.545 | HP | PC | 1.2 |
| 80-424 | BFD BETWEEN HTRS AND GROUP PROTECTION | 195899.072 | HP | PC | 1.2 |

| | | | | | |
|---|---|---|---|---|---|
| 80-425 | BFD FROM FINAL HPH TO SG TP | 57669.747 | HP | PC | 1.2 |
| 80-430 | SPRAY WATER TO HPBP | 5598.512 | HP | PC | 1.2 |
| 80-433 | SPRAY WATER FROM BFP INTERSTAGE | 9600.749 | HP | PC | 1.2 |
| 80-451 | BOILER INTEGRAL PIPING DRAINS | 22380.727 | HP | PC | 1.2 |
| 80-452 | HP PIPING DRAINS - SG SCOPE | 35056.067 | HP | PC | 1.2 |
| 80-453 | LP PIPING DRAINS - SG SCOPE | 2,777.880 | HP | PC | 1.2 |
| 80-455 | DRAIN FROM UNLISTED EQPT/VESSEL-SG SCOPE | 21670.509 | HP | PC | 1.2 |
| 80-457 | MANIFOLDS FOR HP FLASH BOX AND CONDENS | 601.777 | HP | PC | 1.2 |
| 80-395 | AUX STEAM TO FUEL OIL ATOMISING | 491.379 | HP | PC | 1.2 |
| 80-650 | FUEL OIL SUPPLY AND RETURN PIPING | 62615.240 | HP | PC | 1.2 |
| 80-992 | WELDING ELECTRODES-1 | 17682.000 | HP | PC | 1.2 |
| 80-993 | MISC ERECTION MATLS | 372.895 | HP | PC | 1.2 |
| 80-901 | SUB DELIVERY VALVES FOR LIGHT UP | 5197.245 | HP | PC | 1.2 |
| 81-412 | DIRECT GAUGES FOR NON-STEAM LINES | 823.000 | HP | PC | 1.2 |
| 80-431 | SPRAY WATER TO AUX PRDS | 946.730 | LP | PC | 1.3 |
| 80-371 | DRAIN FLASH TANK VENT TO CONDENSER | 2202.073 | LP | PC | 1.3 |
| 80-373 | AUX STEAM HEADER SV EXHAUST | 4459.744 | LP | PC | 1.3 |
| 80-375 | UNLISTED SV EXHAUSTS - TG SCOPE | 7214.762 | LP | PC | 1.3 |
| 80-379 | HPH SV EXHAUST TO FLASH TANK | 4272.687 | LP | PC | 1.3 |
| 80-381 | HP HEATER VENTS - TG SCOPE | 1670.570 | LP | PC | 1.3 |
| 80-382 | LP HEATER VENTS | 2243.267 | LP | PC | 1.3 |
| 80-385 | VENT FROM UNLISTED PPG/EQPT TO COND | 6627.237 | LP | PC | 1.3 |
| 80-388 | CONDENSER AIR EVACUATION PIPING | 8166.328 | LP | PC | 1.3 |
| 80-400 | CONDENSATE SUCTION | 10614.657 | LP | PC | 1.3 |
| 80-401 | CD FROM PUMP TO LPH1/DC INLET TEE AND RE | 41463.711 | LP | PC | 1.3 |
| 80-402 | CD FROM LPH1/DC INLET TEE TO TG TP | 16833.317 | LP | PC | 1.3 |
| 80-403 | CD FROM TG TP TO DEAERATING HEATER | 14464.209 | LP | PC | 1.3 |
| 80-407 | CONDENSATE FOR SEALING OF VACUUM | 3214.662 | LP | PC | 1.3 |
| 80-408 | CONDENSATE DUMP FROM HEADER | 1093.041 | LP | PC | 1.3 |
| 80-419 | DEAERATOR SAFETY VALVE EXHAUST TO ATM | 4800.300 | LP | PC | 1.3 |
| 80-434 | UNLISTED SPRAY WATER - SG SCOPE | 3880.765 | LP | PC | 1.3 |
| 80-435 | UNLISTED SPRAY WATER - TG SCOPE | 946.730 | LP | PC | 1.3 |
| 80-439 | TURBINE FLASH TANK DRAIN TO CONDENSER | 206.274 | LP | PC | 1.3 |
| 80-442 | GLAND STEAM COOLER DRAINS | 423.467 | LP | PC | 1.3 |
| 80-443 | LP HEATER-1 TO CONDENSER | 5011.293 | LP | PC | 1.3 |
| 80-444 | LP HEATER-2/3/4/5 DRAINS AND DRIP PUMP I | 8734.741 | LP | PC | 1.3 |
| 80-446 | DEAERATING HEATER OVER FLOW AND DRAIN | 3803.493 | LP | PC | 1.3 |
| 80-447 | HP HEATER DRAINS | 19900.368 | LP | PC | 1.3 |
| 80-448 | DRAIN FROM UNLISTED EQPT/VESSEL-TG SCOPE | 1102.823 | LP | PC | 1.3 |

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| 80-449 | TG CYCLE PIPING DRAINS AND VENTS | 20590.479 | LP | PC | 1.3 |
| 80-454 | SCAPH DRAINS | 1685.594 | LP | PC | 1.3 |
| 80-459 | HP FLASH TANK DRAIN TO CONDENSER | 1977.201 | LP | PC | 1.3 |
| 80-460 | SG AUX COOLING WATER UNIT SYSTEM | 9136.587 | LP | PC | 1.3 |
| 80-463 | TG AUX COOLING WATER | 91921.900 | LP | PC | 1.3 |
| 80-471 | BOILER WATER WASH TO AND FROM UNIT | 24037.614 | LP | PC | 1.3 |
| 80-477 | SERVICE WATER PIPING | 8605.925 | LP | PC | 1.3 |
| 80-480 | FIRE WATER-OTHER AREAS | 32209.870 | LP | PC | 1.3 |
| 80-493 | HP FLASH TANK VENT TO CONDENSER | 2051.673 | LP | PC | 1.3 |
| 80-494 | LP FLASH TANK VENT TO CONDENSER | 3179.408 | LP | PC | 1.3 |
| 80-495 | LP FLASH TANK DRAIN TO COND | 841.731 | LP | PC | 1.3 |
| 80-545 | LP CONDENSATE PIPING WITHIN TG HALL FOR | 18555.594 | LP | PC | 1.3 |
| 80-610 | SERVICE AIR-COMP SUCT AND DIS TO RECEI | 2000.000 | LP | PC | 1.3 |
| 80-612 | SERVICE AIR FOR INDIVIDUAL UNITS | 2000.000 | LP | PC | 1.3 |
| 80-614 | INST AIR COMP SUC AND DIS TO RECEIVER | 17411.141 | LP | PC | 1.3 |
| 80-616 | INSTRUMENT AIR FOR INDIVIDUAL UNIT | 25521.100 | LP | PC | 1.3 |
| 80-673 | LUBE OIL PIPING SYSTEM | 10559.582 | LP | PC | 1.3 |
| 80-468 | ACW PIPING | 128502.352 | LP | PC | 1.3 |
| 80-473 | DEMINERALISED WATER SYSTEM | 1494.587 | SS | PC | 1.4 |
| 80-478 | DRINKING WATER PIPING | 937.480 | SS | PC | 1.4 |
| 80-468 | ACW PIPING (SS DUPLEX) | 16722.295 | SS | PC | 1.4 |
| 80-601 | LOW PRESSURE DOSING PIPING | 1071.235 | SS | PC | 1.4 |
| 80-412 | CONDENSATE TRANSFER | 413.777 | SS | PC | 1.4 |
| 80-830 | H AND S FOR CRITICAL PIPING - STEAM LINE | 177546.104 | H&S | PC | 1.5 |
| 80-920 | H AND S FOR HYDRO TEST | 29411.937 | H&S | PC | 1.5 |
| 80-921 | H AND S FOR LIGHT UP STEAM LINE | 104092.249 | H&S | PC | 1.5 |
| 80-928 | H AND S FOR BOILER LIGHT UP - TG | 42741.427 | H&S | PC | 1.5 |
| 80-930 | H AND S FOR SYNCHRONISATION - TG | 120450.632 | H&S | PC | 1.5 |
| 80-933 | H AND S FOR LP PIPING | 34755.309 | H&S | PC | 1.5 |
| 80-935 | VLH AND CLH for MS PPG UPTO MSV -HERP | 4385.438 | H&S | PC | 1.5 |
| 80-936 | VLH AND CLH for SG PPG -HERP | 4444.557 | H&S | PC | 1.5 |
| 80-937 | VLH AND CLH Critical PPG -HERP | 42117.752 | H&S | PC | 1.5 |
| 80-940 | AUX STRUCTURE FOR CRITICAL PPG AND CD B | 194936.759 | H&S | PC | 1.5 |
| 80-941 | VLH AND CLH for BFD PPG -HERP | 16838.412 | H&S | PC | 1.5 |
| 80-942 | VLH AND CLH for TG PPG -HERP | 22495.424 | H&S | PC | 1.5 |
| 81-100 | CONDENSATE PUMP | 3000.000 | H&S | PC | 1.5 |
| 81-110 | COOLING WATER PUMP | 380.000 | H&S | PC | 1.5 |
| 80-926 | H AND S FOR TEMPORARY PIPING ACID AND AL | 36000.000 | TEMP-AC | PC | 1.6 |
| 80-604 | ACID CLEANING PIPING-TEMPORARY | 88000.000 | TEMP-AC | PC | 1.6 |
| 80-927 | H AND S FOR TEMPORARY PIPING - STEAM BLO | 10000.000 | TEMP-SB | PC | 1.7 |

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|---|---|---|---|---|---|
| 80-399 | STEAM BLOWING PIPING-TEMPORARY | 108000.000 | TEMP-SB | PC | 1.7 |
| 81-318 | FIX COM FOR MISCELLANEOUS PPG INSULATION | 7114.838 | INSL - FC | PC | 1.9 |
| 81-325 | MINERAL WOOL MATTRESS | 45000.00 | INSL - RW | PC | 1.8 |
| 81-341 | SEALING COMPOUND FOR INSL | 710.000 | INSL - FC | PC | 1.9 |
| 81-350 | ALUMINIUM CLADDING FOR INSULATION | 24698.564 | INSL - AL CL | PC | 1.10 |
| | DMCW BFV VALVES | 23855.000 | LP | PEM | 1.3 |
| | ACW BFV VALVES | 5000.000 | LP | PEM | 1.3 |
| | LP PIPING VALVES | 15000.000 | LP | PEM | 1.3 |
| | AIR TRAP | 500.000 | LP | PEM | 1.3 |
| | BALL VALVES | 2000.000 | LP | PEM | 1.3 |
| | BFV STEAM SERVICE | 15000.000 | LP | PEM | 1.3 |
| | CONTROL VALVES | 13000.000 | LP | PEM | 1.3 |
| | FLOW ELEMENTS (ORIFICE, NOZZLE, ROTAMETER) | 11500.000 | LP | PEM | 1.3 |
| | DESH | 5000.000 | LP | PEM | 1.3 |
| | STEAM TRAPS | 1500.000 | LP | PEM | 1.3 |
| | BELLOWS | 34000.000 | H&S | PEM | 1.5 |
| | AUX PRDS CV | 4000.000 | P91 | PEM | 1.1 |
| | THERMAL INSULATION - MATTRESS | 350000.000 | INSL - RW | PEM | 1.8 |
| | THERMAL INSULATION - ANCILLARY | 30000.000 | INSL - FC | PEM | 1.9 |
| | ALUMINIUM CLADDING FOR INSULATION | 50000.000 | INSL - AL CL | PEM | 1.10 |
| | DMCW BFV | 16737.000 | LP | BPL | 1.3 |
| | ACW BFV | 20000.000 | LP | BPL | 1.3 |
| | DRIVE TURBINE PIPING INSULATION | 5000.000 | INSL - RW | HYD | 1.8 |
| | FCV (3 NOS) | 12000.000 | HP | HYD | 1.2 |
| | ORIFICE | 1000.000 | HP | HYD | 1.2 |
| 80-XXX | TRICHY VALVES | 305025.300 | HP | TRY -VLV | 1.2 |
| 80-XXX | TRICHY VALVES | 11169.119 | P91 | TRY -VLV | 1.1 |
| 20-101 | TRICHY VALVES (HPBP VALVE) | 3171.000 | P91 | TRY -VLV | 1.1 |

**Tentative Tonnage BOQ wise (in MT) is as follows;**

| Sl No | BOQ Description | CL No | | | | | For balance CL No as per terms of payment against each category |
|---|---|---|---|---|---|---|---|
| | | Pre-Assembly 1.7.2.1 | Placement in Position 1.7.2.2 | Alignment 1.7.2.3 | Welding / Bolting / Fixing 1.7.2.4 | Non-Destructive Examination & Stress Relieving / Heat Treatment 1.7.2.5 | |
| 1.1 | P91 Piping | 255.190 | 287.507 | 433.875 | 462.221 | 605.539 | 630.996 |
| 1.2 | HP Piping | 1134.254 | 1240.192 | 1283.971 | 1291.797 | 1364.135 | 1405.587 |
| 1.3 | LP Piping | 671.066 | 704.176 | 710.371 | 710.371 | 756.657 | 756.657 |
| 1.4 | SS Piping | 20.639 | 20.639 | 20.639 | 20.639 | 20.639 | 20.639 |
| 1.5 | Hangers and Supports including Tanks, Vessels, Pumps, etc | 831.596 | 831.596 | 831.596 | 832.235 | NA | 877.140 |
| 1.6 | Temporary Piping- Acid Cleaning | 124.000 | | | | | |
| 1.7 | Temporary Piping- Steam Blowing | 118.000 | | | | | |
| 1.8 | Mineral Wool | 400.000 | | | | | |
| 1.9 | Fixing Components | 37.825 | | | | | |
| 1.10 | Aluminium Sheets | 74.699 | | | | | |

| **Note to Weight Schedule:** | |
|---|---|
| 1 | The weights mentioned above are approximate and liable to vary as per design consideration. There will be change in PG, weight, description etc. However, payments will be made to the contractor for the tonnage actually executed at the respective category as per the quoted / accepted rate. Quantity Variation will be dealt as per clause 2.14 of General Conditions of Contract (Volume I Book II). |
| 2 | There may be variation or addition of PGMAs, description, weights etc., and any additional scope of work supplied under the above package shall be erected by the contractor and payment will be made as per the quoted/accepted rate in the respective category. |
| 3 | The temporary piping for Chemical Cleaning & steam Blowing will be issued as and where conditions in cut pieces. The scope includes cutting and edge preparation and erection as per the site condition & dismantling after the process is over and return to store with identification mark as instructed by the BHEL/Engineer. The quoted rate shall be inclusive of all this. |
| 4 | The erection & dismantling of temporary piping, pumps, tanks, dummy plates & other miscellaneous equipment etc. for pre-commissioning and commissioning activities like hydraulic test, chemical cleaning, steam blowing, etc. are covered in this contract and shall be carried out as a part of work. There will not be any separate payment for this works. |
| 5 | Also refer Erection welding schedule attached with this tender booklet |
| 6 | SS materials supplied in any other PGMA shall also be paid under “SS Piping” |
| 7 | P92 materials supplied (if any) shall also be paid under “P91 Piping” |
| 8 | PGMA weight mentioned in 1.9.2 is tentative balance placement weight. In addition to this tonnage, the contractor is responsible for completing the remaining balance of work that has already been undertaken and the payment will be made as per the activities carried out. |
| 9 | NDT & Post weld heat treatment of the already welded jobs are also included in this contract. |
| 10 | Any repair of already welded joints are also included in this contract |
| 11 | For already placed pipes, subsequent activities should be taken up and payment will be paid for the activity carried out. |
| 12 | Erection of Hangers & Supports, Pressure tapping, temperature elements, and any other tapping point including valve erection, erection of flow elements/ orifice, painting/ Insulation and any other works required for completion of already erected pipes are included in this contract. |
| 13 | Hydraulic Test, flushing & any other commissioning activities including steam blowing for already erected pipes are included in this contract. |

## VOLUME-IA PART-I CHAPTER - X
## GENERAL

**The scope of the work will comprise of but not limited to the following:** (All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

**1.10.1** Successful Bidder is requested to furnish the following at PSSR-Site immediately after release of Letter of Intent (LOI)

(i) Security Deposit.
(ii) Unqualified Acceptance for Detailed LOI/ Work Order.
(iii) Rs.100/- Stamp Paper for preparation of Contract Agreement.

**1.10.2** Successful Bidders are requested to furnish the proof of documents for the following at PSSR- Site.

(i) PF Regn No.
(ii) Labour License No.
(ii) Workmen Insurance Policy No.

**1.10.3** In addition to the clause 2.8 of General Conditions of Contract (Volume1C of Book-II) the contractor shall comply with the following

1.10.3.1 BOCW Act & BOCW Welfare Cess Act

1.10.3.1.1 The Contractor Should Register their Establishment under BOCW Act 1996 read with rules 1998 by submitting Form I (Application for Registration of Establishment) and Form IV (Notice of Commencement /Completion of Building Other Construction Work) to the respective Labour Authorities i.e.,

a) Assistant Labour Commissioner (Central) in respect of the project premises which is under the purview of Central Govt.–NTPC, NTPL etc.
b) Appropriate State authorities in respect of the project premises which is under the purview of State Govt.

1.10.3.1.2 The Contractor Should comply with the provisions of BOCW Welfare Cess Act 1996 in respect of the work awarded to them by BHEL

1.10.3.1.3 The contractor should ensure compliance regarding Registration of Building Workers as Beneficiaries, Hours of work, welfare measures and other conditions of service with particular reference to Safety and Health measures like Safety Officers, safety committee, issue of Personal protective equipments, canteen, rest room, drinking water, Toilets, ambulance, first aid centre etc.,

1.10.3.1.4 The contractor irrespective of their nature of work and manpower (Civil, Mechanical, Electrical works etc) should register their establishment under BOCW Act 1996 and comply with BOCW Welfare Cess Act 1996.

1.10.3.1.5 Contractor shall make remittance of the BOCW cess as per Act in consultation with BHEL as per the rates in force (presently 1%). BHEL shall reimburse the same upon production of documentary evidence. However, BHEL shall not reimburse the Fee paid towards the registration of establishment, fess paid towards registration of beneficiaries and contribution of beneficiaries remitted.

1.10.3.1.6 Non-compliance to provisions of the BOCW act and BOCW welfare Cess act is not acceptable. In case of any non-compliance, BHEL reserves the right to withhold any sum it deems fit. Only upon total compliance to the BOCW act and also discharge of total payment of Cess under the BOCW Cess act by the contractor, BHEL shall consider refund of the amounts.

1.10.3.2 **PROVIDENT FUND**

1.10.3.2.1 The contractor is required to extend the benefit of Provident Fund to the labour employed by the contractor in connection with this contract as per the Employees Provident Fund and Miscellaneous Provisions Act 1952. For due implementation of the same, the contractor is hereby required to get themselves registered with the Provident Fund authorities for the purpose of reconciliation of PF dues and furnish to us the code number allotted to them by the Provident Fund authorities within one month from the date of issue of this letter of intent. In case the contractor is exempted from such remittance an attested copy of authority for such exemption is to be furnished. Please note that in the event of contractor's failure to comply with the provisions of said Act, if recoveries therefore are enforced from payments due to BHEL by the customer or paid to statutory authorities by BHEL, such amount will be recovered from payments due to the contractor.

1.10.3.2.2 The final bill amount would be released only on production of clearance certificate from PF / ESI and labour authorities as applicable.

1.10.3.3 **OTHER STATUTORY REQUIREMENTS**

1.10.3.3.1 The Contractor shall submit a copy of Labour License obtained from the Licensing Officer (Form VI) u/r25 read with u/s 12 of Contract Labour (R&A) Act 1970 & rules and Valid WC Insurance copy or ESI Code (if applicable) and PF code no along with the first running bill.

1.10.3.3.2 The contactor shall submit monthly running bills along with the copies of monthly wages (of the preceding month) u/r78(1)(a)(1) of Contract Labour Rules, copies of monthly return of PF contribution with remittance Challans under Employees Provident Fund Act 1952 and copy of renewed WC Insurance policy or copies of monthly return of ESI contribution with Challans under ESI Act 1948 (if applicable) in respect of the workmen engaged by them.

1.10.3.3.3 The Contractor should ensure compliance of Sec 21 of Contract Labour (R&A) Act 1970 regarding responsibility for payment of Wages. In case of "Non-compliance of Sec 21 or non-payment of wages" to the workmen before the expiry of wage period by the contactor, BHEL will reserve its right to pay the workmen under the orders of Appropriate authority at the risk and cost of the Contractor.

1.10.3.3.4 The Contractor shall submit copies of Final Settlement statement of disbursal of retrenchment benefits on retrenchment of each workman under I D Act 1948, copies of Form 6-A (Annual Return of PF Contribution) along with Copies of PF Contribution Card of each member under PF Act and copies of monthly return on ESI Contribution – Form 6 under ESI Act1948 (If applicable) to BHEL along with the Final Bill.

1.10.3.3.5 In case of any dispute pending before the appropriate authority under I D act 1948, WC Act 1923 or ESI Act 1948 and PF Act 1952, BHEL reserve the right to hold such amounts from the final bills of the Contractor which will be released on submission of proof of settlement of issues from the appropriate authority under the act.

1.10.3.3.6 In case of any dispute prolonged/pending before the authority for the reasons not attributable to the contractor, BHEL reserves the right to release the final bill of the contractor on submission of Indemnity bond by the contractor indemnifying BHEL against any claims that may arise at a later date without prejudice to the rights of BHEL

1.10.3.4 **DEPLOYMENT OF SKILLED / SEMI-SKILLED TRADESMEN**

The following clause is applicable in case the contract value / contract price is Rs. Five crores and above.

The contractor shall, at all stages of work deploy skilled / semi-skilled tradesmen who are qualified and possess certificate in particular trade from CPWD Training Institute / Industrial Training. Institute / National Institute of Construction Management and Research (NICMAR), National Academy of Construction, CIDC or any similar reputed and recognized Institute managed / certified by State / Central Government. The number of such qualified tradesmen shall not be less than 20% of total skilled / semi-skilled workers required in each trade at any stage of work. The contractor shall submit number of man days required in respect of each trade, its scheduling and the list of qualified tradesmen along with requisite certificate from recognized Institute to Engineer-in-Charge for approval. Notwithstanding such approval, if the tradesmen are found to have inadequate skill to execute the work of respective trade, the contractor shall substitute such tradesmen within two days of written notice from Engineer-in-Charge. Failure on the part of contractor to obtain approval of Engineer-in-Charge or failure to deploy qualified tradesmen will attract a compensation to be paid by contractor at the rate of Rs. 100 per such tradesman per day. Decision of Engineer-in-Charge as to whether particular tradesman possesses requisite skill and amount of compensation in case of default shall be final and binding.

## 1.10.4 GENERAL

1.10.4.1 **Site Visit by the Bidder**

The bidder shall, prior to submitting his tender for the work, visit, examine the site of works and its surroundings at his own expense, and obtain and ascertain for himself on his own responsibility all information that may be necessary for preparing his tender and entering into a contract, and take the same into account in the quoted contract price for the work.

The bidder shall satisfy themselves about the following factors:

i) Site conditions including access to the site, existing and required roads and other means of transport/communication

for use by him in connection with the work including diverting and re-routing of services.

ii) Requirement and availability of land and other facilities of his enabling works, establishment of his nursery, office, stores etc.
iii) Ground conditions including those bearing upon transportation, disposal, handling and storage of materials required for the work or obtained there-from.

iv) Source and extent of availability of suitable materials, including water etc., and labour (skilled and unskilled) required for work, and

laws and regulations governing their use and employment.

v) Geological, meteorological, topographical and other general features of the site and its surroundings as are pertaining to and needed for the performance of the work.

vi) The limit and extent of surface and subsurface water to be encountered during the performance of the work, and the requirement of drainage and pumping.

vii) The type of equipment and facilities needed, for and in the performance of the work;

viii) The extent of lead and lift required for the work in complete form over the entire duration of the contract, and

ix) All other information pertaining to and needed for the work including information as to the risks, contingencies and other circumstances which may influence or affect the work or the cost thereof under this contract.

1.10.4.2 The bidder should note that information, if any, in regard to the local conditions, as contained in these tender documents, has been given to tenderer merely for guidance and is not warranted to be complete.

1.10.4.3 A bidder shall be deemed to have full knowledge of the site, whether he inspects it or not, and no extra charges consequent on any misunderstanding or otherwise shall be allowed.

1.10.4.4 The bidder and any of his personnel or agents will be granted permission by the Site-In-Charge or his authorized nominee, on receipt of formal application in respect thereof a week in advance of the proposed date of inspection of site, to enter upon his premises

and lands for purpose of such inspection, but only on the express condition that the tenderer (and his personnel and agents) will relieve and indemnify the Employer (and his personnel and agents) from and against all liability in respect thereof and will be responsible for personal injury (whether fatal or otherwise), loss of or damage to property and any other loss, damage, costs and expenses however caused which, but for the exercise of such permission, would not have arisen.

1.10.4.5 All works shall be carried out in proper workmen like manner. Items of works covered by the following specification shall be carried out as per the best practices and according to the direction of the Engineer In- charge / BHEL, Site Engineer and to his satisfaction. Unless otherwise specified in this section or in the description of item, the cost of stage of works mentioned here under shall be deemed to have been included in the rates of items provided in the schedule.

1.10.4.6 Scope of work covered under this specification requires quality workmanship, engineering, and construction management. The contractor shall ensure timely completion of work. The contractor shall have adequate tools, measuring instruments, etc. in his possession. He shall also have adequate trained, qualified and experienced engineers, supervisory staff and skilled personnel. The manpower deployment identified by contractor shall match with above scope of works.

1.10.4.7 It is not the intent to specify herein all details of all material. Any item related this work not covered by this but necessary to complete the system will be deemed to have been included in the scope of the work

1.10.4.8 All the necessary certificates and licenses required to carry out this scope of work are to be arranged by the contractor then and there at no extra cost.

1.10.4.9 Site testing wherever required shall be carried out for all items / materials installed by the contractor to ensure proper installation and functioning in accordance with drawings, specifications and manufacturer's recommendations.

1.10.4.10 The contractor shall carryout additional tests, if any, which the Engineer feels necessary because of site conditions and also to meet system specification

1.10.4.11 The work shall be executed under the usual conditions without affecting power plant construction and in conjunction with other operations and contracting agencies at site. The contractor and his personnel shall cooperate with the personnel of other agencies, co-ordinate his work with others and proceed in a manner that shall not delay or hinder the progress of work as a whole.

1.10.4.12 The Contractor may have to execute work in such a place and condition where other agencies also will be under such circumstances. The contractor shall co-operate with other contractors and agencies so that various activities can be carried out simultaneously in order to achieve an early completion

1.10.4.13 All the work shall be carried out as per instructions of BHEL engineer. BHEL engineer's decision regarding the correctness of the work and method of working shall be final and binding on the contractor.

1.10.4.14 Wherever Work sequences are furnished by BHEL, the contractor shall follow the same sequence.

1.10.4.15 Contractor shall execute the supply and works as per sequence prescribed by BHEL at site engineer. No claims for extra payment from the contractor will be entertained on the grounds of deviation from the methods of execution of similar job in any other site or for any reasons whatsoever.

1.10.4.16 If required by BHEL, the contractor shall change the sequence of his operation so that work on priority sectors can be completed within the projects schedule. The contractor shall afford maximum assistance to BHEL in this connection without causing delay to agreed completion date.

1.10.4.17 Contractor shall, transport all materials to site and unload at site / working area for inspection and checking. All material handling equipment required shall be arranged by the contractor.

1.10.4.18 The contractor will be responsible for the safe custody and proper accounting of all materials in connection with the work.

1.10.4.19 The contractor must obtain the signature and permission of the security personnel of the customer/BHEL for bringing any of their materials inside the site premises. Without the Entry Gate Pass these materials will not be allowed to be taken outside

1.10.4.20 Contractor shall retain all T&Ps, Material handling equipments etc at site as per advice of BHEL engineer and same shall be taken out from site only after getting the clearances from Engineer In-charge.

1.10.4.21 The contractor at his cost shall arrange necessary security measures for adequate protection of his machinery, equipment, tools, materials etc. BHEL shall not be responsible for any loss or damage to the contractor's construction equipment and materials. The contractor may consult the Engineer-in-Charge on the arrangements made for general site security for protection of his machinery equipment tools etc.

1.10.4.22 Any wrong erection shall be removed and re-erected promptly to comply with the design requirements to the satisfaction of Site Engineer

1.10.4.23 The Contractor may have to execute work in such a place and condition where other agencies also will be under such circumstances. However, completion time for construction, agreed will be subject to the condition that contractor's work is not hampered by the agencies.

1.10.4.24 Contractor has to work in close co-ordination with other agency at site. BHEL engineer will co-ordinate area clearance. In a project of such magnitude, it is possible that the area clearance may be less / more at a particular given time. Activities and Construction program have to be planned in such a way that the milestones are achieved as per schedule/ plans. Contractor shall arrange & augment the resources accordingly.

1.10.4.25 Contractor shall remove all scrap materials periodically generated from his working area in and around power station and collect the same at one place earmarked for the same. Failure to collect the scrap is likely to lead to accidents and as such BHEL reserves the right to collect and remove the scrap at contractor's risk and cost if there is any failure on the part of contractor in this respect. All the package materials, including special transporting frames, etc. shall be returned to the BHEL stores by the contractor.

1.10.4.26 The contractor shall ensure that his premises are always kept clean and tidy to the extent possible. Any untidiness noted on the part of the contractor shall be brought to the attention of the contractor's

site representative who shall take immediate action to clean the surroundings to the satisfaction of the Engineer-in-Charge.

1.10.4.27 The contractor is strictly prohibited from using BHEL's regular components like angles, channels, beams, plates, pipe / tubes, and handrails etc. for any temporary supporting or scaffolding works. Contractor shall arrange himself all such materials. In case of such misuse of BHEL materials, a sum as determined by BHEL engineer will be recovered from the contractor's bill. The decision of BHEL engineer is final and binding on the contractor.

1.10.4.28 No member of the already erected structure / platform, pipes, grills, platform, other component and auxiliaries should be cut without specific approval of BHEL engineer.

1.10.4.29 Contractors shall ensure that all their Staff / Employees are exposed to periodical training programme conducted by qualified agencies/ personnel on ISO 9001 - 2015 Standards.

1.10.4.30 The terminal points decided by BHEL are final and binding on the contractor for deciding the scope of work and effecting the payment for the work done up to the terminals.

1.10.4.31 Crane operators deployed by the contractor shall be tested by BHEL before he is allowed to operate the cranes.

1.10.4.32 On Completion of work, all the temporary buildings, structures, pipe lines, cable etc. shall be dismantled and leveled and debris shall be removed as per instruction of BHEL by the contractor at his cost. In the event of his failure to do so, the expenditure towards clearance of the same will be recovered from the contractor. The decision of BHEL Engineer in this regard is final.

1.10.4.33 It is the responsibility of the contractor to do the checking, testing etc. if necessary, repeatedly to satisfy BHEL Engineer with all the necessary tools and tackles, manpower etc. without any extra cost. The testing will be completed only when jointly certified so, by the BHEL Engineer.

1.10.4.34 The contractor shall ensure that his premises are always kept clean and tidy to the extent possible. Any untidiness noted on the part of the contractor shall be brought to the attention of the contractor's

site representative who shall take immediate action to clean the surroundings to the satisfaction of the Engineer-in-Charge.

1.10.4.35 If any item not covered but requires being executed, same shall be carried out by the contractor. Equivalent or proportional unit rate shall be considered wherever possible from the BOQ. The rates quoted by the contractor shall be uniform as far as possible for similar items appearing in rate schedule.

1.10.4.36 The contractor's work shall not hinder other work, either underground or over ground, such as electrical, phone lines, water or sewage lines, etc. In areas of overlap, the contractor shall work in coordination with other related contractors. Any damage by the landscape contractor's team to such utilities will be penalized and contractor shall be responsible for cost for such damages.

**1.10.5 SITE INSPECTION**

1.10.5.1 BHEL or his authorized agents may inspect various stages of work during the currency of the contract awarded to him. The contractor shall make necessary arrangements for such inspection and carry out the rectification pointed out by the owner / employer without any extra cost to the owner / employer. No cost whatsoever such duplication of inspection of work be entertained.

1.10.5.2 BHEL /Customer will have full power and authority to inspect the works at any time, either on the site or at the contractor's premises. The contractor shall arrange every facility and assistance to carry out such inspection. On no account will the contractor be allowed to proceed with

work of any type unless such work has been inspected and entries are made in the site inspection register by BHEL/Customer.

1.10.5.3 Wherever the performance of work by the contractor is not satisfactory in respect of workmanship, deployment of sufficient labour or equipment, delay in execution of work or any other matter, BHEL shall have the right to engage labour at normal ruling rates and get the work executed through other agency and debit the cost to the contractor and the contractor shall have no right to claim compensation thereof. In such a case, BHEL shall have the right to utilize the materials and tools brought by the contractors for the same work.

**1.10.6 DOCUMENTATION**

1.10.6.1 The following information shall be furnished by the bidder within two weeks of award of contract for purchaser's approval:

a) Bar chart covering planned activities at site

b) Detailed organization chart

c) Details of T&P available with contractors with documents proofs.

1.10.6.2 The following information shall be furnished by the bidder after testing and inspection: Test certificates of various tests conducted at site. All inspection and test certificates shall be signed by BHEL representative also.

## VOLUME-IA PART-I CHAPTER - XI
## PROGRESS OF WORK

(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

1.11.1 Refer forms F -14 to F-18 of volume I D (Forms & Procedure) of volume -I book-II. Plan and review will be done as per the formats.

1.11.2 The progress reports shall indicate the progress achieved against plan, indicating reasons for delays, if any. The report shall also give remedial actions which the contractor intends to make good the slippage or lost time so that further works can proceed as per the original plan the slippages do not accumulate and affect the overall programme.

1.11.3 Contractor is required to draw mutually agreed monthly erection programs in consultation with BHEL well in advance. Contractor shall ensure achievement of agreed program and shall also timely arrange additional resources considered necessary at no extra cost to BHEL.

1.11.4 Progress review meetings will be held at site during which actual progress during the week vis-a-vis scheduled program shall be discussed for actions to be taken for achieving targets. Contractor shall also present the program for subsequent week. The contractor shall constantly update / revise his work program to meet the overall requirement. All quality problems shall also be discussed during above review meetings. Necessary preventive and corrective action shall be discussed and decided upon in such review meetings and shall be implemented by the contractor in time bound manner so as to eliminate the cause of nonconformities.

1.11.5 The contractor shall submit daily, weekly and monthly progress reports, manpower reports, materials reports, consumables (gases / electrodes) report, cranes availability report and other reports as per Performa considered necessary by the Engineer. The periodicity of the reports will be decided by BHEL Engineer at site.

1.11.6 The monthly report as a booklet shall be submitted at the end of every month and shall contain the following details: -

a. Progress photographs in color.

b. Erection progress in terms of tonnage, welding joints, radiography, stress relieving, etc., completed as relevant to the respective work areas against planned.

c. Site Organization chart of engineers & supervisors as on the last day of the month with further mobilization plan

d. Category- wise man hours engaged during the previous month under the categories of fitters, welders, riggers, khalasis, grinder-men, gas-cutters, electricians, crane operations and helpers. Data shall be split up under the work areas like Piping, Insulation etc.

e. Consumables report giving consumption of all types of gases and electrodes during the previous month.

f. Availability report of cranes

g. Safety implementation report in the format

h. Pending material and any other inputs required from BHEL for activities planned during the subsequent month.

1.11.7 The manpower reports shall clearly indicate the manpower deployed, category wise specifying also the activities in which they are engaged.

1.11.8 The contractor shall submit weekly / fortnightly / monthly statement report regarding consumption of all consumables for cost analysis purposes.

During the course of erection, if the progress is found unsatisfactory, or if the target dates fixed from time to time for every milestone are to be advanced, or in the opinion of BHEL, if it is found that the skilled workmen like fitters, operators, technicians employed are not sufficient BHEL will induct required additional workmen to improve the progress and recover all charges incurred on this account including all expenses together with BHEL overheads from contractor's bills.

## VOLUME-IA PART-I CHAPTER -XII
## FOUNDATIONS AND GROUTING

**The scope of the work will comprise of but not limited to the following:**

(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

1.12.1 Foundation for the equipment to be erected shall be provided by BHEL / clients of BHEL. The dimensions of the foundations and anchor bolt pits shall be checked by the contractor for their correctness as per drawings. Further, top elevation of foundations shall be checked with respect to bench mark etc. All adjustments of foundations surfaces, enlarging the pockets in foundations etc. as may be required for the erection of equipment / plants shall be carried out by the contractor.

1.12.2 Cleaning of foundation surfaces, pocket holes and anchor bolt pits etc., dewatering, making them free of oil, grease, sand and other foreign materials by soda wash, water wash, compressed air or any other approved methods etc., form / shuttering work are within the scope this work.

1.12.3 It shall be contractor's responsibility to check the various equipment foundations for their correctness with respect to level, orientation, dimensions etc., and ascertained dimensions shall be measured and submitted to BHEL for approval before erection. Also minor chipping, dressing of foundations up to 30 mm for obtaining proper face for packer plates / shims, and may be required for the erection of the equipment / plants will have to be carried out by the contractor without extra cost

1.12.4 The surface of foundations shall be dressed to bring the surface of the foundations to the required level and smoothness prior to placement of equipment / equipment based on the foundations including shear lug provisions / openings.

1.12.5 Foundation pockets are to be cleaned thoroughly before placing the supports / columns / equipment. Verticality of foundation bolts to be checked along with correctness of the threads and freeness of the nuts movement. If required cleaning of the threads to be done with proper dies.

1.12.6 The concrete foundation, surfaces shall be properly prepared by chipping, as required to bring the top of such foundation to the required level to provide the necessary roughness for bondage and to ensure enough bearing strength. All laitance and surface film shall be removed and cleaned and the packers placed with suitable mortar prior to erection of the equipment.

1.12.7 Non shrink cementitious flow able grout shall be used for grouting of pockets and under pinning work below base plate of columns. Nominal thickness of grout shall be 50 mm. Non shrink cum plasticizer admixture shall be added

in the grout. Crushing strength of the grout shall be generally being one grade higher than that of the base concrete. Minimum grade of grout shall be M30.

1.12.8 However, for Equipment Foundations, high strength (Minimum Characteristic Compressive Strength of 60 N/mm$^2$ at 28 days) ready mixed non-shrink, Chloride free, Cement based, free flowing, non-metallic grout as recommended by Equipment manufacturer shall be used. The ready mix grout shall be of reputed make as approved by the customer. Total grouting of the columns/equipment including pocket grouting, grouting at the gap between foundation and base plates top surface of column / equipment is in the scope of the contractor. The quoted rate shall inclusive of the same.

1.12.9 The contractor shall arrange for grouting of foundation bolt holes of equipment and final grouting of equipment as per the drawings / specification as advised by the Engineer or BHEL after preparing the foundation surface for grouting. The contractor has to arrange, a representative from the supplier of special cement for witnessing the grouting and other works at their cost including any miscellaneous expenditure for this activity. BHEL will not pay any service and incidental charges for arranging the supplier representative. The contractor to take note of this aspect and quote accordingly.

1.12.10 All equipment bases and structural steel bases and foundations pockets shall be grouted and finished as per the specifications after surface preparation unless otherwise recommended by the equipment manufacturers. The surface preparation includes soda washing of the foundations to remove oil, grease etc. to ensure proper grouting.

1.12.11 The certificates of the grout are to be submitted BHEL. If necessary, test cubes are to be made and tested at site to ensure the quality of the grout as per relevant IS standards. In case grouting with Portland cement is approved, necessary cement, sand etc. to be arranged by the contractor including the fine aggregates.

1.12.12 All the materials required for grouting including special cements as approved by BHEL and other materials like Portland cement, sand, chips, gravel, etc., are to be arranged by the contractor at his cost. It shall be the responsibility of the contractor to obtain prior approval of BHEL, regarding suppliers, type of grouting cements before procurement of grouting cements.

1.12.13 Certain packer plates and shims over and above the quantity received as part of supplies from manufacturing units of BHEL will have to be cut out from steel plates / sheets at site by the contractor to meet site requirement. However, machining of the packers, wherever necessary, will be arranged by BHEL at free of cost.

1.12.14 Providing & grouting of pocket holes, pipe sleeves and under base plate of structural steel work/ machinery/ pipe supporting structures including roughening of surface, cleaning, ramming, curing etc. all complete with non-shrink cementitious flow able grout as per specification using non-shrink cum plasticizer admixture. Crushing Strength of the grout shall be one grade higher than that of the base concrete (however grade of grout shall be minimum M30 to max M35 grade).

1.12.15 The contractor at his cost shall arrange for grouting of anchor points of T & P issued to him and also grouting of winches or any other supports required for T & Ps. Necessary grout materials are to be arranged by the contractor at his cost.

1.12.16 Total grouting of the columns/equipment including pocket grouting, grouting at the gap between foundation and base plates top surface of column/equipment is in the scope of the contractor. All the grouting Piping should be carried out by non-shrink cement like Conbextra GPI / Conbextra GP II of 'FOSROC' make / Shrinkkomp or its equivalent etc . This special non-shrink cement shall be arranged by the contractor at his cost. Premixed grout of above mentioned non-shrink cement of crushing strength 650kg/sq cm for major equipment foundation and 450 kg/sq cm for other foundation where concrete grade M30 or higher is provided. The quoted rate shall be inclusive of the same.

1.12.17 **PROCEDURE FOR GROUTING:**

Contractor has to carry out the grouting as per the work instructions for grouting available at site or the grouting is to be carried out as per the supplier's recommendation / IS standard. Copy of those recommendations is to be submitted to BHEL for records.

## VOLUME-IA PART-I CHAPTER -XIII
## MATERIAL HANDLING, TRANSPORTATION AND
## SITE STORAGE

**The scope of the work will comprise of but not limited to the following:**

(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

1.13.1 While BHEL will endeavor to store / stack / identify materials properly in their open / closed storage yard / shed it shall be contractor's responsibility to assist BHEL in identifying materials well in time for erection, taking delivery of the same in time following the procedure indicated by BHEL and transport the material safely to pre-assembly yard / erection site in time according to program.

1.13.2 The contractor shall identify necessary supervisor / labour for the above work in sufficient quantity as may be needed by BHEL for areas covering their scope.

1.13.3 It shall be contractor's responsibility to arrange necessary tractors, trailer or trucks / slings / tools and tackles / labour including operators, Fuel, lubricants etc., for loading from storage yard and on to transport equipment, move it to erection site/pre-assembly yard and unload the same at pre-assembly yard/ erection site and the quoted rate shall include the same.

1.13.4 Any loss / damage to materials issued to contractor shall be made good by him or BHEL will arrange for replacement at cost recovery basis and decision of BHEL shall be final.

1.13.5 All welding filler wires / electrodes is issued to contractor shall be preserved by him carefully to prevent deterioration of their properties. Special care shall be taken to preserve alloy steel and other special electrodes / filler wires. Contractors shall exercise maximum care in using these electrodes, filler wires to minimize wastage by maintaining a record of all usages.

1.13.6 All pipe and tube ends shall be covered with plastic caps or will be closed with wooden plugs as the case may be.

1.13.7 All the surplus damaged, unused materials, package materials / containers / special transporting frames, gunny bags etc. supplied by BHEL shall be returned to the BHEL Stores by the contractor and maintain records.

1.13.8 The contractor shall take delivery of the components and equipment and special consumables from the storage area after getting the approval of the BHEL Engineer on standard indent forms to be specified by BHEL. At periodic / intervals of work, complete and detailed account of the equipment so erected and electrodes used shall be submitted to the BHEL Engineer.

1.13.9 The Contractor shall have total responsibility for all equipment and materials in his custody, stores, loose, semi-assembled, assembled or erected by him at site.

1.13.10 The contractor shall make suitable security arrangement including employment of security personnel to ensure the protection of all materials / equipment and works from theft, fire, pilferage and any other damage and loss.

1.13.11 The contractor shall ensure that the packing materials and protection devices used for the various equipment during transit and storage are removed before these equipment are installed.

1.13.12 All equipment shall be handled very carefully to prevent any damage or loss. No bare wire ropes, slings etc. shall be used for unloading and / or handling of the equipment without the specific written permission of the Engineer. The equipment from the storage yard shall be moved to the actual site of erection / location at the appropriate time as per the direction of BHEL Engineer so as to avoid damage for such equipment at site.

1.13.13 The contractor shall take all reasonable care to protect the materials and work till such time the erected equipment has been taken over by BHEL/their client. Wherever necessary suitable temporary fencing and lighting shall have to be provided by the contractor as a safety measure against accident and damage of property of BHEL. Suitable caution notices shall be displayed where access to any part may be deemed to be unsafe and hazardous.

1.13.14 The contractor shall take delivery of equipment from BHEL / Customer stores and storage yard. He shall also make arrangements for verification of equipment, scrupulously maintain records and keep safe custody watch and ward of equipment after it has been handed over to him till these are fully erected, tested and commissioned and taken over by BHEL's client. The stolen / lost / damaged goods shall have to be made good by the contractor at his own cost.

1.13.15 Loading at BHEL / Customer stores and storage yard, transport to site, unloading at site / pre-assembly area / working area of equipment, placement on respective foundation / location, fabrication yard, pre-assembly bay or at working area are in the scope of work. The scope includes taking materials / Equipment from customer stores / storage yard also. Contractors Quoted / Accepted rate shall be inclusive of the same. Required cranes, tractors, trailer or trucks/ slings/ tools and tackles / labour including operators, fuel, lubricants etc. for loading & unloading of materials will be in the scope of contractor.

1.13.16 The contractor shall provide any fixtures, concrete blocks & wooden sleepers, sandbags which are required for temporary supporting of the components at their stores at site.

1.13.17 Sometimes it may become necessary for the contractor to handle certain unrequired components in order to take out the required materials. The contractor has to take this contingency also into account. No extra payment is payable for such contingencies.

1.13.18 Materials shall be stacked neatly, preserved and stored in the contractor's shed / work area in an orderly manner. In case it is necessary to shift and re-stack the materials kept at work area / site to enable other agencies to carry out their work, same shall be done by the contractor at no extra cost.

1.13.19 The contractor shall take necessary measures to see that all the machined surfaces are preserved and covered.

1.13.20 Contractor has to arrange required fire retardant covering materials (tarpaulins) to protect the machined components / assembled parts drawn from BHEL before and after erection at their cost.

1.13.21 Any fittings such as thermos-well plugs, radiography plugs which has been assembled and dispatched as a single Dispatch Able Unit (DU) shall be checked before drawing materials from BHEL Stores. If any such attachments / fittings are found missing the same shall be intimated to concern BHEL Officials and recorded before drawing materials. It shall be the contractor responsibility to safeguard such attachments / fittings. If lost at contractor custody, the same shall be arranged by the contractor else BHEL shall arrange at the cost of contractor.

1.13.22 Contractor shall plan and transport equipment, components from storage yard to erection site in such a manner and sequence that material accumulation at site does not lead to congestion at site of work.

1.13.23 It is the responsibility of the contractor to ensure that the insulation and refractory materials and sheet metal covering issued to him for application are well protected against loss or damage or weather conditions tending to affect its quality by the provision of close / semi closed sheds at his cost. If any damage occurs to the materials due to improper storage or due to any causes attributable to the contractor except for normal breakage or damaged material shall be to the cost of the contractor.

## VOLUME-IA PART-I CHAPTER- XIV

## ERECTION

### 1.14.1 COMMON TO PIPING AND INSULATION

1.14.1.1 The contractor will have to follow the instructions provided in the technical manuals, drawings, and specifications provided by BHEL, to the contractor from time to time. In case of ambiguity or deviation the decision / clarification of BHEL Engineer will have to be followed.

1.14.1.2 The work covered under this scope of work is of highly sophisticated nature requiring best quality / precision workmanship engineering and construction management. He should also ensure successful and timely commercial operation of equipment installed. The contractor must have adequate quantity of precision tools, construction aids in possession. Contractor must also have adequate trained qualified and experienced supervisory staff and skilled personnel.

1.14.1.3 In case of any class of work for which there is no such specifications as laid down in the contract such as blue matching, welding of stainless steel parts etc., the work shall be carried out in accordance with instructions and requirements of the BHEL engineer at the quoted rates only.

1.14.1.4 The equipment / materials from the storage yard shall be moved in sequence to the actual site of erection / location at the appropriate time as per the direction of BHEL Engineer so as to avoid damage / loss of such equipment at site.

1.14.1.5 Contractor has to arrange required fire retardant covering materials (tarpaulins) to protect the machined components / assembled parts drawn from BHEL before and after erection at their cost.

1.14.1.6 Any fixtures, scaffolding materials, approach ladders, concrete block supports, steel structures required for temporary supporting, pre assembly, checking, welding, lifting & handling during pre assembly and erection and during application of insulations shall be arranged by the contractor at his cost.

1.14.1.7 The contractor shall erect scaffolding / temporary platforms for erection as per the guidelines of relevant IS codes. These should be of adequate capacity and shall never be over loaded. These should be replaced when not found suitable during erection work and dismantled on work completion and removed from work site. Only steel scaffolding materials with proper clamps should be used. Use of bamboo / casuarinas shall not be permitted.

1.14.1.8 Contractor shall remove all scrap materials periodically generated from his working area and collect the same at one place earmarked for the same. Load of scraps is to be shifted to a place earmarked by BHEL. BHEL

reserves the right to collect and remove the scrap at contractor's risk and cost if there is any failure on the part of contractor in this respect. All the packaging materials, including special transporting frames, etc. shall be returned to the BHEL stores / customer's stores by the contractor and maintain records.

1.14.1.9 Contractor shall engage separate gangs throughout the contract period, exclusively for proper housekeeping of the site. The contractor has to make necessary arrangements for collection and for bringing down the scrap from, all locations and taking them away from the erection areas to various locations as indicated by BHEL Engineer. The house keeping must be a routine and continuous activity.

1.14.1.10 Any faulty erection shall be removed and re-erected promptly to comply with the design requirements to the satisfaction of Site Engineer.

1.14.1.11 Prior to erection of any components, inspection to be done for any foreign materials and damages and they are to be removed / attended as per instructions of BHEL engineer.

1.14.1.12 The contractor is strictly prohibited in using any of the BHEL's materials / components like angles, channels, hand-rails for any temporary supporting or scaffolding work or for using as bed for pre-assembly works etc.. In case of such misuse, a sum as determined by BHEL shall be recovered from contractor's bills.

1.14.1.13 The temporary structures / items welded to permanent members / pipes are to be cut and removed without any damage. Any damage so to permanent members / pipes to be made good by the contractor at his cost.

1.14.1.14 Upon completion of daily work, the contractor shall remove from the vicinity of work all scrap packing materials rubbish, unused and other materials and deposit them in places to be specified by BHEL Engineer.

1.14.1.15 Delay in clearance of mechanical equipment and piping for insulations is unlikely to happen. However, if any delay occurs, the contractor shall not claim anything extra, like idle charges.

1.14.1.16 Execution of insulation of Boiler Flash Tanks, Drain Tanks & associated piping is included in the scope of the contract.

### 1.14.2 **ERECTION OF PIPING**

1.14.2.1 Handling at site stores / storage yard, transporting to site, inspection, pre-assembly, erection, alignment, welding, NDT, fixing of hangers & supports, chemical cleaning / pickling, oil flushing, water flushing, hydro testing & steam blowing, surface finish, supply & application of primer & finish paints including labeling & flow direction on the piping over insulation & hangers and supports, pre-commissioning, commissioning, trial operation &

handing over to customer of Power cycle piping and its associated items / systems, hangers and supports, valves and other miscellaneous equipment.

1.14.2.2 Brief list of system / sub system, approximate weight of pipes and accessories to be erected by the contractor mentioned in the Bill of Quantity and numbers of joints mentioned in Erection Welding Schedule of this tender specification are meant for giving general idea to the tender only about magnitude of the work involved. The piping components are sent in parts for convenient transportation / layout requirements. They are to be cleaned, pre-assembled in stage by stage, welded, erected and aligned as per the drawing dimensions / tolerance and instructions of BHEL Engineers.

1.14.2.3 All the works such as cleaning, leveling, aligning, trial assembly, dismantling of certain components for checking and cleaning, surface preparation, fabrication of sheets, tubes and pipes as per general engineering practice and as per BHEL Engineer's instructions at site, cutting, weld depositing, grinding, straightening, chamfering, filing, chipping, drilling, reaming, scrapping, lapping, fitting-up, inspection, edge preparation if required, etc., as may be applicable in such erection works and are necessary to complete the work satisfactorily, shall be carried out by the contractor as part of the work within the quoted rate. Major machining work, which is only to be carried out in workshops, will be arranged by BHEL.

1.14.2.4 Erection of all items comprising piping systems such as valves, filters / strainers, expansion bellows, flow elements, hangers and supports, tanks, level instruments, pumps, associated skids are also a part of the scope.

1.14.2.5 All Operating / Approach platforms, cross over, canopies, ladders etc. along with their supporting structures, for the equipment / valves / filters etc shall be erected by the contractor as per instruction of BHEL and shall be paid as per accepted Tonnage rate for "Hangers and Supports".

1.14.2.6 Additional platforms, Cross over, Canopies, Ladders, etc. for approaching different equipment as per the site requirement, which may not be indicated in drawings, shall be fabricated and erected by contractor. However, the contractor shall be paid for this work on accepted tonnage rate for "Hangers and Supports". The steel materials required for these works shall be supplied by BHEL free of cost and the contractor will have to install them to suit the requirement.

1.14.2.7 If the provision of creep measurement is envisaged in the drawings, stubs erection and welding as per drawing shall be done by the contractor within the quoted rate.

1.14.2.8 The work on piping systems (air, water, oil, steam, gas etc.,) will include laying, edge preparation, fixing and welding of the elbows / fittings / valves etc., welded on the lines, NDE, fixing and adjustment of supports / hangers / shock absorbers and carrying out all other activities / works to complete the erection and also carrying out all pre-commissioning / commissioning operations mentioned in the specification as per BHEL Engineer's instructions and/or as per approved drawings / documents.

1.14.2.9 Contractor should obtain the formal clearance from Director of Boilers to carry out erection & Welding of piping under IBR purview (Power Cycle Piping and any other items as applicable included in the scope). Arrangement for the visit of Boiler inspector for field inspection etc. is in the scope of contractor, and necessary drawing / details only will be given by BHEL. Inspection fee, if any shall be paid by BHEL.

1.14.2.10 Contractor shall arrange the necessary clearance from any other statutory authorities as required for installation of the plant and equipment and render all assistance, service required in this regard. Inspection fee, if any will be paid by BHEL.

1.14.2.11 Fittings like bends, tees, elbow / bends, reducers, flanges etc., will be supplied as loose items.

1.14.2.12 Fittings shall be supplied with standard dimensions. Edge preparation, matching inner diameter of pipes for welding as per the drawing dimensions shall be part of erection works. No separate payment will be made for the correction of pipes, edge preparation of standard fittings such as bends, Tees etc.,

1.14.2.13 Normally weld neck valves will have prepared edges for welding. It may be occasionally necessary to prepare new edges or recondition the edges by grinding or chamfering to match the corresponding tubes and pipes. All fittings like tees, weld neck flanges, reducers, elbows, flanges, inserts etc., shall be suitably edge prepared and matched with pipes for welding. No extra cost shall be paid for this.

1.14.2.14 In case of piping connected to equipment, matching of flanges for achieving the parallelism and alignment at equipment end by suitably resorting to heat correction or other method as instructed by BHEL Engineer is within scope of work.

1.14.2.15 During connection & floating of any decks, etc., before and after pipe connections, adding tentative loads, readjusting of spring to the required level is covered in this scope of work.

1.14.2.16 Carrying out erection of piping as per the specification between equipment constituting terminal points, whether the terminal equipment fall within the scope of work / specification, contractor shall carry out the terminal joints

at either end. Also where the piping connection to the terminal points involve flanged joints, matching of flanges, fixing gaskets, bolting and tightening as per BHEL Engineers instructions is in the scope of work. In case piping connected to equipment, matching of flanges for achieving the parallelism and alignment at the equipment end by suitably resorting to heat correction or other method as instructed by BHEL Engineer, with in the quoted rate.

1.14.2.17 Erection of all drains / vents / relief / escape / safety valve, piping to various tanks / sewage / drain canal / flash box / flash tank / condenser / sump / atmosphere etc. from the stubs on the piping to the equipment erected by the contractor is completely covered in the scope of work.

1.14.2.18 Contractor has to carryout fabrication works such as welding of stubs / nipples, attachments etc., preparation of surface for rust preventive coating and application of rust preventive within the quoted / accepted rate.

1.14.2.19 Attachment, welding of necessary instrumentation tapping points, thermocouple pads, root valves, condensing vessels, flow nozzles and control valves etc., shall be the responsibility of the contractor and the same shall be done as per the instructions of BHEL Engineer. The erection and welding of all above items will be contractor's responsibility even if, the Items are supplied by an agency other than BHEL if they are integral to the scope envisaged under this package.

1.14.2.20 All the valves will have to be checked, cleaned, lapped or overhauled in full or in parts before erection, after chemical cleaning and during commissioning. The contractor, at his own cost, shall arrange experienced technicians for the above work, including required consumables.

1.14.2.21 The valves, actuators etc., will have to be checked, cleaned or overhauled in full or in part before erection, after chemical cleaning, steam blowing and during commissioning as may be necessary.

1.14.2.22 Contractor shall study the layout of LP piping and other site routed piping well before the start of work. Final routing shall be decided after approval from Site erection Engineer for site routed pipe in such a way that it does not foul with critical piping or other equipment or other piping.

1.14.2.23 For thermo-well welding with Carbon steel / alloy steel welding applicable combination electrodes shall be arranged by the contractor within the quoted rate.

1.14.2.24 During floating of critical lines insulation weights has to be added at hanger locations. Suitable weights like plates, structural members, etc shall be arranged by BHEL on returnable basis. Handling of the items shall be done by the contractor within the quoted rate.

1.14.2.25 Immediately after erecting electrically operated valves, Valve Tag Nos shall be painted or stickering shall be done for ease of identification.

1.14.2.26 All the valve packing has to be lubricated as per BHEL Engineer instruction till handing over. Necessary gland packing will be supplied by BHEL.

1.14.2.27 All the lifting equipment, actuators / power cylinders, valves / dampers, etc., shall be serviced and lubricated to the satisfaction of BHEL engineer before erecting the same and also during pre commissioning. The required cleaning, servicing and lubrication of bearings to be carried out before commissioning at no extra cost.

1.14.2.28 In the case of structural members, pipes, plates, ducts etc, in certain cases, the raw material will be supplied in random lengths and the contractor will have to make up the length / prepare the edges to suit the matching profiles, weld / bolt connect the joints within the quoted rates / prices.

1.14.2.29 All the tubes and pipes shall be cleaned and blown with compressed air and shown to the Engineer before lifting. Pipes above 2" diameter have to be cleaned by means of wire brush as per the instruction of BHEL Engineer and subsequently flushed with air before lifting them into position. Pipes below 2" diameter, shall be sponge cleaned with air flushing. After cleaning is over, the end caps shall be put back in tube openings till such time they are welded to other tubes. Required compressors shall be arranged by the contractor at his cost.

1.14.2.30 All the equipment / material to be taken inside the plant building shall be cleaned thoroughly before taking them inside and erect. The contractor shall clean, wherever necessary and paint inside surfaces of the equipment like coolers, oil tanks, Rubber expansion joints assembly and other components as per instruction of BHEL Engineer during erection at the quoted rate. The necessary compressor for air cleaning is to be arranged by contractor at his cost.

1.14.2.31 Fine fittings and other small bore piping have to be routed according to site conditions and hence shall be done only in position as per the site requirement. Necessary sketch for routing these lines should be got approved from BHEL by the contractor. In case any minor modifications are required in these pipelines after completion to meet the system requirements, the same shall be carried out by the contractor within the quoted rate. The contractor should absorb this cost in his quoted rate.

1.14.2.32 Work such as minor rectification of foundation bolts, reaming of holes, drilling of dowels, matching of bolts and nuts, making new dowel pin, etc. are covered in the scope of work.

1.14.2.33 Assistance for calibrating / testing the power cylinders/ actuators / valves, gauges, instruments, etc. and setting to actuators shall be provided by contractor within the quoted rates.

1.14.2.34 Before erecting the valves and other mountings, check for the tag for correct rating with valve schedule. Ensure correct flow direction. Ensure easy accessibility for operation and maintenance of valves.

1.14.2.35 All the drain lines should have sufficient slope towards drain. Slope of 1:500 shall be maintained towards drain point unless otherwise specified. Expansion loops shall be provided in all the vents and drains as per the drawings.

1.14.2.36 Wherever pipes / bends / equipment are supplied in pre-fabricated / assembled packages, there may be necessity to make minor changes, including strengthening by additional welds. This shall be treated as part of the contractor's scope.

1.14.2.37 All the oil & gas piping flanges, wherever provided are to be blue matched using surface plates for at least 80% contact area to attain leak proof of joints.

1.14.2.38 Wherever drawings indicate site routing and site fabrication, such pipes (in general equal to and less than 2" Dia) will be issued in running meters as straight length. These are to be cut to required at site length to suit layout as given in the erection drawing and edge prepared as per the standards / drawings and as per the instruction of BHEL Engineer. In some cases attachments like lugs, stoppers, cleats etc., will be supplied as loose items and to be cut and welded to the pipes at site as per erection drawing necessary drilling of holes on main pipe for welding stubs shall also be done at site by the contractor. The contractor shall weld the joints of site routing piping as per site requirement.

1.14.2.39 Certain extra lengths of portions / parts of various site fabricated components / parts / bellows / piping etc. are provided as erection allowance and they shall have to be cut to suit site conditions and layout. Certain small length of portions / components / bellows / piping casing etc., may have to be added to suit conditions and layouts. Preparing edges afresh and adopting specified heat treatment procedure, are in the scope of work. No extra payment will be admitted for such works.

1.14.2.40 Some extra lengths in various fabricated pipes given as erection allowance shall have to be cut and edges prepared to suit the site conditions at no extra cost. The contractor shall carry out the edge preparation of weld joints at site in accordance with the details acceptable to BHEL Engineer. Wherever possible machining or automatic flame cutting should be done. Gas cutting will be allowed only wherever edge

preparation otherwise is impractical. All slag / burrs shall be removed from the edge and all the hand cuts shall be ground smooth to the satisfaction of engineer. Prepared edges to be preserved / applied with weldable primer.

1.14.2.41 Minor adjustment like removal of ovalities in pipes and opening or closing of the fabricated bends by process of heat correction or any other method approved by BHEL Engineer to suit the layout, with specified heat treatment procedure shall be carried out by the contractor within the quoted rate.

1.14.2.42 For pipes nominal bore size 2" and below routing shall not be shown in piping layouts or in isometrics and the same to be routed / connected as shown in schematics. For the above sizes if the routing is shown in layouts it is only for guidance and the same shall be routed and supported as per site requirement / convenience as per site engineer's advice.

1.14.2.43 For Piping of nominal bore size 2" and below, valves, flanges, fittings etc. shall be supplied as commercially available. Hence fit-ups, edge preparation including welding of stubs, shall be included in the contractor's scope.

1.14.2.44 Contractor should fabricate bends of less than or equal to 2" diameter size at site from running meters of piping for the above and cut, edge prepare and lay the piping as per BHEL Engineer's instructions.

1.14.2.45 Contractor shall use only bolted clamps for achieving alignment of piping. Wherever "L" shaped stoppers and wedges are to be used for aligning piping and equipment, the same shall be subject to the approval of BHEL Engineer. Contractor shall remove the bridge, stopper etc., by grinding / gouging and not by hammering. Any burrs left on the equipment / piping, after welding, shall be ground off or any scar or cavity made good by welding and grinding. NDT tests shall be carried out if necessary to detect surface and sub-surface cracks in these ground areas.

1.14.2.46 Flame cutting of piping and other equipment shall be strictly done as per BHEL Engineer's instructions and in his presence only.

1.14.2.47 All the weld joints on equipment and piping shall be ground or filed after completion of welding and before radiography as per instructions of BHEL Engineer so as to achieve smooth surface to avoid of ripples, undulations etc.,

1.14.2.48 Wherever elbows of 45 deg or any other angle are required, the same shall be cut from 90 deg. elbow supplied and used as per the instructions of BHEL engineer. No extra cost shall be paid.

1.14.2.49 Flow nozzles, orifice, spray nozzles etc., shall be mounted / erected after chemical cleaning / flushing / or steam blowing at site.

1.14.2.50 Erection of Flow nozzles, flow orifices, flow switches, steam traps, filters, flow meters, flow indicators, other metering elements, spray nozzles, steam traps, flow orifices, flow indicators, control valves, aux. control valves, filters, suction strainers, CRH NRV and other NRVs, HPBP Valve and suction strainers of pumps, servomotors etc. forming part of the system (under this scope of work) irrespective of the suppliers is also to be carried out by the agency without any extra cost after chemical and / or steam blowing / oil flushing at site. This will include collecting from BHEL / Customer stores, transport to site, suitably cutting the erected piping, cleaning, erection, welding, radiography, NDE and stress relieving and commissioning.

1.14.2.51 Certain instruments like pressure switches, gauges, air sets, regulators, filters, junction boxes, power cylinders, dial gauges, thermometers, flow meters, valve actuators, flow indicators etc., are received in assembled conditions as integral part of equipment. Contractor shall dismount such instruments and re-erect whenever required prior to commissioning. Sometime this may have to be handed over to store or instrumentation contractor.

1.14.2.52 Fixing, fitting, welding of thermowells, stubs, hoses, tapping points, root valves and instruments etc., on different lines / equipment (which will be supplied by BHEL) is within the scope of work. Fixing of Pick-Ups, Probes & Accessories for vibration monitoring system is in the scope of this specification.

1.14.2.53 Contractor shall also weld small length of piping with root valve to the pressure, flow and level tapping points on piping or flow nozzles / orifices / metering elements fixed on piping as per the instructions of BHEL Engineer.

1.14.2.54 Welding of all thermowells, draft, pressure and temperature instrumentation points and all other instrumentation points on piping and auxiliaries and welding of thermocouple pads for permanent system as well as for performance guarantee test is in the scope of work.

1.14.2.55 It shall be the responsibility of the contractor to provide ladders on column for initial works till such time stairways are completed. For this the ladder should not be welded on the column and should be prefabricated clamping type ladders. No temporary welding on any structural member is permitted except under special circumstances with the approval of BHEL.

1.14.2.56 All thermowells (released under applicable PGMAs and loose received along with instruments) are to be fixed into the equipment and piping erected by PIPING agency as per drawing and same to be welded as per FQP within the quoted rates.

1.14.2.57 All piping items including pipes, valves, flanges, fittings etc. shall be supplied as commercially available. Hence Fit-ups, edge preparation including welding of stubs, shall be included in the contractor's scope.

1.14.2.58 The contractor shall take all reasonable care to protect the materials and equipment during erection. Touch up painting required to be done on any equipment or part during the course of erection will have to be done by the contractor.

1.14.2.59 The contractor shall also weld all thermowells, small length of pipes to all pressure, flow and level tapping points, isolating valves and root valves on all equipment under scope of erection of this contract. All embedded temperature measuring elements provided in the bearings will have to be terminated at the junction box by the contractor. Thermowells tapping point connections incorporated shall be plugged during the pressure testing and steam blow out of piping systems. Upon completion of blow out operation all thermowells and flow elements with branch pipes be installed and welded.

1.14.2.60 The hangers and supports for pipelines and pressure parts may be supplied in dismantled / knocked down condition. It is the responsibility of the contractor to assemble them as per approved drawings and install them in position as per site engineer instructions.

1.14.2.61 For hangers and supports the instruction given in the drawings and documents must be followed for handling, erection and setting of cold / hot values and locking etc.

1.14.2.62 Where the flange comes welded to the equipment, erection of counter flange, Hydrotesting and Normalisation of the line is under the scope of this contract. Where both the flange and counter flange come as loose items and need to be welded, the entire welding of flange and counter flange, Hydrotesting and Normalisation of the line are under the scope of this contract.

1.14.2.63 Wherever hangers and support materials of piping are not received from manufacturing unit in time to suit the erection schedule, contractor shall erect the piping system on temporary supports to ensure the progress of work within quoted rate. The required structural steel materials will be issued on free of charges by BHEL, either from scrap / spare materials. The same shall be removed and returned to BHEL store after erection of permanent supports.

1.14.2.64 Plate / Pipe shoes for piping supports shall be fabricated at site by the contractor at no extra cost. Other supports namely Hangers, U-clamps etc., shall be supplied by BHEL duly bent and threaded. Assembly and

necessary cutting work etc. shall be carried out at site by contractor within the quoted rate.

1.14.2.65 Contractor has to fabricate and erect temporary spool pieces wherever required due to non-receipt of valves in time and after receipt of valves the spool pieces are to be replaced with regular valves at free of cost. For spool pieces materials will be supplied free of cost by BHEL.

1.14.2.66 All welded joints should be painted with anti-corrosive paint, once radiography and stress relieving works are over.

1.14.2.67 Welding, non-destructive testing and heat-treatment as prescribed in BHEL Welding / Heat treatment manual is to be carried out by the contractor. The contractor shall conduct nondestructive tests like radiography, ultrasonic test for weld defects etc., ultrasonic test for finding thickness, dye penetrant tests, magnetic particle test etc. on weld joints, castings, valve bodies and other equipment etc. as per BHEL Engineer's instructions within the quoted rate.

1.14.2.68 The Matching Pieces / Nozzles / Reducers (including the reducers to be connected with HP Heaters) supplied for connecting BFP discharge piping to Boiler forming part of the systems are also in the scope of work including issue, transportation, suitably cutting the erected piping, cleaning, erection, welding, NDE and stress relieving and commissioning.

1.14.2.69 Cutting and removal of dummies for all the shop welded stubs (irrespective of the equipment supplier for the above) for all the terminal points and preparation of edge where the piping is to be terminated is also in the scope of the contractor without any extra payment.

1.14.2.70 The contractor shall fabricate piping, install lube oil systems, if any and carry out the acid cleaning of fabricated piping. The contractor shall also service the lub oil system, carry out the hydraulic test of oil coolers. etc.,

1.14.2.71 For skid mounted equipment, the checking and re-alignment required at site is in the scope of work.

1.14.2.72 All Rotating machineries and equipment shall be cleaned, lubricated, checked for their smooth rotation, if necessary dismantling and refitting before erection. If in the opinion of BHEL Engineer, the equipment is to be checked for clearance, tolerance at any stage of work or during commissioning period, all such works are to be carried out by contractor at his cost.

1.14.2.73 All the shafts of rotating equipment shall have to be properly aligned to those of matching equipment to perfection, accuracy as required and the equipment shall be free from excessive vibration so as to avoid

overheating of bearings or other conditions which may tend to shorten the life of the equipment.

1.14.2.74 All the bearings, gearboxes etc., of the equipment / actuators and electrical motors to be erected are provided with protective greases only. Contractor shall arrange as and when required by the engineer for cleaning the bearing / gear boxes etc., with kerosene or some other agent if necessary by dismantling some of the parts of the equipment during erection and shall arrange for re-greasing / lubricating them with recommended lubricants and assembling back. Lubricants will however be supplied by BHEL at free of cost.

1.14.2.75 The actuators / motors of valves may be supplied in loose parts, contractor shall have to match / assemble and align at site as per instructions of BHEL Engineer including placement on foundation.

1.14.2.76 All dimensions / elevations refers to centerline of pipe unless otherwise specified, the pipe routing shall be carried out as per the drawing. Wherever the dimensions are not specified / shown as approximate the same may be routed as per site requirement / convenience as per site engineer's advice.

1.14.2.77 Pipelines shall be cleaned off welding slag and burrs by hand files, wire brushes and flexible grinders wherever required and using cloth.

1.14.2.78 All welded joints shall be subjected to acceptance by BHEL Engineer.

1.14.2.79 Please refer the "FIELD / ERECTION WELDING SCHEDULES" published as part of this booklet. However, the schedule provided is only for tender purposes and approved schedules shall be provided at site during erection.

1.14.2.80 Also refer "GUIDELINES FOR HEAT TREATMENT" and "GUIDELINES FOR WELDING" published as part of this booklet.

1.14.3 **INSTALLATION OF INSULATION**

1.14.3.1 Handling at site stores / storage yard, Transportation to site of work, Application of refractory & Insulation materials and connected works for Power cycle, LP and Turbine Piping, Gland Steam Piping, Vessels, equipment like Feed Pumps, Flash Tanks, HP and LP Heaters, Deaerator, FST, TDBFP and MDBFP Pumps etc., and binding and cladding with sheets etc., using their own tools plants, tackles, all consumables, supervisor and men as enumerated in the scope of contract.

1.14.3.2 Application of refractory, wool insulation, sheet metal cladding, welding of hooks / supports to hold insulation and refractories under this contract including but are not limited to the following. Insulation of HP & LP piping,

temporary acid cleaning and steam blowing piping connected tubes, all drain lines, traps, flanges, fine fittings, sampling lines etc.

1.14.3.3 Bidders to note that application of Insulation of Main Turbine, Turbine Integral Piping under Hardwar scope of supply, TDBFP Drive Turbine, Boiler and ESP are excluded from the scope of this contract. However, insulation for TDBFP Integral Piping is included in the scope.

1.14.3.4 All insulations and refractory materials including iron components and other sheets casing materials, etc., required as per drawing will be supplied by BHEL and the same have to be erected / applied as per the drawings and specifications of BHEL by the contractor.

1.14.3.5 Clean the Surface to be insulated from Rust, Dust, Grease, Loose scale, Oil, Moisture, etc. Care shall be taken that flexible insulation is not unduly compressed. After insulating the equipment, the gaps / joints shall be filled with loose wool / moulded insulation as applicable.

1.14.3.6 Painting of inner side of sheet metal covering over the insulation walls with two coats of anti-corrosive paint (IS-158) to be applied to the entire satisfaction of BHEL Engineer and application of bituminous sealing compound on cladding / sheet metal joints shall also be carried out by the contractor. Retainer type 'A' must be coated with Aluminium paint. For which the required amount of paint, thinner and other accessories for painting, cleaning the surfaces etc., shall be SUPPLIED by the contractor within the quoted rate.

1.14.3.7 Bituminous sealing compound will be provided by BHEL free of cost which is supplied by the respective Manufacturing Units. However, supply and application of bituminous coating inside aluminium sheet is within the scope of the Contractor at no extra cost.

1.14.3.8 All the insulation, refractory materials and sheet metal covering etc., issued to the contractor shall be properly stored and handled before application of the same. If any damage occurs to the materials due to improper storage or due to any causes attributable to the contractor except for normal breakage or damaged material shall be to the cost of the contractor.

1.14.3.9 Contractor is liable for the exact accounting of the materials issued to him and any unaccountable losses shall be made good by him. The necessary accounting of the material issued will have to be furnished by the contractor periodically.

1.14.3.10 The contractor shall provide the required quantity of wire, nails and other materials for centering works at their cost.

1.14.3.11 Wherever iron components are to be welded on non-pressure parts, the contractor shall employ only approved structural welders. It shall also

be the responsibility of the contractor to weld hooks, flats, plates, supports and other fixtures also. All consumables tools and plants etc., required for the work shall be arranged by the contractor at their cost.

1.14.3.12 Wool insulations are received at site as bonded and unbonded mattresses in standard sizes. These has to be dressed / cut to suit equipment / site work by the contractor.

1.14.3.13 Removal type of insulation to be provided for valves fittings, expansion joints etc., as per the drawings or as directed by BHEL Engineer.

1.14.3.14 All piping insulations shall be carried out in such a manner as to facilitate removal of bolts nuts and washers from the flanges.

1.14.3.15 Fabrication of covering sheets may be necessary like preparing the sheets to the sizes and shapes specified in drawings, beading, swaging, beveling of sheets crowning of the sheets if necessary the same to supports over wool insulation with screws as specified in BHEL drawings or as instructed by BHEL engineer.

1.14.3.16 Fixing or welding of hooks / supports to equipment, piping and other connected equipment to support wool insulation applying of primer paint to welded portion parts welding certain supports, by engaging approved welders on parts other than pressure parts to hold refractory's as per the drawings or as instructed by BHEL Engineer will have to be carried out by the contractor.

1.14.3.17 Fabrication, fixing or welding of hooks / supports to equipment, piping and other connected equipment to support wool insulation applying of primer paint to welded portion parts welding certain supports on parts as per the drawings or as instructed by BHEL Engineer will have to be carried out by the contractor.

1.14.3.18 The contractor shall leave certain gap and opening while doing the work as per the instructions of BHEL Engineer to facilitate inspection by Boiler Inspector or doing commissioning to fix gauges, fittings, instruments. Those gaps will have to be finished as per drawings at a later date by the contractor at his cost, as required by BHEL .

1.14.3.19 Cladding sheets shall be suitably pressed along with diagonals to form diamond shape so as to improve the strength of the sheets, to avoid bumpiness and to give aesthetic look.

1.14.3.20 Plates, bars, rods and other materials that are to be cut, and re-welded from the fabricated places to suit erection requirements for which no extra payment will be made to the contractor.

1.14.3.21 A log book shall be maintained by the contractor for the clearance of the area for application of refractory and insulation. If the contractor does the

work on his own accord without prior permission the area should be redone at his cost.

1.14.3.22 The contractor shall draw only one week's requirement of material for their work from BHEL stores and keep them in their semi-closed shed near to the work area. The materials required for a particular space of work only shall be taken to the work spot. At the end of the day's work the leftover or unused materials shall be taken back to their semi-closed shed for keeping the materials safe. Necessary records shall have to be maintained by the contractor in respect of the above drawls / deposits, on daily basis as instructed by BHEL.

1.14.3.23 Welding of hooks as per pitch, non-pressure parts, applying primer paint to the welded portion as directed as per drawings before application of mineral wool mattresses will have to be done by the contractor.

1.14.3.24 Applying different layers of mineral wool as directed and as per drawings and specifications for pipelines valves and other vessels and after fixing require holdings materials, suitably if necessary, fabrication of rings etc., and fixing as directed and as per drawings and specifications shall also form part of this work.

1.14.3.25 If necessary the hooks may have to be made from the rods, raw materials supplied in running lengths. The contractor may have to carry out this work also and use the same hooks.

1.14.3.26 In case the contractor is required (which is not attributable to contractor) to dismantle and re-erect certain area as and when required for pre-commissioning / commissioning activities the rate as indicated in the rate schedule shall be paid by BHEL for erection. However, for dismantling no extra charge will be paid under any circumstances.

1.14.3.27 Wherever additional / clamps, frame works, etc., are required to be fabricated and installed even though not indicated in the drawings shall be fabricated and installed at their cost. Only steel materials shall be given by BHEL free of cost , consumables like electrodes, gases etc., are to arranged by the contractor at his cost.

1.14.3.28 The contractor shall provide any fixtures, concrete blocks / wooden sleepers, etc., which are required for temporary supporting of the insulation materials at site.

1.14.3.29 Welding of iron components directly on pressure parts and HP piping **is** in the scope of this contract and are to be carried out by certified IBR high pressure welders. Bidder to arrange for the same within the quoted rates.

1.14.3.30 Application of insulation and removal of the same for temporary piping under scope of erection of this contract is also included in the scope of the work. However, BHEL will supply the insulation materials free of cost.

1.14.3.31 Dressing of insulation to suit site conditions, sheet cladding over insulations, form the part of this work.

1.14.3.32 Fabrication, fixing or welding of hooks / supports to equipment of piping and other connected equipment to support wool insulation applying of primer paint to welded portion parts welding certain supports on parts other than pressure parts to hold refractory's (by engaging approved welders) as per the drawings or as instructed by BHEL Engineer will have to be carried out by the contractor.

1.14.3.33 Wastages allowance for the materials issued are envisaged as follows:

a) Wool mattresses 2%
b) Cladding sheets 5%

1.14.3.34 In case the contractor is required to dismantle and re-erect certain area as and when required for pre-commissioning / commissioning activities the rate as indicated in the rate schedule shall be paid by BHEL for erection. However, for dismantling no extra charge will be paid under any circumstances.

1.14.3.35 Also refer 'General Guidelines for Insulation Works' published under this booklet.

## VOLUME-IA PART-I CHAPTER - XV
## WELDING, HEAT TREATMENT & RADIOGRAPHY AND NON-DESTRUCTIVE TESTING

**The scope of the work will comprise of but not limited to the following:**

(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

1.15.1 The pressure parts, equipment and piping shall be erected in conformity with the provisions of Indian Boiler Regulations and as may be directed, as per other standard / specification in practice in BHEL. The method of welding (viz) ARC, TIG or other methods as indicated in the detailed drawing or as instructed by BHEL Engineer shall be followed. BHEL Engineer will have the option to change the method to suit site conditions.

1.15.2 The contractor has to establish the WPS (Welding Procedure Specification) and PQR (Procedure Qualification Requirement) applicable for the scope of work for all the materials involved at his own cost. However, Test Materials for the same will be given by BHEL free of cost.

1.15.3 The technical particulars, specifications and other general details of work shall be in accordance with BHEL welding, Heat treatment and NDE manuals or equivalent as decided by BHEL Engineer.

1.15.4 Contractor shall carryout Radiography as per welding Manual booklet applicable as per IBR. However, percentage radiography shown in the respective drawings shall be final and binding on the contractors.

1.15.5 The field joints are to be radiographed and preheating and post weld heat treatment to be done as per BHEL procedure and manuals.

1.15.6 Erection of equipment involves good quality of Welding, Heat treatment and Non Destructive Testing. Wherever required, 100% dye penetrant tests have to be carried out as per instructions of BHEL Engineer. Contractor's Engineers, Supervisors, Technicians and workers engaged should have adequate knowledge on the above works.

1.15.7 All welded joints shall be subjected to acceptance by BHEL Engineer.

1.15.8 Welding electrodes for welding shall be procured from Customer / BHEL approved vendors only.

1.15.9 For Stainless Steel pipe, welding procedure will be as per BHEL site Engineers directive. During the root runs of stainless steel joints, if required, the contractor shall carry out purging the pipes with inert gas before and during welding.

1.15.10 Welding of pressure parts, piping & fittings (under IBR code), high tensile structural steel shall be done by certified High Pressure welders who possess valid certificate of CIB of the State in which the equipment is erected as per provision of IBR and who are approved by BHEL Engineer. The High pressure welder who possesses necessary certificate shall ensure re-validation as per relevant provisions of IBR and keep the certificate valid till the completion of work. The services of such welders, the validity of whose certificates have expired shall not be utilized for high pressure works.

1.15.11 All welders including tack welders, structural and high pressure welder shall be tested and approved by BHEL Engineer before they are actually engaged on work even though they may possess a valid certificate. BHEL reserves the right to reject any welder if the welder's performance is not found to be satisfactory. The contractor shall maintain the records of qualification and performance of welders. BHEL Engineer will issue all the welders qualified for the work, an identity card. The welder will keep the same with him at work place at all times. He may be stopped from work if he is not found in possession of the same.

1.15.12 BHEL Engineer is entitled to stop any Welder from the work if his performance is unsatisfactory for any technical reasons or if there is a high percentage of rejection of joints welded by him, which in opinion of the BHEL Engineer, will adversely affect the quality of the welding though the Welder has earlier passed the tests prescribed by BHEL Engineers. The welders having passed qualification tests do not absolve the contractor of contractual obligation to check the welder’s performance.

1.15.13 The contractor shall carry out the root run welding of all HP / LP piping, valves by TIG welding method as specified in the drawings / EWS (Erection welding Schedule). Contractor to note that the EWS forms the part of this booklet of this tender specification. EWS of similar project is attached with this tender booklet is only for reference. Contractor shall ascertain the total no of joints for package on their own. The contractor shall have to carry out full TIG welding of butt weld joints of tubes / pipes of lesser thickness if required.

1.15.14 The contractor shall carry out the root run welding of all HP / LP piping, valves by TIG welding method only. The contractor shall have to carry out full TIG welding of butt weld joints of tubes / pipes of lesser thickness if required. During the root runs of stainless steel joints, the contractor shall before and during welding have to purge the pipes with inert gas.

1.15.15 All butt Joints shall be carried out by TIG root run and subsequent runs by Arc welding. Full TIG welding, wherever necessary shall be carried out

within the quoted rates. For oil system piping root run of all the butt joints shall be carried out by TIG welding only.

1.15.16 For approval of contractor's welders for engaging in the erection work, all expenses for testing of welders including destructive and Non- destructive tests conducted by BHEL or by the inspecting authority at site or at laboratory shall have to be borne by the contractor only. Limited quantity of tube and pipe material required for making test pieces will be supplied by BHEL free of cost and all testing facility shall be made available by the contractor.

1.15.17 Only BHEL approved electrodes and filler wire will be used. All electrodes shall be baked and dried in the electric electrode-drying oven to the required temperature for the period specified by the Engineer before these are used in erection work. All welders shall have electrodes drying portable oven at the work spot.

1.15.18 The electrodes brought to the site will have valid manufacturing test certificate. The test certificate should have a co-relation with the lot number / batch number given on electrode packets. No electrodes will be used in the absence of above requirement. The thermostat and thermometer of electrode drying oven will be also calibrated and test certificate from Govt. approved / accredited test house traceable to National / International standards will be submitted to BHEL before putting the oven in use. The contractor shall also arrange periodical calibration for the same. Separate ovens shall be used for baking and holding.

1.15.19 All butt / fillet welds shall be subject to Non Destructive testing as per the Drawing / Procedures / Welding Schedules / Documents at no additional cost.

1.15.20 The contractor shall deploy required number of High pressure welders to carry out the high pressure weld joints. The welding works should not be held up due to shortage / want of I.B.R./ High pressure welders.

1.15.21 The contractor shall maintain a record in the format as prescribed by BHEL of all operations carried out on each weld and maintain a record indicating the number of welds, the names of welders who welded the same, date and time of start and completion, preheat temperature, radiographic results, rejection if any, percentage of rejection etc. and submit copies of the same to the BHEL Engineer as required. Interpretation of the BHEL Engineer regarding acceptability or otherwise of the welds shall be final. All site welds shall be subject to acceptance of BHEL / Customer Engineers.

1.15.22 The contractor shall assist BHEL Engineer in preparing complete field welding schedule for all the field welding activities to be carried out in respect of piping and equipment erected by him involving high pressure

welding at least 30 days prior to the scheduled start of erection work at site. The contractor shall strictly adhere to such schedules.

1.15.23 Faulty welds caused by the poor workmanship shall be cut and re-welded at the contractor's expense. Prior to any repair, approval shall be obtained from BHEL Engineer for the procedure for the repair of defective welds. After the repair has been carried out, the compliance document shall be submitted to the quality engineer.

1.15.24 All necessary preheating, post heating of welds and stress relieving operation of welds are part of the erection work and shall be performed by the contractor in accordance with the relevant regulations and standards of BHEL practice and to the satisfaction of BHEL Engineer and in accordance with the drawings and specifications.

1.15.25 Pre-heating, radiography and other NDE, post weld heating and stress relieving after welding of tubes, pipes including attachment welding wherever necessary, are parts of erection work and shall be carried out by the contractor in accordance with the instructions of the Engineer and as specified in Erection Welding Schedule, Welding, Heat Treatment & NDT manuals and FQP. Contractor at his cost shall arrange all equipment and consumables essential for carrying out the above process.

1.15.26 Contractor shall arrange all necessary Preheating, post weld heating, stress relieving equipment with automatic recording devices. The contractor shall arrange for labour, heating elements, thermocouples, thermo-chalks, temperature recorders, thermocouple attachment units, graphs, sheets insulating materials like asbestos cloth, ceramic beads, asbestos ropes etc. required for heat treatment / stress-relieving operations. The contractor should take a note of the following,

- Temperature shall be measured by thermocouple and recorded on a continuous printing type recorder. All the recorded graphs for heat treatment works shall be the property of BHEL.
- All stress relieving equipment will be used after due calibration and submission of test certificate to BHEL. Periodic calibration from Govt. Approved / accredited Test Houses traceable to National / International standards will also be arranged by the contractor for such equipment at his cost.
- The contractor shall obtain the signature of Engineer or his representative on the strip chart of the recorder prior to the starting of SR operations.

1.15.27 **P 91 WELDING**

The induction heating equipment and other accessories shall be drawn from BHEL stores, transported and installed & commissioned wherever required. For routine maintenance & attending all type of break- down maintenance contractor shall deploy sufficient manpower, tools, and plant with in quoted price. The contractor shall provide electrical cables & switches required. All the equipment shall be protected by providing covers and sheds at site by the contractor with in quoted rate.

Also refer clauses in Chapter IV and chapter V of Part I of Technical Conditions of Contract regarding P91 welding.

1.15.28 Welding of Hangers, supports, stubs and impulse piping to be carried out by the contractor as per drawing specification and as per BHEL engineer's instructions. According to drawing specifications and as per BHEL Engineers instructions pre heating, post heating, stress reliving, etc. have to be carried out by the contractor wherever necessary.

1.15.29 The number of joints to be welded as mentioned in the welding schedule consists of butt welds. All other welds viz. attachment welds on pressure parts / non-pressure parts, fillet welds in non-pressure parts welding in the Piping & other equipment has to be carried out by the Contractor within quoted rates.

1.15.30 All the prepared / patched edges will have to be suitably protected to prevent rusting or foreign material ingression.

1.15.31 For thermowell welding with carbon steel / alloy steel welding applicable combination of electrodes shall be arranged by contractor with in quoted rate.

1.15.32 The regulators used on welding machines shall be calibrated before putting these into use for work. The Contractor at his cost shall also arrange periodic calibration for the same.

1.15.33 The thermostat and thermometer of electrode drying oven shall be also calibrated. All welders shall have electrodes drying portable oven at the work spot.

1.15.34 The contractor shall also be equipped for carrying out other NDT like LPI / MPI / Hardness test etc. as required as per welding schedules / drawings within the finally accepted price / rates. Ultrasonic testing, wherever required, will be arranged by contractor within the quoted rate.

1.15.35 The technical particulars, specification and other general details for radiography work shall be in accordance with ASME, IBR or ISO as specified by BHEL.

1.15.36 The contractor for radiography work shall use iridium-192 / Cobalt 60; the geometric un-sharpness shall not exceed 1.5 mm. The contractor should take adequate safety precautions while carrying out radiography. Contractor at his cost shall arrange necessary safe guards required for radiography (including personnel from BARC).

1.15.37 Low speed high contrasts, fine grain films (D-7 or equivalent) in 10 cm width only are used for weld joint radiography. Film density shall be between 1.5 and 2.0.

1.15.38 All radiographs shall be free from mechanical / chemical process marks to the extent they shall not confuse the radiographic image and defect finding. Penetrometer, as per ASME or ISO or IS must be used for each exposure.

1.15.39 Lead numbers and letters are to be used (generally 6mm size) for identification of radiographs. Contract number, joint identification, source used, welder's identification and SFD are to be noted down on paper cover of radiograph.

1.15.40 Lead intensifying screens for front and back of the film shall be used as per ASME specification or as per the instructions of BHEL Engineer.

1.15.41 The weld joint is to be marked with permanent mark A, B, C, etc. to identify the segments. For this a low stress stamp shall be used to stamp the pipe on the downstream side of the weld. For multiple exposures on pipes, an overlap of about 25 mm of film shall be provided.

1.15.42 Since radioisotopes are being used, all precautions and safety rules as prescribed by BHEL / BARC / Customer shall be strictly followed. BARC / DRP certificate to be provided before taking up the work.

1.15.43 The percentage of Radiography are tentative, which may be increased depending upon the quality of joints at the discretion of BHEL.

1.15.44 In case of radiography of less than 100%, the joints identified by BHEL at random shall be radiographed.

1.15.45 Contractor shall note that 100% radiography will be done at the initial stages on all the piping welding joints. Subsequently radiographic inspection will be done on the basis of quality of welding. However minimum percentage of joints to be radio graphed shall not be less than the requirement of BHEL welding schedule / IBR / Customer's requirements. The percentage may be increased depending upon the quality of joints and at the discretion of BHEL. Radiography on LP piping joints is not envisaged. However other NDT test as called for in the FQP including LPI, MPI and HT will have to be carried out.

1.15.46 All the radiographs shall be properly preserved in air-conditioned rooms and shall become the property of BHEL. They are to be reconciled with the work done, joints radiographed and submitted to BHEL / customer.

1.15.47 Radiography of joints shall be so planned after welding, that the same is done either on the same day or next day of the welding to assess the performance of High Pressure welders. If the performance of welder is unsatisfactory, he is to be replaced immediately.

1.15.48 Heat treatment and radiography may be required to be carried out at any time (day and night) to ensure the continuity of the progress. The contractor shall make all necessary arrangements including labour, supervisors/ Engineer required for the work as per directions of BHEL.

1.15.49 All arrangements for carrying out radiography work including radiography source & equipment and consumables, dark room and air conditioner and other accessories shall be provided by contractor within the space allotted for office at his cost. Contractor shall deploy the NDE and Heat Treatment Agency in site after taking due approval from the site Engineer based on the "Guidelines for NDE and Heat Treatment Agency" furnished as a part of this booklet.

1.15.50 The contractor shall arrange air conditioned dark room, radiography equipment, films, chemicals and other dark room facilities. The air conditioned dark room shall be fully equipped with radiography equipment, film (un-exposed), chemicals and any other dark room accessories. All radiography films shall be developed in the dark room at site. There must be sufficient number of radiographic personnel with sufficient experience and certified by BARC for field radiographic inspection. Further, the contractor must follow strictly the safety rules laid down by BARC, from time to time, contractor's radiographers shall also be registered with BARC for film badge service.

1.15.51 Radiography personnel with sufficient experience and certified by M/s BARC for conducting radiographic tests in accordance with safety rules laid down by Division of Radiological protection only have to be deployed. These personnel should also be registered with DRP / BARC for film badge service.

1.15.52 Contractor shall provide all skilled, unskilled work men required for the job, which will include Engineers, supervisors, operators, as required for timely and satisfactory execution of radiography work. Also contractor has to provide necessary labour required such as Riggers, Helpers etc. to assist the technicians for carrying the above radiography work and making other arrangements. Such as providing scaffolding, approaches, platform lighting arrangements at his cost as per the instructions of BHEL. It may please be

noted that invariably the radiography will be carried out after the normal working hours only.

1.15.53 All welds shall be painted with primer as specified in the painting schedule, once radiography and stress relieving works are over. Necessary consumables and scaffolding etc. including paints shall be provided by contractor at his own cost.

1.15.54 The defects as pointed out by the Engineer shall be rectified immediately to the satisfaction of Engineer and Re-radio graphed. The decision of Engineer regarding acceptance or otherwise of the joint shall be final and binding on the contractor.

1.15.55 Wherever radiographs are not accepted on account of poor exposure / bad shot, joints shall be re-radiographed and the film of the same shall be submitted for evaluation. Radiographs shall be taken again on joints after carrying out repairs. However, if the defect persists after first repair, further repair work followed with radiography shall be repeated till the joint is made acceptable. In case the joint is not repairable, the same shall be cut, re-welded and re-radio graphed at contractor's cost.

1.15.56 The contractor shall also be equipped / arrange for carrying out other NDT like dye penetrant inspection, magnetic particle inspection, Ultrasonic testing, Hardness test etc as per welding schedules / drawings as and when required within the quoted rates.

1.15.57 For carrying out ultrasonic testing of welded joints of large size tubes and pipes, it will be necessary to prepare the surface by grinding to a smooth finish and contour as desired by BHEL Engineer. The contractor’s scope of work includes such preparation and no extra charges are payable for this.

1.15.58 It may also become necessary to adopt inter layer radiography / MPT / UT depending upon the site/technical requirement necessitating interruptions in continuity of the work and making necessary arrangements for carrying out the above work. The contractor shall take all this into account and quote the price inclusive of all such work and radiography.

1.15.59 The welded surface irrespective of place of welding shall be cleaned of slag and painted with primer paint to prevent corrosion at no extra cost towards this including supply of Paint for this purpose.

1.15.60 All welders shall be tested and approved by BHEL Engineer before they are actually engaged on work though they may possess the IBR certificate. BHEL reserves the right to reject any welders without assigning any reason. The welder Identification code as approved by the BHEL Engineer shall be stamped by the welder on each joint done by them. The contractor will be responsible for the periodic renewal, retesting of the welders as demanded by BHEL.

1.15.61 The welding process, weld joint details, joint configuration and material specification may change to suit the design requirements. The contractors quoted rates shall be inclusive of each contingency. All welds involved in the erection of temporary pipe lines for hydraulic test, chemical cleaning, steam blowing etc. to be carried out within the quoted rates.

1.15.62 Heat treatment details of welds indicating minimum, Temperature recorded, Heating rate, cooling rate, soaking time etc. shall also be recorded and documented by the contractor as per BHEL Engineers instructions. Welder's performance record shall be furnished every month. The performance report of welders shall be indicating the percentage of repair for each welder.

1.15.63 All the data such as heating temperatures, heating rate, soaking time, maximum temperature reached during heat treatment shall be properly recorded and documented which will be property of BHEL.

1.15.64 All stress reliving equipment will be used after due calibration and submission of test certificate to BHEL. Periodic calibration from Govt. approved/accredited test houses traceable to National/International standards will also be arranged by the contractor for such equipment at his cost. The contractor shall obtain the signature of engineer or his representative on the strip chart of the recorder prior to starting of SR operations.

1.15.65 For higher thickness joints for which radiography plugs are not provided, alternate NDE methods such as ultra sound examination as instructed by BHEL engineer shall be conducted with in the quoted rate.

1.15.66 Quantum of radiography (percentage of joints) shall be enforced as per specifications and as per the drawings. BHEL Engineer reserves the right to alter the quantum of radiography of joints. The decision of the BHEL Engineer in this regard is fixed and final and binding on the contractor. Any defects as pointed out by BHEL Engineer shall have to be rectified by the contractor at his cost.

1.15.67 If the contractor does not carry out radiography work in time due to non-availability of film, chemical etc. BHEL shall get the work done through some other agency at the risk and cost of the contractor.

1.15.68 Radiography work of the welds connected with this contract shall be arranged by the contractor including provisions of services of technicians and necessary equipment and consumables like Isotope camera, X-Ray films, chemicals and other dark room facilities etc. Also contractor has to provide necessary labour required such as Riggers, Helpers etc. to assist the technicians for carrying the above radiography work and making other arrangements. Such as providing scaffolding, approaches, platform lighting

arrangements at his cost as per the instructions of BHEL. It may please be noted that invariably the radiography will be carried out after the normal working hours only.

1.15.69 Radiography inspection of welds shall be performed in accordance with the requirements and recommendations of BHEL Engineer. The minimum extent of radiographic inspection shall be as per BHEL drawings / IBR Regulations. At the discretion of BHEL Engineer / Boiler inspection authority, they may however be increased depending upon the performance of the individual welder. It is the responsibility of the contractor to get the IBR clearance, wherever required including arranging for IBR Inspection.

1.15.70 All field joints shall be subjected to dye penetrant examination as specified in the respective drawings and shall have to be accepted by BHEL Engineer. Any rectifications required shall have to be done by the contractor at his cost.

1.15.71 Oxy-acetylene flame heating or exo-thermic chemical heating for stress relieving is not permitted. Heating shall be by means of Electric Induction coil or Electric resistance coil. Potentiometric type recorders shall only be used for temperature recording purposes.

1.15.72 Please refer the “FIELD / ERECTION WELDING SCHEDULES” published as a part of this booklet.

1.15.73 Also refer “GUIDELINES FOR HEAT TREATMENT” and “GUIDELINES FOR WELDING” published as a part of this booklet.

1.15.74 Also refer the clauses on FACILITY TO BE PROVIDED BY THE CONTRACTOR FOR P91 WELDING in Chapter-IV of Technical Conditions of Contract (Volume-I Book-I).

1.15.75 Please refer the “Guidelines for NDE and Heat Treatment Agency” published as a part of this booklet.

## VOLUME-IA PART-I CHAPTER – XVI
## HYDRAULIC TEST

**The scope of the work will comprise of but not limited to the following:**

(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

1.16.1 All required tests indicated by BHEL and their clients for successful commissioning are included in the scope of these specifications. These tests / activities may not have been listed in these specifications. Specialized test equipment, if any, shall be provided by BHEL/ its client free of hire charges. The contractor shall carryout all tests as desired by BHEL Engineer on erected equipment covered under the scope of this contract during testing, pre-commissioning, commissioning, and operation, to demonstrate the completion of any part or whole work performed by the contractor.

1.16.2 It is the responsibility of the contractor to provide necessary manpower, tools, tackles and consumable till the completion of work under these specifications including for trial operation, commissioning of piping and the other equipment, even though the delay reasons are not attributable to the contractor.

1.16.3 The contractor shall carryout the required tests on the equipment & pipelines, such as gas tightness test / air tightness test, kerosene test, hydrostatic test and rectify all the defects caused due to contractor's fault at his own cost. Contractor may have to replace old / damaged gaskets / packing etc. of equipment and the same shall be carried out by contractor as per requirement. Compressed air for pneumatic testing is to be arranged by contractor. The contractor shall carry out the trial run of motors including checking the direction of rotation in the uncoupled condition, checking, aligning and coupling the motor to the respective driven equipment. Before starting the motor IR values of insulation shall be recorded and if found necessary dry out to be done by the contractor to improve the IR value at no extra cost.

1.16.4 During the initial stages of work, trenches for draining water may not be available after Leak test, Hydro test, Flushing or mass flushing. For discharging / emptying the equipment, system and piping, necessary low point drains and temporary piping up to safe location are be erected by the contractor at his cost. The materials will be provided by BHEL.

1.16.5 In case any erection defect and / or malfunctioning is detected during various tests / operations, trial runs as detailed above, such as loose components, undue noises, vibration, strain on connected equipment, steam / oil / water leakage, etc. the contractor shall immediately attend these defects and take necessary corrective measures. If any readjustment and re-alignments are

necessary, the same shall be done as per BHEL Engineer's instructions. If any part needs repairs rectification and replacement the same shall be done by the contractor at no extra cost. The parts to be replaced shall be provided by BHEL free of cost. If insulation is to be removed to attend any of the defects the cost of removal and reapplication of insulation should be borne by the contractor.

1.16.6 For conducting Hydro test / steam blowing of MSL, CRH & HRH internals of valves and NRVs (LP BP, ESV, IV & LP BP Valves & NRVs) are to be removed, Hydro Test devices are to be fixed and after Hydro Test the internals are to be re-assembled by the contractor as instructed by BHEL without any additional cost.

1.16.7 Temporary blinds / lugs / caps of piping and associated equipment like tanks, pumps etc. required for oil flushing / alkali cleaning / acid cleaning of piping & other equipment during erection & pre-commissioning shall be erected by contractor within the quoted rate.

1.16.8 During Commissioning, opening / closing of valves, changing of gaskets, attending to leakage and adjustments of erected equipment may arise. Contractor may have to replace old / damaged gaskets / packing etc. for equipment and the same shall be carried out by contractor as per requirement. The finally accepted price / rates shall also include all such work.

1.16.9 Replacing / cleaning of filters of the erected equipment and piping system etc., during pre-commissioning / commissioning stage is within the scope of work.

1.16.10 During steam blowing operations the required manpower for fixing the target plates shall be arranged by the contractor as per the instructions of BHEL Engineer within the quoted rates. The manpower for the above operation may be required round the clock if necessary. The contractor shall carry out the above operation as per the instructions of BHEL Engineer within the quoted rates.

1.16.11 Main Steam Line Strainers bodies are erected first before steam blowing of the lines. After Hydraulic Test, the strainer elements are fixed. During trial operation, if required the strainers are removed for inspection of debris & cleaning. Contractor has to carry out the work as part of his work without any extra cost.

1.16.12 Cleaning of strainers erected by other vendors is also the responsibility of the contractor during pre-commissioning and commissioning activities.

1.16.13 It shall be the responsibility of the contractor to provide various categories of workers in sufficient numbers along with Supervisors during pre-commissioning, commissioning and post commissioning of equipment,

transporting & adding of chemicals / consumables and attending any problem in the equipment erected by the contractor till handing over. The contractor will provide necessary consumables in his scope, T&Ps, IMTEs etc., and any other assistance required during this period. Association of BHEL's / Client's staff during above period will not absolve contractor from above responsibilities.

1.16.14 **After synchronization, the commissioning activities and trial operations will continue up to handing over. It shall be the responsibility of the contractor to provide various categories of workers in sufficient numbers as per the work requirement along with supervisors including necessary consumables, hand tools, supervision etc. as part commissioning assistance for equipment erected by the contractor till handing over of sets to customer**. The rate quoted shall include all these contingencies also. Requirement of manpower shall be mutually agreed between BHEL Engineer and contractor based on site conditions. The various categories of workers required for pre-commissioning, commissioning and post–commissioning activities are as follows.

a. Pipe fitters
b. Mill Wright Fitters
c. HP / Structural welders
d. Riggers
e. Unskilled workers
f. Supervisors
g. Electricians
h. Any other category of workers as may be required

Further in addition to the above, contractor has to arrange the required manpower exclusively for assisting BHEL commissioning engineers during stabilization and trial operation period. This manpower will be directly report to BHEL Commissioning engineers during the period. Requirement of manpower shall be mutually agreed between BHEL Engineer and contractor based on site conditions

It shall be specifically noted that the contractor may have to work round the clock during the pre-commissioning, commissioning and post-commissioning period along with BHEL Engineers and hence considerable overtime payment is involved. The contractor's quoted rates shall be inclusive of all these factors.

1.16.15 Steam blowing of system piping if required will involve laying of temporary pipe lines, valves, etc. and dismantling & restoration of piping. The required steam shall be provided at a central point by BHEL.

1.16.16 All pressure parts and some of the Low Pressure parts shall be subjected to hydraulic test as per the Standard / statutory requirements. The contractor shall supply necessary labour and other services and make necessary arrangements to carry out the required tests as per the instructions and directions of the BHEL Engineers.

1.16.17 Contractor has to arrange Hydraulic Test pump / Hand Pump at his cost for Hydraulic testing of LP lines.

1.16.18 Hydraulic testing pumps for High Pressure lines shall be provided by BHEL free of hire charges. The testing pumps will be issued to the contractor in working conditions. Installation, electrical connection, erection, testing and dismantling and returning to BHEL stores, etc., shall be carried out by the contractor as part of this work without any extra charges. In case any servicing of the test pump is to be done during the course of the test, the contractor shall provide the necessary labour for the same and spares will be arranged by BHEL.

1.16.19 Contractor shall lay all necessary electric cables and switches etc. required for the hydraulic tests and other tests, flushing etc., and maintain the system till the tests are completed satisfactorily.

1.16.20 Contractor at his cost shall lay all necessary temporary piping, install the pumps, blanks, valves required for the test, pressure gauges etc. Required pipes, valves, plates etc., will be given by BHEL. Temporary piping, pumps, valves, flanges, blanks etc. shall be removed by him and returned to BHEL. All thermowell points are to be seal welded, with plug in position. All Temperature Element points are to be provided with blanks and welded. Necessary blanks will be provided by BHEL.

1.16.21 All welded joints for temporary piping required for alkali flushing, acid cleaning and steam blowing should be got done by High Pressure welders only. The root run should be done by TIG welding. All arrangements required for the above shall be the responsibility of the contractor at no additional cost.

1.16.22 Welding and stress relieving of temporary blanks or suitably fixing temporary blank flanges with gaskets and fasteners and welding and providing suitable de-aeration / venting / draining points with valves as per BHEL Engineer's instructions, for performing hydro-test of piping and other equipment is within the scope of work. Gaskets, valves, fasteners will be provided free of cost by BHEL. Contractor shall cut steel blanks from steel provided without charging extra. After completion of hydraulic test, welded blanks shall be cut and removed and weld burrs ground finished and cavities / scars of cutting weld filled and ground as per BHEL Engineer's instructions.

1.16.23 The contractor shall make all necessary arrangements including making of temporary closures / dummy on piping / equipment for carrying out the hydro-static testing on all piping, equipment covered in the specification at no extra cost. Necessary blanks will be provided by BHEL.

1.16.24 Providing dummy / plugs for the thermowell points during hydro test / steam blowing shall be done by the contractor within the quoted rate. During hydro test, pipe end dummy if required shall be supplied by BHEL, plates shall be cut for the requirement and shall be returned back to BHEL Stores.

1.16.25 After hydro test / steam blowing during the restoration works, it is the responsibility of the contactor to ensure the removal of dummy/plugs and edge preparation for the thermowell stubs if required within the quoted rate.

1.16.26 Hanger adjustment / readjustment during erection, before and after Hydraulic Test, before and after steam blowing, during and after full load operation, are to be carried out by the contractor within Quoted Rate.

1.16.27 In general, Hydraulic testing of piping shall be performed after all eventual pipe branches have been completed and valves installed. Should it be required to hasten erection work, pressure tests may be performed by sections. For this scope of work, the erected pipe lines shall be hydraulically tested as per site requirement in segments. For conducting hydraulic test, both ends of pipe lines shall be blanked by welding of plates. Only one or two set of plates and structural materials for blanking required for one segment will be provided by BHEL free of charge. After completion of hydraulic test in one segment, the same plates are to be cut and removed and utilized / welded on the other segment of the pipe lines, to carry out the hydraulic test for the respective segments. No separate plates for blanking for each segment will be provided. After completion of Hydraulic test, the required edge preparations shall be carried out on the end of pipe lines and to be welded with the respective pipe lines. In such cases joint connection shall be checked during a final and additional test, if required. The contractor shall note this aspect and quote accordingly.

1.16.28 During hydraulic test, the pipes being tested shall be isolated from the equipment to which they are connected.

1.16.29 All temporary supports shall be removed in such ways that pipe supports are not subjected to any sudden load. During hydraulic testing of pipes, all piping having variable spring type supports shall be held securely in place by temporary means while constant spring type support hangers shall be pinned or blocked solid during the test.

1.16.30 The contractor shall carry out all the required tests and pre-commissioning and commissioning activities required for successful and reliable operation. These would include hydraulic test of piping, pre-boiler system detergent

flushing / chemical cleaning, steam blowing, water washing etc. as instructed by BHEL using contractors own labour and scaffoldings etc.,

1.16.31 All the tests shall be repeated till all the pipelines / equipment satisfy the requirements / obligation of BHEL to their customer. As far as the hydraulic pressure test is concerned, the same shall be conducted at various stages to the satisfaction of BHEL / Boiler Inspector / Customer Engineers. Any rectifications required shall have to be done / redone by the contractor at his cost.

1.16.32 Test records shall be made for pressure testing of above piping system. These records shall contain the following information:

a) Date of test
b) Identification of piping tested
c) Test fluid
d) Test pressure
e) Approval of the Engineer.

1.16.33 The scope of pre-commissioning activities covers installation of all necessary equipment including temporary piping, supports, valves, blanking, pumps, tanks, with access platforms valves, dummy plates & other miscellaneous equipment etc. along with accessories required for hydro test, pre-boiler system detergent flushing / chemical cleaning, steam blowing or for any other tests on piping. The scope also covers the offsite disposal of effluents.

1.16.34 The erection & dismantling of temporary piping, pumps, tanks, dummy plates & other miscellaneous equipment etc. for pre-commissioning and commissioning activities like hydraulic test, chemical cleaning, steam blowing, etc. are covered in this contract and shall be carried out as a part of work. The quoted rate shall be inclusive of all this.

1.16.35 Temporary lines for chemical cleaning shall be erected as per the instructions of BHEL Engineer. Necessary pipes and other items will be supplied by BHEL free of cost. After the chemical cleaning has been successfully completed, removing all temporary piping, fittings of tanks etc. checking all the valves for any accumulation of foreign materials, welding the valves, pipes which were cut and cleaning, re-fixing as per BHEL Engineer's instructions is within the scope of work/specification.

1.16.36 Temporary lines for Steam blowing / chemical cleaning of Power Cycle piping shall be erected as per the instructions of BHEL Engineer. Necessary pipes, valves and other items will be supplied by BHEL free of cost. All arrangements for erection including welding has to be arranged by the contractor at the rates specifically quoted / accepted for this work. After completion of steam blowing chemical cleaning, all the temporary lines to be

dismantled and restoration of piping to be carried out, within quoted rate. The required steam shall be provided at a central point by BHEL.

1.16.37 Contractor shall lay the temporary pipelines with fittings, accessories and erection & commissioning of pumps, tanks and other installations as instructed by BHEL Engineer for the purpose of chemical cleaning / alkali flushing / steam blowing / steam washing / steam flushing / water flushing / water washing / oil flushing etc., of piping and other equipment are within the scope of work. Necessary materials for this will be provided by BHEL. Overhauling / cleaning / revisioning / servicing of valves, fittings in temporary system and acid cleaning tanks for re-commissioning activities / operation like water flushing / steam blowing / washing / flushing / passivation / chemical cleaning etc., and also over hauling / revisioning of the pumps & equipment and also to carry out the repairs to attend leaks etc., in the temporary piping & equipment, prior & while carrying out the above operations / activities. All the above works are within the scope of work. All the chemicals will be supplied by BHEL free of cost.

1.16.38 Chemical cleaning (Acid cleaning of piping / alkali flushing) will involve the installation of temporary piping, valves, cutting of some of the existing valves, placing the rubber, wedges in the valves, gagging of valves, and installation of temporary tanks for chemical and for mixing. Necessary temporary access platforms to mixing tank are to be made by the contractor. The dissolving tank, neutralizing tank etc. required for acid pickling will have to be carried out by the contractor. Required materials will be provided by BHEL free of cost. Chemicals for chemical Cleaning will be provided by BHEL. All other consumables are to be provided by the contractor.

1.16.39 All items / materials (Including Chemicals) required for conducting hydraulic test, pre-Boiler system detergent flushing / chemical cleaning, steam blowing etc., will be supplied by BHEL. However, fabrication, servicing, erection, dismantling and returning of the same to stores are the responsibility of the contractor who is erecting the equipment / piping. The contractor may note that no separate payment shall be released for any temporary works that are to be carried out for conducting pre-commissioning and commissioning tests. Bidders are advised to include expenses on temporary works along with the rates being quoted by them. Broadly the work on temporary systems will be as under erection etc. of all temporary piping including valves, tanks, effluent pumps, electrical control panel and cabling along with insulation and supports for steam blowing;

Chemical cleaning and effluent disposal are to be carried out as part of work. Contractor will be responsible for their operation and any servicing required during the pre-commissioning activities. He will also service the equipment and handover the equipment to the other agency for further

erection / commissioning activities. All the pumps, motors and electrical control panels/ switch gear, valves and actuators will be furnished to the contractor after due servicing.

Dismantling of the temporary equipment and piping will be done by the agency that has erected the equipment. He will also return the equipment to the stores. The quoted rate shall be inclusive of all this.

The above is only a broad breakup of the temporary works. The Engineer at site will make final break up. His Decision will be final and binding by all the parties.

1.16.40 During commissioning opening of valves changing of gaskets attending to leakages, minor modification, and rectification works may arise. The contractor has to carry out these works at his cost by providing required manpower with T & Ps in all the three shifts.

1.16.41 If any equipment / part is required to be inspected during pre-commissioning and commissioning, the contractor will dismantle / open up the equipment / part and reassemble / redo the work without any extra claim.

1.16.42 Contractor shall cut open the works if needed, as per BHEL Engineer's instructions during commissioning for inspection, checking and make good the works after inspection is over. This contingency shall be included within the quoted value.

1.16.43 In case, any rework is required because of contractor's faulty erection, which is noticed during pre-commissioning and commissioning, the same has to be rectified by the contractor at his cost.

1.16.44 All the valves, Actuators will have to be checked, cleaned, lapped or overhauled / serviced in full or in parts before erection, prior to pre – commissioning, during commissioning and Trial operation. A system for recording of such servicing operations shall be developed and maintained in a manner acceptable to BHEL Engineer to ensure that no valves and valve actuators are left un-serviced. Wherever necessary as required by BHEL Engineer, the contractor shall arrange to lap / grind valve seats. The contractor, at his own cost, shall arrange experienced technicians for the above work, including required consumables.

1.16.45 Necessary scaffolding and approaches for conducting the above shall also be within the scope of the contract.

1.16.46 During commissioning any improvement / repair / rework / rectification / fabrication / modification due to design improvement / requirement is involved, the same shall be carried out by the contractor promptly and expeditiously.

1.16.47 During this period, though BHEL's and customer's staff also be associated in the work, it is the contractor's responsibility to make available the resources in his scope till such time the commissioned units are taken over by the customer / BHEL.

## VOLUME-IA PART-I CHAPTER- XVII

## PAINTING

**The scope of the work will comprise of but not limited to the following:**
(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

### FINAL PAINTING

1.17.1 The scope of work shall also include supply and application of final painting of all the erected equipment as required and specified in the BHEL / Customer / Customer Consultant's painting specification / scheme that forms the part of this tender for the components of all piping & its auxiliaries and other equipment erected under the scope of this tender. Supply & application of primer & finish paints are included in the scope of work.

1.17.2 Required paints, thinner other consumable such as wire brush, brush etc. shall have to be arranged by the contractor at their own cost. The required manpower, other required consumables, T & P etc. shall be provided by the contractor within the quoted rate. The arrangement of primer/paint will be in contractor's scope.

1.17.3 In the case of steel fabricated items, raw steel after fabrication has to be cleaned and subsequent painting to be carried out.

1.17.4 All the exposed metal parts of the equipment including piping, structures, hangers etc., wherever applicable after installation unless otherwise specified the surface protected, are to be first painted with at least one coat of suitable primer and required number of finish coats as indicated in the Painting Specification in TCC which matches the shop primer paint used, after thoroughly cleaning the dust, rust, scales, grease oil, and other foreign materials by wire brushing scrapping and chemical cleaning and the same being inspected and approved by BHEL engineers for painting. Afterwards the above parts shall be finished with as per the instructions of BHEL/Customer official.

1.17.5 Normally Paint shall be applied by brushing as per the instruction of BHEL Engineer. It shall be ensured that brush marks are minimum. If needed and insisted either by BHEL engineer or the BHEL client, in certain cases, spray painting has to be done wherever brush painting is not accessible, by the contractor, within the quoted rates. Contractor has to carryout painting as per the procedure lay down by the customer.

1.17.6 No paint shall be applied when the surface temp is above 55 deg. Centigrade or below 10 deg. Centigrade, and when the humidity is greater than 90% to cause condensation on the surface or frost / foggy weather.

1.17.7 Paint used shall be stirred frequently to keep the pigment in suspension. Paint shall be of the ready mix type in original sealed containers as packed by the paint manufacturer. No thinners shall be permitted. Paint manufacturer's instructions shall be followed in method of application, handling, drying time etc.,

1.17.8 All surfaces shall be thoroughly cleaned, free from scales, dirt and other foreign matter. Each coat shall be applied in an even & uniform film free from lumps, streaks, runs, sags and uncoated spots. Each coat (Primer, intermediate, finish) shall have a minimum thickness of dry film thickness (DFT) in microns and the DFT of finish paint shall not be less than the specified. Necessary instrument for measuring the thickness of paint applied is to be arranged by the contractor.

1.17.9 Before applying the subsequent coats, the thickness of each coat shall be measured and recorded with BHEL / Customer.

1.17.10 Finish coat paint, Number of coat and DFT shall be as indicated in the painting specification enclosed in this tender / relevant BHEL document / customer's specifications. The painting specification mentioned in this booklet which is forming part of this tender shall be used as guidelines to be followed. However, the actual painting to be done based on the approved painting schedule provided by site.

1.17.11 The scope of painting includes application of color bands, lettering the names of the systems equipment; tag Nos. of valves, marking the directions of flow and other data required by BHEL within the quoted rate.

1.17.12 The actual color to be applied shall be approved by the customer before starting of actual painting work.

1.17.13 Primer & finish paint shall be of reputed paint supplier approved by BHEL / Customer. Contractor has to procure paints from the BHEL / Customer approved agencies only, and the paints should be as per the customer painting specification. The quality of the finish paint shall be as per the standards of IS or equivalent as approved by BHEL / Customer. Before procurement of paint the contractor has to obtain the clearance from BHEL authorities. The batch certificates of paints to be submitted to BHEL Engineer before using the same.

1.17.14 Before commencement of final painting, contractor has to obtain written clearance from BHEL / Customer for effective completion of surface preparation.

1.17.15 Primer painting after proper surface cleaning wherever required to be done as per site requirement over all surfaces to be insulated prior to the application of the insulation. This is to be done as a part of contract without any additional charges.

1.17.16 Painting of inner side of sheet metal covering over the insulation walls with two coats of anti-corrosive paint (IS-158) to be applied to the entire satisfaction of BHEL Engineer and application of bituminous sealing compound on cladding / sheet metal joints shall also be carried out by the contractor. Retainer type 'A' must be coated with Aluminium paint. For which the required amount of paint, thinner and other accessories for painting, cleaning the surfaces etc., shall be arranged by the contractor within the quoted rate.

1.17.17 The contractor shall effectively protect the finished work from action of weather and from damage of defacement and shall cover the finished parts, then and there, for their protection.

# VOLUME-IA PART – II CHAPTER 1
# CORRECTIONS / REVISIONS IN SCC, GCC AND FORMS & PROCEDURES

Following Clauses are Modified / Revised / Added in SCC as below

**Sl No: 1**

Clause 4.1.11 of SCC is deleted.

**Sl No: 2:**

a) **OCCUPATIONAL HEALTH, SAFETY & ENVIRONMENT MANAGEMENT/ QUALITY ASSURANCE PROGRAMME**

The following clauses in Occupational Health, Safety & Environment Management / Quality Assurance Programme published in Chapter-IX of Special Conditions of Contract (Volume I Book-II) is revised as under.

**Chapter IX Clause 9.1 is modified as below:**

Contractor will comply with HSE (Health, Safety & Environment) requirements of BHEL as per the "HSE Plan for Site Operations by Subcontractor" (Document No.

HSEP: 14 Rev01) enclosed.

**Chapter IX Clause 9.1.1 to 9.1.25 stands deleted.**

**Chapter IX Clause 9.2 to 9.62 stands deleted.**

**Sl No: 3**

**Clause No. 10.5 on RA Bill Payments, in Special Conditions of Contract (SCC) Volume- IB, Book- II, is revised as under:**

The payment for running bills will normally be released within 30 days of submission of running bill complete in all respects with all documents. It is the responsibility of the contractor to make his own arrangements for making timely payments towards labour wages, statutory payments, outstanding dues etc., and other dues in the meanwhile.

**Following Clauses are Modified / Revised / Added in GCC as below:**

| Sl no. | GCC Clause No. | GCC clause Modified / Revised / Added |
|---|---|---|
| I. | 1.9.1, Sl. No. (ii) | The following mode of deposit, Sl. No. (e) is added: e) Insurance Surety Bonds |

| | | |
|---|---|---|
| II. | 1.10.3,<br>Sl. No. (vi) | The following Clause, Sl. No. (vi) is deleted:<br>Security deposit can also be recovered at the rate of 10% of the gross amount progressively from each of the running bills of the contractor till the total amount of the required security deposit is collected. However, in such cases at least 50% of the required Security Deposit, including the EMD, should be deposited in any form as prescribed before start of the work and the balance 50% may be recovered from the running bills as described above |
| III. | 1.10.3,<br>Sl.No.(vii) | The following mode of deposit, Sl. No. (vii) is added: e) Insurance Surety Bonds |
| IV. | Note mentioned under the GCC Clause 1.10.3 | Note mentioned under GCC Clause 1.10.3 is revised as below:<br>**Note**: (1) BHEL will not be liable or responsible in any manner for the collection of interest or renewal of the documents or in any other matter connected therewith.<br>(2) In case of delay in submission of security deposit, enhanced security deposit which would include interest (Repo rate +4%) for the delayed period, shall be submitted by the bidder. |
| V. | 1.10.8 | GCC Clause 1.10.8 is revised as below:<br>Bidder agrees to submit security deposit required for execution of the contract within the time period mentioned. In case of delay in submission of security deposit, enhanced security deposit which would include interest (Repo rate+4%) for the delayed period, shall be submitted by the bidder. Further, if security deposit is not submitted till such time the first bill becomes due, the amount of security deposit due shall be recovered as per terms defined in NIT / contract, from the bills along with due interest |
| VI. | 2.13.6 | GCC Clause 2.13.6 is revised as:<br>The rate of interest applicable for the above advances shall be the repo rate prevailing on the date of release of advance plus 4%, and such rate will remain fixed till the total advance amount is recovered |
| VII. | 2.22.1 | GCC Clause 2.22.1 is revised as:<br>Retention Amount shall be 5% of the Contract Value and shall be furnished through BG in line with clause 1.12 of GCC before payment of first RA Bill. The validity of the said BG shall be initially for the contract period & shall be extended, if so required, up to acceptance of final bill. In case of increase in contract value, additional BG for 5% of differential amount shall be submitted by Contractor before payment of next RA Bill due. Retention Amount can also be recovered at the rate of 10% of the gross amount progressively from each of the running bills of the contractor till the total amount of the required retention amount is collected.<br>In case, contractor opts cash deduction from RA bills in the beginning & subsequently offers to submit BG later on, then refund of deducted retention amount may be permitted against submission of BG for 5% of the Contract Value. |

| | | |
|---|---|---|
| VIII. | New Clause is added and replace the existing clause of Risk & Cost (i.e. 2.7.2.1 to 2.7.3) | Clause 2.7.2 and 2.7.3 are revised as:<br>**2.7.2 Breach of Contract, Remedies and Termination**<br>**2.7.2.1** BHEL shall terminate the contract after due notice of a period of 14 days in any of the following cases, which if not rectified/ improved within the time period mentioned in the notice, then, Breach of Contract will be considered to have been established:<br><br>i). Contractor s poor progress of the work vis- -vis execution timeline as stipulated in the Contract, backlog attributable to contractor including unexecuted portion of work does not appear to be executable within balance available period considering its performance of execution.<br>ii). Withdrawal from or abandonment of the work by contractor before completion of the work as per contract.<br>iii). Non-completion of work by the Contractor within scheduled completion period as per Contract or as extended from time to time, for the reasons attributable to the contractor.<br>iv). Repeated failure of contractor in deploying the required resources, to comply the statutory requirements etc. even after given by BHEL is writing.<br>v). Strike or Lockout declared is not settled within a period of one month.<br>vi). Termination of Contract on account of any other reason (s) attributable to Contractor. vii). Assignment, transfer, subletting of Contract without BHEL s written permission.<br>viii). Non-compliance to any contractual condition or any other default attributable to Contractor.<br><br>**2.7.2.2 Remedies in case of Breach of Contract is established**<br>In case Breach of Contract is established, Security Deposit and Retention Amount shall be encashed/ forfeited. This is without prejudice to BHEL s right to levy of liquidated damages, debarment etc. which shall be applied as per the provisions of the contract. Sequence of recovery to be made in case of breach of contract is established, is as below:<br>a) In case the value of Security Deposit & Retention Amount, available for the Contract, is less than 10% of the Contract Value, the balance amount shall be recovered from dues available in the form of Bills payable to contractor, BGs against the same contract etc.<br>b) Demand notice for deposit of balance recovery amount shall be sent to contractor, if funds are insufficient to effect complete recovery against dues indicated in (a) above.<br>c) If contractor fails to deposit the balance amount to be recovered within the period as prescribed in demand notice, following action shall be taken for balance recovery:<br>i) Dues payable to contractor against other contracts in the same Region shall be considered for recovery. |

| | | |
|---|---|---|
| | | ii) If recovery cannot be made out of dues payable to the contractor as above, balance amount to be recovered, shall be informed to other Regions/Units for making recovery from the Unpaid Bills/Running Bills/SD/BGs/Final Bills of contractor.<br>iii) In-case recoveries are not possible with any of the above available options, Legal action shall be initiated for recovery against contractor.<br>Note:<br>1) In addition to above, levy of liquidated damages, debarment, termination, short-closure etc. shall be applied as per provisions of the contract.<br>2) If tendering is done for the balance work, the defaulted contractor (including all the members/partners in case of JV/ partnership firm) shall not be eligible for either executing the balance work or to participate in the tender(s) for executing the balance work.<br><br>**2.7.3** In case Contractor fails to deploy the resources as per requirement informed by BHEL in writing ~~to~~ expedite the work, BHEL can deploy own/hired/otherwise arranged resources and recover the expenses incurred from the dues payable to contractor. Recoveries shall be actual expenses incurred plus 5% overheads or as defined in TCC. |

| | | |
|---|---|---|
| IX. | 2.7.7 | GCC Clause 2.7.7 is revised as:<br>BHEL may permit or direct contractor to demobilize and remobilize at a future date as intimated by BHEL in case of following situations for reasons other than Force majeure conditions and not attributable to contractor:<br>i) suspension of work(s) at a Project either by BHEL or Customer,<br>or<br>ii) where work comes to a complete halt or reaches a stage wherein worthwhile works cannot be executed and there is no possibility of commencement of work for a period of not less than three months<br><br>In such cases, charges towards demobilization and remobilization shall be as decided by BHEL after successful remobilization by contractor at site, and decision of BHEL shall be final and binding on the contractor. After remobilization, all conditions as per contract shall become applicable. In case Contractor does not remobilize with adequate resources or does not start the work within the period as intimated, then BHEL reserves the right to terminate the contract and effect remedies under Clause 2.7.2.2. Duration of the contract/time extension shall be revised suitably. In case of any conflict, BHEL decision in this regard shall be final and binding on the contractor. |
| X. | 2.11.3 | GCC Clause 2.11.3 is revised as:<br>However, if any Time extension is granted to the contractor to facilitate continuation of work and completion of contract, due to backlog attributable to the contractor alone, then it shall be without prejudice to the rights of BHEL to impose penalty/LD for the delays attributable to the contractor, in addition to any other actions BHEL may wish to take under clause 2.7.2 of GCC i.e.<br>Breach of Contract, Remedies and Termination . |
| XI. | 2.19.1 | GCC Clause 2.19.1 is revised as:<br>The contractor will be fully responsible for all disputes and other issues connected with his labour. In the event of the contractor s labour resorting to strike or the Contractor resorting to lockout and if the strike or lockout declared is not settled within a period of one month, it may be considered as Breach of Contract under Clause 2.7 and the remedies under Clause 2.7.2.2 may be executed, at the discretion of BHEL. |

| | | |
|---|---|---|
| XII. | 2.24.1 | GCC Clause 2.24.1 is revised as:<br>Even though the work will be carried out under the supervision of BHEL Engineers the Contractor will be responsible for the quality of the workmanship and shall guarantee the work done for a period of Twelve months from the date of commencement of guarantee period as defined in Technical Conditions of Contract, for good workmanship and shall rectify free of cost all defects due to faulty erection detected during the guarantee period. In the event of the Contractor failing to repair the defective works within the time specified by the Engineer, BHEL may proceed to undertake the repairs of such defective works, by itself, without prejudice to any other rights and recover the cost incurred for the same along with 5% overheads from the Security Deposit. |

**VOLUME-IA PART-II**

**CHAPTERS 2-9**

In the next 375 pages as below:

| CHAPTER | Details | No. of sheets |
|---|---|---|
| CHAPTER 2 | Hire charges on issue of capital tools & Plants (Only corresponding charges) | 12 |
| CHAPTER 3 | HSE Plan For Site Operations By Subcontractor | 82 |
| CHAPTER 4 | Field/Erection Welding Schedule | 92 |
| CHAPTER 5 | Painting Scheme | 06 |
| CHAPTER 6 | Guidelines For P91 Welding | 25 |
| CHAPTER 7 | Guidelines For Heat Treatment | 91 |
| CHAPTER 8 | Guidelines For Insulation | 54 |
| CHAPTER 9 | Guidelines For NDE And Heat Treatment Agency | 13 |

Annexure

C1

DATE:31/08/2021

REVISED RATES OF T&P HIRE CHARGES FOR CRANES & TRAILERS ETC. FOR
**SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS**

| SL NO. | ITEM DESCRIPTION | USEFUL LIFE (IN YRS) | Revised rates (Rs./Hour) valid from 01/09/2021 to 31/8/2023 (WITHIN USEFUL LIFE) | Revised rates (Rs./Hour) valid from 01/09/2021 to 31/8/2023 (BEYOND USEFUL LIFE) |
|---|---|---|---|---|
| I. | CRANES:- | | | |
| | | | | |
| 1 | Portal Gantry Crane 500T | 15 | 24500.00 | 24500.00 |
| 2 | 100MT Crawler Crane ZOOMLION CRANE-QUY-100 | 10 | 11370.00 | 10940.00 |
| 3 | Heavy Lift Crawler Crane 600MT Class DEMAG Model CC2800 | 15 | 56290.00 | 53560.00 |
| 4 | PORTAL CRANE, 360T | 15 | 14070.00 | 13390.00 |
| 5 | 600MT Class Crawler Crane- Manitowoc Model 18000-UPGRADED | 15 | 55460.00 | 52770.00 |
| 6 | 600MT Class Crawler Crane- Liebherr Model LR1600-2 (Upgraded version) | 15 | 68610.00 | 65280.00 |
| 7 | CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH RINGER) | 15 | 33510.00 | 31880.00 |
| 8 | CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH-OUT RINGER) | 15 | 20940.00 | 19920.00 |
| 9 | MANITOWOC M-250T TRUCK CRANE | 15 | 30160.00 | 28690.00 |
| 10 | 270 MT Class Crawler Crane- Manitowoc Model 2250 | 15 | 31660.00 | 30130.00 |
| 11 | 300MT Crane Crawler Crane LIEBHERR Model LR-1350/1 | 15 | 26390.00 | 25110.00 |
| 11.A | 300MT Crane Crawler Crane LIEBHERR Model LR-1350/1 (UPGRADED) | 15 | 36110.00 | 34580.00 |
| 12 | 250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2 | 15 | 15130.00 | 14390.00 |
| 12.A | 250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2 (UPGRADED) | 15 | 18850.00 | 18050.00 |
| 13 | LINKBELT LS- 248H CRAWLER CRANE (180T) | 15 | 16750.00 | 15940.00 |
| 14 | MANITOWAC MODEL 888 CRAWLER CRANE (200 MT) | 15 | 21780.00 | 20720.00 |
| 15 | CRAWLER CRANE SUMITOMO, 150T | 15 | 10890.00 | 10360.00 |
| 16 | All Terrain Crane, 150MT- Liebherr Model LTM1150 | 15 | 13400.00 | 12750.00 |
| 17 | CRAWLER CRANE, 120 T Fushun Model QUY120 | 10 | 10830.00 | 10420.00 |
| 18.A | CRAWLER CRANE 135MT Kobelco Model CK1350- 1F | 15 | 10720.00 | 10200.00 |
| 18.B | CRAWLER CRANE 135MT Kobelco Model CK1350 | 15 | 8880.00 | 8440.00 |
| 19 | CRAWLER CRANE 120MT - Tata-Sumitomo Model SCX1200-2 | 15 | 10050.00 | 9560.00 |
| 20 | CRAWLER CRANE 100 T (KH 500) | 15 | 10050.00 | 9560.00 |
| 21 | Hydraulic Crawler Crane 80MT, Fushun Model QUY 80B | 10 | 5410.00 | 5210.00 |
| 22 | ROUGH TERRAIN CRANE 75T (RT880) | 12 | 6140.00 | 5880.00 |
| 23 | CRAWLER CRANE, 75T -Tata Model 955ALC/TFC280 | 12 | 5370.00 | 5150.00 |
| 24 | Mobile Crane, 55MT (TIL) | 12 | 4410.00 | 4230.00 |
| 25 | CRAWLER CRANE, 25T -Tata Model TFC75 | 10 | 3030.00 | 2910.00 |
| 26 | MOBILE CRANE, 20MT (TIL) | 10 | 2270.00 | 2180.00 |
| 27 | MOBILE CRANE, 20MT (ESCORTS) | 10 | 2270.00 | 2180.00 |
| 28 | MOBILE CRANE ESCORTS- 14MT | 10 | 710.00 | 680.00 |
| 29 | HYDAULIC PICK & CARRY CRANE, 8/9/10/11/12 MT | 10 | 390.00 | 370.00 |

Annexure

C1

DATE:31/08/2021

REVISED RATES OF T&P HIRE CHARGES FOR CRANES & TRAILERS ETC. FOR
**SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS**

| SL NO. | ITEM DESCRIPTION | USEFUL LIFE (IN YRS) | Revised rates (Rs./Hour) valid from 01/09/2021 to 31/8/2023 (WITHIN USEFUL LIFE) | Revised rates (Rs./Hour) valid from 01/09/2021 to 31/8/2023 (BEYOND USEFUL LIFE) |
|---|---|---|---|---|
| 30 | FORK LIFT 5T | 5 | 650.00 | 640.00 |
| 31 | FORK LIFT 3T | 5 | 540.00 | 530.00 |

Annexure C2 DATE:31/08/202

## REVISED RATES OF T&P HIRE CHARGES FOR CRANES & TRAILERS ETC. FOR OUTSIDE AGENCIES

| SL NO. | ITEM DESCRIPTION | USEFUL LIFE (IN YRS) | Revised rates (Rs./Hour) valid from 01/09/2021 to 31/8/2023 (WITHIN USEFUL LIFE) | Revised rates (Rs./Hour) valid from 01/09/2019 to 31/8/2021 (BEYOND USEFUL LIFE) |
|---|---|---|---|---|
| I. | CRANES:- | | | |
| | | | | |
| 1 | Portal Gantry Crane 500T | 15 | 27230.00 | 27230.00 |
| 2 | 100MT Crawler Crane ZOOMLION CRANE-QUY-100 | 10 | 12630.00 | 12160.00 |
| 3 | Heavy Lift Crawler Crane 600MT Class DEMAG Model CC2800 | 15 | 62550.00 | 59520.00 |
| 4 | PORTAL CRANE, 360T | 15 | 15630.00 | 14880.00 |
| 5 | 600MT Class Crawler Crane- Manitowoc Model 18000-UPGRADED | 15 | 61620.00 | 58630.00 |
| 6 | 600MT Class Crawler Crane- Liebherr Model LR1600-2 (Upgraded version) | 15 | 76230.00 | 72540.00 |
| 7 | CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH RINGER) | 15 | 37230.00 | 35420.00 |
| 8 | CRAWLER CRANE FMC/LINKBELT 718, 250T (WITH-OUT RINGER) | 15 | 23270.00 | 22140.00 |
| 9 | MANITOWOC M-250T TRUCK CRANE | 15 | 33510.00 | 31880.00 |
| 10 | 270 MT Class Crawler Crane- Manitowoc Model 2250 | 15 | 35180.00 | 33480.00 |
| 11 | 300MT Crane Crawler Crane LIEBHERR Model LR-1350/1 | 15 | 29320.00 | 27900.00 |
| 11.A | 300MT Crane Crawler Crane LIEBHERR Model LR-1350/1 (UPGRADED) | 15 | 40120.00 | 38420.00 |
| 12 | 250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2 | 15 | 16810.00 | 15990.00 |
| 12.A | 250MT Class Mid range Crawler Crane- Kobelco Model CKE2500-2 (UPGRADED) | 15 | 20950.00 | 20060.00 |
| 13 | LINKBELT LS- 248H CRAWLER CRANE (180T) | 15 | 18610.00 | 17710.00 |
| 14 | MANITOWAC MODEL 888 CRAWLER CRANE (200 MT) | 15 | 24200.00 | 23020.00 |
| 15 | CRAWLER CRANE SUMITOMO, 150T | 15 | 12100.00 | 11510.00 |
| 16 | All Terrain Crane, 150MT- Liebherr Model LTM1150 | 15 | 14890.00 | 14170.00 |
| 17 | CRAWLER CRANE, 120 T Fushun Model QUY120 | 10 | 12030.00 | 11580.00 |
| 18.A | CRAWLER CRANE 135MT Kobelco Model CK1350- 1F | 15 | 11910.00 | 11330.00 |
| 18.B | CRAWLER CRANE 135MT Kobelco Model CK1350 | 15 | 9860.00 | 9380.00 |
| 19 | CRAWLER CRANE 120MT - Tata-Sumitomo Model SCX1200-2 | 15 | 11170.00 | 10620.00 |
| 20 | CRAWLER CRANE 100 T (KH 500) | 15 | 11170.00 | 10620.00 |
| 21 | Hydraulic Crawler Crane 80MT, Fushun Model QUY 80B | 10 | 6010.00 | 5790.00 |
| 22 | ROUGH TERRAIN CRANE 75T (RT880) | 12 | 6830.00 | 6540.00 |
| 23 | CRAWLER CRANE, 75T -Tata Model 955ALC/TFC280 | 12 | 5970.00 | 5720.00 |
| 24 | Mobile Crane, 55MT (TIL) | 12 | 4900.00 | 4700.00 |
| 25 | CRAWLER CRANE, 25T -Tata Model TFC75 | 10 | 3370.00 | 3240.00 |
| 26 | MOBILE CRANE, 20MT (TIL) | 10 | 2520.00 | 2430.00 |
| 27 | MOBILE CRANE, 20MT (ESCORTS) | 10 | 2520.00 | 2430.00 |
| 28 | MOBILE CRANE ESCORTS- 14MT | 10 | 790.00 | 760.00 |
| 29 | HYDAULIC PICK & CARRY CRANE, 8/9/10/11/12 MT | 10 | 430.00 | 410.00 |

Annexure C2 DATE:31/08/202

**REVISED RATES OF T&P HIRE CHARGES FOR CRANES & TRAILERS ETC. FOR OUTSIDE AGENCIES**

| SL NO. | ITEM DESCRIPTION | USEFUL LIFE (IN YRS) | Revised rates (Rs./Hour) valid from 01/09/2021 to 31/8/2023 (WITHIN USEFUL LIFE) | Revised rates (Rs./Hour) valid from 01/09/2019 to 31/8/2021 (BEYOND USEFUL LIFE) |
|---|---|---|---|---|
| 30 | FORK LIFT 5T | 5 | 720.00 | 710.00 |
| 31 | FORK LIFT 3T | 5 | 600.00 | 590.00 |

ANNEXURE-T I
DT: 31/08/2021

**RATES OF T&P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILERS ETC. FOR SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS**

| SL NO. | ITEM DESCRIPTION | Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023 |
|---|---|---|
| I. | LIFTING EQUIPMENTS | |
| | | |
| 1 | Strand Jack System for Boiler Drum Lifting | 20930 |
| 2 | MULTI SHEAVE PULLEY BLOCK 40/50T/60T | 310 |
| 3 | MULTI SHEAVE PULLEY BLOCK 100T | 630 |
| 4 | MULTI SHEAVE PULLEY BLOCK 150T | 1260 |
| 5 | ELCTRIC WINCH 5T | 1270 |
| 6 | ELCTRIC WINCH 10T | 2360 |
| 7 | ELECTRIC WINCH 15 T | 2150 |
| 8 | PASSENGER CUM GOODS HOIST 1T | 2270 |
| 9 | FURNACE MAINTENANCE PLATFORM | 5040 |
| 10 | Gang Operated Hydraulic Jack (Set of 4 Jacks - 175 MT each) | 2100 |
| | | |
| II | WELDING & HEAT TREATMENT EQUIPMENT | |
| 1 | 125KW, 3KHZ, AIR-COOLED INDUCTION HEATING EQUIPMENT | 16380 |
| 2 | 75KW, 10 KHZ, COMPACT INDUCTION HEATING EQUIPMENT | 8190 |
| 3 | WELDING GENERATOR 320/300 A | 300 |
| 4 | WELDING RECTIFIER 400A/300A | 300 |
| 5 | WELDING RECTIFIER 600A | 400 |
| 6 | DIESEL WELDING GENERATOR 400A/300A | 400 |
| 7 | TRANSFORMER,600A | 300 |
| 8 | TRANSFORMER 300/400A | 200 |
| | | |
| III | SERVICE PLANTS & ALLIED EQUIPT. | 0 |
| 1 | 500KVA DIESEL GENERATOR | 3800 |
| 2 | TRANSFORMER OIL FILTERATION EQUIPMENT 6000LPH CAPACITY WITHOUT STORAGE TANK | 6370 |
| 3 | -DO- , WITH STORAGE TANK | 7280 |
| 4 | OIL FILTERATION M/C, 250/500 LPH (OTHER THAN SILICON OIL) | 910 |
| 5 | OIL FILTERATION M/C, 250GPH/1000LPH (OTHER THAN SILICON OIL) | 1360 |
| 6 | OIL FILTERATION M/C, 500GPH/2500LPH (OTHER THAN SILICON OIL) | 1820 |
| 7 | OIL FILTERATION M/C, 1000GPH/5000LPH (OTHER THAN SILICON OIL) | 3640 |
| 8 | Portable Lube Oil Purification Unit (Centrifuge M/c) Capacity: 750 LPH | 1270 |
| 9 | Low Vacuum de-hydration unit | 630 |
| 10 | DIESEL GENERATING SET,250 KVA | 1770 |
| 11 | DIESEL GENERATING SET,25 KVA | 500 |

ANNEXURE-T I
DT: 31/08/2021

**RATES OF T&P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILERS ETC. FOR SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS**

| SL NO. | ITEM DESCRIPTION | Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023 |
|---|---|---|
| 12 | VACUUM PUMP(ABSOLUTE V.C.) | 540 |
| 13 | ACID CIRCULATING PUMP WITH MOTOR 120M HEAD, 150T/HR | 1090 |
| 14 | ACID TRANSFER PUMP 20/50 T/HR | 540 |
| 15 | DEWATERING PUMP (Kirloskar make,11KW/15HP) | 80 |
| 16 | HP Air compressor (32 Kg/Sq. Cm, 150 CFM) | 4240 |
| 17 | AIR COMPRESSORS 250/300/330/360/350 CFM | 2730 |
| 18 | AIR COMPRESSORS 140/150/190/210 CFM | 910 |
| 19 | ACID CIRCULATING PUMP WITH MOTOR & STARTER, 200T/HR, 150M, 220 HP | 1820 |
| 20 | Industrial Blower 2000CFM | 1270 |
| 21 | Air Leak Test Blower (Flow: 40000 $m^3$/Hr) | 1160 |
| 22 | Air Blower (Flow: 20000 $m^3$/Hr) | 940 |
| | | |
| IV | METAL FORMING /CUTTING EQUIPMENT | |
| 1 | TUBE EXPANDING M/C PNEUMATIC 60-100 MM | 630 |
| 2 | ELECTRO HYDRAULIC PIPE BENDING M/C 4" | 1630 |
| 3 | BOLTING MACHINE (ALCOA/AVLOCK/ HUCK) | 1800 |
| 4 | -do- Gun with nose Assembly only | 540 |
| | | |
| V | TESTING/INSPECTION EQUIPMENT | |
| 1 | DATA LOGGER for PG TESTING | 36980 |
| 2 | MOTORISED HYDRAULIC TEST PUMP 250kg/cmsq | 800 |
| 3 | MOTORISED HYDRAULIC TEST PUMP 400-450kg/cmsq | 1090 |
| 4 | MOTORISED HYDRAULIC TEST PUMP 600 KG/CMSQ | 1270 |
| 5 | HYDRAULIC TEST PUMP 800 KG/CMSQ | 1330 |
| 6 | HYDRAULIC TEST PUMP 1000 KG/CMSQ | 2230 |
| 7 | BOLT STRETCHING DEVICE | 910 |
| 8 | BOROSCOPE/FIBROSCOPE FLEXIBLE TYPE (FLEXUX) IMPORTED | 3640 |
| 9 | ULTRASONIC FLAW DETECTOR | 2730 |
| 10 | MPI TEST KIT | 360 |
| 11 | GAS LEAK DETECTOR | 270 |
| 12 | VIBRATION/SOUND LEVEL METER IRD-306 | 360 |
| 13 | VIBRATION/SOUND LEVEL METER IRD-308 | 360 |
| 14 | VIBRATION ANALYSER/DYNAMIC BALANCING M/C IRD 350 | 1450 |
| 15 | VIBRATION ANALYSER/DYNAMIC BALANCING M/C IRD 360 | 2540 |
| 16 | SHOCK PULSE METER | 630 |
| 17 | HV.DC TEST KIT UPTO 50 KV | 540 |
| 18 | HV.DC TEST KIT ABOVE 50 KV | 1000 |
| 19 | HV.AC TEST KIT UPTO 50KV | 810 |
| 20 | HV.AC TEST KIT ABOVE 50KV | 2910 |
| 21 | MOTORISED MEGGER 2.5KV | 400 |
| 22 | MOTORISED MEGGAR 5KV | 450 |
| 23 | OSCILLOSCOPE-DUAL BEAM INDIGENOUS | 450 |
| 24 | OSCILLOSCOPE-DUAL BEAM IMPORTED | 1090 |
| 25 | WAVEFORM ANALYSER | 910 |
| 26 | OSCILLOGRAPH/UV RECORDER 24 CHANNEL | 1630 |
| 27 | OSCILLOGRAPH/UV RECORDER 12 CHANNEL | 1090 |
| 28 | OSCILLOGRAPH/UV RECORDER 6 CHANNEL | 910 |

ANNEXURE-T I
DT: 31/08/2021

**RATES OF T&P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILERS ETC. FOR SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS**

| SL NO. | ITEM DESCRIPTION | Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023 |
|---|---|---|
| 29 | DIGITAL LOW RESISTANCE METER | 630 |
| 30 | DC POTENTIOMETER | 180 |
| 31 | PRECISION DEAD WEIGHT TESTER | 1000 |
| 32 | OPTICAL ALIGNMENT KIT | 1360 |
| 33 | BOROSCOPE/FIBROSCOPE(NON FLEXIBLE) | 1200 |
| 34 | VERNIER THEODOLITE,PRECISION | 1200 |
| 35 | VERNIER THEODOLITE,ORDINARY | 200 |
| 36 | ENGINEERS PRECISION LEVEL/DUMPY LEVEL | 120 |
| 37 | ISKAMATIC 'A' | 3200 |
| 38 | CALIBRATOR '03' | 1000 |
| 39 | 48 POLE EXTENDER CARD | 200 |
| 40 | MULTIJET NPM | 400 |
| 41 | OSCILLOMETER | 10190 |
| 42 | VOC EQUIPMENT | 1400 |
| 43 | BINARY SIGNAL GENERATOR | 290 |
| 44 | ELECTRIC COUNTER | 690 |
| 45 | FREQUENCY GENERATOR | 1000 |
| 46 | DBF 3 VIBRATION RECORDER/ANALYSER | 3270 |
| 47 | L&T GOULD OSCILLOGRAPH 2-CHANNEL | 490 |
| 48 | L&T GOULD OSCILLOGRAPH 6-CHANNEL | 1180 |
| 49 | VIBROPORT 41/FFT ANALYSER | 5460 |
| 50 | ELCID kit | 10010 |
| 51 | UNIVERSAL CALIBRATION SYSTEM | 2730 |
| 52 | NATURAL FREQUENCY TESTER | 2910 |
| 53 | DIGITAL HARDNESS TESTER | 360 |
| 54 | ADRE 208 VIBRATION ANALYSER | 7280 |
| 55 | PCB DIAGONISTIC REPAIR KIT | 2000 |
| 56 | SECONDARY INJECTION RELAY TEST KIT | 5270 |
| 57 | MICRO OHM METER | 1450 |
| 58 | DIGITAL MICRO OHM METER<br>MEASURING RANGE: 200 μΩ TO 20KΩ | 3230 |
| 59 | PMI Machine OLYMPUS make | 3350 |
| 60 | Mobile Lighting Mast -<br>9 metres (4X400 W) | 860 |
| 61 | 10KVA RESISTANCE BRAZING MACHINE | 140 |
| 62 | RECURRENT SURGE OSCILLOGRAPH (RSO) TEST KIT WITH PORTABLE HANDHELD OSCILLOSCOPE. | 460 |
| 63 | HYDROGEN GAS LEAK DETECTOR | 50 |
| 64 | STATOR WEDGE ANALYZER KIT WITH COMPLETE ACCESSORIES | 4980 |
| 65 | WEDGE DEFLECTION KIT | 80 |
| 66 | TILE PRESSING MACHINE FOR GAS TURBINE | 270 |
| 67 | INDUCTION BRAZING MACHINE | 4870 |
| 68 | MAGNETIC COHESIVE FORCE (MCF) EQUIPMENT | 3640 |
| 69 | ULTRASONIC FLOW METER | 180 |
| 70 | PORTABLE VIBRATION ANALYSER (MODEL 811T) | 40 |
| 71 | CENTRIFUGAL PUMP SET FOR ACID CLEANING (WITH MOTOR AND PANEL) : PRESSURE -14KG/SQ CM. ; FLOW 60 M3/HR | 470 |
| 72 | CENTRIFUGAL PUMP SET FOR ACID CLEANING (WITH MOTOR AND PANEL) : PRESSURE -30KG/SQ CM. ; FLOW 15 M3/HR | 430 |

ANNEXURE-T I
DT: 31/08/2021

**RATES OF T&P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILERS ETC. FOR SUB-CONTRACTORS WORKING FOR BHEL FOR DOING BHEL JOBS**

| SL NO. | ITEM DESCRIPTION | Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023 |
|---|---|---|
| 73 | HI SPEED MEMORY RECORDER, MAKE -YOKOGAWA, MODEL DL850E-Q-HE/B5/HD1 | 1810 |
| 74 | TROLLEY MOUNTED HYDRAULIC JACK (100 MT) | 1260 |
| 75 | 5KV Insulation Tester | 450 |
| 76 | 4 Channel Digital Oscilloscope /Fast Recorder | 1710 |
| 77 | 4 Channel Oscillographic Recorder | 580 |
| 78 | Sound Level Meter | 230 |
| 79 | Thermal Imaging Camera | 770 |
| 80 | Videoscope (Video Boroscope) | 1510 |
| 81 | DO (Dissolve Oxygen) Meter (0 to 1500 ppb) | 1310 |
| 82 | Conductivity Meter | 80 |
| 83 | Core Flux Test Kit | 7280 |
| 84 | Primary Current Injection Kit (2000A) | 870 |
| 85 | 3 Phase Secondary Injection Kit ( Relay Test ) | 3760 |
| 86 | FRF Filtration Kit | 1330 |
| 87 | FFT Analyser | 2290 |
| 88 | Flue Gas Analyser | 1030 |
| 89 | Oil Test Kit ( Mineral Oil)-Transformer | 1010 |
| 90 | Winding Resistance kit ( R L C Load) | 880 |
| 91 | SFRA test Kit | 1190 |
| 92 | Tan Delta test Kit | 4060 |
| 93 | PF Meter | 330 |
| 94 | Ultrasonic Flow Meter | 830 |
| 95 | Oil Particle Counter | 360 |
| 96 | Plasma Cutting Machine (With complete accessories) | 310 |
| 97 | JCB make DG Set 80 KVA | 670 |
| 98 | Diesel Generating Set 82.5 KVA | 610 |
| 99 | Portable Jacking Oil Pump | 1080 |
| 100 | Alloy Analyser | 1770 |

ANNEXURE-T II
DT: 31/08/2021

# RATES OF T & P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILLERS ETC. FOR OUTSIDE AGENCIES

| SL NO. | ITEM DESCRIPTION | Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023 |
|---|---|---|
| I. | LIFTING EQUIPMENTS | |
| | | |
| 1 | Strand Jack System for Boiler Drum Lifting | 23250 |
| 2 | MULTI SHEAVE PULLEY BLOCK 40/50T/60T | 350 |
| 3 | MULTI SHEAVE PULLEY BLOCK 100T | 700 |
| 4 | MULTI SHEAVE PULLEY BLOCK 150T | 1400 |
| 5 | ELCTRIC WINCH 5T | 1410 |
| 6 | ELCTRIC WINCH 10T | 2620 |
| 7 | ELECTRIC WINCH 15 T | 2390 |
| 8 | PASSENGER CUM GOODS HOIST 1T | 2520 |
| 9 | FURNACE MAINTENANCE PLATFORM | 5600 |
| 10 | Gang Operated Hydraulic Jack (Set of 4 Jacks - 175 MT each) | 2330 |
| | | |
| II | WELDING & HEAT TREATMENT EQUIPMENT | |
| 1 | 125KW, 3KHZ, AIR-COOLED INDUCTION HEATING EQUIPMENT | 18190 |
| 2 | 75KW, 10 KHZ, COMPACT INDUCTION HEATING EQUIPMENT | 9090 |
| 3 | WELDING GENERATOR 320/300 A | 330 |
| 4 | WELDING RECTIFIER 400A/300A | 330 |
| 5 | WELDING RECTIFIER 600A | 440 |
| 6 | DIESEL WELDING GENERATOR 400A/300A | 440 |
| 7 | TRANSFORMER,600A | 330 |
| 8 | TRANSFORMER 300/400A | 220 |
| | | |
| III | SERVICE PLANTS & ALLIED EQUIPT. | |
| 1 | 500KVA DIESEL GENERATOR | 4220 |
| 2 | TRANSFORMER OIL FILTERATION EQUIPMENT 6000LPH CAPACITY WITHOUT STORAGE TANK | 7070 |
| 3 | -DO- , WITH STORAGE TANK | 8080 |
| 4 | OIL FILTERATION M/C, 250/500 LPH (OTHER THAN SILICON OIL) | 1010 |
| 5 | OIL FILTERATION M/C, 250GPH/1000LPH (OTHER THAN SILICON OIL) | 1510 |
| 6 | OIL FILTERATION M/C, 500GPH/2500LPH (OTHER THAN SILICON OIL) | 2020 |
| 7 | OIL FILTERATION M/C, 1000GPH/5000LPH (OTHER THAN SILICON OIL) | 4040 |
| 8 | Portable Lube Oil Purification Unit (Centrifuge M/c) Capacity: 750 LPH | 1410 |
| 9 | Low Vacuum de-hydration unit | 700 |
| 10 | DIESEL GENERATING SET,250 KVA | 1970 |
| 11 | DIESEL GENERATING SET,25 KVA | 560 |
| 12 | VACUUM PUMP(ABSOLUTE V.C.) | 600 |
| 13 | ACID CIRCULATING PUMP WITH MOTOR 120M HEAD, 150T/HR | 1210 |
| 14 | ACID TRANSFER PUMP 20/50 T/HR | 600 |
| 15 | DEWATERING PUMP (Kirloskar make,11KW/15HP) | 90 |
| 16 | HP Air compressor (32 Kg/Sq. Cm, 150 CFM) | 4710 |
| 17 | AIR COMPRESSORS 250/300/330/360/350 CFM | 3030 |
| 18 | AIR COMPRESSORS 140/150/190/210 CFM | 1010 |

ANNEXURE-T II
DT: 31/08/2021

# RATES OF T & P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILLERS ETC. FOR OUTSIDE AGENCIES

| SL NO. | ITEM DESCRIPTION | Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023 |
|---|---|---|
| 19 | ACID CIRCULATING PUMP WITH MOTOR & STARTER, 200T/HR, 150M, 220 HP | 2020 |
| 20 | Industrial Blower 2000CFM | 1410 |
| 21 | Air Leak Test Blower (Flow: 40000 m³/Hr) | 1290 |
| 22 | Air Blower (Flow: 20000 m³/Hr) | 1040 |
| | | |
| IV | METAL FORMING /CUTTING EQUIPMENT | |
| 1 | TUBE EXPANDING M/C PNEUMATIC 60-100 MM | 700 |
| 2 | ELECTRO HYDRAULIC PIPE BENDING M/C 4" | 1810 |
| 3 | BOLTING MACHINE (ALCOA/AVLOCK/ HUCK) | 2000 |
| 4 | -do- Gun with nose Assembly only | 600 |
| | | |
| V | TESTING/INSPECTION EQUIPMENT | |
| 1 | DATA LOGGER for PG TESTING | 41090 |
| 2 | MOTORISED HYDRAULIC TEST PUMP 250kg/cmsq | 880 |
| 3 | MOTORISED HYDRAULIC TEST PUMP 400-450kg/cmsq | 1210 |
| 4 | MOTORISED HYDRAULIC TEST PUMP 600 KG/CMSQ | 1410 |
| 5 | HYDRAULIC TEST PUMP 800 KG/CMSQ | 1480 |
| 6 | HYDRAULIC TEST PUMP 1000 KG/CMSQ | 2480 |
| 7 | BOLT STRETCHING DEVICE | 1010 |
| 8 | BOROSCOPE/FIBROSCOPE FLEXIBLE TYPE (FLEXUX) IMPORTED | 4040 |
| 9 | ULTRASONIC FLAW DETECTOR | 3030 |
| 10 | MPI TEST KIT | 400 |
| 11 | GAS LEAK DETECTOR | 300 |
| 12 | VIBRATION/SOUND LEVEL METER IRD-306 | 400 |
| 13 | VIBRATION/SOUND LEVEL METER IRD-308 | 400 |
| 14 | VIBRATION ANALYSER/DYNAMIC BALANCING M/C IRD 350 | 1610 |
| 15 | VIBRATION ANALYSER/DYNAMIC BALANCING M/C IRD 360 | 2830 |
| 16 | SHOCK PULSE METER | 700 |
| 17 | HV.DC TEST KIT UPTO 50 KV | 600 |
| 18 | HV.DC TEST KIT ABOVE 50 KV | 1110 |
| 19 | HV.AC TEST KIT UPTO 50KV | 900 |
| 20 | HV.AC TEST KIT ABOVE 50KV | 3230 |
| 21 | MOTORISED MEGGER 2.5KV | 440 |
| 22 | MOTORISED MEGGAR 5KV | 500 |
| 23 | OSCILLOSCOPE-DUAL BEAM INDIGENOUS | 500 |
| 24 | OSCILLOSCOPE-DUAL BEAM IMPORTED | 1210 |
| 25 | WAVEFORM ANALYSER | 1010 |
| 26 | OSCILLOGRAPH/UV RECORDER 24 CHANNEL | 1810 |
| 27 | OSCILLOGRAPH/UV RECORDER 12 CHANNEL | 1210 |
| 28 | OSCILLOGRAPH/UV RECORDER 6 CHANNEL | 1010 |
| 29 | DIGITAL LOW RESISTANCE METER | 700 |
| 30 | DC POTENTIOMETER | 200 |
| 31 | PRECISION DEAD WEIGHT TESTER | 1110 |
| 32 | OPTICAL ALIGNMENT KIT | 1510 |
| 33 | BOROSCOPE/FIBROSCOPE(NON FLEXIBLE) | 1330 |
| 34 | VERNIER THEODOLITE,PRECISION | 1330 |
| 35 | VERNIER THEODOLITE,ORDINARY | 220 |

ANNEXURE-T II
DT: 31/08/2021

# RATES OF T & P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILLERS ETC. FOR OUTSIDE AGENCIES

| SL NO. | ITEM DESCRIPTION | Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023 |
|---|---|---|
| 36 | ENGINEERS PRECISION LEVEL/DUMPY LEVEL | 130 |
| 37 | ISKAMATIC 'A' | 3550 |
| 38 | CALIBRATOR '03' | 1110 |
| 39 | 48 POLE EXTENDER CARD | 220 |
| 40 | MULTIJET NPM | 440 |
| 41 | OSCILLOMETER | 11320 |
| 42 | VOC EQUIPMENT | 1550 |
| 43 | BINARY SIGNAL GENERATOR | 320 |
| 44 | ELECTRIC COUNTER | 760 |
| 45 | FREQUENCY GENERATOR | 1110 |
| 46 | DBF 3 VIBRATION RECORDER/ANALYSER | 3630 |
| 47 | L&T GOULD OSCILLOGRAPH 2-CHANNEL | 540 |
| 48 | L&T GOULD OSCILLOGRAPH 6-CHANNEL | 1310 |
| 49 | VIBROPORT 41/FFT ANALYSER | 6060 |
| 50 | ELCID kit | 11120 |
| 51 | UNIVERSAL CALIBRATION SYSTEM | 3030 |
| 52 | NATURAL FREQUENCY TESTER | 3230 |
| 53 | DIGITAL HARDNESS TESTER | 400 |
| 54 | ADRE 208 VIBRATION ANALYSER | 8080 |
| 55 | PCB DIAGONISTIC REPAIR KIT | 2220 |
| 56 | SECONDARY INJECTION RELAY TEST KIT | 5860 |
| 57 | MICRO OHM METER | 1610 |
| 58 | DIGITAL MICRO OHM METER<br>MEASURING RANGE: 200 μΩ TO 20KΩ | 3590 |
| 59 | PMI Machine OLYMPUS make | 3730 |
| 60 | Mobile Lighting Mast -<br>9 metres (4X400 W) | 960 |
| 61 | 10KVA RESISTANCE BRAZING MACHINE | 160 |
| 62 | RECURRENT SURGE OSCILLOGRAPH (RSO) TEST KIT WITH PORTABLE HANDHELD OSCILLOSCOPE. | 510 |
| 63 | HYDROGEN GAS LEAK DETECTOR | 60 |
| 64 | STATOR WEDGE ANALYZER KIT WITH COMPLETE ACCESSORIES | 5530 |
| 65 | WEDGE DEFLECTION KIT | 90 |
| 66 | TILE PRESSING MACHINE FOR GAS TURBINE | 300 |
| 67 | INDUCTION BRAZING MACHINE | 5410 |
| 68 | MAGNETIC COHESIVE FORCE (MCF) EQUIPMENT | 4040 |
| 69 | ULTRASONIC FLOW METER | 200 |
| 70 | PORTABLE VIBRATION ANALYSER (MODEL 811T) | 50 |
| 71 | CENTRIFUGAL PUMP SET FOR ACID CLEANING (WITH MOTOR AND PANEL) : PRESSURE -14KG/SQ CM. ; FLOW 60 M3/HR | 520 |
| 72 | CENTRIFUGAL PUMP SET FOR ACID CLEANING (WITH MOTOR AND PANEL) : PRESSURE -30KG/SQ CM. ; FLOW 15 M3/HR | 480 |
| 73 | HI SPEED MEMORY RECORDER, MAKE -YOKOGAWA, MODEL DL850E-Q-HE/B5/HD1 | 2010 |
| 74 | TROLLEY MOUNTED HYDRAULIC JACK (100 MT) | 1400 |
| 75 | 5KV Insulation Tester | 500 |

ANNEXURE-T II
DT: 31/08/2021

# RATES OF T & P HIRE CHARGES FOR ITEMS OTHER THAN CRANES & TRAILLERS ETC. FOR OUTSIDE AGENCIES

| SL NO. | ITEM DESCRIPTION | Revised rates (Rs./Day) valid from 01/09/2021 to 31/8/2023 |
|---|---|---|
| 76 | 4 Channel Digital Oscilloscope /Fast Recorder | 1900 |
| 77 | 4 Channel Oscillographic Recorder | 650 |
| 78 | Sound Level Meter | 260 |
| 79 | Thermal Imaging Camera | 860 |
| 80 | Videoscope (Video Boroscope) | 1680 |
| 81 | DO (Dissolve Oxygen) Meter (0 to 1500 ppb) | 1460 |
| 82 | Conductivity Meter | 90 |
| 83 | Core Flux Test Kit | 8090 |
| 84 | Primary Current Injection Kit (2000A) | 960 |
| 85 | 3 Phase Secondary Injection Kit ( Relay Test ) | 4180 |
| 86 | FRF Filtration Kit | 1480 |
| 87 | FFT Analyser | 2550 |
| 88 | Flue Gas Analyser | 1140 |
| 89 | Oil Test Kit ( Mineral Oil)-Transformer | 1120 |
| 90 | Winding Resistance kit ( R L C Load) | 970 |
| 91 | SFRA test Kit | 1320 |
| 92 | Tan Delta test Kit | 4510 |
| 93 | PF Meter | 360 |
| 94 | Ultrasonic Flow Meter | 920 |
| 95 | Oil Particle Counter | 400 |
| 96 | Plasma Cutting Machine (With complete accessories) | 340 |
| 97 | JCB make DG Set 80 KVA | 740 |
| 98 | Diesel Generating Set 82.5 KVA | 680 |
| 99 | Portable Jacking Oil Pump | 1200 |
| 100 | Alloy Analyser | 1970 |



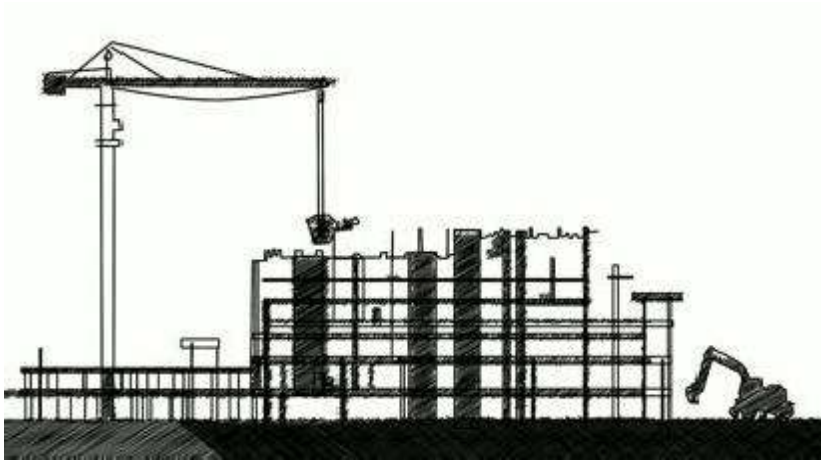
# HEALTH, SAFETY and ENVIRONMENT PLAN

for

## SITE OPERATIONS

by

## SUB-CONTRACTORS



POWER SECTOR

# HSE PLAN FOR SITE OPRATIONS BY BHEL'S SUBCONTRACTORS

## AT A GLANCE

**BEFORE START**

| SIGNING OF MOU |
|---|
| Agree to comply to HSE requirement- Statutory and BHEL's |

**PLAN**

| HSE ORGANISATION | |
|---|---|
| **Manpower**<br>• 1 (one) safety officer for every 500 workers or part thereof<br>• 1(one) safety-steward/ supervisor for every 100 workers<br><br>**Qualification**<br>As per Cl. 7.1 | **HSE Roles and responsibilities**<br>• Site In-charge- As per clause 7.2.1<br>• Safety officer- As per clause 7.2.2 |

| HSE Planning<br>for Man, Machinery/Equipment/Tools & Tackles |
|---|

**PROVIDE**

| HSE INFRASTUCTURE | |
|---|---|
| • PPEs<br>• Drinking Water<br>• Washing Facilities<br>• Latrines and Urinals<br>• Provision of shelter for rest<br>• Medical facilities | • Canteen facilities<br>• Labour Colony<br>• Emergency Vehicle<br>• Pest Control<br>• Scrapyard<br>• Illumination |

**TRAIN**

| HSE TRAINING , AWARENESS & PROMOTION | |
|---|---|
| **Training**<br>• Induction training<br>• Height work and other critical areas<br>• Tool Box talk & Pep Talk | **Awareness & Promotion**<br>• Signage<br>• Poster<br>• Banner<br>• Competition<br>• Awards |

**COMMUNICATE**

| HSE COMMUNICATION | |
|---|---|
| **Incident Reporting**<br>• Accident- Fatal & Major<br>• Property damage<br>• Near Miss | **Event Reporting**<br>• Celebrations<br>• Training<br>• Medical camp |

## EXECUTE SAFELY

**OPERATIONAL CONTROL PROCEDURES**

**PERMIT TO WORK**

Height work (above 2 metres), Hot Work, Heavy Lifting, Confined Space, Radiography, excavation (More than 4 metres)

| **SAFETY DURING WORK EXECUTION** | |
|---|---|
| • Welding<br>• Rigging<br>• Cylinder- storage & Movement<br>• Demolition work<br>• T&Ps<br>• Chemical Handling<br>• Electrical works | • Fire<br>• Scaffolding<br>• Height work<br>• Working Platform<br>• Excavation<br>• Ladder<br>• Lifting<br>• Hoisting appliance |
| **HOUSE KEEPING** | |
| **WASTE MANGEMENT** | |
| **TRAFFIC MANAGEMENT** | |
| **ENVIRONMENTAL CONTROL** | |
| **EMERGENCY PREPAREDNESS AND RESPONSE PLAN** | |

## CHECKS

| **HSE AUDITS & INSPECTION** | |
|---|---|
| • Daily Checks<br>• Inspection of PPEs<br>• Inspection of T& Ps<br>• Inspection of Cranes & Winches | • Inspection of Height work<br>• Inspection of Welding and Gas cutting<br>• Inspection of elevators etc. |

**HSE PERFORMANCE EVALUATION PARAMETERS**

## NON CONFORMANCE

**PENALTY for NON CONFORMANCE**

**Refer Clause 16**

**Incremental penalty**

For repeated violation by the same person, the penalty would be double of the previous penalty

For repeated fatal incident in the same Unit incremental penalty to be imposed. The subcontractor will pay 2 times the penalty compared to previously paid in case there are repeated cases of fatal incidents under the same subcontractor for the same package in the same unit.

## REVISION HISTORY SHEET

| Date | Revision No. | Details of Changes | Reason | Prepared | Reviewed | Approved |
|---|---|---|---|---|---|---|
| 12.08.2014 | 00 | First Issue | First Issue | S. B. Jayant, Dy Manager-FQA & Safety | A. K. Sinha, GM-FQA & Safety | Anuj Bhatnagar, ED-FQA & Safety |
| 20.01.2020 | 01 | Formats added:<br><br>**HSEP:14-F30 – Monthly HSE Planning & Review** (Page 11, Clause 8.0 - updated)<br><br>HSEP:14-F13E-Excavation Inspection Format (part of F30))<br>HSEP:14-F32B – Job Safety Analysis Format (part of F30)<br><br>**HSEP:14-F31A – Daily HSE Reporting** (Page 18, Clause 10.3 – added)<br><br>**HSEP:14-F33 – HSE Performance Evaluation** (Page 31, Clause 13 – revised) | IOM No.<br><br>**PSHQHSE/MONREP/02**<br><br>Dated 08-Jan-2020 | Rohit Kumar | Santosh Nair, GM (MSX & HSE) | |

| Sr. No. | Description | Page No. |
|---|---|---|
| 1.0 | PURPOSE | 4 |
| 2.0 | SCOPE | 4 |
| 3.0 | OBJECTIVES AND TARGETS | 4 |
| 4.0 | HEALTH, SAFETY & ENVIRONMENT POLICY | 5 |
| 5.0 | MEMORANDUM OF UNDERSTANDING | 6 |
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**1.0 PURPOSE**

**1.1** The purpose of this HSE Plan is to provide for the systematic identification, evaluation, prevention and control of general workplace hazards, specific job hazards, potential hazards and environmental impacts that may arise from foreseeable conditions during installation and servicing of industrial projects and power plants.

**1.2** This document shall be followed by BHEL's subcontractors at all installation and servicing sites. In case customer specific documents are to be implemented, this document will be followed in conjunction with customer specific documents.

**1.3** Although every effort has been made to make the procedures and guidelines in line with statutory requirements, in case of any discrepancy relevant statutory guidelines must be followed.

**1.4** In case the customer has any specific requirement, the same is to be fulfilled.

**2.0 SCOPE**

The document is applicable for BHEL's Subcontractors at all installation / servicing activities of BHEL Power Sector as per the relevant contractual obligations.

**3.0 OBJECTIVES AND TARGETS**

The HSE Plan reflects that BHEL places high priority upon the Occupational Health, Safety and Environment at workplaces.

- Ensure the Health and Safety of all persons at work site is not adversely affected by the work.
- Ensure protection of environment of the work site.
- Comply at all times with the relevant statutory and contractual HSE requirements.
- Provide trained, experienced and competent personnel. Ensure medically fit personnel only are engaged at work.
- Provide and maintain plant, places and systems of work that are safe and without risk to health and the environment.
- Provide all personnel with adequate information, instruction, training and supervision on the safety aspect of their work.
- Effectively control, co-ordinate and monitor the activities of all personnel on the Project sites including subcontractors in respects of HSE.
- Establish effective communication on HSE matters with all relevant parties involved in the Project works.
- Ensure that all work planning takes into account all persons that may be affected by the work.
- Ensure fitness testing of all T&Ps/Lifting appliances like cranes, chain pulley blocks etc. are to be certified by competent person.
- Ensure timely provision of resources to facilitate effective implementation of HSE requirements.
- Ensure continual improvements in HSE performance
- Ensure conservation of resources and reduction of wastage.
- Capture the data of all incidents including near misses, process deviation etc. Investigate and analyze the same to find out the root cause.
- Ensure timely implementation of correction, corrective action and preventive action.

**HSE TARGETS**

| | |
|---|---|
| **EXPLOSION** | **ZERO** |
| **FATALITY** | **ZERO** |
| **LOST TIME INJURY** | **ZERO** |
| **FIRE** | **ZERO** |
| **VEHICLE INCIDENTS** | **ZERO** |
| **ENVIRONMENTAL INCIDENTS** | **ZERO** |

## 4.0 BHEL POWER SECTOR HEALTH, SAFETY & ENVIRONMENT POLICY

### Health, Safety & Environment Policy of BHEL

In BHEL, Health, Safety and Environment (HSE) responsibilities are driven by our commitment to protect our employees and people we work with, community and environment. BHEL believes in zero tolerance for unsafe work/non-conformance to safety and in minimizing environmental footprint associated with all its business activities. We commit to continually improve our HSE performance by:

- Developing safety and sustainability culture through active leadership and by ensuring availability of required resources.
- Ensuring compliance with applicable legislation, regulations and BHEL systems.
- Taking up activities for conservation of resources and adopting sound waste management by following Reduce/Recycle/Reuse approach.
- Continually identifying, assessing and managing environmental impacts and Occupational Health & Safety risks of all activities, products and services adopting approach based on elimination/ substitution/reduction/control.
- Incorporating appropriate Occupational Health, Safety and Environment criteria into business decisions, design of products & systems and for selection of plants, technologies and services.
- Imparting appropriate structured training to all persons at workplace and promoting awareness amongst customers, contractors and suppliers on HSE issues.
- Reviewing periodically this policy and HSE Management Systems to ensure its relevance, appropriateness and effectiveness.
- Communicating this policy within BHEL and making it available to interested parties.

` **sd/-**

**CMD, BHEL**

**5.0 MEMORANDUM OF UNDERSTANDING:**

After award of work, subcontractors are required to enter into a memorandum of understanding as given below:

**Memorandum of Understanding**

**BHEL, Power Sector_____Region is committed to Health, Safety and Environment Policy (HSE Policy).**

**M/s_____do hereby also commit to comply with the same HSE Policy w h i l e executing the Contract Number _____**

**M/s_____shall ensure that safe work practices as per the HSE plan. Spirit and content therein shall be reached to all workers and supervisors for compliance.**

**In addition to this, M/S_____shall comply to all applicable statutory and regulatory requirements which are in force in the place of project and any special requirement specified in the contract document of the principal customer.**

**M/s_____shall co-operate in HSE audits/inspections conducted by BHEL /customer/ third party and ensure to close any non-conformity observed/reported within prescribed time limit.**

**Signed by authorized representative of M/s ----------**

**Name :**

**Place & Date:**

## 6.0 TERMS AND DEFINITIONS

### 6.1 DEFINITIONS

#### 6.1.1 INCIDENT

Work- related or natural event(s) in which an injury, or ill health (regardless of severity), damage to property or fatality occurred, or could have occurred.

#### 6.1.2 NEAR MISS

An incident where no ill health, injury, damage or other loss occurs, but it had a potential to cause, is referred to as "Near-Miss".

#### 6.1.3 MAN-HOURS WORKED

The total number of man hours worked by all employees including subcontractors working in the premises. It includes managerial, supervisory, professional, technical, clerical and other workers including contract labours. Man-hours worked shall be calculated from the payroll or time clock recorded including overtime. When this is not feasible, the same shall be estimated by multiplying the total man-days worked for the period covered by the number of hours worked per day. The total number of workdays for a period is the sum of the number of men at work on each day of period. If the daily hours vary from department to department separate estimate shall be made for each department and the result added together.

#### 6.1.4 FIRST AID CASES

First aids are not essentially all reportable cases, where the injured person is given medical treatment and discharged immediately for reporting on duty, without counting any lost time.

#### 6.1.5 LOST TIME INJURY

Any work injury which renders the injured person unable to perform his regular job or an alternative restricted work assignment on the next scheduled work day after the day on which the injury occurred.

#### 6.1.6 MEDICAL CASES

Medical cases come under non-reportable cases, where owing to illness or other reason the employee was absent from work and seeks Medical treatment.

#### 6.1.7 TYPE OF INCIDENTS & THEIR REPORTING:

The three categories of Incident are as follows:

**Non-Reportable Cases:**
An incident, where the injured person is given medical help and discharged for work without counting any lost time.

**Reportable Cases:**
In this case the injured person is disable for 48 hours or more and is not able to perform his duty.

**Injury Cases:**
These are covered under the heading of non-reportable cases. In these cases the incident caused injury to the person, but he still continues his duty.

### 6.1.8 TOTAL REPORTABLE FREQUENCY RATE

Frequency rate is the number of Reportable Lost Time Injury (LTI) per one Million Man hours worked. Mathematically, the formula read as:

$$\frac{\text{Number of Reportable LTI}}{\text{Total Man Hours Worked}} \times 1{,}000{,}000$$

### 6.1.9 SEVERITY RATE

Severity rate is the Number of days lost due to Lost Time Injury (LTI) per one Million Man hours worked. Mathematically, the formula reads as:

$$\frac{\text{Days lost due to LTI}}{\text{Total Man Hours Worked}} \times 1{,}000{,}000$$

### 6.1.10 INCIDENCE RATE

Incidence Rate is the Number of LTI per one thousand manpower deployed. Mathematically, the formula reads as:

$$\frac{\text{Number of LTI}}{\text{Average number of manpower deployed}} \times 1000$$

## 7.0 HSE ORGANISATION

**Number of safety officers:**
The subcontractor must deploy one safety officer for every 500 workers or part thereof in each package. In addition, there must be one safety-steward/safety-supervisor for every 100 workers.

**Deployment**: The subcontractor should deploy sufficient safety officers and safety-steward/Safety-supervisor, as per requirement given above, since initial stage and add more in proportion to the added strength in work force. Any delay in deployment will attract a penalty of Rs.30,000/- per man month for the delayed period.

### 7.1 QUALIFICATION FOR HSE PERSONNEL

| Sl.no | Designation | Qualification | Experience |
|---|---|---|---|
| 1 | Safety officer (Construction Agency) | Degree or Diploma in Engineering with full time diploma in Industrial Safety with construction safety as one of the subjects | Minimum two years for degree holder and five years for diploma holder in the field of Construction of power plant/ major industries |

| | | | |
|---|---|---|---|
| 2 | Safety-Steward/ Safety-Supervisor | Degree or diploma in any discipline with full time diploma in Industrial Safety with construction safety as one of the subjects | Minimum two years |

**7.2 RESPONSIBILITIES**

**7.2.1 SITE IN -CHARGE OF SUBCONTRACTOR**

- Shall sign Memorandum of Understanding (MoU) for compliance to BHEL's HSE Plan for Site Operations as per clause 5.0
- Shall engage qualified safety officer(s) and steward (s) as per clause 7.0
- Shall adhere to the rules and regulations mentioned in this code, practice very strictly in his area of work in consultation with his concerned engineer and the safety coordinator.
- Shall screen all workmen for health and competence requirement before engaging for the job and periodically thereafter as required.
- Shall not engage any employee below 18 years.
- Shall arrange for all necessary PPEs like safety helmets, belts, full body harness, shoes, face shield, hand gloves etc. before starting the job. Shall ensure that no working men/women carry excessive weight more than stipulated in Factory Rule Regulation R57.
- Shall ensure that all T&Ps engaged are tested for fitness and have valid certificates from competent person.
- Shall ensure that provisions stipulated in contract Labour Regulation Act 1970, Chapter V C.9, canteen, rest rooms/washing facilities to contracted employees at site.
- Shall adhere to the instructions laid down in Operation Control Procedures (OCPs) available with the site management.
- Shall ensure that person working above 2.0 meter should use Safety Harness tied to a life line/stable structure.
- Shall ensure that materials are not thrown from height. Cautions to be exercised to prevent fall of material from height.
- Shall report all incidents (Fatal/Major/Minor/Near Miss) to the Site engineer /HSE officer of BHEL.
- Shall ensure that Horseplay is strictly forbidden.
- Shall ensure that adequate illumination is arranged during night work.
- Shall ensure that all personnel working under subcontractor are working safely and do not create any Hazard to self and to others.
- Shall ensure display of adequate signage/posters on HSE.
- Shall ensure that mobile phone is not used by workers while working.
- Shall ensure conductance of HSE audit, mockdrill, medical camps, induction training and training on HSE at site.
- Shall ensure full co-operation during HQ/External /Customer HSE audits.

- Shall ensure submission of look-ahead plan for procurement of HSE equipment's and PPEs as per work schedule.
- Shall ensure good housekeeping.
- Shall ensure adequate valid fire extinguishers are provided at the work site.
- Shall ensure availability of sufficient number of toilets /restrooms and adequate drinking water at work site and labour colony.
- Shall ensure adequate emergency preparedness.
- Shall be member of site HSE committee and attend all meetings of the committee
- Power source for hand lamps shall be maximum of 24 v.
- Temporary fencing should be done for open edges if Hand – railings and Toe-guards are not available.

**7.2.2 HEALTH, SAFETY AND ENVIRONMENT OFFICER OF SUBCONTRACTOR**

- Carry out safety inspection of Work Area, Work Method, Men, Machine & Material, P&M and other tools and tackles.
- Facilitate inclusion of safety elements into Work Method Statement.
- Highlight the requirements of safety through Tool-box / other meetings.
- Help concerned HOS to prepare Job Specific instructions for critical jobs.
- Conduct investigation of all incident/dangerous occurrences & recommend appropriate safety measures.
- Advice & co-ordinate for implementation of HSE permit systems, OCPs & MPs.
- Convene HSE meeting & minute the proceeding for circulation & follow-up action.
- Plan procurement of PPE & Safety devices and inspect their healthiness.
- Report to PS Region/HQ on all matters pertaining to status of safety and promotional program at site level.
- Facilitate administration of First Aid
- Facilitate screening of workmen and safety induction.
- Conduct fire Drill and facilitate emergency preparedness
- Design campaigns, competitions & other special emphasis programs to promote safety in the workplace.
- Apprise PS– Region on safety related problems.
- Notify site personnel non-conformance to safety norms observed during site visits / site inspections.
- Recommend to Site In charge, immediate discontinuance of work until rectification, of such situations warranting immediate action in view of imminent danger to life or property or environment.
- To decline acceptance of such PPE / safety equipment that do not conform to specified requirements.
- Encourage raising Near Miss Report on safety along with, improvement initiatives on safety.
- Shall work as interface between various agencies such customer, package-in-charges, subcontractors on HSE matters

**8.0 PLANNING BY SUBCONTRACTOR**

Monthly planning and review of HSE activities shall be carried out by subcontractor as per format No. HSEP:14-F30 jointly along with BHEL.

**8.1 MOBILISATION OF MACHINERY/EQUIPMENT/TOOLS BY SUBCONTRACTOR**

- As a measure to ensure that machinery, equipment and tools being mobilized to the construction site are fit for purpose and are maintained in safe operating condition and complies with legislative and owner requirement, inspection shall be arranged by in-house competent authority for acceptance as applicable.

- The machinery and equipment to be embraced for this purpose shall include but not limited to the following:

  - Mobile cranes.
  - Side Booms.
  - Forklifts.
  - Grinding machine.
  - Drilling machine.
  - Air compressors.
  - Welding machine.
  - Generator sets.
  - Dump Trucks.
  - Excavators.
  - Dozers
  - Grit Blasting Equipment.
  - Hand tools.

- Subcontractor shall notify the engineer, of his intention to bring on to site any equipment or any container, with liquid or gaseous fuel or other substance which may create a hazard. The Engineer shall have the right to prescribe the condition under which such equipment or container may be handled and used during the performance of the works and the subcontractor shall strictly adhere to such instructions. The Engineer shall have the right to inspect any construction tool and to forbid its use, if in his opinion it is unsafe. No claim due to such prohibition will be entertained.

**8.2 MOBILISATION OF MANPOWER BY SUBCONTRACTOR**

- The subcontractor shall arrange induction and regular health check of their employees as per schedule VII of BOCW rules by a registered medical practitioner.
- The subcontractor shall take special care of the employees affected with occupational diseases under rule 230 and schedule II of BOCW Rules. The employees not meeting the fitness requirement should not be engaged for such job.
- Ensure that the regulatory requirements of excessive weight limit (to carry/lift/ move weights beyond prescribed limits) for male and female workers are complied with.
- Appropriate accommodation to be arranged for all workmen in hygienic condition.

**8.3 PROVISION OF PPEs**

- Personnel Protective Equipment (PPEs), in adequate numbers, will be made available at site & their regular use by all concerned will be ensured
- The following matrix recommends usage of minimum PPEs against the respective job.

| Sl. No | Type of work | PPEs |
|---|---|---|
| 1 | Concrete and asphalt mixing | Nose mask, hand glove, apron and gum boot |
| 2 | Welders/Grinders/ Gas cutters | Welding/face screen, apron, hand gloves, nose mask and ear muffs if noise level exceeds 90dB. Helmet fitted with welding shield is preferred for welders |
| 3 | Stone/ concrete breakers | Ear muffs, safety goggles, hand gloves |
| 4 | Electrical Work | Rubber hand glove, Electrical Resistance shoes |
| 5 | Insulation Work | Respiratory mask, Hand gloves, safety goggles |
| 6 | Work at height | Double lanyard full body harness, Fall arrestor (specific cases) |
| 7 | Grit/Sand blasting | Blast suit, blast helmet, respirator, leather gloves |
| 8 | Painting | Plastic gloves, Respirators (particularly for spray painting) |
| 9 | Radiography | As per BARC guidelines |

- The PPEs shall conform to the relevant standards as below and bear ISI mark.

**Relevant is-codes for personal protection**

| | |
|---|---|
| IS: 2925 – 1984 | Industrial Safety Helmets. |
| IS: 4770 – 1968 | Rubber gloves for electrical purposes. |
| IS: 6994 – 1973 (Part-I) | Industrial Safety Gloves (Leather &Cotton Gloves). |
| IS: 1989 – 1986 (Part-I-II) | Leather safety boots and shoes. |
| IS: 5557 – 1969 | Industrial and Safety rubber knee boots. |
| IS: 6519 – 1971 | Code of practice for selections care and repair of Safety footwear. |
| IS: 11226 – 1985 | Leather Safety footwear having direct molding sole. |
| IS: 5983 – 1978 | Eye protectors. |
| IS: 9167 – 1979 | Ear protectors. |
| IS: 1179-1967 | Eye & Face protection during welding |
| IS: 3521 – 1983 | Industrial Safety Belts and Harness |
| IS:8519 -1977 | Guide for selection of industrial Safety equipment for body protection |
| IS:9473-2002,14166-1994,14746-1999 | Respiratory Protective Devices |

The list is not exhaustive. The safety officer may demand additional PPEs based on specific requirement.

- Where workers are employed in sewers and manholes, which are in use, the subcontractor shall ensure that the manhole covers are opened and ventilated at least for an hour before the workers are allowed to get into manhole, and the manholes so opened shall be cordoned off with suitable railing and provided with warning signals or boards to prevent incident to the public
- Besides the PPEs mentioned above, the persons shall use helmet and safety shoe. The visitors shall use Helmet and any other PPEs as deemed appropriate for the area of work.

Colour scheme for Helmets:

1. Workmen: Yellow
2. Safety staff: Green or white with green band
3. Electrician: Red
4. Others including visitors: White

- All the PPEs shall be checked for its quality before issue and the same shall be periodically checked. The users shall be advised to check the PPEs themselves for any defect before putting on. The defective ones shall be repaired/ replaced.
- The issuing agency shall maintain register for issue and receipt of PPEs.
- The Helmets shall have logo or name (abbreviation of agency name permitted) affixed or printed on the front.
- The body harnesses shall be serial numbered.

### 8.4 ARRANGEMENT OF INFRASTRUCTURE

#### 8.4.1 DRINKING WATER

- Drinking water shall be provided and maintained at suitable places at different elevations.
- Container should be labeled as " Drinking Water"
- Cleaning of the storage tank shall be ensured atleast once in 3 months indicating date of cleaning and next due date.
- Potability of water should be tested as per IS10500 at least once in a year.

#### 8.4.2 WASHING FACILITIES

- In every workplace, adequate and suitable facilities for washing shall be provided and maintained.
- Separate and adequate cleaning facilities shall be provided for the use of male and female workers. Such facilities shall be conveniently accessible and shall be kept in clean and hygienic condition and dully illuminated for night use.
- Overalls shall be supplied by the subcontractor to the workmen and adequate facilities shall be provided to enable the painters and other workers to wash during the cessation of work.

#### 8.4.3 LATRINES AND URINALS

- Latrines and urinals shall be provided in every work place.
- Urinals shall also be provided at different elevations.
- They shall be adequately lighted and shall be maintained in a clean and sanitary condition at all times, by appointing designated person.
- Separate facilities shall be provided for the use of male and female worker if any.

### 8.4.4 PROVISION OF SHELTER DURING REST

Proper Shed & Shelter shall be provided for rest during break

### 8.4.5 MEDICAL FACILITIES

#### 8.4.5.1 MEDICAL CENTRE (As per Schedule V, X and XI of BOCW central Rules, 1998)

- A medical centre shall be ensured/identified at site with basic facilities for handling medical emergencies. The medical center can be jointly developed on proportionate sharing basis with permission from BHEL
- A qualified medical professional, not less than MBBS, shall be deployed at the medical centre
- The medical centre shall be equipped with one ambulance, with trained driver and oxygen cylinder.
- Medical waste shall be disposed as per prevailing legislation (Bio-Medical Waste –Management and Handling Rules, 1998)

#### 8.4.5.2 FIRST AIDER

- Ensure availability of Qualified First-aider throughout the working hours.
- Every injury shall be treated, recorded and reported.
- Refresher course on first aid shall be conducted as necessary.
- List of Qualified first aiders and their contact numbers should be displayed at conspicuous places.

#### 8.4.5.3 FIRST AID BOX (as per schedule III of BOCW)

- The subcontractor shall provide necessary first aid facilities as per schedule III of BOCW. At every work place first aid facilities shall be provided and maintained.
- The first aid box shall be kept by first aider who shall always be readily available during the working hours of the work place. His name and contact no to be displayed on the box.
- The first aid boxes should be placed at various elevations so as to make them available within the reach and at the quickest possible time.
- The first aid box shall be distinctly marked with a Green Cross on white background.
- Details of contents of first aid box is given in Annexure No. 01
- Monthly inspection of First Aid Box shall be carried out by the owner as per format no. HSEP:14-F01
- The subcontractor should conduct periodical first –aid classes to keep his supervisor and Engineers properly trained for attending to any emergency.

#### 8.4.5.4 HEALTH CHECK UP (As per schedule VII and Form XI)

The persons engaged at the site shall undergo health checkup as per the format no. HSEP:14-F02 before induction. The persons engaged in the following works shall undergo health checkup at least once in a year:

a. Height workers
b. Drivers/crane operators/riggers

c. Confined space workers
d. Shot/sand blaster
e. Welding and NDE personnel

### 8.4.6 PROVISION OF CANTEEN FACILITY

- Canteen facilities shall be provided for the workmen of the project inside the project site.
- Proper cleaning and hygienic condition shall be maintained.
- Proper care should be taken to prevent biological contamination.
- Adequate drinking water should be available at canteen.
- Fire extinguisher shall be provided inside canteen.
- Regular health check-up and medication to the canteen workers shall be ensured.

### 8.4.7 PROVISION OF ACCOMODATION/LABOUR COLONY

- The subcontractor shall arrange for the accommodation of workmen at nearby localities or by making a labour colony.
- Regular housekeeping of the labour colony shall be ensured.
- Proper sanitation and hygienic conditions to be maintained.
- Drinking water and electricity to be provided at the labour colony.
- Bathing/ washing bay
- Room ventilation and electrification.

### 8.4.8 PROVISION OF EMERGENCY VEHICLE

- Dedicated emergency vehicle shall be made available at workplace by each subcontractor to handle any emergency

### 8.4.9 PEST CONTROL

Regular pest control should be carried out at all offices, mainly laboratories, canteen, labour colony and stores.

### 8.4.10 SCRAPYARD

- In consultation with customer, scrapyard shall be developed to store metal scrap, wooden scrap, waste, hazardous waste.
- Scrap/Waste shall be segregated as Bio-degradable and non-bio-degradable and stored separately.

### 8.4.11 ILLUMINATION

- The subcontractor shall arrange at his cost adequate lighting facilities e.g. flood lighting, hand lamps, area lighting etc. at various levels for safe and proper working operations at dark places and during night hours at the work spot as well as at the pre-assembly area.

- Adequate and suitable light shall be provided at all work places & their approaches including passage ways as per IS: 3646 (Part-II). Some recommended values are given below:

| S. No. | Location | Illumination (Lux) |
|---|---|---|
| **A.** | **Construction Area** | |
| 1. | Outdoor areas like store yards, entrance and exit roads | 20 |
| 2. | Platforms | 50 |
| 3. | Entrances, corridors and stairs | 100 |
| 4. | General illumination of work area | 150 |
| 5. | Rough work like fabrication, assembly of major items | 150 |
| 6. | Medium work like assembly of small machined parts rough measurements etc. | 300 |
| 7. | Fine work like precision assembly, precision measurements etc. | 700 |
| 8. | Sheet metal works | 200 |
| 9. | Electrical and instrument labs | 450 |
| **B.** | **Office** | |
| 1. | Outdoor area like entrance and exit roads | 20 |
| 2. | Entrance halls | 150 |
| 3. | Corridors and lift cars | 70 |
| 4. | Lift landing | 150 |
| 5. | Stairs | 100 |
| 6. | Office rooms, conference rooms, library reading tables | 300 |
| 7. | Drawing table | 450 |
| 8. | Manual telephone exchange | 200 |

- Lamp (hand held) shall not be powered by mains supply but either by 24V or dry cells.
- Lamps shall be protected by suitable guards where necessary to prevent danger, in case of breakage of lamp.
- Emergency lighting provision for night work shall be made to minimise danger in case of main supply failure.

If the subcontractor fails to take appropriate safety precautions or to provide necessary safety devices and equipment or to carry out instructions issued by the authorized BHEL official, BHEL shall have the right to take corrective steps at the risk and cost of the subcontractor

## 9.0 HSE TRAINING& AWARENESS

### 9.1 HSE INDUCTION TRAINING

All persons entering into project site shall be given HSE induction training by the HSE officer of BHEL /subcontractor before being assigned to work.

In-house induction training subjects shall include but not limited to:

- Briefing of the Project details.
- Safety objectives and targets.
- Site HSE rules.
- Site HSE hazards and aspects.
- First aid facility.
- Emergency Contact No.
- Incident reporting.
- Fire prevention and emergency response.
- Rules to be followed in the labour colony (if applicable)

- Proper safety wear & gear must be issued to all the workers being registered for the induction (i.e., Shoes/Helmets/Goggles/Leg guard/Apron etc.)
- They must arrive fully dressed in safety wear & gear to attend the induction.
- Any one failing to conform to this safety wear& gear requirement shall not qualify to attend.
- On completing attending subcontractor's in-house HSE induction, each employee shall sign an induction training form (format no. HSEP:14-F03) to declare that he had understood the content and shall abide to follow and comply with safe work practices. They may only then be qualified to be issued with a personal I.D. card, for access to the work site.

**9.2 HSE TOOLBOX TALK**

- HSE tool Box talk shall be conducted by frontline foreman/supervisor of subcontractor to specific work groups prior to the start of work. The agenda shall consist of the followings:
    - Details of the job being intended for immediate execution.
    - The relevant hazards and risks involved in executing the job and their control and mitigating measures.
    - Specific site condition to be considered while executing the job like high temperature, humidity, unfavorable weather etc.
    - Recent non-compliances observed.
    - Appreciation of good work done by any person.
    - Any doubt clearing session at the end.
- Record of Tool box talk shall be maintained as per format no. HSEP:14-F04
- Tool box talk to be conducted at least once a week for the specific work.

**9.3 TRAINING ON HEIGHT WORK**

Training on height work shall be imparted to all workers working at height by in-house/external faculty at least twice in a year. The training shall include following topics:

- Use of PPEs
- Use of fall arrester, retractable fall arrester, life line, safety nets etc.
- Safe climbing through monkey ladders.
- Inspection of PPEs.
- Medical fitness requirements.
- Mock drill on rescue at height.
- Dos & Don'ts during height work.

**9.4 HSE TRAINING DURING PROJECT EXECUTION**

- Other HSE training shall be arranged by BHEL/ subcontractor as per the need of the project execution and recommendation of HSE committee of site.
- The topics of the HSE training shall be as follows but not limited to:
    - Hazards identification and risk analysis (HIRA)
    - Work Permit System
    - Incident investigation and reporting
    - Fire fighting
    - First aid
    - Fire-warden training
    - EMS and OHSMS
    - T & Ps fitness and operation

- Electrical safety
- Welding, NDE & Radiological safety
- Storage, preservation & material handling.

- A matrix shall be maintained to keep an up-to-date record of attendance of training sessions carried out.

**9.5 HSE PROMOTION-SIGNAGE, POSTERS, COMPETITION, AWARDS ETC**

**9.5.1 Display of HSE posters and banners**

- Site shall arrange appropriate posters, banners, slogans in local/Hindi/English languages at work place

**9.5.2 Display of HSE signage**

- Appropriate HSE signage shall be displayed at the work area to aware workmen and passersby about the work going on and do's and don'ts to be followed

**9.5.3 Competition on HSE and award**

- Site will arrange different competition (slogan, poster, essay etc.) on HSE time to time (Safety day, BHEL day, World Environment Day etc.) and winners will be suitably awarded.

**9.5.4 HSE awareness programme**

- Subcontractor shall arrange HSE awareness programme periodically on different topics including medical awareness for all personnel working at site

**10.0 HSE COMMUNICATION**

**10.1 INCIDENT REPORTING**

- The subcontractor shall submit report of all incidents, fires and property damage etc to the Engineer immediately after such occurrence, but in any case not later than 24 hours of the occurrence. Such reports shall be furnished in the manner prescribed by BHEL. ( Refer HSE procedure for incident investigation, analysis and reporting for details)
- In addition, periodic reports on safety shall also be submitted by the subcontractor to BHEL from time to time as prescribed by the Engineer. Compiled monthly reports of all kinds of incidents, fire and property damage to be submitted to BHEL safety officer as per prescribed formats.
- HSE incidents of site shall be reported to BHEL site Management as per Procedure for Incident Investigation and Reporting in format no. HSEP:14-F15. Corrective action shall be immediately implemented at the work place and compliance shall be verified by BHEL HSE officer and until then, work shall be put on hold by Construction Manager.

**10.2 HSE EVENT REPORTING**

- Important HSE events like HSE training, Medical camp etc. organized at site shall be reported to BHEL site management in detail with photographs for publication in different in-house magazines
- Celebration of important days like National Safety Day, World Environment Day etc. shall also be reported as mentioned above.

**10.3 DAILY HSE ACTIVITY REPORTING**

Daily HSE activities shall be reported by subcontractor to BHEL as per Format No. HSEP:14-F31A

## 11.0 OPERATIONAL CONTROL

All applicable OCPs (Operational control procedures) will be followed by subcontractor as per BHEL instructions. This will be done as part of normal scope of work. List of such OCPs is given below. In case any other OCP is found to be applicable during the execution of work at site, then subcontractor will follow this as well, within quoted rate. These OCPs (applicable ones) will be made available to subcontractor during work execution at site. However for reference purpose, these are kept with Safety Officer of BHEL at the Power Sector Regional HQ, or available in downloadable format in the website, which may be refereed by subcontractor, if they so desire.

**LIST OF OCPs**

| | | |
|---|---|---|
| Safe handling of chemicals | Safety in use of cranes | Hydraulic test |
| Electrical safety | Storage and handling of gas cylinders | Spray insulation |
| Energy conservation | Manual arc welding | Trial run of rotary equipment |
| Safe welding and gas cutting operation | Safe use of helmets | Stress relieving |
| Fire safety | Good house keeping | Material preservation |
| Safety in use of hand tools | Working at height | Cable laying/tray work |
| First aid | Safe excavation | Transformer charging |
| Food safety at canteen | Safe filling of hydrogen in cylinder | Electrical maintenance |
| Illumination | Vehicle maintenance | Safe handling of battery system |
| Handling and erection of heavy metals | Safe radiography | Computer operation |
| Safe acid cleaning | Waste disposal | Storage in open yard |
| Safe alkali boil out | Working at night | For sanitary maintenance |
| Safe oil flushing | Blasting | Batching |
| Steam blowing | DG set | Piling rig operation |
| Safe working in confined area | Handling & storage of mineral wool | Gas distribution test |
| Safe operation of passenger lift, material hoists & cages | Drilling, reaming and grinding(machining) | Cleaning of hotwell / deaerator |
| Electro-resistance heating | Compressor operation | O&M of control of AC plant & system |
| Air compressor | Passivation | Safe Loading of Unit |
| Safe EDTA Cleaning | Safe Chemical cleaning of Pre boiler system | Safe Boiler Light up |
| Safe Rolling and Synchronization | | |

## 11.1 HSE ACTIVITIES

HSE activities shall be conducted at site based on the HSEMSM developed by Power Sector and issued to site by Regions.
While planning for any activity the following documents shall be referred for infrastructural requirements to establish control measures:

1) HSE Procedure for Register of OHS Hazards and Risks
2) HSE Procedure for Register of Environmental Aspects and Impacts
3) HSE Procedure for Register of Regulations

4) Operational Control Procedures
5) HSE Procedure for Emergency Preparedness and Response Plan
6) Contract documents

### 11.2 WORK PERMIT SYSTEM

- The following activities shall come under Work Permit System
  a. Height working above 2 metres
  b. Hot working at height
  c. Confined space
  d. Radiography
  e. Excavation more than 4 meter depth
  f. Heavy lifting above 50 ton
  Refer Annexure 05 for Work permit formats.
- "HSE Procedure for Work Permit System" shall be followed while implementing permit system. Where customer is having separate Work Permit System the same shall be followed.
- Permit applicant shall apply for work permit of particular work activity at particular location before starting of the work with Job Hazard Analysis.
- Permit signatory shall check that all the control measures necessary for the activity are in place and issue the permit to the permit holder.
- Permit holder shall implement and maintain all control measures during the period of permit .He will close the permit after completion of the work. The closed permit shall be archived in HSE Department of site.

### 11.3 SAFETY DURING WORK EXECUTION

Respective OCPS are to be followed and adherence to the same would be contractually binding

#### 11.3.1 WELDING SAFETY

All safety precautions shall be taken for welding and cutting operations as per IS-818. All safety precautions shall be taken for foundation and other excavation marks as per IS-3764.

#### 11.3.2 RIGGING

Rigging equipment shall not be loaded in excess of its recommended safe working load. Rigging equipment, when not in use, shall be removed from the original work area so as not to present a hazard to employees.

#### 11.3.3 CYLINDERS STORAGE AND MOVEMENT

All gas cylinders shall be stored in upright position. Suitable trolley shall be used. There shall be flash-back arrestors conforming to IS-11006 at both cylinder and burner ends. Damaged tube and regulators must be immediately replaced. No of cylinders shall not exceed the specified quantity as per OCP
Cylinders shall be moved by tilting and rolling them on their bottom edges. They shall not be intentionally dragged, struck or permitted to strike each other violently.

When cylinders are transported by powered vehicle they shall be secured in a vertical position.

### 11.3.4 DEMOLITION WORK

Before any demolition work is commenced and also during the process of the work the following shall be ensured:

- All roads and open areas adjacent to the work site shall either be closed or suitably protected.
- No electric cable or apparatus which is liable to be a source of danger nor a cable or an apparatus used by the operator shall remain electrically charged.
- All practical steps shall be taken to prevent danger to persons employed from the risks of fire or explosion or flooding. No floor, roof or other part of the building shall be so overloaded with debris or materials as to render them unsafe.

### 11.3.5 T&Ps

All T&Ps/ MMEs should be of reputed brand/appropriate quality & must have valid test/calibration certificates bearing endorsement from competent authority of BHEL..Subcontractor to also submit monthly reports of T&Ps deployed and validity test certificates to BHEL safety Officer as per the format/procedure of BHEL.

### 11.3.6 CHEMICAL HANDLING

Displaying safe handling procedures for all chemicals such as lube oil, acid, alkali, sealing compounds etc , at work place.Where it is necessary to provide and/or store petroleum products or petroleum mixture & explosives, the subcontractor shall be responsible for carrying out such provision / storage in accordance with the rules & regulations laid down in the relevant petroleum act, explosive act and petroleum and carbide of calcium manual, published by the chief inspector of explosives of India. All such storage shall have prior approval if necessary from the chief inspector of explosives or any other statutory authority. The subcontractor shall be responsible for obtaining the same.

### 11.3.7 ELECTRICAL SAFETY

- Providing adequate no. of 24 V sources and ensure that no hand lamps are operating at voltage level above 24 Volts.
- Fulfilling safety requirements at all power tapping points.
- High/ Low pressure welders to be identified with separate colour clothings. No welders will be deployed without passing appropriate tests and holding valid welding certificates. Approved welding procedure should be displayed at work place.
- The subcontractor shall not use any hand lamp energized by Electric power with supply voltage of more than 24 volts in confined spaces like inside water boxes, turbine casings, condensers etc.
- All portable electric tools used by the subcontractor shall have safe plugging system to source of power and be appropriately earthed. Only electricians licensed by appropriate statutory authority shall be employed by the subcontractor to carry out all types of electrical works. Details of earth resource ad their test date to be given to BHEL safety officer as per the prescribed formats of BHEL
- The subcontractor shall use only properly insulated and armored cables which conform to the requirement of Indian Electricity Act and Rules for all wiring, electrical applications at site.

- BHEL reserves the right to replace any unsafe electrical installations, wiring, cabling etc. at the cost of the subcontractor.
- All electrical appliances used in the work shall be in good working condition and shall be properly earthed.
- No maintenance work shall be carried out on live equipment.
- The subcontractor shall maintain adequate number of qualified electricians to maintain his temporary electrical installations.
- Area wise Electrical safety inspection is to be carried out on monthly basis as per "Electrical Safety Inspection checklist' and the report is to be submitted to BHEL safety officer
- Adequate precautions shall be taken to prevent danger for electrical equipment. No materials on any of the sites of work shall be so stacked or placed as to cause danger or inconvenience to any person or the public
- The subcontractor shall carefully follow the safety requirement of BHEL/ the purchaser with the regard to voltages used in critical areas.

**11.3.8 FIRE SAFETY**

- Providing appropriate fire fighting equipment at designated work place and nominate a fire officer/warden adequately trained for his job.
- Subcontractor shall provide enough fire protecting equipment of the types and numbers at his office, stores, temporary structure in labor colony etc. Such fire protection equipment shall be easy and kept open at all times.
- The fire extinguishers shall be properly refilled and kept ready which should be certified at periodic intervals. The date of changing should be marked on the Cylinders.
- All other fire safety measures as laid down in the "codes for fire safety at construction site" issued by safety coordinator of BHEL shall be followed.
- Non-compliance of the above requirement under fire protection shall in no way relieve the subcontractor of any of his responsibility and liabilities to fire incident occurring either to his materials or equipment or those of others.
- Emergency contacts nos must be displayed at prominent locations
- Tarpaulin being inflammable should not be used (instead, only non-infusible covering materials shall be used) as protective cover while preheating, welding, stress relieving etc. at site.

**11.3.9 SCAFFOLDING**

- Suitable scaffolds shall be provided for workman for all works that cannot safely be done from the ground, or from solid construction except in the case of short duration of work which can be done safely from ladders.
- When a ladder is used, it shall be of rigid construction made of steel. The steps shall have a minimum width of 45 cm and a maximum rise of 30 cm. Suitable handholds of good quality wood or steel shall be provided and the ladder shall be given an inclination not steeper then ¼ horizontal and 1 vertical.
- Scaffolding or staging more than 3.6 m above the ground floor, swung or suspended from an overhead support or erected with stationery support shall have a guard rail properly bolted, braced or otherwise secured, at least 90 cm above the floor or platform of such scaffolding or staging and extending along the entire length of the outside and ends thereof with only such openings as may be necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from saver, from swaying, from the building or structure.

11.3.10 **WORK AT HEIGHT**:

- Guardrails and toe-board/barricades and sound platform conforming to IS:4912-1978 should be provided.

- Wherever necessary, life-line (pp or metallic) and fall arrestor along with Polyamide rope or Retractable lifeline should be provided.
- Safety Net as per IS:11057:1984 should be used extensively for prevention/ arrest of men and materials falling from height. The safety nets shall be fire resistant, duly tested and shall be of ISI marked and the nets shall be located as per site requirements to arrest or to reduce the consequences of a possible fall of persons working at different heights.
- Reaching beyond barricaded area without lifeline support, moving with support of bracings, walking on beams without support, jumping from one level to another, throwing objects and taking shortcut must be discouraged.
- Use of Rebar steel for making Jhoola and monkey-ladder (Rods welded to vertical or inclined structural members), temporary platform etc. must be avoided.
- Monkey Ladder should be properly made and fitted with cages.
- Jhoola should be made with angles and flats and tested like any lifting tools before use.
- Lanyard must be anchored always and in case of double lanyard, each should be anchored separately.
- In case of pipe-rack, persons should not walk on pipes and walk on platforms only.
- In case of roof work, walking ladder/ platform should be provided along with lifeline and/ or fall arrestor.
- Empty drums must not be used.
- For chimney or structure painting, both hanging platform and men should be anchored separately to a firm structure along with separate fall arrestor. Rope ladder should be discouraged.

### 11.3.11 WORKING PLATFORM

Working platforms, gangways and stairways shall be so constructed that they do not sag unduly or unequally and if the height of the platform gangways provided is more than 3.6 m above ground level or floor level, they shall be closely boarded and shall have adequate width which shall not be less than 750 mm and be suitably fenced as described above. Every opening in the floor or a building or in a working platform shall be provided with suitable means to prevent the fall of persons or materials by providing suitable fencing or railing whose minimum height shall be 90 cm.

### 11.3.12 EXCAVATION

Wherever there are open excavation in ground, they shall be fenced off by suitable railing and danger signals installed at night so as to prevent persons slipping into the excavations.

### 11.3.13 LADDER SAFETY

Safe means of access shall be provided to all working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9 m in the length while the width between side rails in rung ladder shall in no case be less than app. 29.2 cm for ladder upto and including 3 m in length. For longer ladders this width shall be increased at least ¼'' for each additional foot of length.

A sketch of the ladders and scaffolds proposed to be used shall be prepared and approval of the Engineer obtained prior to Construction.

### 11.3.14 LIFTING SAFETY

- It will be the responsibility of the subcontractor to ensure safe lifting of the equipment, taking due precaution to avoid any incident and damage to other equipment and personnel.

- All requisite tests and inspection of handling equipment, tools & tackle shall be periodically done by the subcontractor by engaging only the Competent Persons as per law.
- Defective equipment or uncertified shall be removed from service.
- Any equipment shall not be loaded in excess of its recommended safe working load.

**11.3.15 HOISTING APPLIANCE**

- Motors, gearing, transmission, electric wiring and other dangerous parts of hoisting appliances should be provided with efficient safe guards.
- Hoisting appliance should be provided with such means as will reduce to the minimum the risk of any part of a suspended load becoming incidentally displaced.
- When workers employed on electrical installations which are already energized, insulating mats, wearing apparel, such as gloves, sleeves and boots as may be necessary should be provided.
- The worker should not wear any rings, watches and carry keys or other materials which are good conductor of electricity.

## 11.4 ENVIRONMENTAL CONTROL

Environment protection has always been given prime importance by BHEL. Environmental damage is a major concern of the principal subcontractor and every effort shall be made, to have effective control measures in place to avoid pollution of Air, Water and Land and associated life. Chlorofluorocarbons such as carbon tetrachloride and trichloroethylene shall not be used. Waste disposal shall be done in accordance with the guidelines laid down in the project specification.

Any chemical including solvents and paints, required for construction shall be stored in designated bonded areas around the site as per Material Safety Data Sheet (MSDS).

In the event of any spillage, the principle is to recover as much material as possible before it enters drainage system and to take all possible action to prevent spilled materials from running off the site. The subcontractor shall use appropriate MSDS for clean-up technique

All subcontractors shall be responsible for the cleanliness of their own areas.

The subcontractors shall ensure that noise levels generated by plant or machinery are as low as reasonably practicable. Where the subcontractor anticipates the generation of excessive noise levels from his operations the subcontractor shall inform to Construction Manager of BHEL accordingly so that reasonable &practicable precautions can be taken to protect other persons who may be affected.
It is imperative on the part of the subcontractor to join and effectively contribute in joint measures such as tree plantation, environment protection, contributing towards social upliftment, conversion of packing woods to school furniture, keeping good relation with local populace etc.
The subcontractor shall carry out periodic air and water quality check and illumination level checking in his area of work place and take suitable control measure.

## 11.5 HOUSEKEEPING

- Keeping the work area clean/ free from debris, removed scaffoldings, scraps, insulation/sheeting wastage /cut pieces, temporary structures, packing woods etc. will be in the scope of the subcontractor. Such cleanings has to be done by

subcontractor within quoted rate, on daily basis by an identified group. If such activity is not carried out by subcontractor / BHEL is not satisfied, then BHEL may get it done by other agency and actual cost along with BHEL overheads will be deducted from contractor's bill. Such decisions of BHEL shall be binding on the subcontractor

- Proper housekeeping to be maintained at work place and the following are to be taken care of on daily basis.
- All surplus earth and debris are removed/disposed off from the working areas to identified locations.
- Unused/Surplus cables, steel items and steel scrap lying scattered at different places/elevation within the working areas are removed to identified locations.
- All wooden scrap, empty wooden cable drums and other combustible packing materials, shall be removed from workplace to identified locations. Sufficient waste bins shall be provided at
- Different work places for easy collection of scrap/waste. Scrap chute shall be installed to remove scrap from high location.
- Access and egress (stair case, gangways, ladders etc.) path should be free from all scrap and other hindrances.
- Workmen shall be educated through tool box talk about the importance of housekeeping and encourage not to litter.
- Labour camp area shall be kept clear and materials like pipes, steel, sand, concrete, chips and bricks, etc. shall not be allowed in the camp to obstruct free movement of men and machineries.
- Fabricated steel structures, pipes & piping materials shall be stacked properly.
- No parking of trucks/trolleys, cranes and trailers etc. shall be allowed in the camp, which may obstruct the traffic movement as well as below LT/HT power line.
- Utmost care shall be taken to ensure over all cleanliness and proper upkeep of the working areas

### 11.6 WASTE MANAGEMENT

Take suitable measures for waste management and environment related laws/legislation as a part of normal construction activities. Compliance with the legal requirements on storage/ disposal of paint drums (including the empty ones), Lubricant containers, Chemical Containers, and transportation and storage of hazardous chemicals will be strictly maintained.

### 11.6.1 BINS AT WORK PLACE

- Sufficient rubbish bins shall be provided close to workplaces.
- Bins should be painted yellow and numbered.
- Sufficient nos. of drip trays shall be provided to collect oil and grease.
- Sufficient qty. of broomsticks with handle shall be provided.
- Adequate strength of employees should be deployed to ensure daily monitoring and service for waste management.

### 11.6.2 STORAGE AND COLLECTION

- Different types of rubbish/waste should be collected and stored separately.
- Paper, oily rags, smoking material, flammable, metal pieces should be collected in separate bins with close fitting lids.
- Rubbish should not be left or allowed to accumulate on construction and other work places.
- Do not burn construction rubbish near working site.

### 11.6.3 SEGREGATION

- Earmark the scrap area for different types of waste.
- Store wastes away from building.
- Oil spill absorbed by non-combustible absorbent should be kept in separate bin.
- Clinical and first aid waste stored and incinerated separately.

### 11.6.4 DISPOSAL

- Sufficient containers and scrap disposal area should be allocated.
- All scrap bin and containers should be conveniently located.
- Provide self-closing containers for flammable/spontaneously combustible material.
- Keep drainage channels free from choking.
- Make schedule for collection and disposal of waste.

### 11.6.5 WARNING AND SIGNS

- Appropriate sign to be displayed at scrap storage area
- No toxic, corrosive or flammable substance to be discarded into public sewage system.
- Waste disposal shall be in accordance with best practice.
- Comply with all the requirements of Pollution Control Board (PCB) for storage and disposal of hazardous waste.

## 11.7 TRAFFIC MANAGEMENT SYSTEM

### 11.7.1 SAFE WORKPLACE TRANSPORT SYSTEM

- Traffic routes in a work place shall be suitable for the persons or vehicles using them. This shall be sufficient in number and of sufficient size. This shall reflect the suitability of traffic routes for vehicles and pedestrians.
- Where vehicles and pedestrians use the same traffic routes there shall be sufficient space between them. Where necessary all traffic routes must be suitably indicated. Pedestrians or vehicles must be able to use traffic routes without endangering those at work. There must be sufficient separation of traffic routes from doors, gates and pedestrian traffic routes.
- For internal traffic, lines marked on roads / access routes and between buildings shall clearly indicate where vehicles are to pass.
- Temporary obstacles shall be brought to the attention of drivers by warning signs or hazard cones.
- Speed limits shall be clearly displayed. Speed ramps preceded by a warning signs or marker are necessary.
- The traffic route should be wide enough to allow vehicles to pass and re-pass oncoming or parked traffic and it may be advisable to introduce on-way system or parking restrictions.
- Safest route shall be provided between places where vehicles have to call or deliver.
- Avoid vulnerable areas/items such as fuel or chemicals tanks or pipes, open or unprotected edges and structures likely to collapse

- Safe areas shall be provided for loading and unloading.
- Avoid sharp or blind bends. If this is not possible hazards should be indicated e.g. blind corner.
- Ensure road crossings are minimum and clearly signed.
- Entrance and gateways shall be wide enough to accommodate a second vehicle without causing obstruction.
- Set sensible speed limits which are clearly sign posted.
- Where necessary ramps should be used to retard speed. This shall be preceded by a warning sign or mark on the road.
- Forklift trucks shall not pass over road hump unless of a type capable of doing so.
- Overhead electric cable, pipes containing flammable hazardous chemical shall be shielded by using goal posts height gauge posts or barriers.
- Road traffic signs shall be provided on prominent locations for prevention of incidents and hazards and for quick guidance and warning to employees and public. Safety signs shall be displayed as per the project working requirement and guideline of the state in which project is done. Vehicles hired or used shall not be parked within the 15m radius of any working area. Any vehicle, that is required to be at the immediate/near the vicinity, shall be approved by the person in-charge of the site.

### 11.7.2 TRAFFIC ROUTE FOR PEDESTRIANS

- Where traffic routes are used by both pedestrians and vehicles road shall be wide enough to allow vehicles and pedestrians safely.
- Separate routes shall be provided for pedestrians to keep them away from vehicles. Provide suitable barriers/guard at entrances/exit and the corners or buildings.
- Where pedestrian and vehicle routes cross, appropriate crossing shall be provided.
- Where crowd is likely to use roadway e.g. at the end of shift, stop vehicles from using them at such times.
- Provide high visibility clothing for people permitted in delivery area.

### 11.7.3 WORK VEHICLE

Work vehicle shall be as safe stable efficient and roadworthy as private vehicles on public roads. Site management shall ensure that drivers are suitably trained. All vehicle e.g. heavy motor vehicle forklift trucks dump trucks mobile cranes shall ensure that the work equipment conforms to the following:

- A high level of stability.
- A safe means of access/egress.
- Suitable and effective service and parking brakes.
- Windscreens with wipers and external mirrors giving optimum all round visibility.
- Provision of horn, vehicle lights, reflectors, reversing lights, reversing alarms.
- Provision of seat belts.
- Guards on dangerous parts.
- Driver protection - to prevent injury from overturning and from falling objects/materials.
- Driver protection from adverse weather.
- No vehicle shall be parked below HT/LT power lines.
- Valid Pollution Under Control certification for all vehicles

### 11.7.4 DAILY CHECK BY DRIVER

- There should also be daily safety checks containing below mentioned points by the driver before the vehicle is used.
  - Brakes.
  - Tires.
  - Steering.
  - Mirrors.
  - Windscreen waters.
  - Wipers.
  - Warning signals.
  - Specific safety system i.e. control interlocks
- Management should ensure that drivers carry out these checks.

### 11.7.5 TRANSPORTATION OF PERSONNEL AND MATERIALS BY VEHICLES

- All drivers shall hold a valid driving License for the class of vehicle to be driven and be registered as an authorized BHEL driver with the Administration Department.
- Securing of the load shall be by established and approved methods, i.e. chains with patented tightening equipment for steel/heavy loads. Sharp corners on loads shall be avoided when employing ropes for securing.
- All overhangs shall be made clearly visible and restricted to acceptable limits
- Load shall be checked before moving off and after traveling a suitable distance.
- On no account is construction site to be blocked by parked vehicles Drivers of vehicles shall only stop or park in the areas designate by the stringing foreman.
- Warning signs shall be displayed during transportation of material.
  All vehicles used by BHEL shall be in worthy condition and in conformance to the Land Transport requirement.

### 11.7.6 MAINTENANCE

All Vehicles used for transportation of man and material shall undergo scheduled inspections on frequent intervals to secure safe operation. Such inspections shall be conducted in particular for steering, brakes, lights, horn, doors etc. Site management shall ensure that work equipment is maintained in an efficient, working order and in good repair. Inspections and services carried out at regular intervals of time and or mileage. No maintenance shall be carried below HT/LT power lines.

## 11.8 EMERGENCY PREPAREDNESS AND RESPONSE

- Emergency preparedness and response capability of site shall be developed as per Emergency Preparedness and Response plan issued by Regional HQ
- Availability of adequate number of first aiders and fire warden shall be ensured with BHEL and its subcontractors
- All the subcontractor's supervisory personnel and sufficient number of workers shall be trained for fire protection systems. Enough number of such trained personnel must be available during the tenure of contract. Subcontractor should nominate his supervisor to coordinate and implement the safety measures.
- Assembly point shall be earmarked and access to the same from different location shall be shown
- Fire exit shall be identified and pathway shall be clear for emergency escape.

- Appropriate type and number of fire extinguisher shall be deployed as per Fire extinguisher deployment plan and validity shall be ensured periodically through inspection
- Adequate number of first aid boxes shall be strategically placed at different work places to cater emergency need. Holder of the first aid box shall be identified on the box itself who will have the responsibility to maintain the same.
- First aid center shall be developed at site with trained medical personnel and ambulance
- Emergency contact numbers (format given in EPRP) of the site shall be displayed at prominent locations.
- Tie up with fire brigade shall be done in case customer is not having fire station.
- Tie up with hospital shall be done in case customer is not having hospital.
- Disaster Management group shall be formed at site
- Mock drill shall be arranged at regular intervals. Monthly report of the above to be given to BHEL safety Officer as per prescribed BHEL formats
- Mock drill shall be conducted on different emergencies periodically to find out gaps in emergency preparedness and taking necessary corrective action

## 12.0 HSE INSPECTION

Inspection on HSE for different activities being carried out at site shall be done to ensure compliance to HSEMS requirements. The subcontractor shall maintain and ensure necessary safety measures as required for inspection and tests HV test, Pneumatic test, Hydraulic test, Spring test, Bend test etc. as applicable, to enable inspection agency for performing Inspection. If any test equipment is found not complying with proper safety requirements then the Inspection Agency may withhold inspection, till such time the desired safety requirements are met.

## 12.1 DAILY HSE CHECKS

Both the Site Supervisors and safety officer of Subcontractor are to conduct daily site Safety inspection around work activities and premises to ensure that work methods and the sites are maintained to an acceptable standard. The following are to form the common subjects of a daily safety inspection:

- Personal Safety wears & gear compliance.
- Complying with site safety rules and permit-to-work (PTW).
- Positions and postures of workers.
- Use of tools and equipment etc. by the workers.

The inspection should be carried out just when work starts in beginning of the day, during peak activities period of the day and just before the day's work ends.

## 12.2 INSPECTION OF PPE

- PPEs shall be inspected by HSE officer at random once in a week as per format no. HSEP:14-F06 for its compliance to standard and compliance to use and any adverse observation shall be recorded in the PPE register.
- The applicable PPEs for carrying out particular activities are listed below.

### 12.3 INSPECTION OF T&Ps

- A master list of T&Ps shall be maintained by each subcontractor.
- All T&Ps being used at site shall be inspected by HSE officer once in a month as per format no. HSEP:14-F07 for its healthiness and maintenance.
- The T&Ps which require third party inspection shall be checked for its validity during inspection. The third party test certificate should be accompanied with a copy of the concerned competent person's valid qualification record.
- The validity of T&P shall be monitored as per "Status of T&Ps" format no. HSEP:14-F08

### 12.4 INSPECTION OF CRANES AND WINCHES

- Cranes and winches shall be inspected by the operator through a daily checklist for its safe condition (as provided by the equipment manufacturer) before first use of the day.
- Cranes and Winches shall be inspected by HSE officer once in a month as per format no. HSEP:14-F09 for healthiness, maintenance and validity of third party inspection.
- The date of third party inspection and next due date shall be painted on cranes and winches.
- The operators/drivers shall be authorized by sub-contractor based on their competency and experience and shall carry the I-card.
- The operator should be above 18 years of age and should be in possession of driving license of HMV man & goods), vision test certificate and should have minimum qualification so that he can read the instructions and check list.

### 12.5 INSPECTION ON HEIGHT WORKING

- Inspection on height working shall be conducted daily by supervisors before start of work to ensure safe working condition including provision of
    - Fall arrestor
    - Lifelines
    - Safety nets
    - Fencing and barricading
    - Warning signage
    - Covering of opening
    - Proper scaffolding with access and egress.
    - Illumination
- Inspection on height working shall be conducted once in a week by HSE officer as per format no. HSEP:14-F10.
- Medical fitness of height worker shall be ensured.
- Height working shall not be allowed during adverse weather.

### 12.6 INSPECTION ON WELDING AND GAS CUTTING OPERATION

- Supervisor shall ensure that no flammable items are available in near vicinity during welding and gas cutting activity.
- Gas cylinders shall be kept upright.
- Use of Flash back arrestor shall be ensured at both ends.

- Inspection during welding and gas cutting operations shall be carried out by HSE officer once a month as per format no. HSEP:14-F11.
- Use of fire blanket to be ensured to avoid falling of splatters during welding or gas cutting operation at height.
- Availability of fire extinguisher at vicinity shall be ensured.

### 12.7 INSPECTION ON ELECTRICAL INSTALLATION / APPLIANCES

- Ensure proper earthing in electrical installation
- Use ELCB at electrical booth
- Electrical installation shall be properly covered at top where required
- Use appropriate PPEs while working
- Use portable electrical light < 24 V in confined space and potentially wet area.
- Monthly inspection shall be carried out as per format no. HSEP:14-F12.

### 12.8 INSPECTION OF ELEVATOR

- Elevators shall be inspected by concerned supervisors once in a week as per format no. HSEP:14-F13.
- All elevators shall be inspected by competent person and validity shall be ensured.
- The date of third party inspection and next due date shall be painted on elevator.

### 12.9 INSPECTION OF EXCAVATION

Excavation activities shall be inspected as per Format HSEP:14-F13A

### 13.0 HSE PERFORMANCE

- Contractor shall be assessed on monthly basis for HSE Compliance by BHEL Safety In-charge at site.
  The HSE compliance shall be based on Online HSE Evaluation System of BHEL as per Format No. HSEP:14-F33.
- BHEL shall reserve the right to use this assessment for evaluating bidder's capacity for future tenders
- Suitable HSE reward system shall be developed at site level to promote HSE compliance amongst workmen by the subcontractor.
  To decide HSE reward, performance towards HSE shall be evaluated for workmen and it shall be awarded regularly in public gathering.
- If safety record of the subcontractor in execution of the awarded job is to the satisfaction of safety department of BHEL, issue of an appropriate certificate to recognize the safety performance of the subcontractor may be considered by BHEL after completion of the job.

## 14.0 HSE PENALTIES

- As per contractual provision HSE penalties shall be imposed on subcontractors for non- compliance on HSE requirement as per format no. HSEP:14-F14. The list in the format is only indicative. For any other violation, not listed in the format, the minimum penalty amount is to be decided as per BOCW act.
- If principal customer/statutory and regulatory bodies impose some penalty on HSE due to the non-compliance of the subcontractor the same shall be passed on to them.
- The penalty amount shall be recovered by Site Finance department from subcontractors from the RA/Final bill.

## 15.0 OTHER REQUIREMENTS

- In case of any delay in completion of a job due to mishaps attributable to lapses by the subcontractor, BHEL shall have the right to recover cost of such delay from the payments due to the subcontractor, after notifying the subcontractor suitably.
- If the subcontractor fails to improve the standards of safety in its operation to the satisfaction of BHEL after being given reasonable opportunity to do so and/or if the subcontractor fails to take appropriate safety precautions or to provide necessary safety devices and equipment or to carry out instruction regarding safety issued by BHEL, BHEL shall have the right to take corrective steps at the risk and cost of the subcontractor after giving a notice of not less than 7 days indicating the steps that would be taken by BHEL.
- If the subcontractor succeeds in carrying out its job in time without any fatal or disabling injury incident and without any damage to property BHEL may, at its sole discretion, favorably consider to reward the subcontractor suitably for the performance.
- In case of any damage to property due to lapses by the subcontractor, BHEL shall have the right to recover the cost of such damages from the subcontractor after holding an appropriate enquiry.
- The subcontractor shall take all measures at the sites of the work to protect all persons from incidents and shall be bound to bear the expenses of defense of every suit, action or other proceeding of law that may be brought by any persons for injury sustained or death owing to neglect of the above precautions and to pay any such persons such compensation or which may with the consent of the subcontractor be paid to compromise any claim by any such person, should such claim proceeding be filed against BHEL, the subcontractor hereby agrees to indemnify BHEL against the same.
- The subcontractor shall not employ men below the age of 18 years and women on the work of painting with products containing lead in any form. Wherever men above the age of 18 are employed on the work of lead painting, overalls shall be supplied by the subcontractor to the workmen and adequate facilities shall be provided to enable the working painters to wash during the cessation of work.
- The subcontractor shall notify BHEL of his intention to bring to site any equipment or material which may create hazard.
- BHEL shall have the right to prescribe the conditions under which such equipment or materials may be handled and the subcontractor shall adhere to such instructions.

- BHEL may prohibit the use of any construction machinery, which according to the organization is unsafe. No claim for compensation due to such prohibition will be entertained by BHEL.

**16. NON COMPLIANCE**

NONCONFORMITY OF SAFETY RULES AND SAFETY APPLIANCES WILL BE VIEWED SERIOUSLY AND BHEL HAS RIGHT TO IMPOSE FINES ON THE SUBCONTRACTOR AS UNDER FOR EVERY INSTANCE OF VIOLATION NOTICED:

| SN | Violation of Safety Norms | Fine (in Rs) |
|---|---|---|
| 01 | Not Wearing Safety Helmet | 200/- * |
| 02. | Not wearing Safety Belt or not anchoring life line | 500/-* |
| 03 | Not wearing safety shoe | 200/-* |
| 04 | Not keeping gas cylinders vertically | 200/- |
| 05 | Not using flash back arrestors | 100/- |
| 06 | Not wearing gloves | 50/- * |
| 07. | Grinding Without Goggles | 50/- * |
| 08. | Not using 24 V Supply For Internal Work | 500/- |
| 09. | Electrical Plugs Not used for hand Machine | 100/- |
| 10. | Not Slinging properly | 200/- |
| 11. | Using Damaged Sling | 200/- |
| 12. | Lifting Cylinders Without Cage | 500/- |
| 13. | Not Using Proper Welding Cable With Lot of Joints And Not Insulated Property. | 200/- |
| 14. | Not Removing Small Scrap From Platforms | 500/- |
| 15. | Gas Cutting Without Taking Proper Precaution or Not Using Sheet Below Gas Cutting | 500/- |
| 16. | Not Maintaining Electric Winches Which are Operated Dangerously | 500/- |
| 17. | Improper Earthing Of Electrical T&P | 500/- |
| 18 | No or improper barricading | 500/- |
| 19. | Activity carried out without Safety work permit (Height work, Lifting activity, Hot work-each person/case) | 1000/- |
| 20. | Incident Resulting in Partial Loss in Earning Capacity | 25,000/- per victim |
| 21. | Fatal Incident Resulting in total loss in Earning Capacity | 1,00,000/- per victim for first instance # |

- Legend:-

  *: per head. For repeated violation by the same person, the penalty would be double of the previous penalty. Date of "Repeated violation" will be counted from subsequent days.

  #: or as deducted by customer, whichever is higher. For repeated fatal incident in the same Unit incremental penalty to be imposed. The subcontractor will pay 2 times the penalty compared to previously paid in case there are repeated cases of fatal incidents under the same subcontractor for the same package in the same unit.

Any other non-conformity noticed not listed above will also be fined as deemed fit by BHEL. The decision of BHEL engineer is final on the above. The amount will be deducted from running bills of the subcontractor. The amount collected above will be utilized for giving award to the employees who could avoid incident by following safety rules. Also the amount will be spent for purchasing the safety appliances and supporting the safety activity at site.

## 17.0 HSE AUDIT/INSPECTION

- Regular HSE Audit/inspection shall be carried out by Subcontractor as per Site HSE audit calendar.
- HSE checklist **(Annexure 02)** shall be used for carrying out audit/inspection and report shall be submitted to BHEL site management
- All non-conformities and observations on HSE identified during internal or external HSE audit shall be disposed off by site in a time bound manner and reported back the implementation status
- Corrective action and Preventive action on HSE issues raised by certification body issued by Regional HQs shall be implemented by site and reported to Site management.

## 18.0 MONTHLY HSE REVIEW MEETING

- Site shall hold HSE review meeting every month to discuss and resolve HSE issues of site and improve HSE performance. It will also discuss the incidents occurred since previous meeting,its root cause and Corrective action and Preventive action. The agenda is given below:
  - Implementation of earlier MOM
  - HSE performance
  - HSE inspection
  - HSE audit and CAPA
  - HSE training
  - Health check-up camp
  - HSE planning for the erection and commissioning and installation activities in the coming month
  - HSE reward and promotional activities
- The meeting shall be chaired by Construction Manager, convened by HSE coordinator and attended by all HOS, Site Incharge of Subcontractors and HSE officer of Subcontractors.
- MOM on the discussion will be circulated to the concerned for implementation.

## 19.0 FORMATS USED (Details available in Annexure-04)

| SL. No. | Format Name | Format No. | Rev No. |
|---|---|---|---|
| 01 | Inspection of First Aid Box | HSEP:14-F01 | 00 |
| 02 | Health Check Up | HSEP:14-F02 | 00 |
| 03 | HSE Induction Training | HSEP:14-F03 | 00 |
| 04 | Tool Box Talk | HSEP:14-F04 | 00 |
| 05 | Monthly Site HSE Report | As specified by BHEL | 00 |
| 06 | Inspection of PPE | HSEP:14-F06 | 00 |

| | | | |
|---|---|---|---|
| 07 | Inspection of T&Ps | HSEP:14-F07 | 00 |
| 08 | Status of T&Ps | HSEP:14-F08 | 00 |
| 09 | Inspection of Cranes and Winches | HSEP:14-F09 | 00 |
| 10 | Inspection on Height Working | HSEP:14-F10 | 00 |
| 11 | Inspection on Welding & Gas Cutting | HSEP:14-F11 | 00 |
| 12 | Inspection on Electrical Installation | HSEP:14-F12 | 00 |
| 13 | Inspection on Elevator | HSEP:14-F13 | 00 |
| 14 | HSE Penalty | HSEP:14-F14 | 00 |
| 15 | Accident /incident / property damage /fire incident report | HSEP:14-F15 | 00 |

## 20.0 ANNEXURES

**ANNEXURE 01**

**As per Contract Labour (Regulation & Abolition Act), Central Rules, 1971,**

(1) The first-aid box shall be distinctively marked with a Red Cross on a white background and shall contain the following items, namely:

**(a) For establishments in which the number of contract labour employed does not exceed fifty, each first aid box shall contain the following equipment:**

| | |
|---|---|
| (i) | 6 small sterilized dressings |
| (ii) | 3 medium size sterilized dressings |
| (iii) | 3 large size sterilized dressings |
| (iv) | 6 pieces of sterilized eye pads in separate sealed packets. |
| (v) | 6 roller bandages 10 cm wide. |
| (vi) | 6 roller bandages 5 cm wide. |
| (vii) | One tourniquet |
| (viii) | A supply of suitable splints |
| (ix) | Three packets of safety pins. |
| (x) | Kidney tray. |
| (xi) | 3 large sterilized burn dressings. |
| (xii) | 1 (30ml) bottle containing a two percent alcoholic solution of iodine |
| (xiii) | 1 (30 ml) bottle containing Sal volatile having the dose and mode of administration indicated on the label |
| (xiv) | 1 snake bite lancet |
| (xv) | 1 (30gms) bottle of potassium permanganate crystals. |
| (xvi) | 1 pair scissors |
| (xvii) | 1 copy of the First-Aid leaflet issued by the Director General, Factory Advice Service and Labour Institutes, Government of India. |
| (xviii) | A bottle containing 100 tablets (each of 5 grains) of aspirin |
| (xix) | Ointment for burns |
| (xx) | A bottle of suitable surgical anti-septic solution |

**(b) For establishment in which the number of contract labour exceeds fifty each first-aid box shall contain the following equipment:**

| | |
|---|---|
| (i) | 12 small sterilized dressings |
| (ii) | 6 medium size sterilized dressings |
| (iii) | 6 large size sterilized dressings. |
| (iv) | 6 large size sterilized burn dressings |
| (v) | 6 (15 grams) packets sterilized cotton wool |
| (vi) | 12 pieces of sterilized eye pads in separate sealed packets. |

| | |
|---|---|
| (vii) | 12 roller bandages 10 cm wide. |
| (viii) | 12 roller bandages 5 cm wide. |
| (ix) | One tourniquet. |
| (x) | A supply of suitable splints. |
| (xi) | Three packets of safety pins. |
| (xii) | Kidney tray. |
| (xiii) | Sufficient number of eye washes bottles filled with distilled water or suitable liquid clearly indicated by a distinctive sign which shall be visible at all times. |
| (xiv) | 4 per cent Xylocaine eye drops, and boric acid eye drops and soda by carbonate eye drops. |
| (xv) | 1 (60ml) bottle containing a two percent alcoholic solution of iodine |
| (xvi) | One (two hundred ml) bottle of mercurochrome (2 per cent) solution in water. |
| (xvii) | 1 (120ml) bottle containing Sal volatile having the dose and mode of administration indicated on the label. |
| (xviii) | 1 roll of adhesive plaster (6 cmX1 meter) |
| (xix) | 2 rolls of adhesive plaster (2 cmX1 meter) |
| (xx) | A snake bite lancet. |
| (xxi) | 1 (30 grams) bottle of potassium permanganate crystals. |
| (xxii) | 1 pair scissors |
| (xxiii) | 1 copy of the First-Aid leaflet issued by the Director-General, Factory Advice service and labour Institutes, Government of India. |
| (xxiv) | a bottle containing 100 tablets (each of 5 grains) of aspirin |
| (xxv) | Ointment for burns |
| (xxvi) | A bottle of a suitable surgical anti septic solution. |

(2) Adequate arrangement shall be made for immediate recoupment of the equipment when necessary.

**ANNEXURE 02**

**HSE AUDIT/INSPECTION CHECKLIST CUM COMPLIANCE REPORT**

PROJECT:_____ SUBCONTRACTOR:_____

DATE : _____ OWNER :_____

INSPECTION BY:_____

Note : write 'NA' wherever the items is not applicable

| Item | Yes | No | Remarks | Action |
|---|---|---|---|---|
| ***HOUSEKEEPING*** | | | | |
| Waste containers provided and used | | | | |
| Passageways and walkways clear | | | | |
| General neatness of working area | | | | |
| Other | | | | |
| ***PERSONNELPROTECTIVEEQUIPTMENTS*** | | | | |
| Goggles; shields | | | | |
| Face protection | | | | |
| Hearing protection | | | | |
| Respiratory masks etc. | | | | |
| Safety belts | | | | |
| Other | | | | |
| ***EXCAVATIONS / OPENINGS*** | | | | |
| Openings properly covered or barricaded | | | | |
| Excavations shored | | | | |
| Excavations barricaded | | | | |
| Overnight lighting provided | | | | |
| Other | | | | |
| ***WELDING, CUTTING*** | | | | |
| Gas cylinders chained upright | | | | |
| Cable and hoses not obstructing | | | | |
| Fire extinguisher (s) accessible | | | | |
| Others | | | | |
| ***SCAFFOLDING*** | | | | |
| Fully decked platforms | | | | |
| Guard and intermediate rails in place | | | | |
| Toe boards in place | | | | |
| Adequate shoring | | | | |
| Adequate access | | | | |
| Others | | | | |
| ***LADDER*** | | | | |
| Extension side rails 1 m above | | | | |
| Top of landing | | | | |
| Properly secured | | | | |

| | | | | |
|---|---|---|---|---|
| Angle + $70^0$ from horizontal | | | | |
| Other | | | | |
| ***HOISTS, CRANES AND DERRICKS*** | | | | |
| Condition of cables and sheaf OK | | | | |
| Condition of slings, chains, hooks OK | | | | |
| Inspection & maintenance log maintained | | | | |
| Outriggers used | | | | |
| Signals observed and understood | | | | |
| Qualified operators | | | | |
| Others | | | | |
| ***MACHINERY, TOOLS & EQUIPMENT*** | | | | |
| Proper instruction | | | | |
| Safety devices | | | | |
| Proper cords | | | | |
| Inspection and maintenance | | | | |
| Other | | | | |
| ***VEHICLE AND TRAFFIC*** | | | | |
| Rules and regulations observed | | | | |
| Inspection and maintenance | | | | |
| Licensed drivers | | | | |
| Other | | | | |
| ***TEMPORARY FACILITIES*** | | | | |
| Emergency instructions posted | | | | |
| Fire extinguishers provided | | | | |
| Fire-aid equipment available | | | | |
| General neatness | | | | |
| Others | | | | |
| ***FIRE PREVENTION*** | | | | |
| Personnel instructed | | | | |
| Fire extinguishers checked | | | | |
| No smoking in prohibited areas. | | | | |
| Hydrants | | | | |
| Clearance | | | | |
| Others | | | | |
| ***ELECTRICAL*** | | | | |
| Proper wiring | | | | |
| ELCB's provided | | | | |
| Ground fault circuit interrupters | | | | |
| Protection against damage | | | | |
| Prevention of tripping hazards | | | | |
| Other | | | | |
| ***HANDLING & STORAGE OF MATERIALS*** | | | | |
| Properly stored or stacked | | | | |
| Passageways clear | | | | |
| Other | | | | |
| ***FLAMMABLE GASES AND LIQUIDS*** | | | | |
| Containers clearly identified | | | | |
| Proper storage | | | | |
| Fire extinguisher nearby | | | | |

| | | | | |
|---|---|---|---|---|
| Other | | | | |
| ***WORKING AT HEIGHT*** | | | | |
| Safety nets | | | | |
| Safety belts | | | | |
| Safety helmets | | | | |
| Anchoring of safety belt to the life line rope | | | | |
| ***ENVIRONMENT*** | | | | |
| Lubricant waste/engine oils properly dispose. | | | | |
| Waste from Canteen, offices, sanitation etc. disposed properly. | | | | |
| Disposal of surplus earth, stripping materials, expired batteries, oily rags and combustible materials done properly. | | | | |
| ***HEALTH CHECKS*** | | | | |
| Hygienic conditions at labor camps O.K. | | | | |
| Availability of first-aid facilities | | | | |
| Proper sanitation at site, office & labor camps. | | | | |
| Arrangement of medical facilities. | | | | |
| Measures for dealing with illness. | | | | |
| Availability of potable drinking water for workmen & staff. | | | | |
| Provision of crèches for children. | | | | |
| | | | | |

**ANNEXURE 03**

**REFERENCES**

- Contract documents
- Relevant legislations
- HSEMSM
- Relevant Indian standards as listed below (illustrative only):

| SL NO | CODE NAME | TITLE |
|---|---|---|
| (1) | IS : 818-1888 (Reaffirmed 2003) | Code of Practice for safety and health requirements in Electric and Gas Welding and Cutting operations. |
| (2) | IS: 1179-1967 (Reaffirmed 2003) | Specification for Equipment for Eye & Face protection during welding. |
| (3) | IS : 1989 (Part 2):1986 (Reaffirmed 1997) | Specification for Leather Safety Boots & Shoes |
| (4) | IS:2925 – 1984 (Reaffirmed 2010) | Specification for Industrial Safety Helmets |
| (5) | IS:3521 : 1999 (Reaffirmed 2002) | Industrial Safety Belts & Harnesses-Specification |
| (6) | IS:3646(Part II) – 1966 (Reaffirmed 2003) | Code of Practice for Interior Illumination |
| (7) | IS:3696 (Part I) – 1987 (Reaffirmed 2002) | Safety Code for Scaffolds and Ladders |
| (8) | IS: 3696(Part 2) : 1991 (Reaffirmed 2002 ) | Scaffolds and Ladders-Code of Safety |
| (9) | IS:3786 – 1983 (Reaffirmed 2002) | Method for Computation of Frequency and Severity Rates for Industrial Injuries and Classification of Industrial Incidents |
| (10) | IS:4770 : 1991 (Reaffirmed 2006) | Rubber Gloves – Electricals purposes-Specification |
| (11) | IS:4912 : 1978 (Reaffirmed 2002) | Safety Requirements for Floor and Wall Openings, Railings and Toe Boards |
| (12) | IS: 5983 – 1980 (Reaffirmed 2002) | Specification for Eye-Protectors |
| (13) | IS:6519 – 1971 (Reaffirmed 1997) | Code of Practice for Selection, Care and Repair of Safety Footwear |
| (14) | IS:9167:1979 | Specification for Ear-Protectors |
| (15) | IS:6994(Part I)-1973 (Re affirmed 1996) | Specification for Industrial Safety Gloves Leather and Cotton Gloves |
| (16) | IS:8519 – 1977 (Reaffirmed 1983) | Guide for Selection of Industrial Safety Equipment for Body Protection. |
| (17) | IS 11006 : 2011 | Flash Back(Flame Arrestor) Specification |

| | | |
|---|---|---|
| (18) | IS:8520 – 1977<br>(Reaffirmed 2002) | Guide for Selection of Industrial Safety Equipment for Eye, Face and Ear Protection. |
| (19) | IS:9473:2002 | Respiratory Protective Devices-Filtering Half Masks to protect against Particles-Specification. |
| (20) | IS:9944:1992<br>(Reaffirmed 2003) | Natural and Man-made Fiber Rope Slings-Recommendations on Safe working loads. |
| (21) | IS:11057 – 1884<br>(Reaffirmed 2001) | Specification for Industrial Safety Nets |
| (22) | IS:12254:1993<br>(Reaffirmed 2002) | Polyvinyl Chloride (PVC) Industrial Boots-Specification |
| (23) | IS:13367(Part 1):1992<br>(Reaffirmed 20030 | Safe Use of Cranes-Code of Practice |
| (24) | IS:14166:1994<br>(Reaffirmed 2002) | Respiratory Protective Devices-Full Face Masks Specification |
| (25) | IS:14746 : 1999<br>(Reaffirmed 2003) | Respiratory Protective Devices-Half Masks and Quarter Masks - Specification |
| (26) | IS : 15397 :2003<br>(Reaffirmed 2008) | Portable Extinguisher Mechanical Foam Type(Stored Pressure)-Specification |
| (27) | IS: 19011:2002 | Guidelines for Quality and/or Environmental Management Systems Auditing |

**ANNEXURE 04 : SAFETY FORMATS**
**&**
**ANNEXURE 05 : WORK PERMIT FORMATS**

| | | |
|---|---|---|
| | **POWER SECTOR**<br>**INSPECTION OF FIRST AID BOX** | FORMAT NO: HSEP:14-F01<br>REV NO.: 00<br>PAGE NO. 01 OF 02 |

| | |
|---|---|
| **Name of Site :** | |
| **Name of Sub-Contractor :** | |
| **Inspected by :** | |
| **Date of Inspection :** | |

**Number of employees on the site: -_____**

| Sl.No. | Item | No. Available | Remarks |
|---|---|---|---|
| 1 | No. of small sterilized dressings | | |
| 2 | No of medium sized sterilized dressings | | |
| 3 | No of large sized sterilized dressings. | | |
| 4 | No of large sized sterilized burn dressings | | |
| 5 | No of (15 grams) packets sterilized cotton wool | | |
| 6 | No of pieces of sterilized eye pads in separate sealed packets. | | |
| 7 | No of roller bandages 10 cm wide. | | |
| 8 | No of roller bandages 5 cm wide. | | |
| 9 | Whether tourniquet available | | |
| 10 | Whether supply of Suitable splints available. | | |
| 11 | No of packets of safety pins. | | |
| 12 | Whether kidney tray available | | |
| 13 | Whether sufficient number of eye wash bottles, filled with distilled water or suitable liquid, clearly indicated by a distinctive sign which shall be visible at all times, available. | | |
| 14 | Whether 4%-xylocaine eye drops, and boric acid eye drops and soda by carbonate eye drops available. | | |
| 15 | Whether (60ml) bottle containing a two percent alcoholic solution of iodine available | | |
| 16 | Whether (two hundred ml) bottle of mercurochrome (2 per cent) solution in water available. | | |

| Sl.No. | Item | No. Available | Remarks |
|---|---|---|---|
| 17 | Whether 120ml bottle containing Sal volatile having the dose and mode of administration indicated on the label, available. | | |
| 18 | Whether roll of adhesive plaster (6 cmX1 meter) available | | |
| 19 | No of rolls of adhesive plaster (2 cmX1 meter) | | |
| 20 | Whether snake bite lancet available. | | |
| 21 | Whether (30 grams) bottle of potassium permanganate crystals available. | | |
| 22 | Whether a pair scissors available | | |
| 23 | Whether copy of the First-Aid leaflet issued by the Director-General, Factory Advice service and labour Institutes, Government of India available. | | |
| 24 | Whether bottle containing 100 tablets (each of 5 grains) of aspirin available | | |
| 25 | Whether Ointment for burns available | | |
| 26 | Whether bottle of a suitable surgical anti-septic solution available | | |

Signature of Subcontractor's Site I/C:

| | | |
|---|---|---|
| | **POWER SECTOR** | FORMAT NO: HSEP:14-F02<br>REV NO.: 00<br>PAGE NO. 1 OF 02 |
| | **HEALTH CHECK UP** | |

| | |
|---|---|
| **Name of Site :** | |
| **Name of Sub-Contractor :** | |
| **Name of Employee :** | |

**NAME:**

| | |
|---|---|
| History Of Past Illness | H/O Epilepsy |
| | H/O Drug Allergy |
| | H/O Diabetics/ Hypertension |
| | H/O Unconsciousness |
| Personal History | |

| **EXAMINATION** | | **OBSERVATION** | |
|---|---|---|---|
| **General Physical Examination** | | | |
| Height | : | | |
| Weight | : | | |
| BMI | : | | |
| Built And nourishment | : | | |
| Pallor | : | | |
| Temperature | : | | |
| Chest Expansion | : | Inspiration | Expansion |
| Lymph Node Enlargement | : | | |
| **Ear, Nose, Throat** | : | | |
| Ear | : | | |
| Nose | : | | |
| Throat | : | | |

| EXAMINATION | | OBSERVATION | |
|---|---|---|---|
| **Cardiovascular System Examination** : | | | |
| Inspection | : | | |
| Palpation | : | Pulse | BP |
| Auscultation (Heart Sounds) | : | | |
| **Respiratory System** | : | | |
| Inspection | : | Respiratory Rate | |
| Palpation: | : | | |
| Percussion | : | | |
| Auscultation (Breath Sounds) | : | | |
| **Examination of Abdomen** | : | | |
| Inspection | : | | |
| Palpation | : | | |
| Auscultation (Bowel Sounds) | : | | |
| **Any Other** | : | | |
| **Clinical Impression** | | | |

**Signature of the examining doctor**

| | | |
|---|---|---|
| | **POWER SECTOR**<br>**HSE INDUCTION TRAINING** | FORMAT NO: HSEP:14-F03<br>REV NO.: 00<br>PAGE NO. 01 OF 01 |

| | |
|---|---|
| **Name of Site :** | |
| **Name of Sub-Contractor :** | |
| **Date :** | |
| **Name of Training Co-ordinator** | |

| **Sl No.** | **Name** | **Designation** | **Organisation** | **Signature** |
|---|---|---|---|---|
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| | | | | |
| | | | | |

**Signature of Training co-ordinator :**

| | | |
|---|---|---|
| | **POWER SECTOR** | FORMAT NO: HSEP:14-F04<br>REV NO.: 00<br>PAGE NO. 01 OF 01 |
| | **TOOL-BOX TALK** | |

| | |
|---|---|
| **Name of Site :** | |
| **Sub-Contractors Name :** | |
| **Date :** | |

| **Topic** | **Name of person delivered Tool Box Talk** | **No. of Participants attended** | **Remarks** |
|---|---|---|---|
| | | | |
| | | | |
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**Signature of Site I/C of Subcontractor :**

| | | |
|---|---|---|
| | **POWER SECTOR**<br>**PERSONAL PROTECTIVE EQUIPMENTS** | FORMAT NO: HSEP:14-F06<br>REV NO.: 00<br>PAGE NO. 01 OF 01 |

| | |
|---|---|
| **Name of Site :** | |
| **Name of Sub-Contractor :** | |
| **Inspected by :** | |
| **Date of Inspection :** | |

| **Item** | **Issued this Month** | **Nos. Issued up to the Month** | **Percentage of usage at site** |
|---|---|---|---|
| **Safety Helmet** | | | |
| **Safety Shoes** | | | |
| **Full Body Harness** | | | |
| **Fall Arrestor** | | | |
| **Safety Nets** | | | |
| **Other PPEs.** | | | |

**Signature of Site I/C of Subcontractor :**

| | | |
|---|---|---|
| | **POWER SECTOR**<br>**INSPECTION OF T&Ps** | FORMAT NO: HSEP:14-F07<br>REV NO.: 00<br>PAGE NO. 01 OF 01 |

| | |
|---|---|
| **Name of Site :** | |
| **Name of Sub-Contractor :** | |
| **Date of Inspection :** | |

| Sl.No. | Description | Remarks | |
|---|---|---|---|
| 1.0 | Name of equipment | | |
| 2.0 | Basic Information of equipment | | |
| 2.1 | Specification | | |
| 2.2 | Sr. No. of equipment | | |
| 2.3 | Make | | |
| 2.4 | Year of manufacture | | |
| 3.0 | Major repairs / overhauls(Furnish details of work carried out) | | Date(s) of major repair/overhaul |
| 3.1 | | | |
| 3.2 | | | |
| 3.3 | Repairs carried out at site | | |
| | | | |
| 4.0 | Any performance test conducted | Yes/No | |
| 5.0 | Document Submitted | Yes/No | |
| 6.0 | Manufacturer's test / guarantee certificate | Available/ Not available | |
| 7.0 | Performance test | Done/ Not Done | |
| 8.0 | Acceptance Norms | | |
| 9.0 | Committee Observations | | |
| 10.0 | Date of next review (if accepted) | | |

| | |
|---|---|
| **Signature-Site Safety Officer ( BHEL)** | **Signature-Subcontractor/ Subcontractor's Safety Officer** |

| | | |
|---|---|---|
| | **POWER SECTOR**<br>**STATUS OF T&Ps** | FORMAT NO: HSEP:14-F08<br>REV NO.: 00<br>PAGE NO. 01 OF 01 |

| | |
|---|---|
| **Name of Site** | |
| **Name of Sub-Contractor** | |
| **Date of Inspection** | |

| **Item** | **Nos. Deployed** | **Identification No.** | **Nos. Tested by competent person** | **Validity of Test Certificate** |
|---|---|---|---|---|
| **Winches** | | | | |
| **Chain Blocks** | | | | |
| **Wire Rope Slings** | | | | |
| **Man Cages** | | | | |
| **D-Shackles** | | | | |
| **Air Compressors** | | | | |
| **Crawler Cranes** | | | | |
| **Mobile Cranes** | | | | |
| **Hydra Cranes** | | | | |
| **Others** | | | | |

**Signature of Site I/C of subcontractor:**

| | | |
|---|---|---|
| | **POWER SECTOR**<br>**INSPECTION OF CRANES AND WINCHES** | FORMAT NO: HSEP:14-F09<br>REV NO.: 00<br>PAGE NO. 01 OF 03 |

| | |
|---|---|
| **Name of Site :** | |
| **Name of Sub-Contractor :** | |
| **Inspected by :** | |
| **Date of Inspection:** | |

**Crane Reg. No (Make/Model)** _____

**Name of Driver/Operator** _____

| Sl.no. | Description | Observation | Measures |
|---|---|---|---|
| 1 | Valid Driving license | | |
| 2 | Hook & Hook Latch | | |
| 3 | Over Hoist limit switch | | |
| 4 | Boom limit switch | | |
| 5 | Boom Angle Indicator | | |
| 6 | Boom limit cutoff switch | | |
| 7 | Condition of Boom | | |
| 8 | Condition of ropes | | |
| 9 | Number of load lines | | |
| 10 | Size and condition of the slings | | |
| 11 | Stability of the cranes | | |
| 12 | Soil Condition | | |
| 13 | Swing Break And Lock | | |
| 14 | Proper Break And Lock | | |
| 15 | Hoist Break And Lock | | |
| 16 | Boom Break And Lock | | |
| 17 | Main Clutch | | |
| 18 | Leakage in Hydraulic Cylinders | | |
| 19 | Out riggers filly extendable | | |
| 20 | Tyre pressure | | |
| 21 | Condition of Battery And Lamps | | |

| Sl.no. | Description | Observation | Measures |
|---|---|---|---|
| 22 | Guards of moving and rotating parts | | |
| 23 | Load chart provided | | |
| 24 | Number and position of pedant ropes | | |
| 25 | Reverse Horn | | |
| 26 | Load Test Details | | |
| 27 | Operator's fitness | | |
| 28 | Pollution under control certificate | | |
| 29 | Fire extinguisher of appropriate type. | | |
| 30 | Training of the operator | | |

**WINCH**

| Sl. No. | Description | YES | NO | NA | Remarks |
|---|---|---|---|---|---|
| **1** | Has the copy of Third Party Inspection certificate been provided in winch machine shed? | | | | |
| **2** | Is winch machine operator experienced enough to operate the winch machine? | | | | |
| **3** | Is the winch machine operated by someone other than the winch machine operator? | | | | |
| **4** | Is there guard provided in all moving parts like wheel and motor's shaft? | | | | |
| **5** | Will it protect against unforeseen operational contingencies? | | | | |
| **6** | Are brakes, clutch and locking arrangement working properly? | | | | |
| **7** | Has it been ensured that the guard does not constitute a hazard by itself? | | | | |
| **8** | Are the cranks and the connecting rods protected by guardrails? | | | | |
| **9** | Is there provision for fully covered shed with wooden plank roof? | | | | |
| | | | | | |

| Sl. No. | Description | YES | NO | NA | Remarks |
|---|---|---|---|---|---|
| **10** | Is wire rope free from any kind of damage or wear and tear? | | | | |
| **11** | Is split pin provided for the protection of clutch and brake locking arrangement? | | | | |
| **12** | Is pulley inspected by competent person and certified before use? | | | | |
| **13** | Is pulley free from any wear and tear visually? | | | | |
| **14** | Is winch rope barricaded with clipsheet for the protection of rope and person? | | | | |
| **15** | Is the wire rope lubricated by cardium oil? | | | | |
| **16** | Is there any friction in wire rope which may damage the wire rope rather than the rolling parts? | | | | |
| **17** | Is there any oil leakage in the hydraulic system of the winch machine? | | | | |
| **18** | Has it been ensured that the guard will not cause discomfort or inconvenience to operator? | | | | |
| | **Total Number of NO:** | | | | |
| | **Total Number of NA:** | | | | |
| | **% Compliance :** | | | | |

**Signature of Site I/C of subcontractor :**

| | | |
|---|---|---|
| | **POWER SECTOR** | FORMAT NO: HSEP:14-F10<br>REV NO.: 00<br>PAGE NO. 01 OF 02 |
| | **INSPECTION OF HEIGHT WORKING** | |

| | |
|---|---|
| **Name of Site :** | |
| **Name of Sub-Contractor :** | |
| **Inspected by :** | |
| **Date of Inspection:** | |

| **Sl. No.** | **Descriptions** | **Observation (Yes/No)** | **Remarks** |
|---|---|---|---|
| 1 | All the workers have been explained safe work method? | | |
| 2 | An established communication system has been established and explained to the workers. | | |
| 3 | Adequate illumination has been ensured. | | |
| 4 | Work area inspected prior to the start of the work. | | |
| 5 | Area below the work place barricaded, particularly below hot work. | | |
| 6 | Workers provided with bags /box to carry bolts, nuts and hand tools | | |
| 7 | Arrangement for fastening hand tools made. | | |
| 8 | All work platforms ensured to be of adequate strength and ergonomically suitable. | | |
| 9 | Fabricated makeshift arrangements are checked for quality and type of material welding, anchoring etc. | | |
| 10. | Work at more than one elevation at the same segment is restricted. | | |
| | **ACCESS/EGRESS** | | |
| 1 | Walkways provided with handrail, mid-rail and toe guard? | | |
| 2 | All checkered plates, gratings properly welded/ bolted? | | |
| 3 | Are ladders inspected and they are in good condition? | | |
| 4 | Are ladders spliced? | | |
| 5 | Are ladders properly secured to prevent slipping, sliding or falling? | | |
| 6 | Do side rails extend 36” above top landing? | | |
| 7 | Are built up ladders constructed of sound materials? | | |

| Sl. No. | Descriptions | Observation (Yes/No) | Remarks |
|---|---|---|---|
| 8 | Are rugs and cleats not over 12” on center? | | |
| 9 | Metal ladders not used around electrical hazards. | | |
| 10 | Proper maintenance and storage. | | |
| 11 | Ladders placed at right slope. | | |
| 12 | Ladders / staircases welded/ bolted properly. | | |
| 13 | Any obstruction in the stairs. | | |
| 14 | Are landing provided with handrails, knee rails, toe boards etc.? | | |
| 15 | Whether ramp is provided with proper slope. | | |
| 16 | Proper hand rails / guards provided in ramps. | | |
| | **Housekeeping** | | |
| 1 | Walkways, aisles & all overhead workplaces cleared of loose material. | | |
| 2 | Flammable materials, if any, are cleared. | | |
| 3 | All the de shuttering materials are removed after de shuttering is done. | | |
| 4 | Platforms and walkways free from oil/grease or other slippery material. | | |
| 5 | Collected scrap are brought down or lowered down and not dropped from height. | | |
| | **PPE And Safety Devices** | | |
| 1 | Use of safety helmet, safety belts ensured for all workers | | |
| 2 | Anchoring points provided at all places of work. | | |
| 3 | Common lifeline provided wherever linear movement at height is required. | | |
| 4 | Safety nets are use wherever required. | | |
| 5 | Proper fall arrest system is deployed at critical workplaces. | | |
| 6 | Crawler boards/Safety system or works on fragile roof are used. | | |

**Signature of Site I/C of subcontractor :**

| | | |
|---|---|---|
| | **POWER SECTOR**<br>**INSPECTION OF WELDING AND GAS CUTTING** | FORMAT NO: HSEP:14-F11<br>REV NO.: 00<br>PAGE NO. 1 OF 02 |

| | |
|---|---|
| **Name of Site** | |
| **Name of Sub-Contractor** | |
| **Inspected by** | |
| **Date of Inspection** | |

| **Welding** | | | | |
|---|---|---|---|---|
| Sl.no. | Description | Yes | No | Remarks |
| 1 | Is electric connection given through 30 mA ELCB/RCCB to welding m/c? | | | |
| 2 | Is electric cable fitted properly in junction box on m/c? | | | |
| 3 | Is electrical cable free from joints? | | | |
| 4 | Are the joints attached firmly & insulated with tape? | | | |
| 5 | Is double earthing given to body of m/c? | | | |
| 6 | Is the physical condition of the m/c good? | | | |
| 7 | Is ON/OFF switch connected to the m/c is working and in good condition? | | | |
| 8 | Are indication lamps on m/c working? | | | |
| 9 | Is the electrode holder in good condition? | | | |
| 10 | Are the cables of the welding m/c lugged & tight properly? | | | |
| 11 | Are return lead connected properly (Rod, Angle, Channels shall not be used) | | | |
| | Total No of NO | | | |
| | Total No of YES | | | |

| **Gas Cutting** | | | | |
|---|---|---|---|---|
| **Sl. no** | Description | Yes | No | Remarks |
| **1** | Are Cylinders kept on trolleys? | | | |
| **2** | Physical condition of Gas cylinders Good? | | | |
| **3** | Is there Oil/Grease on valve of the cylinder? | | | |
| **4** | Are pressure regulators in good condition? | | | |
| **5** | Condition of hose pipe OK? | | | |
| **6** | Are hose pipe clamped with hose clip? | | | |
| **7** | Is flash back arrestor & NRV fitted on torch both for O2 and LPG cylinder? | | | |
| **8** | Is nozzle of the torch cleaned? | | | |
| | Total Number of NO | | | |
| | Total No of YES | | | |
| | **% Compliance** | | | |

**Signature of Site I/C of subcontractor :**

| | | |
|---|---|---|
| | **POWER SECTOR**<br>**INSPECTION OF ELECTRICAL INSTALLATION** | FORMAT NO: HSEP:14-F12<br>REV NO.: 00<br>PAGE NO. 01 OF 02 |

| | |
|---|---|
| **Name of Site** | |
| **Name of Sub-Contractor** | |
| **Inspected by** | |
| **Date of Inspection:** | |

| **Sr. No.** | **Contents** | **Yes/No** | **Remarks** |
|---|---|---|---|
| **A** | **Cable** | | |
| 1. | Whether the condition of cable is checked? | | |
| 2. | Are cables received from other sites checked for insulation resistance before putting them into use? | | |
| 3. | Are all main cables taken either underground / overhead? | | |
| 4. | Are welding cables routed properly above the ground? | | |
| 5. | Are welding and electrical cables overlapping? | | |
| 6. | Is any improper joining of cables/wires prevailing at site? | | |
| **B** | **DBs/SDBs** | | |
| 1. | Is earth conductor continued up to DB / SDB? | | |
| 2. | Whether DBs and extension boards are protected from rain / water? | | |
| 3. | Is there any overloading of DBs / SDBs? | | |
| 4. | Are correct / proper fuses & CBs provided at main boards and sub-boards? | | |
| 5. | Is energized wiring in junction boxes, CB panels & similar places covered all times? | | |
| **C** | **ELCB** | | |
| 1. | Whether the connections are routed through ELCB? | | |
| 2. | Is ELCB sensitivity maintained at 30 mA? | | |

| Sr. No. | Contents | Yes/No | Remarks |
|---|---|---|---|
| 3. | Are the ELCB numbered and tested periodically & test results recorded in a logbook countersigned by a competent person? | | |
| **D** | **Grounding** | | |
| 1. | Is natural earthing ensured at the source of power (main DB at Generator or Transformer)? | | |
| 2. | Whether the continuity and tightness of the earth conductor are checked? | | |
| 3. | Mention the gauge of the earth conductor used at the site. | | |
| 4. | Mention the value of Earth Resistance. | | |
| **E** | **Electrically operated Machines or Accessories**. | | |
| 1. | Whether the plug top is provided everywhere. | | |
| 2. | Are all metal parts of electrical equipment and light fittings / accessories grounded? | | |
| 3. | Is there any shed or cover for welding machines? | | |
| 4. | Are halogen lamps fixed at proper places? | | |
| 5. | Are portable power tools maintained as per norms? | | |
| 6. | Any other information: | | |

**Signature of Site I/C of subcontractor :**

| | | |
|---|---|---|
| | **POWER SECTOR**<br>**INSPECTION OF ELEVATOR** | FORMAT NO: HSEP:14-F13<br>REV NO.: 00<br>PAGE NO. 01 OF 01 |

| | |
|---|---|
| **Name of Site** | |
| **Name of Sub-Contractor** | |
| **Inspected by** | |
| **Date of Inspection** | |

| **Sr. No.** | **Description** | **Remarks** | |
|---|---|---|---|
| 1.0 | Name of equipment | | |
| 2.0 | Basic Information of equipment | | |
| 2.1 | Specification | | |
| 2.2 | Sr. No. of equipment | | |
| 2.3 | Make | | |
| 2.4 | Year of manufacture | | |
| 3.0 | Major repairs/overhauls(Furnish details of work carried out) | | Date(s) of major repair/overhaul |
| 3.1 | | | |
| 3.2 | | | |
| 3.3 | Repairs carried out at site | | |
| | | | |
| 4.0 | Any performance test conducted | Yes/No | |
| 5.0 | Document Submitted | Yes/No | |
| 6.0 | Manufacturer's test / guarantee certificate | Available/ Not available | |
| 7.0 | Performance test | Done/ Not Done | |
| 8.0 | Acceptance Norms | | |
| 9.0 | Committee Observations | | |
| 10.0 | Date of next review (if accepted) | | |

| | |
|---|---|
| **Signature-Subcontractor/ Subcontractor's Safety Officer** | **Signature-Site Safety Officer ( BHEL)** |

| | | |
|---|---|---|
| | **POWER SECTOR**<br>**Inspection of Excavation** | FORMAT NO: **HSEP:14-F13E**<br>REV NO.: 00<br>PAGE NO. 01 OF 01 |

| | |
|---|---|
| **Name of Site :** | |
| **Name of Sub-Contractor :** | |
| **Inspected by :** | |
| **Date of Inspection :** | |

| Sl.no. | Description | Yes | No | Remarks |
|---|---|---|---|---|
| 1 | Precautions taken for Underground Electrical Cable | | | |
| 2 | Precautions taken for Under / Above ground sewer/ Drinking Water Line | | | |
| 3 | Precautions taken for Underground Telecommunication Line | | | |
| 4 | Precautions taken for Underground Product/Utility Line | | | |
| 5 | Precautions taken for Underground Fire Water Line | | | |
| 6 | Shoring / Shuttering / Sheet piling done to prevent collapse of excavation walls. Strength of Excavation wall ensured at all times | | | |
| 7 | Slope Cutting / Angle Maintained | | | |
| 8 | Hard Barricading & Edge Protection provided | | | |
| 9 | Separate Safe Access for Man and Vehicle | | | |
| 10 | Lighting arrangement | | | |
| 11 | Banksman Provided | | | |
| 12 | Required basic PPEs provided | | | |
| 13 | Excavated soil / Construction Material / equipment kept away from the edge. | | | |
| 14 | First aid in attendance. | | | |
| 15 | Other: | | | |
| | | | | |
| | Total No of YES | | | |

**Signature-Subcontractor/ Subcontractor's Safety Officer** **Signature-Site Safety Officer ( BHEL)**

**Sub: MEMO for Penalty for non-compliances in Safety**

Following lapse (tick marked) was observed and penalty is imposed as stated at the bottom of this memo. It is requested that such occurrences be please avoided in future.

**Safety Area**

| SN | Violation of Safety Norms | Fine (in Rs) |
|---|---|---|
| 01 | Not Wearing Safety Helmet | 200/- * |
| 02. | Not wearing Safety Belt or not anchoring life line | 500/-* |
| 03 | Not wearing safety shoe | 200/-* |
| 04 | Not keeping gas cylinders vertically | 200/- |
| 05 | Not using flash back arrestors | 100/- |
| 06 | Not wearing gloves | 50/- * |
| 07. | Grinding Without Goggles | 50/- * |
| 08. | Not using 24 V Supply For Internal Work | 500/- |
| 09. | Electrical Plugs Not used for hand Machine | 100/- |
| 10. | Not Slinging properly | 200/- |
| 11. | Using Damaged Sling | 200/- |
| 12. | Lifting Cylinders Without Cage | 500/- |
| 13. | Not Using Proper Welding Cable With Lot of Joints And Not Insulated Property. | 200/- |
| 14. | Not Removing Small Scrap From Platforms | 500/- |
| 15. | Gas Cutting Without Taking Proper Precaution or Not Using Sheet Below Gas Cutting | 500/- |
| 16. | Not Maintaining Electric Winches Which are Operated Dangerously | 500/- |
| 17. | Improper Earthing Of Electrical T&P | 500/- |
| 18 | No or improper barricading | 500/- |
| 19. | Activity carried out without Safety work permit (Height work, Lifting activity, Hot work-each person/case) | 1000/- |
| 20. | Incident Resulting in Partial Loss in Earning Capacity | 25,000/- per victim |
| 21. | Fatal Incident Resulting in total loss in Earning Capacity | 1,00,000/- per victim for first instance # |

**Legend: -**

*: per head. For repeated violation by the same person, the penalty would be double of the previous penalty. Date of "Repeated violation" will be counted from subsequent days.

#: or as deducted by customer, whichever is higher. For repeated fatal incident in the same Unit incremental penalty to be imposed. The subcontractor will pay 2 times the penalty compared to previously paid in case there are repeated cases of fatal incidents under the same subcontractor for the same package in the same unit.

Details (if any) related to non- compliance (Name of persons, Nature of deficiency, etc.)

_____

Penalty imposed:

1, Rate as per above chart_____

2. No. of Persons/ machine/ event/ labour _____

3. Total Penalty= 1. X 2. =_____

Signature:

Witnessed by: (Sub- Contractor representative) (BHEL Personnel)

Name_____ Name_____

Distribution: 1 Copy: to Sub- contractor,
1 Copy to Site Construction Manager (BHEL)

| | | |
|---|---|---|
| बीएचईएल BHEL | **POWER SECTOR- HQ**<br>**Incident Report**<br>(To be submitted within 24 hours of time of incident) | FORMAT NO: HSEP:14-F15<br>REV NO.: 00<br>PAGE NO. 01 OF 01 |

**Type of incident: Fatal/Major/ Minor/Fire/Property Damage/Near-miss**

| | | | | | |
|---|---|---|---|---|---|
| 1 | NAME OF SITE | | 3 | ACTIVITY AREA | |
| 2 | SCOPE OF WORK | | 4 | NAME OF CONTRACTOR | |
| | | | 5 | NAME & DESIGNATION OF BHEL ACTIVITY I/C | |
| 6 | DATE & TIME OF ACCIDENT | | 7 | DATE RESUMED | |
| 8 | NO. OF WORK-DAYS LOST BY VICTIM (If duty not resumed, give estimated figure) | | | | |
| 9 | NO. OF MANHOURS LOST BY OTHERS | | | | |
| 10 | PERSONAL DETAILS OF INJURED AND / OR DETAILS OF MATERIALS / EQUIPMENT / PROPERTY DAMAGED | | | | |

| | | | | | |
|---|---|---|---|---|---|
| NAME | | | | NAME OF MATERIAL / EQUIPMENT / PROPERTY | |
| PERIOD OF EMPLOYMENT | | | | | |
| AGE | YRS | SEX | MALE/ FEMALE | ESTIMATED COST | ACTUAL COST |
| MARITAL STATUS | | SINGLE / MARRIED | | | |
| OCCUPATION | | | | NATURE OF DAMAGE | |
| PART OF BODY INJURED | | | | | |
| NATURE OF INJURY | | | | | |
| AGENCY ( OBJECT / EQUIPMENT / SUBSTANCE ) MOST RESPONSIBLE FOR CAUSING ACCIDENT / INJURY / DAMAGE | | | | | |
| 12 | PERSON (NAME & DESIGNATION) WITH MOST CONTROL OVER AGENCY (OBJECT / EQUIPMENT / SUBSTANCE ) CAUSING ACCIDENT INJURY / DAMAGE | | | | |
| 13 | DESCRIBE CLEARLY HOW THE ACCIDENT OCCURRED (USE ADDITIONAL SHEET, IF REQUIRED | | | | |
| | | | | | |
| ANALYSIS | | | | | |
| 14 | WHAT ACTS AND / OR CONDITIONS CONTRIBUTED MOST DIRECTLY TO THIS ACCIDENT | | | | |
| 15 | WHAT ARE THE BASIC REASON FOR THE EXISTENCE OF THESE ACTS AND / OR CONDITION ? | | | | |
| 16 | WHAT CORRECTIVE ACTIONS HAVE BEEN TAKEN TO PREVENT ACCIDENT RECURRENCE ? | | | | |
| | DATE : | | | SIGNATURE OF SITE HSE COORDINATOR | |
| 17 | COMMENTS OF HEAD / SOX | | | | |
| | DATE: | | | SIGNATURE OF HEAD/SOX | |

| | POWER SECTOR | FORMAT NO: **HSEP:14-F30**<br>REV NO.: 00<br>PAGE NO. 01 OF 3 |
|---|---|---|
| | **Format for Monthly HSE Planning & Review** | |

| **Note: This is a template and can be modified in consultation with BHEL** | | | |
|---|---|---|---|
| **Name of the Site** | | **Name of the Subcontractor** | |
| **Scope of Work** | | **Date** | |
| **PART- A: PLAN OF HSE ACTIVITIES FOR THE MONTH OF……** | | | **PART-B: REVIEW ON ……** |
| **SN.** | **Description of HSE Activity & Formats** | **Plan & Targets for the month** | **Review** |
| 1 | Availability of First Aid Box at Required Places and Inspection thereof as per Format: F01 | Areas<br>1. …<br>… | |
| 2 | Health check-up as per Format: F02 | Health check-up for<br>Nos<br>1. New inductees<br>2. Drivers & Operators<br>3. Workers in following high risk areas:<br>a. … | |
| 3 | Induction training of newly joined workers as per Format: F03 | Minimum No. of workers: | |
| 4 | Toolbox talks (TBT) conducted before start of work as per Format: F04 | Locations of TBTs & No. of workers<br>**1.** … | |
| 5 | PPE usage and issue as per Format: F06 | | |
| 6 | Inspection of T&Ps as per Format: F07 | List of T&Ps to be inspected<br>1. | |
| 7 | Identification & Inspection Status of T&Ps as per Format: F08 | | |
| 8 | Inspection of Cranes & Winches as per Format: F09 | List of Cranes & Winches & Nos.<br>1. … | |
| 9 | Inspection of Height Working as per Format: F10 | Areas:<br>1. … | |
| 10 | Inspection of Welding & Gas Cutting operations as per Format: F11 | Areas:<br>1. … | |
| 11 | Inspection of Electrical Installations as per Format: F12 | Locations:<br>1. … | |
| 12 | Inspection of Elevators (as applicable) as per Format: F13 | Locations:<br>1. … | |
| 13 | Inspection of Excavation as per Format: F13E | **Locations:**<br>**1. …** | |

| SN. | Description of HSE Activity & Formats | Plan & Targets for the month | Review |
|---|---|---|---|
| 14 | Job Safety Analysis as per Format F32B | **Activities:**<br>**1. …** | |
| 15 | Regular Job Specific Training (Re-training) for workers involved in hazardous activities | Topics/ Hazards & No. of workers<br>**1.** … | |
| 16 | Mass housekeeping (HK) drive in work areas | Areas<br>**1.** … | |
| 17 | Vertigo Test of Height workers | Minimum No. of workers: | |
| 18 | Deployment of qualified HSE Officers as per contract | Location(s) & Nos.<br>**1.** … | |
| 19 | Deployment of qualified HSE Stewards as per contract | Location(s) & Nos.<br>**1.** … | |
| 20 | Deployment of Safety tools & Equipment (Safety Nets, Lifelines, Fall arrestors, Man-cages, flashback arrestors, scaffolding etc.) | Tool/ Equipment & Location<br>**1.** … | |
| 21 | Safety Walks by site in charge of agency (4 -Weekly once) | Dates: | |
| 22 | Safety walks by departmental head (8-Weekly twice) | Dates: | |
| 23 | Availability/ deployment of Safety posters/ placards/ signage at strategic locations | Locations: Nos.<br>**1.** … | |
| 24 | Provision of clean drinking water sources for workers | Locations: Nos.<br>**1.** … | |
| 25 | Provision of toilets for workers (separate for male & female workers) | Locations: Nos.<br>**1.** … | |
| 26 | Rest sheds for workers during lunchtime, rain, dust storm etc. | Locations: Nos.<br>**1.** … | |
| 27 | Availability of following in Labor colony | **1. Clean drinking water**<br>**2. Toilets**<br>**3. Cleanliness & Hygiene**<br>**4. Grass cutting,**<br>**5. Fogging**<br>**6. Electrical Inspection …** | |

| SN. | Description of HSE Activity & Formats | Plan & Targets for the month | Review |
|---|---|---|---|
| 28 | Availability of dust/ waste bins at various locations | Locations:<br>**1.** … | |
| 29 | Availability of Ambulance (individual/ joint) in each shift | Ambulance No. | |
| 30 | Availability of emergency vehicle in each shift | Emergency vehicle | |
| 31 | Deployment/ Availability of tested Fire Extinguishers | Locations & Nos.<br>**1.** … | |
| 32 | Tree plantation | Locations & Nos.<br>**1.** … | |
| 33 | Waste disposal & Scrap Bins | Locations<br>**1.** … | |
| 34 | Illumination checks | Locations<br>**1.** … | |
| 35 | Safety award function:<br>1. Display of good practices<br>Award presentation | Minimum 1 per month | |
| **36** | **Submission of Daily Reports as per Format No.F31A** | **Daily Reports (Night & Day Shifts)** | |

| **PLAN** | | **REVIEW** | |
|---|---|---|---|
| **Agency**<br>Name:<br><br>Sign:<br><br>Date: | **BHEL**<br>Name:<br><br>Sign:<br><br>Date: | **Agency**<br>Name:<br><br>Sign:<br><br>Date: | **BHEL**<br>Name:<br><br>Sign:<br><br>Date: |

| | POWER SECTOR | FORMAT NO: **HSEP:14-F31** A<br>REV NO.: 00<br>PAGE NO. 01 OF 1 |
|---|---|---|
| | **Format for Daily HSE Reporting** | |

**Note: Following format to be submitted (preferably) in excel/ soft copy by subcontractor daily at the end of each shift. Any photographs/ records to be attached**

| **Site** | | | | | | | | | **Subcontractor** | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Year** | | | | | | | **Month** | | | | | | | | | | | | | **Day** | | | | | | | |
| SHIFT | Submitted By | Work Area(s) | Staff | Man-Power | Safety Officers | Safety Stewards | Tool Box (Topics and No. of Participants) | Induction Training (No. of Participants) | Vertigo Test (Numbers Tested) | On-the-Job Training (Topic & participants) | Work Permits | Job Safety Analyses conducted | Height Work Inspection | Other Hazardous Activities Inspection | T&P Inspection (Names & Nos. Inspected) | Safety Walk (Designation, Areas) | HSE Meeting | Safety Reward (Details) | Housekeeping/ Dust Suppression/ Tree Plantation Activities (Locations/Details) | Lost time Accident | Restricted Work Case | Medical Treatment Case | First Aid Case | Near miss | Property Damage/ Fire | Non-Compliances Submitted by BHEL | Complied by Agency | Any other Remarks/ Inputs |
| **Day** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Night** | | | | | | | | | | | | | | | NA | | NA | NA | NA | | | | | | | | |

| | | |
|---|---|---|
| | **POWER SECTOR**<br>**Job Safety Analysis Format** | FORMAT NO: **HSEP:14-F32B**<br>REV NO.: 00<br>PAGE NO. 01 OF 1 |

| | |
|---|---|
| **Name of the Site** | |
| **Name of the Subcontractor** | |
| **Activity, Area** | |

| **HAZARDS** | **PRECAUTIONS** |
|---|---|
| | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **(Name)** | **Submitted By (Agency HSE)** | | **Reviewed By (BHEL Execution)** | | **Approved By (BHEL HSE)** | |
| **(Sign)** | | | | | | |
| **(Date)** | | | | | | |

| SL | Parameter for Measurement | M/O | Wt | Supporting Documents |
|---|---|---|---|---|
| 1a | Induction training for new workers conducted through audio-visual medium & documented ? | M | 1 | Induction Training Records |
| 1b | Tool box talk conducted regularly as per plan, and documented? | M | 1 | Toolbox Talk Records |
| 1c | Contractor in charge and safety in charge attended safety meetings? | M | 2 | Minutes of Meeting |
| 1d | Whether observations in safety meetings are complied before next meeting? | M | 2 | -do- |
| 1e | Preparation and submission of Monthly HSE report within stipulated time | M | 1 | Report submission date |
| 1f | Preparation and submission of Incident/near-miss report and RCA Report (as applicable) within stipulated time | M | 1 | Incident/ Near Miss Records |
| 1g | Carrying out Inspections and submission of Inspection reports within stipulated time | M | 1 | Inspection Records |
| 1h | Regular Job Specific Training ensured for High Risk Workers (through audio-visual medium) as per plan | M | 1 | Training & Attendance Records |
| 2a | Whether the contractor is registered under BOCW | M | 2 | BOCW Registration Certificate |
| 2b | Availability of Qualified safety officer (1 for every 500 labour) | M | 2 | Safety Officer qualification & experience records |
| 2c | Availability of Qualified safety supervisor (1 for every 100 labour ) | M | 2 | Safety Officer qualification & experience records |
| 2d | All the workers are provided and using safety helmets and safety shoes/gum boots | M | 2 | PPE Issue Records, Inspection/ non-conformity records |
| 2e | Housekeeping done on regular basis and scrap removal at site | M | 1 | Housekeeping records, Inspection/ non-conformity records |
| 2f | Usage of Goggles/Face shields and Hand gloves for gas cutter and grinders | | 1 | PPE Issue Records, Inspection/ non-conformity records |
| 2g | Wall openings & floor openings are guarded? | | 1 | Inspection/ non-conformity records |
| 2h | Adequate illumination provided in all working area? | | 1 | Inspection/ non-conformity records |
| 2i | Safety posters, sign boards and emergency contact numbers in all prominent location are displayed? | | 1 | Inspection/ non-conformity records |
| 2j | Availability of automatic reverse horns, Main horn, hook latches for Vehicles, mobile cranes, Hydras | | 1 | Inspection/ non-conformity records |
| 2k | Ban of carrying mobile phones to work place is implemented for workers | | 1 | Inspection/ non-conformity records |
| 2l | Availability of Tags & Inspection Certificates for Cranes of all capacities | | 1 | Master T&P List with internal & external test details |
| 2l.2 | Availability of Tags & Inspection Certificates for Winches of all capacities | | 1 | Master T&P List with internal & external test details |
| 2l.3 | Availability of Tags & Inspection Certificates, color coding for Chain pulley blocks | | 1 | Master T&P List with internal & external test details |
| 2l.4 | Availability of Tags & Inspection Certificates for Vehicles - Trailers, Dozers, Dumpers, Excavators. Mixers etc. | | 1 | Master T&P List with internal & external test details |
| 2l.5 | Availability of Tags & Inspection Certificates for Welding machines, grinders, Drilling machines, etc. | | 1 | Master T&P List with internal & external test details |
| 2l.6 | Availability of Tags & Inspection Certificates, colour coding for Wire rope slings etc. | | 1 | Master T&P List with internal & external test details |
| 2l.7 | Availability of Tags & Inspection Certificates for Batching plants | | 1 | Master T&P List with internal & external test details |

| SL | Parameter for Measurement | M/ O | Wt | Supporting Documents |
|---|---|---|---|---|
| 2m.1 | Use of Lifting Permit as per requirement | | 1 | Permit Records |
| 2m.2 | Use of Height Permit as per requirement | | 1 | Permit Records |
| 2m.3 | Use of Hot Work Permit as per requirement | | 1 | Permit Records |
| 2m.4 | Use of Excavation permit as per requirement | | 1 | Permit Records |
| 2m.5 | Use of Confined space work permit as per requirement | | 1 | Permit Records |
| 2m.6 | Use of Grating removal and safety net removal permit as per requirement | | 1 | Permit Records |
| 2m.7 | Use of Lockout-Tag out permit as per requirement | | 1 | Permit Records |
| 2m.8 | Use of Radiography permit as per requirement | | 1 | Permit Records |
| 2m.9 | Use of Night/ Holiday Work Permit as per requirement | | 1 | Permit Records |
| 2m.10 | Use of Any other Applicable Permit as per requirement | | 1 | Permit Records |
| 3a | Material safety data sheet(MSDS) available for all chemicals and displayed in usage and storage area? | | 1 | Inspection/ non-conformity records |
| 3b | Spillages of oil/concrete and other chemical is controlled and cleaned by proper method in case of spill? | | 1 | Inspection/ non-conformity records |
| 3c | Availability of adequate number of urinals in workplace and in elevations and maintained | M | 1 | |
| 3d | Availability of rest rooms for workers at site | M | 1 | |
| 3e | Availability of Drinking water facility at work spot | | 1 | |
| 3f | Hygienic Labour colony is provided for workers. | | 1 | |
| 4a | Is heavy/complex critical lifting permit obtained for heavy, complex materials before handling/erection activity? | | 1 | Work Permit records |
| 4b | Whether area below lifting activities barricaded | | 1 | Inspection/ non-conformity records |
| 4c | Availability of experienced rigging foreman | | 1 | Experience details of rigging foreman |
| 4d | Is agency is following proper storage and handling procedure as per manufacturer standard for all hazardous material? | | 1 | Procedure for storage & handling |
| 4e | Are oxygen and acetylene cylinders are transported to work place from storage area in trolleys | | 1 | |
| 5a | Whether all deep excavation has been protected by barrier | | 1 | Inspection/ non-conformity records |
| 5b | Sloping/benching & shoring provided for excavation as per requirement? | | 1 | -do- |
| 5c | Proper access and egress provided for excavations? | | 1 | -do- |
| 5d | Blasting is done in controlled manner? | | 2 | -do- |
| 6a | Whether Electrical booth is equipped with $Co_2$ fire extinguishers and fire buckets filled with sand? | | 2 | Inspection/ non-conformity records |
| 6b | Availability of Illumination lamp in electric booth? | | 1 | -do- |
| 6c | whether Caution Boards have been displayed? | | 1 | -do- |
| 6d | Usage of Metal Plug top for all hand power tools ? | | 1 | -do- |
| 6e | Usage of Insulated welding cables. | | 1 | -do- |
| 6f | Electrical Booth/Distribution Board to be covered by proper Canopy. | | 1 | -do- |
| 6g | Availability of functional & individual 30ma ELCB / RCCB and MCB for protection and conducting periodical check-up? | | 1 | -do- |
| 6h | Double earthing for panel boards and all machinery & proper earth pit with regular inspection available? | | 1 | -do- |
| 6i | Whether Electrician is qualified and experienced | | 1 | Qualification & Experience records of electrician |
| 6j | Availability and usage of Rubber hand gloves by electrician? | | 1 | Inspection/ non-conformity records |

| SL | Parameter for Measurement | M/ O | Wt | Supporting Documents |
|---|---|---|---|---|
| 7a | Whether Scaffolding pipes made with steel or aluminum, are being used and checked periodically by experienced/ certified scaffolder? | | 2 | Inspection/ non-conformity records |
| 7b | 8mm Stainless Steel wire rope with plastic cladding is provided for life line (Vertical / Horizontal) during height work? | | 2 | -do- |
| 7c | Availability of emergency lighting in case of power failure | | 1 | -do- |
| 7d | Whether all the openings are covered with Safety Nets made of fire proof Nylon? | | 1 | -do- |
| 7e | Whether MS pipe rails around staircases & platforms in usage are provided with top, middle rails and toe guard ? | | 1 | -do- |
| 7f | Whether Ladder with vertical life line /Fall arrestor is available to climb? | | 1 | -do- |
| 7g | Whether all workers deployed for working at height have been issued height pass after undergoing vertigo test? | | 1 | Height Pass records |
| 7h | Whether all workers deployed for height work / climbing ladder are provided and using Double lanyard safety belt? | | 1 | PPE Issue records, inspection/ non-conformity reports |
| 7i | Is all hand tools/Small material used by height workers is tied firmly to prevent fall? | | 1 | -do- |
| 8a | Flash back arrestors for all gas cutting sets is available on Torch side and cylinder side | | 1 | Inspection/ non-conformity records |
| 8b | Oxygen/Acetylene/LPG cylinders not in use have caps in place and stored separately? | | 1 | -do- |
| 8c | Availability of Face screen, Hand gloves, and Apron, for welders | | 1 | -do- |
| 8d | Protection from falling hot molten metal during metal cutting / welding at height by providing GI sheet below the cutting area especially in fire prone areas | | 1 | -do- |
| 9a | Pre-employment medical check-up done for all workers and submitted? | | 1 | Medical check records |
| 9b | Availability of first aid center, with MBBS doctor(Own or Sharing basis) | **M** | 2 | Attendance records |
| 9c | Availability of Ambulance facility 24 hours (Own or sharing basis) | **M** | 2 | -do- |
| 9d | Is First aid trained personnel's are available and their names are displayed at site? | **M** | 1 | -do- |
| 9e | Availability of Emergency vehicle at site | | 1 | |
| 9f | Periodical medical check-up is conducted for all the workers and submitted? | | 1 | Medical check records |
| 9g | Availability of sufficient number of first aid box as per standard list and maintaining record | | 1 | Inspection records |
| 10a | Availability of Fire extinguishers, buckets at all vulnerable points | | 2 | Fire extinguisher records |
| 10b | Periodic fire mock drill conducted? | | 1 | Fire, Mock drill records |
| 10c | Are all flammable materials are stored separately? | | 1 | |
| 10d | Periodic grass cutting is done in material storage area? | | 1 | |
| 10e | Availability of 24V DC lighting in confined space work area | | 1 | |
| 10f | Availability of exhaust fan in confined space work area | | 1 | |

**Note:**

- **M: Mandatory; O: Optional**. Points other than mandatory can be excluded with appropriate justification (scope etc.) by BHEL
- Additionally: 30 Marks for each Fatal Accident and 10 mark for each major accident shall be deducted.

| SAFETY WORK CLEARANCE | Permit no. |
|---|---|
| Project: | Emergency Contact Nos: |
| Subcontractor: | |

# BURNING/WELDING /HOT WORK PERMIT

Area :_____ Date:_____ Time:_____

Name of Site Engineer (Permit Requesting Authority):_____ Sign:_____

Name of Work Performing Contractor: _____

Name of Package In charge:_____ Sign:_____ Date:_____

Description of Work: _____

_____

Work Execution Date:_____ Time Valid from:_____ to _____

*The above signing person(s) will be responsible to ensure that the above described work will be done under all the safety precautions mentioned on the permit to work.*

The following precautions are to be taken:

| No. | Item | Yes | Not required |
|---|---|---|---|
| 1. | Proper Access/Exit available | | |
| 2. | Proper ventilation and /or lighting provided. | | |
| 3. | Proper and safe scaffolding, platform, ladder provided. | | |
| 4. | Welding machine located in a clean and dry area. | | |
| 5. | Welding machine grounded at the equipment and proper leakage current protection device (ELCB) provided for welding machine. | | |
| 6. | Emergency STOP buttons are in working condition. Welder /Helper knows how to operate it. | | |
| 7. | Welding machine input/output cables, welding holder and weld return clamp (Holder) are insulated and in good condition. | | |
| 8. | Welder & Fitter trained to connect ground/work return clamps (Holder) to work place prior to energization of welding machine. | | |
| 9. | Gas cylinders are stacked vertically and not below the welding / cutting area. Regulator key is available with cylinder. | | |
| 10. | Pressure gauges/Flash back arrestor provided and in working condition. | | |
| 11. | Personal Protective equipment Minimum applicable: safety helmet, safety goggles, welding helmet, safety shoes, leather gloves, long sleeve and nose mask -provided | | |
| 12. | In case of pits, water removed from the pit and wood/rubber insulation provided. | | |
| 13. | Safety signboards are in place. | | |
| 14. | Adequate and Suitable nos. of fire fighting extinguisher provided. | | |
| 15. | Nearby combustible material removed. Housekeeping done. | | |
| 16. | Other | | |

Name of Contractor Safety Officer:_____ Sign:_____ Date:_____ Time: _____

**Reviewed and approved by BHEL Site Engineer (Permit Issuing Authority):**

Name:_____ Sign:_____ Date:_____ Time:_____

Name of BHEL Safety Representative:_____ Sign: _____

*I understand the precaution to be taken as described above and as per project requirement and hereby confirm that work will be executed under my supervision by following all precaution and Safety Rules.*

**Name of Work Performing Authority:_____ Sign:_____ Date:_____ Time:_____**

**Permit Cancellation:**

*I hereby declare that the work is complete, all workers under my control have been withdrawn and the site restored to safe tidy condition.*

Name of Work performing Authority:_____ Sign:_____ Date:_____ Time:_____

Name of Site Engr. (Permit Requesting Authority):_____ Sign:_____ Date:_____ Time:_____

Name of BHEL Site Engr. (Permit Issuing Authority):_____ Sign:_____ Date:_____ Time: _____

(This permit is valid only for the date it is issued)

**Original at BHEL site** **Second Copy – BHEL SAFETY** **Third Copy : Contractor**

| SAFETY WORK CLEARANCE | Permit no. |
|---|---|
| Project: | Emergency Contact Nos: |
| Subcontractor: | |

# LIFTING ACTIVITY PERMIT

Area :_____ Date:_____ Time:_____

Name of Site Engineer (Permit Requesting Authority):_____ Sign: Name of Work

Performing Contractor: _____

Name of Package In charge:_____ Sign:_____ Date:_____

Description of Work: _____

_____

Work Execution Date:_____ Time Valid from:_____ to _____

*The above signing person(s) will be responsible to ensure that the above described work will be done under all the safety precautions mentioned on the permit to work.*

The following precautions are to be taken:

| No. | Item | Yes | Not required |
|---|---|---|---|
| 1. | Crane used for lifting activity tested, certified and approved for rated lifting | | |
| 2. | All lifting tackles, gears/appliances are tested and certified for lifting works. | | |
| 3. | Crane operator is trained and competent for lifting operation. | | |
| 4. | Lifting sling/ belt is protected against sharp edge of the jobs to be lifted. | | |
| 5. | Access and exit marked and without obstruction. | | |
| 6. | Lifting arrangement adequate. | | |
| 7. | Unwanted rubbish material removed from work platform. | | |
| 8. | Minimum 2 guidelines have been provided for balancing and guiding jobs to be lifted. | | |
| 9. | Periphery area of crane booms as well as lifting job is barricaded and unauthorized/no-entry sign board posted. | | |
| 10. | Rigger and signal man is trained and competent for lifting work. | | |
| 11. | No lifting activity to be carried out during lightening, heavy wind/rain. | | |
| 12. | If scaffolding to be used during lift, scaffolding with valid tag available for use. | | |
| 13. | Double lanyards safety harness/belt checked an in working condition. | | |
| 14. | Safety shoes (non-slip), helmet with chin strap available with employees. | | |
| 15. | Others. | | |

Name of Contractor Safety Officer:_____ Sign:_____ Date:_____ Time: _____

**Reviewed and approved by BHEL Site Engineer (Permit Issuing Authority):**

Name:_____ Sign:_____ Date:_____ Time:_____

Name of BHEL Safety Representative:_____ Sign: _____

*I understand the precaution to be taken as described above and as per project requirement and hereby confirm that work will be executed under my supervision by following all precaution and Safety Rules.*

**Name of Work Performing Authority:_____ Sign:_____ Date:_____ Time:_____**

**Permit Cancellation:**

*I hereby declare that the work is complete, all workers under my control have been withdrawn and the site restored to safe tidy condition.*

Name of Work performing Authority:_____ Sign:_____ Date:_____ Time:_____

Name of Site Engr. (Permit Requesting Authority):_____ Sign:_____ Date:_____ Time:_____

Name of BHEL Site Engr. (Permit Issuing Authority):_____ Sign:_____ Date:_____ Time: _____

(This permit is valid only for the date it is issued)

**Original at BHEL site** **Second Copy – BHEL SAFETY** **Third Copy : Contractor**

| SAFETY WORK CLEARANCE | Permit no. |
|---|---|
| Project: | Emergency Contact Nos: |
| Subcontractor: | |

# WORKING AT HEIGHT PERMIT

Area :_____ Date:_____ Time:_____

Name of Site Engineer (Permit Requesting Authority):_____ Sign: Name of Work

Performing Contractor: _____

Name of Package In charge:_____ Sign:_____ Date:_____

Description of Work: _____

_____

Work Execution Date:_____ Time Valid from:_____ to _____

*The above signing person(s) will be responsible to ensure that the above described work will be done under all the safety precautions mentioned on the permit to work.*

The following precautions are to be taken:

| No. | Item | Yes | Not required |
|---|---|---|---|
| 1. | All workers on job are medically fit for working at height (Person should not have vertigo) | | |
| 2. | Scaffolding with valid tag available for use | | |
| 3. | Safety harness with life line support/ fall arrester are checked and in working condition | | |
| 4. | Safety shoes ( non-slip), Helmet with chin strip available with employees | | |
| 5. | Safety nets are provided as per design and provided 25 ft. below working area & extending 8 ft beyond. | | |
| 6. | Horizontal life lines are provided to cater to design specification of 2300kg per person. | | |
| 7. | Ladders have been inspected and provided as per BHEL standard/contract. | | |
| 8. | All lifting / tightening tools, hand tools/equipment checked and in good condition | | |
| 9. | Access and exit marked and without obstruction. | | |
| 10. | Lighting arrangement adequate. | | |
| 11. | Unwanted and rubbish material removed from working platform. | | |
| 12. | Electrical cable, welding Hose/Compressed air hose properly secured and lay down without obstruction. | | |
| 13. | Signboards provided on working platforms | | |
| 14. | Hazards in the vicinity are identified and communicated to the worker. | | |
| 15. | Other | | |

Name of Contractor Safety Officer:_____ Sign:_____ Date:_____ Time: _____

**Reviewed and approved by BHEL Site Engineer (Permit Issuing Authority):**

Name:_____ Sign:_____ Date:_____ Time:_____

Name of BHEL Safety Representative:_____ Sign: _____

*I understand the precaution to be taken as described above and as per project requirement and hereby confirm that work will be executed under my supervision by following all precaution and Safety Rules.*

**Name of Work Performing Authority:_____ Sign:_____ Date:_____ Time:_____**

**Permit Cancellation:**

*I hereby declare that the work is complete, all workers under my control have been withdrawn and the site restored to safe tidy condition.*

Name of Work performing Authority:_____ Sign:_____ Date:_____ Time:_____

Name of Site Engr. (Permit Requesting Authority):_____ Sign:_____ Date:_____ Time:_____

Name of BHEL Site Engr. (Permit Issuing Authority):_____ Sign:_____ Date:_____ Time: _____

(This permit is valid only for the date it is issued)

**Original at BHEL site** **Second Copy – BHEL SAFETY** **Third Copy : Contractor**


बी एच ई एल
BHEL

# ERECTION / FIELD WELDING SCHEDULE

SYSTEM : MS FROM SUPERHEATER TO BOILER STOP VALVE

DOC.NO. :
REV. NO. :
WELDING CODE : IBR / ASME
PAGE NO : 01 OF 01

| SL. NO. | DRG NO. FOR WELD LOCATION IDENTIFICATION MARK | DESCRIPTION OF PARTS TO BE WELDED | MATL.SPEC. (ATT) | DIMENSIONS SIZE OD mm | DIMENSIONS THICK mm | PROCESS OF WELDING | TYPE OF WELD | ELECTRODE FILLER SPEC. (ATT) TIG | ARC SPEC. ø2.5 | ARC SPEC. ø3.15 | ARC SPEC. ø4.0 | W.P.S NO. | MIN. PRE HEAT TEMP. °C | HEAT TREATMENT TEMP. °C | HEAT TREATMENT HOLD TIME | NDT METHOD/ QUANTUM | REF. SPEC. NO. | ACC. NORM REF. | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | PART–1 | PART–1 | | | | QTY | QTY(gms) | QTY(NOS.) | | | | | | | | | | |
| | | PART–2 | PART–2 | | | | QTY | ø2.4 | | | | | | | | | | | |
| 01 | 0–80–300–07533 | SH OUTLET HEADER | SA 335 P91 | 508 | 120 | TIG ARC | 120 | ER90S–B9 | E9015–B9 | | | 1050 REV 06 | 220 | 740–770 | 2.5 mts PER mm MIN 60 mts | 100 % UT & 100 % MT | * | * | 100% HARDNESS |
| | | MATCHING PIECE | SA 182 F91 | | | | 2 | 224.42 | 19 | 23 | 2593 | | | | | | | | |
| 02 | 0–80–300–07533 | PIPE | SA 335 P91 | ID330 | 97 | TIG ARC | 97 | ER90S–B9 | E9015–B9 | | | 1050 REV 06 | 220 | 740–770 | 2.5 mts PER mm MIN 60 mts | 100 % UT & 100 % MT | * | * | 100% HARDNESS |
| | | FITTING | SA 182 F91 | | | | 2 | 224.42 | 19 | 23 | 3016 | | | | | | | | |
| 03 | 0–80–300–07533 | PIPE | SA 335 P91 | 88.9 | 23 | TIG ARC | 23 | ER90S–B9 | E9015–B9 | | | 1050 REV 06 | 220 | 740–770 | 2.5 mts PER mm MIN 60 mts | 100 % UT & 100 % MT | * | * | 100% HARDNESS |
| | | FITTING/VALVE | SA 182 F91 | | | | 12 | 286.17 | 66 | 132 | 92 | | | | | | | | |
| 04 | 0–80–300–07533 | PIPE | SA 335 P91 | ID330 | 97/108 | TIG ARC | 97 | ER90S–B9 | E9015–B9 | | | 1050 REV 06 | 220 | 740–770 | 2.5 mts PER mm MIN 60 mts | 100 % UT & 100 % MT | * | * | 100% HARDNESS |
| | | PIPE | SA 335 P91 | | | | 22 | 2468.64 | 217 | 266 | 33178 | | | | | | | | |
| 05 | 0–80–300–07533 | PIPE | SA 335 P91 | 88.9 | 23 | TIG ARC | 23 | ER90S–B9 | E9015–B9 | | | 1050 REV 06 | 220 | 740–770 | 2.5 mts PER mm MIN 60 mts | 100 % UT & 100 % MT | * | * | 100% HARDNESS |
| | | PIPE | SA 335 P91 | | | | 4 | 95.39 | 22 | 44 | 30 | | | | | | | | |
| 06 | 0–80–300–07533 | PIPE | SA 335 P91 | ID330 | 97 | TIG ARC | 97 | ER90S–B9 | E9015–B9 | | | 1050 REV 06 | 220 | 740–770 | 2.5 mts PER mm MIN 60 mts | 100 % UT & 100 % MT | * | * | 100% HARDNESS |
| | | VALVE | SA 182 F91 | | | | 4 | 448.84 | 39 | 48 | 6032 | | | | | | | | |

NOTES:
01.100 % LPI / MPI ON ALL BUTT WELDS AFTER PWHT.
02.* REFER NDE MANUAL NO. PSQ :NDM:COM:REV NO.R00/04–02 AMD.02
03. 3% HARDNESS CHECKING ON BUTT WELDS OF ALLOY STEEL,OTHER THAN P91 & F91

| PREPARED | DESIGN/CHD. | DESIGN/APPD. | CHD./APD. – QA | DATE | DRAWING NO. | REV . |
|---|---|---|---|---|---|---|
| ARJUN | P SURESH | SARAVANAN C | J NANTHINI | 06.08.2019 | 4–80–300–83380 | 00 |

# ERECTION / FIELD WELDING SCHEDULE

SYSTEM : MS FROM BOILER STOP VALVE TO ESV

DOC.NO. :
REV. NO. :
WELDING CODE : IBR / ASME
PAGE NO : 01 OF 01

| SL. NO. | DRG NO. FOR WELD LOCATION IDENTIFICATION MARK | DESCRIPTION OF PARTS TO BE WELDED | MATL.SPEC. (ATT) | DIMENSIONS SIZE OD mm | DIMENSIONS THICK mm | PROCESS OF WELDING | TYPE OF WELD | ELECTRODE FILLER SPEC. (ATT) TIG | ARC SPEC. | | | W.P.S NO. | MIN. PRE HEAT TEMP. °C | HEAT TREATMENT TEMP. °C | HEAT TREATMENT HOLD TIME | NDT METHOD/ QUANTUM | REF. SPEC. NO. | ACC. NORM REF. | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | QTY | QTY(gms) ø2.4 | QTY(NOS.) ø2.5 | ø3.15 | ø4.0 | | | | | | | | |
| 01 | 0-80-301-07529 | HP TURBINE INLET | SA 335 F91 | ID390 | 135 | TIG ARC | 135 | ER90S-B9 | E9015-B9 | | | 1050 REV 06 | 220 | 740-770 | 2.5 mts PER mm MIN 60 mts | 100 % UT & 100 % MT | * | * | 100% HARDNESS |
| | 0-80-301-07534 | MATCHING PIECE | SA 182 F91 | | | | 2 | 264.81 | 25 | 30 | 6221 | | | | | | | | |
| 02 | 0-80-301-07529 | PIPE | SA 335 P91 | ID330 | 97/108 | TIG ARC | 97 | ER90S-B9 | E9015-B9 | | | 1050 REV 06 | 220 | 740-770 | 2.5 mts PER mm MIN 60 mts | 100 % UT & 100 % MT | * | * | 100% HARDNESS |
| | 0-80-301-07534 | PIPE | SA 335 P91 | | | | 56 | 6283.81 | 554 | 677 | 84453 | | | | | | | | |
| 03 | 0-80-301-07529 | PIPE | SA 335 P91 | ID330 | 115 | TIG ARC | 115 | ER90S-B9 | E9015-B9 | | | 1050 REV 06 | 220 | 740-770 | 2.5 mts PER mm MIN 60 mts | 100 % UT & 100 % MT | * | * | 100% HARDNESS |
| | 0-80-301-07534 | PIPE | SA 335 P91 | | | | 1 | 102.01 | 10 | 12 | 2052 | | | | | | | | |
| 04 | 0-80-301-07529 | PIPE | SA 335 P91 | ID330 | 97 | TIG ARC | 97 | ER90S-B9 | E9015-B9 | | | 1050 REV 06 | 220 | 740-770 | 2.5 mts PER mm MIN 60 mts | 100 % UT & 100 % MT | * | * | 100% HARDNESS |
| | 0-80-301-07534 | FITTING | SA 182 F91 | | | | 16 | 1795.37 | 158 | 193 | 24129 | | | | | | | | |
| 05 | 0-80-301-07529 | PIPE | SA 335 P91 | ID330 | 108 | TIG ARC | 108 | ER90S-B9 | E9015-B9 | | | 1050 REV 06 | 220 | 740-770 | 2.5 mts PER mm MIN 60 mts | 100 % UT & 100 % MT | * | * | 100% HARDNESS |
| | 0-80-301-07534 | PIPE | SA 335 P91 | | | | 7 | 785.47 | 69 | 84 | 12805 | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
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NOTES:
01.100 % LPI / MPI ON ALL BUTT WELDS AFTER PWHT.
02.* REFER NDE MANUAL NO. PSQ :NDM:COM:REV NO.R00/04-02 AMD.02
03. 3% HARDNESS CHECKING ON BUTT WELDS OF ALLOY STEEL,OTHER THAN P91 & F91

| PREPARED | DESIGN/CHD. | DESIGN/APPD. | CHD./APD. – QA | DATE | DRAWING NO. | REV . |
|---|---|---|---|---|---|---|
| ARJUN | P SURESH | SARAVANAN C | J NANTHINI | 06.08.2019 | 4-80-301-83384 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-MAIN STEAM TO AUX.PRDS PIPING (80-303)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-303-22769 | PIPE | SA335P91 | OD | 45 | TIG & ARC | 45 | ER90S-B9 | E9015-B9 | | | 1050/ REV06 | 220 * | 755±15 | 2.5 Mts./mm (Min. 60 Mts.) 5 hrs + 15 Mts. for each additional 25mm thick above 125mm. ROH/ ROC: Maximum 140°c/ hr above 305°c | 100% RT/ UT 100% MPT 100% HARDNESS | REFER NOTE-1 | REFER NOTE-1 | Refer WPS for Backing / Purging Gas & NOTE-3 |
| | 1-80-303-22769 | FORGING | SA182F91 | 219.1 | | | 5 | 265 | 90 | 125 | 390 | | | | | | | | |
| 2 | 1-80-303-22769 | PIPE | SA335P91 | OD | 45 | TIG & ARC | 45 | ER90S-B9 | E9015-B9 | | | 1050/ REV06 | 220 * | 755±15 | 2.5 Mts./mm (Min. 60 Mts.) 5 hrs + 15 Mts. for each additional 25mm thick above 125mm. ROH/ ROC: Maximum 140°c/ hr above 305°c | 100% RT/ UT 100% MPT 100% HARDNESS | REFER NOTE-1 | REFER NOTE-1 | Refer WPS for Backing / Purging Gas & NOTE-3 |
| | 1-80-303-22769 | FITTING | SA234WP91 | 219.1 | | | 16 | 848 | 288 | 400 | 1248 | | | | | | | | |
| 3 | 1-80-303-22769 | PIPE | SA335P22 | OD | 9.53 | TIG & ARC | 9.53 | ER90S-B3 | E9018-B3 | | | 1014/ REV03 | 150 * | 700±20 | 2.5 Mts./mm (Min. 60 Mts.) | 100% RT/ UT 100% MPT 3% HARDNESS | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-303-22769 | FORGING | SA182F22 | 457 | | | 1 | 150 | 34 | 53 | 0 | | | | | | | | |
| 4 | 1-80-303-22769 | PIPE | SA335P22 | OD | 9.53 | TIG & ARC | 9.53 | ER90S-B3 | E9018-B3 | | | 1014/ REV03 | 150 * | 700±20 | 2.5 Mts./mm (Min. 60 Mts.) | 100% RT/ UT 100% MPT 3% HARDNESS | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-303-22769 | FITTING | SA234WP22 | 457 | | | 1 | 150 | 34 | 53 | 0 | | | | | | | | |
| 5 | 1-80-303-22769 | FITTING | SA234WP22 | OD | 9.53 | TIG & ARC | 9.53 | ER80S-B2 | E8018-B2 | | | 1012/ REV04 | 150 * | 700±20 | 2.5 Mts./mm (Min. 60 Mts.) | 100% RT/ UT 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-303-22769 | PIPE | SA335P11 | 457 | | | 1 | 150 | 34 | 53 | 0 | | | | | | | | |
| 6 | 1-80-303-22769 | PIPE | SA335P11 | OD | 9.53 | TIG & ARC | 9.53 | ER70S-A1 | E7018-1 | | | 1017/ REV04 | 150 | NIL | NIL | 100% RT/ UT 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-303-22769 | PIPE | SA106GRB | 457 | | | 1 | 150 | 34 | 53 | 0 | | | | | | | | |
| 7 | 1-80-303-22769 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-303-22769 | FITTING | SA234WPB | 457 | | | 7 | 1050 | 238 | 371 | 0 | | | | | | | | |
| 8 | 1-80-303-22769 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-303-22769 | VALVE | SA216WCB | 457 | | | 3 | 450 | 102 | 159 | 0 | | | | | | | | |

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
|---|---|---|---|---|---|---|---|
| | | Approved: | | | | Approved: | |

Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision

(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

(3) 100% MPI on all Butt welds after PWHT for P91 piping.

* Refer WPS for Preheat maintenance, Postheat, Interpass Temp. and Other Requirements

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| JITENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 07.02.2022 | 4-80-303-83638 | 01 | OF | 02 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-MAIN STEAM TO AUX.PRDS PIPING (80-303)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 9 | 1-80-303-22769 | PIPE | SA106GRB | OD | 8.18 | TIG & ARC | 8.18 | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT<br>100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-303-22769 | FITTING | SA234WPB | 219.1 | | | 2 | 140 | 34 | 36 | 0 | | | | | | | | |
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# REF:ERECTION/ FIELD WELDING SCHEDULE-HP BYPASS FROM M S TO HP BYPASS VALVE INLET (80 304)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-304-22746 | PIPE | SA335P91 | ID | 54 | TIG & ARC | 54 | ER90S-B9 | E9015-B9 | | | 1050/ REV06 | 220 * | 755±15 | 2.5 Mts./ mm (Min. 60 Mts.) 5 hrs + 15 Mts. for each additional 25mm thick above 125mm. ROH/ ROC: Maximum 140°c/ hr above 305°c | 100% RT/ UT 100% MPT 100% HARDNESS | REFER NOTE-1 | REFER NOTE-1 | Refer WPS for Backing / Purging Gas & NOTE-3 |
| | 1-80-304-22746 | FORGING | SA182F91 | 200 | | | 4 | 340 | 96 | 156 | 672 | | | | | | | | |
| 2 | 1-80-304-22746 | PIPE | SA335P91 | ID | 54 | TIG & ARC | 54 | ER90S-B9 | E9015-B9 | | | 1050/ REV06 | 220 * | 755±15 | 2.5 Mts./ mm (Min. 60 Mts.) 5 hrs + 15 Mts. for each additional 25mm thick above 125mm. ROH/ ROC: Maximum 140°c/ hr above 305°c | 100% RT/ UT 100% MPT 100% HARDNESS | REFER NOTE-1 | REFER NOTE-1 | Refer WPS for Backing / Purging Gas & NOTE-3 |
| | 1-80-304-22746 | PIPE | SA335P91 | 200 | | | 21 | 1785 | 504 | 819 | 3528 | | | | | | | | |
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Notes:
(1) Refer to the Latest Manual AA/ CQ/ GL/ 011 Part III NDEM latest revision
(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.
(3) 100% MPI on all Butt welds after PWHT for P91 piping.
* Refer WPS for Preheat maintenance, Postheat, Interpass Temp. and Other Requirements

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
|---|---|---|---|---|---|---|---|
| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | REV. NO. |
|---|---|---|---|---|---|---|---|---|
| JITENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 07.02.2022 | 4-80-304-83317 | 01 | OF 01 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-HP BYPASS WARM UP LINE DRAIN PIPING ( 80 307)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-307-22773 | PIPE | SA335P91 | OD | 9.09 | TIG & ARC | 9.09 V | ER90S-B9 | E9015-B9 | | | 1036/ REV09 | 220 * | 745±15 | 2.5 Mts./mm (Min. 30 Mts.) ROH/ ROC: Maximum 140°c/ hr above 300°c | 100% RT/ UT 100% MPT 100% HARDNESS | REFER NOTE-1 | REFER NOTE-1 | Refer WPS for Backing / Purging Gas & NOTE-3 |
| | 1-80-307-22773 | PIPE | SA335P91 | 33.4 | | | 8 | 29 | 112 | 0 | 0 | | | | | | | | |
| 2 | 1-80-307-22773 | PIPE | SA335P91 | OD | 9.09 | TIG & ARC | 9.09 V | ER90S-B9 | E9015-B9 | | | 1036/ REV09 | 220 * | 745±15 | 2.5 Mts./mm (Min. 30 Mts.) ROH/ ROC: Maximum 140°c/ hr above 300°c | 100% RT/ UT 100% MPT 100% HARDNESS | REFER NOTE-1 | REFER NOTE-1 | Refer WPS for Backing / Purging Gas & NOTE-3 |
| | 1-80-307-22773 | FORGING | SA182F91 | 33.4 | | | 8 | 29 | 112 | 0 | 0 | | | | | | | | |
| 3 | 1-80-307-22773 | PIPE | SA335P91 | OD | 9.09 | ARC | 9.09 | | E9015-B91 | | | 1060/ REV02 | 220 * | 755±15 | 2.5 Mts./mm (Min. 60 Mts.) 5 hrs + 15 Mts. for each additional 25mm thick above 125mm. ROH/ ROC: Maximum 140°c/ hr above 350°c | 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-307-22773 | FORGING | SA182F91 | 33.4 | | | 4 | | 0 | 8 | 0 | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
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Notes:
(1) Refer to the Latest Manual AA/ CQ/ GL/ 011 Part III NDEM latest revision
(2) Drain & vent piping: 100% RT upto the last root valve. Beyond the last root valve, 10% RT is applicable.
(3) 100% MPI on all Butt welds after PWHT for P91 piping.
* Refer WPS for Preheat maintenance, Postheat, Interpass Temp. and Other Requirements

| Rev.no. | Date: | Altered: | |
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| | | Approved: | |

| Rev.no. | Date: | Altered: | |
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| | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| JITENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 07.02.2022 | 4-80-307-83404 | 01 | OF | 01 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE CRH PIPING TO DEAERATING HEATER (80 322)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-322-22894 | PIPE | SA106GRC | OD | 15.09 | TIG & ARC | 15.09 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-322-22894 | FITTING | SA234WPC | 355.6 | | | 19 | 2337 | 513 | 836 | 266 | | | | | | | | |
| 2 | 1-80-322-22894 | PIPE | SA106GRC | OD | 15.09 | TIG & ARC | 15.09 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-322-22894 | VALVE | SA216WCC | 355.6 | | | 2 | 246 | 54 | 88 | 28 | | | | | | | | |
| 3 | 1-80-322-22894 | FITTING | SA234WPC | OD | 15.09 | TIG & ARC | 15.09 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-322-22894 | VALVE | SA216WCC | 323.9 | | | 1 | 111 | 24 | 39 | 13 | | | | | | | | |
| 4 | 1-80-322-22894 | FITTING | SA234WPC | OD | 28.58 | TIG & ARC | 28.58 | ER70S-A1 | E7018-1 | | | 1004/R EV04 | 100 | 610±15 | 2.5 Mts./mm (Minimum 30 Mts.) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-322-22894 | VALVE | SA216WCC | 660 | | | 1 | 226 | 51 | 83 | 162 | | | | | | | | |
| 5 | 1-80-322-22894 | PIPE | SA106GRC | OD | 37 | TIG & ARC | 37 | ER70S-A1 | E7018-1 | | | 1004/R EV04 | 100 | 610±15 | 2.5 Mts./mm (Minimum 30 Mts.) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-322-22894 | FITTING | SA234WPC | 965 | | | 1 | 330 | 76 | 125 | 353 | | | | | | | | |
| 6 | 1-80-322-22894 | PIPE | SA106GRC | OD | 37 | TIG & ARC | 37 | ER70S-A1 | E7018-1 | | | 1004/R EV04 | 100 | 610±15 | 2.5 Mts./mm (Minimum 30 Mts.) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-322-22894 | VALVE | SA216WCC | 965 | | | 3 | 989 | 227 | 373 | 1059 | | | | | | | | |
| 7 | 1-80-322-22894 | PIPE | SA672GRB70 | OD | 10 | TIG & ARC | 10 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-322-22894 | VALVE | SA216WCC | 965 | | | 2 | 663 | 152 | 238 | 0 | | | | | | | | |
| 8 | 1-80-322-22894 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-322-22894 | PLATE | SA515GR70 | 323.9 | | | 2 | 208 | 48 | 74 | 0 | | | | | | | | |

Notes:
(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.
(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
|---|---|---|---|---|---|---|---|
| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| JITENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 07.02.2022 | 4-80-322-83621 | 01 | OF | 01 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-EXTRACTION STEAM FROM BFP TURBINE TO HPH-8 (80323)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-323-22994 | PIPE | SA106GRC | OD | 9.53 | TIG & ARC | 9.53 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-323-22994 | FITTING | SA234WPC | 323.9 | | | 19 | 1976 | 456 | 703 | 0 | | | | | | | | |
| 2 | 1-80-323-22994 | FITTING | SA234WPC | OD | 9.53 | TIG & ARC | 9.53 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-323-22994 | VALVE | SA216WCC | 323.9 | | | 2 | 208 | 48 | 74 | 0 | | | | | | | | |
| 3 | 1-80-323-22994 | PIPE | SA106GRC | OD | 14.27 | TIG & ARC | 14.27 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-323-22994 | FITTING | SA234WPC | 323.9 | | | 10 | 1110 | 240 | 390 | 130 | | | | | | | | |
| 4 | 1-80-323-22994 | FITTING | SA234WPC | OD | 12.7 | TIG & ARC | 12.7 | ER70S-A1 | E7018-1 | | | 1017/R EV04 | 150 | NIL | NIL | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-323-22994 | PIPE | SA335P12 | 219.1 | | | 1 | 73 | 17 | 25 | 5 | | | | | | | | |
| 5 | 1-80-323-22994 | VALVE | SA217WC9 | OD | 12.7 | TIG & ARC | 12.7 | ER80S-B2 | E8018-B2 | | | 1012/R EV04 | 150 * | 700±20 | 2.5 Mts./mm (Min. 60 Mts.) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-323-22994 | PIPE | SA335P12 | 219.1 | | | 2 | 146 | 34 | 50 | 10 | | | | | | | | |
| 6 | 1-80-323-22994 | PIPE | SA335P12 | OD | 12.7 | TIG & ARC | 12.7 | ER70S-A1 | E7018-1 | | | 1017/R EV04 | 150 | NIL | NIL | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-323-22994 | VALVE | SA216WCC | 219.1 | | | 1 | 73 | 17 | 25 | 5 | | | | | | | | |
| 7 | 1-80-323-22994 | PIPE | SA106GRC | OD | 12.7 | TIG & ARC | 12.7 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-323-22994 | FITTING | SA234WPC | 219.1 | | | 19 | 1387 | 323 | 475 | 95 | | | | | | | | |
| 8 | 1-80-323-22994 | PIPE | SA106GRC | OD | 6.02 | TIG & ARC | 6.02 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-323-22994 | FITTING | SA234WPC | 114.3 | | | 2 | 54 | 42 | 0 | 0 | | | | | | | | |

Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

* Refer WPS for Preheat maintenance, Postheat, Interpass Temp. and Other Requirements

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
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| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| JTENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 08.02.2022 | 4-80-323-83891 | 01 | OF | 01 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-COLD REHEAT PIPING TO AUXILIARY PRESSURE REDUCING STATION( 80324)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-324-23094 | PIPE | SA106GRC | OD | 6.02 | TIG & ARC | 6.02 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT +100% MPT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-3 |
| | 1-80-324-23094 | FITTING | SA234WPC | 114.3 | | | 20 | 532 | 420 | 0 | 0 | | | | | | | | |
| 2 | 1-80-324-23094 | PIPE | SA106GRC | OD | 6.02 | TIG & ARC | 6.02 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT +100% MPT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-3 |
| | 1-80-324-23094 | VALVE | SA216WCC | 114.3 | | | 7 | 187 | 147 | 0 | 0 | | | | | | | | |
| 3 | 1-80-324-23094 | FITTING | SA234WPB | OD | 6.02 | TIG & ARC | 6.02 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT +100% MPT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-3 |
| | 1-80-324-23094 | VALVE | SA216WCC | 114.3 | | | 1 | 27 | 21 | 0 | 0 | | | | | | | | |
| 4 | 1-80-324-23094 | PIPE | SA106GRC | OD | 12.7 | TIG & ARC | 12.7 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT +100% MPT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-3 |
| | 1-80-324-23094 | FITTING | SA234WPC | 219.1 | | | 1 | 73 | 17 | 25 | 5 | | | | | | | | |
| 5 | 1-80-324-23094 | PIPE | SA106GRC | OD | 12.7 | TIG & ARC | 12.7 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT +100% MPT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-3 |
| | 1-80-324-23094 | VALVE | SA216WCB | 219.1 | | | 1 | 73 | 17 | 25 | 5 | | | | | | | | |
| 6 | 1-80-324-23094 | PIPE | SA106GRB | OD | 6.35 | TIG & ARC | 6.35 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT +100% MPT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-3 |
| | 1-80-324-23094 | VALVE | SA216WCB | 219.1 | | | 5 | 355 | 185 | 0 | 0 | | | | | | | | |
| 7 | 1-80-324-23094 | PIPE | SA106GRB | OD | 6.35 | TIG & ARC | 6.35 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT +100% MPT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-3 |
| | 1-80-324-23094 | FITTING | SA234WPB | 219.1 | | | 17 | 1207 | 629 | 0 | 0 | | | | | | | | |
| 8 | 1-80-324-23094 | PIPE | SA106GRB | OD | 6.02 | TIG & ARC | 6.02 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT +100% MPT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-3 |
| | 1-80-324-23094 | FITTING | SA234WPB | 114.3 | | | 2 | 54 | 42 | 0 | 0 | | | | | | | | |

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
|---|---|---|---|---|---|---|---|
| | | Approved: | | | | Approved: | |

Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve. Beyond the last root valve, 10% RT is applicable.

(3)100% LPI on all Butt welds after PWHT for Non-P91 piping. 100% MPI on all Butt welds after PWHT for P91 piping.

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| JITENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 10.02.2022 | 4-80-324-83911 | 01 | OF | 01 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-EXTRACTION STEAM PIPING TO BFPT-A/ B (80329)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-329-22985 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-329-22985 | FITTING | SA234WPB | 508 | | | 10 | 1670 | 380 | 600 | 0 | | | | | | | | |
| 2 | 1-80-329-22985 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-329-22985 | VALVE | SA216WCB | 508 | | | 4 | 668 | 152 | 240 | 0 | | | | | | | | |
| 3 | 1-80-329-22985<br>1-80-329-22986 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-329-22985<br>1-80-329-22986 | FITTING | SA234WPB | 406.4 | | | 48 | 6336 | 1440 | 2256 | 0 | | | | | | | | |
| 4 | 1-80-329-22985<br>1-80-329-22986 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-329-22985<br>1-80-329-22986 | VALVE | SA216WCB | 406.4 | | | 4 | 528 | 120 | 188 | 0 | | | | | | | | |
| 5 | 1-80-329-22985<br>1-80-329-22986 | PIPE | SA106GRB | OD | 9.27 | TIG & ARC | 9.27 | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-329-22985<br>1-80-329-22986 | FITTING | SA234WPB | 273 | | | 20 | 1740 | 400 | 600 | 0 | | | | | | | | |
| 6 | 1-80-329-22985<br>1-80-329-22986 | PIPE | SA106GRB | OD | 6.35 | TIG & ARC | 6.35 | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-329-22985<br>1-80-329-22986 | FITTING | SA234WPB | 219.1 | | | 4 | 284 | 148 | 0 | 0 | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |

Notes:

(1) Refer to the Latest Manual AA/ CQ/ GL/ 011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
|---|---|---|---|---|---|---|---|
| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| JITENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 10.02.2022 | 4-80-329-83884 | 01 | OF | 01 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-EXTRACTION STEAM PIPING TO LOW PRESSURE HEATER-3 (80331)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-331-22793 | PIPE | SA672GRB70 | OD | 10 | TIG & ARC | 10 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-331-22793 | FITTING | SA234WPB | 610 | | | 19 | 3846 | 878 | 1380 | 0 | | | | | | | | |
| 2 | 1-80-331-22793 | PIPE | SA672GRB70 | OD | 10 | TIG & ARC | 10 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-331-22793 | FITTING | SA234WPB | 813 | | | 17 | 4692 | 1071 | 1683 | 0 | | | | | | | | |
| 3 | 1-80-331-22793 | PIPE | SA672GRB70 | OD | 10 | TIG & ARC | 10 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-331-22793 | VALVE | SA216WCB | 813 | | | 4 | 1104 | 252 | 396 | 0 | | | | | | | | |
| 4 | 1-80-331-22793 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-331-22793 | PLATE | SA515GR70 | 323.9 | | | 2 | 208 | 48 | 74 | 0 | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |

Notes:
(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.
(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | |
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| | | Approved: | |

| Rev.no. | Date: | Altered: | |
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| | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| JITENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 10.02.2022 | 4-80-331-83491 | 01 | OF | 01 | 00 |

# REFERENCE ERECTION/ FIELD WELDING SCHEDULE-EXTRACTION STEAM PIPING TO LOW PRESSURE HEATER-4 (80332)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-332-22814 | PIPE | SA106GRB | OD | 10 | TIG & ARC | 10 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-332-22814 | FITTING | SA234WPB | 610 | | | 2 | 405 | 93 | 146 | 0 | | | | | | | | |
| 2 | 1-80-332-22814 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-332-22814 | FITTING | SA234WPB | 508 | | | 13 | 2171 | 494 | 780 | 0 | | | | | | | | |
| 3 | 1-80-332-22814 | PIPE | SA672GRB70 | OD | 10 | TIG & ARC | 10 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-332-22814 | FITTING | SA234WPB | 660 | | | 16 | 3533 | 807 | 1268 | 0 | | | | | | | | |
| 4 | 1-80-332-22814 | FITTING | SA234WPB | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-332-22814 | VALVE | SA216WCB | 609.6 | | | 2 | 405 | 93 | 146 | 0 | | | | | | | | |
| 5 | 1-80-332-22814 | PIPE | SA672GRB70 | OD | 10 | TIG & ARC | 10 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-332-22814 | VALVE | SA216WCB | 660 | | | 2 | 442 | 101 | 159 | 0 | | | | | | | | |
| 6 | 1-80-332-22814 | FITTING | SA234WPB | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-332-22814 | PIPE | SA106GRC | 609.6 | | | 1 | 203 | 47 | 73 | 0 | | | | | | | | |
| 7 | 1-80-332-22814 | PIPE | SA106GRB | OD | 6.5 | TIG & ARC | 6.5 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-332-22814 | PLATE | SA515GR70 | 219 | | | 2 | 142 | 74 | 0 | 0 | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |

Notes:
(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.
(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
|---|---|---|---|---|---|---|---|
| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| JITENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 10.02.2022 | 4-80-332-83515 | 01 | OF | 01 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-EXTRACTION STEAM PIPING TO LOW PRESSURE HEATER-5

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-334-22826 | PIPE | SA106GRB | OD | 10 | TIG & ARC | 10 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-334-22826 | FITTING | SA234WPB | 610 | | | 1 | 203 | 47 | 73 | 0 | | | | | | | | |
| 2 | 1-80-334-22826 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-334-22826 | FITTING | SA234WPB | 508 | | | 5 | 835 | 190 | 300 | 0 | | | | | | | | |
| 3 | 1-80-334-22826 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-334-22826 | VALVE | SA216WCB | 508 | | | 4 | 668 | 152 | 240 | 0 | | | | | | | | |
| 4 | 1-80-334-22826 | PIPE | SA106GRB | OD | 10 | TIG & ARC | 10 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-334-22826 | FITTING | SA234WPB | 559 | | | 21 | 4251 | 971 | 1525 | 0 | | | | | | | | |
| 5 | 1-80-334-22826 | PIPE | SA106GRB | OD | 10 | TIG & ARC | 10 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-334-22826 | VALVE | SA216WCB | 559 | | | 2 | 405 | 93 | 146 | 0 | | | | | | | | |
| 6 | 1-80-334-22826 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-334-22826 | FITTING | SA234WPB | 457 | | | 1 | 150 | 34 | 53 | 0 | | | | | | | | |
| 7 | 1-80-334-22826 | PIPE | SA106GRB | OD | 6.35 | TIG & ARC | 6.35 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-334-22826 | FITTING | SA234WPB | 219.1 | | | 4 | 284 | 148 | 0 | 0 | | | | | | | | |
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Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
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| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| JITENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 10.02.2022 | 4-80-334-83558 | 01 | OF | 01 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-EXTRACTION STEAM PIPING TO DEAERATING HEATER ( 80335)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-335-22879 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-335-22879 | FITTING | SA234WPB | 406.4 | | | 32 | 4224 | 960 | 1504 | 0 | | | | | | | | |
| 2 | 1-80-335-22879 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-335-22879 | VALVE | SA216WCB | 406.4 | | | 4 | 528 | 120 | 188 | 0 | | | | | | | | |
| 3 | 1-80-335-22879 | PIPE | SA672GRB70 | OD | 10 | TIG & ARC | 10 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-335-22879 | FITTING | SA234WPB | 660 | | | 19 | 4196 | 958 | 1505 | 0 | | | | | | | | |
| 4 | 1-80-335-22879 | PIPE | SA672GRB70 | OD | 10 | TIG & ARC | 10 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-335-22879 | VALVE | SA216WCB | 610 | | | 2 | 405 | 93 | 146 | 0 | | | | | | | | |
| 5 | 1-80-335-22879 | PLATE | SA515GR70 | OD | 10 | TIG & ARC | 10 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-335-22879 | VALVE | SA216WCB | 610 | | | 2 | 405 | 93 | 146 | 0 | | | | | | | | |
| 6 | 1-80-335-22879 | FITTING | SA234WPB | OD | 10 | TIG & ARC | 10 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-335-22879 | PIPE | SA106GRB | 610 | | | 1 | 203 | 47 | 73 | 0 | | | | | | | | |
| 7 | 1-80-335-22879 | PIPE | SA672GRB70 | OD | 10 | TIG & ARC | 10 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-335-22879 | FITTING | SA234WPB | 965 | | | 7 | 2319 | 530 | 832 | 0 | | | | | | | | |
| 8 | 1-80-335-22879 | PIPE | SA672GRB70 | OD | 10 | TIG & ARC | 10 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-335-22879 | FITTING | SA234WPC | 965 | | | 2 | 663 | 152 | 238 | 0 | | | | | | | | |

Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
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| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| JTENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 08.02.2022 | 4-80-335-83644 | 01 | OF | 02 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-EXTRACTION STEAM PIPING TO DEAERATING HEATER ( 80335)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 9 | 1-80-335-22879 | FITTING | SA234WPC | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1003/REV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-335-22879 | FITTING | SA234WPB | 508 | | | 1 | 167 | 38 | 60 | 0 | | | | | | | | |
| 10 | 1-80-335-22879 | PIPE | SA106GRB | OD | 6.35 | TIG & ARC | 6.35 V | ER70S-A1 | E7018-1 | | | 1003/REV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-335-22879 | FITTING | SA234WPB | 219.1 | | | 4 | 284 | 148 | 0 | 0 | | | | | | | | |
| 11 | 1-80-335-22879 | FITTING | SA234WPB | OD | 6.02 | TIG & ARC | 6.02 V | ER70S-A1 | E7018-1 | | | 1003/REV04 | 20 | NIL | NIL(NIL) | 10% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-335-22879 | FITTING | SA234WPB | 114.3 | | | 2 | 54 | 42 | 0 | 0 | | | | | | | | |
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Notes:
(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.
(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
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| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| JTENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 08.02.2022 | 4-80-335-83644 | 02 | OF | 02 | 00 |

# ERECTION/ FIELD WELDING SCHEDULE-EXTRACTION STEAM PIPING TO HPH-7 THROUGH DESH-7 ( 80336)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-336-23002 | PIPE | SA335P22 | OD | 19.05 | TIG & ARC | 19.05 | ER90S-B3 | E9018-B3 | | | 1014/R EV03 | 150 * | 700±20 | 2.5 Mts./mm (Min. 60 Mts. pipes) | 100% RT/UT + 100% MPT 3% HARDNESS | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-336-23002 | FITTING | SA234WP22 | 457 | | | 1 | 158 | 34 | 56 | 41 | | | | | | | | |
| 2 | 1-80-336-23002 | PIPE | SA335P22 | OD | 9.53 | TIG & ARC | 9.53 | ER90S-B3 | E9018-B3 | | | 1014/R EV03 | 150 * | 700±20 | 2.5 Mts./mm (Min. 60 Mts. pipes) | 100% RT/UT + 100% MPT 3% HARDNESS | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-336-23002 | FITTING | SA234WP22 | 355.6 | | | 33 | 3795 | 891 | 1353 | 0 | | | | | | | | |
| 3 | 1-80-336-23002 | FITTING | SA234WP22 | OD | 9.53 | TIG & ARC | 9.53 | ER90S-B3 | E9018-B3 | | | 1014/R EV03 | 150 * | 700±20 | 2.5 Mts./mm (Min. 60 Mts. pipes) | 100% RT/UT + 100% MPT 3% HARDNESS | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-336-23002 | PIPE | SA335P22 | 508 | | | 1 | 167 | 38 | 60 | 0 | | | | | | | | |
| 4 | 1-80-336-23002 | PIPE | SA335P22 | OD | 9.53 | TIG & ARC | 9.53 | ER90S-B3 | E9018-B3 | | | 1014/R EV03 | 150 * | 700±20 | 2.5 Mts./mm (Min. 60 Mts. pipes) | 100% RT/UT + 100% MPT 3% HARDNESS | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-336-23002 | VALVE | SA217WC9 | 355.6 | | | 6 | 690 | 162 | 246 | 0 | | | | | | | | |
| 5 | 1-80-336-23002 | FITTING | SA234WP22 | OD | 7.11 | TIG & ARC | 7.11 | ER90S-B3 | E9018-B3 | | | 1013/R EV02 | 150 | NIL | NIL(NIL) | 100% RT/UT + 100% MPT 3% HARDNESS | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-336-23002 | PIPE | SA335P22 | 168.3 | | | 4 | 212 | 60 | 44 | 0 | | | | | | | | |
| 6 | 1-80-336-23002 | FITTING | SA234WP22 | OD | 6.02 | TIG & ARC | 6.02 | ER90S-B3 | E9018-B3 | | | 1013/R EV02 | 150 | NIL | NIL(NIL) | 100% RT/UT + 100% MPT 3% HARDNESS | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-336-23002 | FITTING | SA234WP22 | 114.3 | | | 1 | 27 | 21 | 0 | 0 | | | | | | | | |
| 7 | 1-80-336-23002 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT/UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-336-23002 | FITTING | SA234WPB | 323.9 | | | 1 | 104 | 24 | 37 | 0 | | | | | | | | |
| 8 | 1-80-336-23002 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT/UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-336-23002 | FITTING | SA234WPB | 355.6 | | | 15 | 1725 | 405 | 615 | 0 | | | | | | | | |

Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

* Refer WPS for Preheat maintenance, Postheat, Interpass Temp. and Other Requirements.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
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| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| JITENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 08.02.2022 | 4-80-336-83903 | 01 | OF | 02 | 00 |

# ERECTION/ FIELD WELDING SCHEDULE-EXTRACTION STEAM PIPING TO HPH-7 THROUGH DESH-7 ( 80336)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 9 | 1-80-336-23002 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-336-23002 | FITTING | SA234WPB | 457.2 | | | 1 | 150 | 34 | 53 | 0 | | | | | | | | |
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# REF:ERECTION/ FIELD WELDING SCHEDULE-EXTRACTION PIPING FROM CRH TO HPH-8 (80337)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-337-22995 | PIPE | SA106GRC | OD | 15.09 | TIG & ARC | 15.09 | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-337-22995 | FITTING | SA234WPC | 355.6 | | | 13 | 1599 | 351 | 572 | 182 | | | | | | | | |
| 2 | 1-80-337-22995 | PIPE | SA106GRC | OD | 15.09 | TIG & ARC | 15.09 | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-337-22995 | VALVE | SA216WCC | 355.6 | | | 4 | 492 | 108 | 176 | 56 | | | | | | | | |
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| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
|---|---|---|---|---|---|---|---|
| | | Approved: | | | | Approved: | |

Notes:
(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.
(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| JTENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 08.02.2022 | 4-80-337-84998 | 01 | OF | 01 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-EXTRACTION STEAM PIPING TP HPH-9 ( 80338)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-338-22951 | PIPE | SA335P22 | OD | 15.09 | TIG & ARC | 15.09 | ER90S-B3 | E9018-B3 | | | 1014/R EV03 | 150 * | 700±20 | 2.5 Mts./mm (Min. 60 Mts. pipes) | 100% RT/ UT + 100% MPT 3% HARDNESS | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-338-22951 | FITTING | SA234WP22 | 273 | | | 28 | 2464 | 560 | 924 | 280 | | | | | | | | |
| 2 | 1-80-338-22951 | PIPE | SA335P22 | OD | 15.09 | TIG & ARC | 15.09 | ER90S-B3 | E9018-B3 | | | 1014/R EV03 | 150 * | 700±20 | 2.5 Mts./mm (Min. 60 Mts. pipes) | 100% RT/ UT + 100% MPT 3% HARDNESS | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-338-22951 | VALVE | SA217WC9 | 273 | | | 2 | 176 | 40 | 66 | 20 | | | | | | | | |
| 3 | 1-80-338-22951 | PIPE | SA335P22 | OD | 12.7 | TIG & ARC | 12.7 | ER90S-B3 | E9018-B3 | | | 1014/R EV03 | 150 * | 700±20 | 2.5 Mts./mm (Min. 60 Mts. pipes) | 100% RT/ UT + 100% MPT 3% HARDNESS | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-338-22951 | VALVE | SA217WC9 | 219.1 | | | 4 | 292 | 68 | 100 | 20 | | | | | | | | |
| 4 | 1-80-338-22951 | PIPE | SA335P22 | OD | 12.7 | TIG & ARC | 12.7 | ER90S-B3 | E9018-B3 | | | 1014/R EV03 | 150 * | 700±20 | 2.5 Mts./mm (Min. 60 Mts. pipes) | 100% RT/ UT + 100% MPT 3% HARDNESS | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-338-22951 | FITTING | SA234WP22 | 219.1 | | | 10 | 730 | 170 | 250 | 50 | | | | | | | | |
| 5 | 1-80-338-22951 | FITTING | SA234WP22 | OD | 10.97 | TIG & ARC | 10.97 | ER90S-B3 | E9018-B3 | | | 1014/R EV03 | 150 * | 700±20 | 2.5 Mts./mm (Min. 60 Mts. pipes) | 100% RT/ UT + 100% MPT 3% HARDNESS | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-338-22951 | FITTING | SA234WP22 | 168.3 | | | 4 | 204 | 60 | 92 | 0 | | | | | | | | |
| 6 | 1-80-338-22951 | PIPE | SA335P22 | OD | 8.6 | TIG & ARC | 8.6 | ER90S-B3 | E9018-B3 | | | 1014/R EV03 | 150 * | 700±20 | 2.5 Mts./mm (Min. 60 Mts. pipes) | 100% RT/ UT + 100% MPT 3% HARDNESS | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-338-22951 | PLATE | SA387GR22 | 114.3 | | | 4 | 101 | 44 | 36 | 0 | | | | | | | | |
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Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
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| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| JITENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 07.02.2022 | 4-80-338-83798 | 01 | OF | 01 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-AUX. STEAM TO BFP TURBINE ( 80339)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-339-22992 | PIPE | SA106GRB | OD | 6.35 | TIG & ARC | 6.35 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-339-22992 | FITTING | SA234WPB | 273.1 | | | 13 | 1391 | 312 | 221 | 0 | | | | | | | | |
| 2 | 1-80-339-22992 | FITTING | SA234WPB | OD | 7.11 | TIG & ARC | 7.11 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-339-22992 | VALVE | SA216WCB | 168.3 | | | 2 | 106 | 30 | 22 | 0 | | | | | | | | |
| 3 | 1-80-339-22992 | PIPE | SA106GRB | OD | 6.35 | TIG & ARC | 6.35 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-339-22992 | FITTING | SA234WPB | 219.1 | | | 16 | 1136 | 592 | 0 | 0 | | | | | | | | |
| 4 | 1-80-339-22992 | PIPE | SA106GRB | OD | 6.02 | TIG & ARC | 6.02 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-339-22992 | FITTING | SA234WPB | 114.3 | | | 2 | 54 | 42 | 0 | 0 | | | | | | | | |
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Notes:
(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.
(2) Drain & vent piping: 100% RT upto the last root valve. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
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| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| JITENDRA | I D B RAJU | SARAVAVAN C | | 07.02.2022 | 4-80-339-83887 | 01 | OF | 01 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-AUX. STEAM HEADER ( 80340)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 0-80-340-07599 | FITTING | SA234WPB | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1003/REV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 0-80-340-07599 | VALVE | SA216WCB | 457.2 | | | 1 | 150 | 34 | 53 | 0 | | | | | | | | |
| 2 | 0-80-340-07599 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1003/REV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 0-80-340-07599 | FITTING | SA234WPB | 457.2 | | | 12 | 1800 | 408 | 636 | 0 | | | | | | | | |
| 3 | 0-80-340-07599 | PIPE | SA106GRB | OD | 6.35 | TIG & ARC | 6.35 V | ER70S-A1 | E7018-1 | | | 1003/REV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 0-80-340-07599 | FITTING | SA234WPB | 273 | | | 2 | 178 | 40 | 22 | 0 | | | | | | | | |
| 4 | 0-80-340-07599 | PIPE | SA106GRB | OD | 6.35 | TIG & ARC | 6.35 V | ER70S-A1 | E7018-1 | | | 1003/REV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 0-80-340-07599 | VALVE | SA216WCB | 273 | | | 2 | 178 | 40 | 22 | 0 | | | | | | | | |
| 5 | 0-80-340-07599 | PIPE | SA106GRB | OD | 6.35 | TIG & ARC | 6.35 V | ER70S-A1 | E7018-1 | | | 1003/REV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 0-80-340-07599 | FITTING | SA234WPB | 219.1 | | | 3 | 213 | 111 | 0 | 0 | | | | | | | | |
| 6 | 0-80-340-07599 | PIPE | SA106GRB | OD | 6.02 | TIG & ARC | 6.02 V | ER70S-A1 | E7018-1 | | | 1003/REV04 | 20 | NIL | NIL(NIL) | 10% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 0-80-340-07599 | FITTING | SA234WPB | 114.3 | | | 4 | 107 | 84 | 0 | 0 | | | | | | | | |
| 7 | 0-80-340-07599 | PIPE | SA106GRB | OD | 6.02 | TIG & ARC | 6.02 V | ER70S-A1 | E7018-1 | | | 1003/REV04 | 20 | NIL | NIL(NIL) | 10% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 0-80-340-07599 | VALVE | SA216WCB | 114.3 | | | 4 | 107 | 84 | 0 | 0 | | | | | | | | |
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Notes:
(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.
(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
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| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| JTENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 09.02.2022 | 4-80-340-83915 | 01 | OF | 01 | 00 |

# REFERENCE ERECTION/ FIELD WELDING SCHEDULE-AUX STEAM TO SCAPH ( 80342)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.Sno. | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.15 | Dia4.0 | | | | | |
| 1 | 1-80-342-22712 | PIPE | SA106GRB | OD | 8.18 | TIG & ARC | 8.18 V | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | As per Site FQP | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPB | 219.1 | | | 35 | 1780 | 875 | 0 | 0 | | | | | |
| 2 | 1-80-342-22712 | PIPE | SA106GRB | OD | 7.11 | TIG & ARC | 7.11 V | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | As per Site FQP | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPB | 168.3 | | | 40 | 1600 | 450 | 0 | 0 | | | | | |
| 3 | 1-80-342-22712 | PIPE | SA106GRB | OD | 6.02 | TIG & ARC | 6.02 V | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | As per Site FQP | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPB | 114.3 | | | 50 | 1340 | 350 | 0 | 0 | | | | | |
| 4 | 2-80-342-16101 | PIPE | SA106GRB | OD | 7.11 | TIG & ARC | 7.11 V | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | As per Site FQP | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPB | 168.3 | | | 30 | 1200 | 350 | 0 | 0 | | | | | |
| 5 | 2-80-342-16101 | PIPE | SA106GRB | OD | 6.02 | TIG & ARC | 6.02 V | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | As per Site FQP | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | PIPE | SA106GRB | 114.3 | | | 50 | 1340 | 350 | 0 | 0 | | | | | |
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Notes:

(1) REFER DOC NO: AA/ CQ/ GL/ 011 (Latest Revision) - MANUAL FOR WELDING, HEAT TREATMENT AND NON DESTRUCTIVE TESTING FOR POWER SECTOR"

| Rev.no. | Date: | Altered: | |
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| Rev.no. | Date: | Altered: | |
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| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| B.B.GHADAI | IDB RAJU | SARAVANAN | NANTHINI | 30.06.2021 | 4-80-342-83205 | 01 | OF | 01 | 00 |

# REFERENCE-ERECTION/ FIELD WELDING SCHEDULE-AUX STEAM TO AH SOOT BLOWERS ( 80343)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.15 | Dia4.0 | | | | | |
| 1 | 1-80-343-22699 | PIPE | SA106GRB | OD | 7.11 | TIG & ARC | 7.11 V | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | As per Site FQP | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPB | 168.3 | | | 42 | 1680 | 480 | 0 | 0 | | | | | |
| 2 | 1-80-343-22699 | PIPE | SA106GRB | OD | 7.11 | TIG & ARC | 7.11 V | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | As per Site FQP | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPB | 141.3 | | | 2 | 60 | 20 | 0 | 0 | | | | | |
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Notes:

(1) REFER DOC NO: AA/ CQ/ GL/ 011 (Latest Revision) - MANUAL FOR WELDING, HEAT TREATMENT AND NON DESTRUCTIVE TESTING FOR POWER SECTOR"

| Rev.no. | Date: | Altered: | |
|---|---|---|---|
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| Rev.no. | Date: | Altered: | |
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| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| B.B.GHADAI | IDB RAJU | SARAVANAN | NANTHINI | 30.06.2021 | 4-80-343-83147 | 01 | OF | 01 | 00 |

# REFERENCE-ERECTION/ FIELD WELDING SCHEDULE-AUX STEAM TO FO SYSTEM TP ( 80344)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions ID/ OD | Thick | Process of Welding | Type of weld | Electrode filler spec. TIG | Arc spec | | | W.P.S no. | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.15 | Dia4.0 | | | | | |
| 1 | 2-80-344-16063 | PIPE | SA106GRB | OD | 6.35 | TIG & ARC | 6.35 V | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | As per Site FQP | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPB | 273 | | | 130 | 8400 | 2500 | 0 | 0 | | | | | |
| 2 | 2-80-344-16063 | PIPE | SA106GRB | OD | 6.35 | ARC | 6.35 ◺ | ER70S-A1 | E7018-1 | | | 1101/ Rev 01 | As per Site FQP | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FORGING | SA105 | 33.4 | | | 130 | 0 | 2000 | 0 | 0 | | | | | |
| | | | | | | | V | | | | | | | | | |
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Notes:
(1) REFER DOC NO: AA/CQ/GL/011 (Latest Revision) - MANUAL FOR WELDING, HEAT TREATMENT AND NON DESTRUCTIVE TESTING FOR POWER SECTOR'

| Rev.no. | Date: | Altered: / Approved: | Rev.no. | Date: | Altered: / Approved: |
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| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| B.B.GHADAI | IDB RAJU | SARAVANAN | NANTHINI | 29.06.2021 | 4-80-344-83178 | 01 | OF | 01 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-AUX. STEAM TO DEAERATOR ( 80345)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-345-22917 | PIPE | SA106GRB | OD | 6.35 | TIG & ARC | 6.35 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-345-22917 | FITTING | SA234WPB | 219.1 | | | 24 | 1704 | 888 | 0 | 0 | | | | | | | | |
| 2 | 1-80-345-22917 | PIPE | SA106GRB | OD | 6.35 | TIG & ARC | 6.35 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-345-22917 | VALVE | SA216WCB | 219.1 | | | 4 | 284 | 148 | 0 | 0 | | | | | | | | |
| 3 | 1-80-345-22917 | PIPE | SA106GRB | OD | 7.11 | TIG & ARC | 7.11 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-345-22917 | FITTING | SA234WPB | 168.3 | | | 9 | 477 | 135 | 99 | 0 | | | | | | | | |
| 4 | 1-80-345-22917 | PIPE | SA106GRB | OD | 7.11 | TIG & ARC | 7.11 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-345-22917 | VALVE | SA216WCB | 168.3 | | | 4 | 212 | 60 | 44 | 0 | | | | | | | | |
| 5 | 1-80-345-22917 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-345-22917 | FITTING | SA234WPB | 355.6 | | | 2 | 230 | 54 | 82 | 0 | | | | | | | | |
| 6 | 1-80-345-22917 | PIPE | SA335P11 | OD | 6.35 | TIG & ARC | 6.35 V | ER70S-A1 | E7018-1 | | | 1017/R EV04 | 150 | NIL | NIL | 100% RT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-345-22917 | FITTING | SA234WPB | 273.1 | | | 1 | 107 | 24 | 17 | 0 | | | | | | | | |
| 7 | 1-80-345-22917 | PIPE | SA335P11 | OD | 6.35 | TIG & ARC | 6.35 V | ER80S-B2 | E8018-B2 | | | 1011/R EV01 | 150 | NIL | NIL(NIL) | 100% RT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-345-22917 | VALVE | SA217WC9 | 273.1 | | | 1 | 107 | 24 | 17 | 0 | | | | | | | | |
| 8 | 1-80-345-22917 | PIPE | SA335P11 | OD | 9.53 | TIG & ARC | 9.53 V | ER80S-B2 | E8018-B2 | | | 1012/R EV04 | 150 | 700±20 | 2.5(60 MINUTES MINIMUM) | 100% RT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-345-22917 | VALVE | SA217WC9 | 406.4 | | | 1 | 132 | 30 | 47 | 0 | | | | | | | | |

Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
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| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| JTENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 09.02.2022 | 4-80-345-8376 | 01 | OF | 02 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-AUX. STEAM TO DEAERATOR ( 80345)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 9 | 1-80-345-22917 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1017/ REV04 | 150 | NIL | NIL | 100% RT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-345-22917 | PIPE | SA335P11 | 406.4 | | | 24 | 3168 | 720 | 1128 | 0 | | | | | | | | |
| 10 | 1-80-345-22917 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-345-22917 | FITTING | SA234WPB | 406.4 | | | 7 | 924 | 210 | 329 | 0 | | | | | | | | |
| 11 | 1-80-345-22917 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-345-22917 | VALVE | SA216WCB | 406.4 | | | 3 | 396 | 90 | 141 | 0 | | | | | | | | |
| 12 | 1-80-345-22917 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-345-22917 | VALVE | SA216WCB | 406.4 | | | 1 | 132 | 30 | 47 | 0 | | | | | | | | |
| 13 | 1-80-345-22917 | PIPE | SA106GRB | OD | 12.7 | TIG & ARC | 12.7 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-345-22917 | FITTING | SA234WPB | 406.4 | | | 1 | 143 | 30 | 50 | 10 | | | | | | | | |
| 14 | 1-80-345-22917 | FITTING | SA234WPB | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-345-22917 | FITTING | SA234WPB | 762 | | | 1 | 258 | 59 | 93 | 0 | | | | | | | | |
| 15 | 1-80-345-22917 | PIPE | SA106GRB | OD | 6.35 | TIG & ARC | 6.35 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-345-22917 | FITTING | SA234WPB | 219.1 | | | 2 | 142 | 74 | 0 | 0 | | | | | | | | |
| 16 | 1-80-345-22917 | PIPE | SA106GRB | OD | 6.02 | TIG & ARC | 6.02 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-345-22917 | FITTING | SA234WPB | 114.3 | | | 2 | 54 | 42 | 0 | 0 | | | | | | | | |

Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
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| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| JITENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 09.02.2022 | 4-80-345-8376 | 02 | OF | 02 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-AUXILIARY STEAM TO TURBINE GLAND SEALING ( 80349)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-349-22835 | PIPE | SA106GRB | OD | 5.49 | TIG & ARC | 5.49 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-349-22835 | FITTING | SA234WPB | 88.9 | | | 33 | 647 | 495 | 0 | 0 | | | | | | | | |
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Notes:
(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.
(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
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| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| JTENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 08.02.2022 | 4-80-349-83578 | 01 | OF | 01 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-AUX STEAM TO MILL INERTING ( 80351)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-351-22692 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-351-22692 | FITTING | SA234WPB | 355.6 | | | 10 | 1150 | 270 | 410 | 0 | | | | | | | | |
| 2 | 1-80-351-22692 | FITTING | SA234WPB | OD | 9.53 | TIG & ARC | 9.53 | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-351-22692 | VALVE | SA216WCB | 355.6 | | | 1 | 115 | 27 | 41 | 0 | | | | | | | | |
| 3 | 1-80-351-22692 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-351-22692 | FITTING | SA234WPB | 323.6 | | | 61 | 6344 | 1464 | 2257 | 0 | | | | | | | | |
| 4 | 1-80-351-22692 | PIPE | SA106GRB | OD | 8.18 | TIG & ARC | 8.18 | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-351-22692 | VALVE | SA216WCB | 219.1 | | | 16 | 1120 | 272 | 288 | 0 | | | | | | | | |
| 5 | 1-80-351-22692 | PIPE | SA106GRB | OD | 8.18 | TIG & ARC | 8.18 | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-351-22692 | FITTING | SA234WPB | 219.1 | | | 38 | 2660 | 646 | 684 | 0 | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
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Notes:
(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.
(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
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| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| JITENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 09.02.222 | 4-80-351-83110 | 01 | OF | 01 | 00 |

# REF;ERECTION/ FIELD WELDING SCHEDULE-BFPT-A& B RUPTURE DISC EXHAUST PIPING;BFPT EXHAUST TO CONDENSER ( 80363)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-363-23212 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-363-23212 | FITTING | SA234WPB | 323.9 | | | 10 | 1040 | 240 | 370 | 0 | | | | | | | | |
| 2 | 1-80-363-23212 | PIPE | SA106GRB | OD | 10 | ARC | 10 | | E7018-1 | | | 1021/ REV02 | 20 | NIL | NIL(NIL) | 10% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-363-23212 | FITTING | SA234WPB | 323.9 | | | 8 | | 0 | 151 | 0 | | | | | | | | |
| 3 | 0-80-363-07530 | PIPE | SA515GR70 | OD | 16 | TIG & ARC | 16 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 0-80-363-07530 | BEND | SA515GR70 | 2032 | | | 4 | 2946 | 622 | 1022 | 341 | | | | | | | | |
| 4 | 0-80-363-07530 | PIPE/ BEND | SA515GR70 | OD | 16 | TIG & ARC | 16 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 0-80-363-07530 | BELLOW | SA515GR70 | 2032 | | | 12 | 8836 | 1865 | 3064 | 1022 | | | | | | | | |
| 5 | 0-80-363-07530 | PIPE | SA515GR70 | OD | 16 | TIG & ARC | 16 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 0-80-363-07530 | VALVE | SA216WCB | 2032 | | | 4 | 2946 | 622 | 1022 | 341 | | | | | | | | |
| 6 | 0-80-363-07530 | PIPE | SA515GR70 | OD | 16 | TIG & ARC | 16 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 0-80-363-07530 | NOZZLE | SA515GR70 | 2032 | | | 2 | 1473 | 311 | 511 | 171 | | | | | | | | |
| 7 | 0-80-363-07530 | BEND | SA515GR70 | OD | 7 | ARC | 7 | | E7018-1 | | | 1021/ REV02 | 20 | NIL | NIL(NIL) | 10% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 0-80-363-07530 | BEND | SA515GR70 | 2032 | | | 4 | | 510 | 0 | 0 | | | | | | | | |
| 8 | 0-80-363-07530 | BEND | SA515GR70 | OD | 10 | ARC | 10 | | E7018-1 | | | 1021/ REV02 | 20 | NIL | NIL(NIL) | 10% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 0-80-363-07530 | BEND | SA515GR70 | 2032 | | | 4 | | 0 | 485 | 0 | | | | | | | | |

Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
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| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| JTENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 10.02.2022 | 4-80-363-83319 | 01 | OF | 01 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-UNIT FLASH TANK VENT TO ATMOSPHERE ;UNIT FLASH TANK DRAIN TO WASTE ( 80371)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 2-80-371-16342 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 2-80-371-16342 | FITTING | SA234WPB | 406.4 | | | 6 | 792 | 180 | 282 | 0 | | | | | | | | |
| 2 | 2-80-371-16343 | PIPE | SA106GRB | OD | 6.35 | TIG & ARC | 6.35 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 2-80-371-16343 | FITTING | SA234WPB | 219.1 | | | 11 | 781 | 407 | 0 | 0 | | | | | | | | |
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Notes:
(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.
(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
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| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| JTENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 10.02.2022 | 4-80-371-83757 | 01 | OF | 01 | 00 |

# ERECTION/ FIELD WELDING SCHEDULE-AUX STEAM HEADERS SAFETY VALVE EXHAUST TO ATMOSPHERE ( 80373)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-373-22878 | PIPE | SA106GRB | OD | 6.35 | TIG & ARC | 6.35 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-373-22878 | FITTING | SA234WPB | 273 | | | 8 | 712 | 160 | 88 | 0 | | | | | | | | |
| 2 | 1-80-373-22878 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-373-22878 | FITTING | SA234WPB | 355.6 | | | 16 | 1840 | 432 | 656 | 0 | | | | | | | | |
| 3 | 1-80-373-22878 | PIPE | SA106GRB | OD | 3 | ARC | 3 ◺ | | E7018-1 | | | 1021/ REV02 | 20 | NIL | NIL(NIL) | 10% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-373-22878 | DRIP PAN ASSY | SA515GR70 | 273 | | | 4 | | 14 | 0 | 0 | | | | | | | | |
| 4 | 1-80-373-22878 | PIPE | SA106GRB | OD | 7 | ARC | 7 ◺ | | E7018-1 | | | 1021/ REV02 | 20 | NIL | NIL(NIL) | 10% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-373-22878 | FLANGE | SA515GR70 | 273 | | | 4 | | 68 | 0 | 0 | | | | | | | | |
| 5 | 1-80-373-22878 | PIPE | SA106GRB | OD | 8 | ARC | 8 ◺ | | E7018-1 | | | 1021/ REV02 | 20 | NIL | NIL(NIL) | 10% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-373-22878 | FLANGE | SA515GR70 | 273 | | | 4 | | 34 | 28 | 0 | | | | | | | | |
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Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
|---|---|---|---|---|---|---|---|
| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| JTENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 11.02.2022 | 4-80-373-83626 | 01 | OF | 01 | 00 |

# ERECTION/ FIELD WELDING SCHEDULE-SAFETY VALVE ESCAPE PIPING OF EXTRACTION LINE TO TDBFP ( 80375)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-375-22918 | PIPE | SA106GRB | OD | 6.35 | TIG & ARC | 6.35 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-375-22918 | FITTING | SA234WPB | 273 | | | 4 | 356 | 80 | 44 | 0 | | | | | | | | |
| 2 | 1-80-375-22918 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-375-22918 | FITTING | SA234WPB | 355.6 | | | 14 | 1610 | 378 | 574 | 0 | | | | | | | | |
| 3 | 1-80-375-22918 | PIPE | SA106GRB | OD | 6.35 | TIG & ARC | 6.35 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-375-22918 | FITTING | SA234WPB | 219.1 | | | 2 | 142 | 74 | 0 | 0 | | | | | | | | |
| 4 | 1-80-375-22918 | PIPE | SA106GRB | OD | 7 | ARC | 7 ◺ | | E7018-1 | | | 1021/R EV02 | 20 | NIL | NIL(NIL) | 10% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-375-22918 | FLANGE | SA515GR70 | 219.1 | | | 2 | | 28 | 0 | 0 | | | | | | | | |
| 5 | 1-80-375-22918 | PIPE | SA106GRB | OD | 10 | ARC | 10 ◺ | | E7018-1 | | | 1021/R EV02 | 20 | NIL | NIL(NIL) | 10% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-375-22918 | FLANGE | SA515GR70 | 219.1 | | | 2 | | 0 | 27 | 0 | | | | | | | | |
| 6 | 1-80-375-22918 | PIPE | SA106GRB | OD | 6 | ARC | 6 ◺ | | E7018-1 | | | 1021/R EV02 | 20 | NIL | NIL(NIL) | 10% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-375-22918 | FLANGE | SA515GR70 | 273 | | | 2 | | 26 | 0 | 0 | | | | | | | | |
| 7 | 1-80-375-22918 | PIPE | SA106GRB | OD | 7 | ARC | 7 ◺ | | E7018-1 | | | 1021/R EV02 | 20 | NIL | NIL(NIL) | 10% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-375-22918 | FLANGE | SA515GR70 | 273 | | | 2 | | 34 | 0 | 0 | | | | | | | | |
| 8 | 1-80-375-22918 | PIPE | SA106GRB | OD | 3 | ARC | 3 ◺ | | E7018-1 | | | 1021/R EV02 | 20 | NIL | NIL(NIL) | 10% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-375-22918 | DRIP PAN ASSY | SA515GR70 | 273 | | | 2 | | 7 | 0 | 0 | | | | | | | | |

Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
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| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| JITENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 11.02.2022 | 4-80-375-83763 | 01 | OF | 01 | 00 |

# ERECTION/ FIELD WELDING SCHEDULE-HP HEATER VENTS - TG SCOPE ( 80381)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | | PIPE | SA106GRB | OD | 4.55 | TIG & ARC | 4.55 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | | PIPE | SA106GRB | 33.4 | | | 20 | 128 | 100 | 0 | 0 | | | | | | | | |
| 2 | | PIPE | SA106GRB | OD | 5.54 | TIG & ARC | 5.54 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | | PIPE | SA106GRB | 60.3 | | | 100 | 1260 | 1000 | 0 | 0 | | | | | | | | |
| 3 | | PIPE | SA106GRB | OD | 4.55 | ARC | 5 ◺ | | E7018-1 | | | 1021/ REV02 | 20 | NIL | NIL(NIL) | 10% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | | FITTINGS | SA105 | 33.4 | | | 47 | | 48 | 0 | 0 | | | | | | | | |
| 4 | | PIPE | SA106GRB | OD | 5.54 | ARC | 6 ◺ | | E7018-1 | | | 1021/ REV02 | 20 | NIL | NIL(NIL) | 10% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | | FITTINGS | SA105 | 60.3 | | | 114 | | 296 | 0 | 0 | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
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Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for Butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
|---|---|---|---|---|---|---|---|
| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| JTENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 19.03.2022 | 4-80-381-84552 | 01 | OF | 01 | 00 |

REF:ERECTION/ FIELD WELDING SCHEDULE GSC EMERGENCY EXHAUST TO ATMOSPHERE;START UP VENT FROM EXTN. STEAM TO BFPT A&B ( 80385)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-385-22925 | FITTING | SA234WPB | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1003/REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-385-22925 | VALVE | SA216WCB | 323.9 | | | 1 | 104 | 24 | 37 | 0 | | | | | | | | |
| 2 | 1-80-385-22925 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1003/REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-385-22925 | FITTING | SA234WPB | 355.6 | | | 17 | 1955 | 459 | 697 | 0 | | | | | | | | |
| 3 | 1-80-385-23226 | PIPE | SA106GRB | OD | 7.11 | TIG & ARC | 7.11 V | ER70S-A1 | E7018-1 | | | 1003/REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-385-23226 | FITTING | SA234WPB | 168.3 | | | 19 | 1007 | 285 | 209 | 0 | | | | | | | | |
| 4 | 1-80-385-23226 | FITTING | SA234WPB | OD | 5.54 | TIG & ARC | 5.54 V | ER70S-A1 | E7018-1 | | | 1003/REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-385-23226 | VALVE | SA105 | 60.3 | | | 4 | 51 | 40 | 0 | 0 | | | | | | | | |
| 5 | 1-80-385-23226 | PIPE | SA106GRB | OD | 5.54 | TIG & ARC | 5.54 V | ER70S-A1 | E7018-1 | | | 1003/REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-385-23226 | FITTING | SA234WPB | 60.3 | | | 25 | 315 | 250 | 0 | 0 | | | | | | | | |
| 6 | 1-80-385-23226 | PIPE | SA106GRB | OD | 6 | ARC | 6 ◺ | | E7018-1 | | | 1021/REV02 | 20 | NIL | NIL(NIL) | 10% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-385-23226 | STUB | SA105 | 60.3 | | | 2 | | 6 | 0 | 0 | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |

Notes:
(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.
(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
|---|---|---|---|---|---|---|---|
| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| JTENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 11.01.2022 | 4-80-385-83770 | 01 | OF | 01 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-CONDENSER AIR EVACUATION PIPING ( 80388)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-388-23137 | PIPE | SA106GRB | OD | 6.53 | TIG & ARC | 6.53 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-388-23137 | FITTING | SA234WPB | 219.1 | | | 69 | 4899 | 2553 | 0 | 0 | | | | | | | | |
| 2 | 1-80-388-23137 | PIPE | SA106GRB | OD | 6.53 | TIG & ARC | 6.53 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-388-23137 | VALVE | SA216WCB | 219.1 | | | 16 | 1136 | 592 | 0 | 0 | | | | | | | | |
| 3 | 1-80-388-23137 | PIPE | SA106GRB | OD | 6.35 | TIG & ARC | 6.35 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-388-23137 | FITTING | SA234WPB | 273 | | | 17 | 1513 | 340 | 187 | 0 | | | | | | | | |
| 4 | 1-80-388-23137 | PIPE | SA106GRB | OD | 7 | ARC | 7 ◺ | | E7018-1 | | | 1021/R EV02 | 20 | NIL | NIL(NIL) | 10% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-388-23137 | FLANGE | SA515GR70 | 219.1 | | | 4 | | 54 | 0 | 0 | | | | | | | | |
| 5 | 1-80-388-23137 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-388-23137 | FITTING | SA234WPB | 323.9 | | | 27 | 2808 | 648 | 999 | 0 | | | | | | | | |
| 6 | 1-80-388-23137 | PIPE | SA106GRB | OD | 6.35 | TIG & ARC | 6.35 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-388-23137 | FITTING | SA234WPC | 273 | | | 14 | 1246 | 280 | 154 | 0 | | | | | | | | |
| 7 | 1-80-388-23137 | PIPE | SA106GRB | OD | 8 | ARC | 8 ◺ | | E7018-1 | | | 1021/R EV02 | 20 | NIL | NIL(NIL) | 10% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-388-23137 | FLANGE | SA515GR70 | 219.1 | | | 4 | | 27 | 22 | 0 | | | | | | | | |
| 8 | 1-80-388-23137 | FITTING | SA234WPB | OD | 7.11 | TIG & ARC | 7.11 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-388-23137 | FITTING | SA234WPB | 168.3 | | | 8 | 424 | 120 | 88 | 0 | | | | | | | | |

Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
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| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| JTENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 11.01.2022 | 4-80-388-84032 | 01 | OF | 01 | 00 |

# REFERENCE - ERECTION/ FIELD WELDING SCHEDULE-CONDENSATE SUCTION (80400)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.15 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-400-22770 | PIPE | SA672GRB70 | OD | 10 | TIG & ARC | 10 | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | 20 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPB | 660 | | | 15 | 2200 | 1000 | 440 | 0 | | | | | | | | |
| 2 | 1-80-400-22770 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | 20 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPB | 508 | | | 20 | 2300 | 1000 | 350 | 0 | | | | | | | | |
| 3 | 1-80-400-22770 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | 20 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPB | 323.9 | | | 15 | 1150 | 480 | 180 | 0 | | | | | | | | |
| 4 | 1-80-400-22770 | PIPE | SA106GRB | OD | 5.54 | TIG & ARC | 5.54 | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | 20 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPB | 60.3 | | | 10 | 150 | 40 | 0 | 0 | | | | | | | | |
| 5 | 1-80-400-22770 | PIPE | SA106GRB | OD | 4.55 | TIG & ARC | 4.55 | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | 20 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | PIPE | SA106GRB | 33.4 | | | 10 | 80 | 10 | 0 | 0 | | | | | | | | |
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Notes:

(1) REFER DOC NO: AA/ CQ/ GL/ 011 (Latest Revision) - MANUAL FOR WELDING, HEAT TREATMENT AND NON DESTRUCTIVE TESTING FOR POWER SECTOR"

| Rev.no. | Date: | Altered: | BB GHADAI |
|---|---|---|---|
| 01 | 08.09.2021 | Approved: | IDB RAJU |

| Rev.no. | Date: | Altered: | |
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| | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| B.B.GHADAI | IDB RAJU | SARAVANAN | NANTHINI | 28.06.2021 | 4-80-400-83385 | 01 | OF | 01 | 01 |

# REFERENCE-ERECTION/ FIELD WELDING SCHEDULE-CD FROM PUMP TO LPH1/ DC INLET TEE AND RE (80 401)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.15 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-401-22869 | PIPE | SA106GRC | OD | 12.7 | TIG & ARC | 12.7 | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | 20 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 457.2 | | | 50 | 5100 | 2250 | 1000 | 1000 | | | | | | | | |
| 2 | 1-80-401-22869 | PIPE | SA106GRC | OD | 9.53 | TIG & ARC | 9.53 | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | 20 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 323.9 | | | 15 | 1100 | 470 | 180 | 0 | | | | | | | | |
| 3 | 1-80-401-22869 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | 20 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPB | 323.9 | | | 45 | 3320 | 1450 | 520 | 0 | | | | | | | | |
| 4 | 1-80-401-22869 | PIPE | SA106GRB | OD | 5.49 | TIG & ARC | 5.49 | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | 20 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPB | 88.9 | | | 25 | 550 | 110 | 0 | 0 | | | | | | | | |
| 5 | 1-80-401-22877 | PIPE | SA106GRC | OD | 12.7 | TIG & ARC | 12.7 | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | 20 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 457.2 | | | 50 | 4900 | 2200 | 950 | 900 | | | | | | | | |
| 6 | 1-80-401-22877 | PIPE | SA106GRB | OD | 12.7 | TIG & ARC | 12.7 | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPB | 406.4 | | | 15 | 1350 | 585 | 250 | 230 | | | | | | | | |
| 7 | 1-80-401-22877 | FITTING | SA234WPC | OD | 9.53 | TIG & ARC | 9.53 | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 355.6 | | | 5 | 430 | 180 | 80 | 0 | | | | | | | | |
| 8 | 1-80-401-22877 | PIPE | SA106GRB | OD | 6.02 | TIG & ARC | 6.02 | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | PIPE | SA106GRB | 114.3 | | | 5 | 150 | 40 | 0 | 0 | | | | | | | | |

Notes:

(1) REFER DOC NO: AA/ CQ/ GL/ 011 (Latest Revision) - MANUAL FOR WELDING, HEAT TREATMENT AND NON DESTRUCTIVE TESTING FOR POWER SECTOR"

| Rev.no. | Date: | Altered: | BB GHADAI |
|---|---|---|---|
| 01 | 08.09.2021 | Approved: | IDB RAJU |

| Rev.no. | Date: | Altered: | |
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| | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| B.B.GHADAI | IDB RAJU | SARAVANAN | NANTHINI | 29.06.2021 | 4-80-401-83624 | 01 | OF | 02 | 01 |

# REFERENCE-ERECTION/ FIELD WELDING SCHEDULE-CD FROM PUMP TO LPH1/ DC INLET TEE AND RE ( 80401)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.15 | Dia4.0 | | in deg C | in deg C | minutes | | | | |
| 9 | 1-80-401-22880 | PIPE | SA106GRC | OD | 12.7 | TIG & ARC | 12.7 | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | 20 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 457.2 | | | 22 | 2200 | 980 | 400 | 380 | | | | | | | | |
| 10 | 1-80-401-22881 | PIPE | SA106GRC | OD | 12.7 | TIG & ARC | 12.7 | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | 20 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 457.2 | | | 22 | 2200 | 980 | 400 | 380 | | | | | | | | |
| 11 | 1-80-401-22882 | PIPE | SA106GRC | OD | 12.7 | TIG & ARC | 12.7 | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | 20 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 457.2 | | | 35 | 3450 | 1550 | 650 | 600 | | | | | | | | |
| 12 | 1-80-401-22882 | PIPE | SA106GRB | OD | 12.7 | TIG & ARC | 12.7 | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | 20 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPB | 406.4 | | | 30 | 2650 | 1180 | 490 | 450 | | | | | | | | |
| 13 | 1-80-401-23218 | PIPE | SA106GRB | OD | 7.11 | TIG & ARC | 7.11 | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | 20 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPB | 168.3 | | | 33 | 1300 | 370 | 0 | 0 | | | | | | | | |
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Notes:

(1) REFER DOC NO: AA/ CQ/ GL/ 011 (Latest Revision) - MANUAL FOR WELDING, HEAT TREATMENT AND NON DESTRUCTIVE TESTING FOR POWER SECTOR"

| Rev.no. | Date: | Altered: | BB GHADAI |
|---|---|---|---|
| 01 | 08.09.2021 | Approved: | IDB RAJU |

| Rev.no. | Date: | Altered: | |
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| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| B.B.GHADAI | IDB RAJU | SARAVANAN | NANTHINI | 29.06.2021 | 4-80-401-83624 | 02 | OF | 02 | 01 |

# REFERENCE-ERECTION/ FIELD WELDING SCHEDULE-CD FROM LPH1/ DC INLET TEE TO TG TP (80402)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.15 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-402-22884-00 | PIPE | SA106GRC | OD | 12.7 | TIG & ARC | 12.7 V | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | 20 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 457.2 | | | 42 | 4150 | 1860 | 770 | 740 | | | | | | | | |
| 2 | 1-80-402-22884-00 | PIPE | SA106GRB | OD | 12.7 | TIG & ARC | 12.7 V | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | 20 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPB | 406.4 | | | 22 | 1950 | 860 | 360 | 350 | | | | | | | | |
| 3 | 1-80-402-22885-00 | PIPE | SA106GRC | OD | 12.7 | TIG & ARC | 12.7 V | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | 20 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 457.2 | | | 25 | 2500 | 1100 | 450 | 425 | | | | | | | | |
| 4 | 1-80-402-22885-00 | PIPE | SA106GRB | OD | 12.7 | TIG & ARC | 12.7 V | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | 20 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPB | 406.4 | | | 10 | 900 | 400 | 170 | 150 | | | | | | | | |
| | | | | | | | V | | | | | | | | | | | | |
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Notes:

(1) REFER DOC NO: AA/ CQ/ GL/ 011 (Latest Revision) - MANUAL FOR WELDING, HEAT TREATMENT AND NON DESTRUCTIVE TESTING FOR POWER SECTOR'

| Rev.no. | Date: | Altered: | BB GHADAI |
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| 01 | 08.09.2021 | Approved: | IDB RAJU |

| Rev.no. | Date: | Altered: | |
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| | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| B.B.GHADAI | IDB RAJU | SARAVANAN | NANTHINI | 28.06.2021 | 4-80-402-83635 | 01 | OF | 01 | 01 |

# REFERENCE-ERECTION/ FIELD WELDING SCHEDULE-CD FROM TG TP TO DEAERATING HEATER (80 403)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.15 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-403-22886 | PIPE | SA106GRC | OD | 12.7 | TIG & ARC | 12.7 V | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | 20 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 457.2 | | | 40 | 4000 | 1780 | 750 | 700 | | | | | | | | |
| 2 | 1-80-403-22886 | PIPE | SA106GRB | OD | 12.7 | TIG & ARC | 12.7 V | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | 20 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPB | 406.2 | | | 16 | 1450 | 650 | 280 | 250 | | | | | | | | |
| | | | | | | | V | | | | | | | | | | | | |
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Notes:

(1) REFER DOC NO: AA/ CQ/ GL/ 011 (Latest Revision) - MANUAL FOR WELDING, HEAT TREATMENT AND NON DESTRUCTIVE TESTING FOR POWER SECTOR"

| Rev.no. | Date: | Altered: | BB GHADAI |
|---|---|---|---|
| 01 | 08.09.2021 | Approved: | IDB RAJU |

| Rev.no. | Date: | Altered: | |
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| | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | REV. NO. |
|---|---|---|---|---|---|---|---|---|
| B.B.GHADAI | IDB RAJU | SARAVANAN | NANTHINI | 28.06.2021 | 4-80-403-83634 | 01 | OF | 01 | 01 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-CONDENSATE FOR SEALING OF VACUUM (80407)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | | PIPE | SA106GRB | OD | 3.73 | TIG & ARC | 3.73 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | | PIPE | SA106GRB | 21.3 | | | 110 | 1485 | 0 | 0 | 0 | | | | | | | | |
| 2 | | PIPE | SA106GRB | OD | 4.55 | TIG & ARC | 4.55 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | | PIPE | SA106GRB | 33.4 | | | 130 | 832 | 650 | 0 | 0 | | | | | | | | |
| 3 | | PIPE | SA106GRB | OD | 5.54 | TIG & ARC | 5.54 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | | PIPE | SA106GRB | 60.3 | | | 60 | 756 | 600 | 0 | 0 | | | | | | | | |
| 4 | | PIPE | SA106GRB | OD | 6.02 | TIG & ARC | 6.02 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | | PIPE | SA106GRB | 114.3 | | | 5 | 133 | 105 | 0 | 0 | | | | | | | | |
| 5 | | PIPE | SA106GRB | OD | 3.73 | ARC | 4 ◺ | | E7018-1 | | | 1021/ REV02 | 20 | NIL | NIL(NIL) | 10% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | | FITTINGS | SA105 | 21.3 | | | 260 | | 101 | 0 | 0 | | | | | | | | |
| 6 | | PIPE | SA106GRB | OD | 4.55 | ARC | 5 ◺ | | E7018-1 | | | 1021/ REV02 | 20 | NIL | NIL(NIL) | 10% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | | FITTINGS | SA105 | 33.4 | | | 370 | | 370 | 0 | 0 | | | | | | | | |
| 7 | | PIPE | SA106GRB | OD | 5.08 | ARC | 6 ◺ | | E7018-1 | | | 1021/ REV02 | 20 | NIL | NIL(NIL) | 10% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | | FITTINGS | SA105 | 48.3 | | | 5 | | 11 | 0 | 0 | | | | | | | | |
| 8 | | PIPE | SA106GRB | OD | 5.54 | ARC | 6 ◺ | | E7018-1 | | | 1021/ REV02 | 20 | NIL | NIL(NIL) | 10% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | | FITTINGS | SA105 | 60.3 | | | 180 | | 465 | 0 | 0 | | | | | | | | |

Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for Butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
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| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| JTENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 19.03.2022 | 4-80-407-84553 | 01 | OF | 01 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-CONDENSATE EXCESS RETURN PIPING TO CST ( 80408)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-408-22903 | PIPE | SA106GRC | OD | 8.18 | TIG & ARC | 8.18 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-408-22903 | FITTING | SA234WPC | 219.1 | | | 16 | 1120 | 272 | 288 | 0 | | | | | | | | |
| 2 | 1-80-408-22903 | PIPE | SA106GRC | OD | 8.18 | TIG & ARC | 8.18 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-408-22903 | VALVE | SA216WCC | 219.1 | | | 4 | 280 | 68 | 72 | 0 | | | | | | | | |
| 3 | 1-80-408-22903 | FITTING | SA234WPC | OD | 7.11 | TIG & ARC | 7.11 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-408-22903 | VALVE | SA216WCC | 168.3 | | | 4 | 212 | 60 | 44 | 0 | | | | | | | | |
| 4 | 1-80-408-22903 | PIPE | SA106GRC | OD | 7.11 | TIG & ARC | 7.11 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-408-22903 | FITTING | SA234WPC | 168.3 | | | 5 | 265 | 75 | 55 | 0 | | | | | | | | |
| 5 | 1-80-408-22903 | FITTING | SA234WPC | OD | 9.27 | TIG & ARC | 9.27 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-408-22903 | FITTING | SA234WPC | 273 | | | 2 | 174 | 40 | 60 | 0 | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
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Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
|---|---|---|---|---|---|---|---|
| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| JITENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 11.02.2022 | 4-80-408-83724 | 01 | OF | 01 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE DEAERATOR SAFETY VALVE ESCAPE PIPING ;DEAERATOR START UP VENT PIPING (80419)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-419-22921 | PIPE | SA106GRB | OD | 6.35 | TIG & ARC | 6.35 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-419-22921 | FITTING | SA234WPB | 273 | | | 6 | 534 | 120 | 66 | 0 | | | | | | | | |
| 2 | 1-80-419-22921 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-419-22921 | FITTING | SA234WPB | 355.6 | | | 18 | 2070 | 486 | 738 | 0 | | | | | | | | |
| 3 | 1-80-419-22921 | PIPE | SA106GRB | OD | 3 | ARC | 3 | | E7018-1 | | | 1021/R EV02 | 20 | NIL | NIL(NIL) | 10% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-419-22921 | DRIP PAN ASSY | SA515GR70 | 273 | | | 6 | | 21 | 0 | 0 | | | | | | | | |
| 4 | 1-80-419-22921 | PIPE | SA106GRB | OD | 9 | ARC | 9 | | E7018-1 | | | 1021/R EV02 | 20 | NIL | NIL(NIL) | 10% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-419-22921 | FLANGE | SA515GR70 | 273 | | | 6 | | 50 | 55 | 0 | | | | | | | | |
| 5 | 1-80-419-22921 | PIPE | SA106GRB | OD | 10 | ARC | 10 | | E7018-1 | | | 1021/R EV02 | 20 | NIL | NIL(NIL) | 10% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-419-22921 | FLANGE | SA515GR70 | 273 | | | 6 | | 0 | 95 | 0 | | | | | | | | |
| 6 | 1-80-419-22922 | PIPE | SA106GRB | OD | 5.54 | TIG & ARC | 5.54 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-419-22922 | FITTING | SA234WPB | 60.3 | | | 25 | 315 | 250 | 0 | 0 | | | | | | | | |
| 7 | 1-80-419-22922 | PIPE | SA106GRB | OD | 5.54 | TIG & ARC | 5.54 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-419-22922 | VALVE | SA105 | 60.3 | | | 2 | 26 | 20 | 0 | 0 | | | | | | | | |
| 8 | 1-80-419-22922 | PIPE | SA106GRB | OD | 6.02 | TIG & ARC | 6.02 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-419-22922 | FITTING | SA234WPB | 114.3 | | | 14 | 373 | 294 | 0 | 0 | | | | | | | | |

Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
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| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| JTENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 14.02.2022 | 4-80-419-83766 | 01 | OF | 02 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE DEAERATOR SAFETY VALVE ESCAPE PIPING ;DEAERATOR START UP VENT PIPING (80419)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 9 | 1-80-419-22922 | PIPE | SA106GRB | OD | 6.35 | TIG & ARC | 6.35 V | ER70S-A1 | E7018-1 | | | 1003/REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-419-22922 | VALVE | SA216WCB | 114.3 | | | 2 | 54 | 44 | 0 | 0 | | | | | | | | |
| 10 | 1-80-419-22922 | PIPE | SA106GRB | OD | 6 | ARC | 6 ◺ | | E7018-1 | | | 1021/REV02 | 20 | NIL | NIL(NIL) | 10% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-419-22922 | FLANGE | SA515GR70 | 60.3 | | | 8 | | 21 | 0 | 0 | | | | | | | | |
| 11 | 1-80-419-22922 | PIPE | SA106GRB | OD | 7 | ARC | 7 ◺ | | E7018-1 | | | 1021/REV02 | 20 | NIL | NIL(NIL) | 10% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-419-22922 | FLANGE | SA515GR70 | 60.3 | | | 8 | | 28 | 0 | 0 | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
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Notes:
(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.
(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
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| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| JTENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 14.02.2022 | 4-80-419-83766 | 02 | OF | 02 | 00 |

**REF:ERECTION/ FIELD WELDING SCHEDULE-BOILER FEED SUCTION FOR TD BFP-1 TO BFP-4 ;BOILER FEED SUCTION PIPING FOR MD BFP-1 & MD ( 80420)**

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-420-22748/ 22752 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-420-22748/ 22752 | FITTING | SA234WPB | 559 | | | 2 | 405 | 93 | 146 | 0 | | | | | | | | |
| 2 | 1-80-420-22748/ 49/ 52/54/57/58 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-420-22748/ 49/ 52/54/57/58 | FITTING | SA234WPB | 406.4 | | | 78 | 10296 | 2340 | 3666 | 0 | | | | | | | | |
| 3 | 1-80-420-22748/ 22752/ 22757 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-420-22748/ 22752/ 22757 | VALVE | SA216WCB | 406.4 | | | 6 | 792 | 180 | 282 | 0 | | | | | | | | |
| 4 | 1-80-420-22748/ 22752/ 22757 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-420-22748/ 22752/ 22757 | FITTING | SA234WPC | 508 | | | 4 | 668 | 152 | 240 | 0 | | | | | | | | |
| 5 | 1-80-420-22749/ 22754/ 22758 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-420-22749/ 22754/ 22758 | FITTING | SA234WPB | 323.9 | | | 49 | 5096 | 1176 | 1813 | 0 | | | | | | | | |
| 6 | 1-80-420-22749/ 22754 | FITTING | SA234WPC | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-420-22749/ 52/54/57 | FITTING | SA234WPB | 457 | | | 6 | 900 | 204 | 318 | 0 | | | | | | | | |
| 7 | 1-80-420-22749/ 52/54/57 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-420-22749/ 52/54/57 | FITTING | SA234WPB | 323.9 | | | 17 | 1768 | 408 | 629 | 0 | | | | | | | | |
| 8 | 1-80-420-22758 | PIPE | SA106GRB | OD | 9.27 | TIG & ARC | 9.27 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-420-22758 | FITTING | SA234WPB | 273 | | | 1 | 87 | 20 | 30 | 0 | | | | | | | | |

Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
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| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| JTENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 14.02.2022 | 4-80-420-83318 | 01 | OF | 01 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-BOILER FEED RECIRCULATION PIPING FROM TD BFP-A, TD BFP-B & MD BFP ( 80421)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-421-22888/ 22889/22890 | PIPE | SA106GRC | OD | 50 | TIG & ARC | 50 W | ER70S-A1 | E7018-1 | | | 1004/R EV04 | 100 | 610±15 | 2.5 Mts./mm (Minimum 30 Mts.) | 100% RT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-421-22888/ 22889/22890 | FITTING | SA234WPC | 273 | | | 23 | 1610 | 460 | 759 | 2783 | | | | | | | | |
| 2 | 1-80-421-22888/ 22889/22890 | PIPE | SA106GRC | OD | 50 | TIG & ARC | 50 W | ER70S-A1 | E7018A1 | | | 1018/R EV05 | 150 | 660±10 | 2.5 Mts./mm (Minimum 60 Mts.) | 100% RT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-421-22888/ 22889/22890 | MATCHING PIECE | SA182F12 | 273 | | | 6 | 420 | 120 | 198 | 726 | | | | | | | | |
| 3 | 1-80-421-22888/ 22889/22890 | MATCHING PIECE | SA182F12 | OD | 50 | TIG & ARC | 50 W | ER80S-B2 | E8018-B2 | | | 1012/R EV04 | 150 * | 700±20 | 2.5 Mts./mm (Minimum 60 Mts.) | 100% RT + 100% MPT 3% HARDNESS | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-421-22888/ 22889/22890 | VALVE | SA217WC9 | 273 | | | 6 | 420 | 120 | 198 | 726 | | | | | | | | |
| 4 | 1-80-421-22888/ 22889/22890 | PIPE | SA106GRC | OD | 50 | TIG & ARC | 50 W | ER70S-A1 | E7018-1 | | | 1004/R EV04 | 100 | 610±15 | 2.5 Mts./mm (Minimum 30 Mts.) | 100% RT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-421-22888/ 22889/22890 | VALVE | SA216WCC | 273 | | | 3 | 210 | 60 | 99 | 363 | | | | | | | | |
| 5 | 1-80-421-22888/ 22889/22890 | PIPE | SA106GRC | OD | 12.7 | TIG & ARC | 12.7 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-421-22888/ 22889/22890 | VALVE | SA216WCC | 273 | | | 3 | 279 | 60 | 99 | 18 | | | | | | | | |
| 6 | 1-80-421-22888/ 22889/22890 | PIPE | SA106GRC | OD | 12.7 | TIG & ARC | 12.7 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-421-22888/ 22889/22890 | FITTING | SA234WPC | 273 | | | 60 | 5580 | 1200 | 1980 | 360 | | | | | | | | |
| 7 | 1-80-421-22890 | PIPE | SA106GRC | OD | 12.7 | TIG & ARC | 12.7 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-421-22890 | FITTING | SA234WPC | 219.1 | | | 1 | 73 | 17 | 25 | 5 | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |

Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

* Refer WPS for Preheat maintenance, Postheat, Interpass Temp. and Other Requirements.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
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| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| JTENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 14.02.2022 | 4-80-421-83637 | 01 | OF | 01 | 00 |

# REFERENCE ERECTION/ FIELD WELDING SCHEDULE-BOILER FEED PUMP TO HPH INCLUDING BYPASS (80423)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.15 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 0-80-423-07573 | PIPE | SA106GRC | ID | 62 | TIG & ARC | 62 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 100 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 265 | | | 20 | 2090 | 500 | 840 | 6130 | | | | | | | | |
| 2 | 0-80-423-07573 | PIPE | SA106GRC | ID | 84 | TIG & ARC | 84 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 150 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 370 | | | 15 | 2150 | 510 | 860 | 10750 | | | | | | | | |
| 3 | 0-80-423-07573 | PIPE | SA106GRC | ID | 64 | TIG & ARC | 64 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 100 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 370 | | | 25 | 3600 | 850 | 1425 | 10580 | | | | | | | | |
| 4 | 0-80-423-07573 | PIPE | SA106GRC | ID | 76 | TIG & ARC | 76 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 150 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | PIPE | SA106GRC | 265 | | | 10 | 1050 | 250 | 420 | 4580 | | | | | | | | |
| 5 | 0-80-423-07573 | PIPE | SA106GRC | ID | 105 | TIG & ARC | 105 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 150 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | PIPE | SA106GRC | 370 | | | 5 | 720 | 170 | 285 | 5570 | | | | | | | | |
| 6 | 0-80-423-07573 | PIPE | SA106GRC | ID | 80 | TIG & ARC | 80 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 150 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | PIPE | SA106GRC | 370 | | | 4 | 780 | 140 | 250 | 2620 | | | | | | | | |
| 7 | 0-80-423-07573 | FITTING | SA234WPC | ID | 65 | TIG & ARC | 65 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 100 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 260 | | | 5 | 520 | 120 | 210 | 1660 | | | | | | | | |
| 8 | 0-80-423-07573 | PIPE | SA106GRC | ID | 68.5 | TIG & ARC | 68.5 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 100 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FORGING | SA105 | 290 | | | 7 | 800 | 200 | 330 | 2800 | | | | | | | | |

Notes:

(1) REFER DOC NO: AA/CQ/GL/011 (Latest Revision) - MANUAL FOR WELDING, HEAT TREATMENT AND NON DESTRUCTIVE TESTING FOR POWER SECTOR"

| Rev.no. | Date: | Altered: | BB GHADAI |
|---|---|---|---|
| 01 | 08.09.2021 | Approved: | IDB RAJU |

| Rev.no. | Date: | Altered: | |
|---|---|---|---|
| | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| B.B.GHADAI | IDB RAJU | SARAVANAN | NANTHINI | 30.06.2021 | 4-80-423-83655 | 01 | OF | 03 | 01 |

# REFERENCE-ERECTION/ FIELD WELDING SCHEDULE-BOILER FEED PUMP TO HPH INCLUDING BYPASS (80423)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.15 | Dia4.0 | | in deg C | in deg C | | | | | |
| 9 | 0-80-423-07573 | PIPE | SA106GRC | OD | 50 | TIG & ARC | 50 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 100 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 273 | | | 5 | 350 | 80 | 150 | 750 | | | | | | | | |
| 10 | 0-80-423-07573 | FITTING | SA234WPC | ID | 37 | TIG & ARC | 37 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 100 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 205 | | | 5 | 410 | 95 | 180 | 435 | | | | | | | | |
| 11 | 0-80-423-07573 | PIPE | SA106GRC | OD | 27.5 | TIG & ARC | 27.5 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 100 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 168.3 | | | 5 | 250 | 55 | 100 | 150 | | | | | | | | |
| 12 | 0-80-423-07574 | PIPE | SA106GRC | ID | 62 | TIG & ARC | 62 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 100 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 265 | | | 40 | 4168 | 1000 | 1680 | 12240 | | | | | | | | |
| 13 | 0-80-423-07574 | PIPE | SA106GRC | ID | 48 | TIG & ARC | 48 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 100 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 205 | | | 10 | 810 | 190 | 340 | 1510 | | | | | | | | |
| 14 | 0-80-423-07574 | PIPE | SA106GRC | ID | 37 | TIG & ARC | 37 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 100 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | PIPE | SA106GRC | 205 | | | 5 | 410 | 100 | 170 | 450 | | | | | | | | |
| 15 | 0-80-423-07574 | PIPE | SA106GRC | ID | 84 | TIG & ARC | 84 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 150 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | PIPE | SA106GRC | 370 | | | 5 | 720 | 180 | 290 | 3580 | | | | | | | | |
| 16 | 0-80-423-07574 | PIPE | SA106GRC | ID | 76 | TIG & ARC | 76 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 100 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | PIPE | SA106GRC | 265 | | | 5 | 530 | 130 | 220 | 2300 | | | | | | | | |

Notes:

(1) REFER DOC NO: AA/ CQ/ GL/ 011 (Latest Revision) - MANUAL FOR WELDING, HEAT TREATMENT AND NON DESTRUCTIVE TESTING FOR POWER SECTOR"

| Rev.no. | Date: | Altered: | BB GHADAI |
|---|---|---|---|
| 01 | 08.09.2021 | Approved: | IDB RAJU |

| Rev.no. | Date: | Altered: | |
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| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| B.B.GHADAI | IDB RAJU | SARAVANAN | NANTHINI | 30.06.2021 | 4-80-423-83655 | 02 | OF | 03 | 01 |

# REFERENCE-ERECTION/ FIELD WELDING SCHEDULE-BOILER FEED PUMP TO HPH INCLUDING BYPASS (80423)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.15 | Dia4.0 | | in deg C | in deg C | | | | | |
| 17 | 0-80-423-07574 | PIPE | SA106GRC | ID | 68.5 | TIG & ARC | 68.5 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 100 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FORGING | SA105 | 290 | | | 7 | 800 | 200 | 330 | 2800 | | | | | | | | |
| 18 | 0-80-423-07574 | PIPE | SA106GRC | OD | 50 | TIG & ARC | 50 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 100 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 273 | | | 5 | 350 | 80 | 145 | 715 | | | | | | | | |
| 19 | 0-80-423-07574 | PIPE | SA106GRC | ID | 60 | TIG & ARC | 60 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 100 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 205 | | | 5 | 410 | 100 | 180 | 1180 | | | | | | | | |
| 20 | 0-80-423-07574 | PIPE | SA106GRC | ID | 46 | TIG & ARC | 46 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 100 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | PIPE | SA106GRC | 205 | | | 5 | 410 | 100 | 180 | 700 | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
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Notes:

(1) REFER DOC NO: AA/ CQ/ GL/ 011 (Latest Revision) - MANUAL FOR WELDING, HEAT TREATMENT AND NON DESTRUCTIVE TESTING FOR POWER SECTOR"

| Rev.no. | Date: | Altered: | BB GHADAI |
|---|---|---|---|
| 01 | 08.09.2021 | Approved: | IDB RAJU |

| Rev.no. | Date: | Altered: | |
|---|---|---|---|
| | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| B.B.GHADAI | IDB RAJU | SARAVANAN | NANTHINI | 30.06.2021 | 4-80-423-83655 | 03 | OF | 03 | 01 |

# REFERENCE ERECTION/ FIELD WELDING SCHEDULE BFD BETWEEN HTRS AND GROUP PROTECTION (80424)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.15 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 0-80-424-07575 | PIPE | SA106GRC | ID | 70 | TIG & ARC | 70 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 100 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 405 | | | 24 | 3750 | 950 | 1500 | 13000 | | | | | | | | |
| 2 | 0-80-424-07575 | PIPE | SA106GRC | ID | 57 | TIG & ARC | 57 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 100 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 325 | | | 5 | 640 | 150 | 260 | 1520 | | | | | | | | |
| 3 | 0-80-424-07575 | PIPE | SA106GRC | ID | 43 | TIG & ARC | 43 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 100 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 240 | | | 35 | 3300 | 780 | 1370 | 4760 | | | | | | | | |
| 4 | 0-80-424-07575 | PIPE | SA106GRC | ID | 53 | TIG & ARC | 53 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 100 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 240 | | | 10 | 950 | 220 | 400 | 2080 | | | | | | | | |
| 5 | 0-80-424-07575 | PIPE | SA106GRC | ID | 71 | TIG & ARC | 71 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 100 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 325 | | | 2 | 260 | 60 | 110 | 950 | | | | | | | | |
| 6 | 0-80-424-07575 | PIPE | SA106GRC | OD | 110.50 | TIG & ARC | 110.50 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 150 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FORGING | SA105 | 711 | | | 2 | 380 | 100 | 150 | 3000 | | | | | | | | |
| 7 | 0-80-424-07575 | PIPE | SA106GRC | ID | 48 | TIG & ARC | 48 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 100 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FORGING | SA105 | 240 | | | 2 | 200 | 50 | 80 | 350 | | | | | | | | |
| 8 | 0-80-424-07575 | PIPE | SA106GRC | ID | 84 | TIG & ARC | 84 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 150 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FORGING | SA105 | 508 | | | 2 | 390 | 100 | 160 | 1850 | | | | | | | | |

Notes:

(1) REFER DOC NO: AA/CQ/GL/011 (Latest Revision) - MANUAL FOR WELDING, HEAT TREATMENT AND NON DESTRUCTIVE TESTING FOR POWER SECTOR"

| Rev.no. | Date: | Altered: | BB GHADAI |
|---|---|---|---|
| 01 | 08.09.2021 | Approved: | IDB RAJU |

| Rev.no. | Date: | Altered: | |
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| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| B.B.GHADAI | IDB RAJU | SARAVANAN | NANTHINI | 01.07.2021 | 4-80-424-83755 | 01 | OF | 04 | 01 |

# REFERENCE ERECTION/ FIELD WELDING SCHEDULE-BFD BETWEEN HTRS AND GROUP PROTECTION (80424)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.15 | Dia4.0 | | in deg C | in deg C | | | | | |
| 9 | 0-80-424-07575 | PIPE | SA106GRC | ID | 68 | TIG & ARC | 68 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 100 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 390 | | | 2 | 310 | 80 | 125 | 1000 | | | | | | | | |
| 10 | 1-80-424-22850 | PIPE | SA106GRC | ID | 64 | TIG & ARC | 64 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 100 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 370 | | | 20 | 2870 | 680 | 1140 | 8460 | | | | | | | | |
| 11 | 1-80-424-22850 | PIPE | SA106GRC | ID | 80 | TIG & ARC | 80 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 150 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 370 | | | 8 | 1145 | 280 | 460 | 5210 | | | | | | | | |
| 12 | 1-80-424-22850 | PIPE | SA106GRC | ID | 81 | TIG & ARC | 81 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 150 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 375 | | | 2 | 300 | 100 | 100 | 1500 | | | | | | | | |
| 13 | 1-80-424-22850 | PIPE | SA106GRC | ID | 65 | TIG & ARC | 65 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 100 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 370 | | | 2 | 300 | 70 | 120 | 950 | | | | | | | | |
| 14 | 1-80-424-22850 | PIPE | SA106GRC | OD | 110.50 | TIG & ARC | 110.5 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 150 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FORGING | SA105 | 711 | | | 2 | 400 | 100 | 160 | 3000 | | | | | | | | |
| 15 | 1-80-424-22850 | PIPE | SA106GRC | ID | 66 | TIG & ARC | 66 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 100 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FORGING | SA105 | 375 | | | 2 | 300 | 100 | 130 | 800 | | | | | | | | |
| 16 | 1-80-424-22850 | PIPE | SA106GRC | ID | 65 | TIG & ARC | 65 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 100 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FORGING | SA105 | 375 | | | 2 | 300 | 100 | 130 | 800 | | | | | | | | |

Notes:

(1) REFER DOC NO: AA/CQ/GL/011 (Latest Revision) - MANUAL FOR WELDING, HEAT TREATMENT AND NON DESTRUCTIVE TESTING FOR POWER SECTOR"

| Rev.no. | Date: | Altered: | BB GHADAI |
|---|---|---|---|
| 01 | 08.09.2021 | Approved: | IDB RAJU |

| Rev.no. | Date: | Altered: | |
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| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| B.B.GHADAI | IDB RAJU | SARAVANAN | NANTHINI | 01.07.2021 | 4-80-424-83755 | 02 | OF | 04 | 01 |

# REFERENCE ERECTION/ FIELD WELDING SCHEDULE-BFD BETWEEN HTRS AND GROUP PROTECTION (80424)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.15 | Dia4.0 | | in deg C | in deg C | | | | | |
| 17 | 1-80-424-22851 | PIPE | SA106GRC | ID | 65 | TIG & ARC | 65 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 100 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 375 | | | 22 | 3000 | 1000 | 1300 | 8000 | | | | | | | | |
| 18 | 1-80-424-22851 | PIPE | SA106GRC | ID | 81 | TIG & ARC | 81 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 150 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 375 | | | 15 | 2250 | 600 | 950 | 10000 | | | | | | | | |
| 19 | 1-80-424-22851 | PIPE | SA106GRC | OD | 110.5 | TIG & ARC | 110.5 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 150 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FORGING | SA105 | 711 | | | 2 | 400 | 100 | 160 | 3000 | | | | | | | | |
| 20 | 1-80-424-22851 | PIPE | SA106GRC | ID | 67 | TIG & ARC | 67 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 100 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 375 | | | 2 | 300 | 100 | 100 | 1500 | | | | | | | | |
| 21 | 1-80-424-22852 | PIPE | SA106GRC | ID | 65 | TIG & ARC | 65 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 100 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 375 | | | 4 | 600 | 200 | 250 | 1500 | | | | | | | | |
| 22 | 1-80-424-22852 | PIPE | SA106GRC | ID | 68 | TIG & ARC | 68 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 100 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 390 | | | 45 | 6750 | 1620 | 2700 | 22320 | | | | | | | | |
| 23 | 1-80-424-22852 | PIPE | SA106GRC | ID | 84 | TIG & ARC | 84 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 150 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 390 | | | 14 | 2100 | 504 | 840 | 10444 | | | | | | | | |
| 24 | 1-80-424-22852 | PIPE | SA106GRC | ID | 72 | TIG & ARC | 72 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 100 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 390 | | | 2 | 350 | 100 | 150 | 1100 | | | | | | | | |

Notes:

(1) REFER DOC NO: AA/CQ/GL/011 (Latest Revision) - MANUAL FOR WELDING, HEAT TREATMENT AND NON DESTRUCTIVE TESTING FOR POWER SECTOR"

| Rev.no. | Date: | Altered: | BB GHADAI |
|---|---|---|---|
| 01 | 08.09.2021 | Approved: | IDB RAJU |

| Rev.no. | Date: | Altered: | |
|---|---|---|---|
| | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| B.B.GHADAI | IDB RAJU | SARAVANAN | NANTHINI | 01.07.2021 | 4-80-424-83755 | 03 | OF | 04 | 01 |

# REFERENCE ERECTION/ FIELD WELDING SCHEDULE-BFD BETWEEN HTRS AND GROUP PROTECTION (80424)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.15 | Dia4.0 | | in deg C | in deg C | | | | | |
| 25 | 1-80-424-22852 | PIPE | SA106GRC | ID | 69 | TIG & ARC | 69 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 100 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 375 | | | 1 | 150 | 50 | 80 | 500 | | | | | | | | |
| 26 | 1-80-424-22852 | PIPE | SA106GRC | OD | 110.50 | TIG & ARC | 110.5 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 150 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FORGING | SA105 | 711 | | | 2 | 400 | 100 | 160 | 3000 | | | | | | | | |
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Notes:

(1) REFER DOC NO: AA/ CQ/ GL/ 011 (Latest Revision) - MANUAL FOR WELDING, HEAT TREATMENT AND NON DESTRUCTIVE TESTING FOR POWER SECTOR"

| Rev.no. | Date: | Altered: | BB GHADAI |
|---|---|---|---|
| 01 | 08.09.2021 | Approved: | IDB RAJU |

| Rev.no. | Date: | Altered: | |
|---|---|---|---|
| | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| B.B.GHADAI | IDB RAJU | SARAVANAN | NANTHINI | 01.07.2021 | 4-80-424-83755 | 04 | OF | 04 | 01 |

# REFERENCE - ERECTION/ FIELD WELDING SCHEDULE BFD FROM FINAL HPH TO SG TP (80425)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.15 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-425-22829 | PIPE | SA106GRC | ID | 70 | TIG & ARC | 70 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 100 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 405 | | | 20 | 3120 | 760 | 1240 | 10800 | | | | | | | | |
| 2 | 1-80-425-22829 | PIPE | SA106GRC | ID | 87 | TIG & ARC | 87 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 150 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 405 | | | 10 | 1600 | 380 | 620 | 8230 | | | | | | | | |
| 3 | 1-80-425-22829 | PIPE | SA106GRC | ID | 63 | TIG & ARC | 63 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 100 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 325 | | | 1 | 130 | 30 | 60 | 380 | | | | | | | | |
| 4 | 1-80-425-22829 | FORGING | SA105 | ID | 78 | TIG & ARC | 78 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 150 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 405 | | | 1 | 160 | 40 | 65 | 660 | | | | | | | | |
| 5 | 1-80-425-22829 | PIPE | SA106GRC | ID | 64 | TIG & ARC | 64 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 100 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 370 | | | 1 | 150 | 35 | 60 | 430 | | | | | | | | |
| 6 | 1-80-425-22829 | PIPE | SA106GRC | ID | 43 | TIG & ARC | 43 | ER70S-A1 | E7018-1 | | | 1004/ Rev 04 | 100 | 610±15 | 2.5(30 MINUTES MINIMUM) | 100%RT/ UT 100%MPI | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 240 | | | 2 | 190 | 50 | 80 | 280 | | | | | | | | |
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Notes:

(1) REFER DOC NO: AA/CQ/GL/011 (Latest Revision) - MANUAL FOR WELDING, HEAT TREATMENT AND NON DESTRUCTIVE TESTING FOR POWER SECTOR"

| Rev.no. | Date: | Altered: | BB GHADAI |
|---|---|---|---|
| 01 | 08.09.2021 | Approved: | IDB RAJU |

| Rev.no. | Date: | Altered: | |
|---|---|---|---|
| | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| B.B.GHADAI | IDB RAJU | SARAVANAN | NANTHINI | 30.06.2021 | 4-80-425-83756 | 01 | OF | 01 | 01 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-FEED WATER SPRAY PIPING TO RH ATTEMPERATION (80433)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 0-80-433-07645 | PIPE | SA106GRC | OD | 13.4 | | 13.4 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 0-80-433-07645 | FITTING | SA234WPC | 114.3 | | | 1 | 34 | 11 | 15 | 0 | | | | | | | | |
| 2 | 0-80-433-07645/ 07646 | PIPE | SA106GRC | OD | 21.9 | | 21.9 W | ER70S-A1 | E7018-1 | | | 1004/ REV04 | 20 | 610 ± 15 | 2.5 Mts./mm (Minimum 30 Mts.) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 0-80-433-07645 07646 | FITTING | SA234WPC | 168.3 | | | 91 | 4459 | 1274 | 2184 | 1183 | | | | | | | | |
| 3 | 0-80-433-07646 | PIPE | SA106GRC | OD | 11.13 | TIG & ARC | 11.13 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 0-80-433-07646 | FITTING | SA234WPC | 88.1 | | | 55 | 924 | 440 | 605 | 0 | | | | | | | | |
| 4 | 0-80-433-07646 | PIPE | SA106GRC | OD | 11.13 | TIG & ARC | 11.13 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 0-80-433-07646 | VALVE | SA216WCC | 88.1 | | | 12 | 202 | 96 | 132 | 0 | | | | | | | | |
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Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
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| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| JTENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 12.02.2022 | 4-80-433-83916 | 01 | OF | 01 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-CONDENSATE SPRAY PIPING TO LP BYPASS SYSTEM ( 80434)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-434-22924 | PIPE | SA106GRC | OD | 9.27 | TIG & ARC | 9.27 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-434-22924 | FITTING | SA234WPC | 273 | | | 27 | 2349 | 540 | 810 | 0 | | | | | | | | |
| 2 | 1-80-434-22924 | PIPE | SA106GRC | OD | 9.27 | TIG & ARC | 9.27 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 100% RT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-434-22924 | VALVE | SA216WCB | 273 | | | 2 | 174 | 40 | 60 | 0 | | | | | | | | |
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Notes:
(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.
(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
|---|---|---|---|---|---|---|---|
| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| JTENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 15.02.2022 | 4-80-434-83769 | 01 | OF | 01 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-GSC DRAIN TO FLASH TANK-A ( 80442)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-442-22908 | PIPE | SA106GRB | OD | 5.49 | TIG & ARC | 5.49 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-442-22908 | FITTING | SA234WPB | 88.9 | | | 25 | 490 | 375 | 0 | 0 | | | | | | | | |
| 2 | 1-80-442-22908 | PIPE | SA106GRB | OD | 5.49 | TIG & ARC | 5.49 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-442-22908 | VALVE | SA216WCB | 88.9 | | | 8 | 157 | 120 | 0 | 0 | | | | | | | | |
| 3 | 1-80-442-22908 | PIPE | SA106GRB | OD | 5.54 | TIG & ARC | 5.54 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-442-22908 | FITTING | SA234WPB | 60.3 | | | 8 | 101 | 80 | 0 | 0 | | | | | | | | |
| 4 | 1-80-442-22908 | PIPE | SA106GRB | OD | 5.54 | TIG & ARC | 5.54 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-442-22908 | VALVE | SA216WCB | 60.3 | | | 2 | 26 | 20 | 0 | 0 | | | | | | | | |
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Notes:
(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.
(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
|---|---|---|---|---|---|---|---|
| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| JTENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 15.02.2022 | 4-80-442-83753 | 01 | OF | 01 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-LPH-1 DRAIN TO FLASH TANK-A THROUGH DRAIN COOLER ( 80443)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-443-22927 | PIPE | SA106GRB | OD | 6.35 | TIG & ARC | 6.35 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-443-22927 | FITTING | SA234WPB | 219.1 | | | 52 | 3692 | 1924 | 0 | 0 | | | | | | | | |
| 2 | 1-80-443-22927 | PIPE | SA106GRB | OD | 10.97 | TIG & ARC | 10.97 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-443-22927 | FITTING | SA234WPB | 168.3 | | | 1 | 51 | 15 | 23 | 0 | | | | | | | | |
| 3 | 1-80-443-22927 | PIPE | SA106GRB | OD | 6.35 | TIG & ARC | 6.35 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-443-22927 | FITTING | SA234WPB | 273 | | | 2 | 178 | 40 | 22 | 0 | | | | | | | | |
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Notes:
(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.
(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
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| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| JTENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 15.02.2022 | 4-80-443-83777 | 01 | OF | 01 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-LP HEATER-2/ 3/ 4/ 5 DRAINS AND DRIP PUMP ( 80-444)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-444-22928<br>22960<br>1-80-444-22928<br>22960 | PIPE<br>FITTING | SA106GRB<br>SA234WPB | OD<br>219.1 | 6.35 | TIG & ARC | 6.35 V<br>91 | ER70S-A1<br>6461 | E7018-1<br>3367 | 0 | 0 | 1003/ REV04 | 20 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| 2 | 1-80-444-22928<br>22960<br>1-80-444-22928<br>22960 | PIPE<br>FITTING | SA106GRB<br>SA234WPB | OD<br>168.3 | 7.11 | TIG & ARC | 7.11 V<br>1 | ER70S-A1<br>53 | E7018-1<br>15 | 11 | 0 | 1003/ REV04 | 20 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| 3 | 1-80-444-22928<br>22960<br>1-80-444-22928<br>22960 | PIPE<br>FITTING | SA106GRB<br>SA234WPB | OD<br>355.6 | 9.53 | TIG & ARC | 9.53 V<br>1 | ER70S-A1<br>115 | E7018-1<br>27 | 41 | 0 | 1003/ REV04 | 20 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| 4 | 1-80-444-22928<br>22960<br>1-80-444-22928<br>22960 | PIPE<br>VALVE | SA106GRB<br>SA216WCB | OD<br>219.1 | 6.35 | TIG & ARC | 6.35 V<br>10 | ER70S-A1<br>710 | E7018-1<br>370 | 0 | 0 | 1003/ REV04 | 20 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| 5 | 1-80-444-22960<br><br>1-80-444-22960<br> | PIPE<br>FITTING | SA106GRB<br>SA234WPB | OD<br>273.1 | 6.35 | TIG & ARC | 6.35 V<br>6 | ER70S-A1<br>642 | E7018-1<br>144 | 102 | 0 | 1003/ REV04 | 20 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| 6 | 1-80-444-22960<br><br>1-80-444-22960<br> | PIPE<br>VALVE | SA106GRB<br>SA216WCC | OD<br>273.1 | 6.35 | TIG & ARC | 6.35 V<br>2 | ER70S-A1<br>214 | E7018-1<br>48 | 34 | 0 | 1003/ REV04 | 20 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| 7 | 1-80-444-22960<br><br>1-80-444-22960<br> | PIPE<br>FITTING | SA335P11<br>SA234WPB | OD<br>168.3 | 7.11 | TIG & ARC | 7.11 V<br>2 | ER70S-A1<br>106 | E7018-1<br>30 | 22 | 0 | 1017/ REV04 | 150 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| 8 | 1-80-444-22960<br><br>1-80-444-22960<br> | PIPE<br>VALVE | SA335P11<br>SA217WC9 | OD<br>168.3 | 7.11 | TIG & ARC | 7.11 V<br>2 | ER80S-B2<br>106 | E8018-B2<br>30 | 22 | 0 | 1011/ REV01 | 150 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |

Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
|---|---|---|---|---|---|---|---|
| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| JTENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 15.02.2022 | 4-80-444-83772 | 01 | OF | 04 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-LP HEATER-2/ 3/ 4/ 5 DRAINS AND DRIP PUMP ( 80-444)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 9 | 1-80-444-22960<br><br>1-80-444-22960<br> | FITTING<br><br>VALVE DRV-65 | SA234WPB<br><br>SA234WP11 | OD<br><br>168.3 | 7.11 | TIG & ARC | 7.11 V<br><br>2 | ER70S-A1<br><br>106 | E7018-1<br><br>30 | 22 | 0 | 1017/ REV04 | 150 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| 10 | 1-80-444-22929<br>1-80-444-22931<br>1-80-444-22929<br>1-80-444-22931 | PIPE<br><br>FITTING | SA106GRB<br><br>SA234WPB | OD<br><br>273 | 6.35 | TIG & ARC | 6.35 V<br><br>50 | ER70S-A1<br><br>4450 | E7018-1<br><br>1000 | 550 | 0 | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| 11 | 1-80-444-22929<br>1-80-444-22931<br>1-80-444-22929<br>1-80-444-22931 | PIPE<br><br>VALVE | SA106GRB<br><br>SA216WCB | OD<br><br>273 | 6.35 | TIG & ARC | 6.35 V<br><br>6 | ER70S-A1<br><br>534 | E7018-1<br><br>120 | 66 | 0 | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| 12 | 1-80-444-22929<br>1-80-444-22931<br>1-80-444-22929<br>1-80-444-22931 | PIPE<br><br>FITTING | SA106GRB<br><br>SA234WPB | OD<br><br>323.9 | 9.53 | TIG & ARC | 9.53 V<br><br>4 | ER70S-A1<br><br>416 | E7018-1<br><br>96 | 148 | 0 | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| 13 | 1-80-444-22931<br><br>1-80-444-22931<br> | PIPE<br><br>VALVE | SA106GRB<br><br>SA216WCB | OD<br><br>323.9 | 9.53 | TIG & ARC | 9.53 V<br><br>2 | ER70S-A1<br><br>208 | E7018-1<br><br>48 | 74 | 0 | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| 14 | 1-80-444-22929<br>1-80-444-22930<br>1-80-444-22929<br>1-80-444-22930 | PIPE<br><br>FITTING | SA106GRB<br><br>SA234WPB | OD<br><br>219.1 | 8.18 | TIG & ARC | 8.18 V<br><br>46 | ER70S-A1<br><br>3220 | E7018-1<br><br>782 | 828 | 0 | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| 15 | 1-80-444-22929<br>1-80-444-22930<br>1-80-444-22929<br>1-80-444-22930 | PIPE<br><br>VALVE | SA106GRB<br><br>SA216WCB | OD<br><br>219.1 | 8.18 | TIG & ARC | 8.18 V<br><br>12 | ER70S-A1<br><br>840 | E7018-1<br><br>204 | 216 | 0 | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| 16 | 1-80-444-22929<br>1-80-444-22930<br>1-80-444-22929<br>1-80-444-22930 | FITTING<br><br>VALVE | SA234WPB<br><br>SA216WCB | OD<br><br>114.3 | 6.02 | TIG & ARC | 6.02 V<br><br>2 | ER70S-A1<br><br>54 | E7018-1<br><br>42 | 0 | 0 | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |

Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
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| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| JTENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 15.02.2022 | 4-80-444-83772 | 02 | OF | 04 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-LP HEATER-2/ 3/ 4/ 5 DRAINS AND DRIP PUMP ( 80-444)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 17 | 1-80-444-22929<br>1-80-444-22930 | PIPE | SA106GRB | OD | 7.11 | TIG & ARC | 7.11 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-444-22929<br>1-80-444-22930 | FITTING | SA234WPB | 168.3 | | | 8 | 424 | 120 | 88 | 0 | | | | | | | | |
| 18 | 1-80-444-22929<br>1-80-444-22930 | PIPE | SA106GRB | OD | 7.11 | TIG & ARC | 7.11 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-444-22929<br>1-80-444-22930 | VALVE | SA216WCB | 168.3 | | | 2 | 106 | 30 | 22 | 0 | | | | | | | | |
| 19 | 1-80-444-22931 | FITTING | SA234WPB | OD | 8.18 | TIG & ARC | 8.18 V | ER70S-A1 | E7018-1 | | | 1017/ REV04 | 150 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-444-22931 | PIPE | SA335P11 | 219.1 | | | 2 | 140 | 34 | 36 | 0 | | | | | | | | |
| 20 | 1-80-444-22931 | PIPE | SA335P11 | OD | 8.18 | TIG & ARC | 8.18 V | ER80S-B2 | E8018-B2 | | | 1012/ REV04 | 150 * | 700±20 | 2.5 Mts./mm (Minimum 60 Mts.) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-444-22931 | VALVE | SA217WC9 | 219.1 | | | 2 | 140 | 34 | 36 | 0 | | | | | | | | |
| 21 | 1-80-444-22961 | PIPE | SA106GRB | OD | 8.18 | TIG & ARC | 8.18 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-444-22961 | FITTING | SA234WPB | 219.1 | | | 2 | 140 | 34 | 36 | 0 | | | | | | | | |
| 22 | 1-80-444-22961 | PIPE | SA106GRB | OD | 8.18 | TIG & ARC | 8.18 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-444-22961 | VALVE | SA216WCB | 219.1 | | | 2 | 140 | 34 | 36 | 0 | | | | | | | | |
| 23 | 1-80-444-22961 | FITTING | SA234WPB | OD | 5.49 | TIG & ARC | 5.49 V | ER70S-A1 | E7018-1 | | | 1017/ REV04 | 150 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-444-22961 | PIPE | SA335P11 | 88.9 | | | 2 | 40 | 30 | 0 | 0 | | | | | | | | |
| 24 | 1-80-444-22961 | PIPE | SA335P11 | OD | 5.49 | TIG & ARC | 5.49 V | ER80S-B2 | E8018-B2 | | | 1011/ REV01 | 150 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-444-22961 | VALVE | SA217WC9 | 88.9 | | | 2 | 40 | 30 | 0 | 0 | | | | | | | | |

Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

* Refer WPS for Preheat maintenance, Postheat, Interpass Temp. and Other Requirements.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
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| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| JTENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 15.02.2022 | 4-80-444-83772 | 03 | OF | 04 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-LP HEATER-2/ 3/ 4/ 5 DRAINS AND DRIP PUMP ( 80-444)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 25 | 1-80-444-22961 | PIPE | SA106GRB | OD | 7.11 | TIG & ARC | 7.11 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-444-22961 | FITTING | SA234WPB | 168.3 | | | 38 | 2014 | 570 | 418 | 0 | | | | | | | | |
| 26 | 1-80-444-22961 | PIPE | SA106GRB | OD | 7.11 | TIG & ARC | 7.11 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-444-22961 | VALVE | SA216WCB | 168.3 | | | 6 | 318 | 90 | 66 | 0 | | | | | | | | |
| 27 | 1-80-444-22961 | FITTING | SA234WPB | OD | 6.02 | TIG & ARC | 6.02 V | ER70S-A1 | E7018-1 | | | 1017/ REV04 | 150 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-444-22961 | VALVE DRV-61 | SA234WP11 | 114.3 | | | 2 | 54 | 42 | 0 | 0 | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
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Notes:
(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.
(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
|---|---|---|---|---|---|---|---|
| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| JTENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 15.02.2022 | 4-80-444-83772 | 04 | OF | 04 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-DEAERATOR OVERFLOW DRAIN TO F/ T-A ( 80 446)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-446-23138 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-446-23138 | FITTING | SA234WPB | 323.9 | | | 3 | 312 | 72 | 111 | 0 | | | | | | | | |
| 2 | 1-80-446-23138 | PIPE | SA106GRB | OD | 6.35 | TIG & ARC | 6.35 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-446-23138 | FITTING | SA234WPB | 219.1 | | | 29 | 2059 | 1073 | 0 | 0 | | | | | | | | |
| 3 | 1-80-446-23138 | PIPE | SA106GRB | OD | 7.11 | TIG & ARC | 7.11 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-446-23138 | FITTING | SA234WPB | 168.3 | | | 35 | 1855 | 525 | 385 | 0 | | | | | | | | |
| 4 | 1-80-446-23138 | PIPE | SA106GRB | OD | 7.11 | TIG & ARC | 7.11 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-446-23138 | VALVE | SA216WCB | 168.3 | | | 4 | 212 | 60 | 44 | 0 | | | | | | | | |
| 5 | 1-80-446-23138 | PIPE | SA106GRB | OD | 6.35 | TIG & ARC | 6.35 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-446-23138 | VALVE | SA216WCB | 219.1 | | | 6 | 426 | 222 | 0 | 0 | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |

Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
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| | | Approved: | | | | Approved: | |

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| JITENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 16.02.2022 | 4-80-446-84035 | 01 | OF | 01 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-HP HEATER DRAINS ( 80 447)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-447-22940<br>1-80-447-22941<br>1-80-447-22940<br>1-80-447-22941 | PIPE<br>FITTING | SA106GRB<br>SA234WPB | OD<br>457.2 | 20 | TIG & ARC | 20 W<br>3 | ER70S-A1<br>474 | E7018-1<br>102 | 168 | 123 | 1004/ REV04 | 20 | 610±15 | 2.5 Mts./mm (Minimum 30 Mts.) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| 2 | 1-80-447-22940<br>1-80-447-22941<br>1-80-447-22940<br>1-80-447-22941 | PIPE<br>FITTING | SA106GRB<br>SA234WPB | OD<br>355.6 | 9.53 | TIG & ARC | 9.53 V<br>55 | ER70S-A1<br>6325 | E7018-1<br>1485 | 2255 | 0 | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| 3 | 1-80-447-22940<br>1-80-447-22941<br>1-80-447-22940<br>1-80-447-22941 | PIPE<br>VALVE | SA106GRB<br>SA216WCB | OD<br>355.6 | 9.53 | TIG & ARC | 9.53 V<br>6 | ER70S-A1<br>690 | E7018-1<br>162 | 246 | 0 | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| 4 | 1-80-447-22940<br><br>1-80-447-22940<br> | FITTING<br>VALVE DRV-22 | SA234WPB<br>SA234WP11 | OD<br>219.1 | 8.18 | TIG & ARC | 8.18 V<br>2 | ER70S-A1<br>140 | E7018-1<br>34 | 36 | 0 | 1017/ REV04 | 150 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| 5 | 1-80-447-22940<br><br>1-80-447-22940<br> | PIPE<br>FITTING | SA106GRB<br>SA234WPB | OD<br>323.9 | 9.53 | TIG & ARC | 9.53 V<br>1 | ER70S-A1<br>104 | E7018-1<br>24 | 37 | 0 | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| 6 | 1-80-447-22941<br><br>1-80-447-22941<br> | PIPE<br>FITTING | SA106GRB<br>SA234WPB | OD<br>273 | 6.35 | TIG & ARC | 6.35 V<br>8 | ER70S-A1<br>712 | E7018-1<br>160 | 88 | 0 | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| 7 | 1-80-447-22941<br><br>1-80-447-22941<br> | PIPE<br>FITTING | SA106GRB<br>SA234WPB | OD<br>406.4 | 9.53 | TIG & ARC | 9.53 V<br>1 | ER70S-A1<br>132 | E7018-1<br>30 | 47 | 0 | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| 8 | 1-80-447-22941<br><br>1-80-447-22941<br> | PIPE<br>VALVE | SA106GRB<br>SA216WCB | OD<br>406.4 | 9.53 | TIG & ARC | 9.53 V<br>2 | ER70S-A1<br>264 | E7018-1<br>60 | 94 | 0 | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |

Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
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| | | Approved: | | | | Approved: | |

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| JTENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 16.02.2022 | 4-80-447-83787 | 01 | OF | 04 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-HP HEATER DRAINS ( 80 447)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 9 | 1-80-447-22941 | PIPE | SA106GRB | OD | 12.7 | TIG & ARC | 12.7 V | ER70S-A1 | E7018-1 | | | 1017/R EV04 | 150 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-447-22941 | FITTING | SA234WP11 | 406.4 | | | 1 | 143 | 30 | 50 | 10 | | | | | | | | |
| 10 | 1-80-447-22941 | FITTING | SA234WP11 | OD | 8.18 | TIG & ARC | 8.18 V | ER80S-B2 | E8018-B2 | | | 1012/R EV04 | 150 * | 700±20 | 2.5 Mts./mm (Minimum 60 Mts.) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-447-22941 | VALVE | SA217WC9 | 219.1 | | | 2 | 140 | 34 | 36 | 0 | | | | | | | | |
| 11 | 1-80-447-22941 | FITTING | SA234WP11 | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1017/R EV04 | 150 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-447-22941 | FITTING | SA234WPB | 355.6 | | | 1 | 115 | 27 | 41 | 0 | | | | | | | | |
| 12 | 1-80-447-22942/ 22962 | PIPE | SA106GRC | OD | 15.09 | TIG & ARC | 15.09 VV | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-447-22942/ 22962 | FITTING | SA234WPC | 273 | | | 5 | 440 | 100 | 165 | 50 | | | | | | | | |
| 13 | 1-80-447-22942 | PIPE | SA106GRC | OD | 15.09 | TIG & ARC | 15.09 VV | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-447-22942 | VALVE | SA216WCC | 273 | | | 2 | 176 | 40 | 66 | 20 | | | | | | | | |
| 14 | 1-80-447-22942 | PIPE | SA106GRC | OD | 15.09 | TIG & ARC | 15.09 VV | ER70S-A1 | E7018A1 | | | 1018/R EV05 | 150 | 660±10 | 2.5 Mts./mm (Minimum 60 Mts.) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-447-22942 | REDUCER | SA182F12 | 273 | | | 1 | 88 | 20 | 33 | 10 | | | | | | | | |
| 15 | 1-80-447-22942 | REDUCER | SA182F12 | OD | 8.56 | TIG & ARC | 8.56 V | ER80S-B2 | E8018-B2 | | | 1012/R EV04 | 150 * | 700±20 | 2.5 Mts./mm (Minimum 60 Mts.) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-447-22942 | VALVE | SA217WC9 | 114.3 | | | 1 | 26 | 11 | 9 | 0 | | | | | | | | |
| 16 | 1-80-447-22942 | REDUCER | SA234WP11 | OD | 8.56 | TIG & ARC | 8.56 V | ER80S-B2 | E8018-B2 | | | 1012/R EV04 | 150 * | 700±20 | 2.5 Mts./mm (Minimum 60 Mts.) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-447-22942 | VALVE | SA217WC9 | 114.3 | | | 1 | 26 | 11 | 9 | 0 | | | | | | | | |

Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for butt joints for butt joints. Beyond the last root valve, 10% RT is applicable.

* Refer WPS for Preheat maintenance, Postheat, Interpass Temp. and Other Requirements.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
|---|---|---|---|---|---|---|---|
| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| JTENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 16.02.2022 | 4-80-447-83787 | 02 | OF | 04 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-HP HEATER DRAINS ( 80 447)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 17 | 1-80-447-22942 | FITTING | SA234WP11 | OD | 12.7 | TIG & ARC | 12.7 V | ER70S-A1 | E7018-1 | | | 1017/R EV04 | 150 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-447-22942 | PIPE | SA106GRC | 219.1 | | | 1 | 73 | 17 | 25 | 5 | | | | | | | | |
| 18 | 1-80-447-22942/ 22962/ 22964 | PIPE | SA106GRC | OD | 12.7 | TIG & ARC | 12.7 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-447-22942/ 22962/ 22964 | FITTING | SA234WPC | 219.1 | | | 82 | 5986 | 1394 | 2050 | 410 | | | | | | | | |
| 19 | 1-80-447-22942/ 22962/ 22964 | PIPE | SA106GRC | OD | 12.7 | TIG & ARC | 12.7 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-447-22942/ 22962/ 22964 | VALVE | SA216WCC | 219.1 | | | 8 | 584 | 136 | 200 | 40 | | | | | | | | |
| 20 | 1-80-447-22943 | PIPE | SA106GRC | OD | 20 | TIG & ARC | 20 VV | ER70S-A1 | E7018-1 | | | 1004/R EV04 | 20 | 610±15 | 2.5 Mts./mm (Minimum 30 Mts.) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-447-22943 | FITTING | SA234WPC | 406.4 | | | 2 | 278 | 60 | 100 | 70 | | | | | | | | |
| 21 | 1-80-447-22962 | FITTING | SA234WPC | OD | 8.56 | TIG & ARC | 8.56 V | ER70S-A1 | E7018-1 | | | 1017/R EV04 | 150 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-447-22962 | FITTING | SA234WP11 | 114.3 | | | 2 | 51 | 22 | 18 | 0 | | | | | | | | |
| 22 | 1-80-447-22964 | PIPE | SA106GRC | OD | 12.7 | TIG & ARC | 12.7 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-447-22964 | FITTING | SA234WPC | 323.9 | | | 1 | 112 | 24 | 51 | 0 | | | | | | | | |
| 23 | 1-80-447-22964 | PIPE | SA106GRC | OD | 12.7 | TIG & ARC | 12.7 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-447-22964 | VALVE | SA216WCB | 323.9 | | | 2 | 224 | 48 | 102 | 0 | | | | | | | | |
| 24 | 1-80-447-22964 | PIPE | SA106GRC | OD | 12.7 | TIG & ARC | 12.7 V | ER70S-A1 | E7018-1 | | | 1017/R EV04 | 150 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-447-22964 | FITTING | SA234WP11 | 323.9 | | | 1 | 112 | 24 | 51 | 0 | | | | | | | | |

Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
|---|---|---|---|---|---|---|---|
| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| JTENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 16.02.2022 | 4-80-447-83787 | 03 | OF | 04 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-HP HEATER DRAINS ( 80 447)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 25 | 1-80-447-22964 | FITTING | SA234WP11 | OD | 12.7 | TIG & ARC | 12.7 V | ER70S-A1 | E7018-1 | | | 1017/REV04 | 150 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-447-22964 | PIPE | SA106GRC | 273 | | | 1 | 93 | 20 | 33 | 6 | | | | | | | | |
| 26 | 1-80-447-22964 | FITTING | SA234WP11 | OD | 10.97 | TIG & ARC | 10.97 V | ER80S-B2 | E8018-B2 | | | 1012/REV04 | 150 * | 700±20 | 2.5 Mts./mm (Minimum 60 Mts.) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-447-22964 | VALVE | SA217WC9 | 168.3 | | | 2 | 102 | 30 | 46 | 0 | | | | | | | | |
| 27 | 1-80-447-22943 | PIPE | SA106GRB | OD | 17 | TIG & ARC | 17 VV | ER70S-A1 | E7018-1 | | | 1003/REV04 | 20 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-447-22943 | FITTING | SA234WPB | 406.4 | | | 1 | 141 | 30 | 50 | 28 | | | | | | | | |
| 28 | 1-80-447-22943 | PIPE | SA106GRC | OD | 12.7 | TIG & ARC | 12.7 V | ER70S-A1 | E7018-1 | | | 1003/REV04 | 20 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-447-22943 | FITTING | SA234WPC | 273 | | | 28 | 2604 | 560 | 924 | 168 | | | | | | | | |
| 29 | 1-80-447-22943 | PIPE | SA106GRC | OD | 12.7 | TIG & ARC | 12.7 V | ER70S-A1 | E7018-1 | | | 1003/REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-447-22943 | VALVE | SA216WCB | 273 | | | 4 | 372 | 80 | 132 | 24 | | | | | | | | |
| 30 | 1-80-447-22943 | REDUCER | SA234WPC | OD | 10.97 | TIG & ARC | 10.97 V | ER70S-A1 | E7018-1 | | | 1017/REV04 | 150 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-447-22943 | VALVE DRV-08 | SA234WP11 | 168.3 | | | 2 | 102 | 30 | 46 | 0 | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |

Notes:
(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.
(2) Drain & vent piping: 100% RT upto the last root valve for butt joints for butt joints. Beyond the last root valve, 10% RT is applicable.
* Refer WPS for Preheat maintenance, Postheat, Interpass Temp. and Other Requirements.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
|---|---|---|---|---|---|---|---|
| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| JTENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 16.02.2022 | 4-80-447-83787 | 04 | OF | 04 | 00 |

## REF:ERECTION/ FIELD WELDING SCHEDULE CONDENSER HOTWELL DRAIN PIPING UNIT FLASH TANK VENT TO ATM & DRAIN TO WASTE (80 448)

| | | | |
|---|---|---|---|
| PROJECT: | 1 X 660MW PANKI TPS EXTN. | CUST. NO: | 7363 |
| | | PGMA: | 80-448 |
| NAME OF THE CUSTOMER: | UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LTD. | CUST. DOC. NO. | |
| | | SYSTEM DESCRIPTION: | CONDENSER HOTWELL DRAIN PIPING<br>UNIT FLASH TANK VENT TO ATM & DRAIN TO WASTE |

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-448-23142 | PIPE | SA106GRB | OD | 6.02 | TIG & ARC | 6.02 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-448-23142 | FITTING | SA234WPB | 114.3 | | | 36 | 958 | 756 | 0 | 0 | | | | | | | | |
| 2 | 1-80-448-22969 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-448-22969 | FITTING | SA234WPB | 406.4 | | | 5 | 660 | 150 | 235 | 0 | | | | | | | | |
| 3 | 1-80-448-22969 | PIPE | SA106GRB | OD | 6.35 | TIG & ARC | 6.35 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-448-22969 | FITTING | SA234WPB | 219.1 | | | 11 | 781 | 407 | 0 | 0 | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |

Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for Butt Joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
|---|---|---|---|---|---|---|---|
| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| JITENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 16.02.2022 | 4-80-448-83840 | 01 | OF | 01 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-TG CYCLE PIPING DRAINS AND VENTS ( 80449)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | | PIPE | SA106GRB | OD | 3.73 | TIG & ARC | 3.73 | ER70S-A1 | E7018-1 | | | 1003/ R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | | PIPE | SA106GRB | 21.3 | | | 40 | 540 | 0 | 0 | 0 | | | | | | | | |
| 2 | | PIPE | SA106GRB | OD | 4.55 | TIG & ARC | 4.55 | ER70S-A1 | E7018-1 | | | 1003/ R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | | PIPE | SA106GRB | 33.4 | | | 305 | 1952 | 1525 | 0 | 0 | | | | | | | | |
| 3 | | PIPE | SA106GRB | OD | 5.08 | TIG & ARC | 5.08 | ER70S-A1 | E7018-1 | | | 1003/ R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | | PIPE | SA106GRB | 48.3 | | | 5 | 50 | 40 | 0 | 0 | | | | | | | | |
| 4 | | PIPE | SA106GRB | OD | 5.54 | TIG & ARC | 5.54 | ER70S-A1 | E7018-1 | | | 1003/ R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | | PIPE | SA106GRB | 60.3 | | | 115 | 1449 | 1150 | 0 | 0 | | | | | | | | |
| 5 | | PIPE | SA106GRC | OD | 4.55 | TIG & ARC | 4.55 | ER70S-A1 | E7018-1 | | | 1003/ R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | | PIPE | SA106GRC | 33.4 | | | 15 | 96 | 75 | 0 | 0 | | | | | | | | |
| 6 | | PIPE | SA106GRC | OD | 9.09 | TIG & ARC | 9.09 | ER70S-A1 | E7018-1 | | | 1003/ R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | | PIPE | SA106GRC | 33.4 | | | 30 | 108 | 420 | 0 | 0 | | | | | | | | |
| 7 | | PIPE | SA312TP304H | OD | 2.77 | TIG & ARC | 2.77 | ER347 | E316 | | | 1016/ R EV02 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | Refer WPS for Backing / Purging Gas |
| | | PIPE | SA312TP304H | 21.3 | | | 35 | 473 | 0 | 0 | 0 | | | | | | | | |
| 8 | | PIPE | SA312TP304H | OD | 3.37 | TIG & ARC | 3.37 | ER347 | E316 | | | 1016/ R EV02 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | Refer WPS for Backing / Purging Gas |
| | | PIPE | SA312TP304H | 21.3 | | | 185 | 2498 | 0 | 0 | 0 | | | | | | | | |

Notes:
(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.
(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
|---|---|---|---|---|---|---|---|
| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| JITENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 21.02.2022 | 4-80-449-84510 | 01 | OF | 02 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-TG CYCLE PIPING DRAINS AND VENTS ( 80449)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 9 | | PIPE | SA312TP304H | OD | 3.38 | TIG & ARC | 3.38 | ER347 | E316 | | | 1016/R EV02 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | Refer WPS for Backing / Purging Gas |
| | | PIPE | SA312TP304H | 33.4 | | | 65 | 416 | 325 | 0 | 0 | | | | | | | | |
| 10 | | PIPE | SA312TP304H | OD | 3.38 | ARC | 4 | | E308 | | | 1217/R EV01 | 20 | NIL | NIL(NIL) | 100% LPT | REFER NOTE-1 | REFER NOTE-1 | |
| | | FITTING | SA312TP304H | 33.4 | | | 105 | | 70 | 0 | 0 | | | | | | | | |
| 11 | | PIPE | SA312TP304H | OD | 2.77 | ARC | 3 | | E308 | | | 1217/R EV01 | 20 | NIL | NIL(NIL) | 100% LPT | REFER NOTE-1 | REFER NOTE-1 | |
| | | FITTING | SA312TP304H | 60.3 | | | 5 | | 4 | 0 | 0 | | | | | | | | |
| 12 | | PIPE | SA106GRB | OD | 3.73 | ARC | 4 | | E7018-1 | | | 1021/R EV02 | 20 | NIL | NIL(NIL) | 10% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | | FITTING | SA105 | 21.3 | | | 75 | | 30 | 0 | 0 | | | | | | | | |
| 13 | | PIPE | SA106GRB | OD | 4.55 | ARC | 5 | | E7018-1 | | | 1021/R EV02 | 20 | NIL | NIL(NIL) | 10% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | | FITTING | SA105 | 33.4 | | | 515 | | 514 | 0 | 0 | | | | | | | | |
| 14 | | PIPE | SA106GRC | OD | 9.09 | ARC | 10 | | E7018-1 | | | 1021/R EV02 | 20 | NIL | NIL(NIL) | 10% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | | FITTING | SA105 | 33.4 | | | 20 | | 0 | 31 | 0 | | | | | | | | |
| 15 | | PIPE | SA106GRB | OD | 5.54 | ARC | 6 | | E7018-1 | | | 1021/R EV02 | 20 | NIL | NIL(NIL) | 10% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | | FITTING | SA105 | 60.3 | | | 220 | | 569 | 0 | 0 | | | | | | | | |
| 16 | | PIPE | SA106GRB | OD | 5.08 | ARC | 6 | | E7018-1 | | | 1021/R EV02 | 20 | NIL | NIL(NIL) | 10% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | | FITTING | SA105 | 48.3 | | | 40 | | 83 | 0 | 0 | | | | | | | | |

Notes:
(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.
(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
|---|---|---|---|---|---|---|---|
| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| JITENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 21.02.2022 | 4-80-449-84510 | 02 | OF | 02 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-BOILER INTEGRAL PIPING DRAINS ( 80 451)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-451-22784 | PIPE | SA335P22 | OD | 14.02 | TIG & ARC | 14.02 | ER90S-B3 | E9018-B3 | | | 1014/R EV03 | 150 * | 700±20 | 2.5 Mts./ mm (Minimum 60 Mts.) | 10% RT/ UT + 100% MPT 3% HARDNESS | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-451-22784 | FITTING | SA234WP22 | 73 | | | 34 | 850 | 272 | 340 | 68 | | | | | | | | |
| 2 | 1-80-451-22784 | PIPE | SA335P22 | OD | 14.02 | TIG & ARC | 14.02 | ER80S-B2 | E8018-B2 | | | 1012/R EV04 | 150 * | 700±20 | 2.5 Mts./ mm (Minimum 60 Mts.) | 10% RT/ UT + 100% MPT 3% HARDNESS | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-451-22784 | PIPE | SA182F12 | 73 | | | 4 | 100 | 32 | 40 | 8 | | | | | | | | |
| 3 | 1-80-451-22784 | PIPE | SA106GRB | OD | 10.97 | TIG & ARC | 10.97 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-451-22784 | FITTING | SA234WPB | 168.3 | | | 53 | 2703 | 795 | 1219 | 0 | | | | | | | | |
| 4 | 2-80-451-16154 | PIPE | SA106GRC | OD | 14.02 | TIG & ARC | 14.02 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 2-80-451-16154 | FITTING | SA234WPC | 73 | | | 20 | 500 | 160 | 200 | 40 | | | | | | | | |
| 5 | 2-80-451-16155 16156/16158 | PIPE | SA106GRC | OD | 6.35 | ARC | 7 | | E7018-1 | | | 1021/R EV02 | 20 | NIL | NIL(NIL) | 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 2-80-451-16155 16156/16158 | STUB | SA105 | 33.4 | | | 3 | | 6 | 0 | 0 | | | | | | | | |
| 6 | 2-80-451-16156 2-80-451-16158 | PIPE | SA106GRC | OD | 6.35 | TIG & ARC | 6.35 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 2-80-451-16156 2-80-451-16158 | PIPE | SA106GRC | 33.4 | | | 17 | 96 | 119 | 0 | 0 | | | | | | | | |
| 7 | 2-80-451-16157 | PIPE | SA106GRC | OD | 26 | TIG & ARC | 26 | ER70S-A1 | E7018-1 | | | 1004/R EV04 | 100 | 610 ± 15 | 2.5 Mts./ mm (Minimum 30 Mts.) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 2-80-451-16157 | FITTING | SA234WPC | 168.3 | | | 8 | 360 | 112 | 192 | 160 | | | | | | | | |
| 8 | 2-80-451-16160/16168 16169/16170/16171 | PIPE | SA335P22 | OD | 5.54 | ARC | 6 | | E9018-B3 | | | 1020/R EV01 | 150 | NIL | NIL(NIL) | 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 2-80-451-16160/16168 16169/16170/16171 | STUB | SA182F22 | 60.3 | | | 6 | | 17 | 0 | 0 | | | | | | | | |

Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

* Refer WPS for Preheat maintenance,Postheat,Interpass Temp. and Other Requirements.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
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| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| JTENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 21.02.2022 | 1-80-451-22784 | 01 | OF | 02 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-BOILER INTEGRAL PIPING DRAINS ( 80 451)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 9 | 2-80-451-16160/16168<br>16169/16170/16171 | PIPE | SA335P22 | OD | 5.54 | TIG & ARC | 5.54 | ER90S-B3 | E9018-B3 | | | 1013/R EV02 | 150 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT<br>3% HARDNESS | REFER NOTE-1 | REFER NOTE-1 | |
| | 2-80-451-16160/16168<br>16169/16170/16171 | PIPE | SA335P22 | 60.3 | | | 71 | 895 | 710 | 0 | 0 | | | | | | | | |
| 10 | 2-80-451-16161 | PIPE | SA106GRC | OD | 15.24 | TIG & ARC | 15.24 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 2-80-451-16161 | PIPE | SA106GRC | 88.9 | | | 11 | 264 | 88 | 110 | 55 | | | | | | | | |
| 11 | 2-80-451-16162 | PIPE | SA106GRC | OD | 20 | TIG & ARC | 20 | ER70S-A1 | E7018-1 | | | 1004/R EV04 | 20 | 610±15 | 2.5 Mts./ mm (Minimum 30 Mts.) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 2-80-451-16162 | FITTING | SA234WPC | 114.3 | | | 8 | 248 | 96 | 112 | 48 | | | | | | | | |
| 12 | 2-80-451-16172<br>2-80-451-16174 | PIPE | SA335P22 | OD | 20 | TIG & ARC | 20 | ER90S-B3 | E9018-B3 | | | 1014/R EV03 | 150 * | 700±20 | 2.5 Mts./ mm (Minimum 60 Mts.) | 100% RT/ UT + 100% MPT<br>3% HARDNESS | REFER NOTE-1 | REFER NOTE-1 | |
| | 2-80-451-16172<br>2-80-451-16174 | FITTING | SA234WP22 | 88.9 | | | 36 | 756 | 288 | 396 | 144 | | | | | | | | |
| 13 | 2-80-451-16175 | PIPE | SA335P22 | OD | 14.02 | TIG & ARC | 14.02 | ER90S-B3 | E9018-B3 | | | 1014/R EV03 | 150 * | 700±20 | 2.5 Mts./ mm (Minimum 60 Mts.) | 100% RT/ UT + 100% MPT<br>3% HARDNESS | REFER NOTE-1 | REFER NOTE-1 | |
| | 2-80-451-16175 | FITTING | SA234WP22 | 73 | | | 55 | 1375 | 440 | 550 | 110 | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |

Notes:
(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.
(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.
* Refer WPS for Preheat maintenance,Postheat,Interpass Temp. and Other Requirements.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
|---|---|---|---|---|---|---|---|
| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| JITENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 21.02.2022 | 1-80-451-22784 | 02 | OF | 02 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-LOW PRESSURE PIPING DRAINS (80453)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-453-23118 | PIPE | SA335P22 | OD | 5.54 | TIG & ARC | 5.54 | ER90S-B3 | E9018-B3 | | | 1013/R EV02 | 150 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT 3% HARDNESS | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-453-23118 | PIPE | SA335P22 | 60.3 | | | 25 | 315 | 250 | 0 | 0 | | | | | | | | |
| 2 | 1-80-453-23118 | PIPE | SA106GRC | OD | 5.54 | TIG & ARC | 5.54 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-453-23118 | PIPE | SA106GRC | 60.3 | | | 20 | 252 | 200 | 0 | 0 | | | | | | | | |
| 3 | 1-80-453-23118 | PIPE | SA106GRB | OD | 5.54 | TIG & ARC | 5.54 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-453-23118 | PIPE | SA106GRB | 60.3 | | | 35 | 441 | 350 | 0 | 0 | | | | | | | | |
| 4 | 1-80-453-23118 | PIPE | SA106GRC | OD | 5.08 | TIG & ARC | 5.08 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-453-23118 | PIPE | SA106GRC | 48.3 | | | 30 | 297 | 240 | 0 | 0 | | | | | | | | |
| 5 | 1-80-453-23118 | PIPE | SA106GRB | OD | 5.08 | TIG & ARC | 5.08 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-453-23118 | PIPE | SA106GRB | 48.3 | | | 40 | 396 | 320 | 0 | 0 | | | | | | | | |
| 6 | 1-80-453-23118 | PIPE | SA106GRC | OD | 9.09 | TIG & ARC | 9.09 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-453-23118 | PIPE | SA106GRC | 33.4 | | | 100 | 360 | 1400 | 0 | 0 | | | | | | | | |
| 7 | 1-80-453-23118 | PIPE | SA335P22 | OD | 9.09 | TIG & ARC | 9.09 | ER90S-B3 | E9018-B3 | | | 1014/R EV03 | 150 * | 700±20 | 2.5 Mts./mm (Min. 60 Mts.) | 100% RT/ UT + 100% MPT 3% HARDNESS | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-453-23118 | PIPE | SA335P22 | 33.4 | | | 25 | 90 | 350 | 0 | 0 | | | | | | | | |
| 8 | 1-80-453-23118 | PIPE | SA106GRC | OD | 4.55 | TIG & ARC | 4.55 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-453-23118 | PIPE | SA106GRC | 33.4 | | | 70 | 448 | 350 | 0 | 0 | | | | | | | | |

Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for Butt joints. Beyond the last root valve, 10% RT is applicable.

* Refer WPS for Preheat maintenance, Postheat, Interpass Temp. and Other Requirements.

| Rev.no. | Date: | Altered: | Approved: | Rev.no. | Date: | Altered: | Approved: |
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| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| JITENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 23.03.2022 | 4-80-453-84031 | 01 | OF | 04 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-LOW PRESSURE PIPING DRAINS (80453)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 9 | 1-80-453-23118 | PIPE | SA106GRB | OD | 4.55 | TIG & ARC | 4.55 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-453-23118 | PIPE | SA106GRB | 33.4 | | | 330 | 2112 | 1650 | 0 | 0 | | | | | | | | |
| 10 | 1-80-453-23118 | PIPE | SA335P22 | OD | 3.73 | TIG & ARC | 3.73 | ER90S-B3 | E9018-B3 | | | 1013/R EV02 | 150 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT 3% HARDNESS | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-453-23118 | PIPE | SA335P22 | 21.3 | | | 25 | 338 | 0 | 0 | 0 | | | | | | | | |
| 11 | 1-80-453-23118 | PIPE | SA106GRB | OD | 3.73 | TIG & ARC | 3.73 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-453-23118 | PIPE | SA106GRB | 21.3 | | | 90 | 1215 | 0 | 0 | 0 | | | | | | | | |
| 12 | 1-80-453-23118 | PIPE | SA106GRC | OD | 7.47 | TIG & ARC | 7.47 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 100% RT/ UT + 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-453-23118 | PIPE | SA106GRC | 21.3 | | | 15 | 82.8 | 15 | 0 | 0 | | | | | | | | |
| 13 | 1-80-453-23118 | PIPE | SA106GRB | OD | 3.73 | ARC | 4 | | E7018-1 | | | 1021/R EV02 | 20 | NIL | NIL(NIL) | 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-453-23118 | FITTINGS | SA105 | 21.3 | | | 360 | | 140 | 0 | 0 | | | | | | | | |
| 14 | 1-80-453-23118 | PIPE | SA106GRB | OD | 4.55 | ARC | 5 | | E7018-1 | | | 1021/R EV02 | 20 | NIL | NIL(NIL) | 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-453-23118 | FITTINGS | SA105 | 33.4 | | | 955 | | 953 | 0 | 0 | | | | | | | | |
| 15 | 1-80-453-23118 | PIPE | SA106GRB | OD | 5.08 | ARC | 6 | | E7018-1 | | | 1021/R EV02 | 20 | NIL | NIL(NIL) | 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-453-23118 | FITTINGS | SA105 | 48.3 | | | 169 | | 345 | 0 | 0 | | | | | | | | |
| 16 | 1-80-453-23118 | PIPE | SA106GRB | OD | 5.54 | ARC | 6 | | E7018-1 | | | 1021/R EV02 | 20 | NIL | NIL(NIL) | 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-453-23118 | FORGING | SA105 | 60.3 | | | 200 | | 518 | 0 | 0 | | | | | | | | |

Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for Butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
|---|---|---|---|---|---|---|---|
| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| JITENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 23.03.2022 | 4-80-453-84031 | 02 | OF | 04 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-LOW PRESSURE PIPING DRAINS (80453)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 17 | 1-80-453-23118 | PIPE | SA106GRC | OD | 7.47 | ARC | 8 | | E7018-1 | | | 1021/REV02 | 20 | NIL | NIL(NIL) | 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-453-23118 | FITTINGS | SA105 | 21.3 | | | 40 | | 18 | 15 | 0 | | | | | | | | |
| 18 | 1-80-453-23118 | PIPE | SA106GRC | OD | 9.09 | ARC | 10 | | E7018-1 | | | 1021/REV02 | 20 | NIL | NIL(NIL) | 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-453-23118 | FITTINGS | SA105 | 33.4 | | | 180 | | 0 | 263 | 0 | | | | | | | | |
| 19 | 1-80-453-23118 | PIPE | SA106GRC | OD | 10.15 | ARC | 11 | | E7018-1 | | | 1021/REV02 | 20 | NIL | NIL(NIL) | 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-453-23118 | FITTINGS | SA105 | 48.3 | | | 10 | | 0 | 28 | 0 | | | | | | | | |
| 20 | 1-80-453-23118 | PIPE | SA335P22 | OD | 3.73 | ARC | 4 | | E9018-B3 | | | 1020/REV01 | 150 | NIL | NIL(NIL) | 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-453-23118 | FITTINGS | SA182F22 | 21.3 | | | 190 | | 74 | 0 | 0 | | | | | | | | |
| 21 | 1-80-453-23118 | PIPE | SA335P22 | OD | 4.55 | ARC | 5 | | E9018-B3 | | | 1020/REV01 | 150 | NIL | NIL(NIL) | 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-453-23118 | FITTINGS | SA182F22 | 33.4 | | | 120 | | 120 | 0 | 0 | | | | | | | | |
| 22 | 1-80-453-23118 | PIPE | SA335P22 | OD | 5.08 | ARC | 6 | | E9018-B3 | | | 1020/REV01 | 150 | NIL | NIL(NIL) | 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-453-23118 | FORGING | SA182F22 | 48.3 | | | 10 | | 21 | 0 | 0 | | | | | | | | |
| 23 | 1-80-453-23118 | PIPE | SA335P22 | OD | 5.54 | ARC | 6 | | E9018-B3 | | | 1020/REV01 | 150 | NIL | NIL(NIL) | 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-453-23118 | FORGING | SA182F22 | 60.3 | | | 70 | | 182 | 0 | 0 | | | | | | | | |
| 24 | 1-80-453-23118 | PIPE | SA335P22 | OD | 4.78 | ARC | 5 | | E9018-B3 | | | 1020/REV01 | 150 | NIL | NIL(NIL) | 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-453-23118 | FORGING | SA182F22 | 21.3 | | | 10 | | 7 | 0 | 0 | | | | | | | | |

Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for Butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
|---|---|---|---|---|---|---|---|
| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| JITENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 23.03.2022 | 4-80-453-84031 | 03 | OF | 04 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-LOW PRESSURE PIPING DRAINS (80453)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 25 | 1-80-453-23118 | PIPE | SA335P22 | OD | 6.35 | ARC | 7 | | E9018-B3 | | | 1020/R EV01 | 150 | NIL | NIL(NIL) | 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-453-23118 | FITTINGS | SA182F22 | 33.4 | | | 10 | | 18 | 0 | 0 | | | | | | | | |
| 26 | 1-80-453-23118 | PIPE | SA335P22 | OD | 9.09 | ARC | 10 | | E9018-B3 | | | 1020/R EV01 | 150 | NIL | NIL(NIL) | 100% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-453-23118 | FITTINGS | SA182F22 | 33.4 | | | 130 | | 0 | 190 | 0 | | | | | | | | |
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Notes:
(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.
(2) Drain & vent piping: 100% RT upto the last root valve for Butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
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| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| JITENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 23.03.2022 | 4-80-453-84031 | 04 | OF | 04 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-ISOMETRIC OF SCAPH DRAIN TO FLASH TANK DRAIN TANK PIPING (80454)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 0-80-454-07508 | PIPE | SA106GRB | OD | 6.02 | TIG & ARC | 6.02 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 0-80-454-07508 | FITTING | SA234WPB | 114.3 | | | 21 | 559 | 441 | 0 | 0 | | | | | | | | |
| 2 | 0-80-454-07508 | PIPE | SA106GRB | OD | 6.02 | TIG & ARC | 6.02 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 0-80-454-07508 | VALVE | SA216WCB | 114.3 | | | 2 | 54 | 42 | 0 | 0 | | | | | | | | |
| 3 | 0-80-454-07508 | PIPE | SA106GRB | OD | 5.49 | TIG & ARC | 5.49 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 0-80-454-07508 | FITTING | SA234WPB | 88.9 | | | 16 | 314 | 240 | 0 | 0 | | | | | | | | |
| 4 | 0-80-454-07508 | PIPE | SA106GRB | OD | 5.08 | TIG & ARC | 5.08 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 0-80-454-07508 | FITTING | SA234WPB | 48.3 | | | 226 | 2238 | 1808 | 0 | 0 | | | | | | | | |
| 5 | 0-80-454-07508 | PIPE | SA106GRB | OD | 5.08 | TIG & ARC | 5.08 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 0-80-454-07508 | VALVE | SA216WCB | 48.3 | | | 64 | 634 | 512 | 0 | 0 | | | | | | | | |
| 6 | 0-80-454-07508 | PIPE | SA106GRB | OD | 5.54 | TIG & ARC | 5.54 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 0-80-454-07508 | FITTING | SA234WPB | 60.3 | | | 16 | 202 | 160 | 0 | 0 | | | | | | | | |
| 7 | 0-80-454-07508 | PIPE | SA106GRB | OD | 5.54 | ARC | 6/7 ◺ | ER70S-A1 | E7018-1 | | | 1021/ REV02 | 20 | NIL | NIL(NIL) | 10% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 0-80-454-07508 | FLANGE | SA515GR70 | 60.3 | | | 16 | NIL | 42 | 0 | 0 | | | | | | | | |
| 8 | 0-80-454-07508 | PIPE | SA106GRB | OD | 5.08 | ARC | 5/6 ◺ | ER70S-A1 | E7018-1 | | | 1021/ REV02 | 20 | NIL | NIL(NIL) | 10% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 0-80-454-07508 | FLANGE | SA515GR70 | 48.3 | | | 80 | NIL | 164 | 0 | 0 | | | | | | | | |

Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
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| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| JTENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 17.02.2022 | 0-80-454-07508 | 01 | OF | 01 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-LP CONDENSATE SUCTION DISCHARGE & RECIRCULATION PIPING ( 80 455)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-455-22761 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-455-22761 | FITTING | SA234WPB | 406.4 | | | 29 | 3828 | 870 | 1363 | 0 | | | | | | | | |
| 2 | 1-80-455-22761 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-455-22761 | VALVE | SA216WCB | 406.4 | | | 6 | 792 | 180 | 282 | 0 | | | | | | | | |
| 3 | 0-80-455-07515 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 0-80-455-07515 | FITTING | SA234WPB | 355.6 | | | 5 | 575 | 135 | 205 | 0 | | | | | | | | |
| 4 | 0-80-455-07515 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 0-80-455-07515 | FITTING | SA234WPB | 323.9 | | | 55 | 5720 | 1320 | 2035 | 0 | | | | | | | | |
| 5 | 0-80-455-07515 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 0-80-455-07515 | VALVE | SA216WCB | 323.9 | | | 12 | 1248 | 288 | 444 | 0 | | | | | | | | |
| 6 | 0-80-455-07515 | PIPE | SA106GRB | OD | 8.18 | TIG & ARC | 8.18 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 0-80-455-07515 | FITTING | SA234WPB | 219.1 | | | 22 | 1540 | 374 | 396 | 0 | | | | | | | | |
| 7 | 0-80-455-07515 | PIPE | SA106GRB | OD | 8.18 | TIG & ARC | 8.18 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 0-80-455-07515 | VALVE | SA216WCB | 219.1 | | | 12 | 840 | 204 | 216 | 0 | | | | | | | | |
| 8 | 1-80-455-22762 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-455-22762 | FITTING | SA234WPB | 406.4 | | | 2 | 264 | 60 | 94 | 0 | | | | | | | | |

Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
|---|---|---|---|---|---|---|---|
| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| JITENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 18.02.2022 | 4-80-455-83253 | 01 | OF | 03 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-LP CONDENSATE SUCTION DISCHARGE & RECIRCULATION PIPING ( 80 455)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 9 | 1-80-455-22762 | PIPE | SA106GRB | OD | 9.27 | TIG & ARC | 9.27 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-455-22762 | FITTING | SA234WPB | 219.1 | | | 20 | 1380 | 340 | 500 | 0 | | | | | | | | |
| 10 | 1-80-455-22762 | PIPE | SA106GRB | OD | 9.27 | TIG & ARC | 9.27 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-455-22762 | VALVE | SA216WCB | 219.1 | | | 8 | 552 | 136 | 200 | 0 | | | | | | | | |
| 11 | 1-80-455-22762 | PIPE | SA106GRB | OD | 5.49 | TIG & ARC | 5.49 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-455-22762 | FITTING | SA234WPB | 88.9 | | | 11 | 216 | 165 | 0 | 0 | | | | | | | | |
| 12 | 1-80-455-22762 | PIPE | SA106GRB | OD | 5.49 | TIG & ARC | 5.49 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-455-22762 | VALVE | SA216WCB | 88.9 | | | 4 | 79 | 60 | 0 | 0 | | | | | | | | |
| 13 | 1-80-455-22763 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-455-22763 | FITTING | SA234WPB | 609.6 | | | 8 | 1620 | 370 | 581 | 0 | | | | | | | | |
| 14 | 1-80-455-22763 | PIPE | SA106GRB | OD | 5.54 | TIG & ARC | 5.54 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-455-22763 | FITTING | SA234WPB | 60.3 | | | 6 | 76 | 60 | 0 | 0 | | | | | | | | |
| 15 | 1-80-455-22764 | PIPE | SA335P11 | OD | 15.09 | TIG & ARC | 15.09 | ER70S-A1 | E7018-A1 | | | 1018/R EV05 | 150 | 660±10 | 2.5 Mts./mm (Minimum 60 Mts.) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-455-22764 | FITTING | SA234WPC | 273 | | | 6 | 528 | 120 | 198 | 60 | | | | | | | | |
| 16 | 1-80-455-22764 | PIPE | SA106GRC | OD | 15.09 | TIG & ARC | 15.09 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-455-22764 | FITTING | SA234WPC | 273 | | | 12 | 1056 | 240 | 396 | 120 | | | | | | | | |

Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
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| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| JITENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 18.02.2022 | 4-80-455-83253 | 02 | OF | 03 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-LP CONDENSATE SUCTION DISCHARGE & RECIRCULATION PIPING ( 80 455)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 17 | 1-80-455-22764 | PIPE | SA106GRC | OD | 36 | TIG & ARC | 36 | ER70S-A1 | E7018-1 | | | 1004/R EV04 | 100 | 610±15 | 2.5 Mts./mm (Minimum 30 Mts.) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-455-22764 | PIPE | SA106GRC | 273 | | | 5 | 395 | 100 | 165 | 325 | | | | | | | | |
| 18 | 1-80-455-22764 | PIPE | SA106GRC | OD | 5.54 | TIG & ARC | 5.54 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-455-22764 | CAP | SA515GR70 | 60.3 | | | 4 | 51 | 40 | 0 | 0 | | | | | | | | |
| 19 | 1-80-455-22764 | PIPE | SA106GRB | OD | 5.54 | ARC | 6 | | E7018-1 | | | 1021/R EV02 | 20 | NIL | NIL(NIL) | 10% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-455-22764 | STUB | SA105 | 60.3 | | | 8 | | 21 | 0 | 0 | | | | | | | | |
| 20 | 1-80-455-22765 | PIPE | SA335P22 | OD | 15.09 | TIG & ARC | 15.09 | ER80S-B2 | E8018-B2 | | | 1012/R EV04 | 150 * | 700±20 | 2.5 Mts./mm (Minimum 60 Mts.) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-455-22765 | FITTING | SA234WP11 | 273 | | | 3 | 264 | 60 | 99 | 30 | | | | | | | | |
| 21 | 1-80-455-22765 | PIPE | SA335P22 | OD | 15.09 | TIG & ARC | 15.09 | ER90S-B3 | E9018-B3 | | | 1014/R EV03 | 150 * | 700±20 | 2.5 Mts./mm (Minimum 60 Mts.) | 10% RT 3% HARDNESS | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-455-22765 | CAP | SA387GR22 | 273 | | | 1 | 88 | 20 | 33 | 10 | | | | | | | | |
| 22 | 1-80-455-22765 | FITTING | SA234WP11 | OD | 15.09 | TIG & ARC | 15.09 | ER70S-A1 | E7018-A1 | | | 1018/R EV05 | 150 | 660±10 | 2.5 Mts./mm (Minimum 60 Mts.) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-455-22765 | NOZZLE | SA515GR70 | 273 | | | 1 | 88 | 20 | 33 | 10 | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
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Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

* Refer WPS for Preheat maintenance, Postheat, Interpass Temp. and Other Requirements.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
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| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| JITENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 18.02.2022 | 4-80-455-83253 | 03 | OF | 03 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-FLASH TANK DRAIN MANIFOLDS ( 80457)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 1-80-457-22919 | PIPE | SA335P22 | OD | 12.7 | TIG & ARC | 12.7 V | ER90S-B3 | E9018-B3 | | | 1014/REV03 | 150 * | 700±20 | 2.5 Mts./mm (Minimum 60 Mts.) | 10% RT 3% HARDNESS | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-457-22919 | FITTING | SA234WP22 | 219.1 | | | 4 | 292 | 68 | 100 | 20 | | | | | | | | |
| 2 | 1-80-457-22919 | PIPE | SA335P11 | OD | 10.31 | TIG & ARC | 10.31 V | ER70S-A1 | E7018-1 | | | 1017/REV04 | 150 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-457-22919 | CAP / NOZZLE | SA515GR70 | 219.1 | | | 4 | 272 | 68 | 116 | 0 | | | | | | | | |
| 3 | 1-80-457-22919 | PIPE | SA106GRB | OD | 8.18 | TIG & ARC | 8.18 V | ER70S-A1 | E7018-1 | | | 1003/REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 1-80-457-22919 | FITTING | SA234WPB | 219.1 | | | 5 | 350 | 85 | 90 | 0 | | | | | | | | |
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Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

* Refer WPS for Preheat maintenance, Postheat, Interpass Temp. and Other Requirements.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
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| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| JITENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 18.02.2022 | 4-80-457-83764 | 01 | OF | 01 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-HP FLASH TANK DRAIN TO CONDENSER ( 80459)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 2-80-459-16336 | PIPE | SA106GRB | OD | 6.35 | TIG & ARC | 6.35 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 2-80-459-16336 | FITTING | SA234WPB | 323.9 | | | 12 | 1284 | 288 | 204 | 0 | | | | | | | | |
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# REFERENCE ERECTION/ FIELD WELDING SCHEDULE-BOILER WATER WASH TO AND FROM UNIT (80 471)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.Sno. | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.15 | Dia4.0 | | | | | |
| 1 | NA | PIPE | IS1239 | OD | 4 | ARC | 4 | NA | E7018-1 | | | 1201/ Rev 03 | As per Site FQP | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA105 | 33.4 | | | 145 | | 110 | 0 | 0 | | | | | |
| 2 | NA | PIPE | IS1239 | OD | 4.8 | ARC | 4.8 | NA | E7018-1 | | | 1201/ Rev 03 | As per Site FQP | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA105 | 88.9 | | | 55 | | 170 | 0 | 0 | | | | | |
| 3 | NA | PIPE | SA106GRC | OD | 11.13 | TIG & ARC | 11.13 | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | As per Site FQP | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA216WCC | 88.9 | | | 75 | 1380 | 600 | 300 | 0 | | | | | |
| 4 | NA | PIPE | IS3589 | OD | 6.4 | TIG & ARC | 6.4 | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | As per Site FQP | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPB | 219.1 | | | 70 | 3612 | 1100 | 0 | 0 | | | | | |
| 5 | NA | PIPE | IS3589 | OD | 6.4 | TIG & ARC | 6.4 | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | As per Site FQP | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPB | 273 | | | 55 | 3580 | 1100 | 0 | 0 | | | | | |
| 6 | NA | PIPE | IS3589 | OD | 8 | TIG & ARC | 8 | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | As per Site FQP | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPB | 355.6 | | | 85 | 7200 | 2200 | 0 | 0 | | | | | |
| 7 | NA | PIPE | SA106GRB | OD | 5.49 | TIG & ARC | 5.49 | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | As per Site FQP | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPB | 88.9 | | | 5 | 120 | 20 | 0 | 0 | | | | | |
| 8 | NA | PIPE | SA106GRC | OD | 9.09 | TIG & ARC | 9.09 | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | As per Site FQP | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPC | 33.4 | | | 5 | 30 | 20 | 0 | 0 | | | | | |

Notes:

(1) REFER DOC NO: AA/CQ/GL/011 (Latest Revision) - MANUAL FOR WELDING, HEAT TREATMENT AND NON DESTRUCTIVE TESTING FOR POWER SECTOR"

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
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| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| B.B.GHADAI | IDB RAJU | SARAVANAN | NANTHINI | 29.06.2021 | | 01 | OF | 02 | 00 |

# ERECTION/ FIELD WELDING SCHEDULE-BOILER WATER WASH TO AND FROM UNIT(80 471)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.15 | Dia4.0 | | | | | |
| 9 | NA | PIPE | SA106GRB | OD | 9.27 | TIG & ARC | 9.27 V | ER70S-A1 | E7018-1 | | | 1003/ Rev 04 | As per Site FQP | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPB | 273 | | | 20 | 1200 | 1560 | 500 | 0 | | | | | |
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Notes:
(1) REFER DOC NO: AA/CQ/GL/011 (Latest Revision) - MANUAL FOR WELDING, HEAT TREATMENT AND NON DESTRUCTIVE TESTING FOR POWER SECTOR"

| Rev.no. | Date: | Altered: | |
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| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| B.B.GHADAI | IDB RAJU | SARAVANAN | NANTHINI | 29.06.2021 | | 02 | OF | 02 | 00 |

# REFERENCE- ERECTION/ FIELD WELDING SCHEDULE-FIRE WATER-OTHER AREAS (80 480)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.15 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | NA | PIPE+PIPE | IS1239 | OD | 4 | SMAW | 4 | NA | E7018-1 | | | 1213/ REV00 | 10 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTINGS | SA105 | 33.4 | | | 765 | NA | 561 | 0 | 0 | | | | | | | | |
| 2 | NA | PIPE+PIPE | IS1239 | OD | 4 | SMAW | 4 | NA | E7018-1 | | | 1213/ REV00 | 10 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTINGS | SA105 | 48.3 | | | 165 | NA | 175 | 0 | 0 | | | | | | | | |
| 3 | NA | PIPE+PIPE | IS1239 | OD | 4.5 | SMAW | 4.5 | NA | E7018-1 | | | 1213/ REV00 | 10 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTINGS | SA105 | 60.3 | | | 120 | NA | 250 | 0 | 0 | | | | | | | | |
| 4 | NA | PIPE+PIPE | IS1239 | OD | 4.8 | GTAW + SMAW | 4.8 | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPB | 88.9 | | | 1330 | 266000 | 3990 | 0 | 0 | | | | | | | | |
| 5 | NA | PIPE+PIPE | IS3589 | OD | 6.4 | GTAW + SMAW | 6.4 | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPB | 219.1 | | | 2 | 100 | 30 | 0 | 0 | | | | | | | | |
| 6 | NA | PIPE+PIPE | IS3589 | OD | 6.4 | GTAW + SMAW | 6.4 | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPB | 273.1 | | | 40 | 2570 | 760 | 0 | 0 | | | | | | | | |
| 7 | NA | PIPE+PIPE | IS3589 | OD | 8 | GTAW + SMAW | 8 | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL | 10% RT | REFER NOTE-1 | REFER NOTE-1 | REFER NOTE-1 |
| | | FITTING | SA234WPB | 355.6 | | | 72 | 5904 | 2736 | 0 | 0 | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
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Notes:

(1) REFER DOC NO: AA/ CQ/ GL/ 011 (Latest Revision) - MANUAL FOR WELDING, HEAT TREATMENT AND NON DESTRUCTIVE TESTING FOR POWER SECTOR"

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
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| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | REV. NO. |
|---|---|---|---|---|---|---|---|---|
| B.B.GHADAI | IDB RAJU | SARAVANAN | NANTHINI | 08.09.2021 | 4-80-480-84432-00 | 01 | OF | 01 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-HP FLASH TANK VENT TO CONDENSER (80 493)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 2-80-493-16337 | PIPE | SA515GR70 | OD | 10 | TIG & ARC | 10 V | ER70S-A1 | E7018-1 | | | 1003/REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 2-80-493-16337 | BEND | SA515GR70 | 1118 | | | 5 | 1932 | 441 | 693 | 0 | | | | | | | | |
| 2 | 2-80-493-16337 | PIPE | SA515GR70 | OD | 10 | TIG & ARC | 10 V | ER70S-A1 | E7018-1 | | | 1003/REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 2-80-493-16337 | BELLOW | SA515GR70 | 1118 | | | 4 | 1546 | 353 | 555 | 0 | | | | | | | | |
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Notes:
(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.
(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
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| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
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| JITENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 18.02.2022 | 4-80-493-83773 | 01 | OF | 01 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-LP FLASH TANK VENT TO CONDENSER (80 494)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 2-80-494-16338 | PIPE | SA515GR70 | OD | 10 | TIG & ARC | 10 V | ER70S-A1 | E7018-1 | | | 1003/REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 2-80-494-16338 | BEND | SA515GR70 | 1118 | | | 1 | 387 | 89 | 139 | 0 | | | | | | | | |
| 2 | 2-80-494-16338 | PIPE | SA515GR70 | OD | 10 | TIG & ARC | 10 V | ER70S-A1 | E7018-1 | | | 1003/REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 2-80-494-16338 | BELLOW | SA515GR70 | 1118 | | | 6 | 2319 | 530 | 832 | 0 | | | | | | | | |
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Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
|---|---|---|---|---|---|---|---|
| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| JITENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 18.02.2022 | 4-80-494-83774 | 01 | OF | 01 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-LP FLASH TANK DRAIN TO CONDENSER ( 80495)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 2-80-495-16339 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 2-80-495-16339 | FITTING | SA234WPB | 508 | | | 11 | 1837 | 418 | 660 | 0 | | | | | | | | |
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# REF:ERECTION/ FIELD WELDING SCHEDULE-LOW PRESSURE CONDENSATE DISCHARGE TO HIGH PRESSURE FLASH TANK (80 545)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | 0-80-545-07514 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 0-80-545-07514 | FITTING | SA234WPB | 355.6 | | | 61 | 7015 | 1647 | 2501 | 0 | | | | | | | | |
| 2 | 0-80-545-07514 | PIPE | SA106GRB | OD | 9.53 | TIG & ARC | 9.53 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | 0-80-545-07514 | VALVE | SA216WCB | 355.6 | | | 4 | 460 | 108 | 164 | 0 | | | | | | | | |
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Notes:
(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.
(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | |
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| Rev.no. | Date: | Altered: | |
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| | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| JITENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 18.02.2022 | 4-80-545-83252 | 01 | OF | 01 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-LOW PRESSURE DOSING PIPING ( 80 601)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P. Sno. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | | PIPE | SA106GRB | OD | 4.55 | TIG & ARC | 4.55 V | ER70S-A1 | E7018-1 | | | 1003/ REV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | | PIPE | SA106GRB | 33.4 | | | 15 | 96 | 75 | 0 | 0 | | | | | | | | |
| 2 | | PIPE | SA312TP304H | OD | 2.77 | TIG & ARC | 2.77 V | ER347 | E316 | | | 1016/ REV02 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | Refer WPS for Backing / Purging Gas |
| | | PIPE | SA312TP304H | 21.3 | | | 5 | 68 | 0 | 0 | 0 | | | | | | | | |
| 3 | | PIPE | SA312TP304H | OD | 3.73 | TIG & ARC | 3.73 V | ER347 | E316 | | | 1016/ REV02 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | Refer WPS for Backing / Purging Gas |
| | | PIPE | SA312TP304H | 21.3 | | | 5 | 68 | 0 | 0 | 0 | | | | | | | | |
| 4 | | PIPE | SA312TP304H | OD | 3.38 | TIG & ARC | 3.38 V | ER347 | E316 | | | 1016/ REV02 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | Refer WPS for Backing / Purging Gas |
| | | PIPE | SA312TP304H | 33.4 | | | 90 | 576 | 450 | 0 | 0 | | | | | | | | |
| 5 | | PIPE | SA106GRB | OD | 4.55 | ARC | 5 ◺ | | E7018-1 | | | 1021/ REV02 | 20 | NIL | NIL(NIL) | 10% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | | STUB | SA105 | 33.4 | | | 15 | | 16 | 0 | 0 | | | | | | | | |
| 6 | | PIPE | SA312TP304H | OD | 3.73 | ARC | 4 ◺ | | E308 | | | 1217/ REV01 | 20 | NIL | NIL(NIL) | 100% LPT | REFER NOTE-1 | REFER NOTE-1 | |
| | | PIPE | SA312TP304H | 21.3 | | | 25 | | 10 | 0 | 0 | | | | | | | | |
| 7 | | PIPE | SA312TP304H | OD | 3.38 | ARC | 4 ◺ | | E308 | | | 1217/ REV01 | 20 | NIL | NIL(NIL) | 100% LPT | REFER NOTE-1 | REFER NOTE-1 | |
| | | PIPE | SA312TP304H | 33.4 | | | 100 | | 67 | 0 | 0 | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |

Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
|---|---|---|---|---|---|---|---|
| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| JITENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 19.02.2022 | 4-80-601-84507 | 01 | OF | 01 | 00 |

# REF:ERECTION/ FIELD WELDING SCHEDULE-FUEL OIL SUPPLY AND RETURN PIPING (80 650)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | | PIPE | SA106GRB | OD | 4.55 | TIG & ARC | 4.55 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | | FITTING | SA234WPB | 33.4 | | | 11 | 71 | 55 | 0 | 0 | | | | | | | | |
| 2 | | PIPE | SA106GRB | OD | 5.54 | TIG & ARC | 5.54 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | | FITTING | SA234WPB | 60.3 | | | 30 | 378 | 300 | 0 | 0 | | | | | | | | |
| 3 | | PIPE | SA106GRB | OD | 5.49 | TIG & ARC | 5.49 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | | FITTING | SA234WPB | 88.9 | | | 145 | 2842 | 2175 | 0 | 0 | | | | | | | | |
| 4 | | PIPE | SA106GRB | OD | 6.02 | TIG & ARC | 6.02 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | | FITTING | SA234WPB | 114.3 | | | 5 | 133 | 105 | 0 | 0 | | | | | | | | |
| 5 | | PIPE | SA106GRB | OD | 7.11 | TIG & ARC | 7.11 V | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | | FITTING | SA234WPB | 168.3 | | | 145 | 7685 | 2175 | 1595 | 0 | | | | | | | | |
| 6 | | PIPE | SA106GRB | OD | 4.55 | ARC | 5 ◺ | | E7018-1 | | | 1021/R EV02 | 20 | NIL | NIL(NIL) | 10% MPT | REFER NOTE-1 | REFER NOTE-1 | |
| | | STUB | SA105 | 33.4 | | | 10 | | 11 | 0 | 0 | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | | | | | | | |

Notes:
(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.
(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
|---|---|---|---|---|---|---|---|
| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| JITENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 19.02.2022 | 4-80-650-83181 | 01 | OF | 01 | 00 |

# REF :ERECTION/ FIELD WELDING SCHEDULE-LUBE OIL PIPING SYSTEM ( 80 673)

| Sl.No. | Drg. No. for weld location | Description of parts to be welded | Matl. Spec. | Dimensions | | Process of Welding | Type of weld | Electrode filler spec. | | | | W.P.S no. | Min pre heat temp. | Heat Treatment | | NDT method/ Quantum | Ref. Spec. No. | Acc. Norm. Ref. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ID/ OD | Thick | | | TIG | Arc spec | | | | | Temp. | Hold time per mm in minutes | | | | |
| | | Part-1 | Part-1 | Size | | | | Qty (gms) | Qty(nos) | | | | | | | | | | |
| | | Part-2 | Part-2 | mm | mm | | Qty | Dia2.4 | Dia2.5 | Dia3.2 | Dia4.0 | | in deg C | in deg C | | | | | |
| 1 | | PIPE | SA106GRB | OD | 5.49 | TIG & ARC | 5.49 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | | FITTING | SA234WPB | 88.9 | | | 475 | 9310 | 7125 | 0 | 0 | | | | | | | | |
| 2 | | PIPE | SA106GRB | OD | 5.54 | TIG & ARC | 5.54 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | | FITTING | SA234WPB | 60.3 | | | 30 | 378 | 300 | 0 | 0 | | | | | | | | |
| 3 | | PIPE | SA106GRB | OD | 4.55 | TIG & ARC | 4.55 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | | FITTING | SA234WPB | 33.4 | | | 35 | 224 | 175 | 0 | 0 | | | | | | | | |
| 4 | | PIPE | SA106GRB | OD | 3.73 | TIG & ARC | 3.73 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | | FITTING | SA234WPB | 21.3 | | | 5 | 68 | 0 | 0 | 0 | | | | | | | | |
| 5 | | PIPE | SA106GRB | OD | 5.08 | TIG & ARC | 5.08 | ER70S-A1 | E7018-1 | | | 1003/R EV04 | 20 | NIL | NIL(NIL) | 10% RT | REFER NOTE-1 | REFER NOTE-1 | |
| | | FITTING | SA234WPB | 48.3 | | | 5 | 50 | 40 | 0 | 0 | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | |

Notes:

(1) Refer to the Latest Manual AA/CQ/GL/011 Part III NDEM latest revision.

(2) Drain & vent piping: 100% RT upto the last root valve for butt joints. Beyond the last root valve, 10% RT is applicable.

| Rev.no. | Date: | Altered: | | Rev.no. | Date: | Altered: | |
|---|---|---|---|---|---|---|---|
| | | Approved: | | | | Approved: | |

| PREPARED BY | DESIGN/ CHD. | DESIGN/ APPD. | QA-CHD./ APPRD. | DATE | DRAWING NO: | SHEET NO: | | | REV. NO. |
|---|---|---|---|---|---|---|---|---|---|
| JITENDRA | I D B RAJU | SARAVANAN C | D SANDRA PRIYA | 19.02.2022 | 4-80-673-84506 | 01 | OF | 01 | 00 |

E-mail : info@desein.com
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**D E S E I N**
DESEIN PRIVATE LIMITED
C O N S U L T I N G E N G I N E E R S
DESEIN HOUSE, GREATER KAILASH – II, NEW DELHI-110 048
CIN: U74899DL1970PTC005474

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**Ref: D- 4039/TANGEDCO/0208**
**Date: 21st September 2018**

**The Chief Engineer/ Projects II,**
**Tamil Nadu Generation & Distribution Corporation Limited,**
**1st Floor, New EB Quarters**
**NPKRR Maaligai**
**144, Anna Salai**
**Chennai – 600002**

**Attention : Mr U.S.Pongiannan, B.E**

**Subject : Job No. D-4039 – TANGEDCO – 2x660 MW Udangudi Supercritical TPS Stage I – PAINTING SCHEME FOR PIPING**

**Reference : BHEL E-Mail Dated: 05.09.2018**

**Dear Sir,**

Approval/comments on the drawings listed in the attached sheet are enclosed. The column against each drawing refers to the remarks applicable to the particular drawing as indicated below:

**REMARKS**

A* - Drawing submitted as approved, proceed with fabrication.

B - Drawing approved subject to comments noted, proceed with fabrication, considering our comments. Correct as necessary and resubmit for record.

C - See attached memo.

D - Correct your original drawing incorporating our comments and resubmit for approval.

E - Information furnished is noted.

Thanking you and assuring you our best services at all times.

**Very truly yours,**
**DESEIN PRIVATE LIMITED**
**Consulting Engineers**

**E.V.ANAND**
**EXECUTIVE DIRECTOR (ENGG.)**

**Desein Ref: 0071** **Date: 10.07.2018**

| S.No. | Drawing/Document No. | Rev | Description | Remarks |
|---|---|---|---|---|
| 1. | 7366:QPC:11 | 1 | PAINTING SCHEME FOR PIPING | A |

BHARAT HEAVY ELECTRICALS LIMITED
PIPING CENTRE, CHENNAI- 17
QUALITY ASSURANCE & CONTROL DEPT.

# PAINTING SCHEME FOR PIPING

**PROJECT NAME :** UDANGUDI THERMAL POWER STATION STAGE-I (2X660 MW)

**BHEL CUSTOMER Nos :** 7366, 7367, 7368 & 7369

**QPNo:** 7366:QPC:11
**REV.NO:** 01
**DATE :** 27.08.2018

| Sl. NO | PGMA / Description | Surface Preparation & Surface Profile | Primer coat | | Intermediate coat | | | Finish coat | | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Primer | No of coats & DFT | Paint | No of coats & DFT | Shade | Paint | No of coats & DFT | Shade | Total DFT Microns (Min.) | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | | 9 | 10 | 11 | 12 | 13 |
| 1 | Insulated Piping, components (MS / HRH / CRH / Aux Steam lines, Tanks&Vessels.. ) | SSPC-SP3/ Power Tool Cleaning | Redoxide Zinc Phosphate Primer (Alkyd Base) to IS12744 | 2 (30 microns per coat. ) | ----- | ----- | ----- | ----- | ----- | Red Oxide | 60 | |
| 2 | Uninsulated Piping, components (Spray Water / Condensate lines, Tanks & Vessels..) | Blast cleaning to Sa2½ with surface profile 35-50 microns | Inorganic Ethyl Zinc Silicate Primer. | 1 (75 microns per coat) | Epoxy resin with MIO | 2 (100 microns per coat) | ----- | Aliphatic Acrylic Polyurethane finish Paint to IS13213 | $1 (75 microns per coat) | Smoke Grey Shade No 692 of IS 5 | 350 | Refer Note 4 |
| 3 | Structures & components other than CLH&VLH | Blast cleaning to Sa2½ with surface profile 35-50 microns | Inorganic Ethyl Zinc Silicate Primer. | 1 (75 microns per coat) | Epoxy resin with MIO | 2 (100 microns per coat) | ----- | Aliphatic Acrylic Polyurethane finish Paint to IS13213 | $1 (75 microns per coat) | Smoke Grey Shade No 692 of IS 5 | 350 | Refer Note 4 |
| 4 | Hangers & Supports - CLH & VLH | Abrasive Blast cleaning to Sa2½ (35-50 microns ) | Epoxy Zinc rich primer to IS 14589 Gr.II, %VS = 35 Min | 1 (40 microns per coat) | ----- | ----- | ----- | Aliphatic Acrylic Polyurethane paint ,%VS = 40 min | 1 (30 microns per coat) | Phirozi Blue Shade No.176 of IS 5 | 70 | Refer Note 3 |
| 5 | Pipe Clamps. | SSPC-SP3/ Power Tool Cleaning | Redoxide Zinc Phosphate Primer (Alkyd Base) to IS12744 | 1 (30 microns per coat) | ----- | ----- | ----- | Synthetic enamel paint long oil alkyd to IS 2932 | 2 (20 Microns per Coat) | Refer Note 1 | 70 | Refer Note 1 |
| 6 | Stainless steel / Galvanized items | No paint | | | | | | | | | | |
| 7 | Internal surface coating for ECW Tank | Blast cleaning to Sa2½ with surface profile 35-50 microns | Epoxy Zinc rich primer to IS 14589 Gr.II, %VS = 35 Min | 1 (75 microns per coat) | ----- | ----- | ----- | Epoxy based Polyamide cured finish paint | 2 (125 microns per coat) | Smoke Grey Shade No 692 of IS 5 | 300 | |

Note 1: Smoke grey shade for Carbon Steel ; White shade for Alloy Steel Clamps.

Note 2: All items (Pipes, Tubes, Plates etc.,) cut to size at site shall be painted with one coat of 30 microns of Red oxide Zinc Phosphate Primer (Surface Preparation :PowerTool Cleaning/ SSPC-SP3).

Note 3: For other than CLH & VLH : Shall be as per sl. No.5 above.

Note 4: Shade for finish coat to be done at site shall be as per project specification/contract requirement.

$ - Aliphatic Acrylic Polyurethane paint shall be applied at site.

| PREPARED BY : J NANTHINI, Sr.Engr/QA | APPROVED BY: VIVEKANANDA YELLU,Dy.Mgr/QA | For Customer use | Page 1 of 1 |
|---|---|---|---|

| | | |
|---|---|---|
| PROJECT | 2 X 660 MW Udangudi Supercritical Thermal Power Project - Stage-1 | |
| | OWNER | TAMILNADU GENERATION & DISTRIBUTION CORPORATION LIMITED |
| | OWNER'S CONSULTANT:- | DESEIN PRIVATE LIMITED<br>DESEIN HOUSE, NEW DELHI |
| | EPC CONTRACTOR:- | BHARAT HEAVY ELECTRICALS LTD<br>BHEL PIPING CENTRE CHENNAI |
| LOGO | EPC CONSULTANT:- | XXXXXXXXXXXXXXXXXXXXX |
| LOGO | VENDOR | XXXXXXXXXX |

DOCUMENT TITLE:

# PAINTING SCHEME FOR LP PIPING

| | | |
|---|---|---|
| DOCUMENT NO. | 7366:QPC:12 | REV 02 |
| SUB VENDER DOCUMENT NO. | | |

**PROJECT : UDANGUDI THERMAL POWER STATION STAGE-I (2X660 MW)**

**BHEL Doc No :** QPNo: 7366:QPC:12 Rev 02

**Document Description :** PAINTING SCHEME FOR LP PIPING

**Customer/Consultant ref : D.577/2018 dt.12.12.2018**

| Sl.No | TANGEDCO / DESEIN Comments | BHEL Response dt:01-10-18 | TANGEDCO'S REPSONSE | BHEL REPLY DT 13.12.18 |
|---|---|---|---|---|
| 1 | **Clause 3 – Internal Surface – revise in line with Volume II, Section 2.25, Annexure 25.1.2, Sheet 27 of 31, Mechanical of Specification and revise accordingly.** | **Indicated paint is only for other than sea water application.**<br><br>**Volume II, Section 2.25, Annexure 25.1.2, Sheet 27 of 31 – is addressing for Cooling water lines used for Sea water application.**<br><br>**For these lines (Sea water application) refer clause 1 of painting scheme.** | **Reply not understood. Please revise as per Volume II, Section 2.25, Annexure 25.1.2, Sheet 26 of 31** | **Cl 3 – Internal Surface – Other than Sea water handling :: BHEL proposed painting specification is superior and better than the Contract specification requirement ie Solvent based IZS + Coal Tar Epoxy.** |
| 2 | **Clause 4 – External Surface – revise in line with Volume II, Section 2.25, Annexure 25.1.2, Sheet 27 of 31, Mechanical of Specification and revise accordingly.** | **External protection incorporated in revised (01) painting scheme inline with specification. Paint System Total DFT – 285microns.** | **The Painting shall be inline with Volume II, Section 2.25, Annexure 25.1.2, Sheet 26& 27 of 31.** | **Cl 4 – External surface – Over ground piping :: BHEL proposed painting scheme is inline with in line with Contract specification.** |

**BHARAT HEAVY ELECTRICALS LIMITED**
**PIPING CENTRE, CHENNAI– 17**
QUALITY ASSURANCE & CONTROL DEPT.

# PAINTING SCHEME FOR LP PIPING

( CW / ACW / ECW / Plant water, Air Piping, etc..., )

**PROJECT NAME : - UDANGUDI THERMAL POWER STATION STAGE-I (2X660 MW)**

**BHEL CUSTOMER Nos : 7366, 7367, 7368 & 7369**

**QPNo: 7366:QPC:12**
**REV.NO: 02**
**Dt : 13.12.2018**

| Sl. NO | PGMA / Description | Surface Preparation & Surface Profile | Primer coat | | Intermediate coat | | | Finish coat | | | Total DFT Microns (Min.) | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Primer | No of coats | Paint | No of coats | Shade | Paint | No of coats | Shade | | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 1 | (a) Internal Surface - Steel Pipe - Seawater handling | Blast Cleaning SSPC SP-10 / SA 2½ *(Refer Note 1)* | Isophthalic polyester / acrylic co-polymer filled with glass flakes coating | | | | | | | | 1000 Microns (min) | (Refer Note 2) |
| | (b) Holiday test (Refer Note 3) | Holiday testing as per Paint Manufacturer's Quality Plan approved by BHEL. Holiday test Equipment shall be calibrated before testing. | | | | | | | | | | |
| 2 | External Surface --Buried Piping / Encased in concrete (Temporary Protection for transportation from works to site). **Further protection to be done by BHEL Erection Group as per Contract requirement. | SSPC-SP3 / Power Tool Cleaning | Red Oxide Zinc Phosphate (Alkyd base to IS 12744) | 1 (30 Microns per coat ) | ----- | ----- | ----- | ----- | ----- | ----- | 30 Microns | |
| 2A | External Surface --Buried Piping - Not Encased in concrete | Blast cleaning to SSPC SP-10 / SA 2½ | Shall be as per cl.8.3.0 of Vol-II Section 2-20 Piping and vlv and ftgs_R0 | | | | | | | | | Shall be done by BHEL's Erection Group. |
| 3 | Internal Surface -Other than Sea water handling - ( For 800Nb and above diameters) | Blast cleaning to SSPC SP-10 / SA 2½ | Epoxy Polyamide resin based Zinc Phosphate Primer | 2 ( 35 microns per coat ) | Epoxy resin with MIO | 1 ( 75 microns per coat. ) | ----- | Epoxy Polyamide finish Paint | $1 ( 40 microns per coat ) | Smoke Grey Shade No 692 of IS 5 (Refer Note-4) | 145 at shop + 40 at site | $: 1 coat of DFT-40 microns finish coat at site |
| 4 | External Surface - Over ground piping ( For all diameters) | Blast cleaning to SSPC SP-10 / SA 2½ | Inorganic Ethyl Zinc Silicate Primer. | 1 (50 microns per coat) | Epoxy resin with MIO | 2 (100 microns per coat) | ----- | Aliphatic Acrylic Polyurethane finish Paint to IS13213 | $1 (35microns per coat) | Smoke Grey Shade No 692 of IS 5 | 285 Microns | $: 1 coat of DFT-35 microns finish coat at site |
| 5 | Galvanised and Stainless Steel Piping | No painting | | | | | | | | | | |

**Notes:**

1. Blast cleaning to near white metal to obtain roughness as per paint manufacturer's recommendations.
2. Application and inspection ( including DFT) of Isophthalic polyester / acrylic co-polymer filled with glass flakes shall be as per Paint manufacturer's QP and Painting procedure approved by BHEL.
3. Witness by BHEL / BHEL nominated inspection agency.
4. Shade for finish coat to be done at site shall be as per project specification/contract requirement.

| PREPARED BY : J.NANTHINI, Sr.Engr/QA | APPROVED BY: C.VAITHIANATHAN, AGM/Q | For Customer use : | Page 1/1 |
|---|---|---|---|
| 13/12/18 | 13/12/18 | | |

# CHAPTER – B1
# ERECTION WELDING PRACTICES FOR SA335 P91/P92, SA182 F91/F92 & SA217 C12A MATERIALS

## 1.0 SCOPE:

1.1. This document details out the practices to be adopted during erection of SA335 P91/P92,SA182 F91/F92 and SA 217 C12A materials.

## 2.0 MATERIAL:

2.1 Pipe materials shall be identified as follows:-

1) Colour codes given by the MUs.
2) Hard Stamping: Specification, Heat No, Size.
3) Paint / Stencil: WO DU, as per the relevant drawing & document.

2.2 When any defect like crack, lamination, and deposit noticed during visual examination the same shall be confirmed by Liquid Penetrant Inspection. If confirmed, it shall be referred to unit.

## 3.0 ERECTION:

### 3.1 Edge Preparation and fit up:

3.1.1 Cutting of P91/P92/F91/F92 material shall be done by band saw / hacksaw / machining / grinding only.Edge preparation (EP) shall be done by grinding/machining. During machining /grinding, care shall be taken to avoid excessive pressure to prevent heating up of the pipe edges.

3.1.2 All Edge Preparations done at site shall be subjected to Liquid Penetrant Inspection (LPI). Weld build-up on Edge Preparation is prohibited.

3.1.3 The weld fit-up shall be carried out properly to ensure proper alignment and root gap. Neither tack welds nor bridge piece shall be used to secure alignment. Partial root weldof minimum 25mm length by GTAW at minimum 4 locations and fit-up by a clamping arrangement is recommended. Use of site manufactured clamps for fit up is acceptable.The necessary purging and preheat shall be done as per clause 3.3 and 5.0 respectively. Welding shall be done employing IBR qualified welders only.

3.1.4 The fit-up shall be as per the drawing. Root gap shall be 2 to 2.5mm and root mismatchshall be within 1.6mm. Suitable reference punch marks shall be made on both the pipes (at least on three axis).

a) At 200 mm from the EP for UT.
b) At 1000 mm from the EP for identifying weld during PWHT.

### 3.2. Fixing of thermocouple (TC) and heating elements during preheating and PWHT:

3.2.1 Heat Treatment Manual (AA/CQ/GL/011/ PART II-HTM-Latest),Chapter 1, Clause no. 3.1.1, 3.1.5, 3.2.1, 3.2.2&3.2.6shall be referred for guidelines for fixing of thermocouples and heating elements on the jobs

**3.3 Arrangement for purging:**

3.3.1 Argon gas conforming to Gr 2 of IS 5760 (latest) shall be used for purging the root side of weld. The purging dam (blank) shall be fixed on either side of the weld bevel prior to pre-heating. The dam shall be fixed inside the pipe and it shall be located away from the heating zone. Purging shall be done for root welding(GTAW) followed by two filler passes of SMAW in case of butt welds. Purging is not required in the case of nozzle and attachment welds, when they are not full penetration joints.

3.3.2 The flow rate which shall be maintained during purging is 10 to 26 litres/minute. Purging shall be started from inside of pipe when root temperature reaches 220°C. Continuous and adequate Argon Gas shall be provided to ensure complete purging in the root area. The minimum pre-flushing time for purging before start of welding shall be 5 minutes, irrespective of the pipe size.

3.3.3 Wherever possible, solid purging gas chambers shall be used which shall be removed after welding. If not possible, only water-soluble paper is to be used. Plastic foils that are not water-soluble are NOT acceptable.

3.3.4 **Using Aluminium dam arrangement:**

In order to retain the Argon gas at the inside of the pipe near root area of the weld joint, the purging dams made of Aluminium (or other suitable material like mild steel) and permanent gaskets may be provided during the weld fit-up work similar to one as indicated in the Figure B2.1.The Aluminium discs shall be firmly secured with a thin wire rope. After completion of the root welding followed by two filler passes, the disc shall be pulled outwards softly.

**CAUTION: ENSURE REMOVAL OF PURGE DAM ARRANGEMENT AFTER WELDING**

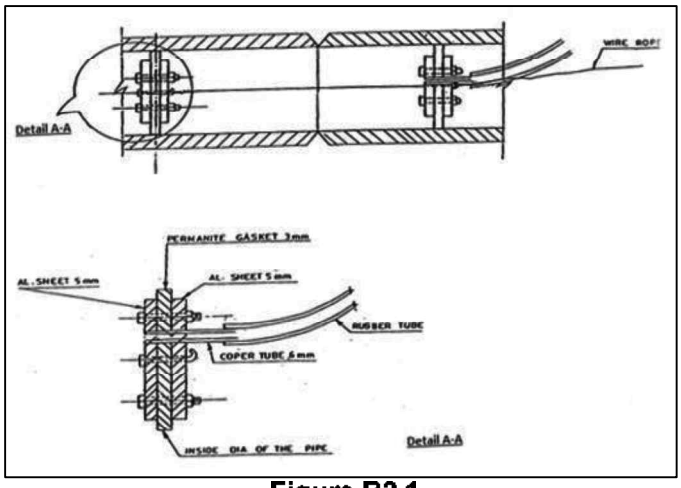



**Figure B2.1**

3.3.5 **Using water soluble paper:**

The dams can be made of water-soluble paper/water soluble tissue paper for creating the purging chamber. The advantage in such dam arrangement is that dissolving in water can flush thedams. The following are different methods used.

The Purge damming process illustrated as below:

3.3.5.1. For small diameter pipes, simply stuff water soluble paper/water soluble tissue paper into each section to be joined(Refer Figure B2.2).

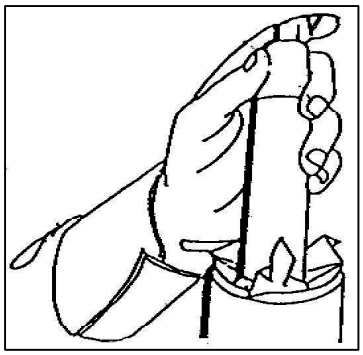


**Figure B2.2**

3.3.5.2. For larger pipes, cut out a circular aluminium foil disc slight larger than the diameter and shape it to the inside pipe circumference. (A small hole may be punched in the paper to ensure complete evacuation of air when purging)(ReferFigureB2.3).

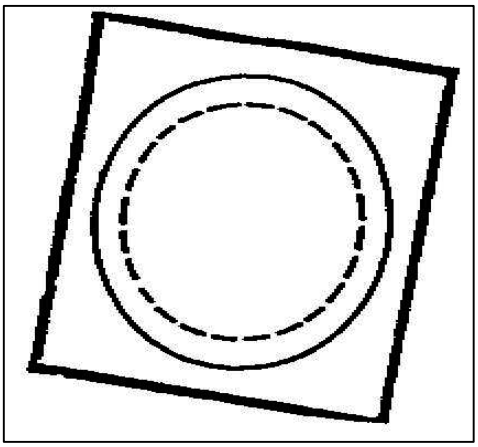


**Figure B2.3**

3.3.5.3. Position the disc within the pipe and tape in place with water soluble paper. Repeat procedure for other section. Insert the backing gas into the joint with a needle valve and make root pass in the usual manner (Refer Figure B2.4).

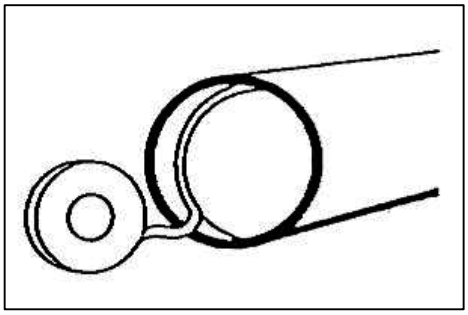


**Figure B2.4**

3.3.5.4. For pipes larger than 508 mm diameter, simply splice two sheets of water soluble paper together with water soluble tape as per Figure B2.5 and repeat procedure as shown in Figure B2.3 and B2.4 above.

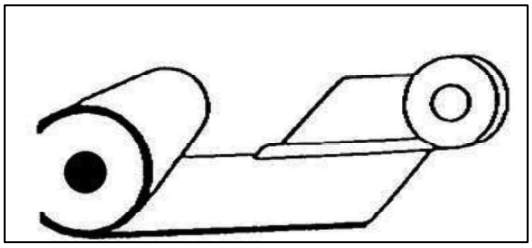


**Figure B2.5**

## 4.0 WELDING / WELDERS QUALIFICATION:

Welders Qualified as per IBR and qualified at site with Gr.91/Gr.92 material only shall be engaged. Welders log book shall be maintained and welders performance shall be monitored by site engineer. The applicable WPS as per FWS shall be followed for welder qualification and welding.

## 5.0 PREHEATING:

Heat Treatment Manual (AA/CQ/GL/011/ PART II-HTM-Latest),Chapter 1, Clause 3.1 shall be referred for guidelines for preheating.

## 6.0 WELDING:

6.1 Root Welding shall be done using GTAW process (as per WPS) five minutes after the start of argon purging. Filler wire shall be cleaned and free from rust or oil. Argon Purging shall be continued till minimum two filler passes of SMAW.

6.2 The inter-pass temperature shall not exceed 350°C. After completion of welding bring down the temp to 80–100°C and hold it at this temperature for one hour minimum. The PWHT shall commence after completing one hour of holding.

## 7.0 STORAGE OF WELDING CONSUMABLES:

Refer Chapter A3, Section A-3.4of this Manual for guidelines which shall be followed for receipt, storage, drying & holding and issue of welding consumables.

**CAUTION:No LPI / Wet MPI/UT shall be carried out on weld before PWHT**

## 8.0 POST WELD HEAT TREATMENT:

8.1 Heat Treatment Manual (AA/CQ/GL/011/ PART II-HTM– Latest), Chapter 1, Clause no. 3.2 shall be referred for guidelines on PWHT. In addition, the below requirements and precautions shall also be followed:

8.2 Welding and PWHT shall be monitored every one hour by site authorized personnel.

8.3 **Preventive measures during power failure and non-functioning of equipment:**No interruption is allowed during welding and PWHT. Hence all the equipment for the purpose of power supply, welding, heating etc., shall have alternative arrangements.(Diesel generator for providing power to the welding and heating equipment, standby welding and heating equipment, reserve thermocouple connections, gas burner arrangement for maintaining temperature etc.). Following preventive measures shall be adopted until normal power supply or backup power supply through diesel generator is restored.

8.3.1 **Interruption during start of preheating**:

In case of any power failure/interruption during preheating, the weld fit-up shall be insulated and brought to room temperature. After the electric supply resumes the joint shall bepreheated as per Clause No: 5.0.

8.3.2 **Interruption during GTAW / SMAW:**

Maintain a preheat temperature of 220°C minimum using LPG gas burners till the welding is restarted. In case, preheat temperature is not maintained, an inter-stage stress relieving shall be carried out followed by visual inspection to ensure that no surface cracks are present in the weld, prior to restart of the welding.

8.3.3 **Interruption during cooling cycle**: After SMAW welding completion and cooling to holding temperature at 80 to 100°C, care shall be taken to avoid faster cooling rate by providing adequate insulation. The required temperatureof 80 – 100°C shall be maintained by gas burner arrangements till power resumes / start of PWHT (within 8 hours).

8.3.4 **Interruption during post weld heat treatment**;Heat treatment Manual (AA/CQ/GL/011/ PART II-HTM– Latest), Chapter 1, clause no. 3.2.5 shall be referred for guidelines to be followed for interruption during PWHT.

8.3.5 In all the above cases (8.3.1 to 8.3.4), the temperaturemeasurement on the weld joint shall be recorded using calibrated gauges/instrumentsat regular Intervals of 15 minutes in the log book by SiteEngineer.

**8.4 Caution:**

The PWHT temperature recorded in the chart shall not deviate from the specified values since any deviations to the specified soaking temperature Range, will adversely affect the mechanical properties of the weldment and may lead to rejection of the weldment. The weld Joints should be kept dry and no water/liquid is allowed to come in contact with the weld or preheated portion of pipe under any circumstances, till PWHT is completed.

## 9.0 CALIBRATION:

All equipment like recorder, thermocouple, compensating cable, oven thermostat etc. shall have valid calibration carried at BHEL approved laboratories. The calibration reports shall be reviewed and accepted by welding In-charge at site prior to use.

## 10.0 NONDESTRUCTIVE EXAMINATION (ReferNDE ManualAA/CQ/GL/011/ Part III-NDEM latest):

10.1 All NDE shall be done after PWHT only.Prior to testing all welds shall be smoothly ground.All welds (fillet & butt) shall be subjected to MPI (MPI shall be done by YOKE type only). In addition to MPI, butt-welds and all full penetration welds shall be examined by UT.

UT procedure shall be as per BHE: NDT: PB: UT21 with additional requirementsas in (a) through (e):

a) The calibration blocks used shall be of the same product form and material specification or equivalent P-Number grouping as one of the materials being examined. P-Nos. 1, 3, 4, 5A through 5C, and 15A through 15F materials are considered equivalent for this purpose.

b) The UT equipment shall be calibrated prior to use and should be of 'digital type' capable of storing calibration data as well as ultrasonic test results as per procedure numberBHE:NDT:PB:UT-21.

c) All recordable indications shall be stored in memory of – either the digital flaw detector or a PC for review at a later period.

d) The equipment calibration data for specific weld as well as the hard copy of 'Static echo-trace pattern' – showing the flaw-echo amplitude with respect to DAC, flaw depth, projection surface distance (probe position) and beam-path shall be attached to UT test report. This hard-copy of echo-trace with equipment calibration data shall form part of test documentation.

e) The examination as well as evaluation shall be performed by a qualified Level II personnel, and a test report shall be issued. Any defect noticed during NDT shall be marked with marker.

## 11.0 REPAIR OF WELD JOINTS:

### 11.1 Weld repair at root:

If any surface defect is revealed at the time of visual inspection during root welding, the following steps shall be followed:

1. Maintain the temperature at 80-100°C for 1 hour.
2. Perform inter-stage PWHT.
3. Remove the defect by grinding.
4. After complete removal of defect, preheat the weld area to 220°C minimum and re weld with GTAW before starting SMAW, if required.

### 11.2 Weld repair on completion:

11.2.1 Any defect observed on the weld shall be brought to the notice of Site engineer. Any repair on weld shall be carried out with their approval only.

11.2.2 If any defects are noticed on the fully completed weld while performing UT after completion of PWHT, the depth of the defect shall be locatedfrom the weld outside surface. The defect area shall be marked and repaired as below:

a) The weld shall be removed by grinding (gouging not permitted) such that the area for repair welding shall be free from sharp corners and provided with sufficient slope towards the weldface sides.

b) Surface examination (MPI/LPI) on the ground area shall be performed to ensure complete defect removal before re-welding. Repair welding shall be carried as per the applicable WPS as for original welding.

## 12.0 HARDNESS SURVEY:

Hardness shall be measured using portable hardness tester.The equipment used for the hardness measurement shall be calibrated as recommended by the equipment manufacturer.

The surface shall be cleaned and prepared as per hardness test instrument manufacturer's recommendation prior to hardness survey.Hardness survey shall be done on each joint at three locations along the circumference. At each location three readings shall be taken on weld and parent metal .The readings on the parent metal shall be taken within 15mm from the edge of the weld.All the hardness values shall be recorded.

The hardness of the weld metal and the base metal in the soak band (heating band), excluding welding heat-affected zone shall be between 160HB & 300HB for Gr.91 and Gr.92 joints. The hardness measurements shall be recorded in the format as given in Annexure IX.Joints having hardness above 300HB shall be re-heat treated

and hardness shall be checked again. If hardness is still more, the case shall be referred to concerned MUs/ECs.In case Hardness falls below 160HB also, the case shall be referred to the concerned MUs/ECs.

Cautionary note: To achieve meaningful and consistent hardness results, below recommendations should be followed:

- The accuracy of the instrument shall be verified prior to use.
- The surface to be tested shall be reasonably flat and free of scale and oxides, grease, paint, etc.
- Prior to hardness test, the de-carburized surface layer with a thickness up to 0.8mm shall be removed by grinding/buffing, without encroaching the specified minimum wall thickness of the pipe/tube.

## ANNEXURE IX – HARDNESS MEASUREMENT

**BHARAT HEAVY ELECTRICALS LTD**

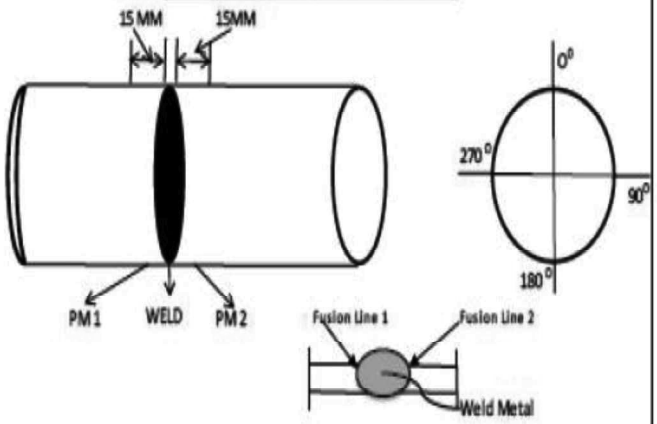
**T91/T92/P91/P92/F91/F92/C12A HARDNESS TESTING PROTOCOL**

| | | |
|---|---|---|
| PROJECT NAME : | UNIT No. : | Customer Name : |
| Report No.: | Date : | Contractor : |
| Description : | Specn : | Stage of test : After PWHT |
| Calibration Block No.: | Equipment details: | |
| PGMA : | Model No : | |
| JOINT NO. : | | |

| Location | PM 1 | WELD | PM 2 |
|---|---|---|---|
| Readings | AVERAGE OF 3 READINGS | AVERAGE OF 3 READINGS | AVERAGE OF 3 READINGS |
| 12 O'Clock/ $0^0$ | | | |
| 3 O' Clock/ $90^0$ | | | |
| 6 O'Clock/ $180^0$ | | | |
| 9 O'Clock/ $270^0$ | | | |

PM: PARENT MATERIAL ( 15 MM FROM THE WELD FUSION LINE). ALL AVERAGE READINGS SHOULD BE LESS THAN THE PERMISSIBLE HARDNESS VALUE.

HARDNESS TEST LOCATIONS SKETCH




Gap between successive reading shall be 1mm in the same spot

RECOMMENDATION / RESULT : ACCEPTED / NOT ACCEPTED / RE-PWHT

| | AGENCY | NAME | SIGNATURE & DATE |
|---|---|---|---|
| INSPECTED BY | CONTRACTOR | | |
| CHECKED BY | BHEL | | |
| WITNESSED BY | CUSTOMER | | |

## 13.0 COMBINATION WELDING:

For other combination of materials with Gr.91/Gr.92, the applicableWPS for the same shall beobtained fromconcerned MUs/ECs.

## 14.0 DEMAGNETIZATION:

Refer NDE Manual BHEL:PS:NDM:latest Chapter 1.10

## 15.0 TRAINING:

15.1 The personnel engaged in P91 piping fabrication shall be trained in the following areas.

a. Method and care to be taken during fit-up.
b. Argon gas root purging arrangement.
c. Fixing of thermocouple and wires.
d. Arrangements for Pre/Post heating requirements and methods.
e. Adjustment of heating pads/cables at the time of controlling the temperature within specified tolerance limits during welding or PWHT in case of induction heating.
f. Good knowledge of the WPS requirements.
g. Handling of P91 welding consumables and re-drying conditions.
h. Special precautions to be taken during the power/equipment failure.
i. Weld joints of dissimilar thickness / material specification.
j. Weld defect control and weld repair systems.

15.2 **Specific training for welders:**

a. The qualified welders who will be engaged in P91 welding shall be given training on pipe joints simulated with P91 welding and heating cycle conditions.
b. The acquaintance on welding positions, as applicable shall be given using P91 pipes and P91 welding consumables.
c. Welding techniques and instructions on Dos and DON'Ts of P91 welding.
d. Welders only who are qualified on P91 welding alone shall be engaged.
e. Whenever new welders have to be engaged they shall undergo all the training as above and shall be qualified with P91 material only.

## 16.0 CONTROL ON WELDERS:

The welder during welding at site follow the following procedures.The welder shall interact with the HT operator (Induction equipment operator) to ensure that preheat and inter-pass temperature during welding are maintained as per requirements.The

welder shall not mix the welding electrodes with that of the other welder. At the end of the shift, the unused electrodes shall be returned to the stores.

## 17.0 PERSONNEL / CONTRACTORS ENGAGED FOR HEATING CYCLES (HT OPERATOR):

17.1 The Personnel / Contractor shall have adequate heat treat experience on P91 or similar material.

17.2 HT operator shall be aware of the following:

a. The equipment used and its working principle and operation.

b. The procedures to be followed in using heating equipment.

c. Procedure to be followed in case of power failure or equipment non-functioning so that heating cycle is not disrupted.

d. Calibration of equipment.

e. Method of fixing thermocouples and compensating cables leading to HT recorder.

f. Fixing of heating pads or elements on the pipe joints and also in maintaining the temperature within the specified limits.

## 18.0 NDE PERSONNEL QUALIFICATIONS:

All NDE personnel performing NDT like UT & MPI/LPI shall be qualified in accordance with BHEL Procedure meeting the requirements of recommended practice SNT–TC-IA.MPI & LPI shall be carried out by level I qualified personnel and shall be evaluated by level II qualified personnel. However UT examination and evaluation shall be done by level II qualified personnel.

## 19.0 LEVEL OF SUPERVISION

Site In charge shall be responsible for the completion of all activities from weld fit-up tofinal clearance of weld joints after satisfactory NDE and acceptance by BHEL/Customer/IBR.

## 20.0 DO'S AND DON'T'S DURING P 9 1 /P 92 /F9 1 /F92 /C1 2 A WELDING.HEAT TREATMENT AND NDE AT CONSTRUCTION SITE:

20.1 **DO ' S:**

a. Cutting by Band saw/Hack saw/Machining.

b. Pipes Edge Preparation by machining. Machining shall be done without excessive pressure to prevent heating up of pipe

c. Grinding may be done on exceptional cases after approval and taking adequate care to prevent overheating.

d. Thermocouple wire (hot/Cold junctions) shall be welded with capacitor discharge portable spot-welding equipment.

e. Reserve Thermocouples shall be madeavailable,in case of failure of connected thermocouple elements.

f. Ensure adequate Argon Gas for complete purging of air inside the pipe before starting GTAW root welding.

g. Ensure Preheating at 220 °C minimum before GTAW root welding.

h. Start preheating only after clearance from Welding engineer / Quality assurance engineer for weld fit-up and alignment of the joint as well as fixing of Thermocouple connections ( for Induction heating)

i. Do visual inspection onroot weld maintaining weld preheating temp.

j. Continue Argon purging until the GTAW root welding followed by minimum two filler passes of SMAW, is completed.

k. Perform partial root welding to facilitate fit-up if necessary.

l. Ensure proper use of TIG wires as identified by color coding or suitable hard punching.

m. Keep the GTAW wires in absolutely clean condition and free from oil, rust, etc.

n. Dry the SMAW electrodes before use.

o. Ensure the inter-pass temperature is less than 350°C.

p. Hold at 80-100°C fora period ofMinimum 1 hour before the start of PWHT.

q. Record entire heating cycle on Chart through recorders.

r. Exercise control during grinding of weld and adjoining base metal while removing surface/sub-surface defects or during preparation for NDE.

s. Ensure no contact with moisture during preheat, welding, post heat and PWHT of Weld Joints.

t. Ensure removal of argon purging arrangements after welding.

u. Use short Arc only. The maximum weaving shall be limited to 1.5 times the Dia. of the electrode.

**20.2 DO N' T' s:**

a. Avoid Oxy-Acetylene flame cutting.

b. Avoid Weld-build up to correct the weld end-d1 or to set right the lip of the weld bevel.

c. Avoid Arc strike on materials at the time of weld fit up or during welding.

d. Do not Tack weld the Thermocouple wires with Manual Arc/TIG welding.

e. NO GTAW root welding without thorough purging of root area.

f. Do not use Oxy-acetylene flame heating for any heating requirements.

g. Do not use Thermal chalks on the weld groove.

h. Do not stop argon purging till completion of GTAW root welding and two layers of SMAW.

i. No Tack welding or Bridge piece welding is permitted.

j. Do not use unidentifiedTIG wires or electrodes.

k. Do not exceed the maximum interpass temperature indicated in WPS

l. Do not allow moisture, rain, water, cold wind, cold draft etc. to come in contact with the weld zone or heating zone during the entire cycle from preheat to PWHT.

m. Do not exceed the limits of PWHT soaking temperature.

n. Do not Interrupt the Welding/heating cycle except for unavoidable power failures

o. Do not use un-calibrated equipment for temperature measurement during heating, welding, post weld, heat treating etc.

**21.0 <u>DOCUMENTATION:</u>**

The documentation shall be as per the approved Quality Plan.

# CHAPTER – B2
# ERECTION WELDING PRACTICES FOR SA 213 T91/T92 MATERIALS

**1.0 SCOPE**:

1.1 This document details out the practices to be adopted during welding of SA213 T91/T92 material.

**2.0 MATERIAL:**

2.1 Tube materials shall be identified as follows:-

a) Colour codes given by the Manufacturing Units (MU).

b) Paint / Stencil: WO DU, as per the relevant drawing & document.

2.2 When any defect like crack, lamination, and deposit noticed during visual examination, the same shall be confirmed by Liquid Penetrant Inspection. If confirmed, it shall be referred to unit.

**3.0 ERECTION:**

3.1 **Edge preparation and Fit up:**

3.1.1 Cutting of T91/T92 material shall be done by band saw/hacksaw/machining/ grinding only. Edge preparation (EP) shall be done by grinding/machining. During machining/ grinding, care should be taken to avoid excessive pressure to prevent heating of the tube edges.

3.1.2 The weld fit-up shall be carried out to ensure proper alignment and root gap. Neither tack welds nor bridge pieces shall be used to secure alignment. Use site fabricated clamps for fit up. Ensure that coil load does not come on stubs/header. Coil load shall be transferred to the crown plate/ end bar assembly. The necessary purging and preheat shall be done as per clause 3.3 and 5.0 respectively.

3.2 **Fixing of thermocouple (TC) and heating elements during preheating and PWHT**

3.2.1 Heat Treatment Manual (AA/CQ/GL/011/ PART II-HTM-Latest), Chapter 1, Clause no. 3.1.1, 3.1.5, 3.2.1, 3.2.2, 3.2.6 & 3.2.7 shall be referred for guidelines for fixing of thermocouples and heating elements on the jobs.

3.3 **Arrangement for purging**:

3.3.1 Argon gas with requisite quality shall be used for purging the root side of weld. The purging dam (water soluble paper) shall be fixed on header nipple side of the weld bevel prior to fit-up and pre-heating. Purging is to be done from cross over tube downstream end. (Refer Figure B3.2 and B3.3). Ensure that atmospheric air is completely purged out through the root gap before starting welding and welding can be continued with Argon backing. The flow rate which shall be maintained for purging is 6 to 8 litres per minute.

3.3.2 When root temperature reaches 220°C, start purging through cross over tube downstream end for 5 minutes. Then the root gap is to be covered by insulating material. Continuous and adequate argon gas shall be provided to ensure complete

purging in the root area. Only water-soluble paper is to be used. Plastic foils that are not water-soluble are NOT acceptable.

**3.3.3 Usage of water soluble paper:**

3.3.3.1 The dams can be made of water-soluble paper /water soluble tissue paper for creating the purging chamber. The advantage in such dam arrangement is that the dissolving paper dam gets flushed during hydraulic test. The following is the method to be used:

3.3.3.2 Stuff the water-soluble paper/ water soluble tissue paper into the Header Nipples at a distance of 60mm(approximately) from the weld end as per attached Figure B3.1

**4.0 WELDING/WELDERS QUALIFICATION:**

4.1 Welders Qualified as per IBR and qualified at site with Gr.91/Gr.92 material only shall be engaged. Welders log book shall be maintained and welders performance shall be monitored by site engineer. The applicable WPS as per FWS shall be followed for welder qualification and welding.

**5.0 PREHEATING (Bunching of tubes can be followed):**

5.1 Heat Treatment Manual (AA/CQ/GL/011/ PART II-HTM-Latest), Chapter 1, Clause 3.1 shall be referred for guidelines for preheating.

**6.0 WELDING:**

6.1 Welding shall be done as per the WPS. Filler wire shall be clean and free from rust or oil. Argon Purging shall be continued till completion of welding in case of full GTAW and for minimum two filler passes of SMAW in case of GTAW + SMAW.

**7.0 POST WELD HEAT TREATMENT (PWHT) – RESISTANCE HEATING METHOD**(Bunching of tubes can be followed):

7.1 Heat Treatment Manual (AA/CQ/GL/011/ PART II-HTM– Latest), Chapter 1, Clause no. 3.2.12 shall be referred for guidelines on PWHT.

**8.0 HARDNESS SURVEY:**

8.1 100% hardness survey shall be conducted on welds and parent material in first five coils. Based on satisfactory results, the hardness survey can be reduced to 10% covering each heat treatment cycles as per FWS requirement. The equipment recommended to measure the hardness is EQUOTIP or equivalent. Portable equipment used in the hardness measurement shall be calibrated.

8.2 The surface shall be cleaned and prepared as per hardness test instrument manufacture's recommendation prior to hardness survey. Hardness survey of weld and parent metal (both tubes) shall be carried out. The hardness shall be between 160HB & 300HB. The hardness measurements shall be recorded in the format as given in Annexure IX. Joints having hardness above 300HB shall be re-heat treated and hardness shall be checked again. If hardness is still more, the case shall be

referred to concerned MUs. In case Hardness falls below 160HB also, the case shall be referred to the concerned MUs.

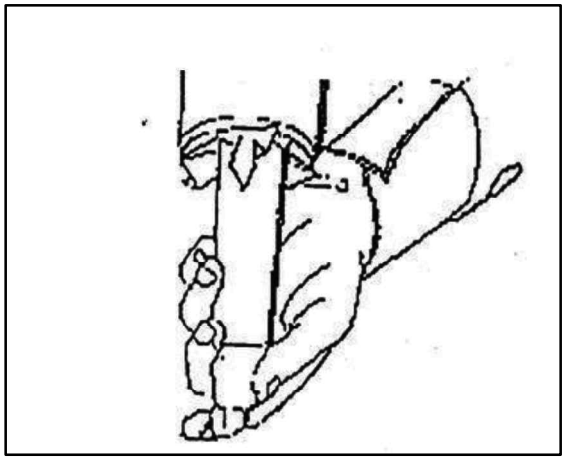


**Figure B3.1: Insertion of Water Soluble Tissue paper**

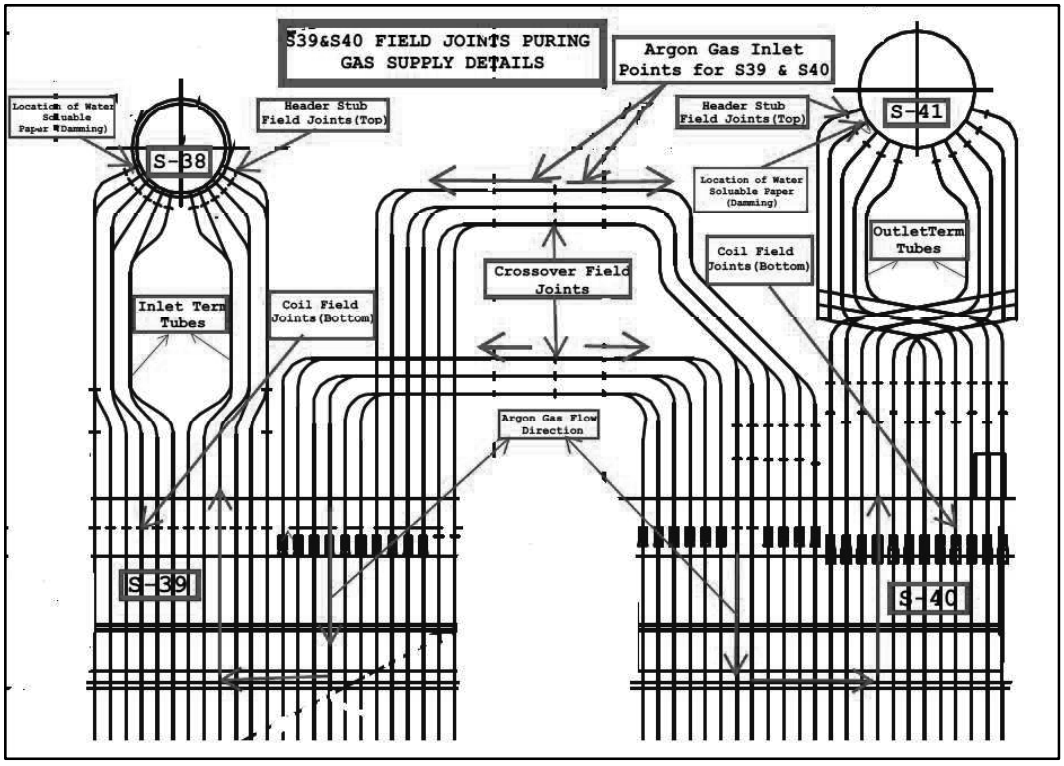



**Figure B2.2: Purging Arrangement for SH Header Field Joints**

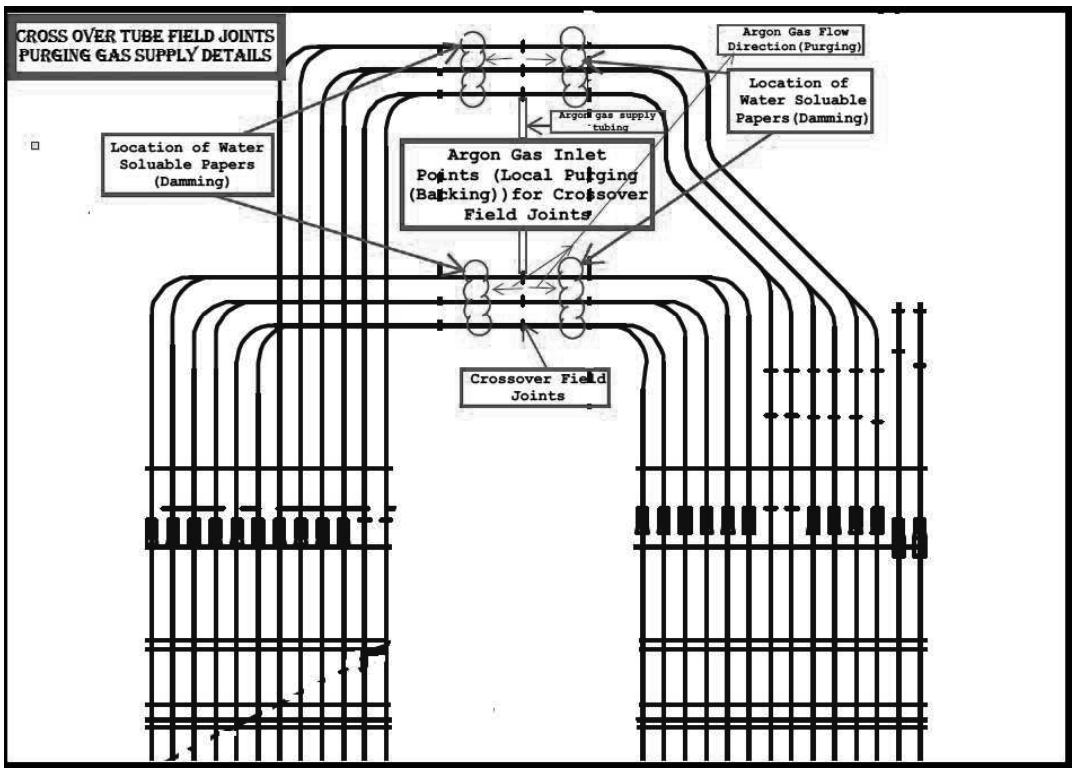



**Figure B2.3: Purging Arrangement for Cross Over Tube Field Joints**

# CHAPTER –B3
# ERECTION WELDING PRACTICES FOR SA213 T23 MATERIAL

## 1.0 SCOPE:

1.1 This procedure is applicable for the welding of T23 tubes at sites.

**2.0** Ensure the availability of the following items/characteristics before preparing the joint for welding:

a) LPG gas (for heating in case of interruption in preheating)
b) Grinding machine
c) Mini cutter
d) Conical grinder
e) Proper illumination
f) Thermal chalk or pyrometer
g) Torch light
h) Portable Oven
i) Hacksaw and chisel

## 3.0 PROCEDURE:

The following procedure shall be followed for T23 Welding at Site:

3.1 Clean the edges of the tube, both OD & ID by buffing upto 30 mm from the edge of the tube.

3.2 Create a purging dam on both tubes at about 200 to 250 mm away from the joint beforefit-up.

3.3 Fit-up the tubes for butt joint with a root gap of 2 to 2.5 mm and ensure a land of 1 to 1.5 mm.

3.4 Set up Argon purging for the tube to tube butt joint.

3.5 Carryout preheating by wrapping heating pads/coils uniformly for a width of 200 mm on both sides of the joint. Each tube should be provided with a thermocouple (K type) at a distance of 75 mm from the joint.(Refer FigureB4.1, B4.2 &B4.3)

3.6 Preheat the joint to a minimum of 200°C and ensure the same with a thermal chalk or a pyrometer before the start of welding.

3.7 Ensure drying of SMAW electrodes at 250 to 300°C for 2 hours and keep them at a temperature of 150°C in a Holding oven after drying.

3.8 The electrodes shall be maintained dry at 65 to 100 °C in a portable oven after issue from the holding oven till use.

3.9 Perform welding as per applicable WPS using IBR qualified welders.

3.10 Ensure the welding of root and second pass by TIG welding process and further layers by SMAW process. Alternatively, the entire joint may be welded by TIG process using the applicable WPS.

3.11 Maintain the Interpass temperature at 350°C max. Ensure the same using thermal chalk or pyrometer after each pass of welding.

3.12 Conduct post heating on the completed weld at 250 to 280°C for a minimum of 1 hour immediately after completion of welding and then allow the joint to cool in air to ambient temperature.(Refer Figure B4. 4)

3.13 Perform RT to ensure that the joints are defect free.

3.14 If RT reveals any unacceptable defect, cut the joint and put a spool piece in place for a minimum length of 200 mm. Repeat the procedure from step 3.1 to 3.13.

3.15 Perform PWHT on the weldment within 7 days after post heating.

3.16 Use only calibrated PWHT accessories (thermocouples, temperature recorder, etc.).

3.17 Use only ceramic resistance pads with low voltage heating arrangement for PWHT.

3.18 Ensure the PWHT arrangement to meet the following conditions;

3.19 When heat treating butt welds, the width of the circumferential heating band on either side of the weld must be at least 3 times the width of the widest part of the weld groove but not less than twice the thickness of the thicker part welded. The width of the insulation band shall be at least twice the total width of the heating band.

3.20 Ensure wrapping of heating pads, location of thermocouples before covering with insulation.(referFigure B4.5& B4.6)

3.21 PWHT shall be carried out with 1 thermocouple per joint.

3.22 PWHT time and temperature shall be as per applicable WPS.

3.23 Measure hardness on the joint and ensure it to be within 160 to 260 HB. If hardness exceeds 260 HB, PWHT shall be repeated and hardness checked. The total no. of PWHT cycles shall not exceed 3 times for a joint.

3.24 In case the hardness measures above 260HB even after 3 PWHT cycles, cut the joint and put a spool piece in place for a minimum length of 200 mm. Repeat the procedure from step 3.1 to 3.23. In case the hardness measures below 160HB, it shall be referred to the MUs.

**4.0 DOCUMENTATION:**

Record the details of welding carried out in correlation to welders, heat treatment and NDE reports.

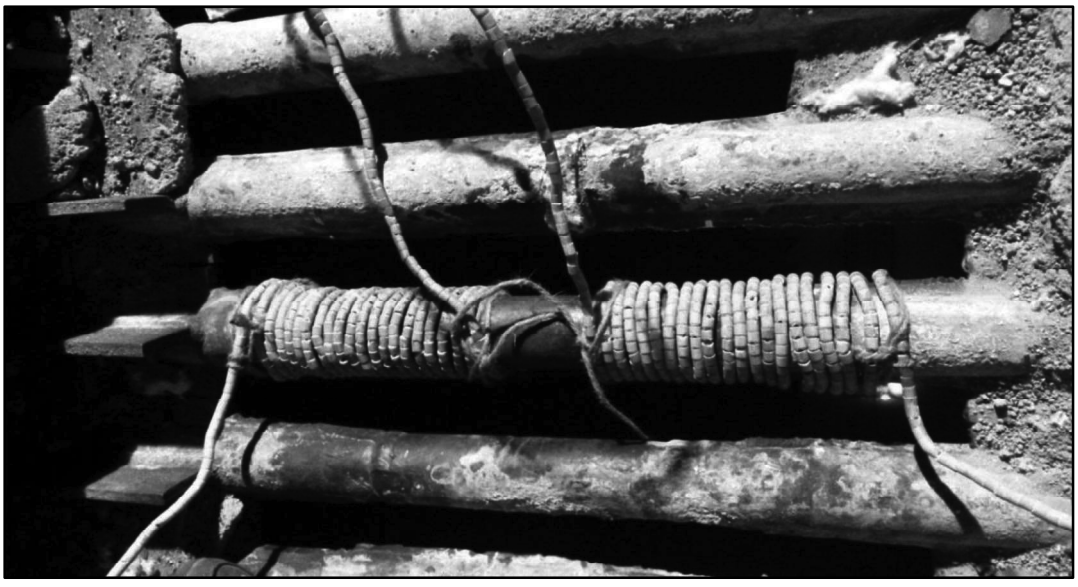


**Figure B3.1: Preheating by Resistance coil winding**



**Figure B3.2: K - Type Thermocouple**

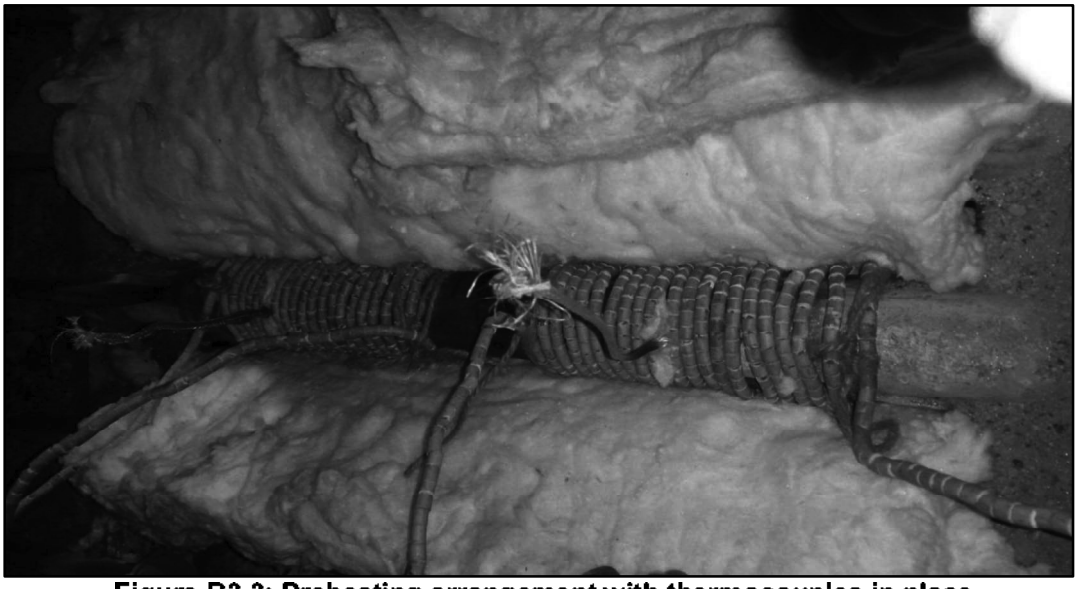


**Figure B3.3: Preheating arrangement with thermocouples in place**



**Figure B3.4: Post heating arrangement**

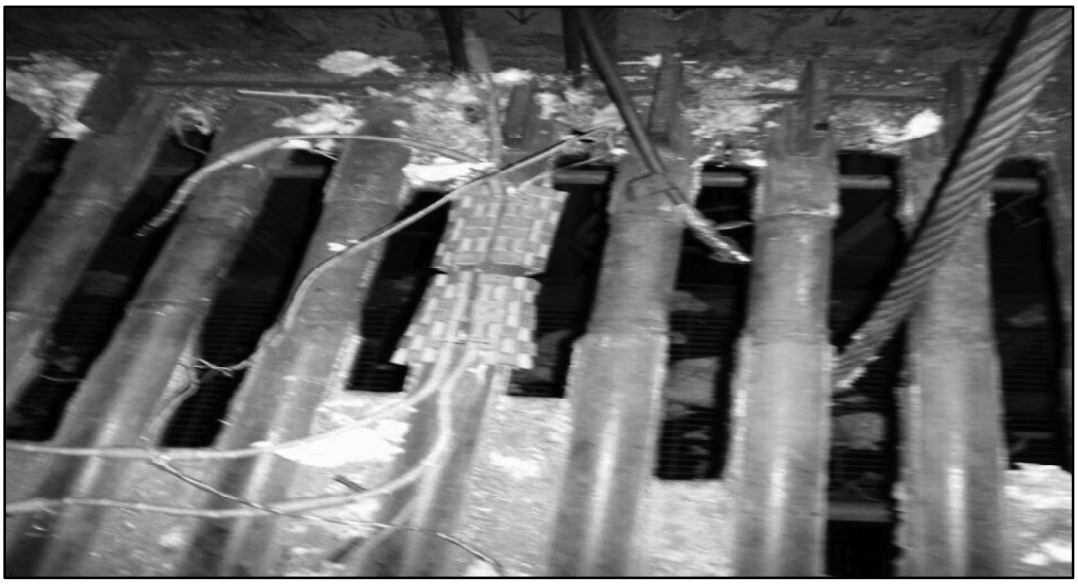


**Figure B3.5: Heating pads in place for PWHT**



**Figure B3.6: PWHT in progress**

# GUIDE LINES FOR HEAT TREATMENT

# IMPORTANT NOTE

**THIS GUIDELINES FOR HEAT TREATMENT PROVIDES BROAD BASED GUIDELINES FOR CARRYING OUT HEAT TREATMENT WORKS AT SITES. HOWEVER, SITES SHALL ENSURE ADHERENCE TO THE PRIMARY DOCUMENTS LIKE CONTRACT DRAWINGS, FIELD WELDING SCHEDULES, WELDING PROCEDURE SPECIFICATIONS, PLANT / CORPORATE STANDARDS, STATUTORY DOCUMENTS, CONTRACTUAL OBLIGATIONS, AS APPILCABLE AND SPECIAL INSTRUCTIONS, IF ANY, ISSUED BY RESPECTIVE MANUFACTURING UNITS SPECIFIC TO THE PROJECTS.**

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# CHAPTER-1
# HEAT TREATMENT PROCEDURE - BOILER AND AUXILIARIES

## 1.0 SCOPE:

1.1 This procedure provides information, method and control for Pre-Heat, Post Heat and Post Weld Heat Treatment (PWHT) of welds of boiler and piping components at sites.

## 2.0 DOCUMENTS:

2.1 The following documents are referred in preparation of this procedure:

- ASME Sec I & Sec IX
- ASME B31.1
- Indian Boiler Regulations
- AWS D1.1
- BHEL Welding Manual (AA/CQ/GL/011/ Part I-WM – Latest)

2.2 The following are to be referred as Primary Documents:

- Contract drawings
- Field Welding Schedule or equivalent
- Plant / Corporate standards, wherever supplied
- Welding procedure specification
- Contractual obligations, if any

2.2.1 Where parameter for Pre-Heat, Post Heat and PWHT are not available in the primary documents, reference may be made to this procedure.

2.2.2 Where such parameters are not contained either in the primary documents or in this procedure, reference may be made to Manufacturing Units.

## 3.0 PROCEDURE:

3.1 **Preheating & Post heating**:

3.1.1 Prior to start of preheating, ensure that surfaces are clean and free from grease, oil and dirt. Preheating temperature shall be maintained as per applicable WPS. Preheating shall be checked and recorded, using thermal chalks/ crayons or pyrometers in case of tubes other than T91/T92/T23. For all other components including T91/T92/T23 tube joints, the preheat temperature shall be ensured by using a calibrated chart recorder and two calibrated thermocouples fixed at 0° and 180° positions on both sides of the joint. Preheating shall be checked at a distance of 1.5 times the part thickness or 75mm (whichever is greater) from weld end. The thermocouple shall be fixed using the capacitor discharge welding machine. The preheating arrangements shall be inspected and approved by site engineer.

3.1.1.1 Bunching of tubes for Preheating:

Where a bunch of closely placed tube welds (e.g. Super Heater / Reheater Coils) requires to be preheated, the same may be grouped together as if they form a single component. The maximum number of tubes bunched together in such cases shall be limited to 12. Each joint

within the bunch shall have at least one thermocouple fixed near the joint for preheat monitoring.

3.1.2 When parts of two different thicknesses are welded together, the preheating requirements of the thicker part shall govern.

3.1.3 When parts of two different P numbers are joined together, the material requiring higher preheat shall govern (please refer Tables A2.1 to A2.7 of Welding Manual, AA/CQ/GL/011/ PART I-WM – Latest, for P numbers).

3.1.4 In case of any power interruption during welding, the joint shall be wrapped with dry thermal insulating blankets to ensure slow and uniform cooling. **Requirement of uninterrupted power supply shall be ensured for materials like Gr.91, 92 & 23 and BS EN 10025**

3.1.5 Preheating & Post Heating Methods:

3.1.5.1 Preheating & Post heating shall be applied by any of the methods given below:

a) Electrical resistance heating
b) Induction heating
c) LPG burners

3.1.5.2 Preheating/post heating using cutting/ heating torches with oxy-acetylene flame is not permitted.

3.1.6 In addition, the following requirements shall also be followed:

3.1.6.1 Alternate burner arrangements shall be made for preheating/post heating during power failure to maintain the required temperature.

3.1.6.2 Two additional spare thermocouples shall be fixed for emergency use.

3.1.6.3 Preheating/Post heating shall be done locally BY heating a circumferential band covering the parent material away from the weld groove by induction or electrical resistance heating. The heating element (Coil/Finger/Ceramic Pad) placed on the heating band shall be closely packed without any gaps between the element. The area shall be free of grease, oil etc. prior to preheating/post heating.

## 3.2 Post Weld Heat Treatment (PWHT):

3.2.1 PWHT shall be done by locally heating a circumferential band covering the entire weld and adjacent area of base metal, by induction or electrical resistance heating. The heating element (coil/ finger element/ pad) placed on the heating band shall be closely packed without any gaps between the elements. The area shall be free of grease, oil etc. prior to PWHT.

3.2.1.1 Unless otherwise specified in the FWS/WPS, the PWHT parameters shall be as per the Tables 1.1, 1.2, 1.3, 1.4.

3.2.2 **Heating and Insulation band for PWHT:**

3.2.2.1 When heat treating butt joints, width of the circumferential heating band on either side of the weld must be at least 3 times the width of the widest part of the weld groove; but not less than twice the thickness of the thicker part being welded. When heat treating nozzles and attachment welds, the width of the heating band beyond the welding to be heat treated on either side of weld shall be at least 3 times the base material thickness. The heating band shall extend axially around the entire vessel. Width of the insulation band on either side shall be at least twice the width of the heating band.

3.2.2.2 In case of fin welded panels where circumferential winding of the coil is not possible heating elements shall be placed on both sides of the panels

3.2.3 Post weld heat treatment temperature cycle shall be measured and monitored by use of thermocouples with calibrated recorders.

3.2.4 Where the soaking temperature is found to be lesser than specified, the PWHT cycle shall be repeated.

3.2.5 In case of interruption during PWHT, the following actions shall be taken depending on the stage during which interruption has occurred.

**1) During heating cycle**

Repeat the whole operation from beginning.

**2) During soaking**

Heat treat subsequently for balance soaking. If the balance soaking time required is less than 15 minutes, soaking time shall be maintained for 15 minutes minimum.

**3) During cooling (above 300 °C).**

If the Rate of Cooling (ROC) during interruption meets the specified rate, cool subsequently at the required rate. Otherwise, reheat to the soaking temperature, hold for 15 minutes and then cool at the specified rate.

3.2.6 **Fixing of thermocouple (TC) during preheating, post heating and PWHT:**

3.2.6.1 Thermocouples shall be fixed on the job using capacitor discharge welding method. Thermocouple leads shall be attached within 6 mm of each other. A Welding Procedure Specification shall be prepared, describing the low-energy capacitor discharge equipment, the combination of materials to be joined, and the technique of application. No preheating is required. Also Qualification of the welding procedure is not required. The energy output of the welding process shall be limited to 125 W-sec. After temporary attachments are removed, the areas shall be examined by LPI.

Following are the equipment / facilities for heating cycles.

(1) Thermo couples: Ni-Cr / Ni-Al of 0.5 mm gauge size (K-Type).

(2) Temperature Recorders: 6 Points / 12 Points/ 24 Points.

3.2.6.2 Following are guidelines regarding number and placement of thermocouples:

- Minimum of two thermocouples shall be placed for each joint, 180° apart.
- Thermocouples shall be located at a distance of approximately 1.5 times the parent metal thickness from the weld centre.
- Additionally, one point of the temperature recorder shall be used for recording ambient temperature.
- For placement of thermocouples on P91/P92/F91/F92/C12A Figure 1.1 shall be referred for preheating and Figure 1.2 shall be referred for PWHT.

3.2.6.3 Thermocouple leads shall be suitably insulated to protect the ends from direct radiation from heating elements.

3.2.6.4 The temperature variation between any two thermocouples shall be within 50°C for temperature above 300°C during heating and cooling.

3.2.7 **Bunching of tubes for PWHT:**

3.2.7.1 Where a bunch of closely placed tube welds (e.g. Super Heater / Reheater Coils) require to be Post weld heat treated, the same may be grouped together as if they form a single component. The maximum number of tubes bunched together in such cases shall be limited to 12. Each joint within the bunch shall have at least one thermocouple fixed near the joint for PWHT temperature monitoring.

3.2.8 **Soaking Time:**

3.2.8.1 Unless otherwise specified in the FWS/WPS, the soaking time shall be calculated as 2.5 minutes per mm of thickness with 30 minutes minimum for tube welds and 60 minutes minimum for other welds. For P1 material, the soaking time shall be calculated as 2.5 minutes per mm of thickness upto 50mm with an additional 15 minutes for every 25mm thickness above 50mm.

3.2.8.2 The following guidelines shall be used to determine the thickness and subsequent selection of the soaking time of PWHT:

*(a)* For full penetration butt welds, the nominal thickness is the thinner of the parts being joined.

*(b)* For full penetration corner welds, the nominal thickness is the depth of the weld.

*(c)* For partial penetration groove and material repair welds, the nominal thickness is the depth of the weld. The total depth of partial or full penetration groove welds made from both sides shall be taken as the sum of the depth of both sides at a given location.

*(d)* For fillet welds, the nominal thickness is the weld throat. When a fillet weld is used in conjunction with a groove weld, the nominal thickness is the total of groove depth and fillet throat thickness.

3.2.8.3 Soaking time is to be reckoned from the time temperature of the joint crosses the recommended lower temperature of the cycle, to the time it comes down below the same recommended lower temperature of the cycle.

3.2.9 **Heating and Cooling Rates:**

3.2.9.1 Wherever not specified, the heating rate above 300°C and cooling rate after soaking upto 300°C shall be as follows: This is applicable for all materials except Gr.91/Gr.92 materials for which Cl. 3.2.11.3 shall be referred.

| **Thickness of Material** | **Maximum Heating Rate Above 300°C** | **Maximum Cooling Rate Upto 300°C** |
|---|---|---|
| ≤ 25 mm | 220°C/hour | 220°C/hour |
| > 25 ≤ 50 mm | 110°C/hour | 110°C/hour |
| > 50 ≤ 75 mm | 75°C/hour | 75°C/hour |
| > 75mm | 55°C/hour | 55°C/hour |

3.2.10 **PWHT Job Card:**

3.2.10.1 Prior to start of PWHT operations, a job card shall be prepared including details of weld reference, soaking time, soaking temperature, maximum rates of heating and cooling, temperature recorder details and date of PWHT as per Annexure I of this manual except Gr.91/Gr.92/Gr.23 materials. For P91/P92/F91/F92/C12A/T91/T92/T23 materials Annexures II, III, IV in Chapter A1 of Welding Manual - AA/CQ/GL/011/ PART I-WM – Latest, as applicable, shall be referred.

3.2.10.2 Obtain the clearance for post weld heat treatment cycle from the site engineer.

3.2.10.3 On completion of PWHT, the actual parameters shall be recorded on the job card.

3.2.10.4 A chart number shall be given to each chart and attached to the job card.

3.2.11 **Heat Treatment of P91/P92/F91/F92/C12A welds:**

3.2.11.1 A minimum of four thermocouples shall be placed such that at least two are on the weld and the other two on the base material on either side of the weld within the heating band, 180° apart, at a distance of 50mm (approximately) from the center of the weld joint as per Figure 1.2. Two standby thermocouples shall also be provided on the weld (to be used in case of any failure of the thermocouple).

3.2.11.2 The PWHT temperature shall be 740-770°C and the soaking time shall be 2.5 minutes per mm of weld thickness, subject to a minimum of one hour. All records shall be reviewed by site Engineer prior to PWHT clearance. Heating shall be done by Induction heating only. However for thickness upto 32 mm, Resistance heating may also be used.

3.2.11.3 The rate of heating / cooling (above 300 ° C):-

Thickness up to 50 mm - 110°C / hour (max)

Thickness 50 to 75mm - 75°C / hour (max)

Thickness above 75mm - 55°C / hour (max)

3.2.11.4 Welding and PWHT shall be monitored every one hour by site engineer. Job card for PWHT shall be maintained as per Annexure II, Chapter A1 of Welding Manual - AA/CQ/GL/011/ PART I-WM – Latest.

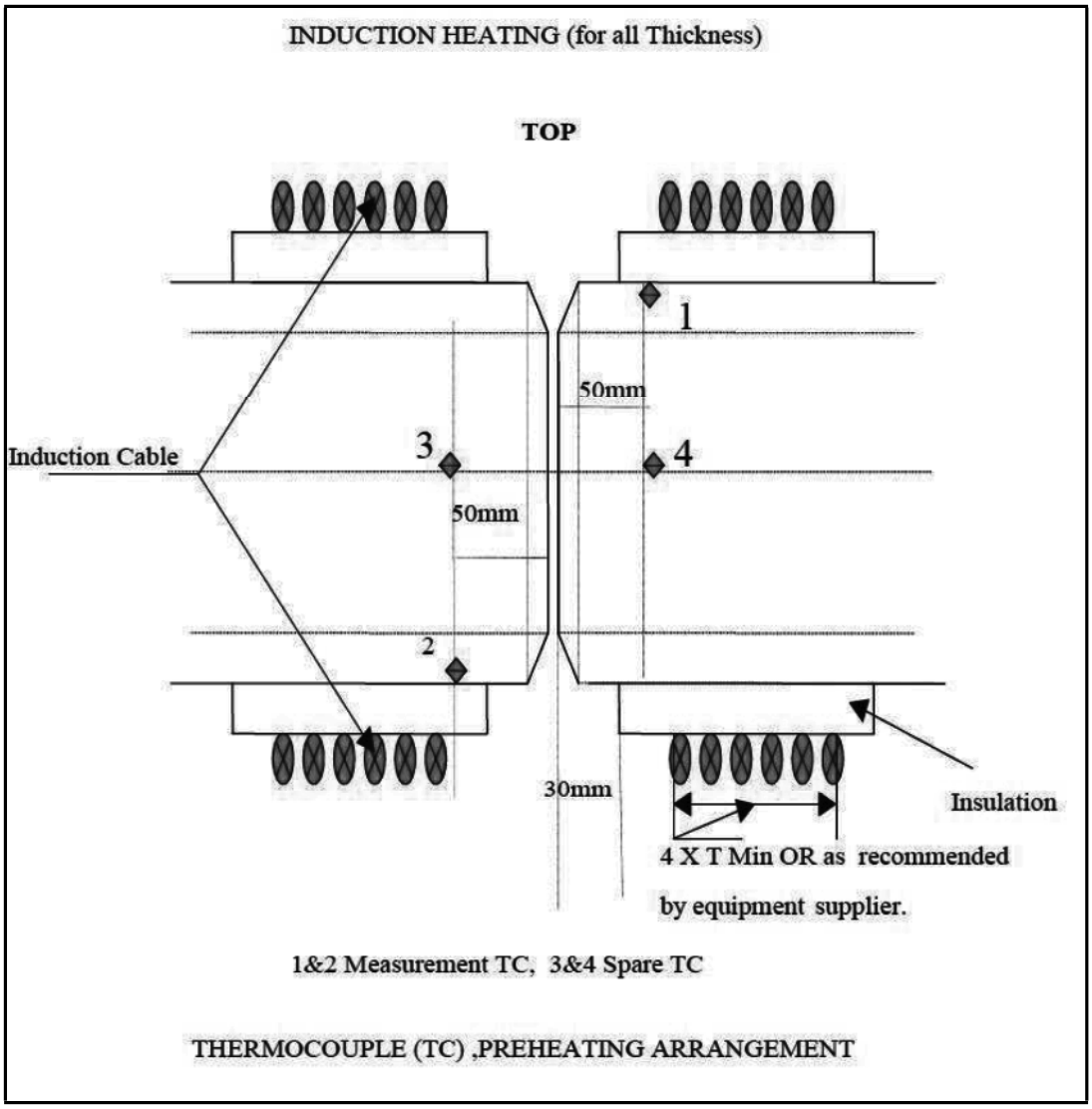



**Figure 1.1: Placement of Thermocouples on P91/P92/F91/F92/C12A materials for Preheating**

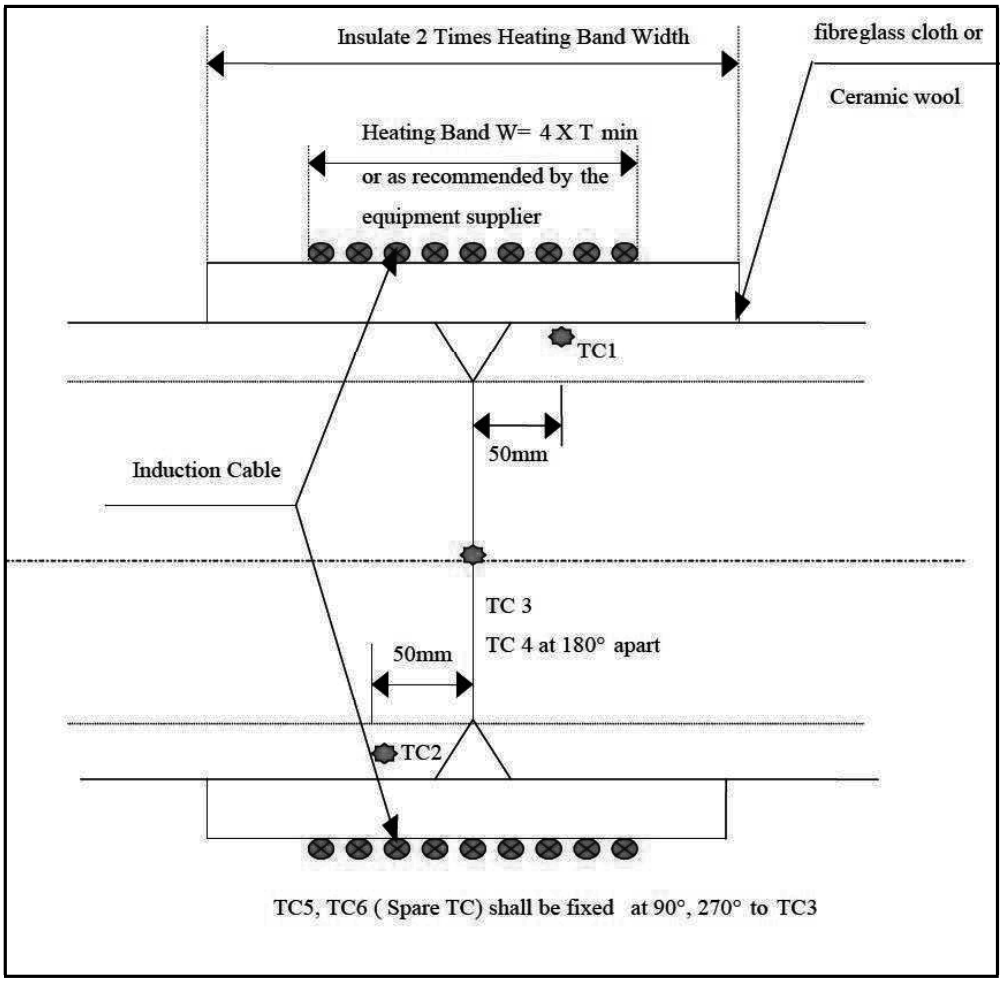



**Figure 1.2: Placement of Thermocouples on P91/P92/F91/F92/C12A materials for PWHT**

3.2.12 **Heat Treatment of T91/T92/T23 welds:**

3.2.12.1 Heat treatment controls of T91/T92 welds shall be as detailed in Cl. 3.2.1 to Cl.3.2.10 of this Manual.

3.2.12.2 Figure 1.2 & 1.3 of this manual shall be referred for Resistance heating coil arrangement for Preheating and PWHT of T91/T92 tube assembly.

3.2.12.3 The PWHT temperature shall be 730-760°C and the soaking time shall be 2.5 minutes per mm of weld thickness, subject to a minimum of 30minutes. All records shall be reviewed by site Engineer prior to PWHT clearance.

3.2.12.4 The rate of heating / cooling (above 300 ° C) for T91/T92 welds shall not exceed 140°C/hour.

3.2.12.5 Heat treatment controls of T23 welds shall be as detailed in Chapter B4 of Welding Manual - AA/CQ/GL/011/ PART I-WM – Latest.

3.3 **Heat Treatment of Components /Systems other than Boiler and Piping:**

3.3.1 Preheating, post heating and PWHT methodologies and parameters shall be as recommended by the concerned equipment suppliers.

3.4 **Heat Treatment Operator Requirements:**

The operator for the Heat Treatment shall be a qualified technician and shall be conversant in the operation & maintenance of heat treatment machines & process. He shall be trained by the concerned Site Engineer in order to operate and maintain the equipment and carry out the process properly.

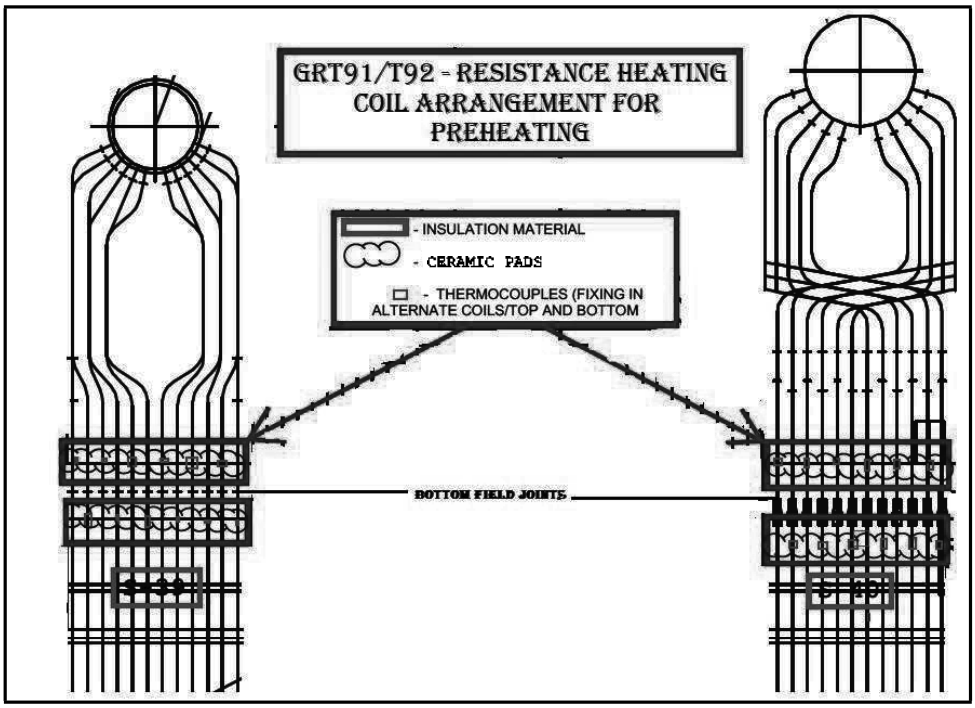



**Figure 1.3: Resistance heating Coil arrangement for Preheating of T91/T92 tube assembly**

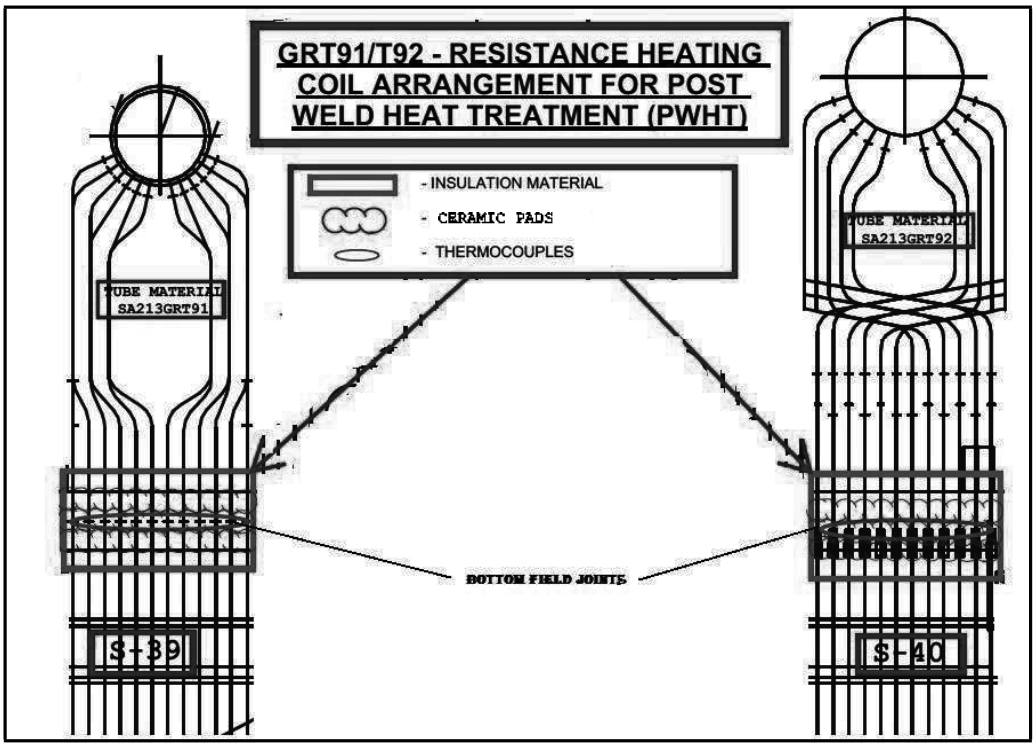



**Figure 1.4: Resistance heating Coil arrangement for PWHT of T91/T92 tube assembly**

3.5 **List of Tables:**

- Table-1.1: Weld preheat and PWHT for tubes and pipes outside diameter ≤ 102 mm.
- Table-1.2: Weld preheat and PWHT for Boiler Header welds.
- Table-1.3: Weld preheat and PWHT for pipes outside diameter > 102 mm.
- Table-1.4: Pre-heat and PWHT for Non-Pressure Parts including Structural.

## 4.0 RECORDS:

Relevant records like Job card and HT Charts shall be maintained by the Site Engineer till the closure of the project. The records may be handed over to the customer at the time of project closure if required by the contract

## ANNEXURE I: PWHT JOB CARD

### POST WELD HEAT TREATMENT (PWHT) JOB CARD

**Project:** _____

Card No. : _____ Date : Unit

No. : _____ Package :

Description: Temp. Recorder Details :

Weld Reference : _____ 1. Make : _____

Material Spec. : _____ 2. Type : _____

Size: Dia. mm _____ 3. Sl. No. _____

Thick (t) mm _____ 4. Chart speed: _____ mm / hour

NDE Cleared on : _____ 5. Calibration Due on : _____

Report No. : _____

---

**Thermocouple Locations :**

Minimum 2

Distance of TC from the weld centre =

Heating Band =

Insulation Band =

---

Date of PWHT Chart No. : _____

Start Time : _____ End Time :

| | Required | Actual | | |
|---|---|---|---|---|
| Rate of Heating (Max) °C/h | | | | |
| Soaking Temperature °C | | | | |
| Soaking Time (Minutes) | | | | |
| Rate of cooling (Max)° C | | | | |

Ambient temperature recorded on the PWHT Chart: _____

**TABLE – 1.1**
**WELD PRE HEAT AND PWHT FOR TUBES & PIPES**
**OUTSIDE DIAMETER ≤ 102 mm**
**(Applicable for Butt Welds and Socket Welds)**

| P. No. of Material | Thickness (mm) | Preheat (°C) | PWHT (°C) |
|---|---|---|---|
| P1 Gr 1 | ≤ 19 | Nil | Nil |
| P1 Gr 2 (C ≤0.25%) | ≤ 19 | Nil | Nil |
| P1 Gr 2 (C > 0.25%) | ≤ 9 | Nil | Nil |
| | > 9 | Nil | 595-625 |
| P3 Gr 1 | ≤ 13 | Nil | Nil |
| P3 Gr 2 | > 13 | 100 (Note 1) | 620 - 650 |
| P4 Gr 1 | ≤ 13 | 150 | Nil |
| | > 13 | 150 | 650 - 670 |
| P5 A Gr 1 | ≤ 8 | 150 | Nil |
| | > 8 | 150 | 680 -710 |
| P15 E Gr 1 (Gr. 91 & Gr.92) | All | 220 | 730 - 760 |
| SA 213 T23 | All | 220 | 730 - 760 |
| P8 | All | Nil | Nil |

**Note 1: Pre-heating is necessary for t >16mm.**

**TABLE – 1.2**
**WELD PREHEAT AND PWHT FOR BOILER HEADER WELDS**
**(Applicable For Welding of Header to Header Joints)**

| P. No. of Header Material | Thickness (mm) | Preheat °C | Post Heating °C | PWHT °C |
|---|---|---|---|---|
| P1Gr 1 | t ≤ 19 | Nil | Nil | Nil |
| | 19 < t ≤ 25 | Nil | Nil | 595 - 625 |
| | 25 < t ≤ 75 | 100 | Nil | 595 - 625 |
| | t > 75 | 150 | Nil | 595 - 625 |
| P1Gr 2 | t ≤ 19 | Nil | Nil | 620 – 635 |
| | t > 19 | 150 | 150 for 2 hours | 620 – 635 |
| P4 Gr 1 | All | 150 | Nil | 650 - 670 |
| P5 A | All | 150 | 250 for 2 hours | 680 - 710 |
| P15E Gr1 (Gr 91 & Gr 92) | All | 220 | Nil | 740 - 770 |
| P15 E Gr1 + P5 A | All | 220 | Nil | 730-760 |
| T23 | All | 220 | 250 for 1 hour | 730 - 760 |

**TABLE – 1.3**
**WELD PREHEAT AND PWHT FOR PIPES**
**OUTSIDE DIAMETER >102 MM**

| P No. of Material | Thickness (mm) | Butt Welds | | Stub and Attachment welds | | | | Post heat °C |
|---|---|---|---|---|---|---|---|---|
| | | Preheat °C | PWHT °C | Throat ≤ 19 mm | | Throat > 19 mm | | |
| | | | | Preheat °C | PWHT °C | Preheat °C | PWHT °C | |
| P1 Gr 1 | ≤ 19 | Nil | Nil | Nil | Nil | Nil | 595 - 625 | Nil |
| | >19≤25 | Nil | 595 - 625 | Nil | 595 - 625 | Nil | 595 - 625 | Nil |
| | >25≤75 | 150 | 595 - 625 | 150 | 595 - 625 | 150 | 595 - 625 | Nil |
| | >75 | 150 | 595 - 625 | 150 | 595- 625 | 150 | 595 - 625 | Nil |
| P1 Gr 2 | ≤9 | Nil | Nil | Nil | Nil | Nil | 595 - 625 | Nil |
| | >9≤19 | Nil | 595 - 625 | Nil | 595 - 625 | Nil | 595 - 625 | Nil |
| | >19 | 150 | 595 - 625 | 150 | 595 - 625 | 150 | 595 - 625 | 150 for 2 hrs |
| P4 Gr 1 | All | 150 | 640-670 | 150 | 640- 670 | 150 | 640- 670 | Nil |
| P5 A | All | 150 | 680 - 710 | 150 | 680- 710 | 150 | 680- 710 | 250 for 2 hrs |
| P15 E Gr1 | All | 220 | 740-770 | 220 | 740- 770 | 220 | 740- 770 | NA |
| P15 E Gr1 + P5 A | All | 220 | 730-760 | 220 | 730- 760 | 220 | 730- 760 | NA |

For butt welds of different P group combinations, PWHT temperature may be as follows:

| | |
|---|---|
| P1 + P3 - | 620 to 650°C |
| P1 + P4 - | 640 to 670°C |
| P4 + P5A- | 680 to 710°C |

(For other P Group combinations, refer to Manufacturing unit)

**TABLE – 1.4**
**PREHEAT AND PWHT FOR NON PRESSURE PARTS INCLUDING STRUCTURALS**

| P. No. of Material / Material Specification | Gas Cutting | | Welding | | |
|---|---|---|---|---|---|
| | Thickness (mm) | Preheat °C | Thickness (mm) | Preheat (°C) | PWHT (°C) |
| P1 / IS 2062<br>E250 BR,<br>E350 BR,E350C | [redacted]<br><br>> 50 | Nil<br><br>100 | [redacted]<br>[redacted]<br>> 63 | Nil<br>100<br>150 | 595-625<br>1.0 All butt welds > 50 mm thick<br>2.0 For Ceiling girders if thickness > 50 mm<br>3.0 No HT required for web to flange fillet welds. |
| BS EN 10025 Gr 420 N ( Ceiling Girder ) | All | 220 | All | 220 | 620 – 650 |
| P3 Gr 1 and Gr 2 | T>25 | 150 | All | 150 | 620-650<br>a) All butt welds in tension member<br>b) All butt welds of fabricated components > 16mm thick and fillet welds with throat thickness > 13 mm |
| P4 Gr 1 | All | 150 | All | 150 | 650-680<br>a) All butt welds in tension member<br>b) All butt welds of fabricated components > 16mm thick and fillet welds with throat thickness > 13 mm |
| P5A Gr 1 | All | 150 | All | 150 | 680-710<br>All welds<br>(Note 2) |
| P15E Gr.1 | Not permitted | Not permitted | All | 220 | 740-770 |

**NOTE:**

1. All gas cut edges shall be ground for a width of 3mm to remove the HAZ.
2. All welds of P5A material shall be post heated at 250°C for 2 hours immediately after welding.

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# GUIDELINES
# FOR
# WELDING

# IMPORTANT NOTE

**THIS GUIDELINES FOR WELDING PROVIDES BROAD BASED GUIDELINES FOR CARRYING OUT WELDING WORK AT SITES. HOWEVER, SITES SHALL ENSURE ADHERENCE TO THE PRIMARY DOCUMENTS LIKE CONTRACT DRAWINGS, FIELD WELDING SCHEDULES, WELDING PROCEDURE SPECIFICATIONS, PLANT / CORPORATE STANDARDS, STATUTORY DOCUMENTS, CONTRACTUAL OBLIGATIONS,AS APPILCABLE ANDSPECIAL INSTRUCTIONS, IF ANY, ISSUED BY RESPECTIVE MANUFACTURING UNITS SPECIFIC TO THE PROJECTS.**

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# CHAPTER–A1
# WELDING - GENERAL

# A1: WELDING-GENERAL

## 1.0 SCOPE:

1.1 This manual deals with activities and information related to welding at site. Where specific documents are supplied by the Manufacturing Units (MUs)/Engineering Centers (ECs), the same shall be adopted.

## 2.0 DOCUMENTS REFERRED:

2.1 The following documents are referred in preparation of this manual.

1. AWS D1.1
2. AWS D1.6
3. ASME sections I, II (A&C), V & IX
4. ASME B31.1
5. IBR
6. BHEL Manufacturing Units/Engineering Centers Standards & practices

## 3.0 PROCEDURE:

3.1 The following documents shall be referred as primary documents

1. Contract drawings
2. Field Welding Schedule or equivalent
3. Plant / Corporate standards, wherever applicable
4. Statutory documents
5. Welding Procedure Specifications
6. Contractual obligations, if any.

## 4.0 WELDER QUALIFICATION:

4.1 Ensure, personnel qualified as per statutory requirements are engaged, where required.

4.2 For welding not under the purview of statutory requirements, qualification of welders shall be as in this manual.

4.3 Monitor performance of qualified butt welders as in this manual.

4.4 Ensure selection, procurement, storage, drying & issue of welding consumables, as detailed in this manual.

4.5 List of approved vendors of general purpose welding electrodes as provided by BHEL-Tiruchy Unit shall be used for selection of brands at sites. Alternatively specific contractual requirements, if any may be followed.

4.6 Where Tiruchy list does not cover site requirements, such specific cases may be referred toconcerned unit and Head (Quality) of the region.

4.7 Welding in-charge shall assign a unique identification for all the butt welds coming under the purview of statutory regulations. Such identification may be traceable through documents like drawings, sketches etc.

4.8 A welding "job card" incorporating the welding parameters and heat treatment requirements is recommended to be issued for all critical welds like pressure part welds, piping welds and

ceiling girder welds. The formats of the job card are enclosed for illustration in Annexure I, II, III and IV.

## 5.0 SELECTION OF ARGON GAS FOR GTAW:

### 5.1 USE OF ARGON GAS AT SITES:

In the welding process, Argon is used for **SHIELDING** and **PURGING (BACKING)** purpose. The welding process when exposed to air, most metals exhibit a strong tendency to combine with Oxygen, and to lesser extent with Nitrogen, especially when in the molten condition. The rate of oxide formation will vary with different metals, but even a thin film of oxide on the surface of metals to be welded can lead to difficulties. For the most part, the oxides are relatively weak, brittle materials that in no way resemble the metal from which they are formed. A layer of oxide can easily prevent the joining of two pieces by welding.

Argon is a shielding gas used in Gas Tungsten Arc Welding (GTAW). It is also used for purging (backing) during the root welding of Gr.91/Gr.92/Stainless steel materials. Argon protects welds against oxidation as well as reduces fume emissions during welding. The compressed argon is supplied in cylinders. The cylinder used for argon will have the body colour of BLUE without band, size of 25 cm dia. &1.5 m length, capacity of 6.2 $m^3$ and pressure of 137 $Kg/Cm^2$ when fully charged at 15°C (approximately).

### 5.2 PURITY LEVEL OF ARGON

As per IS 5760: 1998 there are 3 grades of argon, namely:

- **Grade 1:** Ultra high purity argon for use in electronics and allied industries and indirect reading vacuum spectrograph.
- **Grade 2:** High purity argon for use in lamp and allied industries.
- **Grade 3:** Commercial grade argon for use in welding industry and for other metallurgical operations.

Accordingly the argon shall comply with the requirements given below:

| Sl. No. | CHARACTERISTIC | REQUIREMENT | | |
|---|---|---|---|---|
| | | Grade 1 | Grade 2 | Grade 3 |
| i. | Oxygen, ppm, Max. | 0.5 | 5.0 | 10.0 |
| ii. | Nitrogen, ppm, Max. | 2.0 | 10.0 | 300 |
| iii. | Hydrogen, ppm, Max. | 1.0 | 2.0 | 5.0 |
| iv. | Water vapors, ppm. Max. | 0.5 | 4.0 | 7.0 |
| v. | Carbon dioxide, ppm, Max. | 0.5 | 0.5 | 3.0 |
| vi. | Carbon monoxide, ppm, Max. | 0.5 | 0.5 | 2.0 |
| vii. | Hydrocarbons, ppm, Max. | 0.2 | 0.5 | - |

### 5.3 PURCHASE SPECIFICATION FOR ARGON:

Argon gas as per Grade 2 of IS-5760: 1998 with Argon purity level of min. 99.99%. The supply should accompany Test Certificate for the batch indicating compliance to the above requirements.

**5.4 HEAT TREATMENT:**

5.4.1 Preheat, inter pass, post heat and Post Weld Heat Treatment (PWHT) requirements shall be as per applicable documents; where these are not supplied, reference may be made to Welding / Heat Treatment Manual.

5.4.2 Prior to PWHT operation, a "job card" containing material specification, weld reference, size, rate of heating, soaking temperature, soaking time and rate of cooling shall be prepared referring to applicable documents, and issued.

5.4.3 The PWHT chart shall contain the chart number,Weld Joint No., Temperature recorder details (like Sl. No. make, range, chart speed), date of PWHT, start and end time of operation.

5.4.4 The chart shall be evaluated and results recorded on the PWHT job card. Refer Heat Treatment Manual (Document No. AA/CQ/GL/011/ Part II-HTM- Latest) for details.

**6.0 EQUIPMENT & INSTRUMENTS:**

6.1 Equipment/accessories used shall be assessed for fitness prior to use.

6.2 Use calibrated thermocouples, temperature measuring instruments and recorders.

6.3 Preheating shall be checked and ensured using temperature indicating crayons.

**7.0 INSPECTION:**

7.1 Inspection of welding shall be done as per Chapter A5 of this manual and records maintained as appropriate.

7.2 Weld log containing the following information shall be prepared for all completed systems.

Project / Unit reference
Drawing No.
Weld Joint No.
FWS/ Equivalent
Material specification
Consumable used
Welder code
Date of welding
NDE report No. and results (including repair details)
PWHT Chart No. and results
Remarks, if any.

## 8.0 SAFETY:

8.1 Safe access to weld area shall be provided.

8.2 Adequate protection shall be provided against wind and rain water entry during welding.

## 9.0 RECORDS:

9.1 All records, as required, shall be maintained by welding in-chargeand handed over to the appropriate authority at the end of the project closure.

## Annexure – I: Welding Job Card



**Welding Job Card**

| | | | |
|---|---|---|---|
| Project | : | | |
| Unit No. | : | Area: Boiler/TG/PCP: | |
| Job Card No. | : | Date | : |
| FWS Number | : | | |
| Joint No. | : | | |
| Drawing No. | : | | |
| System Description | : | | |
| Size (Dia. x thick) | : | | |
| Material Specification | : | | |
| Consumable used | : | | |
| Welder No.(s) | : | | |
| Date of welding | : | | |
| Filler wire Specification | : | | |
| Electrode Specification | : | | |
| Preheat temperature | : | | |
| Inter pass temperature | : | | |
| Post Heat temperature | : | | |
| PWHT temperature | : | | |

Welding engineer



**Filler wire/Electrode consumption**

| | | |
|---|---|---|
| SMAW | ϕ 2.5 mm | : |
| | ϕ 3.15 mm | : |
| | ϕ 4.0 mm | : |
| Date of LPI for RG Plug | | : |
| Remarks | | : |
| Date of Return | | : |

## Annexure – II: Welding Job Card for P91/P92 Welds

| JOB CARD<br>(WELDING, HEAT TREATMENT & ND EXAMINATION)<br>FOR P91/P92 WELDS | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Card No.:** | | | | | | | | **Date:** | | | | |
| **Project:** | | | | | **Unit No.** | | | **Contractor:** | | | | |
| System: | | | | | | Drawing No. | | | | | | |
| PGMA: | | | | | | DU No.: | | | Joint No.: | | | |
| Material Specification: | | | + | | | OD (mm): | | | Thick(mm) | | | |
| Filler metal: | GTAW | | | | | SMAW | | | | | | |
| Joint fit-up: | Min. WT: | | Root gap: | | | Root mismatch: | | | Log sheet filled: | Y / N | | |
| No. of T/Cs: | | Location: | | | | Distance from EP edge: | | | | mm | | |
| Welders' ID: | | | | | | M/c No.: | | | | | | |
| Preheat Temp.: | °C Minimum | | | | | Rate of heating: | | | °C per hour | | | |
| Purging flow rate: | | Litres / min. | | | | Purging time: | | | | Minutes | | |
| Shielding flow rate: | | Litres / min. for GTAW | | | | Distance bet. dams: | | | | Metres | | |
| Interpass Temp.: | ° C Maximum | | | | | Rate of cooling: | | | °C per hour | | | |
| Holding Temp. before PWHT: | ° C for min. 1 hour | | | | | | | | | | | |
| PWHT: | ° C | | | | | Rate of heating / cooling: | | | °C per hour | | | |
| Soaking time | | Minutes (2.5 minutes per mm) | | | | Cooling to: | | | 300° C | | | |
| Preheating started at | Hrs. on | | | | | Preheating completed at | | | Hrs. | | | |
| Root welding started at | Hrs. | | | | | Root welding completed at | | | Hrs. | | | |
| Welding started at | Hrs. | | | | | Welding completed at | | | Hrs. | | | |
| Interpass temp. maintained between | °C and | °C | | | | | | | | | | |
| Holding temp. reached at | Hrs. | | | | | Holding completed at | | | Hrs. | | | |
| No. of T/Cs: | | Location | | | | | | | | | | |
| PWHT started at | Hrs. on | . | | | | Soaking started at | | | Hrs. | | | |
| Soaking completed at | Hrs. | | | | | 300°C reached at | | | Hrs. | | | |
| UT Equipment used: | | | | | | Calibration validity: | | | | | | |
| UT carried out on | | | | | | Result : OK / Not OK | | | | | | |
| MPI Equipment used: | | | | | | Calibration validity: | | | | | | |
| MPI carried out on | | | | | | Result: OK / Not OK | | | | | | |
| Hardness test Equipment used: | | | | | | Calibration validity: | | | | | | |
| Hardness test carried out on | | | | | | Value: | | | | | | |
| History of interruption if any, with time: | | | | | | | | | | | | |
| **Contractor** | | | | **BHEL** | | | | | **Customer** | | | |

## Annexure – III: Welding Job Card for T91/T92 Welds

| JOB CARD<br>(WELDING, HEAT TREATMENT & ND EXAMINATION)<br>FOR T91/T92 WELDS | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Card No.:** | | | | | | | | **Date:** | | | | |
| **Project** | | | | **Unit No.** | | | | **Contractor:** | | | | |
| System: | | | | | | Drawing No. | | | | | | |
| PGMA: | | | | | | DU No.: | | | | Joint No.: | | |
| Material Specification: | | | + | | | OD (mm): | | | | Thick(mm) | | |
| Filler metal: | GTAW | | | | | SMAW | | | | | | |
| Joint fit-up: | Min. t: | | Root gap: | | | Root mismatch: | | | Log sheet filled: | | Y / N | |
| No. of T/Cs: | | Location : | | | | Distance from EP edge: | | | | mm | | |
| Welders' ID: | | | | | | M/c No.: | | | | | | |
| Preheat Temp.: | | °C Minimum | | | | Rate of heating: | | | °C per hour | | | |
| Purging flow rate: | | | Litres / min. | | | Purging time: | | | | | Minutes | |
| Shielding flow rate: | | | Litres / min. for GTAW | | | Distance bet. dams: | | | | | Metres | |
| Interpass Temp.: | | ° C Maximum | | | | Rate of cooling: | | | °C per hour | | | |
| PWHT: | | ° C | | | | Rate of heating / cooling: | | | °C per hour | | | |
| Soaking time | | | Minutes (2.5 minutes per mm) | | | Cooling to: | | | 300° C | | | |
| Preheating started at Hrs. | | Hrs. on | | | | Preheating completed at | | | | | | |
| Root welding started at Hrs. | | Hrs. | | | | Root welding completed at | | | | | | |
| Welding started at Hrs. | | Hrs. | | | | Welding completed at | | | | | | |
| Interpass temp. maintained between | | | °C and | | °C | | | | | | | |
| Holding temp. reached at | | Hrs. | | | | Holding completed at | | Hrs. | | | | |
| No. of T/Cs: | | Location | | | | | | | | | | |
| PWHT started at | Hrs. on | | . | | | Soaking started at | | Hrs. | | | | |
| Soaking completed at | Hrs. | | | | | 300°C reached at | | Hrs. | | | | |
| RT carried out on | | | | | | Result : OK / Not OK | | | | | | |
| Hardness test Equipment used | | | | | | Calibration validity: | | | | | | |
| Hardness test carried out on | | | | | | Value: | | | | | | |
| History of interruption if any, with time: | | | | | | | | | | | | |
| **Contractor** | | | | **BHEL** | | | | | **Customer** | | | |

## Annexure – IV: Welding Job Card for T23 Welds

| JOB CARD<br>(WELDING, HEAT TREATMENT & ND EXAMINATION)<br>FOR T23 WELDS | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Card No.:** | | | | | | | | **Date:** | | | | |
| **Project:** | | | | **Unit No.** | | | | **Contractor:** | | | | |
| System: | | | | | | Drawing No. | | | | | | |
| PGMA: | | | | | | DU No.: | | | Joint No.: | | | |
| Material Specification: | | | + | | | OD (mm): | | | Thick(mm) | | | |
| Filler metal: | GTAW | | | | | SMAW | | | | | | |
| Joint fit-up: | Min. t: | | Root gap: | | | Root mismatch: | | | Log sheet filled: | Y / N | | |
| No. of T/Cs: | | Location: | | | | Distance from EP edge: | | | | mm | | |
| Welders' ID: | | | | | | M/c No.: | | | | | | |
| Preheat Temp.: | °C Minimum | | | | | Rate of heating: | | | °C per hour | | | |
| Purging flow rate: | | Litres / min. | | | | Purging time: | | | | Minutes | | |
| Shielding flow rate: | | Litres / min. for GTAW | | | | Distance bet. dams: | | | | Metres | | |
| Interpass Temp.: | ° C Maximum | | | | | Rate of cooling: | | | °C per hour | | | |
| Holding Temp.: | ° C for min. 1 hour. for post heating | | | | | | | | | | | |
| PWHT: | ° C | | | | | Rate of heating / cooling: | | | °C per hour | | | |
| Soaking time | | Minutes (2.5 minutes per mm) | | | | Cooling to: | | | 300° C | | | |
| Preheating started at | Hrs. on | | | | | Preheating completed at | | | Hrs. | | | |
| Root welding started at | Hrs. | | | | | Root welding completed at | | | Hrs. | | | |
| Welding started at | Hrs. | | | | | Welding completed at | | | Hrs. | | | |
| Interpass temp. maintained between | °C and | °C | | | | | | | | | | |
| Holding temp. reached at | Hrs. | | | | | Holding completed at | Hrs. | | | | | |
| No. of T/Cs | | Location | | | | | | | | | | |
| PWHT started at | Hrs. on | | | | | Soaking started at | Hrs. | | | | | |
| Soaking completed at | Hrs. | | | | | 300°C reached at | Hrs. | | | | | |
| RT carried out on | | | | | | Result : OK / Not OK | | | | | | |
| Hardness test Equipment used | | | | | | Calibration validity: | | | | | | |
| Hardness test carried out on | | | | | | Value: | | | | | | |
| | | | | | | Result: | OK / Not OK | | | | | |
| History of interruption if any, with time: | | | | | | | | | | | | |
| **Contractor** | | | | **BHEL** | | | | | **Customer** | | | |

# CHAPTER–A2
# BASE MATERIALS

## 1.0 SCOPE:

1.1. This chapter contains tabulations of chemical compositions and mechanical properties of various materials generally used at BHEL sites.

## 2.0 CONTENTS:

**CHEMICAL COMPOSITION AND MECHANICAL PROPERTIES**


Table A2.1 - Pipes (ASME)

Table A2.2 - Tubes (ASME)

Table A2.3 - Forgings (ASME)

Table A2.4 - Castings (ASME)

Table A2.5 - Plates / Sheets (ASTM, ASME& IS)

Table A2.6 - Pipes (Other specifications)

Table A2.7 - Tubes (Other specifications)


**3.0** The data are for general information purposes. The corresponding P numbers are also indicated.

**4.0** For materials not covered in this chapter,refer the relevant Material Specification Standard. In case it is not available at site, same shall be referred to Head quality of the region.

## TABLE-A2.1: PIPES (ASME)

| Sl. No. | P. No. /Group No. | MaterialSpecification | Chemical Composition (%) | | | | | | | | | | Mechanical Properties (Min.) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | C | Mn | P | S | Si | Ni | Cr | Mo | V | W | T.S MPa | Y.S MPa | % E Min. |
| 1 | P 1 / 1 | SA 106 Gr. B (Remarks: Carbon restricted to 0.25% Max.) | 0.30 Max. | 0.29-1.06 | 0.035 Max. | 0.035 Max. | 0.10 Min. | 0.40 Max. | 0.40 Max. | 0.15 Max. | 0.08 Max | - | 415 | 240 | 30 |
| 2 | P 1 / 2 | SA 106 Gr. C (Remarks: Carbon restricted to 0.25% Max.) | 0.35 Max. | 0.29-1.06 | 0.035 Max. | 0.035 Max. | 0.10 Min. | 0.40 Max. | 0.40 | 0.15 Max. | - | - | 485 | 275 | 30 |
| 3 | P4/1 | SA 335 P 11 | 0.15 Max | 0.30–0.60 | 0.025 | 0.025 | 0.50–1.00 | - | 1.00–1.50 | 0.44–0.65 | - | - | 380 | 205 | 30 |
| 4 | P 4 / 1 | SA 335 P 12 | 0.15 Max. | 0.30-0.61 | 0.025 Max. | 0.025 Max. | 0.50 Max. | - | 0.80-1.25 | 0.44-0.65 | - | - | 415 | 220 | 30 |
| 5 | P 5A / 1 | SA 335 P 22 | 0.15 Max. | 0.30-0.60 | 0.025 Max. | 0.025 Max. | 0.50 Max. | - | 1.90-2.60 | 0.87-1.13 | - | - | 415 | 205 | 30 |
| 6 | P 15E /1 | SA 335 P91 | 0.08-0.12 | 0.30-0.60 | 0.02 Max. | 0.01 Max. | 0.20-0.50 | 0.40 Max. | 8.00-9.50 | 0.85-1.05 | 0.18-0.25 | - | 585 | 415 | 20 |
| 7 | P15E/1 | SA 335 P 92 | 0.13 Max | 0.30-0.60 | 0.020 | 0.010 | 0.50 max | 0.40 max | 8.50-9.50 | 0.0- | 0.15-0.25 | 1.5-2.0 | 620 | 400 | 20 |

## TABLE-A2.2: TUBES(ASME)

| Sl. No. | P. No. /Group No. | MaterialSpecification | Chemical Composition (%) | | | | | | | | | | Mechanical Properties (Min.) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | C | Mn | P | S | Si | Ni | Cr | Mo | V | W | T.S MPa | Y.S MPa | % E Min. |
| 1 | P 1 / 1 | SA 192 | 0.06-0.18 | 0.27-0.63 | 0.035 Max. | 0.035 Max. | 0.25 Max. | - | - | - | - | - | 325 | 180 | 35 |
| 2 | P 1 / 1 | SA 210 Gr A1 (Remarks: Carbon restricted to 0.25% Max.) | 0.27 Max. | 0.93 Max. | 0.035 Max. | 0.035 Max. | 0.10 Max. | - | - | - | - | - | 415 | 255 | 30 |
| 3 | P 1 / 1 | SA 179 | 0.06-0.18 | 0.27-0.63 | 0.035 Max. | 0.035 Max. | - | - | - | - | - | - | 325 | 180 | 35 |
| 4 | P 1 / 2 | SA 210 Gr C (Remarks: Carbon restricted to 0.30% Max.) | 0.35 Max. | 0.29-1.06 | 0.035 Max. | 0.035 Max. | 0.10 Max. | - | - | - | - | - | 485 | 275 | 30 |
| 5 | P 3 / 1 | SA 209 T1 | 0.10-0.20 | 0.30-0.80 | 0.025 Max. | 0.025 Max. | 0.10-0.50 | - | - | 0.44-0.65 | - | - | 380 | 205 | 30 |
| 6 | P 4 / 1 | SA 213 T11 | 0.05-0.15 | 0.30-0.60 | 0.025 Max. | 0.025 Max. | 0.50-1.00 | - | 1.00-1.50 | 0.44-0.65 | - | - | 415 | 205 | 30 |
| 7 | P 4 / 1 | SA 213 T12 | 0.05-0.15 | 0.30-0.61 | 0.025 Max. | 0.025 Max. | 0.50 Max. | - | 0.80-1.25 | 0.44-0.65 | - | - | 415 | 220 | 30 |
| 8 | P 5 A / 1 | SA 213 T22 | 0.05-0.15 | 0.30-0.60 | 0.025 Max. | 0.025 Max. | 0.50 Max. | - | 1.90-2.60 | 0.87-1.13 | - | - | 415 | 205 | 30 |

## TABLE-A2.2: TUBES(ASME) (Contd…)

| Sl. No. | P. No. / Group No. | Material Specification | Chemical Composition (%) | | | | | | | | | | Mechanical Properties (Min.) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | C | Mn | P | S | Si | Ni | Cr | Mo | V | W | T.S MPa | Y.S MPa | % E Min. |
| 9 | P 5 B / 1 | SA 213 T5 | 0.15 Max. | 0.30-0.60 | 0.025 Max. | 0.025 Max. | 0.50 Max. | - | 4.00-6.00 | 0.45-0.65 | - | - | 415 | 205 | 30 |
| 10 | P 5 B / 1 | SA 213 T9 | 0.15 Max. | 0.30-0.60 | 0.025 Max. | 0.025 Max. | 0.25-1.00 | - | 8.00-10.00 | 0.90-1.10 | - | - | 415 | 205 | 30 |
| 11 | P 1 5 E / 1 | SA 213 T91 | 0.07-0.14 | 0.30-0.60 | 0.02 Max. | 0.01 Max. | 0.20-0.50 | 0.40 Max. | 8.00-9.50 | 0.85-1.05 | 0.18-0.25 | - | 585 | 415 | 20 |
| 12 | P 8 / 1 | SA 213 TP 304 H | 0.04-0.10 | 2.00 Max. | 0.045 Max. | 0.03 Max. | 1.00 Max. | 8.00-11.00 | 18.00-20.00 | - | - | - | 515 | 205 | 35 |
| 13 | P8/1 | SA 213 TP 321H | 0.04-0.10 | 2.00 Max. | 0.045 Max. | 0.03 Max. | 1.00 Max. | 9.00-12.00 | 17.00-19.00 | - | - | - | 515 | 205 | 35 |
| 15 | P 8 / 2 | SA 213 TP 347 H | 0.04-0.10 | 2.00 Max. | 0.045 Max. | 0.03 Max. | 1.00 Max. | 9.00-13.00 | 17.00-19.00 | - | - | - | 515 | 205 | 35 |
| 15 | Code case 2199 | SA213 T23 | 0.04-0.10 | 0.10-0.60 | 0.030 | 0.010 | 0.050 | -- | 1.90-2.60 | 0.05-0.30 | 0.20-0.30 | 1.45-1.75 | 510 | 400 | 20 |
| 16 | 15E/1 (Code case 2169) | SA213 T92 | 0.07-0.13 | 0.30-0.60 | 0.020 | 0.010 | 0.50 | 0.40 | 8.5-9.5 | 0.30-0.60 | 0.15-0.25 | 1.5-2.0 | 620 | 440 | 20 |
| 17 | P8/1 (Code case 2328 - S30432) | SA 213 UNS S30432 (Super 304H) | 0.07-0.13 | 1.00 | 0.040 | 0.010 | 0.30 | 7.5-10.5 | 17.0-19.0 | - | - | - | 590 | 235 | 35 |

## TABLE A2.3: FORGINGS (ASME)

| Sl. No. | P. No. / Group No. | Material Specification | Chemical Composition (%) | | | | | | | | | | Mechanical Properties (Min.) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | C | Mn | P | S | Si | Ni | Cr | Mo | V | W, Cb | T.S MPa | Y.S MPa | % E Min. |
| 1 | P 1 / 2 | SA 105 (Remarks: Carbon restricted to 0.25% Max.) | 0.35 Max. | 0.60-1.05 | 0.035 Max. | 0.04 Max. | 0.1 - 0.35 | 0.40 Max. | 0.30 Max. | 0.12 Max. | 0.08 Max | - | 485 | 250 | 30 |
| 2 | P 4 / 1 | SA 182 F11 Class 3 | 0.10-0.20 | 0.30-0.80 | 0.04 Max. | 0.04 Max. | 0.50 - 1.00 | - | 1.00-1.50 | 0.44-0.65 | - | - | 515 | 310 | 20 |
| 3 | P 4 / 1 | SA 182 F 12 Class 2 | 0.10-0.20 | 0.30-0.80 | 0.04 Max. | 0.04 Max. | 0.10 - 0.60 | - | 0.80-1.25 | 0.44-0.65 | - | - | 485 | 275 | 20 |
| 4 | P 5 A / 1 | SA 182 F 22 Class 3 | 0.15 Max. | 0.30-0.60 | 0.04 Max. | 0.04 Max. | 0.50 Max. | - | 2.00-2.50 | 0.87-1.13 | - | - | 515 | 310 | 20 |
| 5 | P 1 5 E / 1 | SA 182 F91 | 0.08-0.12 | 0.30-0.60 | 0.02 Max. | 0.01 Max. | 0.20 - 0.50 | 0.40 Max. | 8.00-9.50 | 0.85-1.05 | 0.18-0.25 | - | 620 | 415 | 20 |
| 6 | P 1 5 E / 1 | SA 182 F92 | 0.7-0.13 | 0.30-0.60 | 0.02 Max. | 0.01 Max. | 0.50 Max. | 0.40 Max. | 8.50-9.50 | 0.30-0.60 | 0.15-0.25 | W:1.50-2.00; Cb: 0.04-0.09 | 620 | 440 | 20 |

## TABLE A2.4: CASTINGS (ASME)

| Sl. o. | P. No. /Group No. | Material S e fi a on | Chemical Composition (%) | | | | | | | | Mechanical Properties (Min.) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | C | Mn | P | S | Si | Ni | Cr | Mo | MPa | MPa | % EMI n. |
| 1 | P 1 / 2 | SA 216 WCB (Remarks: Carbon restricted to 0.25% Max.) | 0.30 Max. | 1.00 Max. | 0.04 Max. | 0.045 Max. | 0.60 Max. | 0.50 Max. | 0.50 Max. | 0.20 Max. | 485 | 250 | 22 |
| 2 | P 1 / 2 | SA 216 WCC | 0.25 Max. | 1.20 Max. | 0.04 Max. | 0.045 Max. | 0.60 Max. | 0.50 Max. | 0.50 Max. | 0.20 Max. | 485 | 275 | 22 |
| 3 | P 4 / 1 | SA 217 WC6 | 0.20 Max. | 0.50-0.80 | 0.04 Max. | 0.045 Max. | 0.60 Max. | - | 1.00-1.50 | 0.45-0.65 | 485 | 275 | 20 |
| 4 | P 5 A / 1 | SA 217 WC 9 | 0.18 Max. | 0.40-0.70 | 0.04 Max. | 0.045 Max. | 0.60 Max. | - | 2.00-2.75 | 0.90-1.20 | 485 | 275 | 20 |
| 5 | P 8 / 1 | SA 351 CF 8 | 0.08 Max. | 1.50 Max. | 0.04 Max. | 0.04 Max. | 2.00 Max. | 8.00-11.00 | 18.00-21.00 | 0.50 Max. | 485 | 205 | 35 |
| 6 | P 8 / 1 | SA 351 CF 8M | 0.08 Max. | 1.50 Max. | 0.04 Max. | 0.04 Max. | 1.50 Max. | 9.00-12.00 | 18.00-21.00 | 2.00-3.00 | 485 | 205 | 30 |
| 7 | P 8 / 1 | SA 351 CF 8C | 0.08 Max. | 1.50 Max. | 0.04 Max. | 0.04 Max. | 2.00 Max. | 9.00-12.00 | 18.00-21.00 | 0.50 Max. | 485 | 205 | 30 |
| 8 | P 8 / 2 | SA 351 CH 20 | 0.04-0.20 | 1.50 Max. | 0.04 Max. | 0.04 Max. | 2.00 Max. | 12.00-15.00 | 22.00-26.00 | 0.50 Max. | 485 | 205 | 30 |
| 9 | P15E / 1 | SA 217 C12A | 0.08-0.12 | 0.30-0.60 | 0.030 Max. | 0.010 Max. | 0.20-0.50 | 0.40 Max. | 8.00-10.00 | 0.85-1.05 | 585 | 415 | 18 |

## TABLE A2.5: PLATES/SHEETS

| Sl. No. | P. No./ Group No. | Material Specification | Thickness mm | C | Mn | P | S | Si | Ni | Cr | Mo | V | T.S (MPa) | Y.S (MPa) | %E Min. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | P 1 / 1 | ASTM A36 | 20 incl. | 0.25 | - | 0.04 | 0.05 | 0.40 | - | - | - | - | 400 | 250 | 20 |
| | | | 20-40 incl. | 0.25 | 0.80-1.20 | | | 0.40 | - | - | - | - | | | |
| | | | 40-65 incl. | 0.26 | 0.80-1.20 | | | 0.40 | - | - | - | - | | | |
| | | | 65-100 incl. | 0.27 | 0.85-1.20 | | | 0.15-0.40 | - | - | - | - | | | |
| | | | over 100 | 0.29 | 0.85-1.20 | | | 0.15-0.40 | - | - | - | - | | | |
| 2 | P 1 / 1 | SA 516 Gr 60 | 12.5 incl | 0.21 | 0.55-0.98 | 0.035 | 0.035 | 0.13-0.45 | - | - | - | - | 415 | 220 | 25 |
| | | | 12.5-50 incl | 0.23 | 0.79-1.30 | | | | - | - | - | - | | | |
| | | | 50-100 incl | 0.25 | | | | | - | - | - | - | | | |
| | | | 100-200 incl | 0.27 | | | | | - | - | - | - | | | |
| | | | over 200 | 0.27 | | | | | - | - | - | - | | | |
| 3 | P 1 / 2 | SA516 Gr70 | 12.5 incl | 0.27 | 0.79-1.30 | 0.035 | 0035 | 0.13-0.45 | - | - | - | - | 485 | 260 | 21 |
| | | | 12.5-50 incl | 0.28 | | | | | - | - | - | - | | | |
| | | | 50-100 incl | 0.3 | | | | | - | - | - | - | | | |
| | | | 100-200 incl | 0.31 | | | | | - | - | - | - | | | |
| | | | over 200 | 0.31 | | | | | - | - | - | - | | | |
| 4 | P 1 / 2 | SA299 Gr.A | <25 | 0.26 | 0.84-1.52 | 0.035 | 0.035 | 0.13-0.45 | - | - | - | - | 515 | 275 | 19 |
| | | | >25 | 0.28 | 0.84-1.62 | | | | - | - | - | - | | | |
| 5 | P 1 / 2 | SA515 Gr70 | <25 | 0.31 | 1.30 | 0.035 | 0035 | 0.13-0.45 | - | - | - | - | 485 | 260 | 21 |
| | | | 25-50 incl | 0.33 | | | | | - | - | - | - | | | |
| | | | 50-100 incl | 0.35 | | | | | - | - | - | - | | | |
| | | | 100-200 incl | 0.35 | | | | | - | - | - | - | | | |
| | | | >200 | 0.35 | | | | | - | - | - | - | | | |
| 6 | P311 | SA204 Gr A | <25 incl | 0.18 | 0.98 | 0.025 | 0.025 | 0.13-0.45 | - | - | 0.41-0.64 | - | 450 | 255 | 23 |
| | | | >50 incl | 0.21 | | | | | - | - | | - | | | |
| | | | >100 incl | 0.23 | | | | | - | - | | - | | | |
| | | | >100 | 0.25 | | | | | - | - | | - | | | |
| 7 | P312 | SA204 Gr B | <25 incl | 0.20 | 0.98 | 0.025 | 0.025 | 0.13-0.45 | - | - | 0.41-0.64 | - | 485 | 275 | 21 |
| | | | >50 incl | 0.23 | | | | | - | - | | - | | | |
| | | | >100 incl | 0.25 | | | | | - | - | | - | | | |
| | | | >100 | 0.27 | | | | | - | - | | - | | | |
| 8 | P411 | SA 387 Gr 12 Class 2 | <125 incl | 0.040.17 | 035-0.73 | 0.025 | 0025 | 0.13-0.45 | - | 0.74-1.21 | 0.40-0.65 | - | 450 | 275 | 22 |
| | | | >125 | 017 | | | | | | | | | | | |
| 9 | P5N1 | SA387 Gr 22 Class 2 | <125 incl | 0.04-0.15. | 025-0.66 | 0.025 | 0.025 | 0.50. | | 1.88-2.62 | 0.85-1.15 | - | 515 | 310 | 18 |
| | | | >125 | 0.17 | | | | | | | | | | | |
| 10 | P15El1 | SA387 Gr 91 | all thickness | 0.06-0.15 | 0.25-0.66 | 0.025 | 0012 | 0.18-0.56 | 0.43 | 7.90-9.60 | 0.80-1.10 | 0.16-0.27 | 585 | 415 | 18 |

TABLE A2.5: PLATES/SHEETS (Contd...)

| Sl. No. | P.No./ Group No. | Material Specification | Thickness mm | C | Mn | P | S | Si | Ni | Cr | Mo | V | T.S (MPa) | Y.S (MPa) | %E Min. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11 | P811 | SA240 TYPE 304 | all thickness | 0.07 | 2 | 0.045 | 0.03 | 0.75 | 8.00-10.50 | 17.5.-19.5.0 | - | | 515 | 205 | 40 |
| 12 | P 1 / 1 | ASTM A572 Gr50 | <40 incl | 0.23 | 1.35 | 0.04 | 0.05 | 0.4 0 | - | - | - | - | 450 | 345 | 17 |
| | | | >40 | | | | | 0.15-0.40 | - | - | - | 0.01-0.1 | | | |
| 13 | P 1 / 1 | IS 2062 E250 Gr.A | all thickness | 0.23 | 1.5 | 0.045 | 0.045 | 0.4 | - | - | - | - | 410 | 230 | 23 |
| 14 | P 1 / 1 | IS 2062 E250 Gr.BR BO | all thickness | 0.22 | 1.5 | 0.045 | 0.045 | 0.4 | - | - | - | - | 410 | 230 | 23 |
| 15 | P 1 / 1 | IS 2062 E250 GrC | all thickness | 0.2 | 1.5 | 0.04 | 0.04 | 0.4 | - | - | - | - | 410 | 230 | 23 |
| 16 | P 1 / 1 | IS 2062 E350 Gr A.BR,BO | all thickness | 0.2 | 1.55 | 0.045 | 0.045 | 0.45 | - | - | - | - | 490 | 320 | 22 |
| 17 | P 1 / 1 | IS 2062 E350 GrC | all thickness | 0.2 | 1.55 | 0.04 | 0.04 | 0.45 | - | - | - | - | 490 | 320 | 22 |
| 18 | P 1 / 1 | IS 2062 E450BR | all thickness | 0.22 | 1.65 | 0.045 | 0.045 | 0.45 | - | - | - | - | 570 | 450 | 20 |
| 19 | P 1 / 1 | BSEN10025 Gr 420N | all thickness | 0.2 | 1.0-1.7 | 0.03 | 0.025 | 0.6 | 0.8 | 0.3 | 0.1 | 0.2 | 500 | 320 | 18 |

## TABLE A2.6: PIPES (OTHER SPECIFICATION)

| Sl. No. | Equivalent P. No. /Group No. | Material Specification | Chemical Composition (%) | | | | | | | | | Mechanical Properties (Min.) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | C | Mn | P | S | Si | Ni | Cr | Mo | V | T.S Kg / $mm^2$ | Y.S Kg / $mm^2$ | % EMin. |
| 1 | P1/1 | DIN St. 35.8 | 0.17 Max. | 0.40-0.80 | 0.04 Max. | 0.04 Max. | 0.10-0.35 | - | - | - | - | 36.70-48.96 | 24 | 25 |
| 2 | P1/1 | DIN St. 45.8 | 0.21 Max. | 0.45-1.20 | 0.04 Max. | 0.04 Max. | 0.10-0.35 | - | - | - | - | 41.80-54.10 | 26 | 21 |
| 3 | P1/1 | BS 3602 / 410 | 0.21 Max. | 0.40-1.20 | 0.045 Max. | 0.045 Max. | 0.35 Max. | - | - | - | - | 41.82-56.10 | 25 | 22 |
| 4 | P1/1 | BS 3602 / 460 | 0.22 Max. | 0.80-1.40 | 0.045 Max. | 0.045 Max. | 0.35 Max. | - | - | - | - | 46.90-61.20 | 28.60 | 21 |
| 5 | P4/1 | BS 3604 620-460 HFS or CDS 620-440 | 0.10-0.15 | 0.40 Max. | 0.04 Max. | 0.04 Max. | 0.10-0.35 | - | 0.70-1.10 | 0.45-0.65 | - | 46.90-62.22 | 18.36 | 22 |
| | | | 0.10-0.18 | 0.40-0.70 | 0.04 Max. | 0.04 Max. | 0.10-0.35 | - | 0.70-1.10 | 0.45-0.65 | - | 44.90-60.20 | 29.58 | 22 |
| 6 | P5/1 | BS 3604 622 HFS or CDS | 0.08-0.15 | 0.40-0.70 | 0.04 Max. | 0.04 Max. | 0.50 Max. | - | 2.00 2.50 | 0.90-1.20 | - | 48.80 | 26.80 | 17 |
| 7 | - | BS 3604 HFS 660 Or CDS 660 | 0.15 Max. | 0.40-0.70 | 0.04 Max. | 0.04 Max. | 0.10-0.35 | - | 0.25-0.50 | 0.50-0.70 | 0.22-0.30 | 47.30 | 30 | 17 |
| 8 | P5B/2 | X20CrMoV121D IN17175 | 0.17-0.23 | ≤ 1.00 | 0.030 Max. | 0.030 Max. | ≥ 0.50 | 0.30-0.80 | 10.00-12.50 | 0.80-1.20 | 0.25-0.35 | 70-86 | 50 | 17 |

## TABLE A2.7: TUBES (OTHER SPECIFICATIONS)

| Sl. No. | Equivalent P. No. /Group No. | Material Specification | Chemical Composition (%) | | | | | | | | | Mechanical Properties (Min.) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | C | Mn | P | S | Si | Ni | Cr | Mo | V | T.S Kg / $mm^2$ (MPa) | Y.S Kg / $mm^2$ (MPa) | % E Min. |
| 1 | P1/1 | DIN St. 35.8 | 0.17 Max. | 0.40-0.80 | 0.04 Max. | 0.04 Max. | 0.10-0.35 | - | - | - | - | 36.70-48.96 | 24 | 25 |
| 2 | P1/1 | DIN St. 45.8 | 0.21 Max. | 0.40-1.20 | 0.04 Max. | 0.04 Max. | 0.10-0.35 | - | - | - | - | 41.80-54.06 | 26 | 21 |
| 3 | P1/1 | BS 3059 / 360 | 0.17 Max. | 0.40-0.80 | 0.045 Max. | 0.045 Max. | 0.35 Max. | - | - | - | - | 36.70-51.00 | 22 | 24 |
| 4 | P1/1 | BS 3059 / 440 | 0.12-0.18 | 0.90-1.20 | 0.040 Max. | 0.035 Max. | 0.10-0.35 | - | - | - | - | 44.88-59.20 | 25 | 21 |
| 5 | P3/1 | 15 Mo3 DIN17175 | 0.12-0.20 | 0.40-0.80 | 0.035 Max. | 0.035 Max. | 0.10-0.35 | - | - | 0.25-0.35 | - | 45.90-61.20 | 27.50 | 22 |
| 6 | P4/1 | 13 Cr Mo 4-5DIN17175 | 0.10-0.18 | 0.40-0.70 | 0.035 Max. | 0.035 Max. | 0.10-0.35 | - | 0.70-1.10 | 0.45-0.65 | - | 44.88-60.18 | 29.60 | 22 |
| 7 | P4 /1 | BS 3059 / 620 | 0.10-0.15 | 0.40-0.70 | 0.040 Max. | 0.040 Max. | 0.10-0.35 | - | 0.70-1.10 | 0.45-0.65 | - | 46.90-62.20 | 18.40 | 22 |
| 8 | P5/1 | 10 Cr Mo 9-10DIN17175 | 0.08-0.15 | 0.40-0.70 | 0.035 Max. | 0.035 Max. | 0.50 Max. | - | 2.00-2.50 | 0.90-1.20 | - | 45.90-61.20 | 28.60 | 20 |
| 9 | P5/1 | BS 3059 (622) - 440 | 0.08-0.15 | 0.40-0.70 | 0.04 Max. | 0.04 Max. | 0.50 Max. | - | 2.00-2.50 | 0.90-1.20 | - | 44.90-60.18 | 17.85 | 20 |
| 10 | P5/1 | BS 3059 (622) - 490 | 0.08-0.15 | 0.40-0.70 | 0.040 Max. | 0.040 Max. | 0.50 Max. | - | 2.00-2.50 | 0.90-1.20 | - | 49.98-65.00 | 28.05 | 20 |
| 11 | - | 14 Mo V 63 DIN17175 | 0.10-0.18 | 0.40-0.70 | 0.035 Max. | 0.035 Max. | 0.10-0.35 | | 0.30-0.60 | 0.50-0.70 | 0.22-0.32 | 46.90-62.22 | 32.60 | 20 |
| 12 | P5B/2 | X20CrMoV121 DIN17175 | 0.17-0.23 | ≤ 1.00 | 0.030 Max. | 0.030 Max. | ≥ 0.50 | 0.30-0.80 | 10.00-12.50 | 0.80-1.20 | 0.25-0.35 | 70-86 | 50 | 17 |

# CHAPTER A3: WELDING MATERIAL SPECIFICATION AND CONTROL

## SECTION A3.1-WELDING MATERIAL SPECIFICATION AND CONTROL

### 1.0 SCOPE:

1.1. This chapter details out the welding material specification and controls at sites.

### 2.0 CONTENTS:

1. Table- A3.1 - Weld Metal Chemical Composition.
2. Table - A3.2 - Mechanical property requirement for all-weld metal.
3. Receipt inspection of welding electrodes/filler wires.
4. Storage and identification of welding electrodes/filler wires.
5. Drying and holding of welding electrodes.
6. Selection and issue of welding electrodes/filler wires.
7. Table-A3.3 - Selection of GTAW filler wire, SMAW electrodes for butt welds in tubes, pipes, headers.
8. Table-A3.4 - Selection of electrodes for welding attachments to tubes.
9. Table-A3.5 - Selection of electrodes, preheat, PWHT for attachment to attachment welds.
10. Table-A3.6 -Selection of electrodes for welding nozzle attachments, hand hole plate, RG plug etc. to headers, pipes.
11. Table-A3.7 –Selection of filler wire and electrodes for non-pressure parts( including structures )
12. Table-A3.8 -A numbers
13. Table-A3.9 -F numbers
14. SFA Classification

**3.0** For welding consumables not covered in this chapter, relevant details may be obtained from the concerned Manufacturing Units.

**Table-A3.1**
**WELD METAL CHEMICAL COMPOSITION**

| Electrode/ Consumable | SFA No. | Weight, % | | | | | | | | | | Other Elements %[a] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | C | Mn | Si | P | S | Ni | Cr | Mo | V | Cu | |
| E 6010 | 5.1 | 0.20 | 1.20 | 1.00 | NS | NS | 0.30 | 0.20 | 0.30 | 0.08 | NS | Combined Limit for Mn+Ni+Cu+Mo+V=1.75 |
| E 6013 | 5.1 | 0.20 | 1.20 | 1.00 | NS | NS | 0.30 | 0.20 | 0.30 | 0.08 | NS | |
| E 7018 | 5.1 | 0.15 | 1.60 | 0.75 | 0.035 | 0.035 | 0.30 | 0.20 | 0.30 | 0.08 | NS | |
| E 7018-1 | 5.1 | 0.15 | 1.60 | 0.75 | 0.035 | 0.035 | 0.30 | 0.20 | 0.30 | 0.08 | NS | |
| E 7018-A1 | 5.5 | 0.12 | 0.90 | 0.80 | 0.03 | 0.03 | NS | NS | 0.40-0.65 | NS | NS | |
| E 8018-B2 | 5.5 | 0.05-0.12 | 0.90 | 0.80 | 0.03 | 0.03 | NS | 1.00-1.50 | 0.40-0.65 | NS | NS | |
| E 9018-B3 | 5.5 | 0.05-0.12 | 0.90 | 0.80 | 0.03 | 0.03 | NS | 2.00-2.50 | 0.90-1.20 | NS | NS | |
| E 9015-B91 | 5.5 | 0.08-0.13 | 1.20 | 0.30 | 0.01 | 0.01 | 0.80 | 8.00-10.50 | 0.85-1.20 | 0.15-0.30 | 0.04 - 0.25 | |
| E9015-B92 | 5.5 | 0.08-0.15 | 1.20 | 0.60 | 0.020 | 0.015 | 1.0 | 8.0-10.0 | 0.30-0.70 | 0.15-0.30 | 0.25 | W: 1.50-2.00; Nb: 0.02-0.08 B:0.006; Al: 0.04; N: 0.03-0.08 |
| E9018-B23/ E9015-B23 | 5.5 | 0.04-0.12 | 1.00 | 0.60 | 0.015 | 0.015 | 0.5 | 1.9-2.9 | 0.30 | 0.15-0.30 | 0.25 | W: 1.50-2.00; Nb: 0.02-0.10 B:0.006; Al: 0.04; N: 0.05 |
| E 308 | 5.4 | 0.08 | 0.50-2.50 | 1.00 | 0.04 | 0.03 | 9.00-11.00 | 18.00-21.00 | 0.75 | NS | 0.75 | |
| E 308-L | 5.4 | 0.04 | 0.50-2.50 | 1.00 | 0.04 | 0.03 | 9.00-11.00 | 18.00-21.00 | 0.75 | NS | 0.75 | |

## Table-A3.1 (Contd...)
## WELD METAL CHEMICAL COMPOSITION

| Electrode/ Consumable | SFA No. | Weight, % | | | | | | | | | | Other Elements %[a] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | C | Mn | Si | P | S | Ni | Cr | Mo | V | Cu | |
| E 309 | 5.4 | 0.15 | 0.50-2.50 | 1.00 | 0.04 | 0.03 | 12.00-14.00 | 22.00-25.00 | 0.75 | NS | 0.75 | |
| E 309-L | 5.4 | 0.04 | 0.50-2.50 | 1.00 | 0.04 | 0.03 | 12.00-14.00 | 22.00-25.00 | 0.75 | NS | 0.75 | |
| E 347 | 5.4 | 0.08 | 0.50-2.50 | 1.00 | 0.04 | 0.03 | 9.00-11.00 | 18.00-21.00 | 0.75 | NS | 0.75 | Cb+Ta 8XC Min. to 1.00 Max. |
| E316 | 5.4 | 0.08 | 0.5-2.5 | 1.00 | 0.04 | 0.03 | 11.0-14.0 | 17.0-20.0 | 2.0-3.0 | NS | 0.75 | |
| E2209-16 | 5.4 | 0.04 | 0.5-2.0 | 1.00 | 0.04 | 0.03 | 7.5-9.5 | 21.5-23.5 | 2.5-3.5 | NS | 0.75 | N:0.08-0.20 |
| ENiCrFe-3 | 5.11 | 0.10 | 5.0-9.5 | 1.00 | 0.03 | 0.015 | 59.0 min | 13.0-17.0 | NS | NS | 0.50 | Fe: 12.0; Ta+ Cb: 1.0-2.5; Ti: 1.0; others: 0.5 |
| ENiCrFe-7 | 5.11 | 0.05 | 5.0 | 0.75 | 0.03 | 0.015 | Rem | 28.0-31.5 | 0.5 | NS | 0.50 | Fe: 7.0-12.0; Ta+ Cb: 1.0-2.5; others: 0.5 |
| ENi-CI | 5.15 | 2.00 | 2.50 | 4.00 | NS | 0.03 | 85[d] min | NS | NS | NS | 2.5[e] | Fe 8.0 Al 1.0 others Total 1.0 |
| ENiFe-CI | 5.15 | 2.00 | 2.50 | 4.00 | NS | 0.03 | 45[d]-60 | NS | NS | NS | 2.5[e] | Fe Rem[f] Al 1.0 others Total 1.0 |
| ER70S-2 | 5.18 | 0.07 | 0.90-1.40 | 0.40-0.70 | 0.025 | 0.035 | 0.15 | 0.15 | 0.15 | 0.03 | 0.50[b] | Ti 0.05-0.15 Zr 0.02-0.12 Al 0.05-0.15 |
| ER70S-A1 | 5.28 | 0.12 | 1.30 | 0.30-0.70 | 0.025 | 0.025 | 0.20 | NS | 0.40-0.65 | NS | 0.35 | Others : 0.50 |
| E8018-G | 5.5 | 0.08 | 1.0-1.8 | 0.5 | 0.025 | 0.025 | 0.5-1.20 | NS | 0.5 | NS | NS | |

**Table-A3.1 (Contd…)**
**WELD METAL CHEMICAL COMPOSITION**

| Electrode/ Consumable | SFA No. | Weight, % | | | | | | | | | | Other Elements %[a] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | C | Mn | Si | P | S | Ni | Cr | Mo | V | Cu | |
| ER80S-B2 | 5.28 | 0.07-0.12 | 0.40-0.70 | 0.40-0.70 | 0.025 | 0.025 | 0.20 | 1.20-1.50 | 0.40-0.65 | NS | 0.35[c] | Total other Elements 0.50 |
| ER90S-B3 | 5.28 | 0.07-0.12 | 0.40-0.70 | 0.40-0.70 | 0.025 | 0.025 | 0.20 | 2.30-2.70 | 0.90-1.20 | NS | 0.35 [c] | Total other Elements 0.50 |
| ER80S-D2 | 5.28 | 0.07-0.12 | 1.60-2.10 | 0.50-0.80 | 0.025 | 0.025 | 0.15 | NS | 0.40-0.60 | NS | 0.50 [c] | Total other Elements 0.50 |
| ER90S-B9 | 5.28 | 0.07-0.13 | 1.20 | 0.15-0.30 | 0.01 | 0.01 | 0.80 | 8.00-10.50 | 0.80-1.20 | 0.15-0.23 | 0.20 | Total other Elements 0.50 |
| ER 308 | 5.9 | 0.08 | 1.00-2.50 | 0.30-0.65 | 0.03 | 0.03 | 9.00-11.00 | 19.50-22.00 | 0.75 | NS | 0.75 | |
| ER 309 | 5.9 | 0.12 | 1.00-2.50 | 0.30-0.65 | 0.03 | 0.03 | 12.00-14.00 | 23.00-25.00 | 0.75 | NS | 0.75 | |
| ER 309-L | 5.9 | 0.03 | 1.00-2.50 | 0.30-0.65 | 0.03 | 0.03 | 12.00-14.00 | 23.00-25.00 | 0.75 | NS | 0.75 | |
| ER316L | 5.9 | 0.03 | 1.0-2.5 | 0.30-0.65 | 0.03 | 0.03 | 11.0-14.0 | 18.0-20.0 | 2.0-3.0 | NS | 0.75 | --- |
| ER 347 | 5.9 | 0.08 | 1.00-2.50 | 0.30-0.65 | 0.03 | 0.03 | 9.00-11.00 | 19.00-21.50 | 0.75 | NS | 0.75 | Cb+Ta 10XC Min. to 1.0 Max. |
| ER2209 | 5.9 | 0.03 | 0.5-2.0 | 0.90 | 0.03 | 0.03 | 7.5-9.5 | 21.5-23.5 | 2.5-3.5 | NS | 0.75 | N:0.08-0.20 |

**Table-A3.1 (Contd…)**
**WELD METAL CHEMICAL COMPOSITION**

| Electrode/ Consumable | SFA No. | Weight, % | | | | | | | | | | Other Elements % [a] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | C | Mn | Si | P | S | Ni | Cr | Mo | V | Cu | |
| ERNiCr-3 | 5.14 | 0.10 | 2.5-3.5 | 0.50 | 0.03 | 0.015 | 67.0 min | 18.0-22.0 | NS | NS | 0.50 | Fe: 3.0; Cb+Ta: 2.0-3.0; Ti: 0.75; Other: 0.5 |
| ERNiCrFe-7A | 5.14 | 0.04 | 1.0 | 0.50 | 0.02 | 0.015 | Rem. | 28.0-31.5 | 0.50 | | 0.30 | Fe: 7.0-11-0; Cb+Ta: 0.5-1.0; Ti: 1.0; Other: 0.5; Co: 0.12; Al: 1.10 |
| YT 304H | -- | Proprietary GTAW rod for Super 304H | | | | | | | | | | |
| THERMANIT 304H Cu | -- | | | | | | | | | | | |
| TGS2CW | -- | Proprietary GTAW rod for T23 | | | | | | | | | | |
| YT-HCM2S | | | | | | | | | | | | |
| 2CrWV-TIG | -- | | | | | | | | | | | |
| 9CRWV TIG | -- | Proprietary GTAW rod for Gr.92 | | | | | | | | | | |
| THERMANIT MTS 616 | -- | | | | | | | | | | | |

## TABLE – A3.1 (Contd...)
## WELD METAL CHEMICAL COMPOSITION

**Notes:**

a) Other elements listed without specified values shall be reported, if intentionally added. The total of these latter unspecifiedelements and all other elements not intentionally added shall not exceed 0.50%.

b) The maximum weight percent of copper in the rod or electrode due to any coating plus the residual copper content in the steel shall be 0.50.

c) The maximum weight percent of copper in the rod or electrode due to any coating plus the residual copper content in the steel shall comply with the stated value.

d) Nickel plus incident Cobalt.

e) Copper plus incident Silver.

f) "Rem" stands for remainder.

g) Manufacturer's certification to have met the requirements of ASME Sec. II Part C is acceptable in cases where the chemical analysis are not reflected.

h) Single values are maximum.

i) NS – Not Specified

**TABLE-A3.2**
**MECHANICAL PROPERTY REQUIREMENTFOR ALL-WELD METAL**

| Electrode | SFA No. | Tensile Strength Ksi / MPa | Yield Strength at 0.2% of Proof Stress, Ksi/ MPa | Elongation In 2 inch (50.8 mm) % |
|---|---|---|---|---|
| E6010 | 5.1 | 60 / 430 | 48 / 330 | 22 |
| E6013 | 5.1 | 60 /430 | 48 / 330 | 17 |
| E7018 | 5.1 | 70 / 490 | 58 / 400 | 22 |
| E7018-1[a] | 5.1 | 540 | 58 / 400 | 22 |
| E7018-A1 | 5.5 | 70 / 490 | 57 / 390 | 22 |
| E8018-G[b] | 5.5 | 570 | 450 | 19 |
| E8018-B2 | 5.5 | 80 /550 | 67 / 460 | 19 |
| E9018-B3 | 5.5 | 90 /620 | 77 / 530 | 17 |
| E9015-B91 | 5.5 | 90 /620 | 77 / 530 | 17 |
| E9015-B92 | 5.5 | 90/620 | 77/530 | 17 |
| E9018-B23 | 5.5 | 90/620 | 77/530 | 17 |
| E308 | 5.4 | 80 / 550 | - | 35 |
| E308L | 5.4 | 75 / 520 | - | 35 |
| E309 | 5.4 | 80 / 550 | - | 30 |
| E309L | 5.4 | 75 / 520 | - | 30 |
| E347 | 5.4 | 75 / 520 | - | 30 |
| E316 | 5.4 | 75/520 | -- | 30 |
| E2209 | 5.4 | 100/690 | -- | 22 |
| ENiCrFe-3 | 5.11 | 80/550 | -- | 30 |
| ENiCrFe-7 | 5.11 | 80/550 | -- | 30 |
| ENi-CI | 5.15 | 40-65 / 276-448 | 38-60 / 268-414 | 3-6 |
| ENiFe-CI | 5.15 | 58-84 / 400 -579 | 43-63 / 294 -434 | 6-18 |

a. These electrodes shall meet the lower temperature impact requirement of average minimum. (27 Joules at – 45° C) and other properties at 620±20°C for 300 minutes.

b. These electrodes shall meet the impact requirement of average minimum (20 Joules at + 25° C) and other properties at 550±10°C for 60 minutes.

**Table- A3.2 (Contd...)**

**MECHANICAL PROPERTY REQUIREMENT FOR ALL-WELD METAL**

| Electrode | SFA No. | Tensile Strength Ksi / MPa | Yield Strength at 0.2% of Proof Stress, Ksi / MPa | Elongation In 2 inch (50.8 mm) % |
|---|---|---|---|---|
| ER70S-6 | 5.18 | 70/480 | 58/400 | 22 |
| ER70S-A1 | 5.28 | 75/515 | 58/400 | 19 |
| ER80S-B2 | 5.28 | 80 / 550 | 68 / 470 | 19 |
| ER90S-B3 | 5.28 | 90 / 620 | 78 / 540 | 17 |
| ER80S-D2 | 5.28 | 80 / 550 | 68 / 470 | 17 |
| ER90S-B9 | 5.28 | 90 / 620 | 60 / 410 | 16 |
| ER308 | 5.9 | These values are not required in the test certificate | | |
| ER308L | 5.9 | | | |
| ER309 | 5.9 | | | |
| ER309L | 5.9 | | | |
| ER347 | 5.9 | | | |
| ER316 | 5.9 | | | |
| ER2209-16 | 5.9 | | | |
| ERNiCr-3 | 5.14 | 80/550 | -- | |
| ERNiCrFe-7A | 5.14 | 85/590 | -- | |

NOTE:

a) Single values are minimum.

b) Manufacturer's certification to have met the requirements of ASME-Section II Part C is acceptable in cases where the mechanical properties are not reflected.

c) 1Ksi is approximately equal to 6.89 MPa.

## Section A3.2- Receipt Inspection of Welding Electrodes / Filler Wires

1.0 All electrodes/filler wires received at site stores shall be segregated for type and size of electrode.

2.0 Ensure that electrode packets received are free from physical damage.

3.0 Where electrodes are damaged, the same shall be removed from use.

4.0 Only electrodes identified in the "list of approved vendors of welding electrodes" shall be accepted.

5.0 Where filler metals are supplied by manufacturing unit, inspect for damages, if any.

6.0 Ensure availability of relevant test certificates. Refer tables of chemical compositions and mechanical properties for acceptance.

7.0 Endorse acceptance/rejection on the test certificate.

# Section A3.3- Storage & Identification of WeldingElectrodes/Filler Wires

**1.0 SCOPE:**

**1.1** This procedure is applicable for storage of welding electrodes/filler wires used at sites.

**2.0 PROCEDURE:**

**2.1** Only materials accepted (based on receipt inspection) shall be taken into account for storage.

**2.2 STORAGE FACILITY:**

2.2.1 The storage facility shall be identified.

2.2.2 Access shall be made available to authorized personnel.

2.2.3 The storage area shall be clean and dry.

2.2.4 Steel racks may be used for storage. Avoid usage of wooden racks for storing inside the storage room.

2.2.5 Maintain the temperature of the storage facility above the ambient temperature. This can be achieved by the use of appropriate heating arrangements.

**2.3** The electrodes/filler wire shall be segregated and identified for

a. Type of electrode e.g. E7018.

b. Size of electrode e.g. Dia. 3.15 mm.

**2.4** Identification of filler wires:

2.4.1 On receipt of GTAW filler wires, check AWS No. or brand name embossed and retain the same identification throughout.

# Section A3.4-Drying and Holding of Welding Electrodes

**1.0 SCOPE:**

1.1 This section details activities regarding drying and holding of welding electrodes used at sites.

**2.0 PROCEDURE:**

2.1 While handling, avoid contact of oil, grease with electrodes. Do not use oily or wet gloves.

2.2 It is recommended that not more than two days' requirements electrodes are dried.

**3.0 GTAW Filler Wires:**

3.1 These wires do not require any drying.

**4.0 Covered Electrodes:**

**4.1 Drying and holding :**

4.1.1 Identify drying oven and holding oven.

4.1.2 They shall preferably have a temperature control facility upto 400°C for drying oven and 200°C for holding oven.

4.1.3 A calibrated thermometer shall be provided for monitoring temperature.

4.2 On opening a packet of electrodes, segregate and place them in the drying oven. Mix-up of electrodes shall be avoided.

4.2.1 After loading, raise the drying oven temperature to the desired range as per table in 4.2.5.

4.2.2 Note the time when the temperature reaches the desired range. Maintain this temperature for the duration required as per Table in 4.2.5.

4.2.3 On completion of drying, the electrodes shall be transferred to holding oven immediately and maintained at minimum temperature of 150°C till issue.

4.2.4 The electrode shall not be subjected to more than three cycles of drying.

4.2.5 Maintaina register containing following details:

| Sl. No. | Date | AWS number/Specification | Batch No./Size | Dia. | Qty. | Drying temperature Start time | Drying Temperature end time | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| | | | | | | | | |

## Drying and Holding Parameters

| AWS Classification | Drying (*) | | Minimum Holding Temperature °C (@) |
|---|---|---|---|
| | Temperature °C | Time (Hours) | |
| E7018 | 250 - 300 | 2 | 150 |
| E7018-1 | 250 - 300 | 2 | 150 |
| E7018-A1 | 250 - 300 | 2 | 150 |
| E8018-G | 250 - 300 | 2 | 150 |
| E8018-B2 | 250 - 300 | 2 | 150 |
| E9018-B3 | 250 - 300 | 2 | 150 |
| E9018-B23 | 250 - 300 | 2 | 150 |
| E9015-B91 | 250 - 300 | 2 | 150 |
| E9015-B92 | 250 - 300 | 2 | 150 |
| E308, E309, E310 E316& E347 | 250 - 300 | 1 | 150 |
| ENiCrFe-3 | 250 - 300 | 2 | 150 |
| ENiCrFe-7 | 250 - 300 | 2 | 150 |

Note: (*) - Guideline has been given however, supplier's recommendations shall be followed.

(@) - Maintain the temperature in the oven till issue.

4.2.4 After issue, maintain the electrodes in a portable oven at a minimum temperature of 65°C till use. This is not applicable for E6013 (Rutile) electrodes, however the following instruction shall be followed for E6013 electrodes:

(1) Rutile electrodes require some moisture in the coating and they would not require drying. If they become damp, re-drying at around 120 to 150°C for 1 hour will be sufficient.

(2) These electrodes with potassium silicate binder can be used on both DCEP/DCEN polarities and on AC. E6013 electrodes generally have better arc striking and stability characteristics with an easily detachable slag.

4.3 Unused, returned electrodes shall be segregated and reused only after repeating drying and holding cycles.

## Section A3.5- Selection and Issue of Welding Electrodes / Filler Wires

### 1.0 SCOPE:

1.1. This procedure details methods for selection and issue of welding electrodes/filler wires for site operations.

### 2.0 PROCEDURE:

### 2.1 Selection:

2.1.1 The type of filler wire/electrode for welding shall be based on the details given in the contract documents like Field Welding Schedule, drawings, Welding Procedure Specifications as supplied by the concernedmanufacturing units.

2.1.2 Where not specified by the manufacturing units, selection shall be based on the tables enclosed (Table A3.3 to Table A3.7. as applicable).

2.1.3 Where electrodes/ filler wires are not covered in the documents mentioned in 2.1.1 and 2.1.2, refer to the concernedmanufacturing units.

### 2.2 Issue:

2.2.1 Issue of welding electrodes / filler wires shall be based on authorised welding electrodes issue voucher.

2.2.2 It is recommended to restrict quantity issued to not more than 4 hours' requirements.

2.2.3 Re-dried low hydrogen electrodes shall be carried to the work spot in a portable oven.

2.2.4 Maintain the temperature in the portable oven at the work spot above 65°C.

2.2.5 Unused electrodes shall be segregated and reused only after repeating drying and holding cycles.

**Table- A3.3**
**SELECTION OF GTAW FILLER WIRE, SMAW ELECTRODE FOR BUTT WELDS IN TUBES, PIPES AND HEADERS**

| Material | Welding Process | P1 Gr 1/ P1 Gr 2 | P3 Gr 1 | P4 Gr 1 | P5A Gr 1 | P15 E Gr 1 | T23 | T92/P92 | P8 | P8 SA 213 UNS S 30432 | DIN14MoV6 3 or equivalent |
|---|---|---|---|---|---|---|---|---|---|---|---|
| P1 Gr 1 | GTAW | ER 70S-A1 | | | | | | | | | |
| P1 Gr 2 | SMAW | E7018-1 Note 1 | | | | | | | | | |
| P3 Gr 1 | GTAW | ER 70S-A1 | ER 70S-A1 | | | | | | | | |
| | SMAW | E7018-1 | E7018-A1 | | | | | | | | |
| P4 Gr 1 | GTAW | ER 70S-A1 | ER 70S-A1 | ER 80S-B2 | | | | | | | |
| | SMAW | E7018-1 | E7018-A1 | E8018-B2 | | | | | | | |
| P5A Gr 1 | GTAW | ER 70S-A1 | ER 70S-A1 | ER 80S-B2 | ER 90S-B3 | ER 90S-B3 | ER90S-B3 | | | | |
| | SMAW | E7018-1 | E7018-A1 | E8018-B2 | E9018-B3 | E9018-B3 | E9018-B3 | | | | |
| P15 E Gr.1 Gr.91 | GTAW | | | | | ER90S-B9 | TGS2CW/ 2CrWVTIG/ YT-SCM2S | ER90S-B9 | | | |
| | SMAW | | | | | E9015-91 | E9018-B23 | E9015-B91 | | | |
| T23 | GTAW | | | | | | TGS2CW/ 2CrWVTIG/YT-SCM2S | TGS2CW/ 2CrWVTIG/ YT-SCM2S | | | |
| | SMAW | | | | | | E9018-B23 | E9018-B23 | | | |

**Table- A3.3 (Contd...)**

| Material | Welding Process | P1 Gr 1 P1 Gr 2 | P3 Gr 1 | P4 Gr 1 | P5A Gr 1 | P15 E Gr 1 | T23 | T92/P92 | P8 | P8 SA 213 UNS S 30432 | DIN14MoV63 or equivalent |
|---|---|---|---|---|---|---|---|---|---|---|---|
| P15 E Gr.1 Gr.92 | GTAW | | | | | | | 9CrWV-TIG/ Themanit-MTS616 | | | |
| | SMAW | | | | | | | E9015-B92 | | | |
| P8 | GTAW | | | ERNi Cr3 | ERNiCr3 | ERNiCr3 | ERNiCr3 | ERNiCrFe7A | ER347 | | |
| | SMAW | | | ENiC rFe3 | ENiCrFe3 | ENiCrFe3 | ENiCrFe3 | ENiCrFe7 | E347 | | |
| P8 SA 213 UNS S30432 | GTAW | | | | | | | | | YT304H/ THERMANIT 304H Cu | |
| DIN14MoV63 or equivalent | GTAW | | | | ER 90S-B3 | | | | | | ER90S-B3 |
| | SMAW | | | | E9018-B3 | | | | | | E9018-B3 |

Note-1: E7018-A1 for P1 Gr2 + P1 Gr2 when PWHT is involved.

**Table- A3.4**
**SELECTION OF ELECTRODES FOR WELDING ATTACHMENTS TO TUBES**

| Tube Material | Attachment Material | | | |
|---|---|---|---|---|
| | **P1 Group 1** | **P4 Group 1** | **P5A Group 1** | **P8** |
| P1 Group 1<br>P1 Group 2 | E 7018 | E 7018 | E 7018 | E 309 |
| P3 | E 7018-A1 | E 7018-A1 | E 7018-A1 | E 309 |
| P4 Group 1 | E 8018-B2 | E 8018-B2 | E 8018-B2 | E 309 |
| P5A Group 1 | E 9018-B3 | E 9018-B3 | E 9018-B3 | E 309 |
| P8 including SA 213<br>UNS S30432 | | E 309 | E 309 | E 347 |
| P15E Gr.1 (Gr. 91/92) | | | E9018-B3 | ENiCrFe-3 |
| SA213T23 | | | E9018-B3 | ENiCrFe-3 |

**Table- A3.5**
**SELECTION OF ELECTRODES, PREHEAT, PWHT**
**FOR ATTACHMENT TO ATTACHMENT WELDS**
**(Seal Bands, High Crown Bars, End Bars, End Bar Lifting Lugs and Collector Plates etc.)**

| Material (Note 2) | Welding Requirements | P1 | P3 | P4 | P5 A | P8 Group 1 | P8 Group 2 | P 15E / 1 |
|---|---|---|---|---|---|---|---|---|
| P1 | Electrode<br>Preheat<br>PWHT | E7018<br>Nil<br>Nil | - | E 7018<br>150°C<br>650 – 670°C | - | - | - | - |
| P3 | Electrode<br>Preheat<br>PWHT | E7018<br>150°C (Note 1)<br>For Thickness>16mm: 620-650°C | E7018-A1<br>150°C<br>For Thickness>16mm: 620-650°C | - | - | - | - | - |
| P4 | Electrode<br>Preheat<br>PWHT | E7018<br>150°C (Note 1)<br>For Thickness>13mm: 650-670°C | E7018-A1<br>150°C<br>For Thickness>13mm: 650-670° | E8018-B2<br>150°C (Note 1)<br>For Thickness>13mm: 650-670°C | - | - | - | - |
| P5 A | Electrode<br>Preheat<br>PWHT | - | - | E8018-B2<br>150°C (Note 1)<br>For Thickness>13: 680-710°C | E9018-B3<br>150°C (Note 1) For Thickness>13:680-710°C | - | - | - |
| P8 | Electrode<br>Preheat<br>PWHT | E309<br>Nil<br>Nil | - | E309<br>Nil<br>Nil | E309<br>Nil<br>Nil | E347<br>Nil<br>Nil | E309<br>Nil<br>Nil | - |
| P 15E/ 1 | Electrode<br>Preheat<br>PWHT | - | - | - | E9018-B3<br>220°C<br>730-760 °C | ENi Cr Fe3<br>220°C (only on P15E side)<br>730-760 °C | ENi Cr Fe3<br>220°C (only on P15E side)<br>730-760 °C | E9015-B91<br>220°C<br>740-770 °C |

Note – 1 : Preheat is not required for P3/P4up to 16 mm& for P5 A up to 13 mm, if PWHT is carried out.
Note - 2: For load carrying members, PWHT is required irrespective of thickness.

**Table- A3.6**
**SELECTION OF ELECTRODES FOR WELDING NOZZLE ATTACHMENTS, HAND HOLE PLATE, RG PLUG ETC. TO HEADERS, PIPES**

| Header, Pipe Material | Attachment Material | | | | | |
|---|---|---|---|---|---|---|
| | **P1** | **P3** | **P4** | **P5 A** | **P15 E/1** | **P8** |
| P1 | E7018-1 | E7018-1 | E7018-1 | - | - | ENiCrFe3 |
| P4 | E7018-1 | E7018-A1 | E8018-B2 | E8018-B2 | - | - |
| P5 A | - | - | E8018-B2 | E9018-B3 | E9018-B3 | ENiCrFe3 |
| P15 E/1 | - | - | - | E9018-B3 | E9015-B91 | ENiCrFe3 |
| DIN 14MoV63 or equivalent | - | - | - | E9018-B3 | - | ENiCrFe3 |

**Table – A3.7**
**SELECTION OF ELECTRODES FOR NON-PRESSURE PARTS (INCLUDING STRUCTURES) (NOTE 1)**

| Material | SMAW Electrodes | SAW Wires | $CO_2$ Wires |
|---|---|---|---|
| P1 + P1 (IS2062 E250) | For butt welds ≤ 6 mm: E 6013 (only for Ducts)<br>> 6 mm: E 7018<br>For fillets ≤8 mm : E 6013<br>>8 mm: E 7018 | EL 8<br>EM 12 K<br>EL 8<br>EM 12 K | E 71 T - 1 |
| Corten Steel + P1 | E 6013 or E 7018 | EM 12 K | |
| Corten Steel + Corten Steel | E 8018 – B2 | EB 2 | E 81 T 1 – B2 |
| IS2062 E350+E350/ E250 | E7018-1 | EM 12 K | NA |
| IS2062 E450+E450 | E8018-G | EG | NA |
| SA 204 Gr.A | E7018-A1 | NA | NA |

Note 1: E 6013 Electrodes can be used for all non-load carrying welds of all thickness of IS 2062 plates up to 20 mm thickness and 8 mm fillets

**TABLE- A3.8**
**A NUMBERS**
**CLASSIFICATION OF FERROUS WELD METAL ANALYSIS FOR PROCEDURE QUALIFICATION**

| A. No. | Types of Weld Deposit | Analysis, % (Note 1) | | | | | |
|---|---|---|---|---|---|---|---|
| | | C | Cr | Mo | Ni | Mn | Si |
| 1 | Mild steel | 0.20 | – | – | – | 1.60 | 1.00 |
| 2 | Carbon-Molybdenum | 0.15 | 0.50 | 0.40-0.65 | – | 1.60 | 1.00 |
| 3 | Chrome (0.4% to 2%)-Molybdenum | 0.15 | 0.40-2.00 | 0.40-0.65 | – | 1.60 | 1.00 |
| 4 | Chrome (2% to 6%)-Molybdenum | 0.15 | 2.00-6.00 | 0.40-1.50 | – | 1.60 | 2.00 |
| 5 | Chrome (6% to 10.5%)-Molybdenum | 0.15 | 6.00-10.50 | 0.40-1.50 | – | 1.20 | 2.00 |
| 6 | Chrome-Martensitic | 0.15 | 11.00-15.00 | 0.70 | – | 2.00 | 1.00 |
| 7 | Chrome-Ferritic | 0.15 | 11.00-30.00 | 1.00 | – | 1.00 | 3.00 |
| 8 | Chromium-Nickel | 0.15 | 14.50-30.00 | 4.00 | 7.50-15.00 | 2.50 | 1.00 |
| 9 | Chromium-Nickel | 0.30 | 19.00-30.00 | 6.00 | 15.00-37.00 | 2.50 | 1.00 |
| 10 | Nickel to 4% | 0.15 | – | 0.55 | 0.80-4.00 | 1.70 | 1.00 |
| 11 | Manganese-Molybdenum | 0.17 | – | 0.25-0.75 | 0.85 | 1.25-2.25 | 1.00 |
| 12 | Nickel-Chrome-Molybdenum | 0.15 | 1.50 | 0.25-0.80 | 1.25-2.80 | 0.75-2.25 | 1.00 |

Note 1: Single values shown above are maximum.

**Table A3.9**
**F NUMBERS GROUPING OF ELECTRODES AND WELDING RODS FOR QUALIFICATION**

| | ASME Specification No. | AWS Classification No. |
|---|---|---|
| 1 | SFA-5.1 | EXX20 |
| 1 | SFA-5.1 | EXX22 |
| 1 | SFA-5.1 | EXX24 |
| 1 | SFA-5.1 | EXX27 |
| 1 | SFA-5.1 | EXX28 |
| 1 | SFA-5.4 | EXXX(X)-26 |
| 1 | SFA-5.5 | EXX20-X |
| 1 | SFA-5.5 | EXX27-X |
| 2 | SFA-5.1 | EXX12 |
| 2 | SFA-5.1 | EXX13 |
| 2 | SFA-5.1 | EXX14 |
| 2 | SFA-5.1 | EXX19 |
| 2 | SFA-5.5 | E(X)XX13-X |
| 3 | SFA-5.1 | EXX10 |
| 3 | SFA-5.1 | EXX11 |
| 3 | SFA-5.5 | E(X)XX10-X |
| 3 | SFA-5.5 | E(X)XX11-X |
| 4 | SFA-5.1 | EXX15 |
| 4 | SFA-5.1 | EXX16 |
| 4 | SFA-5.1 | EXX18 |
| 4 | SFA-5.1 | EXX18M |
| 4 | SFA-5.1 | EXX48 |
| 4 | SFA-5.4 other than austenitic and duplex | EXXX(X)-15 |
| 4 | SFA-5.4 other than austenitic and duplex | EXXX(X)-16 |
| 4 | SFA-5.4 other than austenitic and duplex | EXXX(X)-17 |
| 4 | SFA-5.5 | E(X)XX15-X |
| 4 | SFA-5.5 | E(X)XX16-X |
| 4 | SFA-5.5 | E(X)XX18-X |
| 4 | SFA-5.5 | E(X)XX18M |
| 4 | SFA-5.5 | E(X)XX18M1 |

## Table- A3.9 (Contd...)
## F NUMBERS GROUPING OF ELECTRODES AND WELDING RODS FOR QUALIFICATION

| F.No. | ASME Specification No. | AWS Classification No. |
|---|---|---|
| 5 | SFA-5.4 austenitic and duplex | EXXX(X)-15 |
| 5 | SFA-5.4 austenitic and duplex | EXXX(X)-16 |
| 5 | SFA-5.4 austenitic and duplex | EXXX(X)-17 |
| | | |
| 6 | SFA-5.2 | All classifications |
| 6 | SFA-5.9 | All classifications |
| 6 | SFA-5.17 | All classifications |
| 6 | SFA-5.18 | All classifications |
| 6 | SFA-5.20 | All classifications |
| 6 | SFA-5.22 | All classifications |
| 6 | SFA-5.23 | All classifications |
| 6 | SFA-5.25 | All classifications |
| 6 | SFA-5.26 | All classifications |
| 6 | SFA-5.28 | All classifications |
| 6 | SFA-5.29 | All classifications |
| 6 | SFA-5.30 | INMs-X |
| 6 | SFA-5.30 | IN5XX |
| 6 | SFA-5.30 | IN3XX(X) |
| | | |
| **Aluminium and Aluminium-Base Alloys** | | |
| 21 | SFA-5.3 | E1100 |
| 21 | SFA-5.3 | E3003 |
| 21 | SFA-5.10 | ER1100 |
| 21 | SFA-5.10 | R1100 |
| 21 | SFA-5.10 | ER1188 |
| 21 | SFA-5.10 | R1188 |
| | | |
| 22 | SFA-5.10 | ER5183 |
| 22 | SFA-5.10 | R5183 |
| 22 | SFA-5.10 | ER5356 |
| 22 | SFA-5.10 | R5356 |
| 22 | SFA-5.10 | ER5554 |
| 22 | SFA-5.10 | R5554 |
| 22 | SFA-5.10 | ER5556 |

## TABLE- A3.9 (Contd...)
## F NUMBERS GROUPING OF ELECTRODES AND WELDING RODS FOR QUALIFICATION

| F.No. | ASME Specification No. | AWS Classification No. |
|---|---|---|
| 22 | SFA-5.10 | R5556 |
| 22 | SFA-5.10 | ER5654 |
| 22 | SFA-5.10 | R5654 |
| 23 | SFA-5.3 | E4043 |
| 23 | SFA-5.10 | ER4009 |
| 23 | SFA-5.10 | R4009 |
| 23 | SFA-5.10 | ER4010 |
| 23 | SFA-5.10 | R4010 |
| 23 | SFA-5.10 | R4011 |
| 23 | SFA-5.10 | ER4043 |
| 23 | SFA-5.10 | R4043 |
| 23 | SFA-5.10 | ER4047 |
| 23 | SFA-5.10 | R4047 |
| 23 | SFA-5.10 | ER4145 |
| 23 | SFA-5.10 | R4145 |
| 23 | SFA-5.10 | ER4643 |
| 23 | SFA-5.10 | R4643 |
| 24 | SFA-5.10 | R206.0 |
| 24 | SFA-5.10 | R-C355.0 |
| 24 | SFA-5.10 | R-A356.0 |
| 24 | SFA-5.10 | R357.0 |
| 24 | SFA-5.10 | R-A357.0 |
| 25 | SFA-5.10 | ER2319 |
| 25 | SFA-5.10 | R2319 |
| | | |
| **Copper And Copper Alloys** | | |
| 31 | SFA-5.6 | ECu |
| 31 | SFA-5.7 | ERCu |
| 32 | SFA-5.6 | ECuSi |
| 32 | SFA-5.7 | ERCuSi-A |

**TABLE- A3.9 (Contd...)**
**F NUMBERS**
**GROUPING OF ELECTRODES AND WELDING RODS FOR QUALIFICATION**

| F.No. | ASME Specification No. | AWS Classification No. |
|---|---|---|
| 33 | SFA-5.6 | ECuSn-A |
| 33 | SFA-5.6 | ECuSn-C |
| 33 | SFA-5.7 | ERCuSn-A |
| 34 | SFA-5.6 | ECuNi |
| 34 | SFA-5.7 | ERCuNi |
| 34 | SFA-5.30 | IN67 |
| 35 | SFA-5.8 | RBCuZn-A |
| 35 | SFA-5.8 | RBCuZn-B |
| 35 | SFA-5.8 | RBCuZn-C |
| 35 | SFA-5.8 | RBCuZn-D |
| 36 | SFA-5.6 | ECuAl-A2 |
| 36 | SFA-5.6 | ECuAl-B |
| 36 | SFA-5.7 | ERCuAl-A1 |
| 36 | SFA-5.7 | ERCuAl-A2 |
| 36 | SFA-5.7 | ERCuAl-A3 |
| 37 | SFA-5.6 | ECuNiAl |
| 37 | SFA-5.6 | ECuMnNiAl |
| 37 | SFA-5.7 | ERCuNiAl |
| 37 | SFA-5.7 | ERCuMnNiAl |
| **Nickel And Nickel Alloys** | | |
| 41 | SFA-5.11 | ENi-1 |
| 41 | SFA -5.11 | ENiCrFe-3 & ENiCrFe-7A |
| 41 | SFA-5.14 | ERNi-1 |
| 41 | SFA-5.14 | ERNiCr-3 & ENiCrFe-7A |
| 41 | SFA-5.30 | IN61 |
| 42 | SFA-5.11 | ENiCu-7 |
| 42 | SFA-5.14 | ERNiCu-7 |
| 42 | SFA-5.14 | ERNiCu-8 |
| 42 | SFA-5.30-7 | IN60 |

**TABLE- A3.9 (Contd...)**
**F NUMBERSGROUPING OF ELECTRODES AND WELDING RODS FOR QUALIFICATION**

| F.No. | ASME Specification No. | AWS Classification No. |
|---|---|---|
| | | |
| 45 | SFA5.11 | ENiCrMo-11 |
| 45 | SFA5.14 | ERNiCrMo-1 |
| 45 | SFA5.14 | ERNiCrMo-8 |
| 45 | SFA5.14 | ERNiCrMo-9 |
| 45 | SFA5.14 | ERNiCrMo-11 |
| 45 | SFA5.14 | ERNiFeCr-1 |
| | | |
| **Hard-Facing Weld Metal Overlay** | | |
| | | |
| 71 | SFA-5.13 | E Co Cr – A & All classifications |
| 72 | SFA-5.21 | ER Co Cr – A & All classifications |

INDEX NO. 2-8

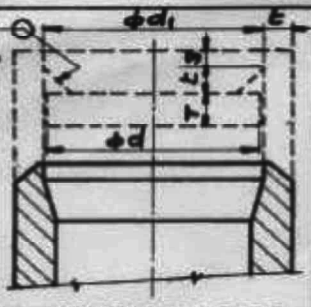
TIRUCHY

# SELECTION CHART FOR DUMMY END COVERS FOR HYDRAULIC TEST

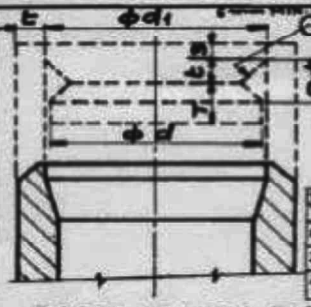
THICKNESS 'T' = 0·5 $d_1\sqrt{\frac{P}{f}}$ (ISO · REC · R 831/1968) $f$ = 1900 kg/cm²
ROUNDED OFF TO THE NEXT NEAREST RATIONALISED PLATE SIZE.

MIN·6mm t

$\phi d = d_1 - 1$ mm (ROUNDED OFF TO THE NEXT INTEGER)




CASE WHEN T ≤ 20




$\phi d = d_1 - 2$ mm (ROUNDED OFF TO THE NEXT INTEGER)

CASE WHEN T > 20

| THICKNESS 'T' mm | MATERIAL |
|---|---|
| 6 to 20 | BM-C20 |
| 21 to 63 | BM-C16 |
| ABOVE 63 | ASTM-A 36 |

THICKNESS OF DUMMY END COVERS FOR HYDRAULIC TEST (T)

| 'd' / 'P' | 30 | 45 | 60 | 75 | 90 | 105 | 120 | 135 | 150 | 165 | 180 | 210 | 240 | 270 | 300 | 350 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| 25 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 6 | 6 | 6 | 8 |
| 30 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 6 | 6 | 6 | 8 | 8 | 8 | 8 |
| 35 | 5 | 5 | 5 | 5 | 5 | 5 | 6 | 6 | 6 | 6 | 8 | 8 | 8 | 8 | 8 | 10 |
| 40 | 5 | 5 | 5 | 5 | 6 | 6 | 6 | 8 | 8 | 8 | 8 | 8 | 8 | 10 | 10 | 10 |
| 45 | 5 | 5 | 5 | 6 | 6 | 6 | 8 | 8 | 8 | 8 | 8 | 10 | 10 | 10 | 10 | 12 |
| 50 | 5 | 5 | 6 | 6 | 8 | 8 | 8 | 8 | 8 | 10 | 10 | 10 | 10 | 12 | 12 | 12 |
| 55 | 5 | 6 | 6 | 8 | 8 | 8 | 8 | 10 | 10 | 10 | 10 | 10 | 12 | 12 | 12 | 14 |
| 60 | 5 | 6 | 8 | 8 | 8 | 8 | 10 | 10 | 10 | 10 | 10 | 12 | 12 | 14 | 14 | 14 |
| 65 | 5 | 6 | 8 | 8 | 8 | 10 | 10 | 10 | 10 | 12 | 12 | 12 | 14 | 14 | 14 | 16 |
| 70 | 6 | 8 | 8 | 8 | 10 | 10 | 10 | 12 | 12 | 12 | 12 | 14 | 14 | 14 | 16 | 16 |
| 75 | 6 | 8 | 8 | 10 | 10 | 10 | 12 | 12 | 12 | 12 | 14 | 14 | 16 | 16 | 16 | 20 |
| 80 | 6 | 8 | 8 | 10 | 10 | 12 | 12 | 12 | 12 | 14 | 14 | 14 | 16 | 16 | 20 | 20 |
| 85 | 8 | 8 | 10 | 10 | 10 | 12 | 12 | 14 | 14 | 14 | 14 | 16 | 16 | 20 | 20 | 20 |
| 90 | 8 | 8 | 10 | 10 | 12 | 12 | 14 | 14 | 14 | 14 | 16 | 16 | 20 | 20 | 20 | 20 |
| 95 | 8 | 10 | 10 | 12 | 12 | 12 | 14 | 14 | 16 | 16 | 16 | 20 | 20 | 20 | 20 | 25 |
| 100 | 8 | 10 | 10 | 12 | 12 | 14 | 14 | 16 | 16 | 16 | 20 | 20 | 20 | 20 | 25 | 25 |
| 125 | 10 | 12 | 12 | 14 | 16 | 16 | 20 | 20 | 20 | 20 | 20 | 25 | 25 | 25 | 32 | 32 |
| 150 | 12 | 14 | 16 | 16 | 20 | 20 | 20 | 25 | 25 | 25 | 25 | 32 | 32 | 32 | 32 | 38 |
| 175 | 12 | 16 | 20 | 20 | 20 | 25 | 25 | 25 | 32 | 32 | 32 | 32 | 32 | 36 | 36 | 40 |
| 200 | 14 | 20 | 20 | 25 | 25 | 25 | 32 | 32 | 32 | 32 | 32 | 36 | 40 | 40 | 56 | 56 |
| 250 | 20 | 20 | 25 | 32 | 32 | 32 | 36 | 36 | 36 | 40 | 40 | 56 | 56 | 56 | 56 | 56 |
| 300 | 20 | 25 | 32 | 32 | 36 | 36 | 40 | 36 | 56 | 56 | 56 | 56 | 56 | 63 | 63 | 63 |
| 350 | 25 | 32 | 32 | 36 | 40 | 36 | 36 | 36 | 56 | 56 | 56 | 63 | 63 | 70 | 75 | 80 |
| 400 | 32 | 32 | 40 | 56 | 56 | 56 | 56 | 56 | 63 | 63 | 63 | 70 | 75 | 80 | 85 | 90 |
| 450 | 32 | 36 | 56 | 56 | 56 | 56 | 63 | 63 | 63 | 70 | 70 | 80 | 85 | 90 | 95 | 100 |
| 500 | 36 | 40 | 56 | 56 | 56 | 63 | 63 | 70 | 75 | 75 | 80 | 85 | 90 | 95 | 100 | 110 |

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ROLL D0037 FRAME 528

PREPARED BY

CHECKED BY

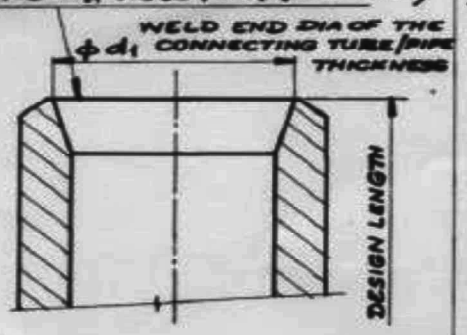
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# NIPPLES - FREE END DETAILS.

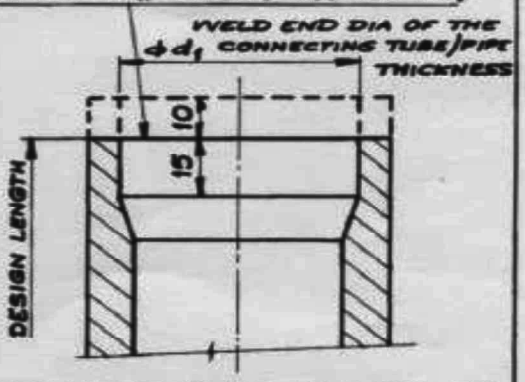
(FOR HEADERS ONLY.)

INDICATE STYLE NO 'D' - $d_1$ TO BPS NO 710004-74 (LAT. REV.)




STRAIGHT NIPPLES WHICH DO NOT REQUIRE ANY ALLO-WANCE. (NO SHOP HYD. TEST.)

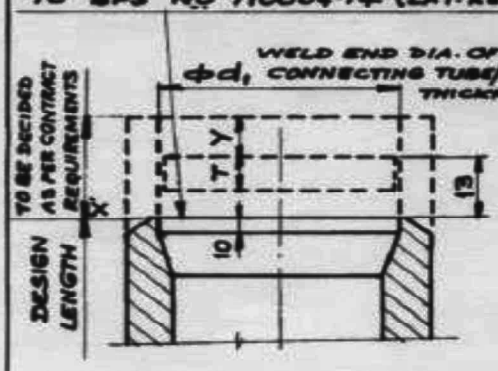
INDICATE STYLE NO 'C' - $d_1$ TO BPS NO 710004-74 (LAT. REV.)




STRAIGHT & BENT NIPPLES WHICH REQUIRE 10 mm ALLO-WANCE. (NO SHOP HYD. TEST.)

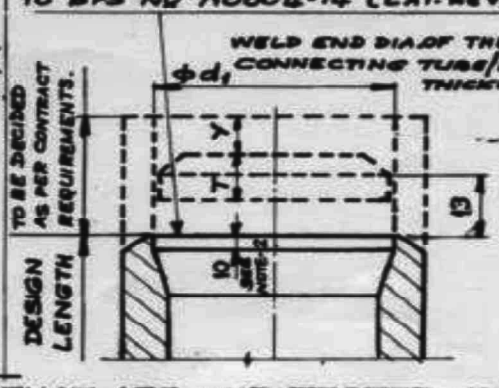
## CASE WHEN T ≤ 20

INDICATE STYLE NO 'C' - $d_1$ TO BPS NO 710004-74 (LAT. REV.)




## CASE WHEN T > 20

INDICATE STYLE NO 'C' - $d_1$ TO BPS NO 710004-74 (LAT. REV.)




STRAIGHT & BENT NIPPLES THAT ARE HYD. TESTED AT SHOPS. (WHETHER THEY REQUIRE ANY ALLOWANCE OR NOT)

NOTE: 1. FOR VALUES OF T & Y FOR DIFFERENT SIZES OF NIPPLES AT VARIOUS TEST PRESSURES REFER DRG. NO 40-B-006-2897.

2. IN CASE THE THICKNESS REQUIRED FOR THE DUMMY END COVER IS MORE THAN 25 mm THE INSIDE HEIGHT OF MACHINING (WHICH IS NOW 10 mm) WILL BE INCREASED ACCORDINGLY.

| PREPARED BY | CHECKED BY. |
|---|---|
| Bhaskar C. | |

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40-B-006-2899

# CHAPTER A4 - PROCEDURE FOR WELDER QUALIFICATION

## SECTION A4.1-PROCEDURE FOR WELDER QUALIFICATION FOR NON-IBR APPLICATIONS

**1.0 SCOPE:**

1.1 This chapter details the procedure for qualification of welder and performance monitoring.

**2.0 CONTENTS:**


1. Qualification of Welder.
2. Table- A6.1 - Welder Qualification Requirements for non-IBR applications.
3. Figure-A6.1 - Structural Tack Weld Specimen.

   Figure- A6.2 - Break test.

   Figure- A6.3 - Weld Positions.

   Figure- A6.4 - 6G position

   Figure- A6.5 - Flat position

   Figure- A6.6 - Vertical position

   Figure- A6.7 - Horizontal position

   Figure- A6.8 - Overhead position

   Figure- A6.9- Plate Butt Weld Specimen.

   Figure- A6.10- Pipe Butt Weld Specimen.
4. Record of Welder Performance Qualification Tests.
5. Welder performance monitoring.

## SECTION A4.2-QUALIFICATION OF WELDER

### 1.0 BASE METAL:

1.1 For selection refer Tables provided in Chapter II (Base Materials) of this manual.

### 2.0 TEST COUPON:

2.1 Depending on the range to be qualified, choose the appropriate test coupon from Table – A6.1

2.2 For plate butt welds, details of edge preparation shall be as per Figure-A6.9.

2.3 For pipe butt welds, details of edge preparation shall be as per Figure-A6.10.

2.4 For structural tack welds, refer Figure-A6.1.

### 3.0 REQUIREMENT OF TESTS:

### 3.1 For Structural Tack Welders:

3.1.1 Break Test as per Figure-A6.2.

### 3.2 For Plate and Pipe Butt welders:

3.2.1 100 % Radiographic examination of test welds shall be carried out. Procedure and acceptance criteria shall be as per NDE Manual (BHEL:PS:NDEM – Latest)

### 4.0 ESSENTIAL VARIABLES :

4.1 Changes to the following variables require requalification.

4.1.1 **Process:** Example: Change from GTAW to SMAW or vice versa.

4.1.2 **Joint:** A change from one type of bevel to another. Example: 'V' bevel to 'U' bevel.

4.1.3 **Base Metal :**A change in thickness or pipe diameter beyond the limits as prescribed in Table- A6.1

4.1.4 **Filler Metal:**A change from one F number to another F-number, except as specified in Table-A6.1.

4.1.5 **Positions:**This procedure envisages qualification of welders to perform in all positions. Deviation to this is not recommended.

4.1.6 **Gas:**This procedure envisages test to pre-prescribed gas as for production welds. Deviation to this is not recommended.

4.1.7 **Electrical Characteristics:**

a) AC to DC and vice versa.

b) In DC, DCEN (Electrode Negative) to DCEP (Electrode Positive) and vice versa.

4.1.8 **Technique:** This procedure envisages only use of uphill progression technique.

**Acceptance Criteria:**

**Structural Tack Welding:**

- No cracks.
- No lack of fusion.
- Undercut not exceeding 1 mm.
- Not more than 1 porosity (max. diameter of porosity 2 mm).

**Plate/Pipe Welding:**

**Visual Inspection:**

a) No cracks.

b) No lack of fusion or incomplete penetration.

c) Not more than 1 porosity in a length of 100 mm of length of weld (max. porosity diameter 2mm).

## 5.0 VALIDITY:

5.1 When a welder meets the requirements of this procedure, the validity will be for a maximum of 2 years from the date of test, limited to validity specified by statutory authority, as applicable.The validity may be extended by one year each time, based on satisfactory performance, with sufficient back up records.

## 6.0 REQUALIFICATION :

6.1 Requalification is required for the following :

a) Where there is a specific reason to doubt the skill of the welder.

b) Due to non-engagement of the welder for a continuous period of 6 months.

## 7.0 RECORDS:

The welding in charge at site shall maintain the following records:

a) Record of Welder Performance qualification Test (as per Annexure V).

b) Register of qualified welders (employer-wise) containing the following details:

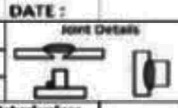
1) Name of welder.
2) Age.
3) Tested for pipe / tube / plate / tack.
4) Performance Test No.
5) Validity.
6) Welder Code.
7) Remarks.

The above register shall be updated for deletions also.Copies of welder identity card (including details as in 7 b and relevant variables qualified) and pertinent radiography reports.

## 8.0 ENCLOSURES :

1. Table –A6.1: Welder Qualification Requirements.
2. Record of Welder Performance Qualification Test.
3. Figure-A6.1: Structural Tack Weld Specimen.
4. Figure-A6.2: Break Test.
5. Figure-A6.3:Weld Positions.
6. Figure- A6.4 - 6G position
7. Figure- A6.5 - Flat position
8. Figure- A6.6 - Vertical position
9. Figure- A6.7 - Horizontal position
10. Figure- A6.8 - Overhead position
11. Figure-A6.9: Plate Butt Weld Specimen.
12. Figure-A6.10: Pipe Butt Weld Specimen

## ANNEXURE - V: RECORD OF WELDER PERFORMANCE QUALIFICATION TEST

| WELDER/TACK WELDER QUALIFICATION TEST RECORD -NON IBR | | | | | |
|---|---|---|---|---|---|
| Site : | | | Test Record No. : | | Affix welder photo |
| Contractor Name : | | | DATE : | | |
| NAME Sri. | | | Joint Details  | | |
| ID NO : | | | | | |
| WPS No. : | | Rev : | | | |
| **Variables** | | | **Recorded Actual values used in Qualification** | | **Qualification Range** |
| Process / Type | | | | | |
| Electrode (Single or Multiple) | | | | | |
| Current / Polarity | | | | | |
| Position | | | | | |
| Weld Progression | | | | | |
| Backing | | | | | |
| Material / Specification | | | to | | |
| Thickness : (Plate) | | | | | |
| Groove | | | | | |
| Fillet | | | | | |
| Thickness : (Pipe / Tube) | | | | | |
| Groove | | | | | |
| Fillet | | | | | |
| Diameter : (Pipe) | | | | | |
| Groove | | | | | |
| Fillet | | | | | |
| **Filler Rod / Electrode** | | | | | |
| SFA No | | | | | |
| AWS Class | | | | | |
| F.No | | | | | |
| Gas / Flux Type : | | | | | |
| Pre-heat temp : | | Inter-pass Temp : | | Post-heat Temp : | |
| **VISUAL INSPECTION** | | | | | |
| ACCEPTABLE : | YES | or | NO | DATE : | |
| **Guided Bend Test Results** | | | | | |
| Type | Result | | Type | | Result |
| | | | | | |
| **Fillet Test Results** | | | | | |
| Apperance | | | | Fillet Size | |
| Fracture Test Root Penetration | | | | Macroetch | |
| Inspected by | | | Test Number | | |
| Organization | | | Date | | |
| **RADIOGRAPHIC TEST RESULTS** | | | | | |
| Report No/Date | | Result | Report No/Date | | Result |
| | | | | | |
| Reviewed by | | | Reviewer Level : | | |
| NDT Company Name : | | | Date | | |
| We certify that the statement in this record is correct and that the test weld were prepared, welded and tested in accordance with requirements. | | | | | |
| **This is valid upto** | | | | | |
| Contractor : | | | Signature : | | Date : |
| BHEL : | | | Signature : | | Date : |
| Customer : | | | Signature : | | Date : |

## TABLE – A6.1
## WELDER QUALIFICATION REQUIREMENTS (FOR NON-IBR APPLICATIONS)

| Sl. No. | Test For | Base[6] Metal Note 1 | Test Coupon Dimension OD, t | Electrode[6] to be used Note 2, 4 | Weld Positions | Reference Figure | Range Qualified Dia. & T | Position Qualified | Electrode Qualified Note 2, 4 |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Structural tack | P1 Gr 1 | t=10mm or 12mm | (E6013) F2 | 3F&4F | Fig. A6.1 A6.2 & A6.3 | T-Unlimited | All | F2, F1 |
| | | | | (E7018) F4 | 3F&4F | | T-Unlimited | All | F4 & Below |
| 2 | Plate Welder (Structural) | - do - | t≥25mm | F4 | 3G & 4G | Fig.A6.7 & A6.8 | T≥3.0 mm* | All | F4 & Below |
| | | | t<25mm | F4 | 3G & 4G | | T>3.0 mm*≤2t | All | F4 & Below |
| 3 | Plate Welder (Other than structural) | - do - | t≥13mm | F4 | 2G, 3G & 4G | Fig.A6.6 , A6.7 & A6.8 | T-Unlimited OD≥600mm | All | F4 & Below |
| | | | t<13mm | F4 | 2G, 3G & 4G | | T≤2t OD≥600mm | All | F4 & Below |
| 4 | Pipe/Tube Welder | - do - | OD<25mm | F4 | 6G | Fig.A6.4 | Test piece Dia.& above | All | F4 & Below |
| | | | OD≥25mm &≤73mm | F4 | 6G | | 25mm & above | All | F4 & Below |
| | | | OD>73mm | F4 | 6G | | 73mm & above | All | F4 & Below |
| | | | t<13mm | F4 | 6G | | T≤2t | All | F4 & Below |
| | | | t≥13mm | F4 | 6G | | T-Unlimited | All | F4 & Below |

* Also qualifies for welding fillet welds on material of unlimited thickness.

**TABLE – A6.1 (contd...)**

**NOTES:**

1. For P grouping refer Chapter II.
2. For F grouping refer Chapter III.
3. Base material limitation:
   a. Where test coupons belong to P1 thro' P15E, welder is qualified for base materials P1 thro' P15E.( ASME Sec IX QW 423, Alternate base material for welder qualification)

      It means, if a welder is qualified with carbon steel material, he is also qualified for alloy steel and vice versa.
   b. Use appropriate F group electrodes.
4. Qualification in one F number, qualifies for that F-number only, except as stated below in A, B, C & D.
   A. Qualification in F4 qualifies for F4 and below.
   B. Qualification in F5 qualifies for F5 only.
   C. Qualification in any of F41 thro' F45 qualifies for F41 thro' F45.
   D. For non-ferrous materials, the base materials shall be typical of production material and appropriate filler materials shall be selected. Qualification is limited to the base material, process and filler F group. Diameter and thickness limitations apply as per Table –A6.1

   OD = outer diameter, t = thickness of test coupon; T = thickness qualified.
5. Where qualification is for GTAW followed by SMAW, the welder is also qualified up-to 6 mm thickness by GTAW process.
6. Base material indicated is carbon steel; for other base materials, corresponding electrodes are to be chosen. Also for GTAW process, the corresponding filler wire should be chosen.

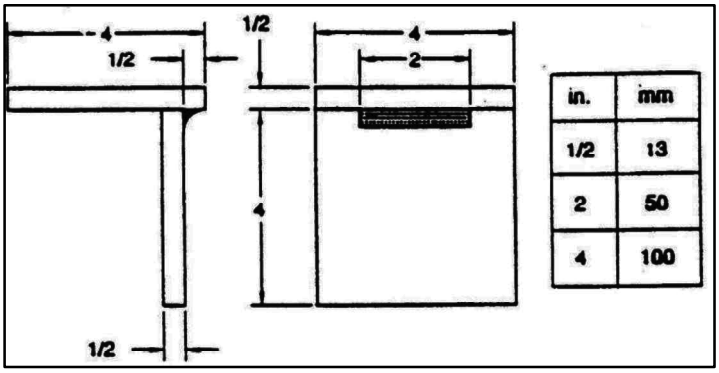



Figure A6.1 – Structural Tack Weld Specimen

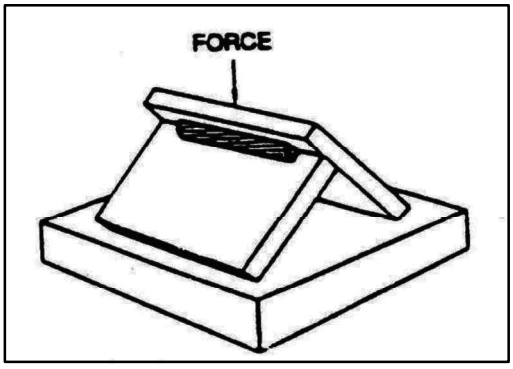



Figure A6.2 – Break Test

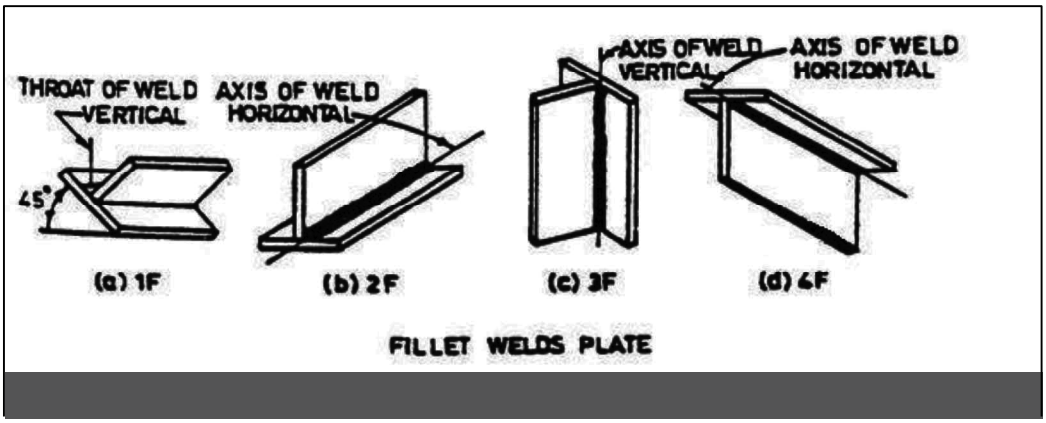



Figure A6.3 - WeldPositions

## SECTION A4.3-PROCEDURE FOR WELDER QUALIFICATION FOR IBR APPLICATIONS

### 1.0 SCOPE

1.1 These requirements shall apply to testing of welders/welding operators engaged in the manufacture and welding connected with sitefabrication, erection and repair of boilers and piping of ferrous material under the purview of IBR.

### 2.0 DEFINITION

**Welder**: one who performs manual or semiautomatic welding.

### 3.0 ENGAGING OF CERTIFIED WELDERS

All welders engaged on welding of boilers or piping under fabrication, erection and repair at site shall possess a valid certificate as required byIBR, as per Form XIII issued by the Competent Authority under IBR.

### 4.0 QUALIFICATION TEST AND ISSUE OF CERTIFICATE

Every welder shall be duly tested and qualified at site to the satisfaction of BHEL/Customer.Every welded test piece for the examination of welders/welding operator shall be stamped by BHEL with an identification mark on either side of the weld. After satisfactory completion of the tests, BHEL shall issue a Certificate/ID Card to each Qualified Welder as per the Format given in Figure no.A6.9.

**4.1** Each welder shall havebasic knowledge on the following:

i. Weld edge preparation
ii. Working of welding equipment.
iii. Properties of material to be welded – cold and hot working, thermal conductivity, fusion point, oxidation (for welders engaged in alloy steel welding).
iv. Electro-technical principles viz. kinds of current, striking arc voltage, welding arc voltage, etc.
v. Weld defects, their causes and prevention.
vi. Electrodes for different types of materials, welds and joints in different positions.

**4.2** **MATERIAL FOR TESTS** – The material of plates, tubes, pipes and electrodes used for these tests shall conform to the requirements given below:

#### 4.2.1 TEST WELDS FOR QUALIFICATION

**(a) PLATE WELDING –**

i. One weld joint of two pieces of boiler quality plates with double 'V' ordouble 'U' grooves over a minimum length of 300 mm shall be made in the following positions (size of plates to be welded being not less than 229 mm x 381 mm x 16 mm each):

(1) Flat position (figure A6.5) - Plate in a horizontal plane with the weld metal deposited from above.

(2) Horizontal Position (figure A6.6) – Plate in a vertical plane with the axis of the weld horizontal.

(3) Vertical Position (figure A6.7)- Plate in a vertical plane with the axis of the weld vertical

(4) Overhead Position (figure A6.8) – Plate in a horizontal plane with the weld metal deposited from underneath.

Qualification in Horizontal position shall automatically qualify Flat position. Qualification in Vertical position shall automatically qualify Flat and Horizontal positions. Also, qualification in Overhead position shall automatically qualify Flat, Horizontal and Vertical positions.

**(b) For Pipe Welding –**6G-Position:

Tube/Pipe with its axis inclined at 45 Deg. to horizontal. Welding shall be done without rotating the Tube/ pipe. Refer FigureA6.4.

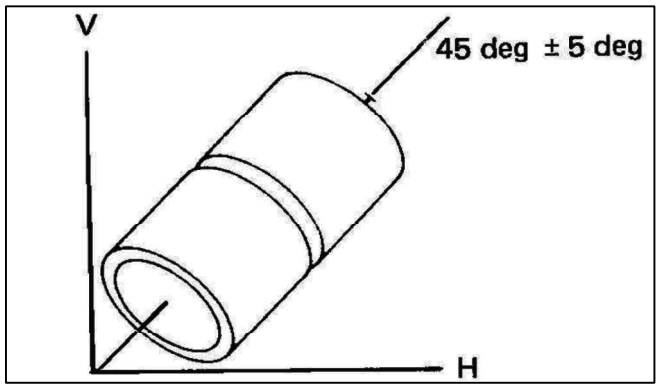



**Figure A6.46G-Position**

## 5.0 VALIDITY OF CERTIFICATE

a) Certificate issued to a welder shall remain valid for a period of twenty-four months from the date of issue, provided that the welder has, subsequent to the test, been continuously (gap not more than six months) employed on the class and type of work for which he is qualified.

b) The certificate may be extended, after the validity period, for another twenty-four months after conducting the re-qualification tests in-line with the initial Qualification tests.

c) In case of unsatisfactory performance of the Certified Welder as observed by the site engineer, the welder shall be re-qualified as per the requirements prior to engaging in subsequent welding works.

d) A welder qualified for a type and process of higher grade of steel can be allowed to weld the lower grade of steel.

e) A welder qualified on groove weld shall automatically qualify for fillet and socket welds.

## 6.0 EXAMINATION OF TEST SPECIMENS FOR QUALIFICATION TESTS

(a) The test specimens shall be visually examined as per Cl 6.0 of Chapter A7 of this Manual.

(b) After visual examination, the test specimen shall be subjected to radiographic examination as per the requirements specified in NDE Manual (BHEL:PS:NDEM-Latest).

## 7.0 MAINTENANCE OF RECORDS

Records of Qualified welders shall be maintained by the site engineer till the closure of the project. At the time of project closure, these records shall be handed over to the customer, if required by the Contract.

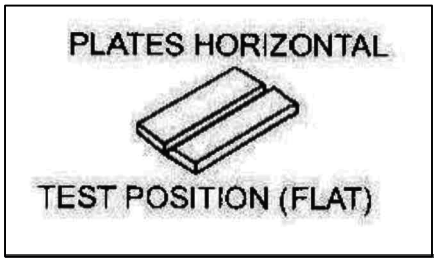



**Figure A6.5Flat position**

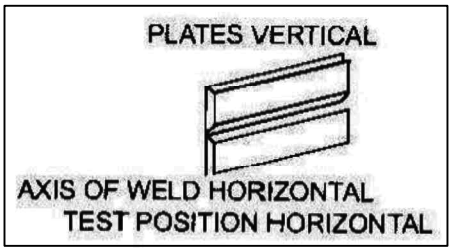



**Figure A6.6Horizontal Position**

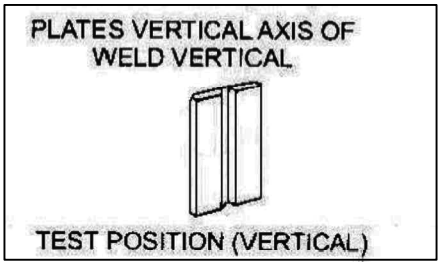



**Figure A6.7Vertical Position**

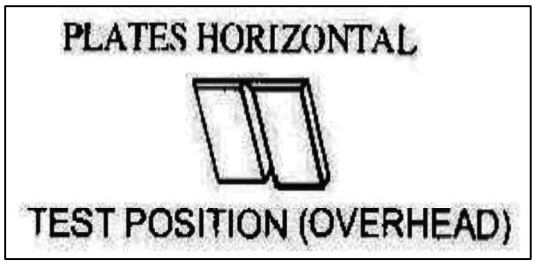



**Figure A6.8Overhead Position**

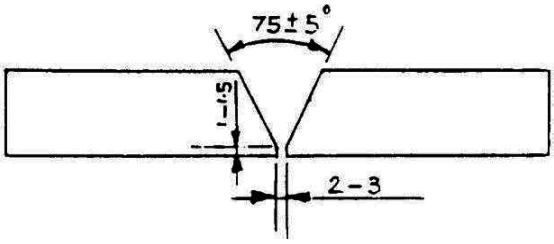
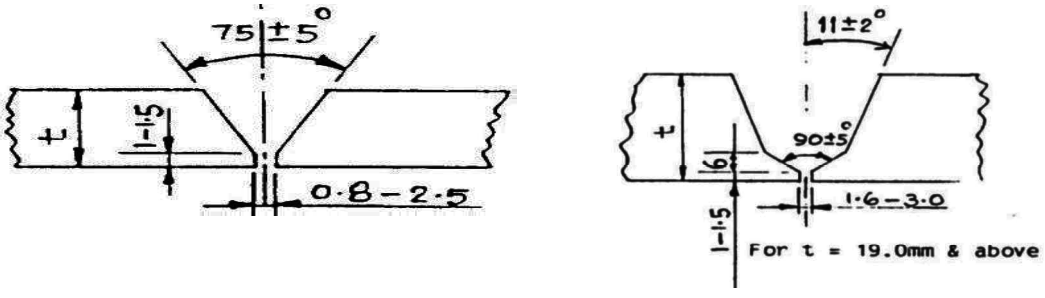
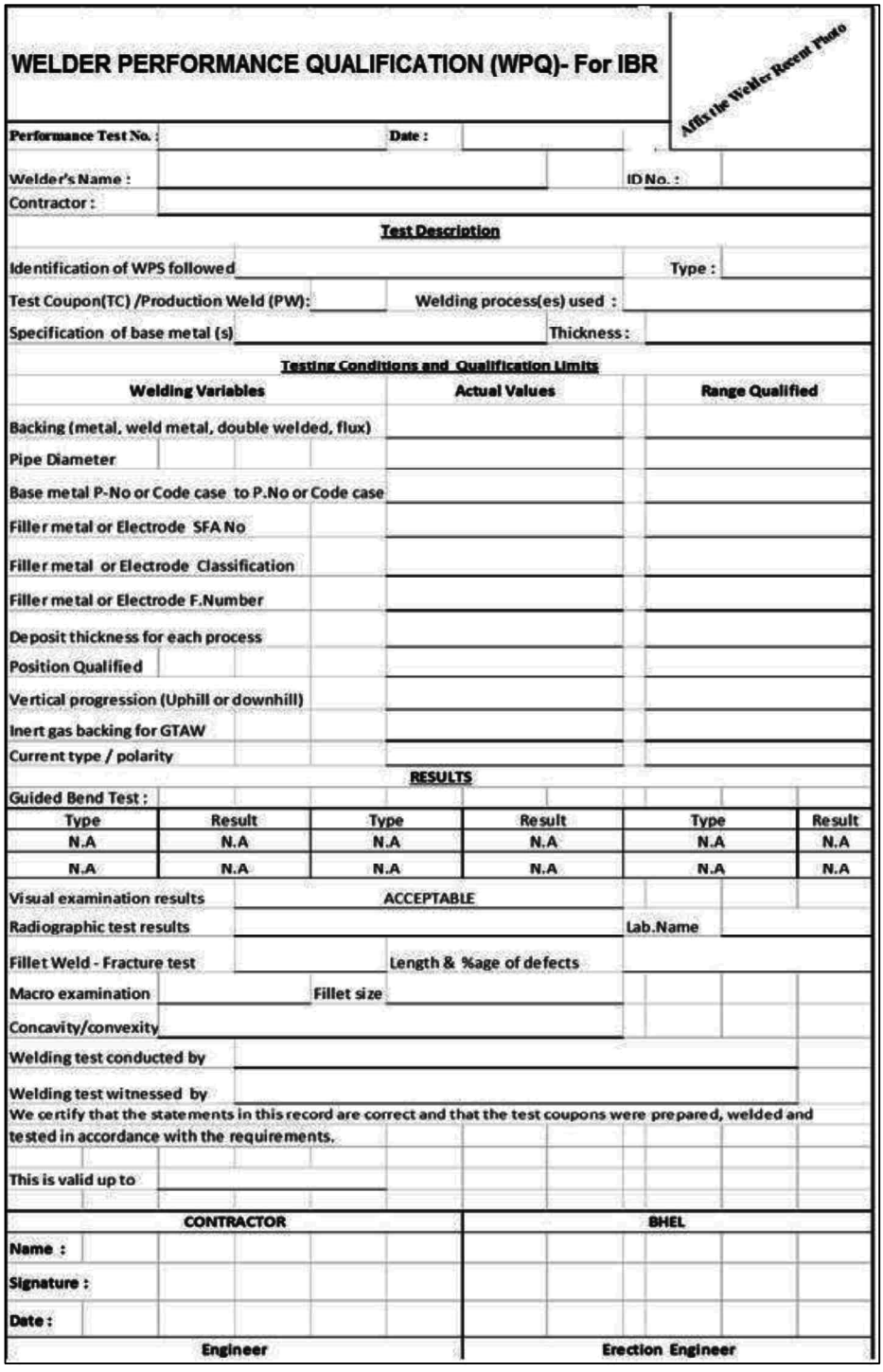



**Figure A6.9- Plate butt weld specimen**




**(A) for T upto 19 mm** **(B) For T = 19.0mm &Above**

**Figure – A6.10 – Pipe Butt Weld Specimen**



## WELDER PERFORMANCE QUALIFICATION (WPQ)- For IBR

Affix the Welder Recent Photo

Performance Test No. : Date :

Welder's Name : ID No. :

Contractor :

**Test Description**

Identification of WPS followed Type :

Test Coupon(TC) /Production Weld (PW): Welding process(es) used :

Specification of base metal (s) Thickness :

**Testing Conditions and Qualification Limits**

| Welding Variables | Actual Values | Range Qualified |
|---|---|---|
| Backing (metal, weld metal, double welded, flux) | | |
| Pipe Diameter | | |
| Base metal P-No or Code case to P.No or Code case | | |
| Filler metal or Electrode SFA No | | |
| Filler metal or Electrode Classification | | |
| Filler metal or Electrode F.Number | | |
| Deposit thickness for each process | | |
| Position Qualified | | |
| Vertical progression (Uphill or downhill) | | |
| Inert gas backing for GTAW | | |
| Current type / polarity | | |

**RESULTS**

Guided Bend Test :

| Type | Result | Type | Result | Type | Result |
|---|---|---|---|---|---|
| N.A | N.A | N.A | N.A | N.A | N.A |
| N.A | N.A | N.A | N.A | N.A | N.A |

Visual examination results ACCEPTABLE

Radiographic test results Lab.Name

Fillet Weld - Fracture test Length & %age of defects

Macro examination Fillet size

Concavity/convexity

Welding test conducted by

Welding test witnessed by

We certify that the statements in this record are correct and that the test coupons were prepared, welded and tested in accordance with the requirements.

This is valid up to

| CONTRACTOR | BHEL |
|---|---|
| Name : | |
| Signature : | |
| Date : | |
| Engineer | Erection Engineer |

**Figure A6.11: BHEL issued Welder Qualification Certificate**

## SECTION A4.4-WELDER PERFORMANCE MONITORING

### 1.0 PURPOSE:

1.1 This procedure deals with monitoring the performance of welders engaged at sites. This procedure is applicable where radiography is performed.

### 2.0 PROCEDURE:

2.1 The welder performance shall be monitored on a calendar month basis.

2.2 Extent of radiography shall be representative of weekly outputs of the welder.

2.3 Quantum of radiography shall be as per contractual requirements.

2.4 Evaluation of welds radiographed shall be as per NDE manual or other documents as specifically applicable.

2.5 **Welder performance evaluation:**

2.5.1 **For welds having diameter≤ 88.9 mm:**

2.5.1.1 The percentage of defects shall be calculated as a percentage of number of unaccepted welds to those radiographed.

2.5.1.2 Upto and including 5% defects: Performance is satisfactory else unsatisfactory.

2.5.2 **For welds having diameter>88.9 mm and plate welds:**

2.5.2.1 The percentage of defects shall be calculated as a percentage of length of defects to the length radiographed.

2.5.2.2 Upto and including 2.5% defects; performance is satisfactory else unsatisfactory.

2.6 When a welder gives unsatisfactory performance for a continuous period of 3 months, he shall be re-qualified.

2.6..1 Requalification of welder shall be called for when there is a specific reason to question his ability to make acceptable welds. This shall override requirements of clause 2.6.

2.7 Welds produced during any month shall be radiographed and evaluated latest by 10th of the succeeding month.

2.7..1 Under circumstances when clause 2.7 is not satisfied for any particular welder, he may be disengaged from the job till such time his performance is evaluated for the month in study.

2.7..2 Site in-charge may waive the restriction imposed in 2.7.1reviewing the situations for non-compliance with Cl.2.7 and may allow engagement of the welder in question for a period not exceeding one successive month to the month in study.

### 3.0 RECORDS:

3.1 Welding in-charge shall prepare and maintain Welder Performance Records, welder-wise as per the Annexure VI.

## ANNEXURE VI: WELDERS PERFORMANCE MONITORING RECORD

| WELDERS PERFORMANCE MONITORING RECORD - MONTH/YEAR : | | | | | | |
|---|---|---|---|---|---|---|
| | Dia ≤ 88.9 mm (Note -1) | | | Dia > 88.9mm (Note-2) | | |
| Welder Code | No of joints RT taken | No of defective joints | %age of defects | Length Radiographed | Length of defects | %age of defects |
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**Note :** 1. Upto and including 5% defects., performance is satisfactory else unsatisfactory.
2. Upto and including 2.5% defects, peformance is satisfactory else unsatisfactory.

# CHAPTER – A5
# INSPECTION OF WELDING

## 1.0 SCOPE:

1.1 This procedure provides details for performing visual inspection of weld fit-ups, welding in progress and completed welds.

## 2.0 REFERENCE:

2.1 Contract drawings.

2.2 Field Welding Schedule (supplied by Units) or equivalent.

2.3 Welding Procedure Specification, where supplied.

2.4 Indian Boiler Regulations (for boilers erected in India)

## 3.0 GENERAL REQUIREMENTS:

3.1 Ensure that the components to be welded are in accordance with the contract drawings, Welding Schedule and other relevant documents.

3.2 The condition of welded surfaces to be inspected shall be clean and dry.

3.3 There shall be sufficient lighting to allow proper interpretation of visual inspection.

## 4.0 WELD FIT-UP INSPECTION:

4.1 The surface to be welded shall be smooth and free from deep notches, irregularities, scale, rust, oil, grease and other foreign materials.

4.2 Positive Material Identification (PMI) shall be carried out for all alloy steel and stainless steel materials for the parent metal before fit-up and for weld after welding.However, in case of tubes random PMI check shall be done on the parent metal and on 10% of the welds made by each welder per day. The procedure recommended by the PMI equipment manufacturer shall be followed for testing.

4.3 Piping, tubing and headers to be joined shall be aligned within allowable tolerances on diameters, wall thicknesses and out-of-roundness as below:

**Maximum permissible misalignment at bore**

| Bore (mm) | Max. Misalignment (mm) | |
|---|---|---|
| | For GTAW | For SMAW |
| Up to 100 | 1.0 | 1.0 |
| Over 100 to 300 | 1.6 | 1.6 |
| Over 300 | 1.6 | 2.4 |

4.4 While fit up, components to be welded shall not show any appreciable off-set or misalignment when viewed from positions apart.

4.5 The root opening of components to be joined shall be adequate to provide acceptable penetration.

4.6 On fillet welds, the parts to be joined shall be brought as close to contact as practical, although in most instances a small opening between the parts is desirable.

4.7 Weld area shall be protected from drafts and wind, to maintain inert gas shield.

## 5.0 CHECKS DURING WELDING OPERATION:

5.1 Ensure the required minimum preheat temperature is maintained during welding. Preheating shall be done using resistance heating or induction heating or LPG burners. Preheating by cutting/ heating torches is not permitted.

5.2 Ensure correct electrode / filler metal is used for welding.

5.3 Tack welds shall be examined by the welder before they are incorporated in the final weld.

5.4 Ensure proper drying / holding of electrodes prior to use.

5.5 Ensure inter pass temperature mentioned in WPS is not exceeded during welding.

5.6 Ensure proper cleaning of weld between beads.

## 6.0 CHECKS ON THE COMPLETED WELD:

6.1 There shall be no visible cracks, pin-holes or incomplete fusion.

6.2 The weld surface must be sufficiently free of coarse ripples, grooves, overlaps, abrupt ridges and valleys, visible slag inclusions, porosity and adjacent starts and stops.

6.3 Undercuts shall not exceed 0.8 mm (0.4 mm for tubes) or 10% of wall thickness whichever is less.

6.4 Where inside surface is readily accessible, the same shall be inspected for excess penetration and root concavity. The permissible limits are given below:

- Root concavity: max of 2.5 mm or 20% of thickness at weld, whichever is lesser, provided adequate reinforcement is present.
- Excess penetration: up to and including 3.2 mm.

6.5 For plate butt welds, the weld reinforcement shall not exceed 3.2 mm.

6.6 For circumferential joints in piping and tubing the maximum weld reinforcements permitted are given below :

**Maximum Permissible Reinforcements (ASME Sec I –PW 35)**

| Thickness of base metal in mm | Reinforcement in mm |
|---|---|
| Up to 3.0 | 2.5 |
| Over 3 to 5 | 3.0 |
| Over 5 to 13 | 4.0 |
| Over 13 to 25 | 5.0 |
| Over 25 to 50 | 6.0 |
| Over 50 | Max of 6.0 or 1/8 of weld width |

6.7 There shall be no overlaps.The faces of fillet welds are not excessively convex or concave and the weld legs are of proper length.

6.8 In case of weld joints in pressure parts and joints like ceiling girder, the weld joint shall be suitably identified.

# CHAPTER – A6
# SAFE PRACTICES IN WELDING

## (This is included for information purposes only)

1.0 This covers many of the basic elements of safety general to arc welding processes. It includes many, but not all, of the safety aspects related to structural welding. The hazards that may be encountered and the practices that will minimize personal injury and property damage are reviewed here.

2.0 **Electrical Hazards**

2.1 Electric shock can kill. However, it can be avoided. Live electrical parts should not be touched. Read and understand the manufacturer's instructions and recommended safe practices. Faulty installation, improper grounding, and incorrect operation and maintenance of electrical equipment are all sources of danger.

2.2 **All electrical equipment and the work-pieces should be grounded.** A separate connection is required to ground the work-piece. The work lead should not be mistaken for a ground connection.

2.3 To prevent shock, the work area, equipment, and clothing should be kept dry at all times. Dry gloves and rubber soled shoes should be worn. The welder should stand on a dry board or insulated platform.

2.4 Cables and connections should be kept in good condition. Worn, damaged or bare cables should not be used. In case of electric shock, the power should be turned off immediately. If the rescuer must resort to pulling the victim from the live contact, non-conducting materials should be used. A physician should be called and CPR continued until breathing has been restored, or until a physician has arrived.

**3.0 Fumes and Gases**

3.1 Many welding, cutting, and allied processes produce fumes and gases which may be harmful to one's health. Fumes and solid particles originate from welding consumables, the base metal, and any coating present on the base metal. Gases are produced during the welding process or may be produced by the effects of process radiation on the surrounding environment. Everyone associated with the welding operation should the possible effects of over-exposure to fumes and gases range from irritation of eyes, skin, and respiratory system to more severe complications. Effects may occur immediately or at some later time. Fumes can cause symptoms such as nausea, headaches, dizziness, and metal fumes fever. Sufficient ventilation, exhaust at the arc,

or both, should be used to keep fumes and gases from breathing zones and the general work area.

**4.0 Noise**

4.1 Excessive noise is a known health hazard. Exposure to excessive noise can cause a loss of hearing. This loss of hearing can be either full or partial, and temporary or permanent. Excessive noise adversely affects hearing capability. In addition, there is evidence that excessive noise affects other bodily functions and behaviour. Personal protective devices such as ear muffs or ear plugs may be employed. Generally, these devices are only accepted when engineering controls are not fully effective.

**5.0 Burn Protection**

5.1 Molten metal, sparks, slag, and hot work surfaces are produced by welding, cutting and allied process. These can cause burns if precautionary measures are not used.

5.2 Workers should wear protective clothing made of fire resistance material. Pant cuffs or clothing with open pockets or other places on clothing that can catch and retain molten metal or sparks should not be worn. High top shoes or leather leggings and fire resistant gloves should be worn. Pant legs should be worn over the outside of high top boots. Helmets or hand shields that provide protection for the face, neck, and ears, should be worn, as well as head covering to protect. Clothing should be kept free of grease and oil. Combustible materials should not be carried in pockets. If any combustible substance is spilled on clothing it should be replaced with fire resistance clothing before working with open arc or flame.

5.3 Appropriate eye protection should be used at all times. Goggles or equivalent also should be worn to give added eye protection.

Insulated gloves should be worn at all times when in contact with hot items or handling electrical equipment.

**6.0 Fire Prevention**

6.1 Molten metal, sparks, slag, and hot work surfaces are produced by welding, cutting, and allied processes. These can cause fire or explosion if precautionary measures are not used.

6.2 Explosions have occurred where welding or cutting has been performed in spaces containing flammable gases, vapours, liquid, or dust. All combustible material should be removed from the work area. Where possible, move the work to a location well

away from combustible materials. If neither action is possible, combustibles should be protected with a cover or fire resistant material. All combustible materials should be removed or safely protected within a radius of 35 ft. (11m) around the work area.

6.3 Welding or cutting should not be done in atmospheres containing dangerously reactive or flammable gases, vapours, liquid, or dust. Heat should not be applied to a container that has held an unknown substance or a combustible material whose contents when heated can produce flammable or explosive vapours. Adequate ventilation should be provided in work areas to prevent accumulation of flammable gases, vapours or dusts. Containers should be cleaned and purged before applying heat.

**7.0 Radiation**

7.1 Welding, cutting and allied operations may produce radiant energy (radiation) harmful to health. Everyone should acquaint themselves with the effects of this radiant energy.

7.2 Radiant energy may be ionizing (such as X-rays) or non-ionizing (such as ultraviolet, visible light, or infrared). Radiation can produce a variety of effects such as skin burns and eye damage, if excessive exposure occurs.

7.3 Some processes such as resistance welding and cold pressure welding ordinarily produce negligible quantities of radiant energy. However, most arc welding and cutting processes (except submerged arc when used properly), laser welding and torch welding, cutting, brazing, or soldering can produce quantities of non-ionizing radiation such that precautionary measures are necessary.

1. Welding arcs should not be viewed except through welding filter plates.
2. Transparent welding curtains are not intended as welding filter plates, but rather, are intended to protect passersby from incidental exposure.
3. Exposed skin should be protected with adequate gloves and clothing as specified.
4. The casual passersby to welding operations should be protected by the use of screens, curtains, or adequate distance from aisles, walkways, etc.
5. Safety glasses with ultraviolet protective side shields have been shown to provide some beneficial protection from ultraviolet radiation produced by welding arcs.

# GENERAL GUIDELINES FOR INSULATION WORKS

This booklet is given as a general guideline to this tenderers about insulation works, However instructions given in the drawings & other schedule issued during execution of the work shall be final and binding of the contractor.

**Bharat Heavy Electricals Limited**
**( A Govt. Of India Undertaking)**
**Power Sector Southern Region**
**690, Anna Salai , Nandanam,**
**Chennai – 600 035**

# GENERAL NOTES ON ERECTION OF INSULATION

1. It is important that the sheet metal covering is done, by a experienced and competent tinsmith.

2. Person, who is doing the actual job, can alter the following said methods of fixing the sheet metal, as and when necessary, only after consulting the BHEL Erection Engineer.

3. Fixing pin of corresponding thickness of insulation shall be welded by **STUD WELDING** process.

4. Circumferential and axial overlapping of outer casing should be 50 mm unless specified otherwise.

5. **FOR HORIZONTAL AND INCLINED DUCT AND PIPE:**

   1) All overlapping in axial direction should be at the bottom of the duct and pipe. Provision of beading and Sealing compound is not required.

   2) For circumferential overlapping of inclined duct and pipe, provision of beading and Sealing compound is not required.

   3) For circumferential overlapping of horizontal pipe and duct, provide beading. Apply Sealing compound if necessary.

5A. **FOR VERTICAL DUCT AND PIPE:**

   1) For overlapping in the axial direction provide beading. Apply Sealing compound if necessary.

   2) For circumferential overlapping provision of beading and Sealing compound is not required.

6. The joints of wool mattresses should be staggered in both circumferential and axial direction. The Wire netting at the joints of Wool mattresses are to be sewn together by G.I. sewing wire dia 0.71 mm.

7. In case more than one layer of Wool mattress is to be applied for pipe insulation the inner layer should be tied by two turns of G.I binding wire dia 1.22 mm at a pitch of 240 mm, and the outer layer should be tied by two turns of G.I. binding wire dia 1.22 mm at a pitch of 160 mm. The ends of the wire should be twisted and pressed in to the insulation.

8. All the overlapping of outer casing should be made such that no rain water enters into the insulation through the joints.

9. Incase of insulation fixing pin welding to tubes, equal circumferential pitch is to be maintained. Use a minimum number of 4 pins, at 90 degree radial spacing.

10. The inner side of the Aluminum / G.I sheet of outer casing should be painted with two coats of anticorrosive Paint (IS:158). Retainer – Type A must be coated with Aluminum paint to avoid bi-metal corrosion or Neoprene strip must be provided between Retainer – Type A and Casing support.

    The above mentioned paints are not in BHEL scope of supply

11. Self tapping screws should be fixed over the circumferential overlapping. The axial joints should be on the Casing supports and outer casing should be fixed to Casing supports with Self tapping screws at a pitch of 150 mm approximately.

12. The outer casing should be wound tightly around the insulation and then fixed with Self tapping screws when there is not any Fixing pin for insulation.

13. Loose wool can be taken from the Wool mattresses wherever required.

14. Clean the surface to be insulated of rust, dust, grease, loose scale, oil, moisture, etc.

15. Care shall be taken that flexible insulation is not unduly compressed.

16. After insulating the equipment with Calcium silicate / Mineral wool mattress, all voids in the joints shall be filled with Moldable insulation / loose mineral wool respectively.

17. Each day application of insulation should be weather proofed overnight by either with the final protective casing or with some temporary weatherproof covering so that it does not get drenched in rain.

18. The indicated thickness of insulation is the minimum requirement which should be provided. Any alteration in the thickness of insulation should be done only after getting the prior approval from the Design Engineer.

19. The layers of Wool mattresses are to be taken as indicated below:

| | LAYER IN mm | | | | |
|---|---|---|---|---|---|
| THICKNESS IN mm | 1st | 2nd | 3rd | 4th | 5th |
| 250 | 50 | 50 | 50 | 50 | 50 |
| 230 | 50 | 60 | 60 | 60 | |
| 210 | 50 | 50 | 50 | 60 | |
| 200 | 50 | 50 | 50 | 50 | |
| 190 | 40 | 50 | 50 | 50 | |
| 180 | 60 | 60 | 60 | | |

| | | | |
|---|---|---|---|
| 160 | 50 | 50 | 60 |
| 150 | 50 | 50 | 50 |
| 140 | 40 | 50 | 50 |
| 120 | 60 | 60 | |
| 100 | 50 | 50 | |
| 80 | 40 | 40 | |

20. Where junctions between two or three bodies or different dia, occur and different insulation thickness is specified the greater thickness shall be continued for a length equal to one dia of the smaller body then smoothly tapered to the required smaller thickness over a length equal to two dia of the smaller body. When there is a differential thermal expansion between these bodies, they should be insulated individually.

21. The required fixing components and outer casing sheets have been released under PG_32. The insulation materials have been released under PG-33.

22. **STORAGE INSTRUCTIONS**:

22a) Mineral wool mattress:

These materials should be stored under fully covered sheds. Stocking must be done over planks and must be out of contact with ground. Height of stacking should not exceed 3 Meters.

Once drenched in water these materials loose all the desired properties and become unsuitable for use. Drying the material does not restore the desired properties.

22b) Outer casing sheets:

Outer surfaces are meant for improving the appearances also scratch marks, dents, etc, spoil the appearance.

23. Typical insulation arrangement drawings are indicated below.

| | | |
|---|---|---|
| 1) | Tees | 4-00-235-08546 |
| 2) | Elbows | 4-00-235-08547 |
| 3) | Flanges | 4-00-235-08548 |
| 4) | Expansion joint for pipe | 4-00-235-08549 |
| 5) | Expansion piece for duct | 3-00-235-06258 & 3-00-235-06259 |
| 6) | Manhole door for duct | 3-00-235-06260 |

# INSULATION OF DRUM END

## MATERIAL:

1) FLAT 50 X 6
2) FIXING PIN INSLN DIA – 6
3) RETAINER TYPE – A
4) G.L. BINDING WIRE DIA – 1.22 / 0.914
5) WOOL MATTRESS
6) OUTER CASING
7) SELF TAPPING SCREW – M4 X 13
8) G.L. SEWING WIRE DIA – 0.71 / 0.914

## APPLICATION:

Install Flat 50 x 6 circumferential bands to fit snugly around the drum.

Flat 50 x 6 lattice bar 8 numbers should be radially placed over the dished end and contouring the same and it is to be welded over circumferential bands.

Weld the Fixing pins to the lattice bars circumferential bands.

Fix the Wool mattress.

Position the Retainer and tack weld to the Pin.

Tie with Binding wire across the Pins.

Fix the outer casing strips by Self tapping screws.

## INSULATION OF PIPES AND BUNCH OF TUBES

**MATERIAL:**

1) WOOL MATTRESS
2) G.L. SEWING WIRE DIA-0.71 / 0.914
3) G.L. BINDING WIRE DIA – 1.22 / 0.914
4) OUTER CASING
5) SELF TAPPING SCREW – M4 x 13

**APPLICATION:**

Fix the insulation over the bunch of tubes / pipes.

Tie the insulation with G.I. binding wire circumferentially.

Fix the outer casing sheet with self-tapping screws.

## INSULATION OF VERTICAL PIPES
## (WELDING OF FIXING PINS NOT PERMITTED ON PIPES)

**MATERIALS:**

1) FIXING PIN INSLN DIA – 6
2) RETAINER TYPE – A
3) CASING SUPPORT – 850MM
4) OUTER CASING
5) WOOL MATTRESS
6) SELF TAPPING SCREW – M4X13
7) CLAMP
8) SUPPORTING SHEET
9) FLAT 50 x 6
10) PACKING CLOTH – 3 MM TK
11) HEX HD BOLT M8X40
12) HEX NUT M8
13) PNCHD WASHER A9
14) GI BINDING WIRE DIA – 1.22 /0.914
15) GI SEWING WIRE DIA – 0.71 / 0.914
16) SHEET 3.15x30x3000

**APPLICATION:**

At every three meters provide the Clamps over the pipe with bolt but and washer by using packing cloth in between the pipe and clamp. Fix the sheet 3.15x30x3000 over the pipe and weld to the clamps. Weld the fixing pin over the sheet. Consult the Welding engineer before welding.

Weld the Flat to the Clamps.

Weld the Supporting sheets to the Flats.

Fix the insulation.

Position the Retainer Type – A and tack weld to the Pins.

Tie the insulation to the pipe with GI biding wire circumferentially.

Fix the casing support to the Retainer by using two numbers of Self tapping screws, fixed diagonally for each Retainer.

Fix the outer casing sheet with self tapping screws.

# INSULATION OF VALVE

## MATERIAL:

1) SM CLAMP FOR DETACHABLE INSULATION TYPE – A (To be used up to 200 mm overall dia)

1)a SM CLAMP FOR DETACHABLE INSULATION TYPE – B (To be used above 200 mm overall dia)

2) WOOL MATTRESS

3) OUTER CASING

4) SELF TAPPING SCRES – M4 x 13

5) G.I SEWING WIRE DIA – 0.71

6) SNAP HD RIVET 3 x 8

7) CHS SCREW M4 x 20

8) HEX NUT M4

## APPLICATION:

The sheeting shall be made in two halves and the Sheet metal clamp mounted.

Wool mattress thickness according to adjacent pipe lines shall be pressed in to two halves.

The two halves shall be fitted over the valve to be insulated and locked by Sheet metal clamp.

Self tapping screws shall be used for clamping the two edges of the outer sheet casing when the length of the valve is more.

After assembling the Clamp put a bit of GI Binding wire as a pin through 1.6 mm hole provided.

# INSULATION OF DUCT / FLAT SURFACE

## MATERIALS:

1) FIXING PIN INSLN DIA – 6
2) WOOL MATTRESS
3) OUTER CASING
4) RETAINER TYPE – A
5) GI BINDING WIRE DA – 1.22 / 0.914
6) CASING SUPPORT – 650 MM
7) SELF TAPPING SCREW M4 x 13
8) GI SEWING WIRE DIA – 0.71 / 0.914

## APPLICATION:

Weld the Fixing pin over the Duct / Flat surface.

Fix the insulation.

Position the Retainer Type – A and tack weld to the Fixing pins.

The GI Binding wire dia 1.22 shall be wound across the Fixing pins diagonally underneath the Retainer Type – A.

Fix the Casing support – 650 long to the Retainer Type – A by using two numbers of Self tapping screws, fixed diagonally for.

Retainer Type – A.

Fix the outer casing by using Self tapping screws.

## DUCT STIFFENERS

When the stiffeners protrudes through the insulation and are exposed to atmosphere, provide an additional 40 mm insulation over the stiffener.

## DUCT DAMPER & GATE

Insulation thickness shall be s per the adjacent duct insulation. The stuffing boxes should not be insulated. A clear gap of 50 mm (minimum) should be maintained all around the stuffing boxes.

## AIR HEATERS

DO NOT insulate over the axial seal, adjuster seal access covers and basket removal doors insulation should be applied in a manner to permit a free circulation of ambient air around the bearing.

# INSULATION OF DUCT
## (CLEARING STIFFENERS)

**MATERIALS:**

1) FIXING PIN INSLN DIA – 6
2) RETAINER TYPE – A
3) RETAINER TYPE – C
4) CASING SUPPORT – 650 MM
5) GI BINDING WIRE DIA – 1.22/0.914
6) GI SEWING WIRE DIA – 0.71 / 0.914
7) OUTER CASING
8) SELF TAPPING SCREW M4X13
9) WOOL MATTRESS
10) WELD MESH
11) CORNER SUPPORT
12) ANGLE 40X40X5 – 100

**APPLICATION:**

Weld the Fixing pin over the Duct.

Position the Retainer Type – C so that it will be in the same plane as that of the top surface of the stiffener.

Tack weld the Retainer – Type – C to the Fixing pin.

For the top plate of the horizontal duct, spread the Weld mesh over the Retainer Type – C.

This serves as the additional support where people walk over the insulation.

Weld the Corner support to the bottom corners of the duct.

Weld the Angle to the corner support.

This arrangement will help to achieve a sharp corner for the insulation and outr casing.

Fix the insulation.

Position the Retainer Type – A and tack weld to the Fixing pin.

The Biding wire shall be wound across the pins diagonally underneath the Retainer Type – A.

Fix the Casing support - 650 mm long to the Retainer by using 2 numbers of Self tapping screws, fixed diagonally for each Retainer.

Fix the outer casing by using Self tapping screws.

# PROCEDURE FOR CURING OF CASTABLE REFRECTORY

## CURING OF REFRACTORY WORK

Curing of refractory means retaining the moisture for a minimum period in order to ensure the proper hydration of the binder. Curing of exposed castable surfaces should start after the surface has become firm. This can be tested when a finger rubbed across the surface comes away clean or when the surface feels warm to the touch. Moisture loss for the first 24 hours, after the material has been installed shall be retarded. Initial set occurs within one or two hours.

Castables should be cured for 24 hours. Moist conditions can be maintained by protection with damp sacking or plastic sheet which should not come into immediate contact with the refractory or alternatively by dry coating the castable with an impervious organic based sealing compound. In some instances, satisfactory results can be obtained by sparkling water over the surface. It should be watered for a period of 20 to 24 hours after 4 to 5 hours of construction. The rate of water applicable should be carefully controlled to prevent washing of the fines and to prevent collection of pools in low spots. Shield the surface from direct sunlight at least for about 48 hours. 8 hours after casting and pouring, remove the wooden frames which have no load bearing function in order to permit watering of the lateral parts of the structures. In case of steel frames apply water without stripping them. On completion of the curing period the application of moisture should be stopped. The exposed castable should be allowed to air dry for 24 hours. Naturally air drying of castable after curing will actually cause slight increase in strength. The castable can be all dried indefinitely without adverse effect. Optimum results cane be obtained with a drying period of 48 hours.

Before lighting the boiler for drying the setting the following shall be attended.

1. All dirt and foreign objects sticking to tube surface are to be removed to ensure a thoroughly clean surface.

2. Expansion joints are to be cleaned and inspected for the proper functioning of expansion during operation.

3. Test sample of castable refractory is to be taken from entry door regions to determine the moisture content in the laboratory.

   Sample of castable are to be taken for the determination of moisture content before and after drying. When the moisture content drops below 0.58 the castable is considered to be dry and the boiler is ready for commissioning. All result of measurement should be duly recorded.

## CARE OF THE REFRACTORY WORK

The refractory work is subjected to considerable thermal stresses during boiler operation. Sudden application of heat or cooling introduces severe stresses and endangers the refractory work. Even when the boiler is operated in the recommended regime possibilities of damage occurring to the refractories (due to severed reasons such as bad workmanship, poor quality, slag deposition, corrosive atmosphere etc) must be kept in mind. The following simple rules to be observed.

(i) Avoid sudden cooling of the furnace after a shut down. A cooling rate of 20° to 30° per hour for the refractory lining in the initial period is recommended. This means that FD fans must be stopped after a shut down of the boiler. Ventilation of the furnace by natural draft is permissible only after six hours of shut down. Forced cooling can be started only after 16 hours.

(ii) Avoid quick heating of the furnace. Boiler starting diagram is usually a reliable guide.

(iii) Thoroughly examine the refractory work during shot downs for cracks, chipping off spelling etc. During operation also this can be checked periodically by visual examination through observation holes.

Whenever defects are notice arrange for their quick alimentation, by shutting down the boiler at the earliest depending on the scarceness of the defect.

(iv) Abnormal heating of outside metal sheet covering of the boiler and hot spots are usually a good indication of damaged refractory and insulation in this area. The leakage of flue gas will spoil the property of good mattresses within a short time.

(v) Deep the access door, observation doors, etc. properly shut. They are entry points for cold air and this cold air can damage the refractory work by localized cooling.

(vi) Sufficient quantity of water is to be added to the castable refractory for mixing before application as per supplier's recommendations.

## METHOD OF APPLICATION AND CURING OF POURABLE INSULATION

(i) Typical application are for insulating behind buckstays and areas such as roofs having multiplicity of hangers, rods and other penetrations.

(ii) The application of pourable insulation cab be pumping and gunning.

(iii) Density of the pourable insulation installed and cured is around 600 to 650 Kgs/ M

(iv) Pourable insulation is a hydraulic setting insulation additive or air entrainment agents shall not be used.

(v) (a) Empty the entire bag at a time and mi the while material so that segregated particles get mixed.

(b) The pourable insulation should be thoroughly mixed with coal clean water to develop casing and pump consistencies.

© The correct quantity of water shall be placed in the mixer before adding the dry pourable insulation normally about 70 to 100 by weight. However this has to be confirmed from the supplier while purchasing this material.

(d) Mixing time shall not to be less than the minutes or more than five minutes.

(e) Dried out material shall not be remixed.

(f) Pourable insulation once mixed must be in place within half an hour.

(vi) (a) All areas where pourable insulation will be placed must be fee of scale, rust, dust or other loose materials.

(b) All porous forms used such as wood etc shall be oiled before pouring.

© All absorbent surface such as insulation brick, concrete, shall be wet down thoroughly to prevent water absorption.

(d) Waiting of wall insulation used as forms at buckstay levels is not required.

(vii) (a) The surface of pourable insulation once in place will become firm in approximately two hours. The surfaces should be kept damp with an occasional light spray or covering with a cloth that is kept damp for the entire 24 hours curing period.

(b) For mixing and spraying the water should be clean and cold.

© Application of moisture after 24 hours should be stopped forms etc should be removed and the materials allowed to air dry for 24 hours.

(viii) The shuttering scaffolding moulds should be removed after about 36 hours of casing.

## APPLICATION OF INSULATION FOR BOILER PIPING, PIPING AND EQUIPMENTS / VESSELS AND ACCESSORIES.

Bonded mattress having standard thickness to 25, 10, 50, 60, 75 mm confirming IS 8103 having a density of 150 kg/cubic meter and light bonded mattress having a density of 150 kg/cubic meter and light bounded mattress having standard thickness of 25. 40, 50, 60, 75 mm conforming to IS 9842 having a density of 144 kg/cubic meter and pipe section in the standard thickness of 25, 40, 50, 60, 75 mm confirming IS 9842 having density of 144 kg/cubic meter will be 100 kg/cubic Mtr.

The application of insulation will be done as per general notes/ drawings enclosed. The application commissioning shall be as per latest editions of IS 7413 code of practice for application and finishing of thermal insulation materials between 40° C to 700° C of Bs 5970 code for practice for thermal insulation of pipe work and equipment (in the temperature range – 100° C to + 870° C).

Inspection before application, during the application and after the application of insulation will be carried out by BHEL Field Quality Engineer as per BHEL Field Quality Plan. Every layer of insulation shall be got approved by BHEL Engineer / FQA Engineer.

Prior to applying insulation the surfaces to be insulated shall be made clean and dry and free from dirt and grease. Where cladding is attached to carbons steel or low alloy steels the steel shall be first prime painted with zinc chromate and then painted with Aluminum paintings. Wherever required to provide aluminum foil as protective covering for bolts and other fittings shall be arranged by contactor. The prints wherever required for preservation coating shall be supplied by contractor.

For insulation of piping with performed pipe sections the came shall be applied over pipe and finally be held in position with 15 mm wide aluminum band at greater than 300 mm spacing for mineral wool insulation.

For insulation of piping with mattresses having backing GI wire netting, the required lengths and shapes are to be cut from the blankets and wrapped on the piping and held in position with proper support by fastening the binding to be done circumferential at not greater than 300 mm spacing.

Performed insulation on vertical or near vertical piping must be supported in position by means of metal ring at interval not greater than 960 mm.

The support attachment may be welded or clamped to the pipe, subject to the approval of BHEL Site Engineer Necessary fabrication of support rings to be done as per site requirement.

Piping bends shall be insulated to the same specification as adjacent straight piping and should form a smooth external surface. Where performed material is used it should be cut loster-back fashion and wired or strapped into position.
Pipe insulation shall be cut to fit nearly around hangers and supports. On horizontal lines which are supported directly on pipe racks the insulation and weather proofing shall be sufficiently cut away at the support to accommodate pipe movement.

Protrusions through insulations which themselves do not required insulations such as pipe clamps supports of small pipings instrument take offs etc shall be covered to the same thickness as the adjacent insulation expect for hanger rods.

At outdoor location the hanger rod protraction shall be shielded with metal flashing to deflect rain and protect the insulation from moisture while permitting the movement of the hanger rod.

Arrangement of securing the metal finish even the insulation shall ensure that direct metal contact between the insulated surface and outer meter cladding is avoided. 4mm thick asbestos board packing shall be used at interface to thermally isolate the metal covering from supporting arrangement. All cladding joints shall be vapours tight and shall be able to accommodate thermal movements. Paste type self setting vapours sealing compound shall be used.

Metal cladding on piping shall be screwed with self tapping screws. These joints should be arranged approximately 30° below horizontal centre line so as to shed water on any horizontal pipe line. The screws shall be flat or round head types of 12mm size and overlapping of 50 mm on both longitudinal and circumferential joints. The screws shall be provided at not greater than 150 mm spacing.

Insulation expansion joints shall be provided in all pipelines to allow movements and expansion of the pipe. The recommended intervals of expansion joints are.

| Pipe Temperature | Spacing of Insulation Expansion joints |
|---|---|
| Below 200°C | 5.5 M |
| 201° - 300°C | 3.5 M |
| 301°C - 400°C | 3.0 M |
| Above 400°C | 2.0 M |

All joints in the insulation shall be staggered. For multiple layer of insulation the different layers shall be applied so that the butt joints of one layer do not coincide with those of the other layers. At the joint of each layer of insulation loose insulation shall be packed firmly.

## Equipments Insulation Application Procedure

For equipment and shells a matrix of insulation support shall be developed by:-

(a) Welding the insulation support lugs on a frame work prepared with 20 mm x 3 mm size MS Straps where direct welding of lugs to he sheet is not permitted.

(b) Welding the directly on shell after written permission by Site Engineer. The material of the support shall be similar to the material of the shell in this case.

The support shell be pitched at 300 mm for vertical and underside surfaces and 500 mm for oppressed surfaces. A support shall be located above each vessel flange at a sufficient distance above the flange bolts to allow for easy removal. The top and bottoms supports shall be slotted suitably for attachments of straps and wires.

The support lugs shall be 6 mm

Insulation with back up GI wire noting, shall be cut to fit the equipments and shall be wrapped on the equipment and held in position with proper support and tie wires. All joints between course shall be staggered and tightly butter and adjacent edges laced together with lacing wire.

Insulation shall be fastened in place with MS Straps of 20 x 3 mm, on approx., 300 mm centers where contour of equipment permits. Straps shall be tightened with a banding machine and champed with seals.

Insulation on top of horizontal heads shall be cut to fit the curvature of the head and shall be secured in place with the help of radial straps fixed in between circumferential rings. Insulation on bottom heads shall be wired to nuts welded to head. Insulation shall also be strapped to bottoms insulation support. For outdoor equipments insulation shall be arranged to be weather proof.

Metal jacketing shell be applied directly over the met insulation and neatly fitted to place. All gaps shall be arranged so as to shed water. Suitable flashing and weather proofing shell be provided at all nozzles, manholes and other projections to prevent the entrance of water.

## VALVES & FLANGES INSULATION APPLICATION

The insulation on all valves and flanged joints shall be enclosed in a removable jacketing so that it may be removed without disturbing the concerned equipment or piping. The thickness of insulation shall be same as that of the pipe line in which these valves and fittings are located.
The layout of wool mattresses to be adopted to obtain the specified insulation thickness are as per be on unless otherwise specified:

| Thickness of Insulation (mm) | Layer | | | |
|---|---|---|---|---|
| | I | II | III | IV |
| 25 | 25 | | | |
| 40 | 40 | - | - | - |
| 50 | 50 | - | - | - |
| 60 | 60 | - | - | - |
| 65 | 40 | 25 | - | - |
| 75 | 75 | - | - | - |
| 80 | 40 | 40 | - | - |
| 100 | 50 | 50 | - | - |
| 110 | 60 | 50 | - | - |
| 125 | 75 | 50 | - | - |
| 135 | 75 | 60 | - | - |
| 150 | 75 | 75 | - | - |
| 155 | 75 | 40 | 40 | - |
| 160 | 75 | 60 | 25 | - |
| 165 | 75 | 50 | 40 | - |

The material density of boned mineral wool used for pipe having outside diameter more than 355.6 mm is 150 kg/cubic mater 13 8183.

The material density of bonded mineral wool used for pipe having outside diameter less than or equal to 355.6 mm is 144 kg/cubic meter IS 9842.

Cladding material used is galvanised steel sheet as per IS 277 GRADE 375.

Cladding material gauge for pipe outside diameter less than or equal to 300 mm is 24 SWG.

Cladding material gauge for pipe outside diameter greater than 300 is 22 SWG.

For piping up to including 355.6 mm OD, first layer shall be pipe sections and subsequent layer shall be bonded. Wherever pipe sections are not supplied the first layer has to be wrapped using bonded wool material for piping 355.6 mm OD, bonded mattress shall be used or all the layers.

## Description of type of insulation and the method of Application for Boiler Feed Pumps

1. **Type of insulation**

   The pumps should be insulated with 125 mm thick flexible wire backed mineral wool mattress of 150 kg/ density.

2. **Method of Application**

   The above insulation is to be applied to 2.0 mm thick flats aluminum sheeting (18 SWG) and secured by 19 mm vide aluminum retaining dips and 1/8 inch diameter aluminum pop rivets, all to be secured by 2 inch long X No.8 spacing to a 40 mm wide x 3 mm thick angle iron frame work of all welded construction bound by 40 mm PVC tape.

| SECTION | TITLE | NO. OF SHEETS |
|---|---|---|
| A | METHOD OF APPLICATION OF THERMAL INSULATION FOR PIPING AND EQUIPMENTS AND MATERIAL SPECIFICATIONS (ANNEXURE-1) | 4 |
| B | THERMAL INSULATION APPLICATION DRAWINGS | 13 |

# SECTION - A

# THERMAL INSULATION FOR PIPING AND EQUIPMENTS

## 1.0 INTRODUCTION

In a thermal power station or process plant, thermal insulation or heat lagging of piping and equipment's carrying hot fluids is essential for hest economy and protection of operating personnel. Any pip which is at a temperature higher than it s surroundings will loose heat and the amount of heat lost will depend upon the temperature of the fluid and the thermal conductivity of the piping material/covering.

The heat lost through bare pipe increases with

a) Increase in the temperature of fluid conveyed
b) Decrease in ambient temperature and
c) Increase in wind velocity of the surroundings.

The heat so lost hast potential for work and rapidly increasing cost of fuel in the recent past has promoted to find all possible means to conserve energy. Providing proper and adequate insulation on to the piping and equipments controls heat transfer and maintains the required services temperature.

## 2.0 METHOD OF APPLICATION

The method of application is highly skilled job. Badly fitted/laid insulation can lead to greater hear loss, higher cold surface temperature than that estimated and frequent maintenance. Following are the important points to be considered in the application of the insulation.

2.1 Before applying insulation, it should be ensured that all instrument tappings, clamps, lugs and other connections on the surface to be insulate d have been properly installed as per relevant drawings.

2.2 All surfaces to be insulated shall be cleaned of all foreign materials such as dirt, grease, loose scale, moisture etc.

2.3 Welding of lugs, attachments, clips etc. on the surface to be insulated for supporting insulation shall not be carried out without the permission of the authorized person.

2.4 All flanged joints shall be insulated only after final tightening and testing.

2.5 The insulation shall be applied to all surfaces when they are at ambient temperature.

2.6 Where more than one layer of insulation is involved, mattresses should have staggered joints (at 60 deg) and they must be held in close contact with face of

pipes/fittings by means of binding wires / Aluminum bands / seals. Circumferential joints of multilayer insulation should also be staggered by at least 150 mm.
(Refer Drg. No. PE-4-999-169-01).

2.7 For the first layer of insulation and in case of multi layer of insulation, mattresses with hexagonal wire netting will be facing on outer side.

2.8 Insulation mattresses shall be held in place by fastening over with binding wire. Care should be taken to see that the flexible insulation mattresses are not unduly compressed. The ends of binding wire shall be lightly twisted together, bent over and pressed into the insulation. For mattresses, binding wire shall be used at intervals of 300mm.

In the addition Aluminium bands shall also be provided at 300 mm intervals for diameters greater than 500mm. (Refer Drg No. PE-4-99-169-01.)

2.9 Where junctions between bodies of different diameters occur and difference in insulation thickness is specified, the greater thickness is to be continued for a length equal to one diameter of the smaller body and then smoothly tapered to the required smaller thickness over a length equal to two diameters of the small body.

2.10 The indicated thickness of insulation are minimum requirement which should be maintained. Any change in the thickness of the insulation should be done only after prior approval of the design engineer.

2.11 The day-to-day insulation work should be covered with suitable protective materials to prevent the rain water entry, if same is expected.

2.12 The insulation shall be cut to fit the piping O.D / equipment and shall be wrapped on the piping / equipments and held in position with proper support and wires. All the joints should be properly staggered and tightly butted and adjacent edges laced (Refer Drg No. PE-4-999/169/01)

2.13 The insulation of valves and flange joints shall be enclosed in a removable jacketing so that it may be removed without disturbing the concerned equipment or piping. The thickness of insulating shall be same as that of the pip line in which these valves and fittings are located. (Refer Drg No. PE-4-999-169-07.)

2.14 Steam / Air / Gas leakages in and around the pipes to be insulated with be attended before applying insulation.

2.15 In order to provide support to Aluminium cladding, support rings made out of 20 x 3 mm M.S. flats shall be fixed at equal intervals of approximately 850 mm spacing and at every circumferential joints. These rings shall be fixed with 'L'

type lugs and shall be fabricated from 20 x 3 mm M.S flats. To reduce that conductivity through these lugs 20 mm x 3 mm size Ceramic mill board shall be used between rings and lugs (Refer Drg No. PE-4-999-169-04 and PE-4-999-169-13).

2.16 Spacing between supporting rings for vertical piping shall be 3 mtrs. Support rings are to be provided only when the vertical height exceeds 3 mtrs. (Refer Drg No. PE-4-999-169-03-and PE-4-999-169-05).

2.17 For vertical pipes since support rings is provided ate every 3 mtrs interval, only two spacer rings shall be provided in between support rings.

2.18 Spacer rings shall be provided at both ends of elbows/bends, valves and flanges pipe having dia more than 89mm.

2.19 Wherever the end of hanger clamp assembly protrudes out of the insulation at the bottom suitable box structure are to be provided. Pipe hangers and supports should be covered in such a way that the moisture cannot penetrate into the insulation.

2.20 It is very important that sheet metal cladding should be done by a well experienced and competent fabricator. Person doing the job can alter the method of fixing of cladding sheet after consulting the concerned design engineer.

2.21 The longitudinal joint in the outer cladding sheet should always be at the lower half of the circumference for horizontal piping so that no rain water enters the insulation through the joints. (Refer Drg No. PE-4-999-169-01).

2.22 The joints of outer cladding should be staggered axially.

2.23 Inside surface of all Aluminium sheet will have two coats of Bituminous paint applied uniformly.

2.24 Aluminium sheets covering on outdoor horizontal pipes will be provided with 3 mm drain hole at the bottom center line at 6 mtr intervals.

2.25 The cladding sheet shall provides directly over the insulation/finishing cement (1F APPLICABLE). Suitable flashing and weather proofing shall be provided at all nozzles, manholes and other projections to prevent the entrance of water.

2.26 Loose wool can be taken from wool mattresses. Wherever gaps and voids have to be filled.

2.27 Sealing compound to be applied on Aluminum cladding sheet joints.

2.28 Support rings/spacer rings shall be provided if the insulation thickness > 40mm and pipe diameter > 89mm.

2.29 Equipment's name plates shall not be insulated.

2.30 Clips made out of sheet be riveted inside the box for insulation of valves and flanges to hold the insulation in box. (Refer Drg No. PE-4-999-169-06).

2.31 The insulation local to the inspection points of the critical piping shall be removable.

3.00 For Thermal Insulation Material Specification related to the project refer Annexure – 1.

**IMPORTANT POINTS TO BE TAKEN CARE DURING APPLICATION**

I) Binding wires for all layers of insulation will be at distance of 300mm.

ii) In addition Aluminum bands/seals also to be provided at distance of 300 mm for sizes above 500mm.

iii) Aluminum bands/seals to be provided over aluminum sheets at distance of 500mm.

iv) Ceramic mill boards to be used between all 'L' type lugs and the support rings.

v) Inside surface of Aluminum sheets to have 2 coats of bituminous paint applied uniformly.

vi) Gaps to be properly filled with loose wool taken from mattresses.

vii) End of hanger clamp assembly protruding out of insulation at the bottom should be suitably boxed with Aluminum sheets.

viii) Valves to be insulated properly in box structure as given in enclosed drawings.

ix) Multilayer longitudinal and circumferential joints should be staggered.

## ANNEXURE – 1

1.0 **Thermal insulating materials shall be per the details given below:-**

1.1 **Lightly Bonded Mineral (Rock) wool Mattresses** of density 150 Kg / Cub. Mt with S.S. wire netting will be applied for the first layer of insulation where hot face temperature greater than 400 degree centigrade. For subsequent layers matters of density 150 Kg / Cub. Mtr with G.S. wire netting will be applied.

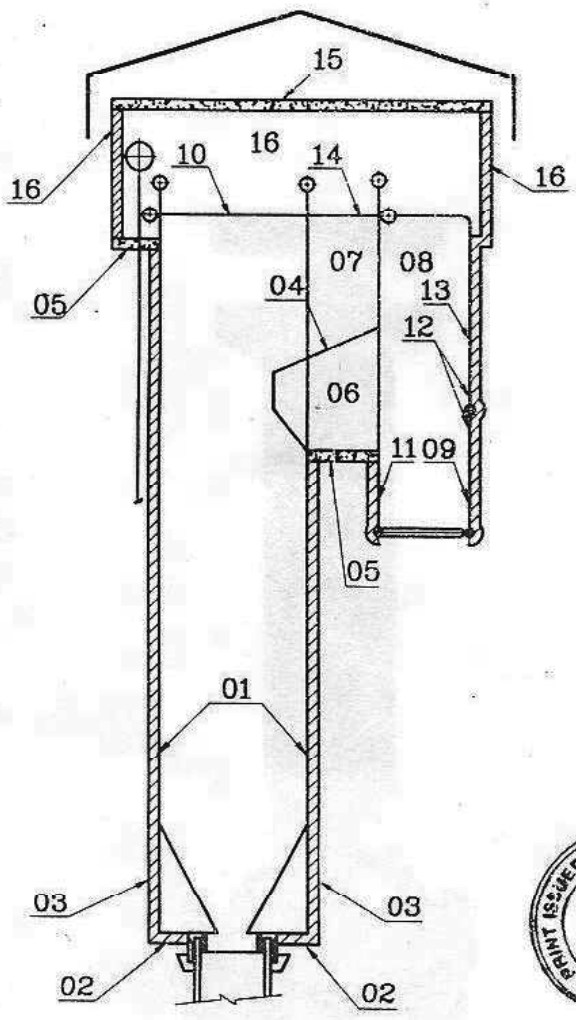
1.2 **Lightly Bonded Mineral (Rock) wool Mattresses** of density 100 Kg/Cub. Mt with G.S. wire netting will be applied for all layers of insulation for host face temperature less than and equal to 400 degree centigrade.

2.0 **Binding and lacing wires:** For insulation matters shall be of stainless steel for all insulation interface temperatures.

3.0 **Aluminum cladding sheet** shall be provided over the Mattresses ad per details given below.

| | |
|---|---|
| 18 SWG (1.22 mm thk.) | For pipes with dia over insulation above 450 MM. |
| 20 SWG (0.91 mm thk.) | For pipes with dia over insulation above 150 MM and less than equal to 450MM. |
| 22 SEG (0.71 mm thk.) | For pipes with dia over insulation less than equal to 150mm. |

# SECTION – B



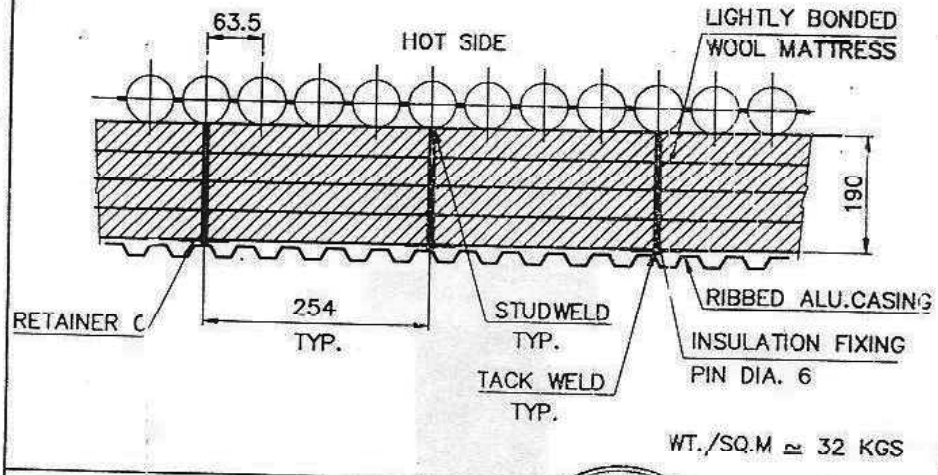

PRINT ISSUED BY ★ COLOUR
CENTRAL ARCHIVES
BHEL TRICHY
★ ORIGINAL SEAL IN GREEN

| | | | | | |
|---|---|---|---|---|---|
| INSULATION | DRN | C.S | | DRG.NO. | REV.NO. |
| | CHD | C.G.S | | 4-00-215-08551 | 00 |
| | APPD | C.G.S | | | |

CTS001384-0

## DETAIL 01

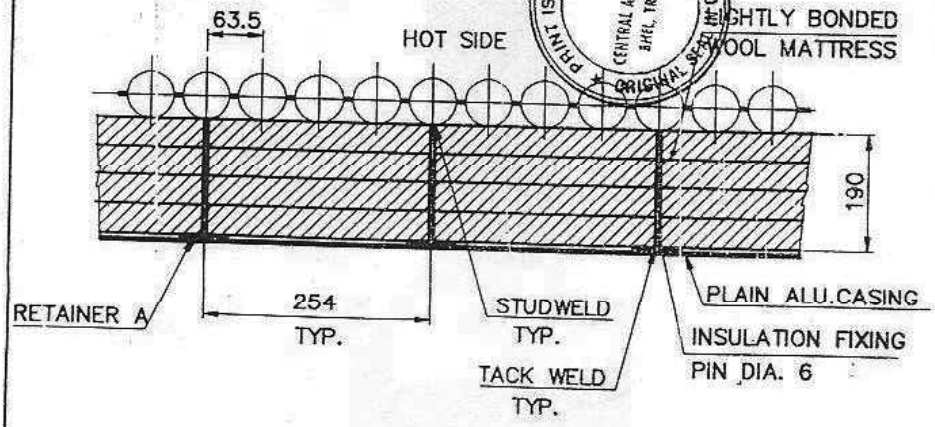
SHEET 02 OF 09




WT./SQ.M ≃ 32 KGS

## DETAIL 02

PRINT ISSUED BY BHEL GREEN
CENTRAL ARCHIVES BHEL, TRICHY.
ORIGINAL SIZE

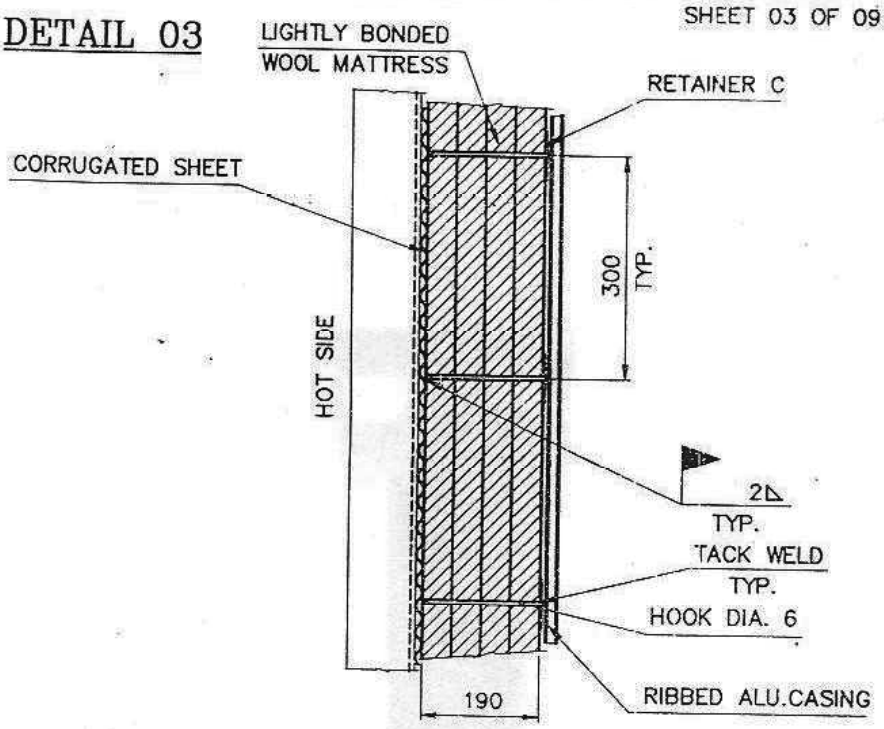



WT./SQ.M. ≃ 29 KGS

| | | | | | |
|---|---|---|---|---|---|
| INSULATION | DRN | C.S | | DRG.NO. | REV.NO. |
| | CHD | C.G.S | | 4-00-215-08552 | 00 |
| | APPD | C.G.S | | | |

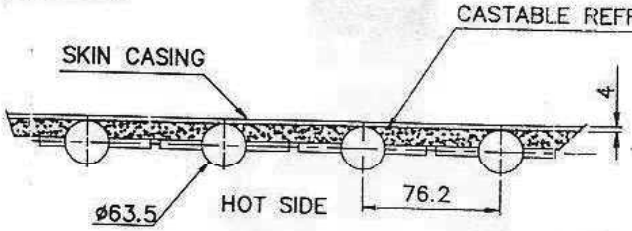
CTS001384-0

## DETAIL 03




WT./SQ.M. ≃ 45 KGS

## DETAIL 04



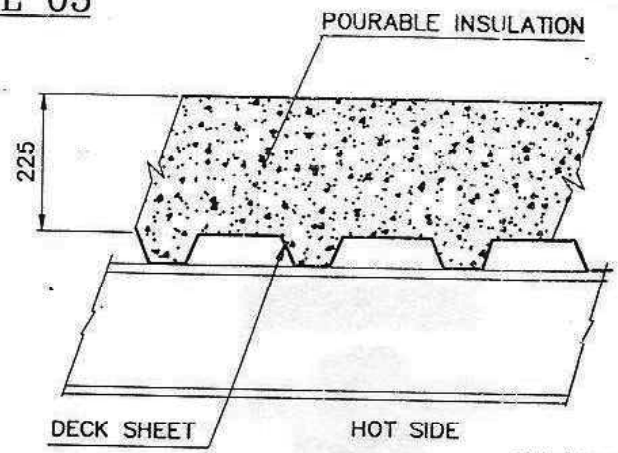

PRINT ISSUED BY BHEL COLONY
CENTRAL ARCHIVES BHEL TRICHY
ORIGINAL SEAL IN GREEN

WT./SQ.M. ≃ 72 KGS

| | | | | | |
|---|---|---|---|---|---|
| INSULATION | DRN | C.S , | | DRG.NO. | REV.NO. |
| | CHD | C.G.S | | 4–00–215–08553 | 00 |
| | APPD | C.G.S | | | |

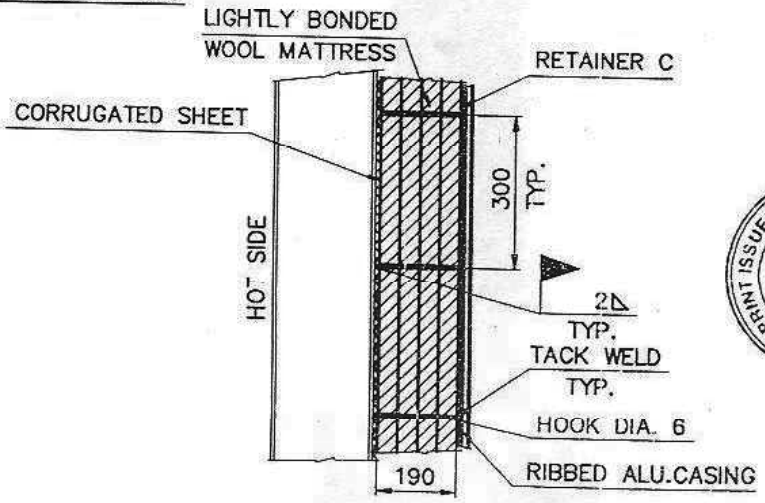
CTS001384-0

## DETAIL 05




WT./SQ.M ≃ 193 KGS

## DETAIL 06




PRINT ISSUED BY ★ COLOUR SCHEME ★ ORIGINAL SEAL ★ CENTRAL ARCHIVES

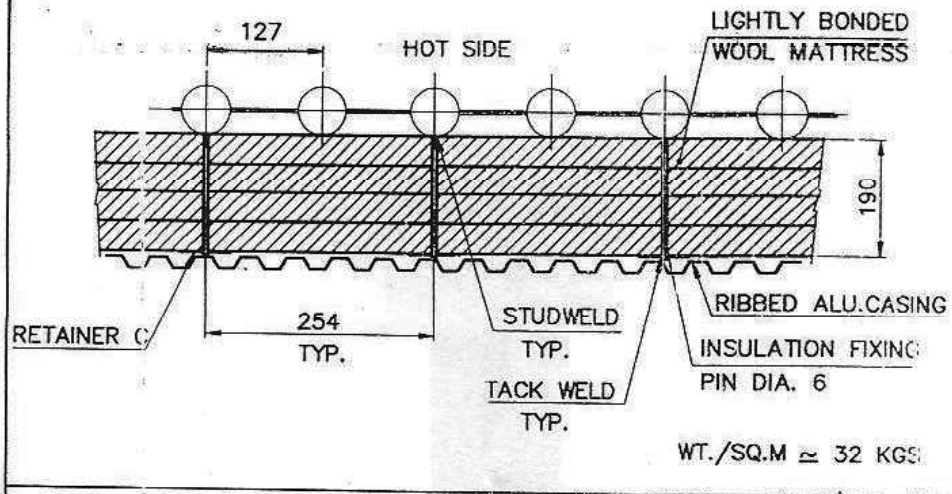
WT./SQ.M ≃ 45 KGS

| | | | | | |
|---|---|---|---|---|---|
| INSULATION | DRN | C.S | | DRG.NO. 4-00-215-08554 | REV.NO. 00 |
| | CHD | C.G.S | | | |
| | APPD | C.G.S | | | |

CTS001384-0

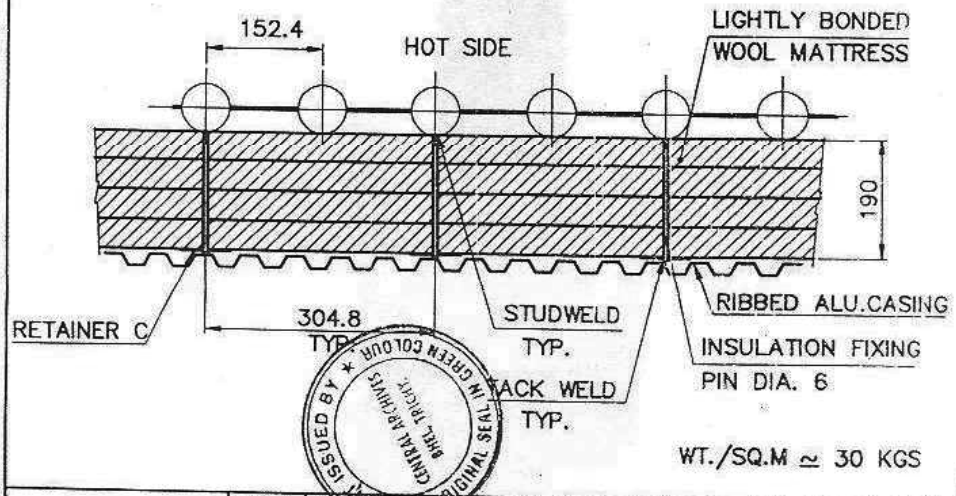
## DETAIL 07

SHEET 05 OF 09




WT./SQ.M ≃ 32 KGS

## DETAIL 08



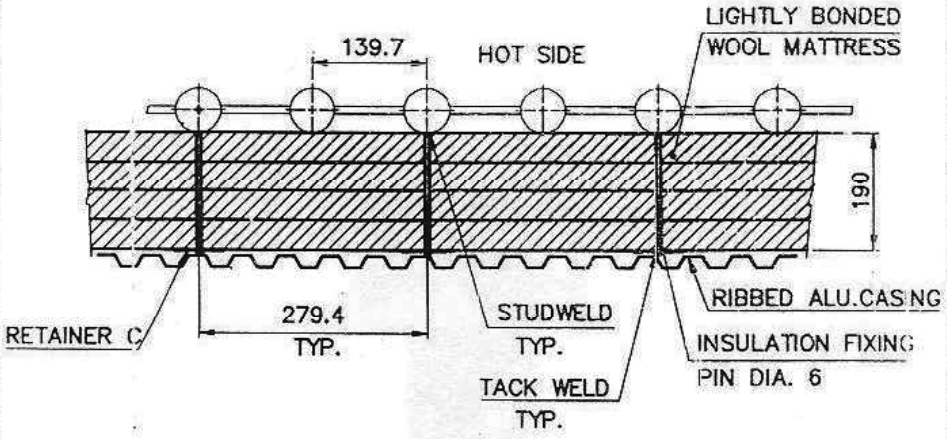

WT./SQ.M ≃ 30 KGS

ISSUED BY * PRINT IN GREEN COLOUR * ORIGINAL SEAL
CENTRAL ARCHIVES
BHEL, TRICHY

| | | | | |
|---|---|---|---|---|
| INSULATION | DRN | C.S | DRG.NO. 4-00-215-08555 | REV.NO. 00 |
| | CHD | C.G.S | | |
| | APPD | C.G.S | | |

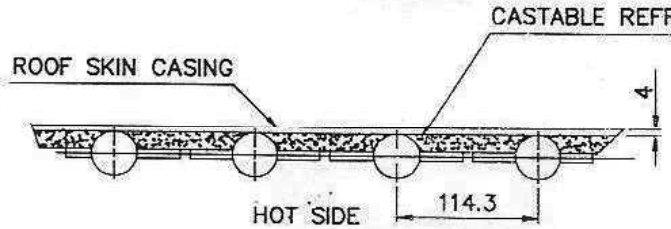
CTS001384-0

## DETAIL 09




WT./SQ.M ≃ 30 KGS

## DETAIL 10



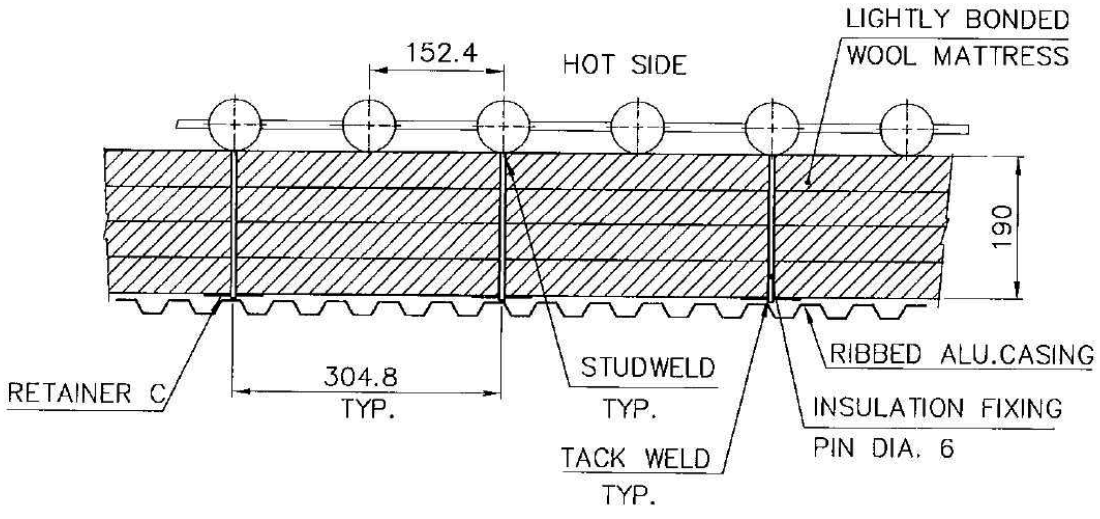

PRINT ISSUED BY ★ ORIGINAL SEAL IN GREEN COLOUR
CENTRAL ARCHIVES
BHEL, TRICHY.

WT./SQ.M. ≃ 75 KGS

| | | | | | |
|---|---|---|---|---|---|
| INSULATION | DRN | C.S | | DRG.NO. 4-00-215-08556 | REV.NO. 00 |
| | CHD | C.G.S | | | |
| | APPD | C.G.S | | | |

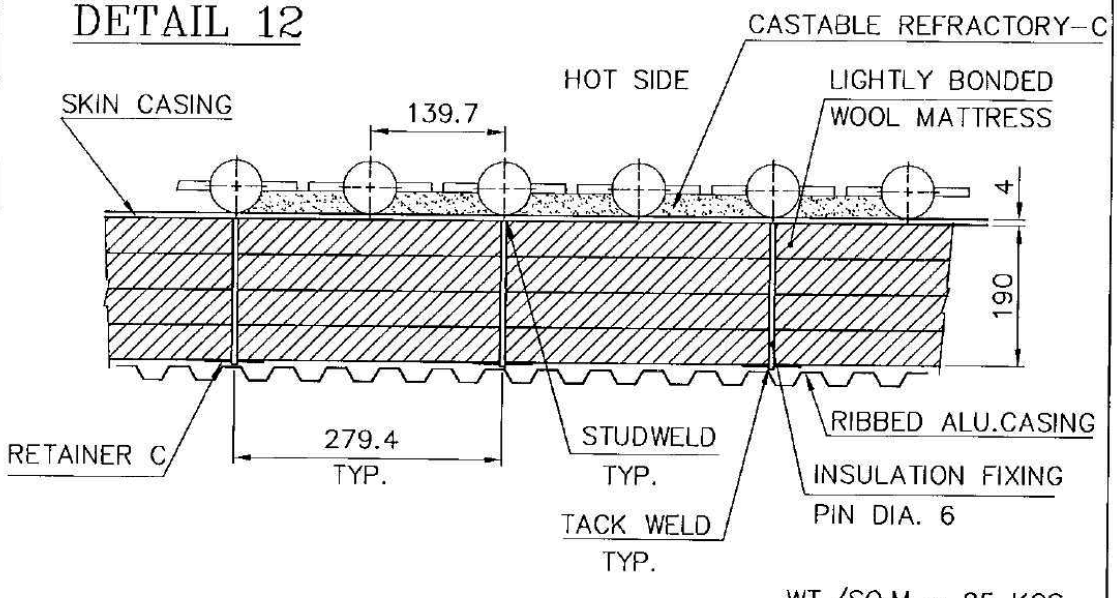
CTS001384-0

# DETAIL 11




WT./SQ.M ≃ 30 KGS

# DETAIL 12

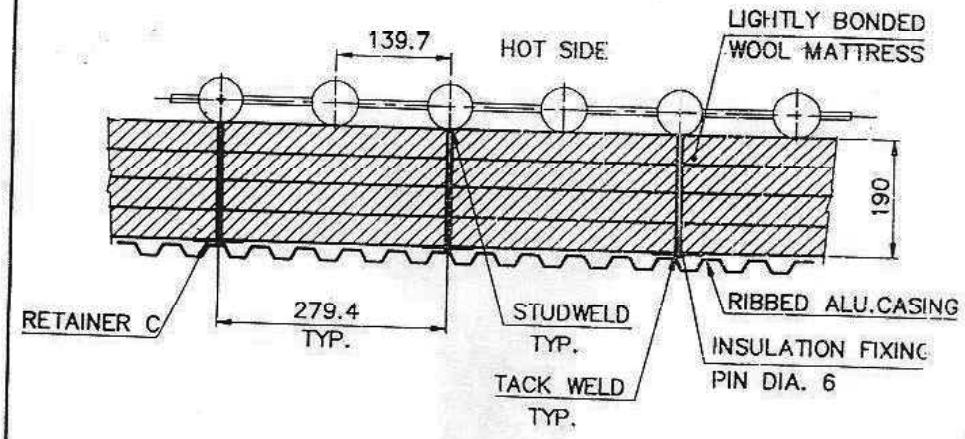



WT./SQ.M ≃ 85 KGS

| | | | | | |
|---|---|---|---|---|---|
| INSULATION | DRN | C.S | | DRG.NO. 4-00-215-08557 | REV.NO. 00 |
| | CHD | C.G.S | | | |
| | APPD | C.G.S | | | |

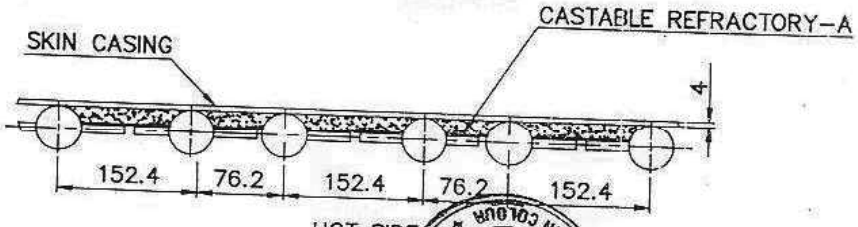
## DETAIL 13

SHEET 08 OF 09




WT./SQ.M ≃ 30 KGS

## DETAIL 14



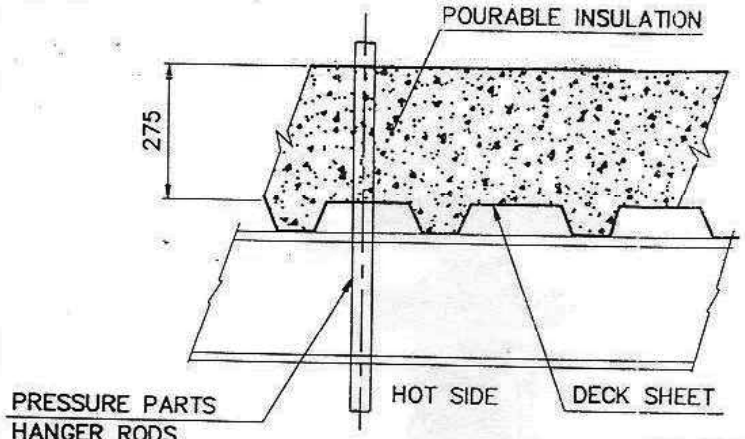

WT./SQ.M. ≃ 75 KGS

PRINT ISSUED BY ★ GREEN COLOUR ★ ORIGINAL SEAL IN GREEN COLOUR

| | | | | | |
|---|---|---|---|---|---|
| INSULATION | DRN | C.S | DRG. | 4-00-215-08558 | REVISED 00 |
| | CHD | C.G.S | | | |
| | APPD | C.G.S | | | |

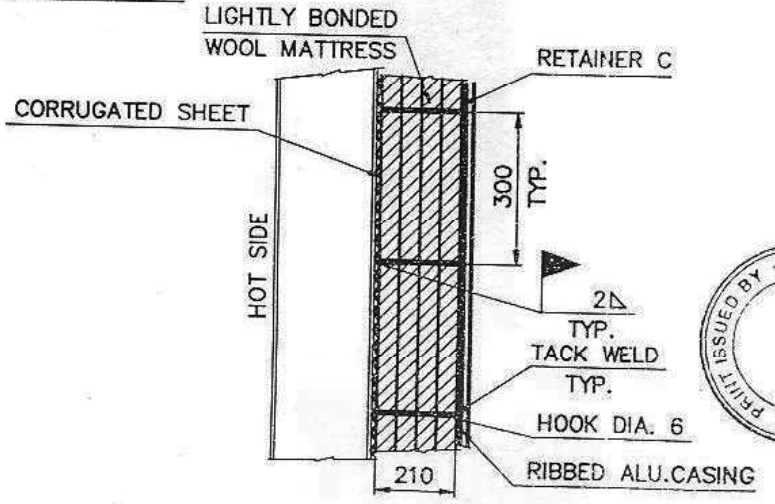
CTS001384-0

## DETAIL 15




WT./SQ.M ≃ 233 KGS

## DETAIL 16




WT./SQ.M ≃ 46 KGS

PRINT ISSUED BY ★ GOLDEN COLOUR ★ ORIGINAL SEAL IN GOLDEN COLOUR

| | | | | | |
|---|---|---|---|---|---|
| INSULATION | DRN | C.S | | DRG.NO. | REV.NO. |
| | CHD | C.G.S | | 4-00-215-08559 | 00 |
| | APPD | C.G.S | | | |

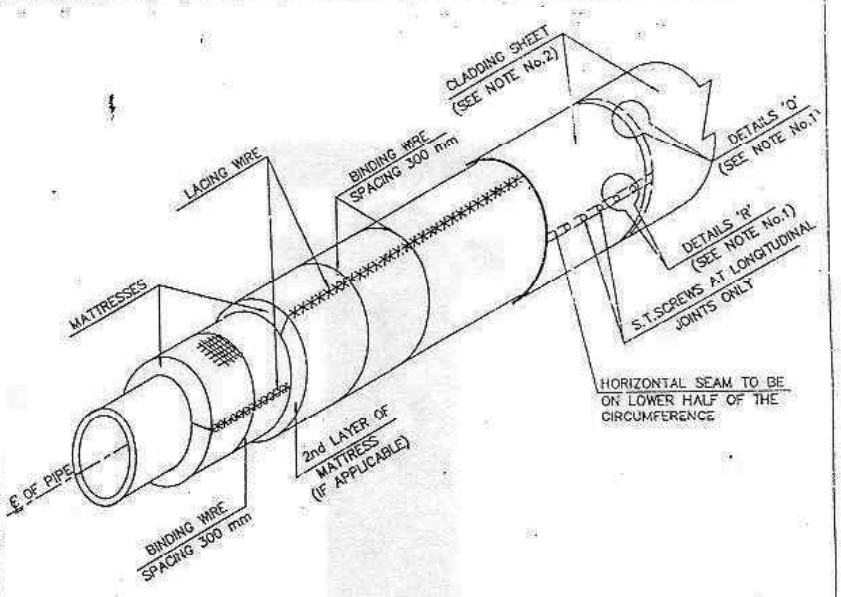
CTS001284-0

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)

| REV. | DATE | ALTERED / CHECKED | REV. | DATE | ALTERED / CHECKED |
|---|---|---|---|---|---|
| | | | | | |

JOB NO. STANDARD

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## NOTES:–

1. FOR DETAILS 'Q' AND 'R' REFER DRG No. PE-4-999-169-12
2. FOR SHEET SUPPORT REFER DRG No. PE-4-999-169-04
3. FOR GENERAL INFORMATION ON APPLICATION OF INSULATION REFER DOCUMENT "INSTRUCTIONS FOR APPLICATION OF THERMAL INSULATION FOR PIPING AND EQUIPMENTS".
4. IN ADDITION TO BINDING WIRE ALUMINIUM BANDS TO BE PROVIDED FOR DIAMETERS > 500 MM.

## MATERIALS REQUIRED:–

1. MATTRESSES
2. BANDS AND SEALS
3. CLADDING SHEET
4. S.T.SCREWS
5. SEALING COMPOUND
6. LACING WIRE
7. BINDING WIRE

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECTS ENGINEERING MANAGEMENT
NEW DELHI

| DEPT. | CODE | SCALE | WEIGHT (KG.) | REF. TO ASSY. DRG | ITEM |
|---|---|---|---|---|---|
| MP | M | N.T.S. | — | — | — |

TITLE:–
INSULATION APPLICATION
(HORIZONTAL PIPES WITH MATTRESSES)

| | NAME | SIGN | DATE |
|---|---|---|---|
| DRN | S.C.S. | | |
| DESN | S.C.S. | | 9.6.97 |
| CHD | D.B.S. | | 9.6.97 |
| APPD | S.K.J. | | 11.6.97 |

| CARD CODE | DRAWING NO. | |
|---|---|---|
| — | PE-4-999-169-01 | |
| | SHEET 1 OF 1 | REV. 00 |

DL

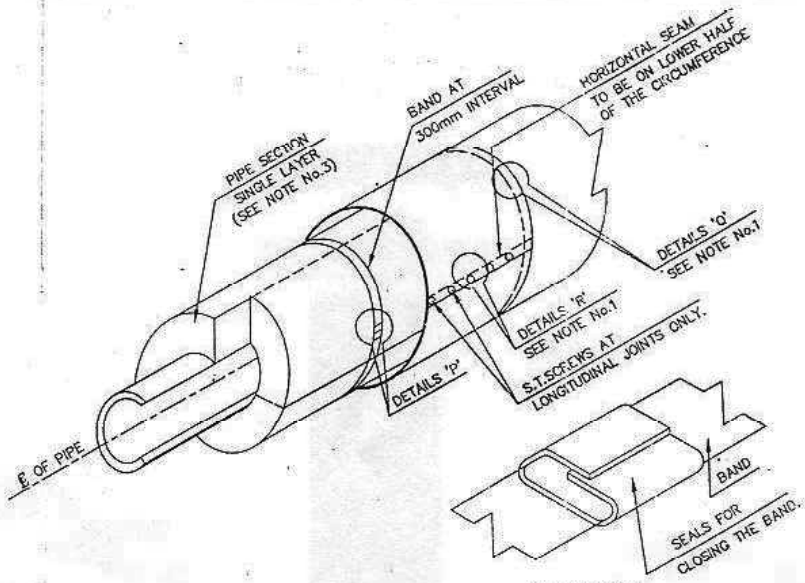
A4

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)

| REV. | DATE | ALTERED / CHECKED | REV. | DATE | ALTERED / CHECKED |
|---|---|---|---|---|---|
| | | | | | |

JOB NO. STANDARD

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DETAILS 'P'

NOTES:–

1. FOR DETAILS 'Q' AND 'R' REFER DRG. No. PE–4–999–169–12
2. FOR CLADDING SHEET SUPPORT REFER DRG. No. PE–4–999–169–04
3. 2nd & 3rd LAYER IF ANY SHALL BE OF MATTRESSES.
4. FOR GENERAL INFORMATION ON APPLICATION OF INSULATION REFER DOCUMENT "INSTRUCTIONS FOR APPLICATION OF THERMAL INSULATION FOR PIPING AND EQUIPMENTS"

MATERIALS REQUIRED:–

1. PIPE SECTIONS
2. BANDS AND SEAL
3. CLADDING SHEET
4. S.T. SCREWS
5. SEALING COMPOUND

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECTS ENGINEERING MANAGEMENT
NEW DELHI

| DEPT. | CODE | SCALE | WEIGHT (KG.) | REF. TO ASSY. DRG | ITEM |
|---|---|---|---|---|---|
| MPL | M | N.T.S. | — | — | — |

TITLE:–
INSULATION APPLICATION
(HORIZONTAL PIPES WITH PIPE SECTION)

| | NAME | SIGN | DATE |
|---|---|---|---|
| DRN | S.C.S. | | |
| DESN | S.C.S. | | 6.6.97 |
| CHD | D.B.S. | | 9.6.97 |
| APPD | S.K.J. | | 11.6.97 |

CARD CODE —

DRAWING NO. PE–4–999–169–02

SHEET 1 OF 1 REV. 00

L1

D2

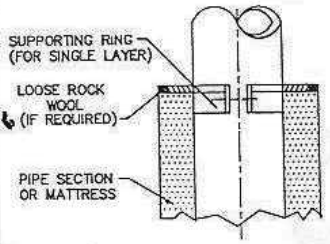
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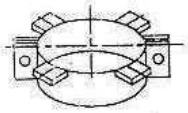
FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)

| REV. | DATE | ALTERED / CHECKED | REV. | DATE | ALTERED / CHECKED |
|---|---|---|---|---|---|
| | | | | | |

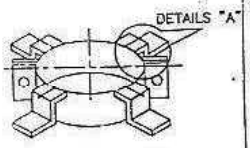
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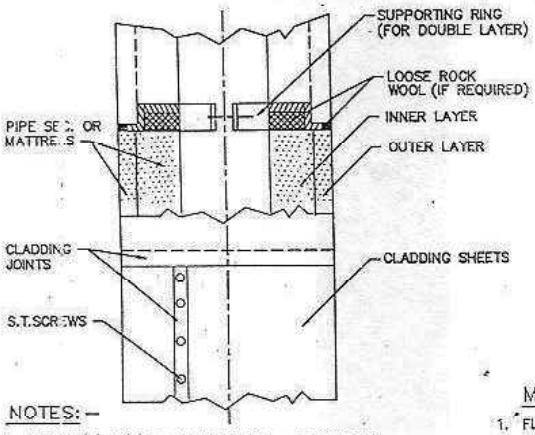


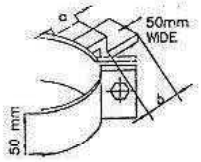



SUPPORT RING
(FOR SINGLE LAYER)




SUPPORT RING
(FOR DOUBLE LAYER)




DETAIL 'A'

NOTES:—

1. LENGTH 'a' & 'b' TO BE 12 TO 50mm LESS THAN SPECIFIED INSULATION THICKNESS.
2. SUPPORT RING TO BE FABRICATED OUT OF MS FLATS/STRAPS.
3. SUPPORT RING REQUIRED FOR PIPE 80 Nb & LARGER IF INSULATION THICKNESS LARGER THAN 30mm.
4. SUPPORT RINGS REQUIRED FOR MATTRESS ONLY.
5. FOR GENERAL INFORMATION ON APPLICATION OF INSULATION REFER DOCUMENT "INSTRUCTIONS FOR APPLICATION OF THERMAL INSULATION FOR PIPING AND EQUIPMENTS"

MATERIALS REQUIRED:—

1. FLATS/STRAPS
2. MATTRESSES/PIPE SECTIONS
3. CLADDING SHEET
4. NUTS AND BOLTS
5. SELF TAPPING SCREWS
6. SEALING COMPOUND
7. SUPPORT RINGS (FOR MATTRESSES ONLY)

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECTS ENGINEERING MANAGEMENT
NEW DELHI

| DEPT. | CODE | SCALE | WEIGHT (KG.) | REF. TO ASSY. DRG | ITEM |
|---|---|---|---|---|---|
| MPL | M | N.T.S. | — | — | — |

TITLE:—
INSULATION APPLICATION
(VERTICAL PIPING)

| | NAME | SIGN | DATE |
|---|---|---|---|
| DRN | S.C.S. | | 9.6.97 |
| DESN | S.C.S. | | 9.6.97 |
| CHD | D.B.S. | | 9.6.97 |
| APPD | S.K.J. | | 9.6.97 |

CARD CODE —

DRAWING NO. PE-4-999-169-03

SHEET 1 OF 1 REV. 00

D3

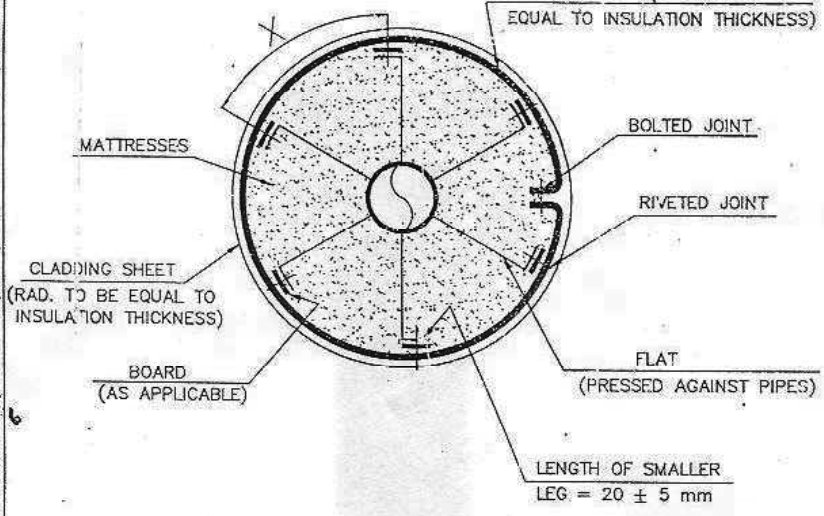
A4

FIRST ANGLE PROJECTION ALL DIMENSIONS ARE IN MM

| REV. | DATE | ALTERED / CHECKED | REV. | DATE | ALTERED / CHECKED |
|---|---|---|---|---|---|
| | | | | | |

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X = 150 mm TO 200 mm SO THAT NUMBER OF WEBS IS EVEN NUMBER

MATERIAL REQUIRED:–

1. FLATS
2. RIVETS
3. BOLTS AND NUTS
4. BOARD

NOTE:–

1. FOR GENERAL INFORMATION ON APPLICATION OF INSULATION REFER DOCUMENT "INSTRUCTIONS FOR APPLICATION OF THERMAL INSULATION FOR PIPING AND EQUIPMENTS".

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECTS ENGINEERING MANAGEMENT
NEW DELHI

| DEPT. | CODE | SCALE | WEIGHT (KG) | REF. TO ASSY. DRG | ITEM |
|---|---|---|---|---|---|
| MPL | M | N.T.S. | — | — | — |

TITLE:– INSULATION APPLICATION (CLADDING SHEET, SUPPORT RING FOR HOR. PIPE O.D>114.3mm & HOR. EQUIPMENTS)

| | NAME | SIGN | DATE |
|---|---|---|---|
| DRN | S.C.S. | | |
| DES'N | S.C.S. | | 9.6.92 |
| CHD | D.B.S. | | 9.6.92 |
| APP'D | S.K.J. | | 11.6.92 |

CARD CODE —

DRAWING NO. PE-4-999-169-04

SHEET 1 OF 1 REV. 00

AL-11

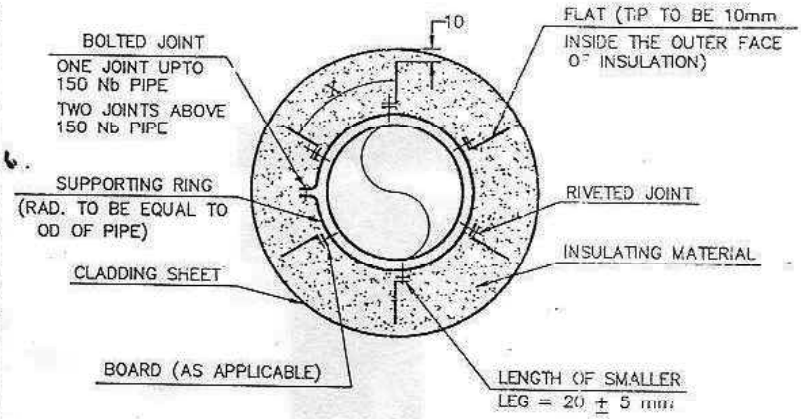
A4

FIRST ANGLE PROJECTION ALL DIMENSIONS ARE IN MM

| REV. | DATE | ALTERED / CHECKED | REV. | DATE | ALTERED / CHECKED |
|---|---|---|---|---|---|
| | | | | | |

JOB NO. STANDARD

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X = 150 mm TO 200 mm SO THAT NUMBER OF WEBS IS EVEN NUMBER

MATERIAL REQUIRED:–

1. FLATS
2. RIVETS
3. BOLTS AND NUTS
4. BOARD

NOTES:–

1. INSULATION DETAILS ON VERTICAL PIPING SHALL BE SAME AS PER FOR HORIZONTAL PIPES.
2. SPACING BETWEEN SUPPORTING RINGS SHALL BE 3 Mtrs.
3. FOR INSULATION OF END OF VERTICAL EQUIPMENTS REFER DRG. No. PE–4–999–169–09.
4. FOR GENERAL INFORMATION ON APPLICATION OF INSULATION REFER DOCUMENT "INSTRUCTIONS FOR APPLICATION OF THERMAL INSULATION FOR PIPING AND EQUIPMENTS.
5. FLATS/RINGS OF REQUIRED LENGTH/DIA SHALL BE MADE BY ERECTING AGENCY AT SITE FROM MS FLATS/STRAPS.

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECTS ENGINEERING MANAGEMENT
NEW DELHI

| DEPT. | CODE | SCALE | WEIGHT (KG) | REF. TO ASSY. DRG | ITEM |
|---|---|---|---|---|---|
| M-L | M | N.T.S. | | — | |

TITLE:– INSULATION APPLICATION (INSULATION SUPPORT RING FOR VERTICAL PIPING & VERTICAL EQUIPMENTS)

| | NAME | SIGN | DATE |
|---|---|---|---|
| DRN | S.C.S. | | 9.6.97 |
| DESN | S.C.S. | | 9.6.97 |
| CHD | D.B.S. | | 9.6.97 |
| APPD | S.K.J. | | 11.6.97 |

CARD CODE

DRAWING NO. PE–4–999–169–05

SHEET 1 OF 1 REV. 00

AL–222

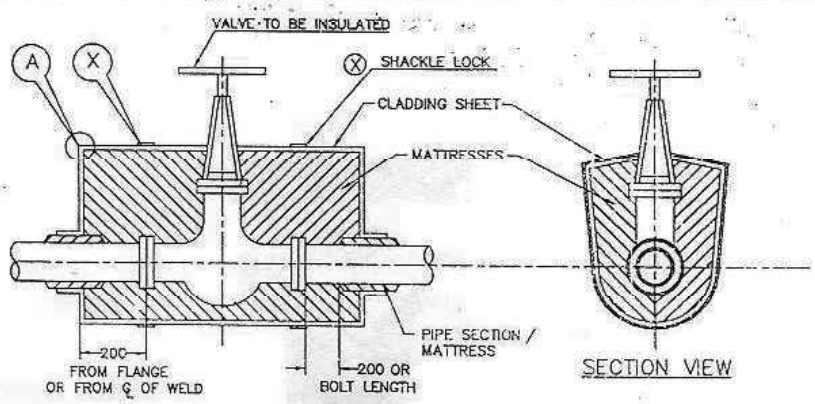
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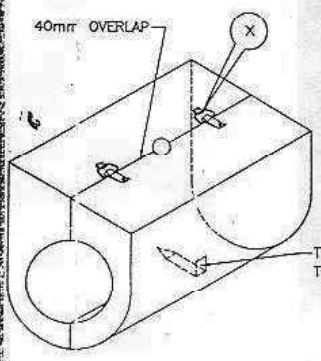
A4

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)

| REV. | DATE | ALTERED / CHECKED | REV. | DATE | ALTERED / CHECKED |
|---|---|---|---|---|---|
| | | | | | |

JOB NO. STANDARD




ASSEMBLED VALVE BOX

MATERIALS REQUIRED:–

1. MATTRESSES
2. CUPS OF SHACKLE LOCKS FABRICATED OUT OF CLADDING SHEET
3. CLADDING SHEET
4. RIVETS
5. SHACKLE LOCKS CONNECTING BUCKLES. (REF. DRG. PE–4–999–169–10)
6. SELF TAPPING SCREWS
7. SEALING COMPOUND.

NOTE:–

1. FOR DETAIL A & X REFER DRG No. PE–4–999–169–10
2. FOR GENERAL INFORMATION ON APPLICATION OF INSULATION REFER DOCUMENT "INSTRUCTIONS FOR APPLICATION OF THERMAL INSULATION FOR PIPING AND EQUIPMENTS".

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BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECTS ENGINEERING MANAGEMENT
NEW DELHI

| DEPT. | CODE | SCALE | WEIGHT (KG.) | REF. TO ASSY. DRG | ITEM |
|---|---|---|---|---|---|
| MPL | M | N.T.S. | — | — | — |

TITLE:–

INSULATION APPLICATION
(VALVES)

| | NAME | SIGN | DATE |
|---|---|---|---|
| DRN | S.C.S. | | 5.6.97 |
| DESN | S.C.S. | | 5.6.97 |
| CHD | D.B.S. | | 5.6.97 |
| APPD | S.K.J. | | 11.6.97 |

CARD CODE —

DRAWING NO. PE–4–999–169–06

SHEET 1 OF 1 REV. 00

D8

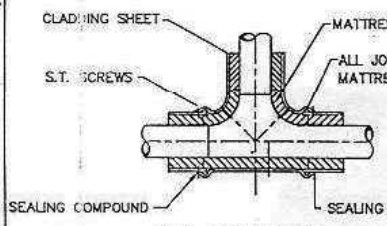
A4

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)

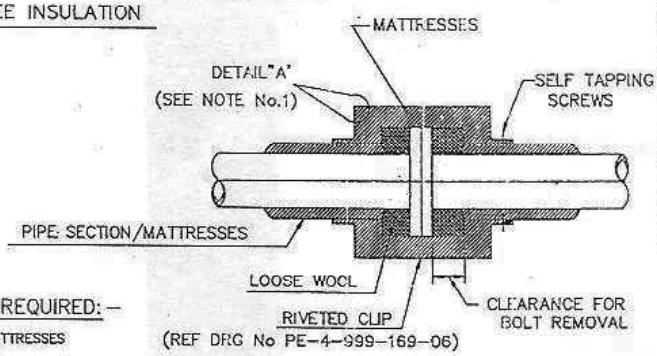
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|---|---|---|---|---|---|
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JOB NO. STANDARD

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TEE INSULATION




(REF DRG No PE-4-999-169-06)

FLANGE JOINT INSULATION

MATERIALS REQUIRED:-

1. PIPE SECTION/MATTRESSES
2. STITCHING WIRE .
3. CLADDING SHEET
4. BINDING WIRE
5. SELF TAPPING SCREWS
6. SEALING COMPOUND

NOTE:-

1. FOR DETAIL "A" REFER DRG No. PE 4 999-169-10
2. FOR GENERAL INFORMATION ON APPLICATION OF INSULATION REFER DOCUMENT "INSTRUCTIONS FOR APPLICATION OF THERMAL INSULATION FOR PIPING AND EQUIPMENTS.

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POWER SECTOR
PROJECTS ENGINEERING MANAGEMENT
NEW DELHI

| DEPT. | CODE | SCALE | WEIGHT (KG.) | REF. TO ASSY. DRG | ITEM |
|---|---|---|---|---|---|
| MPL | M | N.T.S. | | — | — |

TITLE:-
INSULATION APPLICATION
(TEES AND FLANGE JOINTS)

| | NAME | SIGN | DATE |
|---|---|---|---|
| DRN | S.C.S. | | |
| DESN | S.C.S. | | 9.6.97 |
| CHD | D.B.S. | | 9.6.97 |
| APPD | S.K.J. | | 11.6.97 |

CARD CODE —

DRAWING NO. PE-4-999-169-07

SHEET 1 OF 1 REV. 00

L-6

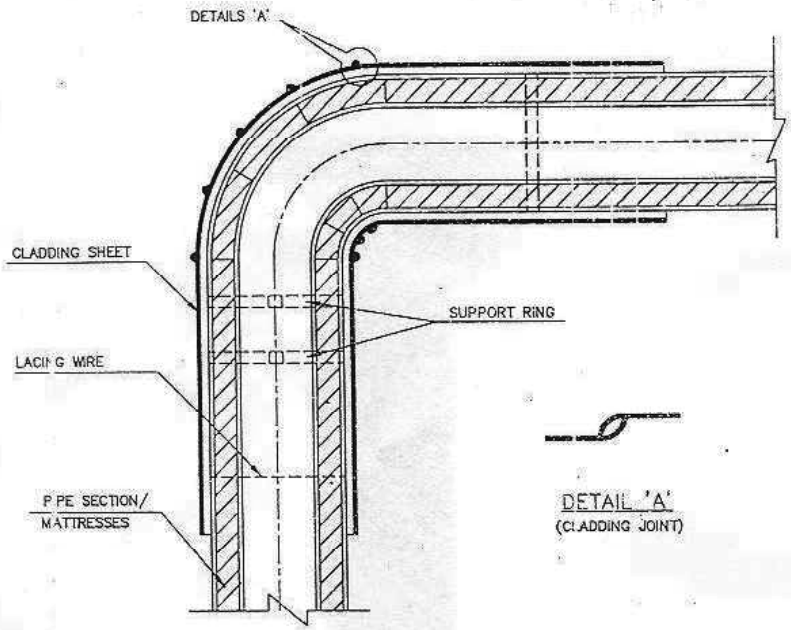
A4

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)

| REV. | DATE | ALTERED / CHECKED | REV. | DATE | ALTERED / CHECKED |
|---|---|---|---|---|---|
| | | | | | |

JOB NO. STANDARD

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## MATERIALS REQUIRED:–

1. MATTRESSES
2. PIPE SECTION (IF APPLICABLE)
3. LACING WIRE
4. CLADDING SHEET
5. BINDING WIRE
6. SELF TAPPING SCREWS
7. SEALING COMPOUND

## NOTES:–

1. TWO SELF TAPPING SCREWS TO BE USED FOR EACH SHEET SEGMENT AT INNER SIDE OF BEND.
2. FOR GENERAL INFORMATION ON APPLICATION OF INSULATION REFER DOCUMENT "INSTRUCTIONS FOR APPLICATION OF THERMAL INSULATION FOR PIPING AND EQUIPMENTS.

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECTS ENGINEERING MANAGEMENT
NEW DELHI

| DEPT. | CODE | SCALE | WEIGHT (KG.) | REF. TO ASSY. DRG | ITEM |
|---|---|---|---|---|---|
| MPL | M | N.T.S. | — | — | — |

TITLE:–
INSULATION APPLICATION
(ELBOWS & BENDS SIZE EXCEEDING 150mm)

| | NAME | SIGN | DATE |
|---|---|---|---|
| DRN | S.C.S. | | 9.6.97 |
| DESN | S.C.S. | | 9.6.97 |
| CHD | D.B.S. | | 9.6.97 |
| APPD | S.K.J. | | 11.6.97 |

CARD CODE —

DRAWING NO. PE-4-999-169-08

SHEET 1 OF 1 REV. 00

L-7

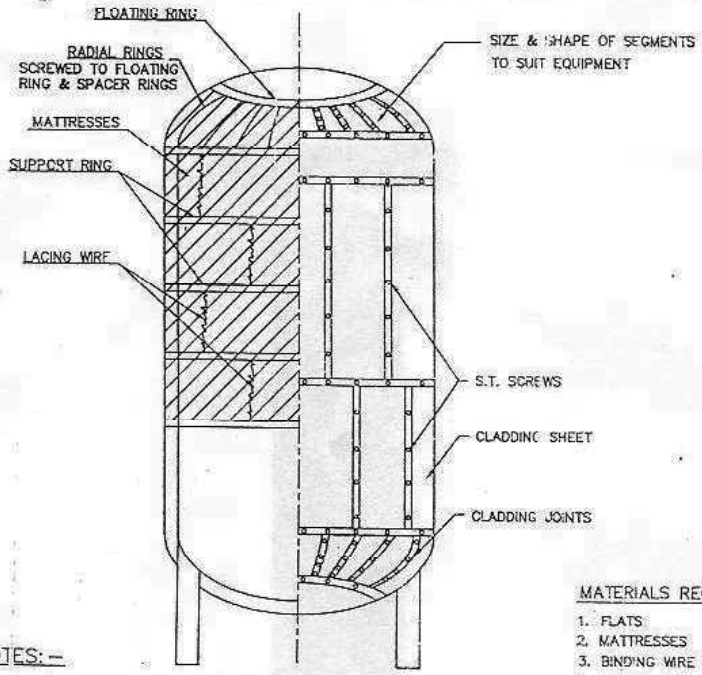
D8

A4

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)

| REV. | DATE | ALTERED / CHECKED | REV. | DATE | ALTERED / CHECKED |
|---|---|---|---|---|---|
| | | | | | |

JOB NO. STANDARD




MATERIALS REQUIRED:-

1. FLATS
2. MATTRESSES
3. BINDING WIRE
4. LACING WIRE
5. CLADDING SHEET
6. GLASS FABRIC/BOARDS (AS APPLICABLE)
7. RIVETS
8. SELF TAPPING SCREWS
9. SEALING COMPOUND
10. STRAPS/BANDS

NOTES:-

1. STRAPS/BANDS CUT FROM SHEET, WITH SEAL SHALL BE USED OVER FINAL LAYER AT 300mm INTERVALS.
2. INSULATION OF HOR. EQPTS. SHALL BE AS FOR HOR. PIPES. REFER DRG No. PE-4-999-169-01 & PE-4-999-169-02
3. FOR CLADDING SHEET SUPPORT REF. DRG. No. PE-4-999-169-04.
4. FOR INSULATION SUPPORT REF. DRG. No. PE-4-999-169-05.
5. INSULATION OF ENDS OF HOR. EQPTS. SHALL BE SIMILAR TO THIS DRG.
6. WELDING TO EQUIPMENT NOT PERMITTED.
7. FOR GEN. INF. ON APPLICATION OF INSULATION REF. DOC. "INSTRUCTIONS FOR APPLICATION OF THERMAL INSULATION FOR PIPING & EQPTS".

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECTS ENGINEERING MANAGEMENT
NEW DELHI

| DEPT. | CODE | SCALE | WEIGHT (KG.) | REF. TO ASSY. DRG | ITEM |
|---|---|---|---|---|---|
| MPL | M | N.T.S. | — | — | — |

TITLE:-
INSULATION APPLICATION
(EQUIPMENT)

| | NAME | SIGN | DATE |
|---|---|---|---|
| DRN | S.C.S. | | 9.6.17 |
| DESN | S.C.S. | | 9.6.17 |
| CHD | D.B.S. | | 9.6.17 |
| AFPD | S.K.J. | | 11.6.17 |

CARD CODE —

DRAWING NO. PE-4-999-169-09

SHEET 1 OF 1 REV. 00

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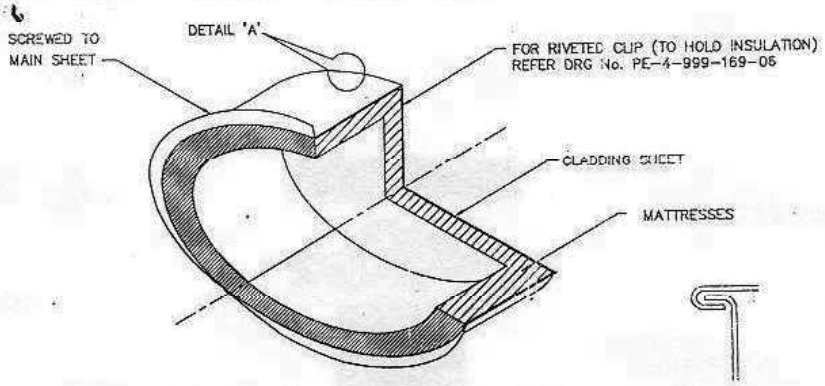
D9

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)

| REV. | DATE | ALTERED / CHECKED | REV. | DATE | ALTERED / CHECKED |
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JOB NO. STANDARD

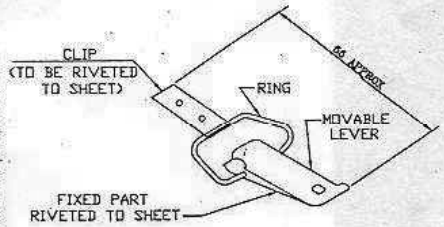
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INSULATING COVER FOR MAN HOLE



DETAILS 'A'
(LOCKING OF SHEETS)




G.I. SHACKLE LOCK CONNECTING BUCKLE

DETAILS 'X'

MATERIAL REQUIRED:-
(FOR SHACKLE LOCK)

1. CLIP (MADE FROM CLADDING SHT.)
2. RIVETS

MATERIAL REQUIRED:-
(MAN HOLE)

1. MATTRESSES
2. CLADDING SHEET
3. SELF TAPPING SCREWS
4. RIVETS
5. CLIPS (TO BE MADE AT SITE)
6. SEALING COMPOUND

NOTES:-

1. FOR GENERAL INFORMATION ON APPLICATION INSULATION REFER DOCUMENT "INSTRUCTIONS FOR APPLICATION OF THERMAL INSULATION FOR PIPING AND EQUIPMENTS".

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECTS ENGINEERING MANAGEMENT
NEW DELHI

| DEPT. | CODE | SCALE | WEIGHT (KG.) | REF. TO ASSY. DRG | ITEM |
|---|---|---|---|---|---|
| MPL | M | N.T.S. | — | — | — |

TITLE:- INSULATION APPLICATION (FABRICATED HEAT INSULATING COVER FOR MAN-HOLE)

| | NAME | SIGN | DATE |
|---|---|---|---|
| DRN | S.C.S. | | 9.5.97 |
| DESN | S.C.S. | | 9.5.97 |
| CHD | D.B.S. | | 9.5.97 |
| APPD | S.K.J. | | 4.6.97 |

| CARD CODE | DRAWING NO. | REV. |
|---|---|---|
| — | PE-4-999-169-10 | 00 |

SHEET 1 OF 1

ZLO

A4

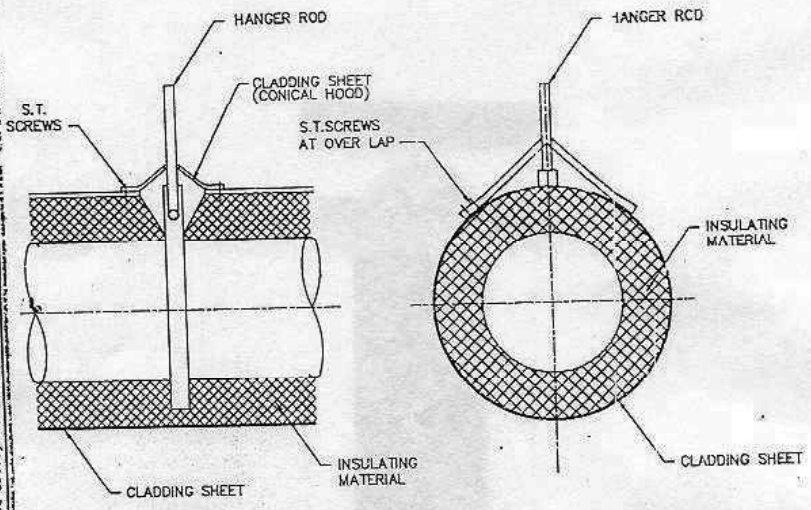
FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)

| REV. | DATE | ALTERED / CHECKED | REV. | DATE | ALTERED / CHECKED |
|---|---|---|---|---|---|
| 01 | 10.5.12 | | | | |

NOTE 2 ADDED.

JOB NO. STANDARD

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## MATERIALS REQUIRED:-

1. MATTRESSES/PIPE SECTIONS
2. CLADDING SHEET
3. SELF TAPPING SCREWS
4. SEALING COMPOUND

## NOTES:-

1. FOR GENERAL INFORMATION ON APPLICATION OF INSULATION REFER DOCUMENT "INSTRUCTIONS FOR APPLICATION OF THERMAL INSULATION FOR PIPING AND EQUIPMENTS".
2. WHEREVER THE END OF CLAMP PROTRUDES OUT OF INSULATION AT THE BOTTOM, SUITABLE BOX STRUCTURE TO BE PROVIDED MADE OF ALUMINIUM.

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POWER SECTOR
PROJECTS ENGINEERING MANAGEMENT
NEW DELHI

| DEPT. | CODE | SCALE | WEIGHT (KG.) | REF. TO ASSY. DRG | ITEM |
|---|---|---|---|---|---|
| MPL | M | N.T.S. | — | — | — |

TITLE:- INSULATION APPLICATION (METAL FLASHING ON HANGER ROD PROTRUSION)

| | NAME | SIGN | DATE |
|---|---|---|---|
| DRN | S.C.S. | | |
| DESN | S.C.S. | | |
| CHD | D.B.S. | | |
| APPD | S.K.J. | | |

| CARD CODE | DRAWING NO. | |
|---|---|---|
| — | PE-4-999-169-11 | |
| | SHEET 1 OF 1 | REV. 00 |

DLL

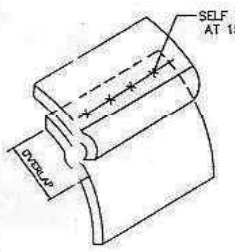
L-10

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)

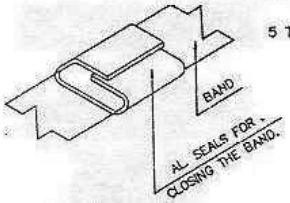
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JOB NO. STANDARD

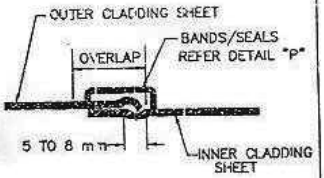
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**DETAIL 'R'
(LONGITUDINAL JOINT)




DETAIL 'P'




*DETAIL 'Q'
(CIRCUMFERENCIAL JOINT)

**

1. JOINTS TO BE MADE AT 45° FROM BOTTOM
2. JOINTS TO BE ON LOWER HALF OF THE CURCUMFERENCE FOR HORIZONTAL PIPES AND EQUIPMENTS.
3. SEALING COMPOUND WILL BE USED ON ALL LONGITUDINAL JOINTS.

*

1. TELESCOPIC SLIDING JOINTS SHALL HAVE 5 TO 8mm SPACING.
2. THE OVERLAPING OF TELESCOPIC JOINTS SHALL BE AS BELOW:-

| CIRCUMFERENCE OF SHEET(mm) | LONGITUDINAL OVERLAP(mm) |
|---|---|
| ≤ 400 | 30 |
| 401 - 500 | 40 |
| > 500 | 50 |

3. TELESCOPIC JOINT SHALL BE PLAIN.

NOTE:-

1. ALL JOINTS NEAR OIL PIPING TO HAVE SEALING COMPOUND.
2. FOR GENERAL INFORMATION ON APPLICATION OF INSULATION REFER DOCUMENT "INSTRUCTIONS FOR APPLICATION OF THERMAL INSULATION FOR PIPING AND EQUIPMENTS".

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POWER SECTOR
PROJECTS ENGINEERING MANAGEMENT
NEW DELHI

| DEPT. | CODE | SCALE | WEIGHT (KG.) | REF. TO ASSY. DRG | ITEM |
|---|---|---|---|---|---|
| MPL | M | N.T.S. | — | — | — |

TITLE:- INSULATION APPLICATION (DETAILS OF "P", "Q" AND "R")

| | NAME | SIGN | DATE |
|---|---|---|---|
| DRN | S.C.S. | | 9.3.97 |
| DESN | S.C.S. | | 9.6.97 |
| CHD | D.B.S. | | 9.6.97 |
| APPD | S.K.J. | | 11.6.97 |

CARD CODE —

DRAWING NO. PE-4-999-169-12

SHEET 1 OF 1 REV. 00

L-11

D12

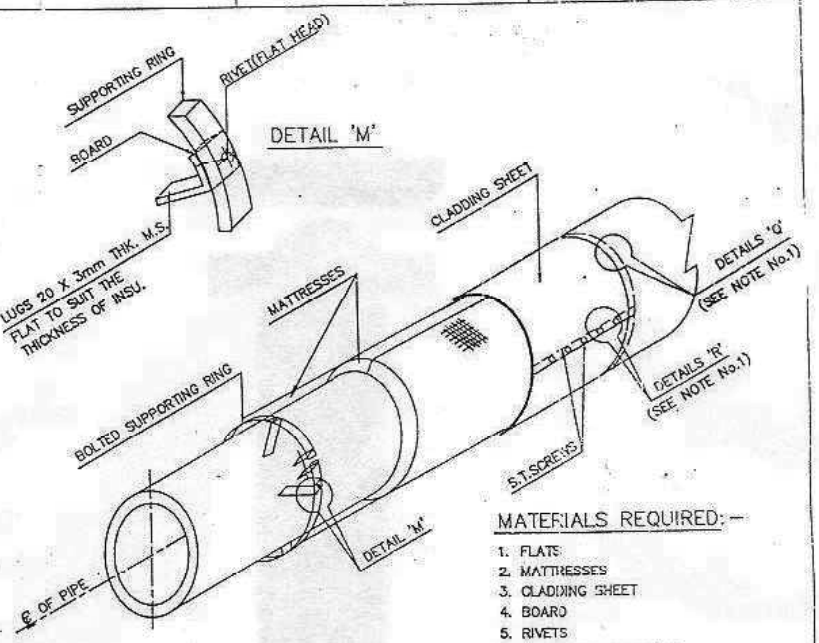
A4

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)

| REV. | DATE | ALTERED / CHECKED | REV. | DATE | ALTERED / CHECKED |
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JOB NO. STANDARD

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## MATERIALS REQUIRED:–

1. FLATS
2. MATTRESSES
3. CLADDING SHEET
4. BOARD
5. RIVETS
6. SELF TAPPING SCREWS
7. SEALING COMPOUND
8. BOLTS & NUTS.

## DETAILS OF LUGS:

| PIPE Nb(mm) | No. OF LUGS |
|---|---|
| 1. 33 – 150 | 4 |
| 2. 200 – 300 | 6 |
| 3. 350 – 450 | 8 |
| 4. 500 – 600 | 10 |

## NOTES:–

1. FOR DETAILS 'Q' AND 'R' REFER DRG No. PE–4–999–169–12
2. FOR GENERAL INFORMATION ON APPLICATION OF INSULATION REFER DOCUMENT "INSTRUCTIONS FOR APPLICATION OF THERMAL INSULATION FOR PIPING & EQUIPMENTS".

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECTS ENGINEERING MANAGEMENT
NEW DELHI

| DEPT. | CODE | SCALE | WEIGHT (KG.) | REF. TO ASSY. DRG | ITEM |
|---|---|---|---|---|---|
| MPL | M | N.T.S. | — | — | — |

TITLE:–
INSULATION APPLICATION
(SUPPORT RING FOR PIPE O.D.>168.3mm)

| | NAME | SIGN | DATE |
|---|---|---|---|
| DRN | S.C.S. | | 7.6.95 |
| DES'N | S.C.S. | | 7.6.95 |
| CHD | D.B.S. | | 9.6.95 |
| APPD | S.K.J. | | |

CARD CODE —

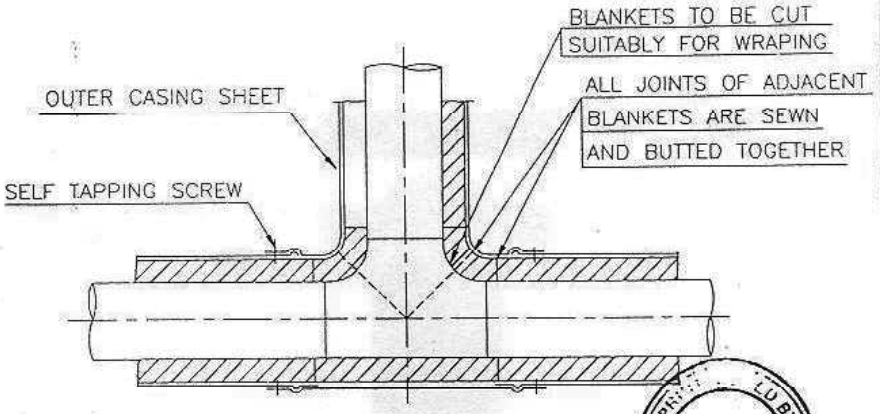
DRAWING NO. PE-4-999-169-13

SHEET 1 OF 1 REV. 00

L-3

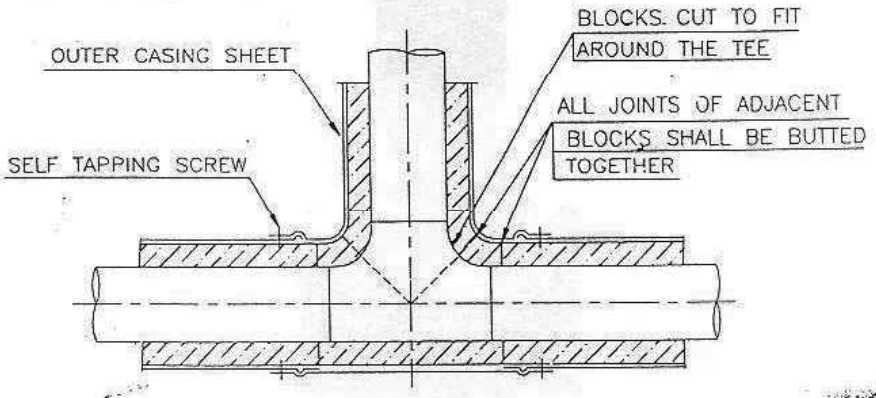
D13

# TEE INSULATION




TEE INSULATION
(WITH WOOL MATTRESS)

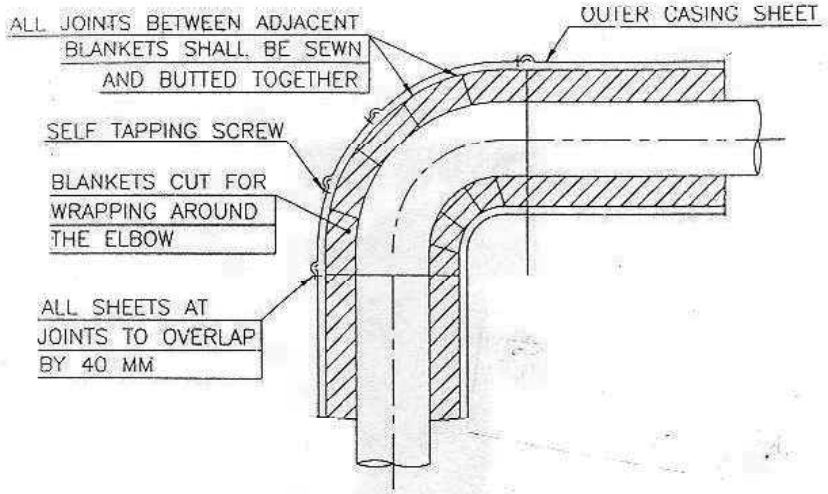
CENTRAL ARCHIVES
BHEL TRICHY
ORIGINAL SEAL IN
GREEN COLOUR



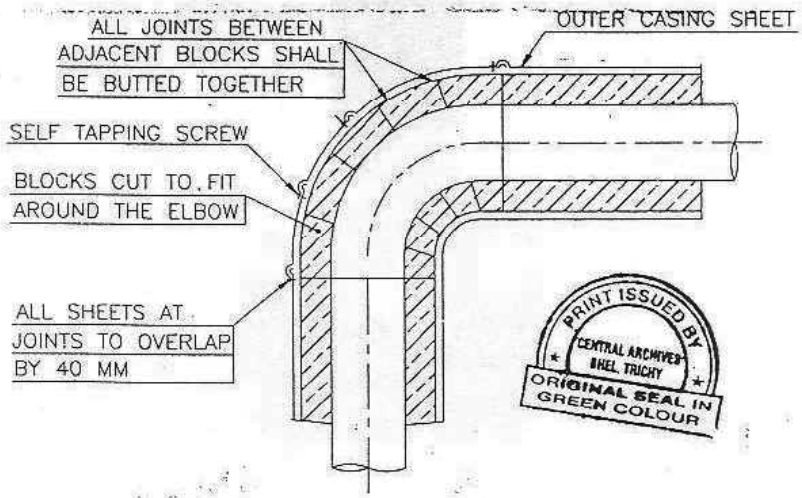

TEE INSULATION
(WITH CALCIUM SILICATE)

| | | | | | | |
|---|---|---|---|---|---|---|
| INSULATION | PREPARED | A.R.JOTHIGURUNATHAN | SIGNATURE | DATE 04.12.03 | DRAWING NO : 4-00-235-08546 | REV. |
| | CHECKED | K.KALIRAJAN | | | | |
| | APPROVED | C.GUNASEKARAN | | | | |

# ELBOW INSULATION




WITH WOOL MATTRESS

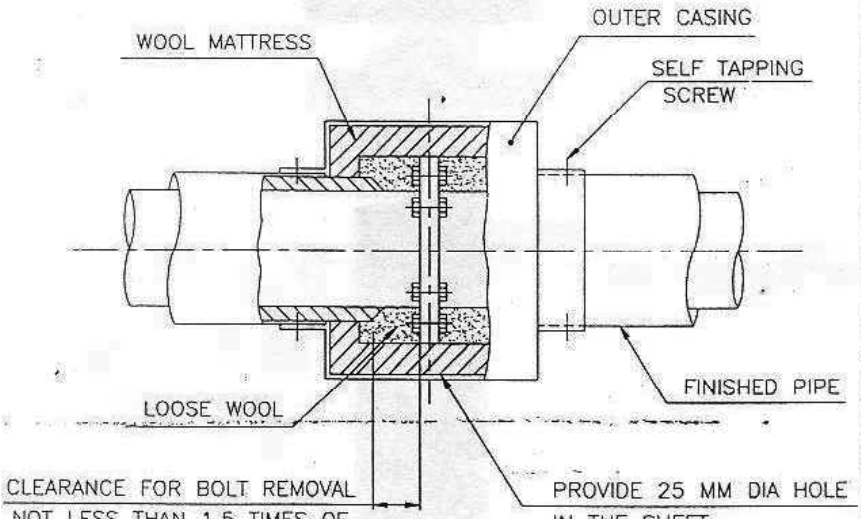



PRINT ISSUED BY CENTRAL ARCHIVES BHEL TRICHY ORIGINAL SEAL IN GREEN COLOUR

WITH CALCIUM SILICATE

| | | | | | | |
|---|---|---|---|---|---|---|
| INSULATION | PREPARED | A.R.JOTHIGURUNATHAN | | DATE 04.12.03 | DRAWING NO : 4-00-235-08547 | REV |
| | CHECKED | K.KALIRAJAN | | | | |
| | APPROVED | C.GUNASEKARAN | | | | |

# FLANGE INSULATION



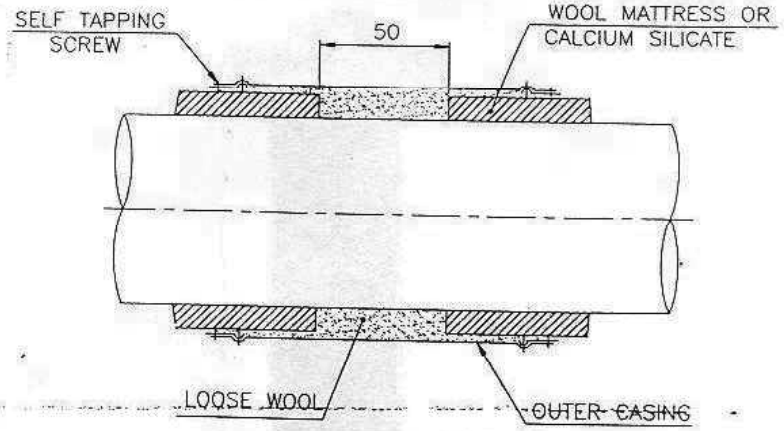

PRINT ISSUED BY
CENTRAL ARCHIVES
BHEL, TRICHY
ORIGINAL SEAL
GREEN COLOUR

NOTE:-

1. WHEREEVER THE FLANGES ARE ENVISAGED FOR DISMANTLING, THIS TYPICAL ARRANGEMENT IS TO BE FOLLOWED.

| | | | | | | |
|---|---|---|---|---|---|---|
| INSULATION | PREPARED | A.R.JOTHI GURUNATHAN | | DATE 04.12.03 | DRAWING NO : 4-00-235-08548 | REV |
| | CHECKED | K.KALIRAJAN | | | | |
| | APPROVED | C.GUNASEKARAN | | | | |

# EXPANSION JOINT FOR PIPES



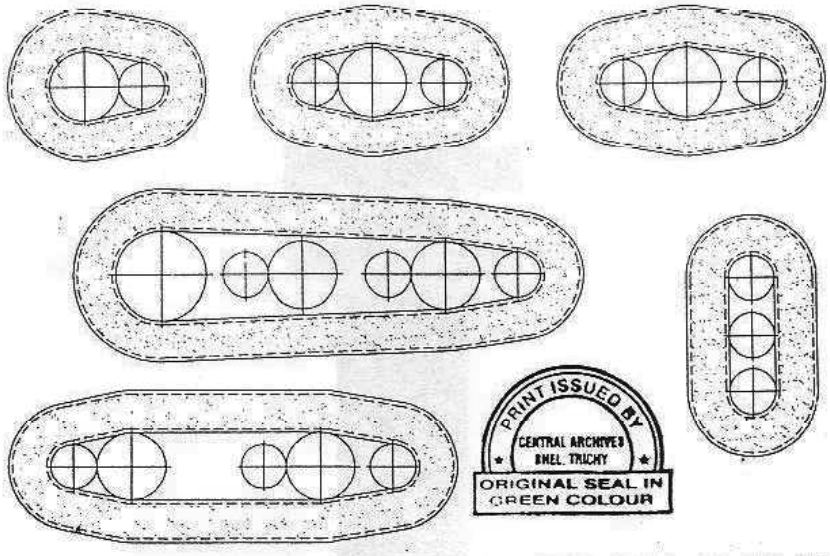

NOTE:-

1. THIS ARRANGEMENT IS APPLICABLE FOR BOTH HORIZONTAL AND VERTICAL PIPE LINES,AT EVERY 5 METRES.
2. WHEN THE OPERATING TEMPERATURE IS BELOW 230°C,EXPANSION JOINTS ARE NOT REQUIRED.
3. FOR PIPES,WHERE THE FLOW IS ONLY INTERMITTANT,EXPANSION JOINTS ARE NOT REQUIRED.

PRINT ISSUED BY CENTRAL ARCHIVES BHEL, TRICHY ORIGINAL SEAL IN GREEN COLOUR

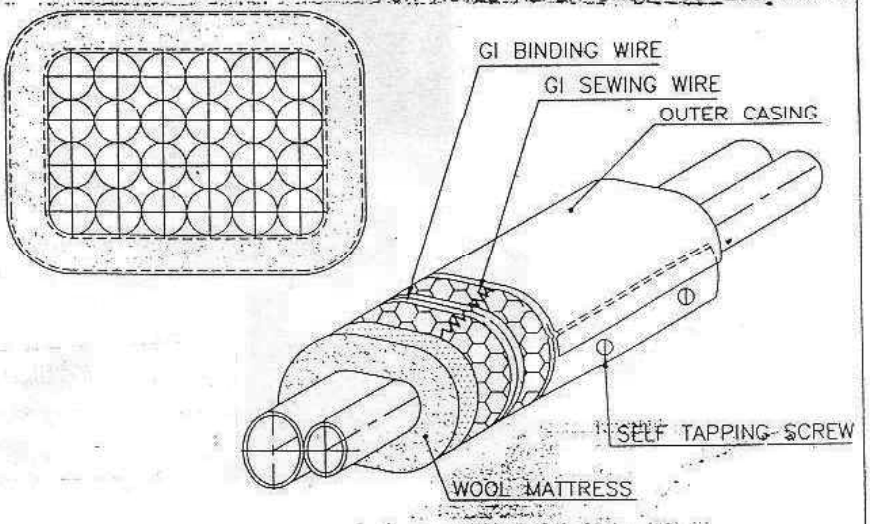
| | | | | | |
|---|---|---|---|---|---|
| INSULATION | PREPARED | A.R.JOTHI GURUNATHAN | SIGNATURE | DATE 04.12.03 | DRAWING NO : 4-00-235-08549 REV |
| | CHECKED | K.KALIRAJAN | | | |
| | APPROVED | C.GUNASEKARAN | | | |

# BUNCH INSULATION



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BHEL TRICHY
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GREEN COLOUR

FOR NOTES REFER DRG 4-00-235-08541

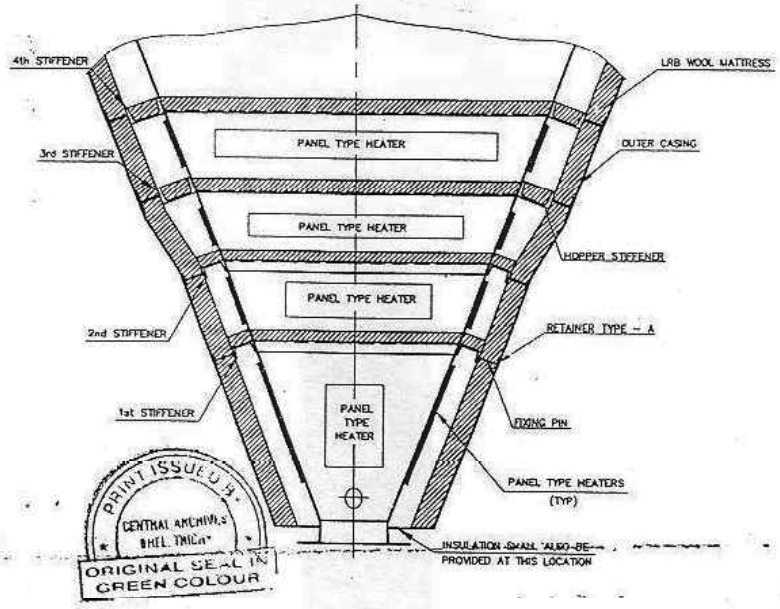



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| INSULATION | PREPARED | A.R.JOTHISURYANATHAN | SIGNATURE | DATE 04.12.03 | DRAWING NO : 4-00-235-08550 |
| | CHECKED | K.KALIRAJAN | | | REV |
| | APPROVED | C.GUNASEKARAN | | | |

| REV | DATE | ALTERED : A.R.J |
|---|---|---|
| 01 | 01.10.05 | CHD & APPD : C.G.S |
| DRAWING ALTERED | | |

FOR TOLERANCES OF UNTOLERANCED DIMENSIONS DURING MANUFACTURE REFER PLANT STD. NO TP 023 0299

CAUTION: THE INFN. ON THIS DOCUMENT IS THE PROPERTY OF BHEL IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF BHEL




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ORIGINAL SEAL IN GREEN COLOUR

NOTE:

01. THE INSULATION SHOWN IS FOR TYPICAL PANEL HEATER HOPPERRS.THIS IS TO BE FOLLOWED WHERE EVER PANEL TYPE HEATERS ARE ENVISAGED.

02. INSULATION FIXING PINS AND RETAINERS SHOULD NOT FOUL WITH THE PANEL HEATERS .

03. FOR OTHER INSULATION DETAILS, REFER DRG. 1-00-235-06654.

Bharat Heavy Electricals Ltd
UNIT: HIGH PRESSURE BOILER PLANT
TIRUCHIRAPALLI - 620014

355-056

| | NAME | SIGNATURE | DATE |
|---|---|---|---|
| DRN | A.R.J | | 20.09.05 |
| CHD | C.G.S | | 22.09.05 |
| APPD | C.G.S | | 22.09.05 |

| DEPT | ALL DIMENSIONS ARE IN MM | PROJECTION | SCALE | WEIGHT (Kg) | REF TO ASSY / OLD DWG |
|---|---|---|---|---|---|
| L&I | | | | | |
| CODE 123 | | | | | |

TITLE

# HOPPER INSULATION DETAIL FOR PANEL TYPE HEATERS

DRAWING NO : 4-00-235-08702 REV 01

# GUIDELINES FOR SELECTION OF NDE AND HEAT TREATMENT AGENCIES AT SITE

(to be deployed by BHEL's E&C Associates)

**Bharat Heavy Electricals Limited**

Power Sector Eastern Region

Kolkata - 700091

**Doc. No. : PP-QLY-AA-DC-106/01-20**

**Rev. No. : 0**

# Title : Guidelines for Selection of NDE and Heat Treatment Agencies at Site
(to be deployed by BHEL's E&C Associates)

| | | |
|---|---|---|
| Prepared By Committee | Smarak Kumar Sahoo / Dy Engr. (Member) | |
| | Sontosh Pal / Addl. Engineer Gr.II (Co-opted) | |
| | Subhradip Joarder / Engineer (Co-opted) | |
| | Saurav Srivastava / Dy. Manager (Member) | |
| | Tathagata Dutta / Dy. Manager (Member) | |
| | Rajesh Das / Dy. Manager (Member) | On behalf of the committee |
| | Arup Ratan Paul / Engineer (Convener) | अरुप रतन पाल / Arup Ratan Paul DN: c=IN, o=BHARAT HEAVY ELECTRICALS LIMITED, ou=BHEL-PSER-HQ, postalCode=700091, st=West Bengal, 2.5.4.20=b6355c0e40c2ad6bdcd8[illegible] a564865593, cn=ARUP RATAN PAUL Date: 2020.09.14 17:24:20 +05'30' |
| | Mridul Taisum / Sr. Manager (Chairman of the committee) | |
| Approved By | Head/ QLY & BE | Digitally signed by SUMANTA CHATTERJEE DN: c=IN, o=BHARAT HEAVY ELECTRICALS LIMITED, ou=BHEL-PSER-HQ, postalCode=700091, st=West Bengal, 2.5.4.20=b8585eb2e62f6511c82073907e19d5[illegible] fa875666724bfa32fed52c3c0d8bcded, cn=SUMANTA CHATTERJEE Date: 2020.09.14 17:25:36 +05'30' |

## ISSUE CONTROL:

| | |
|---|---|
| DOCUMENT NO. | PP-QLY-AA-DC-106/01-20 |
| ORIGINAL DATE OF ISSUE | 14/09/2020 |
| REVISION NO. & DATE | Rev. No. : 0, Date : 14/09/2020 |
| COPY NO. | |
| ISSUED TO | |
| DATE OF ISSUE | |
| PURPOSE : | |
| ISSUED BY (SIGNATURE & DESIGNATION) | |

## STATUS OF REVISIONS

| SL. NO. | REFERENCE OF SHEETS REVISED | REVISION NO. & DATE | REMARKS |
|---|---|---|---|
| 01 | All | 0, Dtd.: 14/09/20 | New guidelines developed.<br>Valuable comments / guidelines from CQ&BE and QA-Trichy incorporated in the document. |

## 1.0 Object

Object of the guidelines is to enable BHEL engineers to make informed decision regarding selection/acceptance of NDE & Heat Treatment agencies; those are deployed by BHEL's E&C associates at site and to evaluate the performance of the agencies.

## 2.0 General Guidelines

A. BHEL's E&C associates have to take prior permission/approval before deployment of NDE & Heat Treatment agencies at site. All relevant documents along with the filled-up format as per Annex-A & Annex-B to be submitted by BHEL's E&C associates.

B. The personnel, proposed by the agency for NDE, should have sufficient experience in testing of welds/castings/forgings/plates and should be capable to interpret the given procedure and carry out the test. Trained, experienced and certified personnel qualified as Level I / II / III (as required) as per SNT-TC-1A of ASNT or BSEN 473 of EN through ASNT / ISNT / CSWIP or its Accredited Agencies should only be deployed.

C. The personnel, proposed by the agency for Heat Treatment job, should have sufficient experience in heat treatment of welds/castings/forgings/plates and should be capable to interpret the given procedure and carry out the test.

D. On receipt of proposal along with all necessary supporting documents from E&C associates at site, concerned BHEL Erection engineer & BHEL FQA engineer shall jointly review the proposal and record the details of the accepted agencies as per Annex-C and share with the Construction manager and Head/ Quality & BE/ BHEL-PSER HQ.

E. The FQA engineer shall also take necessary clearance / acceptance from customer, if required, before acceptance of the proposed agency and maintain a record for that. If customer approval is not required, prior intimation shall be given to the customer through memo.

F. The NDE / Heat Treatment agency shall meet the requirements of this document plus any additional qualification requirements specified in latest revision of the BHEL NDE Manual (AA/CQ/GL/011 Part III-NDEM), as applicable.

G. Based on the feedback from BHEL FQA engineers, a controlled list (with revision number & date) of accepted NDE & Heat Treatment agencies with their BHEL-approved personnel shall be maintained by PSER-HQ Quality department and this list shall be uploaded in PSER intranet portal.

H. Monthly performance of the accepted agency/s shall be monitored by BHEL FQA Engineer and the evaluation report to be sent to Head/ Quality & BE/ BHEL-PSER HQ, in MSQR.

I. The agency may be disqualified/debarred on following grounds:
   i. if a re-inspection of material or a recheck of NDE / Heat Treatment data shows significant variation from the agency's report, as determined by BHEL FQA engineer
   ii. if a significant discrepancy or issue (*viz.* or malpractices like usage of modified/ manipulated Reports/ Charts, other fraudulent activity) is noted during the process audit / routine site inspection..
   iii. if any of the agency's BHEL-approved personnel has changed without taking prior approval from BHEL FQA In-charge.

iv. if the equipment mobilised by the agency no longer meets the requirements for approved usage.

v. if the Agency is not able to ensure re-qualification of his personnel/ equipment on expiry of certification or is not able to replace such personnel/ equipment in time with permission of the FQA.

J. The debarred / disqualified agency may apply for re-acceptance only after three months with a written clarification of its previous misconduct and corrective action taken to avoid occurrence of the same incidence. A standing committee of FQA Engineers shall be constituted by Head/Quality & BE/PSER, which shall scrutinise the documents

K. If, for any of the above reasons, the agency is debarred / disqualified, the same shall be immediately intimated by BHEL FQA engineer to Head/ Quality & BE/ BHEL-PSER Site CM and Main Sub-Contractor with intimation for immediate replacement.. The same shall be updated in controlled list of accepted agencies.

L. This guideline does not specifically provide any recommendation for safety measures to be taken during NDE & Heat Treatment work. Suitable safety analysis & hazard identification is to be done at site as per the project HSE manual & standard OCP.

## 3.0 Specific Guidelines for selection of NDE Agency for PAUT (Phase Array UT)

A. The NDE agency should have executed at least 30% of the proposed work quantity in a single job. In case, multiple agencies are proposed to be deployed, each agency should have executed at least 30% of proposed quantity in a single job. The necessary documents (*viz.* copy of Work Order, End User Performance Certificate, *etc.*) for above to be produced by agency.

B. The Agency to submit their organizational setup, supervision arrangement and list of resources to be deployed at site.

C. For PAUT, the agency shall be capable of mobilising the PAUT equipment & accessories and manpower as follows –

i. **PAUT equipment**: Omni scan MX/MX2/X3 or equivalent Phased Array equipment shall be used coupled with Scanner (16:68 or higher configuration), having

- Weld inspection features including setting up of weld profile.
- Multi grouping capability.
- Capability of using two PAUT probes simultaneously. Necessary adapter/splitter (if required) for attaching two probes for simultaneously working should be available for inspection.
- Operation with battery.
- A-scan, B-scan, C-scan, S-scan, Linear scan, Sectional scan
- Calibration: Velocity, Wedge delay, Sensitivity, TCG, DAC, Encoder calibration features.
- Data analysis and report building
- Encoder recognition.

- Probes: At least two numbers of low profile suitable PAUT probes for ( MS and Alloy Steel) of 7.5 -10 Mhz frequency,16-32 element with more than 2 meters of cable length. The probes shall have couplant supply mechanism (passage of couplant) to test surface & required accessories for the same.
- Suitable probes for SS to be made available for inspection of SS joints.
- For Circumferential weld Inspection of Small-Diameter Pipes Advanced semi-automated scanning equipment/ Cobra scanner

ii. **Wedges:** Specially designed wedges to fit in the above probes and having reference angle of 50 to 60 Degree sheer wave in steel will be required. Wedges should have suitable contour to fit around required range of tubes OD (NORMALLY 25 TO 100mm).

iii. **Scanner:** A manual/automated scanner capable for scanning of required OD (normally 25 mm to 100 mm) tubes. The scanner should have encoder with it for precise data acquisition. The scanner should be able to hold two low profile phased array probes and wedges, as mentioned above for complete inspection of the weld in one rotation of the scanner. The design of scanner, probe & wedges shall allow complete inspection of circumferential weld on tube having gap more than 15 mm with any adjacent tubes, supports and structures etc.

iv. **Manpower**: The NDE agency shall deploy minimum two persons for performing non-destructive testing. They shall be qualified and certified in accordance with NDE written practice for Training, Examination, and Qualification & Certification of NDE Personnel as PAUT Level-II. The personnel who acquires the data, scan the job, does the calibration and analyse Phased Array data shall be trained on same specific technique and certified as PAUT level II. However, data evaluation and analysis shall be performed by a PAUT Level II or UT Level III. The necessary document/certificate for above to be produced by agency.

D. **Test Plan** / **Scan Plan:** The agency shall be capable of submitting the written inspection procedure for PAUT of weld complying with the requirement of latest BHEL NDE Manual (AA/CQ/GL/011 Part III-NDEM ), duly approved by a UT Level-III person. The procedure / test plan shall be qualified at site as per latest BHEL NDE Manual (AA/CQ/GL/011 Part III-NDEM ).

E. **Calibration:** Velocity, wedge delay, sensitivity, TCG, encoder calibration shall be performed by PAUT operator before inspection and as per frequency of code. Verification shall be done by BHEL FQA engineer regarding competency of the personnel deployed by the agencies, prior to start of job.

F. **Reference block:** Tubes with similar dia & wall thk (within 10% as per code) and circumferential notches/groves shall be used as reference block. The reference block should have length not less than 200 mm. It should have two circumferential grooves/notches (one each on ID & OD) having depth of 10% of wall thickness. 1 to 1.5 mm width & length between 25 to 50 mm. These two grooves should be located at opposite ends of the tube. The notches should be separated from adjacent tube edge by about 50 mm. These two grooves should be located at opposite ends of the tube. The notches should be separated from adjacent tube edge by about 50 mm. The length of reference block and

location of reflectors (notches/grooves) should comply the requirement of calibration for angle beams. Agency to take tube samples in advance so that Machine calibration work can be completed before start of work.

G. **Data Storage:** The calibration data and inspection data should be in the equipment and should be available for verification. Inspection data file to be stored by giving identifiable marking for reporting & interpretation. Agency must be capable to hand over data in suitable media (DVD / Flash Drive).

H. **Test Result:** The test result submitted by the agency for each tested tube should provide information on type of defects (like lack of penetration, porosity, lack of fusion etc), their location, length, height, depth etc. The final report with above information to be given in an excel sheet along with PAUT inspection data file & images for all the tested joints. Sample copy of test result of previous job to be submitted by the agency.

## 4.0 Specific Guidelines for selection of NDE Agency for RT (Radiography Test)

A. The NDE agency should have executed at least 30% of the proposed work quantity in a similar single job. In case, multiple agencies are proposed to be deployed, each agency should have executed at least 30% of proposed quantity in a similar single job. The necessary documents (*viz.* copy of Work Order, End User Performance Certificate, *etc.*) for above to be produced by agency.

B. Agency will submit their organizational setup, supervision arrangement and list of radiography sources to be deployed at site.

C. Agency to submit the documents of BARC / AERB Level- I & II personnel for doing RT & Interpretation of films, respectively. Personnel's skill & capability will be reviewed by FQA before engaging them in job.

D. The agency shall comply with all safety norms as per BARC/AERB & agency must submit source movement authorization for the subject site from BARC/AERB before start of work. The source movement within the site shall also be maintained by the agency in the log book. The agency shall fulfil all the safety precautions as per statutory requirements including Radiological safety at their own cost.

**E. Manpower & Resources:**

i. For a single unit, The agency shall deploy one BARC/AERB certified site in-charge and minimum of two numbers of BARC/AERB qualified Level-I radiographers for deployment of each number of source and one number of Trained, experienced and BARC/AERB qualified RT Level-II film interpreter. Personnel's skill & capability will be reviewed by FQA before engaging them in job.

ii. Agency shall mobilize one full time Radiation Safety Officer (RSO) and one site in-charge at site and maintained as per BARC and BHEL OCP guidelines.

iii. For a single unit, the NDE agency shall have permission from BARC/AERB for mobilizing a minimum of two radioactive sources (as per contractual guidelines) of sufficient strength all the time (minimum of 10 Curie). The source should be replaced immediately after decay to 10 Curie. Agency shall be capable to arrange additional source on emergency.

iv. The Agency has to submit the decay chart and all records regarding movement of the source.
v. The agency should be responsible for security of their source in the plant or during movement of camera at site.
vi. All employees of the agency to use TLD badges & pocket dosimeters while doing radiography testing at site. Also submit annual dose report of radiation workers.
vii. The agency to calculate cordon-off distance & provide 'Radiography warning sign boards & symbols' with cordon-off rope & warning alarm while carrying out the radiography.
viii. Radiography team to be available at site round the clock
ix. Equipment, Film and other consumables used shall be BHEL approved brands.

F. Agency has to demonstrate and establish various parameters for the quality of radiograph (*e.g.* Image density, sensitivity, source size, source to film distance, geometric unsharpness etc.,) to the satisfaction of BHEL.

## 5.0 Specific Guidelines for selection of NDE Agency for UT & MPI

A. The NDE agency should have executed at least 30% of the proposed work quantity in a similar single job. In case, multiple agencies are proposed to be deployed, each agency should have executed at least 30% of proposed quantity in a similar single job. The necessary documents (viz. copy of Work Order, End User Performance Certificate, etc.) for above to be produced by agency.
B. Agency will submit their organizational setup, supervision arrangement and list of resources to be deployed at site.
C. For a single unit, the NDE agency shall deploy a minimum of two number Digital type Pulse Echo A Scan UT equipment (preferably of OLYMPUS, EINSTEIN-II & Krautkramer) along with required calibration block at site.
D. For a single unit, the NDE agency shall deploy a minimum of two numbers of Trained, experienced and certified Level-I UT technicians and one number of Trained, experienced and certified Level-II Interpreter in UT.
E. For a single unit in MPI work, the NDE agency shall deploy a minimum of two sets of magnetic yokes, pie indicators, iron oxide particles, colour contrast, etc. Should have portable AC/HWAC equipment delivering current of minimum of 1000 amps and portable AC/DC electromagnetic yokes. Calibrated Equipment/ Ammeters shall be used for testing. The equipment should be capable of testing with visual and fluorescent magnetic particles.
F. The agency shall deploy a minimum of two numbers of Trained, experienced and certified Level-I technician in MPI and one number of Trained, experienced and certified Level-II Interpreter in MPI.

## 6.0 Specific Guidelines for selection of Heat Treatment Agency

A. The NDE agency should have executed at least 30% of the proposed work quantity in a similar single job. In case, multiple agencies are proposed to be deployed, each agency should have executed at least 30% of proposed quantity in a similar single job. The necessary documents (viz. copy of Work Order, End User Performance Certificate, etc.) for above to be produced by agency.

B. Agency will submit their organizational setup, supervision arrangement and list of resources to be deployed at site. This must coresponf to the requirement mentioned in Sl. No. F

C. The T & P's for Resistance Heating being deployed by Heat Treatment agency at site *viz.* PID Control Heating panels, Thermocouples, heating elements, Recorders shall be of renowned make/ branded having provision for digital display (*e.g.* temperature, Amp/ Voltage *etc.*), calibrated and in good working condition. Also to be noted that insulation being used should be in workable condition.

D. The T & P's for Induction Heating being deployed by Heat Treatment agency at site *viz.* Induction Heating equipment, induction cables, Thermocouples, auto-recorders shall be of renowned make/ branded having provision for digital display (e.g. temperature, Amp/ Voltage etc.),calibrated and in good working condition. The Induction heating equipment should be inverter type (IGBT H Bridge) and output frequency should be 7.5-10 KHz. Also, to be noted that insulation being used should be in workable condition.

E. Guidelines of BHEL Heat Treatment manuals shall also be referred.

F. The agency shall be capable of mobilising required number of machines and against each machine one experienced operator & one technician-cum-electrician must be deployed. One experienced supervision staff must be engaged by the agency exclusively for HT job. Qualification of the supervision staff shall be minimum Diploma in Mechanical/ Metallurgical engineering. The competency of operator & condition of equipment must be verified at site, as elaborated in Sl. No. H.

G. The agency should have capability of mobilising flexible ceramic pads as & when advised by BHEL.

H. One trial Heat Treatment must be conducted by BHEL engineers before acceptance of the HT equipment and the manpower, to assess the competency of the deployed persons and the condition of the machinery. The thickness & material to be selected based on the maximum thickness & material to be heat treated at site. All results to be recorded by BHEL engineer for future reference. The following are to be monitored and assessed -

1) For resistance heating process:
   i. Equipment's condition and calibration documents
   ii. Competency of the operator to follow SR job card instruction/ WPS instruction
   iii. Competency of the operator for selection of Resistance coil gauge
   iv. Wrapping skill of the operator for single tube/pipe
   v. Wrapping skill of the operator for bunching of tubes
   vi. Insulating skill of the operator
   vii. Competency of the operator for Thermocouple fixing skill
   viii. Competency of the operator for Programming of PID controller
   ix. Competency of the operator for selection of ROH/ROC
   x. Performance after completion of PWHT
2) For Induction heating process:
   i. Equipment's condition and calibration documents
   ii. Competency of the operator to follow SR job card instruction/ WPS instruction
   iii. Competency of the operator for Induction coil/ annealing cable rotation

iv. Wrapping skill of the operator for single tube/pipe
v. Insulating skill of the operator
vi. Competency of the operator for Thermocouple fixing skill
vii. Competency of the operator for programming in auto controller of IHE
viii. Competency of the operator for selection of ROH/ROC
ix. Performance after completion of PWHT
x. Competency of the operator to download PWHT graph from auto controller recorder

One mock power failure shall be staged during the trial process to verify readiness of the agency & BHEL's E&C associate for contingency. Acceptability shall depend on the hardness achieved (as measured by UCI machine)

## 7.0 Revision of this Guidelines

A. Revision in this Guideline, as may be felt from time to time, shall be decided by the standing committee of FQA Engineers constituted by Head/Quality & BE/BHEL-PSER.

******

**Annex-A**

**Application for approval of NDE / Heat Treatment Agency at …….**

*(Name of Project)*

Name of the NDE / Heat Treatment Agency : ……

Address : ……

Name of the Proprietor : ……

PAN / TIN of agency : ……

Contact No. : ……

Email address : ……

1. Details of Qualified / Certified NDT Personnel (ASNT / ISNT)
   (*Including BARC certified Radio grapher-RT-1, Site In-charge-RT-2, RSO*)

| Sl. No. | Name | NDT Method | Level | Date of first Certification | Certificate Valid upto | Certifying Authority |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |

2. Details of Heat Treatment Personnel

| Sl. No. | Name | Qualification | Previous Experience |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

3. Details of NDE / HT Equipment proposed to be mobilised

| Sl. No. | Equipment (Make/Model) | Type (RT/ UT/ MPI/ PAUT/ HT) | Quantity | Specification / Rating | Calibration Status | Capacity of the Equipment |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |

4. Details of Previous work done (in past 3 years):

| Sl. No. | Project Name & Customer | Type of Job (RT/ UT/ MPI/ PAUT/ HT) | Number Tube Joints completed | Number of Pipe Joints Completed |
|---|---|---|---|---|
| | | | | |
| | | | | |

…… ……

Signature of the Owner of the Agency & seal Signature of BHEL's E&C Associate & seal

*Note : Applicant shall submit supporting documents along with this application and fill the Annex-B*

SAMPLE FORMAT

**Annex-B**

**Check list for Annex-A**

| Note : Applicant shall fill the following details and no column shall be left blank | | |
|---|---|---|
| ***Sl. No.*** | ***Description*** | |
| A. | Name of the Proposed Agency | |
| B. | Quantum of job being proposed for the agency | |
| C. | Copy of agencies Govt. Registration | Page no. |
| D. | Duly filled in Annex-A | Page no. |
| E. | Certificates for Individuals as mentioned in Sl. No. 1 of Annex-A<br>(Not applicable for HT agency) | Page no. from ….. to ….. |
| F. | AERB approval certificate<br>(for RT agency Only) | Page no. from ….. to ….. |
| G. | Supporting documents for previous work Experience as mentioned in Sl. No. 2 of Annex-A | Page no. from ….. to ….. |
| H. | Supporting documents for previous work Experience as mentioned in Sl. No. 3 of Annex-A | Page no. from ….. to ….. |

SAMPLE FORMAT

……

Signature of BHEL's E&C Associate & seal

**Annex-C**

**Agencies Authorised for conducting NDE / Heat Treatment at ……**

*(Name of Project)*

Date : ……

Proposed By (Name of BHEL E&C Associate) : ……..

| SL. No | Name & Address of Agency | Type of Job (RT/ UT/ MPI/ PAUT/ HT) | Name of the Persons | Method | Level | Certificate Valid upto | Contact Person, Contact number |
|---|---|---|---|---|---|---|---|
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SAMPLE FORMAT

Tick (√) applicable

1. Credentials of the above agencies have been reviewed as per Guideline and found acceptable.
2. Trial Heat Treatment has been performed by the HT agency and found to be satisfactory
3. The agencies' personnel have been interviewed and found to possess knowledge of the process & equipment

…… ……

(BHEL Erection Engineer) (BHEL FQA Engineer)

**Distribution:**

1. Construction Manager / BHEL Site
2. Head / Quality & BE, BHEL-PSER