



OIL & GAS DEVELOPMENT COMPANY LTD.

TENDER ENQUIRY NO.: PROC-FC/CB/PROJ/KPD-2015/2017

TENDER DOCUMENTS

FOR

HIRING THE SERVICES OF PC CONTRACTOR FOR
SUPPLY/INSTALLATION AND COMMISSIONING OF
MECHANICAL, ELECTRICAL AND INSTRUMENTATION
EQUIPMENT/WORK SERVICES FOR ACID GAS
INCINERATOR PACKAGE

(VOLUME – II)



Consultant:



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OIL & GAS DEVELOPMENT COMPANY LTD.

TENDER ENQUIRY NO.: PROC-FC/CB/PROJ/KPD-2015/2017

(SECTION – V)

OVERALL SCOPE OF SUPPLY AND SPECIFICATIONS

FOR

HIRING THE SERVICES OF PC CONTRACTOR FOR

SUPPLY/INSTALLATION AND COMMISSIONING OF

MECHANICAL, ELECTRICAL AND INSTRUMENTATION

EQUIPMENT/WORK SERVICES FOR ACID GAS

INCINERATOR PACKAGE



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1.0 **INTRODUCTION**

Oil & Gas Development Company Limited (OGDCL) is operating oil/gas fields in various parts of Islamic Republic of Pakistan. OGDCL has constructed a gas processing facility Gas Processing Plant (GPP) named as KPD-TAY Phase-II to process raw gas. The processed sales gas from the facility is being supplied to gas transmission/distribution Company operating in the area. The LPG will also be extracted from the gas stream. The facilities that are constructed include:

- Wellhead Facilities
- Surface Gas Gathering Network
- Gas Processing Plant (including Amine Sweetening Unit)
- LPG and Condensate Recovery
- Produced Water Handling System
- LPG & Condensate Storage & handling System

The gas processing facility shall treat 250 MMSCFD raw gas with a margin of 10%. The 250 MMSCFD raw gas shall yield 225.2 MMSCFD sales gas 5058 bbls/day condensate and 413 MT/day LPG.

OGDCL has engaged Zishan Engineers (Pvt.) Ltd. (ZEL) as Consultant for the project.

2.0 **GENERAL**

2.1 **Definitions**

- | | | |
|-----------------|---|--|
| Owner / Company | : | Oil & Gas Development Company (OGDCL) |
| Consultant | : | Party which carries out all or part of the design, engineering of the Project. Zishan Engineers (Pvt.) Ltd. (ZEL) is the Consultant. |
| Contractor | : | Contractor" means the person or persons, firm or Proprietor whose proposal has been accepted by the Owner for engineering design, procurement, inspection, supply of material and equipment, installation, construction/ commissioning, performance testing, one year of defect liability period and training of Owner's personnel for equipment supplied under this tender and includes the Contractor's representative(s), successors and permitted assignees. |

Vendor / Supplier : The organization, firm or agency with whom order for the supply of equipment and or material has been placed.

2.2 **Errors or Omissions**

2.2.1 The review and comment by the Company of any Contractor's drawings, procedures or documents shall only indicate acceptance of general requirements and shall not relieve the Contractor of its obligations to comply with the requirements of this specification and other related parts of the Tender Documents.

2.2.2 Any errors or omissions noted by the Contractor in this Specification shall be immediately brought to the attention of the Company / Consultant.

2.3 **Deviations**

All deviations to this specification, other specifications or attachments shall be brought to the knowledge of the Company as a section in the bid. All deviations made during the procurement, design, manufacturing, fabrication, installation, testing, inspection, pre-commissioning, commissioning and start-up shall be with written approval of the Company prior to execution of the work. Such deviations shall be shown in the documentation prepared by the Packager.

2.4 **Conflicting Requirements**

In the event of any conflict, inconsistency or ambiguity between the Contractor's scope of work, this Specification, National Codes & Standards, referenced in the Project Specification or any other documents, the Packager shall refer to the Company whose decision shall prevail.

2.5 **Reporting Procedure**

2.5.1 A reporting and documentation system shall be agreed between the Contactor and the Company / Consultant for the status of procurement, design, manufacturing, fabrication, installation, testing, inspection, pre-commissioning, commissioning, start-up and shipment of the equipment/material to be supplied / installed under this specification. Contractor shall provide reports and summaries for procurement and construction performance and testing operations in conformance with a schedule approved by Company.

2.5.2 Daily, weekly monthly and run summaries of all major aspects of the production process shall be provided as reports to the Company/Consultant.

2.5.3 Third Party Inspection

In addition to the inspection and witnessing of tests by the inspectors during the manufacturing and shipment of the Equipment/Material, Company may appoint a third party or its own inspector for witnessing of the inspection and tests to be carried out by Contractor under this specification.

2.6 Unit Responsibility

The Contractor shall assume full unit responsibility for it's and free-supplied / installed equipment & material and all ancillaries. The Contractor shall handle and expedite drawings and data, and supervise and coordinate all inspection and testing specified.

Contractor shall guarantee that all material and parts included in the construction shall be new, unused and of the required/specified grade.

2.7 Documentation

- a) Documents, calculation sheets, drawings, etc., to be submitted to the Company shall be in the English Language.
- b) Unless otherwise specified, the US Customary System Units shall be used in documents and drawings, except that pipe sizes, flange sizes and bolts/nuts shall be indicated in inches.
- c) The form of fabrication drawings and documents may be as per the Contractor's Standards. However, the format of the data sheet will be submitted to Company for approval.
- d) Fabrication drawings and documents shall be submitted for the approval of the Company. But, such approval of the Company shall in no way relieve the Contractor of his obligations with respect to such drawings and documents.

- e) Variations from or additions to this specification shall be called to the attention of the Company and approved in writing by the Company prior to starting fabrication.
- f) Welding procedure specification and welding qualification record shall be submitted to the Company prior to the start of fabrication.
- g) Information for installation, operating, maintenance or inspection purposes shall be submitted to Company.

3.0 **SCOPE OF WORK**

This document defines the Scope of Work for the Contractor which includes all activities necessary for supply, procurement, construction, installation / erection, testing and completion of all the Mechanical, Electrical & Instrumentation Works for Acid Gas incinerator Package.

This section, in particular, and the whole document, in general, shall be read in conjunction with all BOQs, specifications, data sheets, drawing, etc. attached with the tender document. All requirements mentioned therein, shall be deemed to be included in Contractor's scope of work, whether or not same is explicitly covered in this scope of work document.

3.1 **General**

Contractor shall provide all services required for the implementation of the project in conformity with the requirements indicated herein. In addition to the technical requirements of the tender (which are defined in subsequent sections of this document and tender documents), Contractor's scope for the supply and services shall also include all activities necessary for verification of design data, procurement / supply of equipment and material, fabrication, construction, installation/erection, testing and completion of all works, pre-commissioning and to provide startup and commissioning of mechanical, electrical, instrumentation, control & allied works, as detailed herein.

3.1.1 The Contractor's Scope of Work shall include, but not be limited to:

- Verification of design data provided by the Company.
- Engineering design for Equipment / Systems supplied as packaged systems
- Supply of Equipment / Materials / Systems

- Shipping, delivery, inland transportation and offloading at port and site.
- Construction, Installation and Erection of all equipment supplied by Contractor and / or OGDCL.
- Testing of Equipment / Packages / Systems supplied by Contractor
- Pre-commissioning, Commissioning of the systems / equipment / packages supplied by Contractor.
- Commissioning Assistance for systems / equipment / packages supplied by OGDCL.
- Site Supervision, Management, Planning and Control of the whole project from contract award to final acceptance by the company.
- Security, Safety and Environment.
- Hand Over of project on successful performance test

3.1.2 Contractor shall use the technical requirements, mentioned in tender document, as minimum and shall remain responsible for verification of design data. Compliance with the requirements of the tender document does not relieve the Contractor of furnishing the required equipment along with its accessories of proper design, meeting all the specified codes & standards

3.1.3 Contractor shall prepare and obtain Company / Consultant's Representative approval of all documentation and materials, consumables, etc. required for the work. The Contractor shall be responsible for procurement, expediting, inspection, testing and transportation of all equipment and material. All material furnished by the Contractor shall be approved before work is commenced. Only brand new materials from the Preferred Vendor List (Doc. No. 165-4-SPG-1097) attached in Volume-II will be preferred by the Company. Any deviation/ exception from Vendor list shall be clearly mentioned by the Contractor in its Technical Bid.

The Procurement Plan to be submitted as part of the technical bid shall clearly demonstrate Contractor's capability to procure equipment and material in limited time. The procurement sources shall also be identified.

- 3.1.4 Contractor shall furnish all materials and equipment, tools, construction materials and consumable supplies required for the project and shall make the complete installation of the system covered in this Scope of Work. The project when turned over to Company shall be in a commissioned condition with successful and tested performance.
- 3.1.5 To achieve the maximum quality work and full satisfaction, it is required that all works must be carried out under supervision of Contractor's engineers of adequate experience.
- 3.1.6 The Contractor shall be responsible for liaison and coordination with Company and Suppliers. Liaising with certifying Local Authorities to obtain the permissions and licenses for executing the work and preparation of all the necessary documentation shall be in the Contractor's Scope of Work.
- 3.1.7 The Contractor shall provide all management, planning, control, QA/QC, services, plant, vehicles, ordinary and special tools, test equipments, transport, labour, supervision and all other necessary arrangements regarding the execution of the specified work and arrangements for the security of its personnel, and equipment and materials. All consumables, equipment, tools and vehicles shall be subjected to Company inspection and approval
- 3.1.8 The Contractor shall transport to Project site all materials, equipment, plant and vehicles, consumables, labour and personnel necessary for the work. The number of journeys shall not be limited, and shall take place, as the Work requires them. Payments of all levies, taxes as applicable during the transportation of material, equipment under scope of the Contractor to the project site shall be the responsibility of the Contractor.
- 3.1.9 Company's supplied equipment and material will be provided to the Contractor at Company's warehouse / storage / lay down area within or near KPD-TAY-Phase-II site. Contractor shall be responsible for their shifting to Project site. The number of journeys (for shifting of equipment and material) shall not be limited, and shall take place, as the work requires them. Furthermore, Contractor shall be responsible to follow OGDCL's standard procedures for issuance of material from OGDCL warehouse.

- 3.1.10 The Contractor shall provide a temporary camp for his own personnel. The Contractor shall also establish a warehouse where he will store/place all equipment and material. The Contractor shall maintain scores record of all equipment and material and handover such records to Company after completion of the Project to facilitate reconciliation of consumed/installed and left over equipment/material.
- 3.1.11 The Contractor shall also establish all necessary workshops/fabrication shops for execution of project construction activities. Demobilization of all equipment, camps, stockyard, workshops, fabrication shops, etc. and cleaning / restoring these areas, shall also be the responsibility of the Contractor.
- 3.1.12 The Contractor shall carryout the necessary temporary works, and construct, install and mechanically complete all the works and submit all documentation as required by this Scope of Work. This also includes furnishing temporary electrical supplies, lighting, water, etc. required for construction purposes.
- 3.1.13 The construction, installation and mechanical completion activities shall take full account of other work being carried out. During construction works the Contractor shall ensure, together with his own personnel and equipment, the safety of the existing equipment and material at site. The Contractor shall abide by the Company's safety policies/procedures (attached with this tender as reference) and shall ensure that his work in any way shall not affect normal operation of existing facilities. The Contractor shall clearly identify the areas of works inside the facility in operation and shall make all arrangements required for safe execution of construction related activities. The Contractor shall also be responsible for obtaining all hot or cold permits or any other permits as deemed necessary by the Company on day-to-day basis.
- 3.1.14 The Contractor shall make all necessary work plans/procedures as required by the Company and shall submit the same for approval prior to execution. Contractor shall submit a detailed execution plan for the project including identification of hold points / key stages of OGDCL/ZEL inspection and approval The Contractor shall ensure completion of all works within the agreed time schedule with due diligence and shall make all necessary arrangements, thereof. A detailed schedule shall also be required prior to commencement of construction activities.

- 3.1.15 All work shall be carried out by Contractor under the supervision of experienced personnel in accordance with Company approved procedures, and the best and latest approved practices in the oil and gas industry.
- 3.1.16 Health, Safety and Environment requirements and provisions shall be in accordance with the requirements of the Contract and shall fully comply with Company's policies/procedures (attached as reference with this tender).
- 3.1.17 Contractor shall also comply with the QA/QC, Safety, Planning and Scheduling requirements of the Contract throughout the execution of the Project.
- 3.1.18 Contractor shall be responsible for liaison and coordination with OGDCL and other Contractors through Company/ Consultant Representative working in the KPD-TAY Phase-II Plant.
- 3.1.19 For ease of coordination identification of each contractor, contractor shall use different uniform/ helmet colors with approval of OGDCL
- 3.1.20 Contractor shall also be responsible for coordination and expediting with the sub- contractors to ensure that all equipment and materials under its scope arrive on site as per schedule. All Contractors' supplied equipment/ material shall be 100% traceable and suitably marked for easy identification of manufacturer or supplier, grade, source, size and rating. Contractor shall submit the expediting system for its vendors and subcontractors in his technical bid. Contractor shall also mentioned the software/ procedure used for material tracking at different project stages.
- 3.1.21 Contractor shall co-operate with and assist Company in checking, marking and maintaining full records of materials procured by the Contractor. These records shall include quantities used and remaining.
- At the completion of the work, all excess material, tools, fixtures including consumable shall be returned by the Contractor to a location designated and shall become the property of Company.
- 3.1.22 Contractor shall also furnish the final as-built details/ drawings, etc. of all procured and installed equipment, material etc. to Company/ Consultant.

3.1.23 Contractor shall be responsible for the medical welfare and insurance of his own and Sub-Contractor's employees, servants or agents and their families and shall take care of periodical medical examinations, arrangements for medical attendance, treatment or hospitalization if and when necessary and shall arrange suitable insurance coverage for such contingencies. In cases of emergency, Company may make or provide for (if available), the necessary emergency arrangements, the costs of which shall be reimbursed to Company by Contractor.

The following description in subsequent sections does not represent an exhaustive list of all work items and is meant to indicate major work / items categories. All works for to BOP's mechanical, electrical, instrumentation & related works remain within Contractor's scope as per itemized BOQ attached with the tender. Contractor shall be responsible for:

- a) The complete execution of the Works in accordance with Drawings, Specification and Bill of Quantities.
- b) The performance of any other works and/or obligations, the provision of any other services and/or items which are necessary for the complete execution of the Works, whether expressly indicated or not, shall be considered included in the unit rates of the Contract price given in the Bill of Quantities.

3.2 **Company Supplied Equipment & Material**

Company has procured the following equipment / package, which will be provided by Company as free issue to the Contractor, when desired by Company, for installation / field erection by Contractor. The details of this equipment / package are given below:

- Acid Gas Incinerator System

The Contractor shall inspect / witness Company's supplied equipment/ package prior to taking custody of them. The Contractor shall inform the Company in writing of any deficiencies or shortages after taking their possession. Any delay caused to Contractor's schedule as a result of Contractor's failure to inform the Company in a timely manner of any deficiency/ shortage shall be on Contractor's account.

3.2.1 Acid Gas Incinerator System

Acid Gas Incinerator System will be installed at GPP. The Acid Gas Incinerator System will be a self contained vendor supplied packaged unit, consisting of several skids. The said system contains the following equipment as a minimum:

- Incinerator K.O. Drum (V-101)
- Incinerator Stack (ST-101)
- Horizontal Thermal Incinerator (H-101)
- Burner (B-101)
- Combustion Air Blowers (C-101A/B)
- Secondary Air Blowers (C-102A/B)
- Piping Skid (Skid-1)
- Piping Skid (Skid-2)

Contractor shall be responsible for installation, inspection, testing & commissioning assistance of Acid Gas Incinerator System at KPD-TAY Phase-II Plant. Supply of Acid Gas Incinerator System is not included in Contractor's scope and will be supplied by the Company as free issue. Foundations for all above mentioned equipment skids and associated interconnection piping are also not included Contractor's Scope.

No.	Equipment Name	Qty.	Unit Weight (Kg)	Total Weight (Kg)	Total Weight (Metric Ton)
1.	Incinerator K.O. Drum (V-101)	1	6622	6622	6.62
2.	Incinerator Stack (ST-101)	1	20675	20675	20.68
3.	Horizontal Thermal Incinerator (H101)	1	35948	35948	35.95
4.	Burner (B-101)	1	3295	3295	3.30
5.	Combustion Air Blowers (C-101A/B)	2	2095	4190	4.19
6.	Secondary Air Blowers (C-102A/B)	2	1386	2772	2.77
7.	Inlet Stack for Combustion Air Blowers	1	1213	1213	1.21
8.	SKID 1	1	8200	8200	8.20
9.	SKID 2	1	10100	10100	10.10

The interconnecting piping between skid equipment/columns has been supplied by Incinerator Vendor, considering prefabricated spools with flanged connections.

However, installation of interconnecting piping (pre-fabricated spools) is in Contractor's scope (if required).

3.2.2 Piping Installation / Tie-ins

Contractor shall be responsible for installation, inspection, testing & commissioning of Miscellaneous piping installations and their tie-ins but not limited to the following:

- Acid Gas to Flare Header System (TI-100)
- Acid Gas from Regeneration Reflux Drum V-4406 (TI-101)
- Acid Gas from Regeneration Reflux Drum V-5406 (TI-102)
- Separated Water to Closed Drain (TI-103)
- Instrument Air System (TI-104)
- Fuel Gas System (TI-105)
- Connection to Acid Gas to Flare Line (TI-106)
- Connection to Stack ST-101 (TI-107)

Contractor shall be responsible for all tie-ins, all necessary 'As-Built' of the facility for the required tie-ins shall be performed by the Contractor.

3.3 Contractor supplied Equipment / Materials

The Contractor shall provide the equipment / material in accordance with the Bill of Quantities & Bid Price Schedule included in the Tender Document.

Contractor shall furnish all materials and equipment (including initial charges of any desiccant, lubricants, portable fire extinguishers and chemicals where required), tools, construction equipment and materials and consumable supplies required for the project and shall make the complete installation of the system covered in this Scope of Work. The project when turned over to Company shall be in a commissioned condition with successful and tested performance.

Any mechanical, instrumentation or safety items which need to be shipped loose for installation on site, or any additional items found to be required at site, will be procured from the Vendor lists (165-4-SPG-1097) and comply in all respects with the contract specifications.

Contractor shall submit un-priced technical quotation / bid of the selected vendor, from the vendor list, before the placement of order to Company / Consultant Representative for review and approval.

Contractor shall also submit the final details/ drawings, etc., of all procured equipment, material etc. to Company/ Consultant after 20 days of the award of contract for the finalization of the civil/ mechanical drawings.

Contractor shall provide all construction equipment, consumables, labor and services necessary for carrying out the mechanical, civil, electrical and instrumentation construction, testing and mechanical completion. This will include welding and purging gasses or flanges, spool pieces, piping, hoses, manifolds, consumables, etc. that are required for hydro-testing and mechanically completing the pipe-work.

Contractor shall liaise with Company on the sourcing of all of these materials and services, and provide all necessary documentation and certificates relating to them, as required by Company.

All consumables, equipment, tools and vehicles shall be subjected to Company inspection and approval.

It shall be Contractor's responsibility to see that all equipment is installed / fabricated / constructed in accordance with the Specifications, drawings relevant codes and standards.

To achieve the maximum quality work and full satisfaction, it is required that all works must be carried out under supervision of Contractor's engineers of adequate experience.

3.4 **Mechanical Works**

- The Mechanical features shall incorporate high quality equipment in accordance with the best industry practices and shall embody the Specifications for the equipment included herein.
- Installation of equipment including accessories within the package to be as per the specified codes and specifications.
- Installation and dry out of refractory material as per Vendor/OEM's Refractory Dry out Procedures.
- Assembly of equipment and accessories on the skid(s).

- General Arrangement drawings, Supply of materials, detailed fabrication drawings and field installation of access platforms and caged ladders as necessary with hand railing.
- All skids with lifting lugs, foundation bolts and two earthing studs located diagonally opposite with grating floor.
- The Contractor shall be responsible for all the Piping Engineering installation within its battery limits, including all pipe work. Piping Engineering shall include piping studies, including tie-in of all skid mounted Process Unit, tie-ins where suggested with the piping outside its battery limit, development of line lists, tie-in lists, equipment list, equipment layouts and plot plan, and preparation of specification for facilities and equipment.
- The Contractor shall install insulation, as deemed necessary, for personnel protection thermal insulation and acoustic control, at all required locations. Provision of clips on vessels and columns for installation of insulation to also be provided by the CONTRACTOR.

Scope of work shall include the following as required for the completeness of the job but not limited to the following:

- Co-ordinate with vendor and obtain relevant data/ documents.
- Preparation/ Submission of all engineering drawings and Vendor documents for review of Company/Consultant and obtaining approval for the same including statutory approval (wherever required).
- Fabrication, assembly, inspection, PWHT, testing (including NDT, Hydrotest, Pneumatic test, vacuum test, etc.) of equipment & piping, painting, packing (seaworthy when imported), forwarding, transportation to site etc.
- Supply of spares (for equipment in Contractor's Scope)
- Storage and handling of equipment.
- Obtaining statutory approvals
- Site erection of equipment
- Surface preparation, primer and final painting, insulation.
- Painting of piping material, as required.
- Fitting of internal and external attachments
- Installation of all accessories such as ladders, platforms as required for equipment
- Special surface preparation where required.

- Fitting/ Filling of internals, packings and providing necessary equipment and detailed procedure for filling and storage for mercury guard and mol. sieves.
- Trial runs
- Field testing and guarantee run tests, hydrostatic tests, vibration tests, noise level tests etc.
- Special testing as required
- Chemical cleaning and flushing including passivation
- Pre-commissioning and commissioning assistance.
- Performance Guarantee
- Documentation as per Vendor data requirements
- Any other requirement for safe and smooth operation.

3.5 **Instrumentation Works**

Contractor's scope of work for Instrumentation for Acid Gas Incinerator shall be include but not limited to following major activities.

- 3.5.1 Installation, calibration, testing and commissioning of all field instruments, F&G detectors, Analyzer etc., (as listed in Instrument list) and as per instrument datasheets, including installation of tubings, fittings, valve manifolds, air sets, tubing supports, tubing trays, etc. complete in all respects as per hookup drawings.

This shall also include related civil works (such as but not limited to construction of foundation / pads for mounting of transmitter stanchions.(if required).

Note: Instruments to be mounted in-line with piping (such as Control valves, PSV, orifice, in-line flow meters, solenoid operated on-off valves, etc.), shall be supplied & installed by others (Mechanical / Piping Contractor). However, contractor shall test and commission the system including installation of all tubings / fittings, airset, etc. complete in all respects for these instruments / valves, as shown in the relevant hookup drawings.

- 3.5.2 Installation, calibration, testing and commissioning of all field instruments/ devices related to Fire and Gas (F&G) detection system including but not limited to
- Flame detectors
 - Gas Detectors

The job includes supply, fabrication and installation of stanchion / poles assemblies, mounting stands / brackets, all other mounting and installation accessories complete in all respects as per typical detail drawings (where specified in BOQ).

This shall also include all related civil works (such as but not limited to construction of foundation pads for mounting of poles / stanchions / stands including supply of all civil material (where specified in BOQ)).

- 3.5.3 Laying, dressing, tagging, terminations, testing and commissioning of instrumentation control cables including installation of lugs / glands, cable ties, clamps etc. This shall also include cable armour grounding connection with earth stud, at JB's end, through earth tags / rings associated with cable glands.

Supply, Laying, dressing, tagging, terminations, testing and commissioning of multi-pair instrumentation cables including supply and installation of lugs / glands, cable ties, clamps etc. This shall also include cable armour grounding connection with earth stud, at JB's / PLC end, through earth tags / rings associated with cable glands.

The cables shall be laid on cable tray / ladders, buried in trenches, in conduit and / or in MS channels.

In some areas of the Acid Gas Incinerator (falling under battery limit of other contractors), some sections of the above mentioned cable ways (tray/ ladder / conduit / trench, etc.) shall be provided as pre-installed by others. For rest of the Acid Gas Incinerator / plant area, all cable ways shall be supplied, installed / constructed by contractor as specified in subsequent clauses.

This shall also necessary on-site coordination with other contractors necessary for tie-ins with cable ways provided by others in pant area.

This also includes laying of all cables within CCR room in:

- Cable trays/ladder/conduit to be installed by contractor beneath false flooring of Cabinet / Control room of CCR building.
- Cable trays/ladder/conduit to be installed by Contractor in cable cellar beneath adjacent electrical building of CCR building.

- Above ground cable trays/ladders/conduits, to be installed by Contractor, in CCR building.

All cable routing specified in the construction drawings by Company shall be treated as preliminary by the Contractor, who shall remain responsible to verify and finalize all cable routes as per actual site conditions with Company's approval.

All cables are tentatively listed in the BQI attached with the tender document and shall include but not limited to following major categories:

- Instrument Cabling from field devices / instruments to Field Junction Boxes (or directly to designated marshalling cabinets in CCR or UCP systems); and multipair cabling from JB's to designated marshalling cabinets of PLC/UCP systems in CCR).
- Instrument Cabling from F&G field devices to Field Junction Boxes (or directly to PLC marshalling cabinets); and multi-pair cabling from JB's to PLC marshalling cabinet).
- RS-485 serial interface cabling from owner supplied DCS to 3rd party Controllers / panels / UCP.

- 3.5.4 Installation and commissioning of all field Junction boxes including fabrication and installation of mounting frames / stands (if required) and supply and installation of all other required installation and mounting accessories.

This shall also include all related civil works (such as but not limited to construction of foundation pads for mounting of JB mounting frames / stands including supply of all civil material) if required.

- 3.5.5 Supply and installation of UPVC, PVC and GI conduit (complete with fittings and accessories) to be installed underground or above ground for laying of cabling, complete in all respects including supply and installation of clamps, supports, brackets, nuts, bolts, screws, washers, etc and all other installation and mounting accessories. This includes supply and installation of these conduits as stub-up pipes for taking the cable from underground trenches to above ground connection point.

- 3.5.6 Excavation of cable trenches in natural strata for buried cable installation including backfilling of trench with requisite layers (as shown in typical drawings) laying of cable tiles, warning tapes, compacting, supply and installation of cable markers, etc. complete in all respects.
- 3.5.7 Construction of underground road crossing for cables including laying of MS pipe sleeves across road crossing (encased in concrete) as shown in the typical details drawings complete in all respects including all related civil works with civil materials.
- 3.5.8 Supply and installation of UPVC / MS pipes as sleeves under paved areas of the plant for use as cable ways. This includes all related on-site coordination with Civil / Mechanical contractors.
- 3.5.9 Construction of concrete man holes / hand holes / cable pits in paved areas of the plant complete in all respects as per typical detail drawings including all civil works (with material), pit covers, MS/UPVC pipes, etc. as required.
- 3.5.10 Installation Only of OGDCL supplied Equipment / materials at GPP

Wherever, installation of owner supplied equipment is included in scope of work, following shall be deemed to be an integral part of the scope of work.

- Unloading at work site,
- receipt of material,
- Transporting upto location of installation.
- Placement, assembling, fixing / installation, securing, supporting etc complete in all respects.

3.5.10.1 Other Control Cabinets

Contractor's scope shall include installation of Unit Control Panels/PLC (and auxiliary / marshalling cabinets) supplied by different 3rd Party Suppliers. These panels / cabinets shall be installed indoors (generally in CCR) and shall include, but not limited to:

- 1 Nos. UCP/PLC System cabinets

3.6 **Electrical Works**

Contractor's scope of work for electrical and allied systems as GPP shall include but not limited to following major activities.

- 3.6.1 Supply, Installation Testing & Commissioning of 400V, 50 Hz Switchgear assembly (Acid Gas incinerator Distribution Board) complete in all respects as per single line diagram, data sheet and specification. The job includes supply, installation of testing & commissioning of all associated components.

The job also includes Supply Fabrication, Fixing / Bolting of galvanized steel base frames for panel mounting complete with all other installation material / services required for job completion inside the CCR Building.

Furthermore, scope also includes all earthing connections of the panels / auxiliaries complete with equipotential bonding of the system complete in all respects.

- 3.6.2 Supply, Installation, testing and commissioning of local control stations for motors, as indicated in the BOQ, complete in all respects including mounting stand / frames and all other mounting and installation accessories. This also includes all related civil works involving construction of foundations / pads for completion of installation.

This shall also include control cabling terminations and integration with MCC, earthing of the installed system, equipotential bonding and connection with main earth grid.

- 3.6.3 Supply, Installation, testing and commissioning of complete earthing and lightning protection system complete with supply and installation of all installation, termination and mounting accessories. This shall also include all related civil works with civil material supply. the system shall comprise of, but not limited to:

- Electrical System Earthing
- Earthing of all other electrical and instrumentation installation.
- Earthing of all non-electrical exposed metallic structures, tanks, vessels, bullets, skids, fence, etc.
- All equipotential bonding connections.

- Supply and installation of earth rods, earth plates / bars.
- Supply, Laying and termination of earth cable (underground and above ground) complete with all required underground exothermic connections and above ground crimp connections.

Earth resistance value of the completed earth network shall not exceed 1 ohm. In case, the desired value is not achieved, Contractor shall install additional rods / earth pits with Company approval until the desired value is reached.

All equipment to be provided with double earthing connections.

- 3.6.4 Supply, Laying, dressing, tagging, terminations, testing and commissioning of power, control lighting, earthing cables including supply and installation of lugs / glands, cable ties, clamps etc. This shall also include cable armour grounding connection with earth stud at enclosures, through earth tags / rings associated with cable glands.

The cables shall be laid on cable tray / ladders, buried in trenches, in conduit and / or in MS channels.

All cable routing specified in the construction drawings by Company shall be treated as preliminary by the Contractor, who shall remain responsible to verify and finalize all cable routes as per actual site conditions with Company's approval.

All cables are tentatively listed in the Cable Schedule attached with the tender document.

- 3.6.5 Excavation of cable trenches in natural strata for buried cable installation including backfilling of trench with requisite layers (as shown in typical drawings) laying of cable tiles, warning tapes, compacting, supply and installation of cable markers, etc. complete in all respects. Contractor should existing trench where ever possible and manual excavation will only be allowed. Furthermore proper backfilling of trench along with danger tape and bricks will be contractor responsibility. Other works related to civil over these trench such as grading with compaction will also lie in contractor's scope.

3.7 **Material Certification and Documentation**

Material traceability and equipment conformance certificates will form part of the permanent documentation to be complied and provided by the Contractor, and will form a specific item on the purchase order for delivery by the Contractor.

3.8 **Inspection & Testing**

Contractor shall prepare a detailed inspection and testing plan, which will be subject to approval by Company. Plan shall include:

- An inspection and testing program per specific equipment item.
- Details of certification and documentation requested per equipment item.
- Details of inspection and witnessing agencies being used.

Contractor shall employ only qualified inspectors after approval of Company for the inspection. Details of personnel and CVs shall be provided.

Contractor shall inform Company in advance of all planned material inspection and testing so that Company/ Consultant representative may attend, as required.

Where Company selects to employ a third party inspection authority for specific equipment and materials for statutory insurance or any other Company reasons, such inspection shall in no way relieve Contractor of his own responsibilities. Such third party inspection agency shall function independently and report to OGDCL.

Contractor shall prepare and issue written reports for review by OGDCL on all inspection and tests.

Contractor shall endorse as correct all fabrication and manufacturing data folders containing, but not limited to, mill certificates, equipment test certificates hazardous area certificate and certificate of origin and all other relevant inspection data.

OGDCL reserves the right to accept or reject any equipment, material or test and ask for rectification/ replacement at no extra cost, without giving any reason, what so ever and without any time impact.

3.9 **Transportation**

The Contractor shall transport to Project site all materials, equipment, plant and vehicles, consumables, labour and personnel necessary for the work. The number of journeys shall not be limited, and shall take place, as the Work requires them. Contractor shall be responsible for the transportation of all equipment, packages and materials (procured by itself) from the source of supply to the Project Site. Contractor will be responsible for organizing and coordinating these activities to ensure that all equipment and materials arrive on site, intact and on schedule. Payments of all levies, taxes as applicable during the transportation of such material, equipment to the site are the responsibility of the Contractor.

Unloading of Company supplied equipment from OGDCL will be the responsibility of Contractor. Lifting, Transportation, loading, unloading of all Company supplied equipment and material from Company warehouse to the erection site will be under the scope of Contractor.

3.10 **Liaison and Coordination**

The Contractor shall be responsible for liaison and coordination with Company and Suppliers. Liaising with certifying Local Authorities to obtain the permissions and licenses for executing the work and preparation of all the necessary documentation shall be in the Contractor's Scope of Work.

The Contractor shall be responsible for liaison and coordination with OGDCL and other Contractors through Company/ Consultant Representative working in the KPD-TAY Phase-II Plant.

3.11 **Planning, Execution and Monitoring**

The Contractor shall provide all management, planning, control, QA/QC, services, plant, vehicles, ordinary and special tools, test equipments, transport, labor, supervision and all other necessary arrangements regarding the execution of the specified work and arrangements for the security of its personnel, and equipment and materials. The Contractor shall furnish materials and equipment, construction materials and consumable supplies required for the project and shall make the complete installation of the Project covered in this Scope of Work. All material furnished by Contractor shall be approved before work is commenced. Only new, top quality materials from preferred vendors/manufacturers (list attached) will be acceptable to Company.

All work shall be carried out by Contractor under the supervision of experienced personnel in accordance with Company approved procedures, and the best and latest approved practices of the oil and gas industry.

Throughout the execution of the Project, Contractor shall, at all times, comply with the QA/QC, Safety, Planning and Scheduling requirements of the Contract.

3.12 **Safety**

The construction, installation and mechanical completion activities shall take full account of other work being carried out. During construction works the Contractor shall ensure, together with his own personnel and equipment, the safety of the existing equipment and material at site. The Contractor shall abide by the Company's safety policies/procedures.

At all times, throughout the execution of the project, Health, Safety and Environmental requirements and provisions shall always be in accordance with the requirements of the Contract and shall fully comply with Company's policies/procedures.

Contractor shall be responsible for the medical welfare and insurance of his own and Sub-Contractor's employees, servants or agents and their families and shall take care of periodical medical examinations, arrangements for medical attendance, treatment or hospitalization if and when necessary and shall arrange suitable insurance coverage for such contingencies. In cases of emergency, Company may make or provide for (if available), the necessary emergency arrangements, the costs of which shall be reimbursed to Company by Contractor.

3.13 **Schedule**

The Contractor shall make all necessary work plans/procedures as required by the Company and shall submit the same for approval prior to execution. The Contractor shall ensure completion of all works within the agreed time schedule with due diligence and shall make all necessary arrangements, thereof. A detailed schedule shall also be required prior to commencement of construction activities during shutdown.

All work shall be carried out by Contractor under the supervision of experienced personnel in accordance with Company approved procedures, and the best and latest approved practices in the oil and gas industry.

Health, Safety and Environment requirements and provisions shall be in accordance with the requirements of the Contract and shall fully comply with Company's policies/procedures.

Contractor shall also comply with the QA/QC, Safety, Planning and Scheduling requirements of the Contract throughout the execution of the Project.

4.0 **ENGINEERING**

The Contractor shall be responsible for the provision of all engineering and design services necessary to complete the project in conformity with the requirements indicated within this Scope of Work. The general requirement will include but not be limited to:

Verification of the provided design data. Contractor shall, by site visit (s) and otherwise, familiarize himself with existing facilities, field operation and site details, verify the design data presented to him, clarify any inconsistencies and obtain any additional information he may require to complete his work; and check, correct and supplement any existing drawings required as a basis for his work. Updating of all received data as a result of site visit, information received from Company etc. shall be the responsibility of the Contractor.

- Performance of any additional studies or calculations required to further define equipment or system requirements, or to demonstrate the adequacy of the proposed design.
- Preparation and updating on a regular basis of all drawings, specifications, requisitions and other documents required for the purchase, fabrication, testing and installation of all equipment, materials and facilities defined herein.
- Provision of procurement, expediting and inspection services for all equipment, materials and skids.
- Review of vendor data, drawings and other documentation to ensure compliance with specifications.

The Contractor shall ensure that the Plant facilities to be implemented as part of this project shall be capable of continuous, safe and efficient operation at all anticipated conditions during the active life of the installation.

4.1 **Design Verification**

The Contractor shall undertake design verification of all package related engineering required to furnish the packages covering;

- Site Data verification
- Civil & Structural
- Mechanical
- Electrical
- Instrumentation & Controls

4.2 **Mechanical**

All verification of detail design shall follow the enclosed specifications and industry standards. General Plot Plan is included in the tender. Contractor use this as a guide line to finalize the installation works of Acid Gas Incinerator System.

4.2.1 **Welding**

Welding of Materials such as piping, etc shall be as per the welding specifications (165-4-SPM-034), industry codes and standard stated in tender. The following welds requirements also apply to structural attachment in such equipment and pipe supports.

Welding procedure specifications (WPS) shall be developed by the Contractor in accordance with the specifications referred above. All welding procedures shall be identified by number and referenced on all applicable fabrication drawings. The WPS shall indicate, among other things, the type and grade of electrode and the weld geometry. The electrodes used for welding shall be of an appropriate grade and supplied by a reputable manufacturer.

Procedure qualifications for weld overlay deposits shall include a complete chemical analysis of the overlay and procedure qualification test record.

4.2.2 Equipment Erection

For erection of equipment having empty weight exceeding 10 tons, a rigging plan shall be developed by the contractor. The rigging plan and planned movement of the equipment on the site shall be reviewed and approved by Company. Any comment or recommendations on the rigging plan shall be followed by the contractor.

The scope of work under this contract shall include installation and procurements of all materials including spares, inspection, testing, painting, erection, commissioning, trial run and supply (including accessories) of all the equipments as per Specifications, standards, applicable codes and technical requirements covered in the tender package.

4.2.3 Piping

All material for piping shall be according to Company's specifications. Where a specific Owner's specification is not available the referenced industry standards shall be used as a guideline.

Piping work shall follow the enclosed Piping & Instrumentation Diagrams (P&ID's) and detail design documents including;

- Pipe routing drawings.
- Piping General Arrangement Drawings.
- Piping layouts and sectional details showing isolation valves, vents, drains, branch connections, instrument connections, corrosion coupons, locations of racks, sleepers and individual line supports. Support drawings shall incorporate stress analysis requirements for free, sliding, anchored and guided supports.
- Key plan and area division.
- As-built Drawings.
- Isometric drawings with bills of quantities for each line.
- Preparation of Bill of Materials including material summary on the basis of P&IDs, GADs, Isometrics including fabrication allowance, pre-commissioning and commissioning spares.

- Nozzle orientation for all vessels.
- Area piping material summaries.
- Overall piping material summary.
- Quality plan for piping activities.

All piping of nominal bore 2” and above related to vendor packages or piping where the connection type is not specified in the piping specification, the piping shall have flanged connections.

Drawings shall also be prepared to show the break-up of piping into systems for hydrostatic pressure testing of constructed piping systems. These system test pressures shall be reflected in the design of the piping.

Personnel access steel structure and pipe supports structure design shall also be prepared. The detail design will be subject to approval by Owner whether they are prepared at Contractor’s, subcontractor’s or Supplier’s premises.

4.3 **Electrical, Instrumentation & Controls**

Contractor shall remain responsible for verification of all ‘Issued for Construction (IFC)’ design data. This includes data sheets and similar documents that form the basis of procurement activity.

The activities pertaining to verification of design data shall include, but not limited to:

- Verification of all cable routes as per actual site conditions in coordination with other services / equipment / installations in the subject area. This includes verification of locations for cable pits / hand holes / manholes and underground road crossings.
- Verification of all cable lengths mentioned in the cable schedules, as per verified, finalized and approved cable routes. This includes verification of cable entry / cable gland size and type.
- Company will provide the Contractor Issued Drawings, data sheets and corresponding BOQs. Contractor shall verify the quantities of IFC BOQs and identify any additional quantities of materials if required. This shall also involve seeking approval / confirmation from Company on quantities to be ordered by Contractor.

- Verification of locations of all devices viz-a-viz site conditions and presence of any other installation impeding E&I equipment erection at the location designated in the drawings.

For verification of the provided design data, Contractor shall, by site visit (s) and otherwise, familiarize himself with existing facilities, field operation and site details, verify the design data presented to him, clarify any inconsistencies and obtain any additional information he may require to complete his work; and check, correct and supplement any existing drawings required as a basis for his work. Updating of all received data as a result of site visit, information received from Company etc. shall be the responsibility of the Contractor.

For items involving electrical switchgear panels / Distribution Panels, UPS, etc. all detailed fabrication / wiring / shop drawings shall be engineered and submitted by Contractor for Company's approval.

Contractor shall be responsible to furnish all documentation mentioned in specifications / data sheets / drawings attached with the tender document. Contractor shall consider the same as minimum requirement and shall furnish any other document required by Company to establish compliance of Contractor's supplied equipment / works with the tender requirements.

The cost of all engineering, engineering verification & documentation shall be deemed to be included in the prices quoted in the bid price schedules / BOQs of this tender.

5.0 **PROCUREMENT**

5.1 **General**

The Contractor shall be responsible for procurement of materials / equipment as per items specified as well as all material / equipment required for on-site installation of the supplied system. Contractor shall bear all cost of such equipment and materials.

A list of preferred equipment suppliers is attached to the tender document as 165-4-SPG-1097.

All procured equipment / material shall be new and covered with a manufacturer's warrantee in Company's name and extending through and fully covering the Maintenance or Defects Liability Period specified in the Volume-I, Section-IV of Tender documents. The warrantee period shall be specified to the equipment manufacturers / supplier by the Contractor after taking due cognizance of the approved project schedule, commissioning time for the particular equipment and performance acceptance of the project. At the time of issue of Provisional Acceptance Certificate all equipment / material warrantees shall be delivered to Owner.

For all equipment / material, instruments etc. requiring maintenance and spares, the Contractor shall wherever possible, consistent with quality and economic requirements, purchase from suppliers who are able to both supply spares and/or provide technical support services. The Contractor shall also for such items, endeavor to purchase from single suppliers for particular classes of equipment and instruments.

Where practicable, the Contractor shall purchase items whereby spares can be common across similar items or classes of equipment.

Preference shall otherwise be given, consistent with best price, to purchase from reputable suppliers in recognized industrial locations.

The Contractor's scope of supply shall also include the following: -

- Spare parts for 2 years operation of MCC and VFD along with gaskets and stud bolts for piping. The cost of 2 years spares shall be lump sum. However the list of spares shall be furnished with the bid.
- All safety equipment and warning signs for use during construction and commissioning of the units.
- Any special tools required for construction and maintenance.
- The supply of recommended consumable items and spares for commissioning and test runs with the quantity and cost breakdown of each item e.g.
 - All equipment internals.
 - All oils and lubricants for equipment.
 - All consumables.
 - All construction, pre-commissioning and commissioning spares including gaskets, strainers, filters, bolting, etc.

The Contractor shall be responsible for any repeat start ups until satisfactory completion of the Plant Performance Tests.

The shipping documents to be submitted to Owner will be as follows:

- Shipping invoices
- Packing List
- Bills of Lading (One copy should be handed over to Owner offices and one to Contractor's office at site)
- Certificate of Origin and Manufacturer's Certificate
- Confirmation of Declaration of Insurance
- Any other Subcontractor specific documents required for shipping purposes.

Contractor's scope shall include but shall not be limited to the following: -

- Supply of Insulating material, primer & paints, materials wherever required.
- Supply of materials and equipment required for blast cleaning, chemical cleaning, passivation, surface preparation & polishing & coating of internal surfaces etc.
- Supply of all equipment, tools & tackles including, torque wrench, bolt tensioner etc. as per specifications and all materials required for inspection and testing (i.e. NDT, hydrostatic testing, performance testing etc.), erection & hydrotesting including all site re-hydrotested equipment.
- Supply of all tools and tackles, templates for foundation and cranes for the erection of all equipment.
- Preparation and supply of check lists for all types of equipment to ensure their correct installation, alignment, assembly, leveling, grouting and completion.
- Supply of all other materials whether specifically mentioned or not but required for completion of the job in all respect as per tender.

- Contractor's scope shall include complete supply, transportation of equipment package from vendor's shop to site, Receipt of material at site, Handling at site and arrangement for storage at site shall be as per the requirements indicated in this Tender Document.
- Equipment, which is transported by sea, shall have sea-worthy packing. The Contractor shall strictly follow the recommended preservation procedures during the period of storage for all equipment.

Contractor shall be responsible for any export licence in respect of any application for export of materials from the country of origin. Company may assist Contractor as an end user of material whenever such documentation is required. However, Contractor shall be responsible for such documentation. The above shipping documents are for information purposes only and shall in no way release Contractor of its obligations to ship, deliver and install the materials at site and/or any relevant work site in accordance with the contract. Contractor shall prepare all necessary documentation and take all necessary steps, including submission of documentation to the relevant governmental authority, to ensure timely delivery.

A list of preferred equipment suppliers is attached to the tender document as 165-4-SPG-1097.

5.2 **Enquiries**

The Contractor shall issue enquiries and place orders on suppliers and for any deviation must obtain the approval of the Company prior to the enquiry being issued. Any liaison with the Vendors including clarification of technical queries, expediting shall be carried out by Contractor's personnel.

Prior to floating an enquiry the Contractor shall obtain approval from the Owner for the purchase specifications and equipment data sheets attached to the enquiry.

5.3 **Orders**

The Contractor shall, prior to placing order(s) for equipment and materials provide the Company with documentation for their review and approval of the supplier, technical bid comparison, vendor data requirements, quality plan, spares recommendations, delivery date, shipping details and warranty.

Contractor shall note that requirements for shop fabrication and inspection shall follow the guidelines provided in the relevant industry standard such as API 650, ASME Sec. VIII Div. 1 and ASME B31.3.

For locally procured materials only reputable manufacturer's product may be used. Company reserves the right to ask for a sample or a lab test for review of quality of the material.

The Contractor shall provide similar data as appropriate to items such as instruments, electrical equipment, structures and bulk piping and other materials.

The Contractor shall ensure that all questions, reservations etc. are satisfactorily resolved with suppliers prior to issue of the Purchase Order, either by correspondence for minor issues, or by pre-award discussions. The Company shall be invited to attend the technical part of such discussions.

5.4 **Expediting**

The Contractor shall expedite all purchase orders. The emphasis shall be on visits to supplier's and their sub supplier's works to physically view progress of work and witness tests and also to transport companies and other organizations where the potential for delay can occur. Expediting Reports shall be provided to the Owner. The level of Contractor expediting shall be such as to ensure that all orders are delivered to suit the requirements of the project schedule.

The Contractor shall undertake inspection such as is required to ensure that equipment and materials meet the requirements of the technical specifications.

6.0 **SHIPPING AND TRANSPORTATION**

Following Factory Acceptance Tests, the Contractor shall arrange for shipment of all Equipment and Materials (Tagged Equipment and Bulk Materials) to the Site and for the offloading onto foundations or storage at the Site. Delivery shall be by sea, air and road as appropriate. The marine port of entry to Pakistan shall be Karachi. The Contractor shall undertake the clearance of all imports through the port (and any re-exports), providing all documentation including equipment test reports.

7.0 **FABRICATION & CONSTRUCTION**

7.1 **General**

The Contractor shall undertake the construction and installation of work under its scope.

The Contractor shall work in compliance with Company's Site Rules and regulations and he may use his own Site Rules and Regulations where the former is not covering, for construction, subject to their review and acceptance by the Owner. The regulations must be applied to all work within the Battery limit specified on the plot plan.

The Safety Manual and other Owner requirements below are considered particularly important: -

- Use of protective equipment by staff
- Accident Prevention Program.
- Co-ordination with Owner on Safety
- Safety Instructions for Sub Contractor.
- Safety in Construction practice.
- Work Permits.
- Confined Space and Vessel Entry.
- Excavations/Trenching and Shoring.
- Fire Prevention and Emergency Procedures.
- Scaffolding and Lifting Procedures.
- Area and Machinery Guarding.
- Site Security procedures.
- Recruitment of Temporary Labour.
- Electrical Equipment Safety.
- Health and Environmental Pollution Control.

- OSHA Guidelines for Incident and Inquiry Reporting.
- Maintaining of Lost Time Incidence, and Near Miss Incidence Log with periodical review by Safety Incharge

Any breach of the Owner's Safety procedures may result in work being stopped until corrective action is agreed.

All construction work within the battery limits will be undertaken using the Company's permit to work system. This shall also apply to all Contractor's and its Subcontractor's personnel at the Site following the integration of the facilities with the battery limit.

The Contractor shall undertake construction using specialist Subcontractors fully conversant with the activity they have been selected for.

Consistent with quality and economics, the Contractor shall endeavor to maximize the use of renowned Subcontractors for field work, where possible. The Subcontractors proposed by the Contractor shall be named in his bid for Owner's approval.

All work to be constructed, installed, tested and mechanically completed shall be carried out in accordance with the latest revisions of the relevant standards, codes, Contract specifications, drawings, legislation, site rules and regulations, and this Scope of Work. The Contractor shall maintain records of all work and shall record all changes from the design drawings and specifications. The marked up changes shall be used for production of As-Built Drawings to be provided to Owner.

The Owner shall have access to all inspection and test records and shall have the right to witness all inspections and tests.

The Contractor shall be responsible for the security of all construction facilities and for the equipment and materials at the site during construction work.

The Contractor shall maintain a clean construction site and periodically dispose off excess material such as redundant pipes, cable trays, cables, steel scrap, excess earth, construction debris and other scrap items at a designated location agreed by the Owner, at the Contractor's expense.

Contractor shall be responsible for setting up new permanent bench marks & control points at Plant site for Company's future reference. These points shall be established with reference to the existing bench marks and survey details. The leveling and grading of construction area shall be consistent with the approved leveling plan and level / datum.

For lay down area and site fabrication shop, Contractor is to provide fencing around the perimeter of these areas and also to provide temporary gates (at least two) to control access during construction.

The Contractor will provide any other fencing he considers necessary for his own security purposes.

The subsoil water if not suitable for direct use in construction, Contractor shall arrange sweet water bouzers from external source or setup a treatment unit for desalinating the ground water. Contractor shall make appropriate arrangement for disposal of reject water from desalination unit. The local sewerage system shall not be used for this purpose.

7.2 **Site Establishments**

The Contractor shall be responsible for the supply, installation, hookup and maintenance of all services required to enable him to carry out the work, which is not itemized above in Company supply. These shall include office accommodation, messing facilities, workshops, warehouses, prefabrication sheds, power, water, sewage disposal, communications (telephone/telex/Email), etc. The Contractor shall also be responsible for installation or erection of any temporary facilities required to assist the work including weather protection, lighting, scaffolding, etc., and removes these on completion of the work.

The Contractor is to maintain all establishments clean and safe to the satisfaction of the Company and is to avoid (and clean up) any contamination of the Site.

All construction activity shall adhere to the drawings and documents of relevant discipline which have been issued by Consultant / Contractor and approved by Company's representative. This relates to the material being used and the construction and commissioning activity. Any waiver from approved documents is only acceptable through a written approval from the Company's representative.

As the project works shall be carried out in parallel with other construction activities, the Contractor is required to undertake all precautionary measures to ensure safety and operation of all parallel on-going works as well as any existing installations. Special care shall be required during the construction work of pipe supports, pipe racks and drainage etc. which are required to be interfaced with the other constructed / under construction facilities. The Contractor shall also implement work plan, the recommendations made by the Owner, for the safety of such facilities.

These site establishments shall be near but outside Plant battery limits.

7.2.1 Temporary Camp

The Contractor shall establish a temporary camp for storage of equipment & material work area and staff residence on land at Site to be acquired by the Contractor. Any such establishment shall be self sufficient in all respects, including supply of all utilities.

7.2.2 Temporary Site Facilities

The Contractor shall provide, erect, construct, furnish, equip, clean, maintain, heat, light and subsequently remove all temporary offices, sanitary conveniences, messing and first aid facilities, stores, workshops, compounds, parking areas, necessary for the completion of the Work and the site and layout of which shall be to the general approval of Company.

Before providing any of the above the Contractor shall submit detailed proposals for the approval of Company.

It is the Contractor's responsibility to provide firefighting equipment. Ownership of temporary buildings and any furniture and equipment provided as aforesaid shall refer to the Contractor.

The offices shall be lockable and furnished with new or reconditioned furniture and be level ground finished with gravel concrete or paving slabs. Suitable paths shall be ensured by the Contractor.

7.2.3 Material Storage and Control

The Contractor shall be responsible for receiving, storing, protecting and issuing all materials and consumables as required for fabrication and installation at the site. The Contractor will develop material control procedures to ensure that the materials are correctly stored and used in the appropriate service and can be readily identified at all times. These procedures will be subject to agreement with Company.

Loading, hauling and unloading shall be performed by the Contractor in such a manner, that it prevents damage and if materials do sustain damage, Contractor shall be responsible for all repair and/or replacement costs.

The Contractor is to ensure that all equipment is properly stored and protected from weather and damage. Whenever possible, unloading of major equipment items shall be scheduled to permit the equipment to be placed directly on foundations.

7.2.4 Testing Facilities

The Contractor shall be responsible for providing adequate Testing Facilities to enable him to complete the work, including radiography and other NDT methods and instrument calibration and testing.

It should be noted that Company will not provide water, gas, electricity (power), compressed air for any of the construction activities. After approval from the Company for the location and laboratory test boring water could be used for watering during construction. Potable quality water shall be used for hydrostatic testing of carbon steel equipment & piping. Water with controlled chloride contents not more than 50 ppm will be used for hydro-testing of austenitic steel. Water after hydro-testing will be disposed off to a place to be advised by OGDCL. Nitrogen for purging and leak testing of equipment and piping shall be arranged by PC Contractor complete with all required accessories.

7.2.5 Site Security

- i) Contractor shall be responsible for site security and shall make any provision, including but not restricted to security of personnel and fencing to ensure the security of the site.

- ii) Contractor shall at all times take all necessary precautionary measures and conduct all works in a manner which shall minimize as far as practicable the risk of loss, theft or damage by vandalism or sabotage to any property.
- iii) Contractor shall comply with all applicable security laws and regulations including, but not limited to, regulations and procedures of Owner applicable to site and execution of the works on site. Contractor shall cooperate with Owner on all security matters and shall promptly comply with any security requirements. Such compliance with security requirements of the Owner shall not relieve Contractor of his responsibility for maintaining proper security as described above, nor shall it be construed as limiting in any manner Contractor's obligations to undertake reasonable action as required to establish and maintain secure conditions at site.
- iv) Contractor shall prepare and maintain accurate reports of any incident(s) of loss, theft or vandalism and shall furnish such reports to Owner as part of the agreed reporting procedure for the works.
- v) Contractor shall take all other precautions necessary to protect persons and property from damage or injury arising out of works and shall comply and shall ensure that Subcontractors or other persons under its direction and control shall comply with statutory, Owner and Contractor's own regulations.

7.3 **Civil and Structural Construction**

7.3.1 **General**

The Contractor shall undertake construction of all civil and structural works related to installation of all Company & Contractor's supplied packages / skids / equipment, and miscellaneous infra structure works as defined in respective Scope of Work documents. The construction of all civil and structural works for the contract scope areas shall be carried out in accordance with the approved for construction Drawings and Specifications for Construction works.

The contractor is required to undertake the inspection and appropriate test applicable to the particular work activities e.g. cement, aggregate, excavation and backfill, reinforcement, form work, concrete cube test etc. and is to submit the results of such inspections and test for review and acceptance by the Company. Excess earth shall be removed from the site to a designated dumping place on a daily basis.

The material to be used in structural works elements shall comply with the latest edition of the industry codes and standards and attached project specifications.

7.3.2 Grouting

The Contractor shall be responsible for undertaking the Grouting at the underside of Base Plates of Equipment, Pipe Racks and Supports for equipment etc. The Grouting shall also be required for the pockets in foundations for fixing Anchor Bolts. Generally the type of Grouting Material to be used is Non-Shrinkable Cementitious Grout and Non-Shrinkable Epoxy Grouts.

For the Grouting of Equipments, manufacture's recommendations for the type and thickness of Grout shall be strictly followed.

7.3.3 Misc. Steel Structure Works

The fabrication of steel structure shall generally follow the AISC Code. The material and workmanship shall be according to the Project specification for steel structure.

All structural steel material for access platforms should have galvanized surface.

7.3.4 Shop Fabrication

All steel structure shall be shop welded from a company well experienced in industrial fabrication. The structure includes:

- Pipe Supports

All physical dimensions shall be measured and welding shall be visually inspected by an independent third party inspector from a reputable inspection company hired by the Contractor.

7.3.5 Erection

Following activities, as a minimum, shall be carried out:

- Setting of Base Plates and Bearing Plates on the concrete pedestals.
- Tightening up of anchor bolts to specified torque after supported members are positioned and plumbed.
- Placement and cutting of non-shrink grout solidly between bearing surfaces and plates or steel member so that no voids remain. Comply with Grout Manufacturer's instructions.
- Setting up of structural frames accurately to lines and elevations indicated.
- Alignment and adjustment of the various members forming part of the complete frame or structure before permanently fastening.

7.3.6 Painting and Surface Preparation

Surface preparation and painting shall follow the general guidelines provided in Project Specifications.

7.4 Mechanical Construction

The Contractor shall use a proven material control system for all elements of material to be incorporated into the system and other interfacing works.

In general, the field mechanical works shall follow the work specifications attached to this tender document. Scaffolding pipes and fasteners shall be in good condition and free from rust. Scaffolding shall be subject to inspection prior to use.

Cranes used for erection work shall follow the requirements given in the tender documents. All heavy lifts shall be planned and their plan submitted for approval by the Company. Lifting plan shall be approved by Contractor's own quality control staff, followed by Company approval.

Contractor shall be responsible for the transportation of all equipment to the erection location. Equipments which are transported by sea shall have sea-worthy packing. Recommended preservation procedures shall be strictly followed by the Contractor during the period of storage for all equipment.

No nozzles or other vital attachments on the equipment being lifted shall be used as supporting or lifting points other than those which have been specifically designed and designated for the purpose.

On all stress relieved equipment, it shall be stenciled that “equipment is stress-relieved and no welding shall be permitted after PWHT”.

Alignment of rotary equipment shall follow manufacturer’s recommended procedure and tolerance.

All pressure bearing equipment hydrostatically tested in workshop shall be re hydrostatic tested after erection on foundation.

It should be noted that Company will not provide water, gas, electricity (power), compressed air for any of the construction activities. After approval from the Company for the location and laboratory test boring water could be used for watering during construction. Whereas, the water for hydro-testing, will be of potable quality for carbon steel equipment and piping. Water with controlled chloride contents not more than 50 ppm will be used for hydro-testing of austenitic steel. Water after hydro-testing will be disposed off to a place to be advised by Company. Nitrogen for purging and leak testing of equipment and piping shall be arranged by Contractor complete with all required accessories.

Pressure Safety Valves (PSVs) shall be bench tested for set pressure prior to installation in place.

Welding procedure specifications (WPS) shall be developed by the Contractor in accordance with the specifications referred above. The WPS shall indicate, among other things, the type and grade of electrode and the weld geometry. The electrodes used for welding shall be of an appropriate grade and supplied by a reputable manufacturer. WPS/ PQR/ WPQR shall be as per ASME Sec. IX.

The welders employed for welding shall be tested on the approved WPS. The welding test strips from the welder test shall be checked by destructive testing as recommended by the industry standards. The record for weld test of each welder shall be submitted for Company review and information.

All aspects of construction activity are subject to the appropriate inspections and acceptances by the Company. The Contractor shall give the Company 7 days notice of inspections for both intermediate work and for completion inspections and tests. Copies of all Non-Destructive Testing (NDT) and other inspection data shall be provided to the Company for each aspect of construction, inspection and testing. The Company shall also be invited to witness all pressure tests, electrical tests, instrumentation tests and other tests.

The Contractor shall plan all construction, pre-commissioning and commissioning work from the overall Project program level down to daily task levels with all such plans to be available to the Company.

The Contractor is to prepare detailed plans for each aspect of the work effecting performance of existing facilities at least 01 week prior to such work being undertaken. The detailed plans will include timing and duration of piping, equipment, instruments and electrical, including preparatory work, inspection, testing and commissioning of the integrated facilities and any civil works, building modifications, etc. The detailed plans will be subject to the approval of the Company.

The Contractor shall maintain an adequate construction force at the Site to undertake any remedial work or maintenance required during the period from pre-commissioning through to Acceptance of the facilities (completion of performance tests). This particularly applies to piping, electrical and instrumentation specialists.

The Contractor should notify the Company about completion of construction at least 45 days before the estimated date of completion of construction of the facility.

7.4.1 Shop Fabrication

All pressure equipment and structures shall be shop welded from a Vendor/Fabricator well experienced in industrial fabrication. The pressure equipment shall be hydro tested after fabrication, to a test pressure specified in the data sheet. All physical dimensions shall be measured and welding shall be visually inspected by an independent third party inspector from a reputable inspection company. The hydro test shall also be witnessed by the third party inspector. Company upon his discretion or his representative may also witness the hydro test.

7.4.2 Painting and Surface Preparation

Surface preparation and painting shall follow the general guidelines provided in attached Specification with the Tender.

7.4.3 Testing and Mechanical Completion

“Testing” shall mean the carrying out of such hydraulic, pneumatic, leak tests, electrical and other field tests as are specified or are necessary to demonstrate that the various sections and components of the Works have been constructed in accordance with the Contract. Mechanical testing would typically include:

- Hydrostatic, pneumatic or other NDT testing of all pressure containing parts of the system.
- Mechanical run test of rotary equipment.
- Load Testing of Overhead Cranes
- Completion of appropriate test sheets and documentation.
- Assistance in mechanical running test of Acid Gas Incinerator System under the supervision of OEM’s representatives and as per their instructions.

All such testing of system components shall be subjected to witnessing by OGDCL/ OGDCL Representative.

7.5 Electrical & Instrumentation Construction

This Clause is only meant to outline major requirements pertaining to Electrical & Instrumentation installation works. Detailed requirements are covered in relevant Specifications for E&I Installations, attached with the tender document

Personnel engaged on the construction of electrical installations shall be fully qualified and competent tradesmen skilled in the particular activity in which they are engaged. The Packager shall be prepared to give written proof or demonstrations of this requirement to the satisfaction of Company.

Material and equipment supplied under this contract shall be new, comply with specifications, and where appropriate shall be provided with certificates issued by the National Certifying Authority for use in classified Hazardous Areas. All materials and equipment shall be subject to inspection and approval by Company.

Work in Classified Areas shall be carried out strictly in accordance with BS 5345 (all parts)/IEC 79 and with the site construction safety instructions. Particular attention shall be paid to the location and weather protection of EExd equipment.

When installing Group IIC enclosures, no solid object such as steelwork, walls, guards or other electrical equipment shall be within 40mm of flange or opening. For Group IIB enclosures this distance should not be less than 30mm and for Group IIA not less than 10mm. For weather protection, component approved non-hardening sealants only shall be used. Non-hardening tape shall not be applied to groups IIB or IIC apparatus.

In general, instruments shall be accessible, from grade, platform or permanent walkway, for isolation, adjustment and maintenance (e.g. instrument data plates, zero and span adjustments and valve manifolds) without the use of ladders or scaffolding.

Instruments shall be located above grade or platform as indicated on the layout drawings and shall be positioned so as not to cause obstruction to access ways. Transmitters that need to be mounted remotely from the related element shall be located as close to the element as possible.

Close coupled instruments shall be mounted individually, close to the process connection as shown on the Process Hook-Up Drawings. Remote mounted instruments shall be grouped together as far as is practical to minimize cabling/tubing runs.

No instrument shall be mounted on hand-railing or any structure that is liable to be removed for maintenance purposes. No instrument (other than direct mounted gauges) shall be installed such that it depends for support or rigidity on the impulse piping or electrical cabling connection to it.

Locally mounted instruments shall be mounted on the specified instrument stands or shall be suitably bracketed and mounted on the nearest suitable firm steelwork or masonry in a fashion and position to be agreed with the Purchaser. Surface mounting pressure gauges with blow-out pressure release devices at the rear, shall be mounted at least 20 mm away from the mounting plate by means of distance pieces.

Instruments that are directly mounted on process pipe work e.g. pressure gauges, level gauges, etc., shall be installed such that they are accessible and easy to read.

Parallel runs of instrument cables and power cables should generally be avoided. Where parallel runs are must be made (for example in shared underground trenches), instrument cables shall be segregated by at least 500 mm from electrical cables.

Where instrument and power cables cross over each other, this should be at right angles with at least 300 mm segregation.

8.0 **INSPECTION & TESTING**

Contractor shall carry out all inspection and witness testing for equipment and materials at Contractor's/ manufacturer's works and shall be responsible for ensuring that all items of equipment and materials purchased are supplied strictly in accordance with the contract specifications. Contractor shall prepare a detailed inspection and testing plan, which will be subject to approval by Company. Plan shall include:

- An inspection and testing program per specific equipment item.
- Details of certification and documentation requested per equipment item.
- Details of inspection and witnessing agencies being used.

Contractor shall employ only qualified inspectors after approval of Company for the inspection. Details of personnel and CVs shall be provided.

Contractor shall inform Company in advance of all planned material inspection and testing so that Company/ Consultant representative may attend, as required.

Where Company selects to employ a third party inspection authority for specific equipment and materials for statutory insurance or any other Company reasons, such inspection shall in no way relieve Contractor of his own responsibilities. Such third party inspection agency shall function independently and report to OGDCL.

Contractor shall prepare and issue written reports for review by OGDCL on all inspection and tests.

Contractor shall endorse as correct all fabrication and manufacturing data folders containing, but not limited to, mill certificates, equipment test certificates hazardous area certificate and certificate of origin and all other relevant inspection data.

OGDCL reserves the right to accept or reject any equipment, material or test and ask for rectification/ replacement at no extra cost, without giving any reason, what so ever and without any time impact.

9.0 **PRE-COMMISSIONING**

The Contractor shall undertake all pre-commissioning activities for its own scope of items and shall ensure that the equipment and systems are safe, tested, purged, blanketed, etc. and ready to be commissioned. Commissioning shall not commence until the Company (and representatives of major equipment where appropriate) is satisfied that the system is ready for commissioning and have signed the appropriate System Acceptance certificate.

The Contractor must prepare at least 02 weeks in advance of pre-commissioning of any unit, a schedule of staff required from the Company to assist in pre-commissioning, commissioning and in the initial operation of each facility. Such staff shall operate under the supervision of the Contractor through to the Performance Tests and then take over the operation.

The Contractor shall be responsible for pre-commissioning, which is defined as the systematic check of equipment and systems, on completion of fabrication installation and testing i.e. after signature of the mechanical completion certificate, in order to verify that:

- All installation work, including testing, is complete.
- The equipment and systems are fit and safe to be put into operation with the intended service fluids, power sources, etc.

The Contractor shall furnish and install all lubricants, desiccants, chemicals, preservatives and any other consumables necessary for operation of the entire facility.

The Contractor shall be responsible for preparing and submitting for approval to Company, his proposed procedures, acceptance forms and sequences for the pre-commissioning of each section of the work. This shall include, but not be limited to the following:

9.1 **Mechanical**

- Running of all pumps drives.
- Cleaning screens and filters, replacing and adjusting packing and seals.
- For piping system, installation and removal of temporary blinds as required, circulation and pre-commissioning of systems including service and potable water, effluent and Drainage, fire protection, instrument and plant air, relief and blow-down and interconnecting lines.

- For engine driven equipment, the setting of governors, and the alignment of coupling, cleaning and removal of temporary screens.
- Vibration checks, alignment checks in accordance with the manufacturer's requirements and subject to Company's approval.
- All running tests to ensure that the sections and components of the Works are ready for operation and safe commissioning.
- Any other checks and running tests required by the Vendor.

10.0 **COMMISSIONING ASSISTANCE FOR START-UP OF ACID GAS INCINERATOR PACKAGE**

Contractor shall be responsible of commissioning assistance for start-up of the following Company supplied Package (free-issue to Contractor).

- Acid Gas Incinerator System

The Contractor shall provide experienced team of professionals and technical personnel for providing Commissioning Assistance for Start-up Services.

Curriculum Vitae (CVs) of commissioning & testing personnel and Installation & experts to be provided by the Contractor for Company/Consultant approval. Commissioning Plan with responsibilities of individual team members shall also be provided by the Contractor.

11.0 **MANAGEMENT, PROJECT CONTROL AND ADMINISTRATION**

11.1 **Management**

11.1.1 Contractor shall develop his Execution Plan in accordance with all requirements of the Contract. Contractor shall be responsible for producing, maintaining and updating through-out the execution of the works according to the Execution Plan.

11.1.2 As a minimum, Contractor's responsibility will include the means to ensure management of:

- Contractor's Own departments and resources
- All Subcontractors' activities

- All external interfaces required for completion of scope of work. Certain design documents may be required for attachment to applications prepared by Contractor and signed by Company that are made to the Government departments. Such design documents shall be promptly prepared. Contractor shall be solely responsible for delay in Work as a result of delay in applying or preparing the supporting documents.
- All interfaces with Company or his representatives.

12.0 **MISCELLANEOUS**

12.1 **Spare Parts**

12.1.1 **Construction, Pre-commissioning & Commissioning Spares**

All spares used during the construction, pre-commissioning, commissioning and operation period up to completion of Performance Tests or Acceptance shall be provided by the Contractor.

12.1.2 **Spares for 2 years Operation**

The Contractor is to provide detailed priced listings of his and his suppliers' recommended spares for 2 years operation (for MCC & VFD along with gaskets and stud bolts for piping) prior to placing the respective purchase orders. The Company will then decide whether to include supply of the spares, at the price listed, within the Contractor's scope of a respective purchase order or whether the Company is to purchase directly.

The Contractor is to ensure spares that he orders for the Company are delivered in time for commissioning.

13.0 **INTERFACE PLAN**

Contractor shall manage all external interfaces with the project and its mediation with all third parties involved with or affected by those external interfaces, in accordance with at least the following requirements:

- 13.1 Identifying, specifying and resolving all interface matters, such as the type of information needed by Contractor from the other parties shall be an integral part of the scope of works. Contractor shall prepare the design, planning, scheduling or other work required for progressing the resolution of such interface matters.

- 13.2 Contractor shall be responsible for the management and coordination of all external interfaces associated with the project. These interfaces cover engineering, procurement and supply, construction, pre-commissioning, commissioning and start-up activities. Interfaces include those areas where Contractor has to exchange information with other parties for carrying out the project, as well as physical interfaces at the limits of supply between Contractor and other parties. This includes the communication with the certifying authority, licensor, Company or Company appointed representative for the project.
- 13.3 Contractor shall issue drawings and documents as requested by other parties and be responsible for the review of all engineering work associated with the interface in question to ensure that the final design is in accordance with his own engineering works.
- 13.4 All official contacts with third parties at the external interfaces with the project shall be directed through Company. Company may however, at its option, instruct Contractor to have direct contact with the interface party in question on conditions as set down by Company.
- 13.5 Contractor shall, as a minimum:
- Prepare, submit for approval and implement a detailed interface matrix and coordination procedure to cover for all of the external interface activities as defined above, identifying as a minimum, dates for issue and receipt of interface documents and the personnel responsible for management of the interface on behalf of Contractor.
 - Initiate and organize contacts at the technical level with the parties involved.
 - Advise Company of any meetings with sufficient notice so that Company or Company representative may attend any or all meetings arranged to discuss such matters.
- 13.6 Provide for travel to and attendance in meetings at various office locations of the following:
- Contractor (design office or site)
 - Third parties
 - Company or Company representative
 - Subcontractor
 - Vendors/suppliers

- 13.7 Contractor is responsible for preparation of minutes of meetings, arrange for electronic approval by all parties concerned of those minutes, and electronic distribution to all parties. In addition, Contractor shall formally advise Company of any interface problem, which may arise from such meetings and propose remedial action.
- 13.8 Technical interface coordination meetings shall take place as soon as practical afterward between parties involved at the interfaces. Contractor shall initiate interface kick off meetings with the consent of the Company.
- 13.9 Contractor shall schedule the project relating to interface matters to coincide with the schedules of other parties identified in the interface plan.
- 13.10 In all instances where materials and/or equipment is handed over between parties at an interface, the Contractor taking receipt of material and/or equipment shall inspect all such material and/or equipment for quantities, damage and description. Upon endorsement, the care and custody of the material and/or equipment shall rest with the Contractor. Contractor shall record such transfer in an Company approved format.

14.0 **DOCUMENT REQUIREMENT**

Contractor shall be responsible for furnishing all documentation mentioned in **Annexure-A** of this document complete in all respects.

15.0 **DESCRIPTION OF TECHNICAL REVIEWS**

15.1 **Design Review by the Company**

The Contractor shall make arrangements for Company reviews at Contractor's headquarters, where main design and procurement activities will be performed.

During the project kick off the Contractor shall present the project schedule, design/ procurement packages, coordination procedure, project quality/ HSE documents and procedures.

During the engineering meetings/ reviews the Contractor shall present the requisition, memorandum for the facilities, design/ procurement packages, project schedule, project quality/ HSE documents and procedures.

At the end of the engineering stage and during the procurement/ supply activities the Contractor among other things presents reports to Company's representatives on:

- a) Detailed design and procurement
- b) Constructability review

15.2 **Technical Review of the Procurement/ Supply Activities**

The purpose of this technical review will be:

- a) To check conformity of technical documents sent to Vendors / Subcontractors with latest issue of Approved for Construction (AFC) documents.
- b) To review the inspection program and reports and identify critical items.
- c) To review corrective or other specific actions carried out or proposed to be carried out by Contractor for such critical items.
- d) To review the factory acceptance test procedures and check the test records.
- e) To verify accuracy of the materials control procedure and other systems or procedures implemented during procurement.

15.3 **Technical Review Prior to Construction Mobilization**

The purpose of this technical review will be:

- a) To review the construction manual and ensure that latest revisions of specifications, procedures and drawings are included; and
- b) To ensure that required construction equipment is available in due time and complies with all applicable requirements.

Contractor shall make available for the review all detailed engineering documentation in the latest AFC form, as well as the appropriate procedures and reports.

15.4 **Technical Review at the Construction Stage**

The purpose of this technical review will be:

- a) To review any document not available during the above engineering review and to confirm compliance with that review.
- b) To review changes to the specifications and designs post AFC stage.
- c) To confirm that the preparation of plans and procedures for testing and pre-commissioning is in progress in accordance with applicable schedules.
- d) To check correctness of documents used for construction and installation.
- e) To review the welding/NDE procedures.
- f) To check conformity of welding operation with welders qualification.
- g) To check storage conditions for all materials, and ensure that Subcontractors instructions are complied with in relation thereto.
- h) To review HSE procedures.
- i) To check conformity of fabricated elements with AFC documentation.
- j) To ensure that all equipment materials and consumables for testing and pre-commissioning operations are available.
- k) To review pre-commissioning procedures and equipment.
- l) To check pre-commissioning operations and records.

15.5 **Technical Review at the Pre-Commissioning Stage**

The purpose of this technical review will be:

- a) To generally check the conformity of the facilities with the AFC documentation (principally the P&IDS and including all modifications) and to confirm compliance with the previous technical review actions.
- b) To check that the operations department has been consulted and that their requirements have been taken into consideration.
- c) To check that the commissioning manual and start-up procedures are in place and workable.

- d) To review the operations manual and safety procedures.
- e) To generally ensure that the facilities can be operated in a satisfactory and safe manner.

Contractor shall give access to all documentation available at sites. Contractor shall make available for the review all detailed engineering documentation in the latest AFC or as-built revisions as well as the pre-commissioning, safety and other procedures and test reports.

15.6 **Technical Review at the Commissioning**

The purpose of this technical review will be:

- a) To generally check the conformity of the procedures for start-up the Facilities with the actual work process performed by the operators. Commissioning manual (final P&IDS and including all modifications and the as build drawings) and to confirm compliance with the previous technical review actions.
- b) To check that the operations department has been consulted and that their requirements have been taken into consideration.
- c) To review the final operations manual, the trainings program for the operators, the safety procedures.
- d) To generally ensure that the facilities can be operated in a satisfactory and safe manner.

Contractor shall give access to all documentation available at sites.

16.0 **CERTIFICATION OF WORK**

Contractor shall engage the services of an independent third party certifying authority and bear all costs associated for the following activities whether undertaken within Pakistan or in the country of manufacture of equipment;

- Material Testing Laboratories for certifying the Strength of concrete cubes, earth compaction quality Testing of reinforcement steel, Ground water sample testing Any other laboratory test related to works which is necessary for quality control
- Material Testing laboratory for certifying the grade of metal proposed for use by the Subcontractor (equipment manufacturer).

- Radiography of welding and interpretation of radiography reports.
- Destructive testing of specimens.
- Welding Procedure qualification and welder tests at the manufacturer's premises.
- Witness of the calibration of PSV or other safety devices.
- Review of Heavy Lift Procedures.
- Review of Heat Treatment Procedure.
- Hydrostatic test of equipment.

Contractor shall make available to the certifying authority all necessary information and allow them full access to the works.

Certificates will be issued for document certifying authority approval or review of individual design and construction phases or witnessing of essential tests. The certifying authority (Governmental Organizations) shall issue to company one copy of all certificates and non-conformance reports issued to Contractor. All certifying authority certificates will be incorporated into the final documentation.

Approvals, recommendations and clearances given by the certifying authority shall not relieve Contractor of its ultimate responsibility for properly complying with all of its obligations under the agreement.

17.0 **LOGISTICS**

When transporting Materials and Construction Equipment to site, the Contractor shall prepare a transport plan showing suitability for the lifting and transport of the projected loads for the individual equipment and selected vehicles and mobile crane and the select route with the roads to be used.

Based on the transport plan, Contractor shall obtain all necessary approvals from Company, local authorities, and prior to the commencement of the transport to the site and shall be responsible, without limitation, for making any road required to accommodate the transportation of Material, Equipment and Construction Equipment to site in accordance with the transport plan.

18.0 **LIFTING EQUIPMENT INSPECTION AND MAINTENANCE PROCEDURE**

Contractor is to prepare inspection and maintenance procedures for construction equipment and materials, in respect of all lifting appliances, including and not limited to, runway beams, gantry cranes, travelling jib cranes, jib crane on fixed base, tower crane, derrick crane, portable jib crane, mobile jib crane, lorry loading crane, fork lift trucks and passenger and goods lift (“Lifting Equipment”). Relevant procedures by Company shall govern and where addition in terms of procedures or guide lines is required, Company shall review and approve.

The Lifting Inspection and Maintenance Procedure shall include at least the following requirements:

- a) Certificates from internationally recognized bodies are required for operators of all Lifting Equipment. Copies of such certificates are to be held in the operator cabin of the equipment.
- b) The procedure shall state the inspection regime for lifting tackle and how this is visually examined and tested and how an inventory of all inspection records is filed, maintained and the lifting tackle identified.
- c) Contractor shall undertake periodic inspection of lifting tackle including hooks, chains, slings, rings, links, shackles, swivels, pulley blocks, chain blocks and spreader beams. Each item of lifting tackle is to be addressed in its own test certificate and distinctly marked.
- d) Contractor shall undertake periodic inspection of wire ropes and ensure that the manufacturer's test certificates for wire ropes are available and in order.
- e) When undertaking periodic inspection of wire ropes Contractor is to examine the entire length for signs of damage in respect of:-
 - i) Evidence of broken wire
 - ii) Corrosion
 - iii) Kinking
 - iv) Crushing
 - v) Unstranding
 - vi) Bird Caging
 - vii) Core protusion
 - viii) Reduction in diameter

19.0 **LIFTING AND MOVEMENT PROCEDURE**

All materials and construction equipment at work sites that must be off loaded at the point of entry, loaded onto a transport vehicle, moved to and installed/erected at the site shall comply with a lifting/movement procedure covering each of these phases of the work.

Contractor shall accordingly prepare a “Lifting Procedure” and a “Movement Procedure” as part of the Construction Planning. These procedures shall address as a minimum the requirement and approvals for minor, medium, heavy and critical lifts and movements as defined below.

19.1 **Categories**

Lifts and movements are subdivided into 3 categories:-

- Minor 0 to 10 tons
- Medium size 10 to 50 tons
- Heavy 50 to over 100 tons

19.2 **General Requirements**

Prior to any lift or movement (of any category) Contractor shall obtain and have at the location of the lift as a minimum the following:

- All required certificates for all cranes, slings, shackles, operator qualifications in relation to the list
- All appropriate approvals as defined by the Lifting Procedure. Minor, medium size and heavy lifts can be carried out using a standard lifting procedure identified in the Lifting Procedure, to be submitted within the Construction Plan and included in the Construction Manual.

19.3 **Critical Lifts and Movements Requirements**

For each critical lift/ movement, Contractor must submit a lift/ movement procedure for approval, at least 21 days before the planned execution, covering as a minimum the following:

- Detailed lift/movement study with a scale drawing of:
 - i) Crane or cranes required for the lift;
 - ii) Equipment to be lifted;

- iii) Lifting accessories;
 - iv) Foundations or support structure;
 - v) Clearances between cranes and other equipment; and
 - vi) Lifting sequence;
- Detailed procedure for the lift/ movement including responsibilities, communications and safety procedures
 - Lift/movement control methods
 - Special precautions before, during and after the lift/ movement
 - Transportation study inside the site for the crane and for the equipment to be lifted
 - Approval for all necessary road closures
 - Review of Subcontractor recommendations concerning lift/ movement
 - Soil bearing load calculations
 - Marking of drawing North on foundation and equipment to avoid orientation errors
 - Checking of anchor bolts and placing of shim plates.

Lift/movement procedures will include checks to guarantee that lifting can be performed safely and efficiently.

For critical lifts/movements Contractor shall not initiate the lift/movement until all requirements of the Lifting Procedure/Movement Procedure in relation to that category have been satisfied.

Contractor shall maintain adequate supervisory and safety personnel as defined by the Lifting Procedure/Movement Procedure during the lift/ movement. Working in the danger zone will be prohibited during all the lift/ movement activities.

Contractor shall confirm to Company when critical lifts/ movements are to be executed 24 hours before they are to take place.

20.0 **DISPOSAL OF PERMANENT WASTE**

During construction, Contractor shall remove all its and its Subcontractor's waste, scrap and excess material each day from all work areas, unless otherwise directed by Company. Litter, garbage and similar waste shall be disposed of by Contractor in locations authorized by the Company in consultation with applicable local authority.

Contractor shall dispose of all unwanted batteries via an Company approved specialist or shall return them to the Subcontractor for recycling.

Contractor shall dispose of all unwanted abrasives used in any blasting process to be carried out prior to painting via a specialized Company approved procedure. Alternatively, these materials may (subject to approval) be taken away for recycling by Contractor.

Contractor shall ensure that all waste engine oil and lubrication oil is properly contained and disposed of in an approved manner.

Permanent waste such as tins, cans, locally procured waste construction materials etc., shall be gathered in containers within the areas allocated by Company and disposed of in authorized locations at maximum seven days intervals, unless otherwise directed by Company.

Scrap from imported materials must be gathered and disposed of in accordance with the procedure to be developed by Contractor for the control of Materials at the site.

Excavated soil and any clear fill material surplus to requirements shall be disposed of by Contractor in places as advised by Company within or outside the plant as authorized by applicable local authorities. All costs, including royalties, imposed by local authorities for dumping of waste materials or excavation of soil or any clear fill shall be borne by Contractor.

21.0 **CONSTRUCTION COMPLETION**

Contractor shall prepare a construction completion procedure as part of the construction plan as developed under the execution plan.

The construction completion procedure shall include checklist forms, document flow, schedule, certification scheme and status monitoring method for attaining Construction Completion. Separate checklists for different systems and for different disciplines of engineering will be required.

All documents, checklist forms and procedures required for Construction Completion shall be compiled in a construction punch list, which itself forms a part of the documentation which has to be submitted and approved prior to the achievement of Construction Completion. All quality control data to support this documentation shall be filed in a separate quality control dossier for each Subsystem.

22.0 **COMMUNICATION**

Contractor shall present a comprehensive communication procedure for review and approval as an element of the Execution Plan for the project. This procedure shall set forth an orderly, clear and effective basis for controlling the performance of the works.

22.1 **References and Language**

All documents shall be written in the English language, and shall bear the following references:

22.2 **Contractor Representative**

In order to enable Company to maintain an efficient level of communication with Contractor as Company may consider appropriate in connection with matters pertaining to the contract, the Contractor representative shall at any time make himself available to Company at Contractor's Project Management Office, the site or other work site, as the case may be. When the Contractor representative is absent, the Contractor shall ensure that his appointed deputy makes himself available to Company in the same manner.

22.3 **Communication Procedures**

22.3.1 **General**

All relations/communications between Company or Company appointed representative and Contractor shall be direct.

The works require a single point of contact between Company and Contractor. Contractor representative shall be the person authorized by Contractor to act in that capacity.

All instructions to Contractor shall be given in writing. All communications shall bear a reference number according to a communication procedure agreed between Contractor and Company. All communications between Company and Contractor shall be under a cover of correspondence issue sheet.

Company shall approve the Contractor individuals who shall be authorized to issue communications, and shall advise Contractor from time to time the Company individuals who shall be similarly authorized. Communications from Contractor to Company shall be addressed directly to Company or Company's representative.

Telephone calls that should appropriately be a matter of record shall be confirmed in writing, by faxes or by letter by the originator of the call.

22.4 **Site Correspondence**

Site correspondence shall be limited to "Site Instructions" and "Site Memoranda". The Company will advise Contractor from time to time of its authorized persons entitled to issue and receive Site correspondence.

Contractor shall co-ordinate with other Contractor's during construction and installation.

22.4.1 **Site Instructions**

Company, at any time, may issue a Site Instruction to Contractor:

- Either as a reminder of Contractor's contractual obligations.
- or as an instruction to Contractor to carry out a specific aspect of the works (other than an instruction to Contractor to perform a variation).
- Or for any other purpose described in the contract. In each of these cases, a "Site Instruction" will be used. Site Instructions shall be addressed to Contractor's representative and copied to the appropriate Contractor's Manager. All instructions shall be given in writing either onsite or offsite. Any possible reference by either party as "verbal instruction" or non-written agreement shall be of no effect. Contractor shall promptly acknowledge his intent to perform the work by returning a signed copy of the Site Instructions to Company representative informing him of the commencement of work requested by such Site Instruction.

22.4.2 Site Memoranda

Company representative may, at any time, issue a Site Memorandum:

- Either as a clarification to Contractor on any matter concerning the works
- Or as a request for clarification by Contractor on any matter concerning the works
- Or as a request for quotation, estimate and effect on schedule of possible additional work.

Contractor representative may, at any time, issue a Site Memorandum for technical clarification queries.

22.5 Meetings

All meetings shall be recorded and minuted. Contractor shall mention the progress of the project and meeting agenda shall be issued in advance.

22.5.1 Weekly Meetings

Company representative and Contractor representative shall meet on a weekly basis in accordance with at least the following:

- The location shall be Contractor's Engineering office or particular work site office (at Company's option), depending upon the phase of the works in progress.
- The day of the week for the regular meetings shall be advised by Company
- The standing agenda shall include:
 - Complete review of all work units, progress in performance of the works and associated matters;
 - Review of schedules in view of progress;
 - Review of resources (personnel and equipment) with respect to progress planned in future;
 - Highlighting of expected or experienced problems and corrective actions to be undertaken;

- Technical queries;
 - Safety;
 - Materials;
 - Forecast activities;
 - Presentation of all timesheets;
 - Any other business.
- Those in attendance shall include, as a minimum (for both Company and Contractor):
- Contractor representative and Company representative;
 - Personnel in charge of main activities (Engineering - Procurement - Construction Installation - Mobilization / Demobilization of construction equipment) for each part of the works; and
 - Specialists as necessary.

22.5.2 Monthly Meetings

The location and date of monthly meetings will be defined before each meeting, and each meeting will include the following agenda items:

- Review of the works progress by work unit for the previous month.
- Review of main activities (Engineering, Procurement, Construction, Installation, Mobilization / Demobilization of construction equipment) for each part of the works.
- Review of planning in relation to the works.
- Status of all variation orders.
- Minimum attendants as per weekly meetings.

22.5.3 Other Meetings

Meetings may be held at Contractor or Company premises upon request of Contractor on specific matters. Company may direct such meetings if the circumstances warrant.

Such meetings shall be scheduled with sufficient advance notice for all participants as may be necessary.

22.5.4 Minutes of Meetings

Contractor will prepare the minutes of all weekly, monthly meetings & technical meetings between Company and Contractor. Each set of minutes will be promptly issued for review by Company.

The minutes shall include:

- Minutes document number
- Date and location of meeting
- List of attendants with indication of companies represented
- Object of the meeting
- Record of discussions
- Record of actions agreed, with name of the person/ party responsible for execution of each action and the date of completion of the action, indicated in a separate action column.
- Date of issue

For convenience, minutes shall be divided into Sections with sub-headings indicating the various topics discussed. Company has the right to review and have the minutes amended where required. Unless notice of amendment is received by the Contractor within five (5) working days after the date of issue, the minutes shall be accepted as a true record of the meetings.

22.6 **Reporting**

Without limitation to Contractor's obligations to promptly report to Company any and all matters significantly affecting the progress of the works and/or quality, Contractor shall issue the reports listed below.

22.6.1 **Bi-Weekly Report**

Contractor shall issue a bi-weekly report as at the cut-off date to be advised by Company, which shall comprise of:

- An executive summary outlining key events occurring over the past week
- With respect to all work pages and work units, a works area report section describing the main events (or such other levels of detail as directed by Company) and the progress thereof
- Forecast activities on the same basis for the upcoming week as mentioned above for the past week.
- Areas of particular concern.

22.6.2 **Other Report**

Upon Company's request, Contractor shall prepare such additional reports as in the Company's sole judgment are required to keep Company informed of the progress and status of all aspects of the work

SUPPLEMENTARY TECHNICAL DOCUMENTS

MECHANICAL SPECIFICATIONS



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OIL & GAS DEVELOPMENT COMPANY LTD.

SPECIFICATION FOR

EXPORT PACKING AND CRATING



0	15-05-2012	Issued for Tender	MIAH	MAJ	MAS
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1.0 **INTRODUCTION**

This standard specification defines the minimum requirements for packing of equipment items in preparation for shipment to the Project Site.

2.0 **DEFINITIONS**

Following definitions apply throughout this document:

OWNER / COMPANY: Oil & Gas Development Company Ltd. (OGDCL)

CONSULTANT M/s. Zishan Engineers (Pvt.) Ltd. (ZEL).ZEL have been awarded the work of Engineering, Procurement Assistance and Project Management.

VENDOR / SUPPLIER: The organization, firm or agency with whom order for the supply of equipment and or material has been placed.

CONTRACTOR: Means the construction company to be engaged by the COMPANY to perform the Construction work.

3.0 **PRIORITY ORDER**

Priority order of documents controlling the Work performed shall be as follows:

- 3.1 Local laws and regulations.
- 3.2 Project specific engineering specifications as issued by CONSULTANT on behalf of COMPANY.
- 3.3 Industry Codes and Standards (API, ASME, etc.).
- 3.4 SUPPLIER's bid response documents.
- 3.5 In the event of any conflict between this specification and the requirements of other COMPANY specifications or industry standards and codes, the more stringent requirements shall apply with the written approval of COMPANY.

4.0 **GENERAL REQUIREMENTS**

- 4.1 Transportation shall also address packing requirements for single components, partial fabrications and completed items and be suitable for transportation whether by rail, road, plane or ship.
- 4.2 Where applicable instruments shall be suitably tagged, packaged and crated.
- 4.3 Package should be enclosed in cellophane and sealed against ingress of air.
- 4.4 Title and address of the consignee should be printed /marked on at least three side of the crate.
- 4.5 SUPPLIER shall be responsible to provide the commissioning spares parts in separate crate.
- 4.6 All Work shall be subject to inspection by the COMPANY and/or the CONSULTANT appointed by the COMPANY at any time. The SUPPLIER shall immediately make any items available for inspection at the request of the COMPANY and/or the CONSULTANT appointed by the COMPANY. The inspection or lack of inspection of the work by the COMPANY does not relieve the SUPPLIER from the responsibility of performing the Work in accordance with this specification and shall make any repairs at his cost.
- 4.7 Work shall not be released for shipment from SUPPLIER's company ship until it has been inspected and approved by the COMPANY and/or the CONSULTANT Party appointed by the COMPANY, or such inspection and approval has been waived in writing from the COMPANY.
- 4.8 SUPPLIER shall be responsible for load out, packaging, bracing and securing for transportation for the work. SUPPLIER shall provide COMPANY design, specifications, procedures and/or drawings on SUPPLIER's plan for load out method, transportation securing and bracing, packaging and field installation for COMPANY's approval 30 days before load out.
- 4.9 Where applicable equipment is concerned the following shall apply:
 - a) All lifting devices necessary to lift and transport equipment and/or materials shall be fully identified, listed with the specific lift points and for large package items detailed prior to any handling operations. Spreader bar design calculation should be submitted to the COMPANY for review. Sling & shackles with adequate capacity and spreader bar should be provided along with shipped items by the SUPPLIER.
 - b) All equipment should be empty and dry from test fluid.
 - c) All items subject to mechanical damage or corrosion shall be properly packed and protected from damage during shipment.

- d) Exposed machined and threaded surfaces shall be coated with easily removable rust preventive.
- e) Blank off all the nozzles with plastic caps.
- f) Rounded shell should be supported with on wooden saddles with adequate numbers.
- g) Exchangers shipped over the ocean shall be purged with nitrogen (N₂) prior to closing for shipment and provided make-up with a N₂ bottle. Exchanger shipped over land shall have a suitable desiccant, such as silica gel placed inside the nozzle.

5.0 **CONTAINER STUFFING**

- 5.1 Weight should be evenly distributed throughout the container.
- 5.2 Packages must not be placed on the top of other packages without adequate sub-flooring and bracing.
- 5.3 All packages must be blocked and braced to prevent lateral, horizontal and vertical movement of the packages.
- 5.4 All bulk heading, blocking, bracing and tie-down must conform to applicable railroad specifications for material shipped.
- 5.5 All containers must be sealed with rail type seal numbers recorded for future reference.
- 5.6 Locks are to be provided upon COMPANY's request.

6.0 **COMMERCIAL EXPORT PACKING SPECIFICATIONS**

- 6.1 This specification covers the minimum requirements for SUPPLIER with regard to preparing equipment, materials and spare parts for shipment in wooden boxes overseas.
 - 6.1.1 Equipment and materials will be protected to withstand extended periods of storage at the jobsite.
 - 6.1.2 System specified herein contains the minimum requirements. If the SUPPLIER's standard procedures for export packing will provide equal or better protection than specified herein, this information should be brought to the attention of the COMPANY for review and authorization.

- 6.2 These requirements are minimum and are designed to protect the equipment and materials from the normal hazards associated with inland transportation, port handling, ocean shipping and worksite storage. If certain aspects of aforementioned activities are not addressed explicitly in this Specification then generally accepted handling and shipping practices shall be used by SUPPLIER. SUPPLIER is required to obtain written approval from COMPANY CONSULTANT prior to apply any such practice or procedure.

7.0 **EXPORT PREPARATION**

- 7.1 All COMPANY's cargo shall be stored in a designated area and not intermingled with other cargoes to the extent possible.
- 7.2 All wooden boxes, crates and skids shall be suitable for 4-way mechanical handling by forklifts or cranes. All heavy cardboard boxes should be banded to a pallet. All hood boxes shall clearly indicate the "Center of Gravity" and, where applicable, be marked "For Crane Lift Only" in English.
- 7.3 SUPPLIER shall ensure that every equipment or part of equipment is delivered to COMPANY according to the correct specifications.

8.0 **EXPORT PACKING METHODS**

8.1 **Methods**

It is important that all material arrive at its destination in undamaged condition. The intent of this Specification is to serve as a minimum requirement for "commercial packaging for export", but compliance does not relieve SUPPLIER from responsibility for adequately packing materials, supplies and equipment.

The following methods apply to designated materials and materials not suited for container shipments. The choice of methods to be used will be selected by mutual agreement between SUPPLIER and the COMPANY CONSULTANT.

8.1.1 **Method I**

Preservative coating with greaseproof wrap. Method I requires the use and application of preservative compounds. The coated part or item shall be enclosed in a greaseproof bag or wrap of greaseproof barrier material that shall be loosely applied around the coated part of item and shall be secured by taping, tying or other suitable means. Projections, sharp edges or other features of the part or item, which may damage the barrier shall be cushioned. The type of barrier material and cushioning used shall be commensurate with the size, weight and irregularities of the preserved part or item.

8.1.2 Method II

Waterproof – Vapor Proof Barrier with Shell VPI-260. Items preserved, wrapped and cushioned shall be enclosed in a sealed bag. Shell VPI-260 (or equivalent when approved in writing by COMPANY) shall be in small porous bags positioned in the package at location such that the metal surfaces to be protected are within 300mm of the bags. Bags shall be secured by tying, by storage in specially provided baskets, by taping or otherwise secured so as to prevent movement, rupture of the bags or barrier and damage of the parts. Shell VPI-260 shall be in porous bags of standard sizes. Cushioning shall eliminate projections, sharp edges or other features of the item(s) that may damage the water-vapor proof barrier. A sufficient vacuum shall be drawn to cause the flexible bag to cling snugly to the enclosed item. Care shall be exercised to ensure that an excessive amount of vacuum is not drawn which might cause puncture or rupture to the flexible barrier or the equipment itself.

8.1.3 Method III

Packaging for Mechanical and Physical Protection Method III is intended only for items not susceptible to damage or deterioration from corrosion. Un-preserved items shall be bundled; secured by tying, taping or strapping, skin packaged or enclosed with wrapping, bags, cartons, boxes or other containers, as applicable to the extent necessary to provide protection from hazards of contamination and physical damage encountered in handling, storage and issue. When bags, wrap or other flexible barriers are used, cushioning shall be applied as required to protect the enclosing media. Items packaged in rigid containers shall be supported as necessary to prevent free movement. The methods of preservation - packaging, cushioning, blocking, bracing or bolting shall be applied to provide controlled movement within rigid containers to prevent rupture of flexible barriers and physical damage of contents due to transmission shock and vibration. Items such as machines and assemblies having bolt holes in parts of the item which are sturdy enough to resist breakage when roughly handled shall be bolted to one face of the container or to a base which can be secured by use of lock nuts or cotter pins, or by upsetting bolt threads by pricking bolt threads in four places.

9.0 PACKING MATERIAL/PRACTICES

- 9.1 For wooden boxes lumber shall be sound and well seasoned, knots are permitted provided they are sound and tight and do not exceed one-third of the board width.
- 9.2 For heavy cardboard, double wall, and waxed boxes, 227 kg (500 lb) test boxes are to be used.
- 9.3 Plywood shall be construction and industrial grade and fabricated with exterior glue. It shall give equal strength in both directions of length and width and shall withstand full weather and water exposure.
- 9.4 Nails shall be cement-coated.
- 9.5 Metal strapping shall be un-annealed steel and applied to all packages with a stretching tool and secured with crimped steel seals. For heavy cardboard boxes nylon strapping securing the box to a pallet shall be crimped with steel seals.
- 9.6 In all wooden boxes constructed with lumber or plywood the top shall be lined with waterproof paper where necessary.
- 9.7 When consolidating material in a box or crate, items shall be packaged or nested reducing volume as much as possible. All items shall be braced and/or cushioned as necessary within the container to prevent damage from shifting.
- 9.8 Small items and spare parts not secured to main item shall be separately boxed and properly identified as to its main item number.
- 9.9 All controls and instruments mounted on equipment, including motor starters, shall be protected internally with Ludlow VPI wrap, Daubert VCI paper or porous bags of VPI-260. Exterior doors will be sealed by applying petroleum jelly to the sealing surfaces and closing. The jelly will cause more efficient seal. SUPPLIER may substitute equivalent materials for Ludlow VPI wrap, Daubert VCI paper, or porous bags of Shell VPI-260, if approved in writing by COMPANY.
- 9.10 It is necessary that all shipping containers be tightly packed. Where voids appear, they will be filled with cushioning material or securely blocked off to prevent any movement of contents.
- 9.11 Machinery and large equipment shall be skidded, and shall be bolted and strapped to the skids. As required, items shall be cradled within crates for stability purposes. Specific packing instruction, as mutually agreed between COMPANY and SUPPLIER, will be included in the purchase order for crating or boxing of large equipment, if required.
- 9.12 Heavy items shall be securely blocked and braced to prevent damage to lighter materials packed in the same box. Heavy items, where possible, shall be packed on the bottom with light items on the top.

- 9.13 Outer packages shall be packed in such a manner to insure an even distribution of weight within the case. All other packages will bear warning signs on the outside denoting the center of balance and sling marks. Top heavy containers will be so marked as "top heavy" or "heavy end". Outer packaging shall be constructed in a manner that will provide protection from pilferage.

10.0 **TYPES OF PACKING**

10.1 **Palletizing**

Items which are not crated or boxed and are impervious to damage from moisture, seawater, handling and external damage, which can be conveniently secured to a pallet to facilitate handling, shall be palletized.

10.2 **Bundling and skidding**

All items shall be segregated to length and size and bundled or skidded into units not to exceed 1814 kg (4000 lbs) or 12 m (40 feet) in length unless previously approved by purchaser. Apply steel strap with a stretching tool and secure with crimped steel seals spaced up to 1-meter apart (40").

10.3 **Boxes and Crates**

10.3.1 The construction and reinforcing of a wooden box depends upon the weight of the box and its contents. The following are minimum requirements for various boxes.

45 – 1814 kg (100 - 4000 lbs.)

Box shall be made of a minimum of 25.4 mm (1-inch) nominal lumber board, 9.5 mm (3/8") plywood sheathing, completely cleated ends. All boxes over 22 kg shall be skidded. All seams shall be backed with an upright or brace.

1814 kg (4000 lbs) and up

Box shall be constructed with a 102 mm (4") by 102 mm (4") nominal skid base. 51 mm (2") nominal floor, 25.4 mm lumber or 13 mm (1/2") plywood sheathing, with cleated ends. Top and sides shall be braced, with corner post, bracing and stiffening members of 51 mm (2") by 102 mm (4") nominal lumber. Load bearing members shall be placed as needed. Top and upper edge members of large or heavy boxes shall be reinforced with 102 mm (4") by 102 mm (4") or 102 mm (4") by 152 mm (6") nominal spreaders to prevent crushing of boxes when lifting-slings are used.

All wooden boxes to be fork liftable - 4 ways.

Cardboard boxes to be of double wall waxed construction, 227 kg (500 lb) test and 1118 mm (44") x 1118 mm (44") x 1118 mm (44") OD with pallet. Intended to double stack and fit side by side in a standard 6.1 (20') or 12.2 m (40') shipping container

10.4 **Strapping**

All wooden boxes must be strapped with a minimum of 2 steel bands running parallel to skids. 19mm (3/4") nominal banding may be used on boxes less than 180 kg. For boxes or crates over 2722 kg (6000 lbs) 32 mm (1 1/4") or 51 mm (2") nominal banding must be used.

10.5 **Special Requirements**

Electrical switchgear, electrical panels, chromatographs, computers, all material/equipment which are susceptible to damage or deterioration from moisture, (i.e., humidity or rain), must be warehouse stored upon receipt and vacuum packed immediately, after checking. If the material has a discrepancy, all efforts should be made to quickly clear the discrepancy and pack the material.

Note: The above listed materials are not all inclusive and other possible applications should be noted and brought to the attention of COMPANY.

Special Materials: Any material which might need packaging differently than that which is stated herein shall be reviewed in writing on an individual item/order basis with COMPANY.

11.0 **MARKING AND DOCUMENTATION**

- 11.1 All material must be packed within 4 working days after receipt, if automatic pack Purchase Orders, or within 2 working days after release by COMPANY if inspection is required.
- 11.2 Specific instructions for shipping markings and documentation procedures will be in the order. Color coding of all packages and/or pieces will be required. All packing/documentation shall be segregated according to COMPANY's Job No.
- 11.3 All markings and tags on wooden boxed equipment, packages, and crates shall be paint-stenciled (not marking pens) and capable of remaining legible after extended periods of storage in bright sunlight and atmospheric conditions encountered enroute to storage at the destination.

All markings and tags on heavy cardboard boxes may be written on "peel and stick" labels with indelible marking pens, provided writing is neat and legible.

- 11.4 Combined Commercial Invoice/Packing Lists must be issued for each shipment indicating all material orders export packed per package, with copy attached to package detailing contents of that package prior to delivery to dock. If pricing is in question, Packing List only may be attached to package prior to dock delivery.
- 11.5 Final Combined Commercial Invoice/Packing List covering all shipments for a particular vessel must be completed and delivered to COMPANY within 48 hours of last dock delivery. Transfer should take place electronically.

12.0 **REPORTING**

- 12.1 SUPPLIER will provide COMPANY with the following reports within the time intervals and at the frequencies shown:
 - 12.1.1 Cargo "On Hold" Report (Detailing all cargo "On Hold" pending resolution of problems). Nature of problem to be outlined on Report (e.g., missing Purchase Order No., overages, shortages, damaged materials, incorrect part numbers, etc). Report shall be issued every Monday morning and transmitted to COMPANY & CONSULTANT electronically.
 - 12.1.2 "Packed Out" Report (Detailing all tonnage packed and ready for shipment). Report shall include SUPPLIER's estimate of 12.2 m (40 ft.) Standard Containers needed to move cargo. Report to be issued weekly and transmitted to COMPANY and CONSULTANT.



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OIL & GAS DEVELOPMENT COMPANY LTD.

SPECIFICATION FOR

WELDING



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1.0 **GENERAL**

1.1 **Scope**

This Specification covers the basic requirements for welding, heat treating, and non-destructive examination of certain pressure-containing components. This includes piping, pressure vessels, steam generators, fired heater coils, heat exchangers, pumps and compressors etc. requirements also apply to structural attachment welds in such equipment.

1.2 **Definitions**

Following definitions apply throughout this document:

OWNER / COMPANY: Oil & Gas Development Company Ltd. (OGDCL)

CONSULTANT M/s. Zishan Engineers (Pvt.) Ltd. (ZEL).ZEL have been awarded the work of Engineering, Procurement Assistance and Project Management.

CONTRACTOR: Means the construction company to be engaged by the COMPANY to perform the Construction work.

VENDOR / SUPPLIER: The organization, firm or agency with whom order for the supply of equipment and or material has been placed.

1.3 **Errors or Omissions**

1.3.1 Review and comment by the CONSULTANT / COMPANY of any CONTRACTOR / SUPPLIER's drawings, procedures or documents shall only indicate acceptance of general requirements and shall not relieve the CONTRACTOR/SUPPLIER of its obligations to comply with the requirements of this specification and other related parts of the contract documents.

1.3.2 Any errors or omissions noted by the CONTRACTOR/SUPPLIER in this Specification shall be immediately brought to the attention of the CONSULTANT / COMPANY.

1.4 **Deviations**

All deviations to this specification, other specifications or attachments shall be brought to the knowledge of the CONSULTANT / COMPANY in the bid. All deviations made during the procurement, design, manufacturing, testing and inspection shall be with written approval of the CONSULTANT prior to execution of the work. Such deviations shall be shown in the documentation prepared by the CONTRACTOR/SUPPLIER.

1.5 **Conflicting Requirements**

In the event of conflict, inconsistency or ambiguity between the contract scope of work, this Specification, National Codes & Standards referenced in this Specification or any other documents, the CONTRACTOR/ SUPPLIER shall refer to the CONSULTANT whose decision shall prevail.

2.0 **REFERENCES**

The following Guides and industry publications are referenced herein and shall be considered a part of this Specification. Refer to the latest editions unless otherwise specified.

2.1 ASME - American Society of Mechanical Engineers

- ASME B31.3 Process Piping
- ASME SEC I BPVC SECTION I Rules for Construction of Power Boilers
- ASME SEC II-C Material Specifications - Welding Rods, Electrodes and Filler Metals
- ASME SEC V BPVC SECTION V Nondestructive Examination
- ASME SEC V B SE-94 STANDARD GUIDE FOR RADIOGRAPHIC EXAMINATION
- ASME SEC VIII Rules for Construction of Pressure Vessels
- ASME SEC IX Qualification Standard for Welding and Brazing Procedures, Welding and Brazing Operators

2.2 AWS - American Welding Society

3.0 **WELDING PROCEDURE AND WELDER QUALIFICATIONS**

3.1 **Welding Procedures**

3.1.1 Welding procedures shall be in writing and shall be qualified in accordance with ASME SEC IX and this Specification, using the latest revision in effect on the date of the purchase order for the equipment being fabricated. All welding procedures shall include a weld procedure specification (WPS) and a procedure qualification record (PQR).

- 3.1.2 Complete welding procedures for all materials to be welded shall be submitted to the CONSULTANT for review and approval prior to use. These procedures shall include the following: Welding Procedure Specifications, Procedure Qualification Test Records, ranges of variables qualified, a weld map or description identifying which welding procedure will be used for each weld and the method and extent of inspection. The CONTRACTOR/SUPPLIER shall furnish complete information for each applicable item, as required. For piping a typical drawing representing all applicable weld procedures to be used on the work shall be submitted to the CONSULTANT for approval prior to work commencing.
- 3.1.3 Complete welding procedures shall be submitted for approval sufficiently in advance of the actual welding, so as to allow for adequate review and approval. A typical weld map (or specific weld map) where each procedure will be used shall be included with this submittal. No welding shall be performed until all such welding procedures are approved by the CONSULTANT.
- 3.1.4 The information contained in each welding procedure specification and in the procedure qualification test records shall include, but not be limited to, the information contained on forms QW 482 and QW 483 shown in ASME SEC IX.
- 3.1.5 All welding procedures shall be identified by number and referenced on all applicable fabrication drawings.

3.2 **Qualification of Welding Procedures**

- 3.2.1 P-number shall be considered an essential variable for all welding processes. Materials that do not have P-numbers (not listed in QW 422 of ASME SEC IX) shall be qualified individually.
- 3.2.2 Welding position shall be considered an essential variable for groove welds in all automatic welding processes.
- 3.2.3 All welding consumables not listed in ASME SEC II-C shall be individually qualified.
- 3.2.4 For submerged arc welding, brand name and grade of flux shall be considered an essential variable, together with changes in speed or heat input beyond the range qualified. The procedure qualification test record shall indicate the name of the manufacturer, plus the trade name of the wire and flux used to qualify the procedure.
- 3.2.5 Postweld heat treatment (time and temperature) shall be considered an essential variable for P-3, P-4, P-5, and P-6 materials. A decrease in time of more than 15 percent and/or in temperature of 10 percent or more, from the range qualified, will require a separate welding procedure qualification.

- 3.2.6 Impact testing of welds and heat-affected zones (HAZ) for ferritic materials at minimum design temperature is required for welding procedure qualification under the following conditions:
- a) When the base material requires impact testing
 - b) When the base material does not require impact testing, but the material thickness exceeds 12.7 mm (1/2 in) and the minimum design temperature is 0°C (32°F) or lower.
 - c) When the base metal does not require impact testing, but the submerged arc welding process is used with weld pass thickness greater than 9.5 mm (3/8 in).
- 3.2.7 When impact testing is required, the Charpy V-notch impact values for parent material, weld metal, and heat-affected zones shall be not less than those specified in ASME B31.3, Table 323.2.2. The impact test shall be performed on the same type (ASTM or other similar specification) and grade of material as will be used in fabrication.
- 3.2.8 Procedure qualifications for weld overlay deposits shall include a complete chemical analysis of the overlay, procedure qualification test record, and unless specifically waived by the CONSULTANT, a sample of the overlay. Specimens taken for chemical analysis shall be representative of material 2.5 mm (0.1 in) below the surface. The weld metal chemical composition shall be within the nominal range specified for the alloy. Monel overlays shall have a maximum iron content of 4.5 percent. The procedure qualification tests shall include the following:
- a) Dye penetrant examination of the completed weld
 - b) Side bend tests per QW 453 for weld metal soundness
 - c) Chemical composition analysis per QW 462.
- 3.2.9 Excessive fissuring shall be caused for rejection. Fissures shall not exceed four per specimen, nor shall they exceed 1.6 mm (1/16 in) in length. Cracks in corners shall not be considered part of the examination.
- 3.2.10 The welding procedure qualification tests shall include hardness tests of base, HAZ, and weld for the following materials:
- a) Quenched and tempered carbon steel
 - b) High-strength, low-alloy (HSLA) steel
 - c) Carbon-molybdenum (C-Mo), manganese-molybdenum (Mn-Mo), and chromium-molybdenum (Cr-Mo) steels.
 - d) Other air-hardenable materials.

- 3.2.11 Procedure qualification tests for welding carbon steel shall also include a hardness survey, if any of the following conditions exist:
- a) Submerged arc welding is performed with F8XX or higher flux designation.
 - b) Shielded metal arc welding is performed with covered electrodes of E80XX or higher classification.
 - c) Filler metal contains at least 1.6 percent manganese, or manganese and silicon exceed 1.4 and 0.8 percent, respectively.
 - d) The job specifications or data sheets require a maximum specified hardness in the weld and/or heat-affected zone.
 - e) Process conditions (wet hydrogen sulfide, amine, caustic) require production hardness testing.
- 3.2.12 The hardness testing for welding procedure qualification shall be performed on the base metal, weld, and heat-affected zone, with an instrument having an indenter not larger than 1.6 mm (1/16 in) in diameter. The hardness shall be reported as Brinell (HB) or Vickers (HV) equivalent numbers. Hardness surveys shall be performed along two lines parallel to the outer and inner surfaces of the weld, and located approximately 2 mm (0.08 in) below them. The type of hardness test instrument shall be reported and the test results shall meet the hardness requirement in accordance with ASME B31.3.
- 3.2.13 Welding procedure tests shall demonstrate that all details are capable of producing satisfactory full-penetration butt welds, unless the weld joints are specifically designated as fillet welds.
- 3.2.14 For gas tungsten arc and gas metal arc welding, the qualification record shall include the composition and flow rate of the shielding and inert gas backing, if used.
- 3.2.15 For the gas metal arc process, the electrode diameter and extension, amperage, voltage, wire feed rate, and travel speed shall be specified in the welding procedure.
- 3.2.16 Base material used in qualification tests shall have the nominal chemistry and mechanical properties of the material to be welded. For carbon steel, the carbon content of base material shall be at the higher end of the specification range.

3.3 **Qualification of Welders and Welding Operators**

- 3.3.1 Welders and welding operators shall be qualified in accordance with ASME SEC IX and local requirements, as a minimum. Qualification shall be completed prior to start of fabrication. Performance qualification records shall be made available to the CONSULTANT / COMPANY upon request. At the CONSULTANT / COMPANY option, witnessing of performance qualification, welding, and testing may be required.
- 3.3.2 Qualification of welders and welding operators solely by means of radiography of a weld sample is subject to the COMPANY approval.
- 3.3.3 Qualification of welders using the GMAW process shall be by mechanical testing only.

4.0 **WELDING PROCESSES**

- 4.1 Welds shall be made by the shielded metal arc, gas tungsten arc, gas metal arc, or submerged arc welding process. All other welding processing, including electro-gas, electro-slag, oxyacetylene and the flux cored process, require prior to the CONSULTANT / COMPANY approval.
- 4.2 The flux cored arc welding (FCAW) process may be used, subject to the CONSULTANT / COMPANY review and approval (proposal to use FCAW must be submitted prior to order placement), provided the following conditions exist:
 - 4.2.1 Gas shielding is used.
 - 4.2.2 Material to be welded is carbon steel or for application of weld overlay on carbon steel or low alloy steel.
 - 4.2.3 FCAW process is not "short arc"
 - 4.2.4 FCAW process is not used for the root pass in single-sided welding.
 - 4.2.5 Production consumables are restricted to the manufacturer and grade qualified.
 - 4.2.6 Only EXXT-1 or EXXT-5 (flat or horizontal position only) welding wires are used.
 - 4.2.7 Service is not hot hydrogen [over 260°C (500°F)], wet hydrogen sulfide, or hydrogen fluoride
 - 4.2.8 At least five percent of the individual welds are 100 percent radiographed or ultrasonically examined.

4.2.9 Ten percent of the nozzle to shell or head welds (including at least one of each size) shall be 100 percent radiographed or ultrasonically examined.

4.2.10 Low hydrogen electrodes are used

For all other applications not meeting the above conditions, FCAW process may be considered on a case-by-case basis. The review will include the evaluation of the specific application, verification of the fabricator's experience, additional qualification and/or NDE requirements, and the CONSULTANT / COMPANY witnessing of welding procedure and/or welder qualification.

4.3 The gas metal arc process (GMAW) in the "short circulating transfer" (short arc) mode may be used for the following purposes:

4.3.1 Root pass welding in a combination process.

4.3.2 Fit-up welding that will subsequently be completely removed by back gouging, chipping, or grinding

4.3.3 Weld metal overlays made in the flat position

4.3.4 Non-pressure retaining fillet welds made in the flat, horizontal, or vertical-up positions.

4.4 The short arc process shall not be used under the following conditions:

4.4.1 Where the joint geometry or large mass can affect the integrity of the weld; for example, on nozzles, couplings, slip-on flanges, socket-welded flanges, O-type branch fittings, or extended surface (FIN) attachments.

4.4.2 With ferritic or martensitic filler metal for design service below 0°C (32°F).

4.5 During GMAW short arc welding of the root pass, the root gap (including tolerance) shall not be less than 2.4 mm (0.1 in) wide. The root face thickness (including tolerance) shall not exceed 0.8 mm (3/32 in). All tack welds shall have both ends ground to feather edge.

4.6 Except for piping, double-welded butt joints shall be used wherever possible in pressure-containing equipment. Where access or wall thickness precludes the use of double-welded butt joints, single-welded joints may be made. This requires a root pass deposited by the GTAW process or (subject to the CONSULTANT approval) by the GMAW process.

4.7 A gas tungsten arc root pass is required for the following circumstances:

4.7.1 Single-welded, full-penetration butt joints in C-Mo, Mn-Mo, and Cr-Mo steels; in all non-ferrous alloys; and in carbon steel for hydrogen fluoride service.

- 4.7.2 All heater tubes
- 4.7.3 All carbon steel single-welded, full-penetration butt joints over 38 mm (1.5 in) thick.
- 4.8 In an inert gas welding process, inert gas backing (argon or helium) is not required for carbon steels, carbon-molybdenum steels, or low-alloy chromium-molybdenum steels with a chromium content not exceeding 1½ percent by weight. Inert gas backing shall be used for all other alloy materials, including aluminum and copper alloys. The use of nitrogen, however, for gas shielding of stainless steel shall not be allowed.
- 4.9 The following restrictions and limitations apply to all welding processes.
 - 4.9.1 All welding processes shall be protected from wind, rain, and other harmful weather conditions that can affect weld quality. CONTRACTOR/SUPPLIER shall provide habitat arrangements that afford full weather protection as approved by the CONSULTANT.
 - 4.9.2 Welding techniques shall be selected to ensure that specified tolerances for straightness and out-of-roundness are not exceeded. If such tolerances are not stated in the drawings, standards, or specifications, the applicable section of the relevant code shall govern.
 - 4.9.3 Welded joints shall be made by completing each layer before succeeding layers are deposited. Block welding is prohibited.
 - 4.9.4 Vertical welding shall be performed vertically up, downward vertical position welding shall not be permitted unless specifically approved in writing by the CONSULTANT.
- 4.10 The following limitations shall apply when welding aluminum:
 - 4.10.1 The gas tungsten arc process shall not use thoriated tungsten electrodes. Electrode configuration shall be shown in the welding procedure and shall be considered an essential welding variable.
 - 4.10.2 Except for piping, the gas metal arc process shall employ run on and run off tabs in all groove welding.
 - 4.10.3 For all processes, the welding procedure shall contain a detailed cleaning treatment indicating joint preparation prior to welding. All full-penetration joints shall be back-purged with argon or helium.

5.0 MATERIALS

5.1 Filler Materials and Flux

5.1.1 Filler metal for welding similar materials shall be of the same nominal analysis as the base material, except as follows:

- a) AWS Type 347 filler metal shall be used for welding Type 321 stainless steel material.
- b) AWS Type 308 filler metal shall be used for welding Type 304 stainless steel material. (Type 308L shall be used for Type 304L.)
- c) The following filler metals shall be used for welding 11 to 13 percent chromium steels: Inco-Weld A; Inconel 82 or 182; AWS E309, E410, or E410Cb. However, for 11 to 13 percent steels in cyclic service, or for design temperatures over 350°C (660°F), only Inco-Weld A, Inconel 82, or Inconel 182 are acceptable.
- d) For chromium-molybdenum steel, filler materials such as Inconel 82 or 182 or Inco-Weld A may be used, if approved by CONSULTANT.

5.1.2 Filler metals for welds joining dissimilar materials shall be in accordance with Table 1. Filler metals for combinations of materials other than those in Table 1 shall be submitted to CONSULTANT / COMPANY for approval.

Table 1: Filler Metal for Welds Joining Dissimilar Materials

Base Matl Num	Nominal Analysis of Base Materials	Base Material Number																								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
1	Carbon Steel		A	A	A	A	A	A	A	A	A	B	B	B	B	B	B	B	B	B	B	B	C	D	C	
2	Carbon-Molybdenum Steel	A		E	C	E	E	E	E	E	E	B	B	B	B	B	B	B	B	B	B	B	C	D	C	
3	2 1/2% Nickel & 3 1/2% Nickel Steel	A	E		C										B	B	B	B	B	B	B	B	C	C	C	
4	9% Nickel Steel	A	C	C											C	C	C	C	C	C	C	C	C	C	C	
5	1% Cr-1/2% Mo Steel	A	E				F	F	F	F	F				B	B	B	B	B	B	B	B	B	C	D	C
6	1 1/4% Cr-1/2% Mo Steel	A	E			F		F	F	F	F				B	B	B	B	B	B	B	B	B	C	D	C
7	2 1/4% Cr - 1% Mo Steel	A	E			F	F		F	G	G				B	B	B	B	B	B	B	B	B	C	C	C
8	5% Cr-1/2% Mo Steel	A	E			F	F	H	H		H	H			B	B	B	B	B	B	B	B	B	C	C	C
9	7% Cr-1/2% Mo Steel	A	E			F	F	G	H		I				B	B	B	B	B	B	B	B	B	C	C	C
10	9% Cr-1% Mo Steel	A	E			F	F	G	H	I			J	J	B	B	B	B	B	B	B	B	B	C	C	C
11	Type 405 Stainless Steel	B	B										K	K	B	B	B	B	B	B	B	B	B	C	C	C
12	Type 410S Stainless Steel	B	B								J	K		K	B	B	B	B	B	B	B	B	B	C	C	C
13	Type 410 Stainless Steel	B	B								J	K	K		B	B	B	B	B	B	B	B	B	C	C	C
14	Type 304 Stainless Steel	B	B	B	C	B	B	B	B	B	B	B	B	B		L	L	P	L	L	O	O	C	C	C	
15	Type 304L Stainless Steel	B	B	B	C	B	B	B	B	B	B	B	B	B	L		M	M	L	M	O	O	C	C	C	
16	Type 321 Stainless Steel	B	B	B	C	B	B	B	B	B	B	B	B	B	L	M		N	L	M	O	O	C	C	C	

Base Matl Num	Nominal Analysis of Base Materials	Base Material Number																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
17	Type 347 Stainless Steel	B	B	B	C	B	B	B	B	B	B	B	B	B	P	M	N		P	M	P	P	C	C	C
18	Type 316 Stainless Steel	B	B	B	C	B	B	B	B	B	B	B	B	B	L	L	L	P		Q	O	O	C	C	C
19	Type 316L Stainless Steel	B	B	B	C	B	B	B	B	B	B	B	B	B	L	M	M	M	Q		O	O	C	C	C
20	Type 309 Stainless Steel	B	B	B	C	B	B	B	B	B	B	B	B	B	O	O	O	P	O	O		R	C	C	C
21	Type 310 Stainless Steel	B	B	B	C	B	B	B	B	B	B	B	B	B	O	O	O	P	O	O	R		C	C	C
22	Alloy 800 (Incoloy 800)	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
23	Monel 400	D	D	C	C	D	D	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
24	Inconel 625	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C

Legend (Table 1)

- A AWS A5.1, classification EXX15, EXX16, or EXX18.
- B AWS A5.4 and AWS A5.11, classification E309-XX, ENiCrFe-3 (Inconel182), or ENiCrFe-2 (Inco-Weld A).
- C AWS A5.11, classification ENiCrFe-3 (Inconel 182) or ENiCrFe-2 (Inco-Weld A).
- D AWS A5.11, classification ENiCrFe-3 (Inconel 182), ENiCrFe-2 (Inco-Weld A), or ENiCr-7 (Monel 190).
- E AWS A5.5, classification E7015-A1, E7016-A1, or E7018-A1.
- F AWS A5.5, classification E8016-B2, E8018-B2, or E8015-B2L, E8018-B2L.
- G AWS A5.5, classification E9015-B3, E9016-B3, E9018-B3, or E9015-B3L, E9018-B3L.
- H AWS A5.4, classification E502-XX.
- I AWS A5.4, classification E7Cr-XX.
- J AWS A5.4, classification E505-XX.
- K AWS A5.4 and AWS A5.11, classification E410-XX, E410 Cb-XX, E309-XX, ENiCrFe-3 (Inconel 182), or ENiCrFe-2 (Inco-Weld A).
- L AWS A5.4, classification E308-XX.
- M AWS A5.4, classification E308L-XX.
- N AWS A5.4, classification E347-XX.
- O AWS A5.4, classification E309-XX or E308-XX.
- P AWS A5.4, classification E308-XX or E347-XX.
- Q AWS A5.4, classification E316-XX or E316L-XX.
- R AWS A5.4, classification E309-XX.

Notes:

1. Blank spaces in Table 1 indicate combinations that are considered unlikely or unsuitable. For these combinations, consult COMPANY / CONSULTANT to approval.
2. Table 1 refers to coated electrodes. For bare wire welding (SAW, GMAW, GTAW), use equivalent electrode classifications (AWS A5.9, AWS A5.14, AWS A5.18, AWS A5.20, AWS A5.23, and AWS A5.28).
 - 5.1.3 Filler metals for welds shall meet the same minimum impact test requirements as those imposed on the base metal.
 - 5.1.4 In all welding processes, the filler wire shall contain all alloying elements and shall meet all chemical composition requirements for the wire classification. Exceptions are subject to CONSULTANT approval.
 - 5.1.5 For gas metal arc welding of carbon steels, base wire filler metals shall conform to AWS A5.18.
 - 5.1.6 For gas tungsten arc welding of carbon steels, the filler metal shall meet the chemical and physical test requirements of AWS A5.18.
 - 5.1.7 For flux cored arc welding of carbon steels (when permitted by Section 5.2), the electrodes shall conform to AWS A5.20. These electrodes shall be used with an external shielding gas.
 - 5.1.8 Carbon steels shall not be welded with C-1/2 Mo weld metal, unless the weld is post weld heat treated and the procedure qualification record includes weld hardness data. These data shall show that the weld and heat-affected zone have not exceeded with reference Codes and Standards.
 - 5.1.9 Filler metals and consumable inserts for austenitic stainless steel welds shall be selected to produce weld deposits, which fall within the ferrite ranges and numbers, in accordance with reference Codes and Standards. This restriction is intended to prevent problems associated with sigma-phase formation and micro-fissuring in fully austenitic welds.
 - 5.1.10 For cryogenic service with temperatures of -100°C (-150°F) and lower, the ferrite content of all austenitic stainless steel welding materials shall be in the range 2 to 5 percent (FN2 to FN5).
 - 5.1.11 Austenitic stainless steel filler metals for service temperatures -100°C (-150°F) and below shall meet the impact requirements.
 - 5.1.12 For welding carbon steel, submerged arc welding wires shall be limited to AWS classifications ELXX and EMXXX.

- 5.1.13 All completed weld joints (except for 5 through 9 percent nickel steels) shall be within the mechanical property limits specified for the base materials to be joined.
- 5.1.14 All welding consumables shall be used within the limits recommended by their manufacturers. The welding parameters shall be as used in the welding procedure qualification.
- 5.1.15 Low-hydrogen electrodes are required for all shielded metal arc welding when any of the following conditions apply:
- Design temperature is below 0°C (32°F).
 - Valve or flange rating is Class 400 or higher.
 - Base metal has a carbon equivalent exceeding 0.43 percent, based on:

$$CE = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}$$

- Base metal has a minimum specified tensile strength greater than 415 Mpa (60,000 psi).
 - Thickness of butt welds and fillet welds (throat) exceeds 12.7 mm (1/2 in).
 - Castings are weld repaired.
- 5.1.16 For root pass welding of P-1 and P-3 steel piping materials, AWS cellulose electrode shall be used.
- 5.1.17 Electrodes, filler wires, and fluxes shall be kept clean, dry, and properly stored according to the manufacturer's recommendation.
- 5.1.18 For welding 5 through 9 percent nickel steels, the filler materials shall be reviewed and approved by CONSULTANT and qualified by procedure testing in the maximum plate thickness specified for each job.
- 5.1.19 Equivalency to AWS specifications of other national specifications for welding consumables shall be verified. The basis for equivalence shall be subject to CONSULTANT approval. Equivalence may be determined by review of consumables (electrodes and fluxes) and manufacturers' catalogs, and/or by chemical analysis and mechanical testing of weld deposits.

5.2 **Backing Rings and Consumable Inserts**

Permanently installed backing rings or strips shall not be used. Consumable inserts shall be used only with prior CONSULTANT / COMPANY approval.

6.0 **JOINT PREPARATION, SPACING, AND ALIGNMENT**

6.1 **Edge Preparation**

- 6.1.1 Welding bevels shall be suitable for the welding process to be used. For pressure-containing welds, the contour shall permit complete fusion throughout the joint. Bevels shall conform reasonably to those used in the procedure qualification.
- 6.1.2 All weld bevels and weld surfaces shall be free from cracks, porosity, slag inclusions, and other defects indicative of inferior workmanship.
- 6.1.3 Weld bevels shall be made by machining, grinding, or thermal cutting, and the surfaces shall be smooth, free of burning dross or fluting and true. Materials that require preheat for welding (refer to Section 10.1) shall be preheated in the same manner for thermal cutting or gouging.
- 6.1.4 Special weld bevel preparation is required for quenched and tempered carbon steels, HSLA steels, and steels containing more than 1/2 percent chromium. The steels shall be machined or ground back to clean and sound metal if they are flame or arc cut. At least 1.6 mm (1/16 in) of metal shall be removed.
- 6.1.5 Socket-welded joints shall have a gap between the bottom of the socket and the end of the pipe to be welded. The gap opening shall be at least 1.6 mm (1/16 in). The pipe for socket welding shall be square cut.

6.2 **Cleaning**

- 6.2.1 All surfaces to be welded shall be clean and free from paint, oil, dirt, scale, oxides, and other contaminants detrimental to welding. Cleaning shall be performed in a manner that will not lead to additional contamination of the weld or adjoining base metal.
- 6.2.2 Only stainless steel brushes and tools shall be used on stainless steel and nickel-alloyed materials.
- 6.2.3 Grinding disks containing sulfur (iron sulfide) shall not be used on steels with 5 through 9 percent nickel, stainless and alloy steels, or on non-ferrous materials.
- 6.2.4 Cleanliness shall be maintained after completion of welding. All stubs, rods, flux, slag, and foreign material shall be removed from the vicinity of the equipment or piping.

6.3 **Butt Joints**

- 6.3.1 Full penetration welds are required for single-sided welded joints.
- 6.3.2 Double-welded joints shall be prepared for back welding by grinding, arc-air gouging and grinding or chipping, so as to allow complete penetration and fusion. The depth of the back cut shall be sufficient to remove all the initial 1st pass welds but not deep enough to cause distortion in the welded joint by excess 2nd side welding.

6.4 **Tack Welds**

- 6.4.1 All tacks in the weld groove shall be performed by qualified welders (in conformance with ASME SEC IX), according to an approved welding procedure. Tack welding procedures, including for bridge and bullet tacks shall be qualified prior to fabrication operations.
- 6.4.2 Non-groove tack welds to be incorporated into the main weld seams shall have the ends ground and feathered.
- 6.4.3 Tack welds made by non-ASME SEC IX welders shall be completely ground out. The ground areas shall be examined by the magnetic particle or dye penetrant method prior to completing the permanent weld.

7.0 **WELD CONTOUR AND FINISH**

- 7.1 Weld beads shall be contoured to permit complete fusion at the sides of the bevel and to eliminate inter run and side wall slag inclusions. Flux and slag shall be removed completely from weld beads and from the surface of completed welds and adjoining base material. The flux removal shall be performed in a manner that will not cause the weld or adjoining base material to become contaminated or overheated.
- 7.2 Weld reinforcement and finish shall be as required by the applicable codes and standards. Undercutting of base metal is prohibited, except for piping fabricated according to ASME B31.3, undercutting shall be removed by smooth profile toe grinding, where allowed.
- 7.3 After removal of temporary welded attachments on all materials, except carbon steel (P-1) and austenitic stainless steel (P-8), the weld area shall be dressed and examined by magnetic particle or dye penetrant for the detection of cracks. Any defects found shall be removed and repaired.
- 7.4 Peening of partial or completed welds shall not be permitted, unless prior approval is given by CONSULTANT and the CONTRACTOR/SUPPLIER can demonstrate that the final weld joint integrity has not been affected.
- 7.5 All arc strikes, starts, and stops shall be confined to the welding groove. Arc strikes outside the welding groove shall be removed by grinding and examined by magnetic particle or liquid dye penetrant.

8.0 ALLOY LINING

- 8.1 VENDOR/SUPPLIER approval is required for any proposed alloy overlay system.
- 8.2 For both integrally clad plate and weld overlay, the surface of base plate welds that would be exposed to the corrosive environment shall be protected by depositing not less than two layers of corrosion-resistant weld metal.
- 8.3 In austenitic stainless steel overlays, where the base metal requires PWHT or the design temperature exceeds 450°C (840°F), the first weld layer shall be made with Type 309L. Subsequent layers of deposit shall be made with low-carbon, 18 Cr-8 Ni stainless steel, or stabilized grades of austenitic stainless steel, depending upon service conditions.
- 8.4 For Monel overlays on carbon or low-alloy steel, the first layer shall be made with a high-nickel consumable (nickel or Inconel). The second and any successive layers shall be made with a filler metal that nominally matches the Monel chemistry. The first layer of high-nickel deposit shall be applied over bright, clean, oxide-free steel.
- 8.5 When integrally clad stainless plates are being joined, the following shall apply:
 - 8.5.1 The clad layer shall be stripped for a minimum distance of 8 mm (0.31 in) from the bevel. In addition, the base material shall be etched with nitric acid or copper sulfate to ensure prevention of austenitic weld dilution.
 - 8.5.2 When the cladding is removed, the base material thickness shall not be reduced below the design thickness by more than 1 mm (0.04 in).
 - 8.5.3 The procedure for back-cladding of internal attachments and nozzle welds requires approval by CONSULTANT. This procedure shall include base metal examination, welding sequence, and final inspection.
- 8.6 All internal exposed alloy welds joining clad components, and all alloy weld overlays inside vessels and heat exchangers shall be fully examined by the liquid dye penetrant method.
- 8.7 A certified report of the chemical analysis of production as-deposited alloy weld overlays, or alloy welds covering base metal welds in clad plates, shall be furnished to CONSULTANT. The weld metal chemistry shall be within the nominal range specified for the alloy. At least three drillings from each vessel section (vessel can), each heat exchanger, and each head shall be made to obtain sample material for analysis. One sample shall be taken at the beginning of the overlay and two samples at locations to be designated by the inspector. The samples shall be taken 2.5 mm (0.1 in) below the surface of the material.

Welding overlays shall be qualified in accordance with the WPS and PQR requirements specified herein. The Procedure Qualification Record shall also include corrosion testing of the weld overlays, specifically the ASTM G48 test and the ASTM A262 test. The G48 test shall yield a corrosion rate of 5 mpy or less. The A262 test shall show no evidence of cracking or pitting at 100x magnification.

9.0 THERMAL TREATMENT

9.1 Preheat and Interpass Temperature

The minimum preheat temperatures for thermal cutting, arc-air gouging, and welding (including butt, fillet, socket, seal, and tack welds) shall be in accordance with the requirements of the applicable code. Exceptions are as follows:

- 9.1.1 No welding shall be performed when metal temperature is 0°C (32°F) or lower.
- 9.1.2 Carbon steel shall be preheated to 10°C (50°F) , minimum, unless low-hydrogen electrodes are to be used.
- 9.1.3 Carbon steel shall be preheated to 93°C (200°F), minimum, when any of the following conditions apply:
 - a) Base metal thickness exceeds 25.4 mm (1 in)
 - b) Carbon content exceeds 0.30 percent
 - c) Carbon equivalent exceeds 0.43 percent, based on:

$$CE = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}$$

- d) The material is highly restrained; for example, nozzles or major attachments.
 - e) All ferritic alloy materials shall be preheated in accordance with Table 2.
 - f) The maximum interpass temperature for austenitic stainless steels shall be 180°C (350°F).
- 9.1.4 The maximum preheat and inter-pass temperature for carbon steel and low-alloy steel shall be 300°C (572°F), unless otherwise approved by CONSULTANT.
 - 9.1.5 During the welding of a casting, an area extending 300 mm (12 in) on either side of the weld shall be maintained at the approved preheat and inter-pass temperature.
 - 9.1.6 The preheat and inter-pass temperature shall be determined by temperature-indicating crayons, contact pyrometers, thermocouples, or other equally suitable means. Temperature-indicating crayons used on austenitic stainless steels and nickel-base alloys shall cause no corrosive or other harmful effects. They shall not contain more than one percent by weight of total halogens or sulfur, or 200 ppm by weight of inorganic halogens. It is the fabricator's responsibility to determine suitable brands and melting temperatures that may be used. This information shall be made available to CONSULTANT upon request.

- 9.1.7 When the specified preheat temperature is 150°C (300°F) or higher, the metal shall be maintained at preheat temperature until the welds are completed. The preheat temperature shall be maintained until the start of post weld heat treatment or unless an intermediate tempering treatment is performed, for welds in thickness over 50 mm (2 in) or under a high degree of restraint (at nozzles, branch connections, and the like). CONSULTANT shall be consulted if uncertainties exist regarding the degree of restraint. An intermediate tempering heat treatment shall consist of heating to 600°C (1100°F), minimum, holding for a minimum of 15 minutes, and cooling slowly to the ambient temperature.
- 9.1.8 As an alternative for butt welds only, a hydrogen out-gassing treatment can be substituted for the intermediate tempering treatment. The hydrogen out-gassing procedure shall consist of either raising the preheat temperature to 260°C - 300°C (500°F - 570°F) and holding for four hours, or raising the preheat temperature to 325°C - 400°C (620°F - 750°F) and holding for two hours. All other pressure welds, such as nozzle and manhole attachment welds, shall be given the full 600°C (1100°F) tempering treatment. The foregoing out-gassing procedure does not apply to 5 through 9 percent nickel steels.

Table No. 2: Minimum Preheat Temperatures for Ferritic Materials

Material (Nominal Analysis)	P-No.	Minimum Preheat Temperature	
		°C	°F
Carbon Steel	1	(Refer to Paragraph 10.1)	
Manganese- Molybdenum	3	150	300
C - 1/2 Mo	3	95	200
1/2 Cr - 1/2 Mo	3	95	200
1 Cr - 1/2 Mo	4	150	300
1 1/4 Cr - 1/2 Mo	4	150	300
2 1/4 Cr - 1 Mo	5	200	400
3 Cr - 1 Mo	5	200	400
5 Cr - 1/2 Mo	5	200	400
7 Cr - 1/2 Mo	5	200	400
9 Cr - 1 Mo	5	200	400
12 Cr (martensitic)	6	200	400
12 Cr (ferritic)	7	10	50
2 1/4 Ni	9A	150	300
3 1/2 NI	9B	150	300
5 Ni	11A	150	300
9 Ni	11A	150	300

9.2 Postweld Heat Treatment (PWHT)

9.2.1 PWHT shall conform to the applicable construction code, except as follows:

- a) Minimum PWHT of ferric materials shall conform to Table 3.
- b) All ferritic piping materials, except carbon steel piping with wall thickness 19 mm (3/4 in) or less (nominal thickness), shall be post-weld heat treated.
- c) The PWHT for welds joining austenitic stainless steels to dissimilar materials shall be as specified in the qualified welding procedure and approved by CONSULTANT prior to the start of fabrication.
- d) Under special circumstances (non-critical service), PWHT of field welds in low-alloy steels (C-Mo, Mn-Mo, and Cr-Mo) made with Inconel filler metal may be omitted, subject to CONSULTANT approval.
- e) For P-6 materials, the PWHT temperature used shall be the lowest possible to avoid overheating and hardening on cooling.
- f) Holding time at PWHT temperatures shall be one hour per 25.4 mm (1 in) of thickness, with a one-hour minimum. For chromium-molybdenum steels (1/2 to 9 percent chromium) and 12 percent chromium stainless steels, the minimum holding time shall be two hours.
- g) For P-3, P-4, P-5, and P-6 materials, the production PWHT (time and temperature) shall be essentially the same as in the welding procedure qualifications.
- h) A sufficient number of thermocouples or other acceptable measuring devices shall be attached, so as to accurately indicate metal temperature in all critical areas during PWHT.
- i) Direct flame impingement by torch or furnace burner during PWHT is not permitted.
- j) No exothermic heat treatment shall be allowed without prior written approval from CONSULTANT.

Table No. 3: Post Weld Heat Treatment for Ferritic Materials

Material (Nominal Analysis)	P-No.	PWHT Temperature Range	
		°C	°F
Carbon Steel	1	610 - 665	1130 - 1230
Manganese-Molybdenum	3	620 - 720	1150 - 1325
C - 1/2 Mo	3	620 - 720	1150 - 1325
1/2 Cr - 1/2 Mo	3	620 - 720	1150 - 1325
1 Cr - 1/2 Mo	4	705 - 745	1300 - 1375
1 1/4 Cr - 1/2 Mo	4	705 - 745	1300 - 1375
2 1/4 Cr - 1 Mo	5	720 - 760	1325 - 1400
3 Cr - 1 Mo	5	720 - 760	1325 - 1400
5 Cr - 1/2 Mo	5	720 - 760	1325 - 1400
7 Cr - 1/2 Mo	5	720 - 760	1325 - 1400
9 Cr - 1 Mo	5	720 - 760	1325 - 1400
12 Cr (martensitic)	6	720 - 790	1325 - 1450
12 Cr (ferritic)	7	None	None
2 1/4 Ni	9A	595 - 635	1100 - 1175
3 1/2 Ni	9B	595 - 635	1100 - 1175
5 Ni	11A	550 - 585	1025 - 1085
9 Ni	11A	550 - 585	1025 - 1085

Notes:

1. The temperature of any part of weldment during PWHT shall not be less than shown above. The minimum holding time at temperature shall be one hour.
2. This table does not apply to normalized and tempered materials or to quenched and tempered materials. The PWHT of such materials shall be approved by CONSULTANT. It shall be such that the weld and HAZ hardnesses do not exceed with ASME B31.1, and the mechanical properties are not less than the specification minimum.

- 9.2.2 The maximum Brinell hardness of welds and heat-affected zones in all steels after heat treatment shall be in accordance with ASME B31.3. If welds are furnace heat treated, a sufficient number (10 percent) shall be tested to verify that the hardness criterion has been met. If local heat treatment has been applied, each weld shall be tested.

10.0 INSPECTION AND EXAMINATION

10.1 General

Examinations of welds shall conform to procedures and acceptance standards required by the ASME Code. The exception is piping, which shall be in accordance with specification for fabrication/installation of piping and the paragraphs of this section.

Table 4: Weld Examination Procedures and Acceptance Standards

Method	Standard, ASME Code	
	Section I	Section VIII
Radiography: - Complete - Random	PW-51	Par. UW 51 Par. UW 52
Magnetic particle	N/A	Appendix 6
Liquid penetrant	N/A	Appendix 8
Ultrasonic	PW-52	Appendix 12

Notes:

1. Examination of piping welds fabricated in accordance with ASME B31.3 shall be in accordance with Specification for Fabrication/Installation of Piping.
2. Detailed weld inspection procedures and acceptance criteria shall be reviewed and approved by CONSULTANT.

10.2 All inspection and non-destructive examination (NDE) procedures shall be in writing and submitted to CONSULTANT for approval. All inspections and NDE shall be performed in accordance with the approved procedures. The NDE operators shall be at least ASNT Level – II certified for the examination they are performing.

10.3 Welds that are to be examined by non-destructive methods shall be finished as required by the applicable code.

10.4 **Radiographic Examination**

The following are additional requirements for radiographic examination:

- 10.4.1 ASME SEC V-B-2-SE-94 Type 1 fine-grain film (Kodak AA or equivalent) shall be used.
- 10.4.2 Only lead screens shall be used.
- 10.4.3 Use of penetrameters other than those specified in ASME SEC V-B-2-SE-94, Article 2 and 22 (ASTM SE 94), (such as DIN/IIW wires) is permissible. However, the thickness sensitivity and hole sensitivity shall be equivalent to those required by the applicable ASME Code, and prior approval shall be obtained from CONSULTANT.
- 10.4.4 Suitable film density shall be used.
- 10.4.5 Radiography of welds in NPS 2½ pipe or smaller may be performed by the elliptical projection technique. At least two separate exposures are required at locations 90 degrees apart.

10.5 **Magnetic Particle Examination**

Following are additional requirements for magnetic particle examination:

- 10.5.1 Only the yoke method shall be used after final postweld heat treatment.
- 10.5.2 Permanent magnets or yokes shall be used on air-hardening steels.
- 10.5.3 In examination by the prod method, the control switch shall be built into the prod handles, so as to prevent arcing.
- 10.5.4 Severe arc strikes resulting from magnetic particle examination shall be removed by grinding and the area subject to 100% MPI or DPI.
- 10.5.5 Magnetic particle inspection shall not be used on 5 through 9 percent nickel steels.

10.6 **Liquid Penetrant Examination**

Following are additional requirements for liquid penetrant examination:

- 10.6.1 Except for piping, liquid penetrant shall only be used for non-magnetic materials and 5 through 9 percent nickel steels, unless otherwise approved by CONSULTANT.
- 10.6.2 Cleaning and developing solutions with a combined total residual sulfur and halogen content of one percent by weight or greater shall not be used.

10.7 **Ultrasonic Examination**

Following are additional requirements for ultrasonic examination:

- 10.7.1 The weld shall be examined from at least two different probe angles.
- 10.7.2 Welds are not acceptable if the echoes from discontinuities exceed the reference curve. Each weld groove face shall be completely examined from both sides of the joint. If, however, complete examination can be performed from one side only, echoes that exceed 50 percent of the reference curve are not acceptable. Echoes exceeding 20 percent of the reference curve shall be fully evaluated and accurately sized.
- 10.7.3 All echoes from discontinuities that exceed 50 percent of the reference curve shall be recorded in the examination report and transmitted to CONSULTANT. This record shall locate each area, the echo height, the dimensions, the depth below the surface, and the classification.

10.8 **Extent of Inspection**

The minimum inspection shall be as follows:

- 10.8.1 All welds shall be visually inspected after completion and inspected per the construction code and this specification.
- 10.8.2 For piping, the extent and type of examination shall be as required in accordance with reference Codes and Standards.
- 10.8.3 All final non-destructive examinations shall be performed after post weld heat treatment, unless otherwise approved by CONSULTANT. Final radiography or ultrasonic examination for vessels shall be performed no sooner than 48 hours after the vessel has cooled to ambient temperature. In special cases, based on equipment type, materials, and process conditions, NDE examination may be separated; some performed before PWHT and some after.
- 10.8.4 Where CONSULTANT allows non-destructive examination to be performed before the final post weld heat treatment, the welds shall also be examined on all accessible surfaces by the magnetic particle method (dye penetrant method for non-magnetic materials and all piping) after PWHT.
- 10.8.5 The attachment welds between structural components and pressure parts of quenched and tempered carbon steel, HSLA steel, and ferritic alloy materials shall be examined by the magnetic particle method (dye penetrant for piping) after PWHT. This requirement does not apply to 5 through 9 percent nickel steels.
- 10.8.6 All pressure-containing equipment designed with 100 percent joint efficiency, irrespective of material, shall have all nozzle and reinforcing pad attachment welds examined by the magnetic particle or liquid penetrant method, as applicable. Inspection shall be performed on all accessible weld surfaces (inside and outside).

- 10.8.7 After completion of welding. This final inspection shall be made after post weld heat treatment, if any.
- 10.8.8 When examination by radiography is specified but is not practical, ultrasonic examination or an alternative non-destructive test method shall be proposed for CONSULANT approval.
- 10.8.9 For all piping and heater coils requiring radiography, the minimum number of shots per circumferential seam shall be as follows:
- a) Up to and including NPS 2 1/2 diameter: two shots (90 degrees apart)
 - b) Over 2 1/2 NPS diameter: three shots (120 degrees apart)
- 10.8.10 Where random non-destructive examination is specified, at least one weld shall be examined for every material grouping, each welding process, and each welder. For each weld found to be defective, two additional representative welds shall be examined. If these additional welds are free from defects, only the defects indicated in the first examination shall be repaired and re-examined. However, if either of the two additional welds shows defects, all welds represented shall be either (1) fully non-destructively examined and repaired as necessary, or (2) completely replaced.
- 10.8.11 For spot radiography, at least one of each type and position of weld made by each welder shall be examined.

10.9 **Hardness Tests**

- 10.9.1 The hardness of welds and HAZ, when used in the as-welded condition or after post weld heat treatment, shall not exceed with reference Codes and Standards.
- 10.9.2 Where the following conditions occur, hardness tests of P-1 and P-3 materials shall be taken on the center of the inside surface of weld seams, where possible; otherwise, on the outside surface of the weld seams at the weld centre line and also the HAZ interface between the weldmetal and base material. (including nozzle, manhole, and attachment welds):
- a) Submerged arc welding is performed with F70 or higher flux classification.
 - b) Shielded metal arc welding is performed with covered electrodes of E80XX or higher classification.
 - c) Filler metal contains at least 1.6 percent manganese, or when manganese and silicon exceed 1.4 and 0.8 percent, respectively.
- 10.9.3 For carbon steel in critical service, such as wet H₂S, amine, HF, and caustic, the hardness of deposited weld metal shall not exceed 200 HB.

11.0 **REJECTION AND REPAIR**

- 11.1 Defects that are outside the limits of the codes, job specifications, or other requirements stated on the purchase order shall be cause for rejection. The CONTRACTOR/SUPPLIER shall provide rectification procedures and take such remedial action as is necessary to re-establish the weld integrity and secure acceptance by CONSULTANT. The cost of the remedial action shall be borne by the CONTRACTOR/SUPPLIER. The CONTRACTOR/SUPPLIER shall only attempt 2 repairs of a defective weldment before the complete weld is removed and replaced.
- 11.2 Repairs of major defects, and all repairs in plate or forgings, require prior approval by CONSULTANT. Repairs of weld defects are considered major when the defect size exceeds one-half the wall thickness and the thickness of the component is over 25.4 mm (1 in); or when the defect resulted in leakage during a hydrostatic test. The repair procedure shall be in writing and shall include information on methods used for defect removal, inspection of cavity, welding procedures, welding techniques and details of non-destructive examination of the excavated and repaired area.
- 11.3 All welds (including weld overlays) that are found by inspection to be unsound or that are deposited by procedures differing from those properly qualified shall be rejected. They shall be completely removed from the equipment and replaced in accordance with an approved procedure or be repaired, subject to CONSULTANT written approval.
- 11.4 Repair of local cavities in overlay welds that penetrate the base metal by more than 10 percent or 4.8 mm (3/16 in), whichever is the smaller, shall include having the base metal re-welded. The welding procedure and materials used shall be compatible with the original base metal.
- 11.5 Removal of defects by chipping, grinding, or gouging shall be done in such a manner as to avoid reducing the adjacent base material thickness. If the adjacent material thickness is reduced, it shall be restored to its original condition. Complete removal of defects shall be verified by non-destructive examination before repair is started. Repair welding shall be performed only by qualified welders using qualified procedures.
- 11.6 When a welder's or welding operator's welding is judged unsatisfactory by CONSULTANT, the welder shall be removed from the work. All such welding by that welder or operator shall be inspected by non-destructive examination and removed or repaired at CONTRACTOR/SUPPLIER expense, as directed by CONSULTANT. The welder may be reassigned after additional training and the completion of satisfactory re-qualification tests, but only with the approval of CONSULTANT.

12.0 **REPAIRS AND ALTERATIONS**

All repairs or alterations of existing welded equipment shall be done in accordance with the latest addition of the applicable code for new construction. For pressure vessels, both code and non-code repairs and alterations shall conform to ANSI NB-23 or other national requirements.

13.0 **WELD IDENTIFICATION**

In field and shop welding, each qualified welder or welding operator shall have an identification symbol assigned to him to ensure all production welds are traceable to the welder, WPS and NDE report. The welder shall permanently mark each pressure weld with this identification symbol. If more than one welder welds a joint, each shall apply his symbol in such a manner as to indicate the part of the joint he welded. Alternatively, subject to CONSULTANT written approval, an accurate record keeping system shall be established and maintained to identify welds and the welders that fabricate them.

14.0 **DOCUMENTATION**

All CONTRACTOR/SUPPLIER as built data reports for new construction, alteration, and repairs shall be furnished to CONSULTANT upon completion of the fabrication. Such documentation may include, but not be limited to, the following elements: assembly and spool drawings, welding procedures, heat treating charts, inspection records, and appropriate code documents. For details on as built documentation requirements, refer to specific equipment guides and Contract requirements. Sub CONTRACTOR/SUPPLIER shall provide a typical as built documentation index to CONSULTANT prior to work commencing.

Appendix – A - Explanation of Abbreviations

FCAW	Flux Cored Arc Welding
FIN	Ferrite Index Number
GMAW	Gas Metal Arc Welding
GTAW	Gas Tungsten Arc Welding
HAZ	Heat Affected Zone
HB	Brinnell Hardness
HSLA	High Strength, Low Alloy
HV	Vickers Hardness
NDE	Non-Destructive Examination
PWHT	Post Weld Heat Treatment
SAW	Submerged Arc Welding
SMAW	Shielded Metal Arc Welding
WRC	Welding Research Council

ATTACHMENT A: Inspection and Testing Requirements Sheet							
Facility Name:				Purchase Order No.:			
Location:				Requisition No.:			
Item Name: Pressure Containing Equipment				Project No.:			
Item No.:							
INSPECTION or TESTING		Supplier Inspection and Testing			ADDITIONAL COMMENTS		
		Contractor	Witness	Documented Results of Inspection or Test			
1 Fabrication and manufacturing procedures							
2	WPS	X	X	X	Review and Approval		
3	Welding (Each Operator)	X		X			
4	PMI	X		X	Review and Approval		
5	Welder or Welding Operator Qualification Record	X		X			
5	Quality Assurance / Control Manual	X	X	X	Review and Approval		
6	NDE Operator Records	X		X			
7	PWHT Procedures	X	X	X	Review and Approve procedure and PWHT charts		
8	Standard manufacturing checks and tests	X		X	Inspections/tests as per approved ITP		
9 Other Examination							
10	Radiographic Examination	X	X	X	Review of radiographs		
11	Ultrasonic Examination	X		X	As built records		
12	Magnetic Particle Examination	X		X	As built records		
13	Liquid Penetrant Examination	X		X	As built records		
14 Leak Testing							
15	Hydrostatic Leak Test	X	X	X	As built records / test charts		
16	Pneumatic Leak Test	X		X	As built records / test charts		
17	Special Leak Test	X		X	As built records / test charts		
18 Hardness Testing							
19	Welds	X		X	If PWHT is required by Code		
20	Heat Affected Zone	X		X	If PWHT is required by Code		
21 Impact Testing							
22	Welds and HAZ	X		X	As required to qualify WPS or materials		
23	Forged fittings	X		X	As required to qualify WPS or materials		
24 Prior to shipment							
25	Packaging and preservation				In accordance with shipping spec		
26	Fabrication/manufacturing record book	X	X	X	Review and sign off prior to shipping		
27	Issue of IRN	X	X	X	To release item (to include any OWL)		
Detailed Inspection and Testing Requirements:							
All CONTRACTOR/SUPPLIER HOLD inspection and test points will be identified during pre-construction meetings and formal mark up of the Inspection and Test Plan for the WORK.							
Notes:							
CONTRACTOR/SUPPLIER inspection/hold points shall be confirmed during prefabrication meeting.							
COMPANY at its option and with prior notification, shall be permitted free access to the CONTRACTOR/SUPPLIER facilities during all phases of the work for performing visual inspections and for routine checking of documentation and work progress.							
Revision Log							
Rev	Date	Aprvl	Description	Rev	Date	Aprvl	Description



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OIL & GAS DEVELOPMENT COMPANY LTD.

SPECIFICATION FOR CARBON AND STAINLESS STEEL PIPES



0	23-08-2012	Issued for Tender	MIAH	MIK	MAS
Rev.	Date	Description	Prepared By	Checked By	Approved By

C O N T E N T S

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1.0 **GENERAL**

1.1 **Scope**

This specification defines the minimum requirements for manufacturing, testing, inspection, packing & shipping of Carbon and Stainless Steel Pipes.

1.2 **Definitions**

Following definitions apply throughout this document:

COMPANY: Oil & Gas Development Company Ltd. (OGDCL)

CONSULTANT: M/s. Zishan Engineers (Pvt.) Ltd. (ZEL).ZEL have been awarded the work of Engineering, Procurement Assistance and Project Management.

CONTRACTOR: Means the construction company to be engaged by the COMPANY to perform the Construction work.

VENDOR / SUPPLIER: The organization, firm or agency with whom order for the supply of equipment and or material has been placed.

1.3 **Errors or Omissions**

1.3.1 The review and comment by the COMPANY of any SUPPLIER'S drawings, procedures or documents shall only indicate acceptance of general requirements and shall not relieve the SUPPLIER of its obligations to comply with the requirements of this specification and other related parts of the Contract Documents.

1.3.2 Any errors or omissions noted by the SUPPLIER in this Specification shall be immediately brought to the attention of the COMPANY.

1.4 **Deviations**

All deviations made during the procurement, design, manufacturing, testing and inspection shall be with written approval of the COMPANY prior to execution of work. Such deviations shall be shown in the documentation prepared by the Supplier.

1.5 **Conflicting Requirements**

In the event of any conflict, inconsistency or ambiguity between the SUPPLIER scope of work, this Specification, National Codes and Standards, referenced in the Project Specification or any other documents, the SUPPLIER shall refer to the COMPANY whose decision shall prevail.

1.6 **Supplier's Responsibility**

The SUPPLIER shall be responsible for the complete design, manufacture, supply, inspection and testing of all the Carbon and Stainless Steel pipes in full compliance with the applicable design codes and standards stated in section 2.0 of this document, all other project specifications and with the requirements of the COMPANY.

1.7 **Reporting Procedure**

1.7.1 A reporting and documentation system shall be agreed between the SUPPLIER and the COMPANY for the status of procurement, design, manufacturing, inspection, testing and shipment of the equipment/material to be supplied under this specification. SUPPLIER shall provide reports and summaries for production performance and testing operations in conformance with a manufacturing schedule approved by COMPANY.

1.7.2 Daily, weekly, monthly and run summaries of all major aspects of the production process shall be provided as reports to the COMPANY.

1.7.3 **Third Party Inspection**

In addition to the inspection and witnessing of tests by the SUPPLIER's inspectors during the manufacturing and shipment of the equipment/material, COMPANY may appoint a third party or its own inspector for witnessing of the inspection and tests to be carried out at SUPPLIER'S facility under this specification.

1.8 **Documentation**

1.8.1 Documents, drawings, etc., to be submitted to the COMPANY shall be in English Language.

1.8.2 Unless otherwise specified, metric units shall be used in documents and drawings.

1.8.3 Variations from or additions to this specification shall be called to the attention of the COMPANY and approved in writing by the COMPANY prior to starting fabrication.

1.8.4 Information for installation, inspection purposes shall be submitted to COMPANY.

2.0 **CODES & STANDARDS**

All Latest codes, standards and regulations mentioned below have been considered for the design basis:

API–American Petroleum Institute

- API 5L Specification for Line Pipe, 44th or Latest Edition

ASME–American Society of Mechanical Engineers

- ASME B36.10 Welded and Seamless Wrought Steel Pipe
- ASME B31.3 Process Piping
- ASME B16.47 Large Diameter Steel Flanges NPS 26 Through NPS 60
- ASME B1.20.1 Pipe Threads, General Purpose (Inch)
- ASME B16.25 Butt Welding Ends.
- Section IX Welding and Brazing Qualifications.

ASTM–American Society of Testing and Materials

- ASTM A106 Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
- ASTM A153 Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.
- ASTM A312/A312M Standard Specification for Seamless, Welded and Heavily Cold Worked Austenitic Stainless Steel Pipes E1-1996
- ASTM A333/A333M Standard Specification for Seamless and Welded Steel Pipe for Low-Temperature Service.
- ASTM A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

MSS-Manufacturers Standardization Society

- MSS SP-25 Standard Marking System for Valves, Fittings, Flanges and Unions.

3.0 **PROJECT SPECIFICATION**

- 165-4-SPM-046 Specification for Piping Class Material
- 165-4-SPM-031 Specification for Export Packing & Crating
- 165-4-SPM-034 Specification for Welding

4.0 **GENERAL REQUIREMENTS**

- 4.1 Carbon Steel, seamless and welded pipes for high temperature services as per ASTM specification of A 106 Gr. B or API 5L Gr. B.
- 4.2 Carbon Steel, seamless pipes for Low temperature services as per ASTM specification of A-333 Gr.B.
- 4.3 Carbon Steel Seamless, Galvanized, Screwed ended as per ASTM specification of A-106 Gr.B.
- 4.4 Austenitic Stainless Steel Seamless Pipes as per ASTM specifications A-312 Gr. TP-304.
- 4.5 The design, dimensions and weight of Carbon and Stainless Steel pipes shall comply with ASME B.36.10 upto 24" Size and ASME B16.47 for size above 24".
- 4.6 Unless specified otherwise, Pipes NPS ¼" through NPS 26 shall be furnished in single random length.
- 4.7 Except where threaded pipe is specified, NPS 1 ½" and smaller pipe shall be furnished with plain ends, Cut Square.
- 4.8 Pipes NPS 2 and larger shall be furnished with beveled ends to an angle of 30° + 5° - 0° measured from a perpendicular drawn to the axis of the pipe with a root face of 1.6 mm ± 0.5mm.
- 4.9 Threaded pipe shall be furnished with taper-threaded ends in accordance with ASME B1.20.1.
- 4.10 For a distance of 100mm both ends of the pipe, variation in outside diameter shall not be more than +0.5% or -0.1% max.
- 4.11 In case of wall thickness variation, wall thickness shall not deviate from the nominal thickness by more than 12.5% or -12.5%.
- 4.12 The weight of finished length of pipe shall not be less than 98.5%.

- 4.13 Pipe not in accordance with the purchase order and this specification shall be subject to rejection.
- 4.14 The SUPPLIER shall refer all conflicts between the requirements of the purchase order and this Specification to the COMPANY in writing, for clarification and resolution before proceeding with the manufacture and or procurement of the affected pipe.
- 4.15 Any substitution to, or variance from, this specification or purchase order require written approval from the COMPANY before implementation.
- 4.16 The SUPPLIER shall have an established, routine, and documented quality control program. When requested, the SUPPLIER shall submit this quality control program to the COMPANY for approval.

5.0 **MATERIAL**

- 5.1 Material used in the manufacturing of pipes shall be new and unused.
- 5.2 The Steel shall be made by one or more of the following processes: open-hearth, electric-furnace or basic-oxygen process, and shall be fully killed and made to fine grain practice.
- 5.3 Carbon Steel / Stainless Steel pipes shall conform to the requirements of chemical composition prescribed in Table 1 of the relevant ASTM Specifications.
- 5.4 At the request of the COMPANY an analysis for chemical composition shall be done. For this analysis, two pipes from each lot made by the SUPPLIER. The result of these analyses shall be reported to the COMPANY.

6.0 **TESTING & INSPECTION**

- 6.1 All Supplier facilities, materials, and fabrication work shall be subject to inspection by the COMPANY.
- 6.2 Pipe containing defects originating with the SUPPLIER design, materials, or workmanship, or which are not in complete compliance with the requirements of the purchase order and referenced documents will be subject to rejection.
- 6.3 Inspection and acceptance of the pipe by the COMPANY does not relieve the SUPPLIER of the responsibility to comply with the requirements of this specification and the purchase order.
- 6.4 The Pipes SUPPLIER shall perform all testing and examination required by the referenced standards and the purchase order.
- 6.5 Impact testing, when required, shall meet the requirements of ASME B31.3, Paragraph 323.3.

7.0 **MARKING**

- 7.1 All Marking Shall be in English.
- 7.2 Both ends of each pipe length shall be externally hard die stamped as a minimum with following information or according to the marking requirements of MSS-SP-25 and any additional requirements contained in the applicable material specifications:
- Heat/Cast no
 - Material/Manufacturer's Name
 - Outside diameter/ wall thickness
 - Work Inspector/Inspection Authority
- 7.3 Marking shall be stenciled on the inside of the pipe within 200mm of the beveled ends.
- 7.4 The pipes may be carefully die stamped on the Beveled end.

8.0 **ENGINEERING DATA REQUIREMENTS**

8.1 **General**

- 8.1.1 All records indicated herein shall be fully identified with the specific materials they represent. All records shall be available for examination to the COMPANY by the SUPPLIER at the time and place of inspection.
- 8.1.2 If Engineering data beyond those listed in this Practice are required, a statement of those requirements shall be included in the request for quotation and/or the purchase order.
- 8.1.3 All required engineering data shall be in English.

8.2 **Welding Procedures**

Welding Procedure Specifications (WPS) and Procedure Qualification Records (PQR), if applicable, shall be in accordance with ASME Boiler and Pressure Vessel Code, Section IX. Individual WPSs and PQRs shall be available for examination upon request.

8.3 **Material Test Reports**

SUPPLIER shall furnish Material Test Reports (MTRs) that show actual results of chemical analyses, mechanical tests, impact test results (if applicable), and heat treatment (if applicable) in compliance with the referenced material specification. The test reports shall be traceable to each production lot. These documents shall be identified with COMPANY order number and shall be signed by the SUPPLIER.

8.4 **Certificate**

SUPPLIER shall be liable to provide certificates of the manufactured pipes. This certificate in addition to the information required by specification A530/A 530M, the certification shall state whether or not the material was hydraulically tested. In case of nondestructively tested, the certificate shall so state.

9.0 **SHIPPING AND HANDLING**

- 9.1 Pipe shall be prepared for shipment in a manner that damages or atmospheric corrosion of internal or external surfaces is avoided during storage and transport.
- 9.2 Pipe ends shall be protected with wood, plastic, or metal covers. These covers shall protect the ends and prevent dirt and other foreign matter from entering the interior. Butt welding bevels are protected with metal covers, a layer of nonmetallic material shall also be provided between the butt-welding bevel and the metal cover. Tape shall not be used as the sole covering method.
- 9.3 Machined or threaded surfaces of Ferritic pipe shall be coated with an easily removable rust preventative compound, unless otherwise specified by purchaser. Pipe cleaned for special service shall not have rust preventative compound applied.
- 9.4 The SUPPLIER shall give assurance of required vapor-proof barrier material for Austenitic Stainless Steel pipe.
- 9.5 The Packing of the pipes shall also meet the packing requirements as detailed in specification for Export Crating and Packing (165-4-SPM-031).



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OIL & GAS DEVELOPMENT COMPANY LTD.

SPECIFICATION FOR CARBON AND STAINLESS STEEL FITTINGS



0	23-08-2012	Issued for Tender	MIAH	MIK	MAS
Rev.	Date	Description	Prepared By	Checked By	Approved By

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1.0 **GENERAL**

1.1 **Scope**

This specification alongwith defines the minimum requirements for manufacturing, testing, inspection, packing and shipping of factory-made Butt-welded, Socket Welded and threaded fittings of following material:

- 1.1.1 Carbon Steel for moderate and high temperature services as per ASTM A-234 Gr. WPB.
- 1.1.2 Carbon steel for Low temperature services as per ASTM-420 Gr. WPL 6.
- 1.1.3 Austenitic Stainless Steel as per ASTM A-403 Gr. WP304S.
- 1.1.4 Forged or Rolled alloy steel as per ASTM A182.F304.
- 1.1.5 Carbon Steel Forging Fittings as per ASTM A-105.

1.2 **Definitions**

Following definitions apply throughout this document:

COMPANY:	Oil & Gas Development Company Ltd. (OGDCL)
CONSULTANT:	M/s. Zishan Engineers (Pvt.) Ltd. (ZEL).ZEL have been awarded the work of Engineering, Procurement Assistance and Project Management.
CONTRACTOR:	Means the construction company to be engaged by the COMPANY to perform the Construction work.
VENDOR / SUPPLIER:	The organization, firm or agency with whom order for the supply of equipment and or material has been placed.

1.3 **Errors or Omissions**

- 1.3.1 The review and comment by the COMPANY of any SUPPLIER'S drawings, procedures or documents shall only indicate acceptance of general requirements and shall not relieve the SUPPLIER of its obligations to comply with the requirements of this specification and other related parts of the Contract Documents.
- 1.3.2 Any errors or omissions noted by the SUPPLIER in this Specification shall be immediately brought to the attention of the COMPANY.

1.4 **Deviations**

All deviations made during the procurement, design, manufacturing, testing and inspection shall be with written approval of the COMPANY prior to execution of work. Such deviations shall be shown in the documentation prepared by the SUPPLIER.

1.5 **Conflicting Requirements**

In the event of any conflict, inconsistency or ambiguity between the SUPPLIER'S scope of work, this Specification, National Codes and Standards, referenced in the Project Specification or any other documents, the SUPPLIER shall refer to the COMPANY whose decision shall prevail.

1.6 **SUPPLIER'S Responsibility**

The SUPPLIER shall be responsible for the complete design, manufacture, supply, inspection and testing of all the fittings in full compliance with the applicable design codes and standards stated in section 2.0 of this document, all other project specifications and with the requirements of the COMPANY.

1.7 **Reporting Procedure**

1.7.1 A reporting and documentation system shall be agreed between the SUPPLIER and the COMPANY for the status of procurement, design, manufacturing, inspection, testing and shipment of the equipment/material to be supplied under this specification. SUPPLIER shall provide reports and summaries for production performance and testing operations in conformance with a manufacturing schedule approved by COMPANY.

1.7.2 Daily, weekly, monthly and run summaries of all major aspects of the production process shall be provided as reports to the COMPANY.

1.7.3 **Third Party Inspection**

In addition to the inspection and witnessing of tests by the SUPPLIER inspectors during the manufacturing and shipment of the fittings, COMPANY may appoint a third party or its own inspector for witnessing of the inspection and tests to be carried out at SUPPLIER'S facility under this specification.

1.8 **Documentation**

1.8.1 Documents, drawings, etc., to be submitted to the COMPANY shall be in the English Language.

1.8.2 Unless otherwise specified, the metric units shall be used in documents and drawings.

1.8.3 Variations from or additions to this specification shall be called to the attention of the Company and approved in writing by the COMPANY prior to starting fabrication.

1.8.4 Information for installation, inspection purposes shall be submitted to COMPANY.

2.0 **CODES & STANDARDS**

All fittings shall be manufactured in accordance with the latest edition of the American Codes, standards & reference documents listed below and the requirements of this specification.

ASME-American Society of Mechanical Engineers

- ASME B16.9 Factory Made Wrought Steel Butt-welding Fittings.
- ASME B16.11 Forged fittings, Socket-Welding and Threaded.
- ASME B1.20.1 Pipe threads, General purpose (Inch)
- ASME B16.25 Butt welding Ends
- ASME B31.3 Process Piping

ASTM-American Society for Testing and Materials

- ASTM A153 Standard Specification for Zinc coating (Hot-Dip) on Iron and Steel Hardware.

MSS-Manufacturers Standardization Society

- MSS SP-25 Standard Marking system for valves, fittings, flanges and unions

Project Specifications

- Specification for Export Packing & Crating 165-4-SPM-031
- Specification for Welding 165-4-SPM-034
- Piping Class Specifications 165-4-SPM-046

3.0 **DESIGN**

Each condition of fittings shall be furnished in accordance with the following:

- 3.1 Butt Weld Ends – ASME B16.25
- 3.2 Socket Weld Ends- ASME B16.11
- 3.3 Threaded Ends-taper-threaded per ASME B1.20.1

4.0 **MATERIALS**

4.1 **Carbon Steel Fittings**

Steel used in the manufacture of fittings to this specification shall be fully killed and made by the Open-hearth, Electric-furnace or Basic-oxygen processes.

The chemical composition of each heat of steel shall be determined by the Manufacturer, and shall have maximum carbon content 0.30%, and maximum sulphur content 0.04%. and 0.30% and 0.058% for High temperature carbon steel.

The carbon equivalent shall not exceed 0.43% as determined by the following formula:

$$C.E. = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Cu + Ni}{15}$$

4.2 **Stainless Steel Fittings**

The Steel used in manufacturing of fittings to this specification shall be melted by one of the process Electric Furnace or Vacuum furnace.

The Chemical composition shall be determined by the manufacturer and shall have Maximum Carbon content 0.08% and sulphur 0.03%.

5.0 **HEAT TREATMENT**

All Carbon steel and Stainless steel Fittings shall be furnished in the heat treated condition

6.0 **DIMENSIONS**

6.1 Dimensions shall be generally in accordance with ASME B16.9

6.2 In all cases fittings shall be suitable for butt-welding into the adjacent pipe work with the internal diameter of ends and outlets matching that of the pipe.

7.0 **TRANSITION PIECES**

Where pipes of different material grades, or of different wall thickness (or both) are to be jointed, and where the miss-match of wall thickness cannot be rectified by grinding in accordance with the tolerances of ANSI B31.3, then a transition piece shall be used.

The transition piece shall have a length of at least 2 pipe diameters and shall have minimum specified yield strength equivalent to the thinner of the two pipes to be jointed. The ends of the transition pieces shall be machined to suit the respective pipe wall thickness.

8.0 **TESTING, INSPECTION AND REJECTION**

- 8.1 All SUPPLIER facilities, materials and fabrication work shall be subject to inspection by the COMPANY.
- 8.2 The Supplier shall afford the COMPANY's representative all reasonable facilities necessary to satisfy him the material is being produced and furnished in accordance with the specification.
- 8.3 Fittings supplied shall be examined visually. The surfaces of fittings shall be free from surface discontinuities more than 5% of specified wall thickness, finish scale and mechanical marks. General appearance, workmanship and fit-up shall be acceptable in accordance with ASME B31.3 paragraph 344.2. Dimensions of the fitting shall be checked against ASME B16.9 or approved SUPPLIER'S drawing.
- 8.4 Fittings containing defects originating with the SUPPLIER design, materials, or workmanship or which are not in complete compliance with the requirement of the purchased order and referenced documents will be subject to rejection.
- 8.5 Inspection and acceptance of the fittings by the COMPANY does not relieve the SUPPLIER of the responsibility to comply with the requirements of this specification and the purchase order.
- 8.6 The fittings SUPPLIER shall perform all testing and examination required by the referenced standards and the purchase order.
- 8.7 Impact testing, when required, shall meet the requirements of ASME B31.3, paragraph 323.3

9.0 **ENGINEERING DATA REQUIREMENTS**

- 9.1 All records indicated herein shall be fully identified with the specific materials they represent. All records shall be available for examination by the COMPANY.
- 9.2 All required engineering data shall be in English.
- 9.3 Welding Procedure Specification (WPS) and Procedure Qualification Records (PQR), if applicable, shall be in accordance with the ASME Boiler Vessel Code, Section IX. Individual WPSs and PQRs shall be available for examination by COMPANY'S request.
- 9.4 When requested by COMPANY, SUPPLIER shall furnish Material Test Reports (MTR) that show actual results of chemical analyses, mechanical tests, impact test results (if applicable) , and the heat treatment in compliance with the referenced material specification. The test report shall be traceable to each production lot. These documents shall be identified with the Company' purchase order number and shall be signed by the SUPPLIER'S authorized agent.
- 9.5 The SUPPLIER shall provide a certification of compliance with ASME B16.9, and the relevant ASTM standards and with the requirements of this specification.

10.0 **PRODUCT MARKING, COATING AND PACKING**

- 10.1 Each fitting shall have prescribed information stamped or otherwise suitably marked. The prescribed information for fittings shall be at least:
- Manufacturer's name or trademark.
 - Schedule No.
 - Nominal Wall Thickness.
 - Size, Class, grade, Length.
 - Fitting designation.
 - Heat No.
- 10.2 Fittings shall be supplied with a protective coating that does not hide marking or surface defects. This temporary coating combined with appropriate packing, must protect against corrosion during Ocean shipment. The coating shall be hard and dry. It can be either a clear coating or a thin opaque coating. Except for clear coating, the maximum dry film thickness shall be 0.076 mm. The fitting's normal stamped markings must be readable.
- 10.3 The welding ends shall be coated with an Aluminum-flake weld able primer or a coating that is easily strippable and does not leave a residue that interferes with welding. The maximum dry film thickness of a weld able coating shall not exceed 0.050 mm. A welding end strippable coating is allowed to be any thickness. Example of strippable coatings include high build vinyl, urethane, PVC or strippable tape applied before coating.
- 10.4 A fitting must be protected from mechanical damage. Welding ends must be protected with suitable wood, plastic or metal covers. Fittings must be packed in steel-banded wooden crates or secured to skids.
- 10.5 The Packing of the Fittings shall also meet the packing requirements as detailed in the specifications for Export Packing & Crating (165-4-SPM-031)



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OIL & GAS DEVELOPMENT COMPANY LTD.

SPECIFICATION FOR STEEL FLANGES



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1.0 **INTRODUCTION**

1.1 **General**

This specification is a standard specification for Steel Flanges and outlines the minimum requirements of the COMPANY.

This specification covers the manufacture, testing, and inspection of steel pipeline flanges, for use in pipelines and associated installations.

Flanges such as weld neck flanges and blind flanges shall conform to the requirements of ASME B16.5 upto sizes (24") and MSS-SP-44 for sizes (26") and above.

Spectacle blind and spacer & blind shall conform to the requirements of ASME B 16.48 upto sizes (24"). For sizes (26") and above, spectacle blind and spacer & blind shall conform to Manufacturer's standard.

Design and manufacture shall be in accordance with ANSI B16.5/MSS-SP-44, Steel Pipe Flanges and Flanged Fittings, the relevant ASTM standards, and with the requirements of this specification.

1.2 **Definitions**

Following definitions apply throughout this document:

COMPANY: Oil & Gas Development Company Ltd. (OGDCL)

CONSULTANT: M/s. Zishan Engineers (Pvt.) Ltd. (ZEL).ZEL have been awarded the work of Engineering, Procurement Assistance and Project Management.

CONTRACTOR: Means the construction company to be engaged by the COMPANY to perform the Construction work.

VENDOR / SUPPLIER: The organization, firm or agency with whom order for the supply of equipment and or material has been placed.

1.3 **Errors or Omissions**

1.3.1 The review and comment by the COMPANY / CONSULTANT of any SUPPLIER's or its manufacturer's drawings, procedures or documents shall only indicate acceptance of general requirements and shall not relieve the SUPPLIER of its obligations to comply with the requirements of this specification and other related parts of the contract documents.

1.3.2 Any errors or omissions noted by the SUPPLIER in this Specification shall be immediately brought to the attention of the COMPANY.

1.4 **Deviations**

All deviations to this specification, other specifications or attachments shall be brought to the knowledge of the COMPANY as a section in the bid. All deviations made during the procurement, design, manufacturing, testing and inspection shall be with written approval of the COMPANY prior to execution of the work. Such deviations shall be shown in the documentation prepared by the SUPPLIER.

1.5 **Conflicting Requirements**

In the event of conflict, inconsistency or ambiguity between the contract scope of work, this Specification, National Codes and Standards referenced in this Specification or any other documents, the SUPPLIER shall refer to the COMPANY whose decision shall prevail.

1.6 **Reporting Procedure**

1.6.1 A reporting and documentation system shall be agreed between the COMPANY and the SUPPLIER for the status of procurement, design, manufacturing, inspection, testing and shipment of the equipment/material to be supplied under this specification. SUPPLIER'S manufacturer shall provide reports and summaries for production performance and testing operations in conformance with a manufacturing schedule approved by COMPANY.

1.6.2 Weekly, monthly and run summaries of all major aspects of the production process shall be provided as reports to the COMPANY.

1.7 **Unit Responsibility**

The SUPPLIER shall be responsible for the complete design, manufacture supply, inspection and testing of the steel flanges, including full compliance with all applicable design codes, and standards, including those listed in Section 2.0 of this document and with the requirements of the independent certifying authority, where applicable.

2.0 **REFERENCE CODES & STANDARDS (LATEST EDITIONS)**

a) **Codes**

ANSI B 16.5, latest edition, Steel Pipe Flanges and Flanged Fittings

MSS-SP-44, latest edition, Steel Pipeline Flanges

ASTM Standards

b) Project Specifications

- Piping Class Specification 165-4-SPM-046
- Specification for Seamless Carbon & Stainless Steel Pipes 165-4-SPM-035

3.0 GENERAL REQUIREMENTS

Welding neck/slip-on flanges covered by this specification shall be in the range of nominal sizes as follows:

- Welding neck/slip-on flanges (2" to 24") incl as per ASME B 16.5.
- Welding neck flanges (26" and above) as per MSS-SP-44
- Blind flanges (2" to 24") incl. as per ASME B 16.48
- Blind flanges (26" and above) incl. as per Manufacturer's Standard

4.0 TEMPERATURE AND PRESSURE RATINGS

Class	Operating Pressure	Test Pressure
150	19.65 barg	29.50 barg
300	51.0 barg	76.5 barg
400	68.2 barg	102.3 barg
600	102.0 barg	153.0 barg

5.0 FLANGE FACINGS

Flanges shall be provided with Raised Faced (RF) unless otherwise specified in the Purchase Order.

Ring Type Joint (RTJ) flanges will be provided for Rating 900# or above.

6.0 MATERIAL

- 6.1 The steel used shall be suitable welding quality carbon steel, low grade as per ASTM A-105 / MSS-SP-44.

The steel shall be of such quality as to properly respond to the intended heat treatment, and shall be fully killed. Steel shall be made by the open hearth, basic oxygen, or electric furnace processes, and shall be suitable for field welding to other project fittings, flanges and pipe.

6.2 Chemical composition of the steel, as determined by ladle analysis, shall conform with the following:

Carbon	0.20% Max.
Sulphur	0.02% Max.

6.3 The Carbon equivalent shall be determined by formula:

$$\text{C.E.} = \text{C} + \frac{\text{Mn}}{6} + \frac{\text{Cr} + \text{Mo} + \text{V}}{5} + \frac{\text{Cu} + \text{Ni}}{15}$$

and shall not exceed a value of 0.42% on check analysis.

7.0 **TENSILE PROPERTIES**

In order to provide satisfactory transitions of flange hubs to adjacent pipe-work, materials of sufficiently high yield strength shall be selected.

8.0 **HEAT TREATMENT**

All flanges shall be furnished in the heat treated condition.

Details of the heat treatment employed shall be reported on the manufacturers material test certificates.

9.0 **DIMENSIONS**

9.1 All flange dimensions shall be in accordance with the requirements of the relevant standards

9.2 All flanges furnished to this specification shall be supplied with hub inside diameter uniformly bored to suit dimensions of matching pipe and shall not exceed $1.5 \times t$, where t is the run pipe thickness at the bevel of welding ends.

10.0 **INSPECTION, NON-DESTRUCTIVE TESTING, REPAIR OF DEFECTS**

10.1 Flanges shall be examined internally and externally for surface defects.

10.2 Repair by welding of injurious defects shall not be permitted after final heat treatment.

10.3 All flanges shall be subject to inspection at Suppliers works by the Purchaser or his representative.

11.0 **MARKING**

Marking shall be in accordance with the requirements of the relevant specifications and as may be further specified in the purchase order.

12.0 **CERTIFICATION**

The Supplier shall furnish test certificates covering all tests carried out and shall certify compliance with relevant specifications.



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OIL & GAS DEVELOPMENT COMPANY LTD.

SPECIFICATION FOR GASKETS



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1.0 **GENERAL**

1.1 **Scope**

This specification covers the following types of gaskets:

Non-metallic type consisting of a flat continuous non-metallic ring.

Combination type consisting of either a metallic core and non-metallic casing or a metallic retainer with non-metallic inserts for use in a High Pressure Gas pipeline and its associated equipment.

1.2 **Definitions**

Following definitions apply throughout this document:

COMPANY: Oil & Gas Development Company Ltd. (OGDCL)

CONSULTANT: M/s. Zishan Engineers (Pvt.) Ltd. (ZEL).ZEL have been awarded the work of Engineering, Procurement Assistance and Project Management.

CONTRACTOR: Means the construction company to be engaged by the COMPANY to perform the Construction work.

VENDOR / SUPPLIER: The organization, firm or agency with whom order for the supply of equipment and or material has been placed.

1.3 **Errors or Omissions**

1.3.1 The review and comment by the COMPANY of any Supplier's drawings, procedures or documents shall only indicate acceptance of general requirements and shall not relieve the SUPPLIER of its obligations to comply with the requirements of this specification and other related parts of the Contract Documents.

1.3.2 Any errors or omissions noted by the SUPPLIER in this Specification shall be immediately brought to the attention of the COMPANY.

1.4 **Deviations**

All deviations made during the procurement, design, manufacturing, testing and inspection shall be with written approval of the COMPANY prior to execution of work. Such deviations shall be shown in the documentation prepared by the Supplier.

1.5 **Conflicting Requirements**

In the event of any conflict, inconsistency or ambiguity between the SUPPLIER's scope of work, this Specification, National Codes and Standards, referenced in the Project Specification or any other documents, the SUPPLIER shall refer to the COMPANY whose decision shall prevail.

1.6 **Supplier's Responsibility**

The SUPPLIER shall be responsible for the complete design, manufacture, supply, inspection and testing of all the fittings including full compliance with the applicable design codes and standards stated described in this document, all other project specifications and with the requirements of the COMPANY.

1.7 **Reporting Procedure**

1.7.1 A reporting and documentation system shall be agreed between the SUPPLIER and the COMPANY for the status of procurement, design, manufacturing, inspection, testing and shipment of the equipment/material to be supplied under this specification. SUPPLIER shall provide reports and summaries for production performance and testing operations in conformance with a manufacturing schedule approved by COMPANY

1.7.2 Daily, weekly monthly and run summaries of all major aspects of the production process shall be provided as reports to the COMPANY.

1.7.3 **Third Party Inspection**

In addition to the inspection and witnessing of tests by the SUPPLIER's inspectors during the manufacturing and shipment of the equipment / material, COMPANY may appoint a third party or its own inspector for witnessing of the inspection and tests to be carried out at SUPPLIER's facility under this specification.

1.8 **Documentation**

1.8.1 Documents, drawings, etc., to be submitted to the COMAPNY shall be in the English Language.

1.8.2 Unless otherwise specified, the metric units shall be used in documents and drawings.

1.8.3 Variations from or additions to this specification shall be called to the attention of the COMPANY and approved in writing by the COMPANY prior to manufacturing.

1.8.4 Information for installation and inspection purposes shall be submitted to COMPANY.

2.0 **REFERENCE CODES & STANDARDS (LATEST EDITIONS)**

ASME B16.20 Metallic Gaskets for Pipe Flanges-Ring-Joint, Spiral-Would, and Jacketed.

3.0 **GENERAL REQUIREMENTS**

3.1 Type: The gaskets covered by this specification shall be suitable for use with RF Flanges ANSI Class 150, 300, 400 & 600.

3.2 Size: 50 mm (2 inch) and above.

4.0 **PRESSURE TEMPERATURE RATING**

All gaskets covered by this specification shall be suitable for use with natural gas at the maximum operating pressure and temperature.

5.0 **GOVERNING SPECIFICATIONS**

5.1 Gaskets up to and including 609.6mm (24 inch) size shall conform to ANSI B16.5 Annex E latest edition, except as allowed for, in sub-clause 16.6.4 (b).

5.2 If a proprietary combination gasket offered does not conform entirely to the standards called for in sub-clause 16.6.4 (a) then the Manufacturer must provide sufficient substantiating evidence with his tender to enable the Purchaser to satisfy himself of the gaskets suitability for use under all the conditions specified.

5.3 Spiral wound gasket as per ASME B 16.20 shall match flanges to ASME B 16.5 upto 24" and for 22" inch and 26" inch and above shall comply with MSS-SP 44

5.4 Non metallic gasket as per ASME B 16.21 shall match flanges to ASME B 16.5 upto 24" and for 22" inch and 26" inch and above shall comply with MSS-SP 44

6.0 **DIMENSIONS**

6.1 **Non-metallic and combination type**

- Gaskets up to (24 inches) in size excluding (22 inches) shall conform to ANSI B 16.5 Latest edition.
- Gaskets including 22(inches) and (26 inches) and above in size shall conform to MSS-SP44 Latest edition.
- I.D. of Gasket (G) shall be as listed.
- O. D. of Gasket (R) shall be increased to the bolt P.C.D minus one bolt diameter of the flange.

6.2 All gaskets shall be of the thickness and finish suitable for use at the design and service conditions specified.

6.3 All gaskets shall offer a continuous face to their adjacent flanges.

7.0 **MATERIALS**

7.1 **Non-metallic gaskets**

Shall be made either from Klingerite, or other similar proprietary material recommended by the manufacturer as suitable for use at the specified design and service conditions.

7.2 **Combination gaskets**

All metallic components shall be spiral wound 316L.

All non-metallic components must be either creep resistant or suitably restrained by the metallic parts, and free from any age hardening properties which would ultimately impair their sealing properties.

8.0 **INSPECTION**

Visual inspection only, at the Purchaser's option, will be required.

9.0 **MARKING**

Each gasket shall be clearly tagged by the Manufacturer with:

- Flange size
- Flange rating

10.0 **PACKING**

Gaskets shall be packed so as to prevent damage during shipment.



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OIL & GAS DEVELOPMENT COMPANY LTD.

SPECIFICATION FOR STUD BOLTS & NUTS



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1.0 **GENERAL**

1.1 **Scope**

This specialization cover the requirements for stud bolts and nuts connecting carbon and low alloy steel pipe flanges on high pressure pipelines and associated facilities.

1.2 **Definitions**

Following definitions apply throughout this document:

COMPANY:	Oil & Gas Development Company Ltd. (OGDCL)
CONSULTANT:	M/s. Zishan Engineers (Pvt.) Ltd. (ZEL).ZEL have been awarded the work of Engineering, Procurement Assistance and Project Management.
CONTRACTOR:	Means the construction company to be engaged by the COMPANY to perform the Construction work.
VENDOR / SUPPLIER:	The organization, firm or agency with whom order for the supply of equipment and or material has been placed.

1.3 **Errors or Omissions**

1.3.1 The review and comment by the COMPANY of any Supplier's drawings, procedures or documents shall only indicate acceptance of general requirements and shall not relieve the SUPPLIER of its obligations to comply with the requirements of this specification and other related parts of the Contract Documents.

1.3.2 Any errors or omissions noted by the SUPPLIER in this Specification shall be immediately brought to the attention of the COMPANY.

1.4 **Deviations**

All deviations made during the procurement, design, manufacturing, testing and inspection shall be with written approval of the COMPANY prior to execution of work. Such deviations shall be shown in the documentation prepared by the Supplier.

1.5 **Conflicting Requirements**

In the event of any conflict, inconsistency or ambiguity between the SUPPLIER scope of work, this Specification, National Codes and Standards, referenced in the Project Specification or any other documents, the SUPPLIER shall refer to the COMPANY whose decision shall prevail.

1.6 **Supplier's Responsibility**

The SUPPLIER shall be responsible for the complete design, manufacture, supply, inspection and testing of all the studs and nuts in full compliance with the applicable design codes and standards stated described in this document, all other project specifications and with the requirements of the COMPANY.

1.7 **Reporting Procedure**

1.7.1 A reporting and documentation system shall be agreed between the SUPPLIER and the COMPANY for the status of procurement, design, manufacturing, inspection, testing and shipment of the equipment/material to be supplied under this specification. SUPPLIER shall provide reports and summaries for production performance and testing operations in conformance with a manufacturing schedule approved by COMPANY

1.7.2 Daily, weekly, monthly and run summaries of all major aspects of the production process shall be provided as reports to the COMPANY.

1.7.3 **Third Party Inspection**

In addition to the inspection and witnessing of tests by the SUPPLIER's inspectors during the manufacturing and shipment of the material. COMPANY may appoint a third party or its own inspector for witnessing of the inspection and tests to be carried out at SUPPLIER's facility under this specification.

1.8 **Documentation**

1.8.1 Documents, drawings, etc., to be submitted to the COMAPNY shall be in the English Language.

1.8.2 Unless otherwise specified, the metric units shall be used in documents and drawings.

1.8.3 Variations from or additions to this specification shall be called to the attention of the COMPANY and approved in writing by the COMPANY prior to manufacturing.

1.8.4 Information for installation and inspection purposes shall be submitted to COMPANY.

2.0 **SIZES**

This specification covers sizes from 12.7 to 89 mm ($1/2$ " to 3- $1/2$ ") bolt diameter.

3.0 **TYPE**

Each stud bolt shall be threaded full length and supplied with two hexagonal head nuts and two washers

4.0 **DIMENSIONS**

Dimensions shall be in accordance with ANSI B18.2.

5.0 **MATERIALS**

- Stud bolts shall be alloy steel in accordance with ASTM A 193 Grade B7, Galvanized.
- Nuts shall be carbon steel to ASTM A 194 Grade 2H. Galvanized
- Washers shall be in accordance with ASTM A-307

Nuts machined from bar stock in such a manner that the axis will be parallel to the direction of rolling of the bar are not acceptable.

6.0 **THREADS**

All bolting supplied to this specification shall be threaded in accordance with ANSI B 1.20.1.

Stud bolts shall have Class 2A dimension. Nuts shall have Class 2B dimensions.

7.0 **PACKING**

All stud bolts shall be suitably protected so as to prevent rust and/or mechanical damage during transit.

The method of protection shall be approved by the Purchaser.

8.0 **INSPECTION**

Unless otherwise indicated in the Purchase Order all material shall be subject to inspection by the Purchaser or his representative.

9.0 **CERTIFICATION**

The Supplier shall furnish certificates of compliance with the relevant specification and of chemical analyses and mechanical tests carried out.



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OIL & GAS DEVELOPMENT COMPANY LTD.

SPECIFICATION FOR STEEL GATE, PLUG, BALL AND CHECK VALVES



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1.0 **INTRODUCTION**

1.1 **Scope**

This specification covers flanged and welding end steel gate, plug, ball and check valves for use in gas pipeline, pipe work and associated facilities.

1.2 **Definitions**

Following definitions apply throughout this document:

- **COMPANY:** Oil & Gas Development Company Ltd. (OGDCL)
- **CONSULTANT:** M/s. Zishan Engineers (Pvt.) Ltd. (ZEL).
ZEL have been awarded the work of Engineering, Procurement Assistance and Project Management.
- **CONTRACTOR:** Means the construction company to be engaged by the COMPANY to perform the Construction work.
- **SUPPLIER/VENDOR:** The organization, firm or agency with who order for the supply of equipment and or material has been placed. SUPPLIER shall solely be responsible for the quality and satisfactory performance of all the items included in his scope of supply.

2.0 **SCOPE**

The CONTRACTOR / SUPPLIER scope of work shall include, among others, the following items of work:

- 2.1 All valves shall comply with the requirements of ANSI B16.10.
- 2.2 Valves shall be made in accordance with API STD 6D, Specification for steel gate, plug, ball and check valves. latest edition. and with the requirements of this specification.
- 2.3 Valve size, type, and rating, material connection type and, where possible, dimensions for operating mechanisms will be specified on the Purchase order.
- 2.4 Where indicated on the specifications/data sheets, valves shall be actuated.
- 2.5 Requirements for ball valves, laid down in the specification for mainline Ball valves, Spec No. 165-4-SPM-044, shall also be applicable.

3.0 **GENERAL SERVICE CONDITIONS**

- 3.1 Fluid handled: Natural Gas
- 3.2 Valves may be installed:
- Underground with dirt cover over the pipe.
 - Underground in covered sump.
 - Above ground unsheltered.
- 3.3 Valve stem may be positioned:
- Vertically
 - Horizontally

4.0 **MATERIAL**

- 4.1 Bodies, including end flanges and welding ends, bonnets and covers of valves shall be made of materials conforming to the specifications listed in API STD 6D, and as further specified in this specification.
- 4.2 Material selected for welding ends shall have a guaranteed minimum yield strength of not greater than 36,000 psi (Grade B).
- 4.3 Material selected for welding shall have a carbon content of 0.20% maximum, 0.02% sulphur maximum and maximum carbon equivalent of 0.43% as determined by the formula:

$$\text{C.E.} = \text{C} + \frac{\text{Mn}}{6} + \frac{\text{Cr} + \text{Mo} + \text{V}}{5} + \frac{\text{Cu} + \text{Ni}}{15}$$

- 4.4 Steel castings used for valves bodies shall be of X-ray quality, Class 2, as specified in ASTM Specification E71 'Industrial Radiographic Standards for Steel Casting'.

5.0 **DESIGN AND CONSTRUCTION**

- 5.1 The design and construction of valves shall comply with the requirements of the latest editions of API Standard 6D, ANSI B16.10 and this specification..
- 5.2 Welding ends shall be beveled for welding to pipe or fittings in accordance with ANSI B31.3, Fig. 327.3.1 unless otherwise specified, and shall be bored to the inside diameters as specified in the purchase order.
- 5.3 Due consideration of difference in SMYS shall be taken when calculating wall thickness at welding ends.
- 5.4 Flanged valve dimensions shall be in accordance with ANSI B16.5 ‘Steel Pipe Flanges and Flanged Fittings’ for sizes 2(inch) to 24 (inch) excluding 22 (inch) size , and in accordance with MSS-SP44 for 22 (inch) and 26 (inch) and above.
- 5.5 Valve operating mechanisms shall be fitted with suitable locking device.
- 5.6 Ball valves greater than 8" size shall be pinion supported.
- 5.7 Plug valves shall be of the lubricated type. Lubrication systems shall be fitted with ‘button head’ type lubrication fittings. Valves shall be shipped with a lubricant suitable for operation in the specified service conditions. The lubricant shall resist dissolving, gumming, or chemical change in service.
- 5.8 Valves shall be fitted with renewable seats. Welding end Ball valves shall have body configurations which allow complete maintenance of the valve without its removal from the line. Top entry design shall be utilized to meet this requirements. Ball valves shall also be fire safe to appropriate API or BS code.
- 5.9 All welding shall be in accordance with the requirements of ASME Boiler and Pressure Vessel Code, latest edition, sections VIII & IX.

6.0 **TESTING**

- 6.1 All valves size 3” and above shall be subjected to a shell hydrostatic pressure test in accordance with API STD 6D requirements. Three certified copies of this chart shall be supplied to the purchaser.
- 6.2 Hydrostatic seat tests shall be carried out as required by API STD 6D for gate, ball and plug valves, while the test pressure is on each side of the valve, it shall be operated at least twice to demonstrate satisfactory mechanical operation as well as continued tightness after operation under differential pressure conditions.

- 6.3 Valves shall be subjected to air seat tests in accordance with API STD 6D requirements.
- 6.4 The valve manufacturer shall give sufficient advance notice satisfactory to the purchaser of the time and place at which testing is to be performed.

7.0 **INSPECTION**

- 7.1 All welds shall be 100% radiographed to meet the acceptance standards of ASME Boiler and Pressure Vessel Code, Latest Edition, Section VIII.
- 7.2 Where X-ray quality steel casting are specified, records of test shall be furnished to the purchaser.

8.0 **DATA AND DRAWINGS**

The manufacturer shall provide the following information:

- Outline dimensions and mechanical details for the valve.
- Number of complete revolutions of hand wheel or other operating device to close or open the valve.
- The maximum permissible torque and the rated torque required to close or open the valve at the maximum pressure differential.
- Actual time to fully open or close the valve.
- Head loss curve and data for the valve.

9.0 **MARKING**

Each valve shall be marked in accordance with API 6D requirements and as may be further specified in the purchase order.



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OIL & GAS DEVELOPMENT COMPANY LTD.

SPECIFICATION FOR

EQUIPMENT WITH LOW TEMPERATURE SERVICE &

THEIR MATERIALS OF CONSTRUCTION



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1.0 SCOPE

This specification covers the basic requirement of pressure vessels in low temperature services. Vendor may suggest better material subject to company / consultant's approvals.

2.0 ABBREVIATION USED

ABP	Atmospheric Boiling Point – Is the temperature correspondence to an absolute vapour pressure of 1 bar of the product concerned.
AFT	Adiabatic Flash Temperature – Is the lowest temperature which the liquid reaches if a mixture is adiabatically depressurized to atmospheric pressure.

3.0 MATERIAL SELECTION FOR COLD SERVICES

3.1 Materials, for pressure retaining parts for pumps in cold service, shall be as given in the following Table – 1:

TABLE – 1

Material for Pumps Casing for Cold Service

Material	Min. Design Temperature °C	Impact Tested
A-352 LCB	0 to -46	Yes
A-352 LC2	-46 to -73	No
A-352 LC3	-73 to -100	No

The other parts for the centrifugal pump shall be in fully compliance of API 610 & the other parts for the reciprocating pump shall be in fully compliance of API 674.

3.2 The bolts and nuts for the pumps shall be as given in following Table – 2.

TABLE – 2

Material for Bolts and Nuts in Pumps for Cold Service

Carbon Steel	Min. Design Temperature °C	Impact Tested
Bolts and Nuts	-100	SA 320 Gr. L7 and SA 194 Gr. 7 Cadmium Plated

3.3 **Materials for Air Cooled Heat Exchangers in Cold Service**

3.3.1 Materials, for pressure retaining parts in Air Cooled Heat Exchangers for cold service shall be as given in the following Table – 3:

TABLE – 3

Material for Pressure Parts in Air Cooled Heat Exchangers for Cold Service

Parts	Min. Design Temperature °C	Material
Tubes	-55	SA 269 TP 316-L
Bolts and Nuts	-100	SA 320 Gr. L7 and SA 194 Gr. 7 Cadmium Plated

3.4 **Materials for Shell & Tube Heat Exchanger in Cold Service**

3.4.1 Materials, for pressure retaining parts in Shell & Tube Heat Exchangers in cold service shall be as given in the following Table – 4:

TABLE – 4

Material for Pressure Parts in Shell & Tube Heat Exchangers for Cold Service

Parts	Min. Design Temperature °C	Material
Tubes	-55	SA 269 TP 316-L
Tube Sheet	-55	SA 240 TP 316-L
Channels	-55	SA 350 LF 3
Shells, Baffles	-55	SA-516, Gr. 70
Tie Rods	-55	SA-182, Gr. F316L
Bolts and Nuts	-100	SA 320 Gr. L7 and SA 194 Gr. 7 Cadmium Plated

3.4.2 For Braze Aluminum Heat Exchanger, the materials of construction shall be in full compliance of ALPEMA (The Braze Aluminum Plate – Fire Heat Exchanger Manufacturer Association) standards.

3.5 Materials in Pressure Vessels for Cold Service

TABLE – 5

Material For Parts in Pressure Vessels for Cold Service

Parts	Min. Design Temperature °C	Material	Remarks
Pressure vessel sheet	0°C to -46°C	ASTM A-516, Gr.70	Material for pressure vessel shall be impact tested corresponding to vessel design temperature.
Pressure vessel sheet	0°C to -101°C	ASTM A-240 Gr.304	With impact testing according to design temperature.
Nuts & bolts	-100 °C	SA 320 Gr. L7 and SA 194 Gr. 7 Cadmium Plated	

NOTE: Other materials can be used subject to their minimum design temperature range. As specified in Table – A1 (basic allowable stresses in tension for metals) of ASME B31.3.

3.6 Materials in Compressor for Cold Service

TABLE – 6

Compressors with cast steel body and minimum design temperature as shown

Material of Pressure Containing Parts	Lower Design Temperature (ABP/AFT of Contents)	Remarks
A-216 Gr. WCA	-20 °C	Without Impact Test
A-216 Gr. WCA	-46°C	Material Impact Tested at the minimum design temperature
A-352 Gr. LC3	-50 °C	Without Impact Test
A-352 Gr. LC3	-100 °C	Without Impact Test

NOTES:

1. All compressor materials shall be properly heat treated, i.e. normalised, and tempered, or quenched and tempered. PWHT shall be applied after welding.
2. Materials with a nominal wall thickness below 6 mm are exempted from impact testing, if permitted by the ASME code.
3. For reciprocating compressors, grey cast iron is considered acceptable.

TABLE – 7**Compressors Made of Austenitic Materials**

Material of Pressure Containing Parts	Lower Design Temperature (ABP/AFT of Contents)	Remarks
Ductile austenitic cast iron (ASTM A-571, Type D-2M)	-29 °C	Without Impact Test
Ductile austenitic cast iron (ASTM A-571, Type D-2M)	-196 °C	Material Impact Tested at minimum design temperature

3.7 Materials for Pipes in Cold Services

3.7.1 Materials for pipes in cold services shall be as given in the following Table – 8:

TABLE – 8**Material for Pipes in Cold Services**

Material	Min. Design Temperature °C	Range (inch)
ASTM A-312 TP. 316 (SMLS) P.E.	-100	1/2" – 1-1/2"
ASTM A-312 TP. 316 (SMLS) B.E.	-100	2" – 6"
ASTM A-358 TP. 316 EFW Class-1 B.E.	-100	8" – 24"

3.8 **Materials for Piping Materials in Cold Services****TABLE – 9****Material for Flanges in Cold Services**

Material	Min. Design Temperature °C	Range (inch)
ASTM A-182 Gr. 316	-100	1/2" – 24"

TABLE – 10**Material for Fittings in Cold Services**

Material	Min. Design Temperature °C	Size (inch)
ASTM A-182 Gr. 316	-100	1/2" – 1-1/2"
ASTM A-403 WP-316 TP. 316 (SMLS) B.E.	-100	2" – 24"

TABLE – 11**Material for Gaskets in Cold Services**

Material	Min. Design Temperature °C	Size (inch)
<u>For 150 lb</u> Ring Compressed Asbestos is not acceptable Fiber 0.06mm in (1.5mm)	-100	1/2" – 24"
<u>For 300 lb and 600 lb</u> Spiral wound compressed of 4.5mm thickness. Type 316 SS strip with Asbestos is not acceptable Filler and 3.2mm thickness carbon steel external guide ring.	-100	1/2" – 12"



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OIL & GAS DEVELOPMENT COMPANY LTD.

SPECIFICATION FOR PIPING MATERIAL



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11	06-12-2013	Re-issued for Tender	MMA/MIAH	MAJ	MAS
10	13-11-2013	Re-issued for Tender	MMA/WUS	MIAH	MAS
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OIL & GAS DEVELOPMENT COMPANY LTD.**PIPING MATERIAL SPECIFICATIONS**

S. No.	Piping Specification	Service	Piping Class	Design Code	C.A. (mm)	Temp (°F)	PSIG	REMARKS
1	A1 CARBON STEEL	- FUEL OIL - HOT OIL - INERT GAS - STABILIZED CONDENSATE - GLYCOL - FIRE WATER (A/G) - TREATED GAS Sales Gas LPG	ANSI Class 150# RF	ASME B31.3	1.6	-20 to 100 200 300 400 500 600 650 700	285 260 230 200 170 140 125 110	
2	A1 (S) CARBON STEEL	- FUEL OIL - HOT OIL - INERT GAS - STABILIZED CONDENSATE - GLYCOL - FIRE WATER (A/G) - TREATED GAS Sales Gas LPG	ANSI Class 150# RF	ASME B31.3	1.6	-20 to 100 200 300 400 500 600 650 700	285 260 230 200 170 140 125 110	
3	A2 CARBON STEEL	- RAW GAS - LEAN AMINE - FUEL GAS - OPEN DRAIN / VENTS - CLOSED DRAIN - AMINE DRAIN	ANSI Class 150# RF	ASME B31.3	3.0	-20 to 100 200 300 400 500 600 650 700	285 260 230 200 170 140 125 110	
4	A2 (S) CARBON STEEL	- RAW GAS - LEAN AMINE - FUEL GAS - OPEN DRAIN / VENTS - CLOSED DRAIN - AMINE DRAIN	ANSI Class 150# RF	ASME B31.3	3.0	-20 to 100 200 300 400 500 600 650 700	285 260 230 200 170 140 125 110	
5	A3 LOW TEMPERATURE CARBON STEEL	- FLARE / VENT - PROCESS GAS - GLYCOL (COLD SERVICE) - PROCESS LIQUID	ANSI Class 150# RF	ASME B31.3	3.0	-50 to 100 200 300 400 500 600 650	285 260 230 200 170 140 125	
6	A3 (S) LOW TEMPERATURE CARBON STEEL	- FLARE / VENT - PROCESS GAS - GLYCOL (COLD SERVICE) - PROCESS LIQUID	ANSI Class 150# RF	ASME B31.3	3.0	-50 to 100 200 300 400 500 600 650	285 260 230 200 170 140 125	
7	A4 GALVANIZED CARBON STEEL	- UTILITY, INSTRUMENT & PLANT AIR - POTABLE WATER - SERVICE WATER	ANSI Class 150# RF	ASME B31.3	1.6	-20 to 100 200 300	285 260 230	
8	A5 DUPLEX UNS S31803	- PRODUCED WATER (A/G)	ANSI Class 150# RF	ASME B31.3	NIL	-150 to 100 200 300 400 500 600 650 700	290 260 230 200 170 140 125 110	

OIL & GAS DEVELOPMENT COMPANY LTD.**PIPING MATERIAL SPECIFICATIONS**

S. No.	Piping Specification	Service	Piping Class	Design Code	C.A. (mm)	Temp (°F)	PSIG	REMARKS
9	A6 316L STAINLESS STEEL	- LIQUIFIED GAS UNDER - 100 °C - RICH AMINE - ACID GAS	ANSI Class 150# RF	ASME B31.3	NIL	-150 to 100 200 300 400 500 600 650 700	230 195 175 160 145 140 125 110	
10	A7 G.R.E.	- FIRE WATER (U/G) - PRODUCED WATER (U/G)	ANSI Class 150# RF	ASME B31.3	NIL	-20 to 100	285	
11	B1 CARBON STEEL	- FUEL OIL - HOT OIL - INERT GAS - STABILIZED CONDENSATE - GLYCOL - FIRE WATER (A/G) - TREATED GAS Sales Gas LPG	ANSI Class 300# RF	ASME B31.3	1.6	-20 to 100 200 300 400 500 600 650 700	740 675 655 635 600 550 535 535	
12	B2 CARBON STEEL	- RAW GAS - LEAN AMINE - FUEL GAS - OPEN DRAIN / VENTS - CLOSED DRAIN - AMINE DRAIN	ANSI Class 300# RF	ASME B31.3	3.0	-20 to 100 200 300 400 500 600 650 700	740 675 655 635 600 550 535 535	
13	B3 LOW TEMPERATURE CARBON STEEL	- FLARE / VENT - PROCESS GAS - GLYCOL (COLD SERVICE) - PROCESS LIQUID	ANSI Class 300# RF	ASME B31.3	3.0	-50 to 100 200 300 400 500 600 650	740 675 655 635 600 550 535	
14	B5 DUPLEX UNS S31803	- PRODUCED WATER (A/G)	ANSI Class 300# RF	ASME B31.3	NIL	-150 to 100 200 300 400 500 600 650 700	750 720 665 615 575 555 550 540	
15	B6 316L STAINLESS STEEL	- LIQUIFIED GAS UNDER - 100 °C - RICH AMINE - ACID GAS	ANSI Class 300# RF	ASME B31.3	NIL	-150 to 100 200 300 400 500 600 650 700	600 505 455 415 380 360 350 345	
16	D1 CARBON STEEL	- FUEL OIL - HOT OIL - INERT GAS - STABILIZED CONDENSATE - GLYCOL - FIRE WATER (A/G) - TREATED GAS Sales Gas LPG	ANSI Class 600# RF	ASME B31.3	1.6	-50 to 100 200 300 400 500 600 650 700	1480 1350 1315 1270 1200 1095 1075 1065	

OIL & GAS DEVELOPMENT COMPANY LTD.**PIPING MATERIAL SPECIFICATIONS**

S. No.	Piping Specification	Service	Piping Class	Design Code	C.A. (mm)	Temp (°F)	PSIG	REMARKS
17	D2 CARBON STEEL	- RAW GAS - LEAN AMINE - FUEL GAS - OPEN DRAIN / VENTS - CLOSED DRAIN - AMINE DRAIN	ANSI Class 600# RF	ASME B31.3	3.0	-50 to 100 200 300 400 500 600 650 700	1480 1350 1315 1270 1200 1095 1075 1065	
18	D2 (S) CARBON STEEL	- RAW GAS - LEAN AMINE - FUEL GAS - OPEN DRAIN / VENTS - CLOSED DRAIN - AMINE DRAIN	ANSI Class 600# RF	ASME B31.3	3.0	-50 to 100 200 300 400 500 600 650 700	1480 1350 1315 1270 1200 1095 1075 1065	
19	D3 LOW TEMPERATURE CARBON STEEL	- FLARE / VENT - PROCESS GAS - GLYCOL (COLD SERVICE) - PROCESS LIQUID	ANSI Class 600# RF	ASME B31.3	3.0	-50 to 100 200 300 400 500 600 650	1480 1350 1315 1270 1200 1095 1075	
20	D5 DUPLEX UNS S31803	- PRODUCED WATER (A/G)	ANSI Class 600# RF	ASME B31.3	NIL	-150 to 100 200 300 400 500 600 650 700	1500 1440 1330 1230 1150 1115 1100 1085	
21	D6 316L STAINLESS STEEL	- LIQUIFIED GAS UNDER - 100 °C - RICH AMINE - ACID GAS	ANSI Class 600# RF	ASME B31.3	NIL	-150 to 100 200 300 400 500 600 650 700	1200 1015 910 825 765 720 700 685	
22	D8 CARBON STEEL	- SLUG CATCHER	ANSI Class 600# RF	ASME B31.3	3.0	-50 to 100 200 300 400 500 600 650 700	1480 1350 1315 1270 1200 1095 1075 1065	
23	D8 (S) CARBON STEEL	- SLUG CATCHER	ANSI Class 600# RF	ASME B31.3	3.0	-50 to 100 200 300 400 500 600 650 700	1480 1350 1315 1270 1200 1095 1075 1065	
24	E1 CARBON STEEL	- FUEL OIL - HOT OIL - INERT GAS - STABILIZED CONDENSATE - GLYCOL - FIRE WATER (A/G) - TREATED GAS Sales Gas LPG	ANSI Class 900# RTJ	ASME B31.3	1.6	-50 to 100 200 300 400 500 600 650 700	2220 2025 1970 1900 1795 1640 1610 1600	

OIL & GAS DEVELOPMENT COMPANY LTD.**PIPING MATERIAL SPECIFICATIONS**

S. No.	Piping Specification	Service	Piping Class	Design Code	C.A. (mm)	Temp (°F)	PSIG	REMARKS
25	E2 CARBON STEEL	- RAW GAS - LEAN AMINE - FUEL GAS - OPEN DRAIN / VENTS - CLOSED DRAIN - AMINE DRAIN - WELLHEAD PIPING (A/G)	ANSI Class 900# RTJ	ASME B31.3	3.0	-50 to 100 200 300 400 500 600 650 700	2220 2025 1970 1900 1795 1640 1610 1600	
26	E2 (S) CARBON STEEL	- RAW GAS - LEAN AMINE - FUEL GAS - OPEN DRAIN / VENTS - CLOSED DRAIN - AMINE DRAIN - WELLHEAD PIPING (A/G)	ANSI Class 900# RTJ	ASME B31.3	3.0	-50 to 100 200 300 400 500 600 650 700	2220 2025 1970 1900 1795 1640 1610 1600	
27	E3 LOW TEMPERATURE CARBON STEEL	- FLARE / VENT - PROCESS GAS - GLYCOL (COLD SERVICE) - PROCESS LIQUID	ANSI Class 900# RTJ	ASME B31.3	3.0	-50 to 100 200 300 400 500 600 650	2220 2025 1970 1900 1795 1640 1610	
28	E5 DUPLEX UNS S31803	- PRODUCED WATER (A/G) - FLOW LINE (without Corrosion Inhibitor)	ANSI Class 900# RTJ	ASME B31.3	NIL	-150 to 100 200 300 400 500 600 650 700	2250 2160 1995 1845 1730 1670 1650 1625	
29	E6 316L STAINLESS STEEL	- LIQUIFIED GAS UNDER - 100 °C - RICH AMINE - ACID GAS	ANSI Class 900# RTJ	ASME B31.3	NIL	-150 to 100 200 300 400 500 600 650 700	1800 1520 1360 1240 1145 1080 1050 1030	
30	E8 CARBON STEEL API 5L X-52	- FLOW LINES	ANSI Class 900# RTJ	ASME B31.8	3.0	-50 to 100 200 300 400 500 600 650 700	2220 2025 1970 1900 1795 1640 1610 1600	
31	E8 (S) CARBON STEEL API 5L X-52	- FLOW LINES	ANSI Class 900# RTJ	ASME B31.8	3.0	-50 to 100 200 300 400 500 600 650 700	2220 2025 1970 1900 1795 1640 1610 1600	
32	F5 DUPLEX UNS S31803	- WELLHEAD PIPING (without Corrosion Inhibitor) Upstream of and including Choke Valve	ANSI Class 1500# RTJ	ASME B31.3	NIL	-150 to 100 200 300 400 500 600 650 700	3750 3600 3325 3070 2880 2785 2750 2710	

OIL & GAS DEVELOPMENT COMPANY LTD.**PIPING MATERIAL SPECIFICATIONS**

S. No.	Piping Specification	Service	Piping Class	Design Code	C.A. (mm)	Temp (°F)	PSIG	REMARKS
33	F5 (S) DUPLEX UNS S31803	- WELLHEAD PIPING (without Corrosion Inhibitor) Upstream of and including Choke Valve	ANSI Class 1500# RTJ	ASME B31.3	NIL	-150 to 100 200 300 400 500 600 650 700	3750 3600 3325 3070 2880 2785 2750 2710	
34	G1 CARBON STEEL	- Methanol Injection	ANSI Class 2500# RTJ	ASME B31.3	1.6	-150 to 100 200 300 400 500 600 650 700	6170 5625 5470 5280 4990 4560 4475 4440	
35	G5 DUPLEX UNS S31803	- WELLHEAD PIPING (without Corrosion Inhibitor) Upstream of and including Choke Valve	ANSI Class 2500# RTJ	ASME B31.3	NIL	-150 to 100 200 300 400 500 600 650 700	6250 6000 5540 5120 4800 4640 4580 4520	
36	G5 (S) DUPLEX UNS S31803	- WELLHEAD PIPING (without Corrosion Inhibitor) Upstream of and including Choke Valve	ANSI Class 2500# RTJ	ASME B31.3	NIL	-150 to 100 200 300 400 500 600 650 700	6250 6000 5540 5120 4800 4640 4580 4520	

NOMINAL PIPE SIZE	1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	30"	34"	36"		
MIN. WALL THK. (mm)	SCH 80					SCH 40					SCH. STD.					SCH. STD.	10.31	11.12			
PIPE	SEAMLESS CARBON STEEL, ASTM A106-B or API 5L Gr. B, ASME 36.10																	API 5L GR.B, HFV			
	SW / Plain Ends					BW Beveled Ends															
FLANGES	ASME B16.5 Class 150 Raised Face, ASTM A - 105																	ASME B16.47, A105			
	Socket Weld					Weld Neck, Bore to Match Pipe I.D.															
FITTINGS	ASME B16.11 S.W. Class 3000, ASTM A-105					ASME B16.9, Beveled Ends, Wall Thk. to Match Pipe Seamless Steel, ASTM A234 Gr. WPB,															
	S.W. End, MSS-SP-97 Class 3000, ASTM A105					B.W. End, MSS-SP-97 ASTM A105															
BRANCH OUTLETS (Sockolet, Weldolet, etc.)	S.W. End, MSS-SP-97 Class 3000, ASTM A105					B.W. End, MSS-SP-97 ASTM A105															
UNIONS	Class 3000, S.W. Ground Joint, ASTM A-105,																				
PLUG	Hex. Head		Bull Plugs																		
	ASTM A105																				
VENTS / DRAINS	1/2"	3/4"					3/4" / 1"					3/4" / 1 1/2"									
	Use 'in spec.' branch connection with 4" long Nipple and Ball Valve with Square head Plug																				
THR'D NIPPLE & SWAGES	A106-B SMLS																				
	Class 3000, ASTM A - 105																				
GASKETS	Class 150, 1/8" THK. Flexible graphite W/ 304 or 316 SS corrugated insert, ASME B16.20																				
BOLTING	STUDS : ASTM A193 Gr. B7, Cadmium plated																				
	NUTS : ASTM A194 Gr. 2H, Heavy Hex, Cadmium plated																				
SPEC. PLATE / BLANK & SPACER						SPEC. PLATE ASTM A516 Gr. 60					BLANK & SPACER ASTM A516 Gr. 60										
VALVES	GATE	VG-101					VG-201														
	GLOBE	VGL-101					VGL-201														
	CHECK	VC-101					VC-201														
	BALL	VB-101					VB-201														
	PLUG																				
	BUTTERFLY																				

90° BRANCH CONNECTIONS																				
NOMINAL BRANCH SIZE (in.)																				
	1/2	3/4	1	1 1/2	2	3	4	6	8	10	12	14	16	18	20	24	30	34	36	
NOMINAL RUN PIPE SIZE (in.)	36	S	S	S	S	W	W	W	W	W	W	W	W	R	R	R	R	R	R	E
	34	S	S	S	S	W	W	W	W	W	W	W	W	R	R	R	R	R	R	E
	30	S	S	S	S	W	W	W	W	W	W	W	R	R	R	R	R	R	R	E
	24	S	S	S	S	W	W	W	W	W	W	R	R	R	R	R	R	R	R	E
	20	S	S	S	S	W	W	W	W	W	R	R	R	R	R	R	R	R	R	E
	18	S	S	S	S	W	W	W	W	R	R	R	R	R	R	R	R	R	R	E
	16	S	S	S	S	W	W	W	R	R	R	R	R	R	R	R	R	R	R	E
	14	S	S	S	S	W	W	W	R	R	R	R	R	R	R	R	R	R	R	E
	12	S	S	S	S	W	W	W	R	R	R	R	R	R	R	R	R	R	R	E
	10	S	S	S	S	W	W	R	R	R	R	R	R	R	R	R	R	R	R	E
	8	S	S	S	S	W	W	R	R	R	R	R	R	R	R	R	R	R	R	E
	6	S	S	S	S	W	R	R	R	R	R	R	R	R	R	R	R	R	R	E
	4	S	S	S	S	R	R	R	R	R	R	R	R	R	R	R	R	R	R	E
	3	S	S	S	S	R	R	R	R	R	R	R	R	R	R	R	R	R	R	E
	2	TS	TS	TS	TS	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
1 1/2	R	R	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	
1	R	R	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	
3/4	R	R	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	
1/2	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	

LEGEND:
R Reducing Tee
S Sockolet
E Equal Tee
W Weldolet
TS Equal Tee & Swage Nipple

Note: Reducing fittings thickness shall match heavier pipe thickness.

DESIGN CONDITIONS			STUD BOLTS		
TEMP.	PRESS.	NOMINAL	DIA. ,in. &	NO. OF	
°F	psig	PIPE SIZE	LENGTH, mm	BOLTS	
-20 TO 100	285	1/2"	M14 x 60	4	
200	260	3/4"	M14 x 65	4	
300	230	1"	M14 x 65	4	
400	200	1 1/2"	M14 x 70	4	
500	170	2"	M16 x 80	4	
600	140	3"	M16 x 90	4	
650	125	4"	M16 x 90	8	
700	110	6"	M20 x 100	8	
°C	barg	8"	M20 x 110	8	
-29 TO 38	19.66	10"	M24 x 115	12	
93	17.93	12"	M24 x 120	12	
149	15.86	14"	M27 x 130	12	
204	13.79	16"	M27 x 135	16	
260	11.72	18"	M30 x 150	16	
316	9.66	20"	M30 x 150	20	
343	8.62	24"	M33 x 175	20	
371	7.59	30"	M33 x 185	28	
		34"	M39 x 204	32	
		36"	M39 x 210	32	

FOR SPEC. NOTES SEE SHEET 43 OF 43									
SERVICE: FUEL OIL, HOT OIL, INERT GAS, STABILIZED CONDENSATE,					HYDROTEST LIMITED BY : FLANGES				
GLYCOL, FIREWATER (A/G), TREATED GAS (SALES GAS, LPG)					BARG. 30		PSIG. 435		
DESCRIPTION:	DRN.	HM/SMHA/MMA/BS	DESCRIPTION:	DRN.		DESCRIPTION:	DRN.		
14 FOR TENDER	CHK.	WUS		CHK.			CHK.		
	APP.	MAS		APP.			APP.		

CONSULTANT:				DRAWN				CHECKED				APPROVED			
Zishan Engineers (Pvt.) Ltd.				NAME		HM/SMHA/ MMA /BS		MAIAH		MAS		CLIENT : Oil & Gas Development Company L			
				DATE		16-02-2015		16-02-2015		16-02-2015					
				PIPING MATERIAL SPECIFICATION											



MATERIAL : CARBON STEEL			RATING : 150 #		
CORR. ALLOWANCE : 1.6 mm			SHEET : 7 OF 43		
PIPE WALL TOLERANCE : ± 12.5%			SPEC. A1 REV. 14		
DESIGN CODE : ASME B.31.3					

NOMINAL PIPE SIZE	1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	30"	34"	36"	
MIN. WALL THK. (mm)	SCH 80					SCH 40					SCH. STD.					SCH. STD.	10.31	11.12		
PIPE	SEAMLESS CARBON STEEL, ASTM A106-B or API 5L Gr. B, ASME 36.10																	API 5L GR.B, HFW		
	SW / Plain Ends					BW Beveled Ends														
FLANGES	ASME B16.5 Class 150 Raised Face, ASTM A - 105																	ASME B16.47, A105		
	Socket Weld					Weld Neck, Bore to Match Pipe I.D.														
FITTINGS	ASME B16.11 S.W. Class 3000, ASTM A-105					ASME B16.9, Beveled Ends, Wall Thk. to Match Pipe Seamless Steel, ASTM A234 Gr. WPB,														
	S.W. End, MSS-SP-97 Class 3000, ASTM A105					B.W. End, MSS-SP-97 ASTM A105														
BRANCH OUTLETS (Sockolet, Weldolet, etc.)	S.W. End, MSS-SP-97 Class 3000, ASTM A105					B.W. End, MSS-SP-97 ASTM A105														
UNIONS	Class 3000, S.W. Ground Joint, ASTM A-105,																			
PLUG	Hex. Head		Bull Plugs																	
	ASTM A105																			
VENTS / DRAINS	1/2"		3/4"			3/4" / 1"			3/4" / 1 1/2"											
	Use 'in spec.' branch connection with 4" long Nipple and Ball Valve with Square head Plug																			
THR'D NIPPLE & SWAGES	A106-B SMLS																			
	Class 3000, ASTM A - 105																			
GASKETS	Class 150, 1/8" THK. Flexible graphite W/ 304 or 316 SS corrugated insert, ASME B16.20																			
BOLTING	STUDS : ASTM A193 Gr. B7, Cadmium plated																			
	NUTS : ASTM A194 Gr. 2H, Heavy Hex, Cadmium plated																			
SPEC. PLATE / BLANK & SPACER						SPEC. PLATE ASTM A516 Gr. 60					BLANK & SPACER ASTM A516 Gr. 60									
VALVES	GATE	VG-101				VG-201														
	GLOBE	VGL-101				VGL-201														
	CHECK	VC-101				VC-201														
	BALL	VB-101				VB-201														
	PLUG																			
	BUTTERFLY																			

90° BRANCH CONNECTIONS																			
NOMINAL BRANCH SIZE (in.)																			
	1/2	3/4	1	1 1/2	2	3	4	6	8	10	12	14	16	18	20	24	30	34	36
36	S	S	S	S	W	W	W	W	W	W	W	W	R	R	R	R	R	R	E
34	S	S	S	S	W	W	W	W	W	W	W	W	R	R	R	R	R	R	E
30	S	S	S	S	W	W	W	W	W	W	W	R	R	R	R	R	R	R	E
24	S	S	S	S	W	W	W	W	W	W	R	R	R	R	R	R	R	R	E
20	S	S	S	S	W	W	W	W	W	R	R	R	R	R	R	R	R	R	E
18	S	S	S	S	W	W	W	W	R	R	R	R	R	R	R	R	R	R	E
16	S	S	S	S	W	W	W	R	R	R	R	R	R	R	R	R	R	R	E
14	S	S	S	S	W	W	W	R	R	R	R	R	R	R	R	R	R	R	E
12	S	S	S	S	W	W	W	R	R	R	R	R	R	R	R	R	R	R	E
10	S	S	S	S	W	W	W	R	R	R	R	R	R	R	R	R	R	R	E
8	S	S	S	S	W	W	W	R	R	R	R	R	R	R	R	R	R	R	E
6	S	S	S	S	W	R	R	E											
4	S	S	S	S	R	R	E												
3	S	S	S	S	R	E													
2	TS	TS	TS	TS	E														
1 1/2	R	R	E	E															
1	R	R	E																
3/4	R	E																	
1/2	E																		

DESIGN CONDITIONS					STUD BOLTS				
TEMP.	PRESS.	NOMINAL	DIA. .in. &	NO. OF					
°F	psig	PIPE SIZE	LENGTH, mm	BOLTS					
-20 TO 100	285	1/2"	M14 x 60	4					
200	260	3/4"	M14 x 65	4					
300	230	1"	M14 x 65	4					
400	200	1 1/2"	M14 x 70	4					
500	170	2"	M16 x 80	4					
600	140	3"	M16 x 90	4					
650	125	4"	M16 x 90	8					
700	110	6"	M20 x 100	8					
°C	barg	8"	M20 x 110	8					
-29 TO 38	19.66	10"	M24 x 115	12					
93	17.93	12"	M24 x 120	12					
149	15.86	14"	M27 x 130	12					
204	13.79	16"	M27 x 135	16					
260	11.72	18"	M30 x 150	16					
316	9.66	20"	M30 x 150	20					
343	8.62	24"	M33 x 175	20					
371	7.59	30"	M33 x 185	28					
		34"	M39 x 204	32					
		36"	M39 x 210	32					

MATERIAL : CARBON STEEL		RATING : 150 #	
CORR. ALLOWANCE : 1.6 mm		SHEET : 8 OF 43	
PIPE WALL TOLERANCE : ± 12.5%		SPEC. A1 (S) REV. 14	
DESIGN CODE : ASME B.31.3			

FOR SPEC. NOTES SEE SHEET 43 OF 43																
SERVICE: FUEL OIL, HOT OIL, INERT GAS, STABILIZED CONDENSATE,										HYDROTEST LIMITED BY : FLANGES						
GLYCOL, FIREWATER (A/G), TREATED GAS (SALES GAS, LPG)										BARG. 30			PSIG. 435			
DESCRIPTION:	DRN.	HM/SMHA/MMA/BS	DESCRIPTION:	DRN.		DESCRIPTION:	DRN.									
14 FOR TENDER	CHK.	WUS		CHK.			CHK.									
	APP.	MAS		APP.			APP.									
CONSULTANT:			DRAWN			CHECKED			APPROVED							
Zishan Engineers (Pvt.) Ltd.			NAME HM/SMHA/ MMA /BS			MAIAH			MAS							
			DATE 16-02-2015			16-02-2015			16-02-2015							
			CLIENT : Oil & Gas Development Company Ltd													
PIPING MATERIAL SPECIFICATION										JOB NO. 165-4						



NACE - MR - 0175 (LATEST REVISION)

NOMINAL PIPE SIZE		1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	90° BRANCH CONNECTIONS																																																																																																																																																																																																																																																																																																															
MIN. WALL THK.		SCH 160			SCH 80		SCH 40			SCH. STD.						NOMINAL BRANCH SIZE (in.)																																																																																																																																																																																																																																																																																																																	
PIPE		Carbon Steel ASTM A106-B SMLS or API 5L Gr. B SMLS, ASME 36.10																																																																																																																																																																																																																																																																																																																															
		SW / Plain Ends								BW Beveled Ends																																																																																																																																																																																																																																																																																																																							
FLANGES		ASME B 16.5 Class 150 Raised Face, ASTM A-105																																																																																																																																																																																																																																																																																																																															
		Socket Weld								Weld Neck, Bore to Match Pipe I.D.																																																																																																																																																																																																																																																																																																																							
FITTINGS		ASME B16.11 S.W. Class 3000, ASTM A-105				ASME B16.9, Beveled Ends, Wall Thk. to Match Pipe																																																																																																																																																																																																																																																																																																																											
		Class 3000, ASTM A-105				Seamless Steel, ASTM A234 Gr. WPB																																																																																																																																																																																																																																																																																																																											
BRANCH OUTLETS (Sockolet, Weldolet, etc.)		S.W. Ends, MSS-SP-97 Class 3000, ASTM A105				B.W. Ends, MSS-SP-97 ASTM A105																																																																																																																																																																																																																																																																																																																											
UNIONS		Class 3000, S.W. Ground Joint, ASTM A105																																																																																																																																																																																																																																																																																																																															
PLUG		Square Head, 3000# ASTM A -105																																																																																																																																																																																																																																																																																																																															
VENTS / DRAINS		1/2"	3/4"			3/4" / 1"			3/4" / 1 1/2"																																																																																																																																																																																																																																																																																																																								
		Use 'in spec.' branch connection with 4" long Nipple and Ball Valve with Square head Plug																																																																																																																																																																																																																																																																																																																															
THR'D NIPPLE & SWAGES		ASTM A106-B SMLS Class 3000, ASTM A - 105																																																																																																																																																																																																																																																																																																																															
GASKETS		Class 150, 1/8" THK. Flexible graphite W/ 304 or 316 SS corrugated insert, ASME B16.20																																																																																																																																																																																																																																																																																																																															
BOLTING		STUDS : ASTM A193 Gr. B7, Cadmium plated NUTS : ASTM A194 Gr. 2H, Heavy Hex, Cadmium plated																																																																																																																																																																																																																																																																																																																															
SPEC. PLATE / BLANK & SPACER						SPEC. PLATE ASTM A516 Gr. 60				BLANK & SPACER ASTM A516 Gr. 60																																																																																																																																																																																																																																																																																																																							
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Zishan Engineers (Pvt.) Ltd.				HM/SMHA/ MMA /BS				MAH		MAS		CLIENT : Oil & Gas Development Company Ltd.				CORR. ALLOWANCE : 3.0 mm																																																																																																																																																																																																																																																																																																																	
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NOMINAL PIPE SIZE		1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	28	30	36	90° BRANCH CONNECTIONS																																																																																																																																																																																																																																																			
MIN. WALL THK.		SCH 160			SCH 80			SCH. 40			SCH. STD.			10.31		11.12		SCH. XS		NOMINAL BRANCH SIZE (in.)																																																																																																																																																																																																																																																				
PIPE		ASTM A - 333 GR. 6 SMLS, ASME 36.10										A-333 GR. 6, WELDED										<table border="1"> <tr> <th>1/2</th><th>3/4</th><th>1</th><th>1 1/2</th><th>2</th><th>3</th><th>4</th><th>6</th><th>8</th><th>10</th><th>12</th><th>14</th><th>16</th><th>18</th><th>20</th><th>24</th><th>28</th><th>30</th><th>36</th> </tr> <tr> <td>36</td><td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <td>30</td><td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <td>28</td><td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <td>24</td><td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <td>20</td><td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>R</td><td>R</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <td>18</td><td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>W</td><td>W</td><td>W</td><td>R</td><td>R</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <td>16</td><td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>W</td><td>W</td><td>R</td><td>R</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <td>14</td><td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>W</td><td>W</td><td>R</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <td>12</td><td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>W</td><td>W</td><td>R</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <td>10</td><td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>W</td><td>R</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <td>8</td><td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>W</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <td>6</td><td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <td>4</td><td>S</td><td>S</td><td>S</td><td>S</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <td>3</td><td>S</td><td>S</td><td>S</td><td>S</td><td>R</td><td>E</td> </tr> <tr> <td>2</td><td>TS</td><td>TS</td><td>TS</td><td>TS</td><td>E</td> </tr> <tr> <td>###</td><td>R</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <td>1</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <td>3/4</td><td>R</td><td>E</td> </tr> <tr> <td>1/2</td><td>E</td> </tr> </table>																1/2	3/4	1	1 1/2	2	3	4	6	8	10	12	14	16	18	20	24	28	30	36	36	S	S	S	S	W	W	W	W	W	W	W	W	W	R	R	R	R	R	R	E	30	S	S	S	S	W	W	W	W	W	W	W	W	R	R	R	R	R	R	E	28	S	S	S	S	W	W	W	W	W	W	W	R	R	R	R	R	R	E	24	S	S	S	S	W	W	W	W	W	W	R	R	R	R	R	E	20	S	S	S	S	W	W	W	W	W	R	R	R	R	E	18	S	S	S	S	W	W	W	W	R	R	R	R	E	16	S	S	S	S	W	W	W	R	R	R	R	E	14	S	S	S	S	W	W	W	R	R	R	E	12	S	S	S	S	W	W	W	R	R	R	E	10	S	S	S	S	W	W	R	R	R	E	8	S	S	S	S	W	W	R	R	E	6	S	S	S	S	W	R	R	E	4	S	S	S	S	R	R	E	3	S	S	S	S	R	E	2	TS	TS	TS	TS	E	###	R	R	R	E	1	R	R	E	3/4	R	E	1/2	E
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FLANGES		ASME B 16.5 Class 150 RF, ASTM A 350-LF2										ASME B 16.47, A 350-LF2																																																																																																																																																																																																																																																												
FITTINGS		ASME B16.11 S.W. Class 3000,ASTM A350 LF2					BW ASTM A 420 WPL6 PER ASME B16.9, WALL THICKNESS TO MATCH PIPE ID																																																																																																																																																																																																																																																																	
BRANCH OUTLETS (Sockolet,Weldolet,etc.)		S.W. Ends, MSS-SP-97 Class 3000, ASTM A350 LF2					B.W. Ends, MSS-SP-97 ASTM A350 LF2																																																																																																																																																																																																																																																																	
UNIONS		Class 3000, S.W. Ground Joint, ASTM A 350-LF2					Use Flange Connection																																																																																																																																																																																																																																																																	
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THR'D NIPPLE & SWAGES		ASTM A 333 GR-6 Class 3000, ASTM A350 LF2																																																																																																																																																																																																																																																																						
GASKETS		Class 150, 1/8" THK. SPIRAL WOUND CS RING 304 SS OR 316 SS WINDING, FLEXIBLE GRAPHITE ASME B16.20																																																																																																																																																																																																																																																																						
BOLTING		STUDS : ASTM A320 Gr. L7, Cadmium plated NUTS : ASTM A194 Gr. 7, Heavy Hex, Cadmium plated																																																																																																																																																																																																																																																																						
SPEC. PLATE / BLANK & SPACER		SPEC. PLATE ASTM A516 Gr. 60					BLANK & SPACER ASTM A516 Gr. 60																																																																																																																																																																																																																																																																	
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CONSULTANT:		DRAWN		CHECKED	APPROVED	CLIENT : Oil & Gas Development Company Ltd.					MATERIAL : LOW TEMP CARBON STEEL					RATING : 150 #																																																																																																																																																																																																																																																								
Zishan Engineers (Pvt.) Ltd.		NAME		HM/SMHA/ MMA /BS	MAIAH	MAS						CORR. ALLOWANCE: 3.00 mm					SHEET : 11 OF 43																																																																																																																																																																																																																																																							
		DATE		16-02-2015	16-02-2015	16-02-2015						PIPE WALL TOLERANCE : ± 12.5%					SPEC. A3 REV. 14																																																																																																																																																																																																																																																							
PIPING MATERIAL SPECIFICATION										JOB NO. 165-4											Design Code: ASME B 31.3																																																																																																																																																																																																																																																			

LEGEND:
R Reducing Tee
S Sockolet
E Equal Tee
W Weldolet
TS Equal Tee & Swage Nipple

Note : Reducing fittings thickness shall match heavier pipe thickness.

DESIGN CONDITIONS		STUD BOLTS			
TEMP.	PRESS.	NOMINAL PIPE SIZE	DIA. ,in. & LENGTH, mm	NO. OF BOLTS	
° F	psig				
- 50 TO 100	285	1/2"	M14 x 60	4	
200	260	3/4"	M14 x 65	4	
300	230	1"	M14 x 65	4	
400	200	1 1/2"	M14 x 70	4	
500	170	2"	M16 x 80	4	
600	140	3"	M16 x 90	4	
650	125	4"	M16 x 90	8	
		6"	M20 x 100	8	
° C	barg	8"	M20 x 110	8	
-45 TO 38	19.66	10"	M24 x 115	12	
93	17.93	12"	M24 x 120	12	
149	15.86	14"	M27 x 130	12	
204	13.79	16"	M27 x 135	16	
260	11.72	18"	M30 x 150	16	
316	9.66	20"	M30 x 160	20	
343	8.62	24"	M33 x 175	20	
		28"	M33 x 180	28	
		30"	M39 x 185	28	
		36"	M39 x 210	32	

NOMINAL PIPE SIZE		1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	28	30	36	90° BRANCH CONNECTIONS																																																																																																																																																																																																																																																																																																																																																																																																																																																		
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<tr><td>1/2</td><td>E</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> </tbody> </table>																1/2	3/4	1	1 1/2	2	3	4	6	8	10	12	14	16	18	20	24	28	30	36	36	S	S	S	S	W	W	W	W	W	W	W	W	R	R	R	R	R	R	E	E	30	S	S	S	S	W	W	W	W	W	W	W	W	R	R	R	R	R	R	E	E	28	S	S	S	S	W	W	W	W	W	W	W	W	R	R	R	R	R	R	E	E	24	S	S	S	S	W	W	W	W	W	W	W	W	R	R	R	R	R	R	E	E	20	S	S	S	S	W	W	W	W	W	W	W	W	R	R	R	R	R	R	E	E	18	S	S	S	S	W	W	W	W	W	W	W	W	R	R	R	R	R	R	E	E	16	S	S	S	S	W	W	W	W	W	W	W	W	R	R	R	R	R	R	E	E	14	S	S	S	S	W	W	W	W	W	W	W	W	R	R	R	R	R	R	E	E	12	S	S	S	S	W	W	W	W	W	W	W	W	R	R	R	R	R	R	E	E	10	S	S	S	S	W	W	W	W	W	W	W	W	R	R	R	R	R	R	E	E	8	S	S	S	S	W	W	W	W	W	W	W	W	R	R	R	R	R	R	E	E	6	S	S	S	S	W	W	W	W	W	W	W	W	R	R	R	R	R	R	E	E	4	S	S	S	S	W	W	W	W	W	W	W	W	R	R	R	R	R	R	E	E	3	S	S	S	S	W	W	W	W	W	W	W	W	R	R	R	R	R	R	E	E	2	TS	TS	TS	TS	E																1 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FLANGES		ASME B 16.5 Class 150 RF, ASTM A 350-LF2										ASME B 16.47, A 350-LF2																																																																																																																																																																																																																																																																																																																																																																																																																																																											
FITTINGS		ASME B16.11 S.W. Class 3000,ASTM A350 LF2					BW ASTM A 420 WPL6 PER ASME B16.9, WALL THICKNESS TO MATCH PIPE ID																																																																																																																																																																																																																																																																																																																																																																																																																																																																
BRANCH OUTLETS (Sockolet,Weldolet,etc.)		S.W. Ends, MSS-SP-97 Class 3000, ASTM A350 LF2					B.W. Ends, MSS-SP-97 ASTM A350 LF2																																																																																																																																																																																																																																																																																																																																																																																																																																																																
UNIONS		Class 3000, S.W. Ground Joint, ASTM A 350-LF2					Use Flange Connection																																																																																																																																																																																																																																																																																																																																																																																																																																																																
PLUG		Square Head Class 3000,ASTM A350 LF2																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
VENTS / DRAINS		1/2"	3/4"			3/4" / 1"			3/4" / 1 1/2"			Use 'in spec.' branch connection with 4" long Nipple and Ball Valve with Square head Plug																																																																																																																																																																																																																																																																																																																																																																																																																																																											
THR'D NIPPLE & SWAGES		ASTM A 333 GR-6 Class 3000, ASTM A350 LF2																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
GASKETS		Class 150, 1/8" THK. SPIRAL WOUND CS RING 304 SS OR 316 SS WINDING, FLEXIBLE GRAPHITE ASME B16.20																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
BOLTING		STUDS : ASTM A320 Gr. L7, Cadmium plated NUTS : ASTM A194 Gr. 7, Heavy Hex, Cadmium plated																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
SPEC. PLATE / BLANK & SPACER		SPEC. PLATE ASTM A516 Gr. 60					BLANK & SPACER ASTM A516 Gr. 60																																																																																																																																																																																																																																																																																																																																																																																																																																																																
VALVES	GATE	VG-101			VG-202																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
	GLOBE	VGL-101			VGL-202																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
	CHECK	VC-101			VC-202																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
	BALL	VB-102			VB-202																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
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	FOR SPEC. NOTES SEE SHEET 43 OF 43																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
SERVICE: FLARE / VENT, PROCESS GAS, (WELLHEAD COMPRESSOR)										HYDROTEST LIMITED BY : FLANGES																																																																																																																																																																																																																																																																																																																																																																																																																																																													
										BARG. 30					PSIG. 435																																																																																																																																																																																																																																																																																																																																																																																																																																																								
DESCRIPTION:		DRN.	HM/SMHA/MMA/BS	DESCRIPTION:						DRN.			DESCRIPTION:		DRN.																																																																																																																																																																																																																																																																																																																																																																																																																																																								
14 FOR TENDER		CHK.	WUS							CHK.					CHK.																																																																																																																																																																																																																																																																																																																																																																																																																																																								
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CONSULTANT:				DRAWN	CHECKED	APPROVED	CLIENT : Oil & Gas Development Company Ltd.				MATERIAL : LOW TEMP CARBON STEEL				RATING : 150 #																																																																																																																																																																																																																																																																																																																																																																																																																																																								
Zishan Engineers (Pvt.) Ltd.				NAME	HM/SMHA/ MMA /BS	MAH	MAS					CORR. ALLOWANCE: 3.00 mm				SHEET : 12 OF 43																																																																																																																																																																																																																																																																																																																																																																																																																																																							
				DATE	16-02-2015	16-02-2015	16-02-2015					PIPE WALL TOLERANCE : ± 12.5%				SPEC. A3 (S) REV. 14																																																																																																																																																																																																																																																																																																																																																																																																																																																							
PIPING MATERIAL SPECIFICATION										JOB NO. 165-4					Design Code: ASME B 31.3																																																																																																																																																																																																																																																																																																																																																																																																																																																								

NACE - MR - 0175 (LATEST REVISION)

NOMINAL RUN PIPE SIZE (in.)

LEGEND:
R Reducing Tee
S Sockolet
E Equal Tee
W Weldolet
TS Equal Tee & Swage Nipple

Note : Reducing fittings thickness shall match heavier pipe thickness.

DESIGN CONDITIONS		STUD BOLTS		
TEMP.	PRESS.	NOMINAL PIPE SIZE	DIA. .in. & LENGTH, mm	NO. OF BOLTS
- 50 TO 100 ° F	285 psig	1/2"	M14 x 60	4
200	260	3/4"	M14 x 65	4
300	230	1"	M14 x 65	4
400	200	1 1/2"	M14 x 70	4
500	170	2"	M16 x 80	4
600	140	3"	M16 x 90	4
650	125	4"	M16 x 90	8
		6"	M20 x 100	8
-45 TO 38 ° C	19.66 barg	8"	M20 x 110	8
93	17.93	10"	M24 x 115	12
149	15.86	12"	M24 x 120	12
204	13.79	14"	M27 x 130	12
		16"	M27 x 135	16
		18"	M30 x 150	16
		20"	M30 x 160	20
		24"	M33 x 175	20
		28"	M33 x 180	28
		30"	M39 x 185	28
		36"	M39 x 210	32

NOMINAL PIPE SIZE		1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	90° BRANCH CONNECTIONS																				
MIN. WALL THK.		SCH 5S				SCH 10S												NOMINAL BRANCH SIZE (in.)																			
PIPE		DUPLEX SS, AS PER ASTM A790 UNS S31803, SEAMLESS																																			
		PLAIN END				BW BEVELED END																															
FLANGES		ASME B 16.5 Class 150 Raised Face, ASTM A 182 F-51 Weld Neck, Bore to Match Pipe I.D.																																			
FITTINGS		ASME B16.9, Beveled Ends, Wall Thk. to Match Pipe Seamless Steel, ASTM A 815 UNS S31803																																			
BRANCH OUTLETS (Sockolet, Weldolet, etc.)		B.W. Ends, MSS-SP-97 ASTM A 815 UNS S31803																																			
UNIONS		NOT PERMITTED																																			
PLUG		NOT PERMITTED																																			
VENTS / DRAINS		1/2"	3/4"				3/4" / 1"				3/4" / 1 1/2"																										
		Use 'in spec.' branch connection with 4" long Nipple and Ball Valve with Square head Plug																																			
THR'D NIPPLE & SWAGES		NOT PERMITTED																																			
GASKETS		Class 150, 1/8" Thk. Spiral Wound CS Ring 304 SS or 316 SS Winding, Flexible Graphite ASME B16.20																																			
BOLTING		STUDS : ASTM A 193 Gr. B7, Cadmium plated NUTS : ASTM A194 Gr. 2HM																																			
SPEC. PLATE / BLANK & SPACER		X				SPEC. PLATE : DUPLEX SS, AS PER ASTM A182 Gr.F51														X																	
VALVES	GATE		X				X														X																
	GLOBE		VGL-203																																		
	CHECK		VC-203				VC-204																														
	BALL		VB-204																																		
	PLUG		X				X														X																
	BUTTERFLY		X				X														X																
			X				X														X																
FOR SPEC. NOTES SEE SHEET 43 OF 43																																					
SERVICE: PRODUCED WATER (A / G), FLOWLINE (WITHOUT CORROSION INHIBITOR)									HYDROTEST LIMITED BY : FLANGES																												
									BARG. 30			PSIG. 435																									
DESCRIPTION:		DRN.	HM/SMHA/MMA/BS	DESCRIPTION:		DRN.			DESCRIPTION:		DRN.																										
14 FOR TENDER		CHK.	WUS			CHK.					CHK.																										
		APP.	MAS			APP.					APP.																										
CONSULTANT:				DRAWN				CHECKED				APPROVED				MATERIAL : DUPLEX STAINLESS STEEL				RATING : 150 #																	
Zishan Engineers (Pvt.) Ltd.								HM/SMHA/ MMA /BS				MIAH MAS				CLIENT : Oil & Gas Development Company Ltd.				CORR. ALLOWANCE: NIL				SHEET : 14 OF 43													
								NAME				DATE				DATE				PIPE WALL TOLERANCE : ± 12.5%				SPEC. A5 REV. 14													
								DATE				DATE				DATE				Design Code: ASME B 31.3																	
PIPING MATERIAL SPECIFICATION																		JOB NO. 165-4																			
																		Notes : Reducing fittings thickness shall match heavier pipe thickness.																			
																		LEGEND: R Reducing Tee S Sockolet E Equal Tee W Weldolet TS Equal Tee & Swage Nipple																			
																		DESIGN CONDITIONS																STUD BOLTS			
																		TEMP.		PRESS.		NOMINAL PIPE SIZE		DIA. ,in. & LENGTH, mm		NO. OF BOLTS											
																		° F		psig																	
																		- 150 TO 100		290		1/2"		M14 x 60		4											
																		200		260		3/4"		M14 x 65		4											
																		300		230		1"		M14 x 65		4											
																		400		200		1 1/2"		M14 x 70		4											
																		500		170		2"		M16 x 80		4											
																		600		140		3"		M16 x 90		4											
																		650		125		4"		M16 x 90		8											
																		700		110		6"		M20 x 100		8											
																		° C		barg		8"		M20 x 110		8											
																		-101 TO 38		20.00		10"		M24 x 115		12											
																		93		17.93		12"		M24 x 120		12											
																		149		15.86		14"		M27 x 130		12											
																		204		13.79		16"		M27 x 135		16											
																		260		11.72		18"		M30 x 150		16											
																		316		9.66		20"		M30 x 150		20											
																		371		7.59																	

NOMINAL PIPE SIZE	1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	28"	30"	36"	
MIN. WALL THK. (mm)	SCH 10S																5.47	5.86	7.03	
PIPE	ASTM A 312 TP 316 SMLS, ASME 36.19										A 312 TP 316 WELDED									
	SW / Plain Ends					BW Beveled Ends														
FLANGES	ASME B 16.5 Class 150 Raised Face, ASTM A 182 F-316										A 182 F-316, B16.47									
	Socket Weld					Weld Neck, Bore to Match Pipe I.D.														
FITTINGS	ASME B16.11 S.W. CLASS 3000,ASTM A182-F316					ASME B16.9, Beveled Ends, Wall Thk. to Match Pipe Seamless Steel, ASTM A 403 WP-316										ASME B16.9, BW A 403 WP-316, WELDED				
	S.W. Ends, MSS-SP-97 Class 3000, ASTM A182 F316					B.W. Ends, MSS-SP-97 ASTM A182 F316														
UNIONS	Class 3000, S.W. Ground Joint,																			
	Square Head 3000# ASTM A182-F316																			
PLUG	ASTM A182-F316																			
	Use 'in spec.' branch connection with 4" long Nipple and Ball Valve with Square head Plug																			
VENTS / DRAINS	1/2"	3/4"			3/4" / 1"			3/4" / 1 1/2"												
THR'D NIPPLE & SWAGES	ASTM A 312 Gr. TP 316 Class 3000, A182-F316																			
GASKETS	Class 150, 1/8" THK. Flexible graphite W/ 304 or 316 SS corrugated insert,ASME B16.20																			
BOLTING	STUDS : ASTM A 193 Gr. B7, Cadmium plated																			
	NUTS : ASTM A194 Gr. 8A, Heavy Hex, Cadmium plated (Impact Tested)																			
SPEC. PLATE / BLANK & SPACER	SPEC. PLATE ASTM A-240 Gr. 316																			
	[Crossed out]																			
VALVES	GATE	VG-103	VG-203																	
	GLOBE	VGL-103	VGL-204																	
	CHECK	VC-103	VC-205																	
	BALL	VB-104	VB-206																	
	PLUG	[Crossed out]																		
	BUTTERFLY	[Crossed out]																		

		90° BRANCH CONNECTIONS																											
		NOMINAL BRANCH SIZE (in.)																											
		1/2	3/4	1	1 1/2	2	3	4	6	8	10	12	14	16	18	20	24	28	30	36									
NOMINAL RUN PIPE SIZE (in.)	36	S	S	S	S	W	W	W	W	W	W	W	W	R	R	R	R	R	R	R	E								
	30	S	S	S	S	W	W	W	W	W	W	W	R	R	R	R	R	R	R	E									
	28	S	S	S	S	W	W	W	W	W	W	R	R	R	R	R	E												
	24	S	S	S	S	W	W	W	W	W	R	R	R	R	E														
	20	S	S	S	S	W	W	W	W	R	R	R	R	E															
	18	S	S	S	S	W	W	W	R	R	R	R	E																
	16	S	S	S	S	W	W	R	R	R	R	E																	
	14	S	S	S	S	W	W	R	R	R	E																		
	12	S	S	S	S	W	W	R	R	E																			
	10	S	S	S	S	W	W	R	R	E																			
	8	S	S	S	S	W	W	R	R	E																			
	6	S	S	S	S	W	R	R	E																				
	4	S	S	S	S	R	R	E																					
	3	S	S	S	S	R	E																						
	2	TS	TS	TS	TS	E																							
1 1/2	R	R	E	E																									
1	R	R	E																										
3/4	R	E																											
1/2	E																												

LEGEND:
R Reducing Tee
S Socket
E Equal Tee
W Weldolet
TS Equal Tee & Swage Nipple

NOTE : Reducing fittings thickness shall match heavier pipe thickness.

DESIGN CONDITIONS		STUD BOLTS		
TEMP. ° F	PRESSURE psig	NOMINAL PIPE SIZE	DIA. .in. & LENGTH, mm	NO. OF BOLTS
- 325 TO 100	230	1/2"	M14 x 60	4
200	195	3/4"	M14 x 65	4
300	175	1"	M14 x 65	4
400	160	1 1/2"	M14 x 70	4
500	145	2"	M16 x 80	4
600	140	3"	M16 x 90	4
650	125	4"	M16 x 90	8
700	110	6"	M20 x 100	8
° C	barg	8"	M20 x 110	8
-200 TO 38	15.86	10"	M24 x 115	12
93	13.45	12"	M24 x 120	12
149	12.07	14"	M27 x 130	12
204	11.03	16"	M27 x 135	16
260	10.00	18"	M30 x 150	16
316	9.66	20"	M30 x 160	20
343	8.62	24"	M33 x 175	20
371	7.59	28"	M33 x 180	28
		30"	M39 x 185	28
		36"	M39 x 210	32

FOR SPEC. NOTES SEE SHEET 43 OF 43																					
SERVICE: LIQUIFIED GAS UNDER - 100 C, RICH AMINE, ACID GAS										HYDROTEST LIMITED BY : FLANGES											
										BARG. 24 PSIG. 348											
DESCRIPTION: 14 FOR TENDER	DRN.	HM/SMHA/MMA/BS	DESCRIPTION:	DRN.		DESCRIPTION:	DRN.														
	CHK.	WUS		CHK.			CHK.		CHK.												
	APP.	MAS		APP.			APP.		APP.												

CONSULTANT:			DRAWN	CHECKED	APPROVED	MATERIAL : STAINLESS STEEL (316 L)		RATING : 150 #		
Zishan Engineers (Pvt.) Ltd.			NAME	HM/SMHA/ MMA /BS	MAH	MAS	CORR. ALLOWANCE: NIL		SHEET : 15 OF 43	
			DATE	16-02-2015	16-02-2015	16-02-2015	PIPE WALL TOLERANCE : ± 12.5%		SPEC. A6 REV. 14	
			PIPING MATERIAL SPECIFICATION				CLIENT : Oil & Gas Development Company Ltd.	Design Code: ASME B 31.3		

JOB NO. 165-4

NOMINAL PIPE SIZE		1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	30"	34"	36"	90° BRANCH CONNECTIONS																																																																																																																																																																																																																																																																																																																																																																																																																																																			
MIN. WALL THK. (mm)		SCH 80				SCH 40				SCH STD				SCH XS		SCH 40		20.62	23.82	25.40	NOMINAL BRANCH SIZE (in.)																																																																																																																																																																																																																																																																																																																																																																																																																																																			
PIPE		Carbon Steel ASTM A106-B SMLS, ASME 36.10,																		API 5L GR.B, HFW		<table border="1"> <thead> <tr> <th></th> <th>1/2"</th> <th>3/4"</th> <th>1"</th> <th>1 1/2"</th> <th>2"</th> <th>3"</th> <th>4"</th> <th>6"</th> <th>8"</th> <th>10"</th> <th>12"</th> <th>14"</th> <th>16"</th> <th>18"</th> <th>20"</th> <th>24"</th> <th>30"</th> <th>34"</th> <th>36"</th> </tr> </thead> <tbody> <tr> <td>36</td> <td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <td>34</td> <td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <td>30</td> 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FLANGES		ASME B 16.5 Class 300 Raised Face, ASTM A105																		ASME B16.47, A105																																																																																																																																																																																																																																																																																																																																																																																																																																																				
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BRANCH OUTLETS (Sockolet, Weldolet, etc.)		S.W. End, MSS-SP-97 Class 3000, ASTM A105				B.W. End, MSS-SP-97 ASTM A105																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
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THR'D NIPPLE & SWAGES		ASTM A106-B SMLS Class 3000, ASTM A - 105																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
GASKETS		Class 300, 1/8" THK. Flexible graphite W/ 304 or 316 SS corrugated insert, ASME B16.20																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
BOLTING		STUDS : ASTM A193 Gr. B7, Cadmium plated NUTS : ASTM A194 Gr. 2H, Heavy Hex, Cadmium plated																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
SPEC. PLATE / BLANK & SPACER						BLANK & SPACER ASTM A516 Gr. 60				BLANK & SPACER ASTM A516 Gr. 60																																																																																																																																																																																																																																																																																																																																																																																																																																																														
VALVES	GATE	VG-101				VG-211																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
	GLOBE	VGL-101				VGL-211																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
	CHECK	VC-101				VC-211																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
	BALL	VB-101				VB-211																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
	NEEDLE	VN-101				VN-212																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
	BUTTERFLY																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
	FOR SPEC. NOTES SEE SHEET 43 OF 43																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
SERVICE: FUEL OIL, HOT OIL, INERT GAS, STABILIZED CONDENSATE, GLYCOL, FIREWATER (A/G), TREATED GAS (SALES GAS, LPG)										HYDROTEST LIMITED BY : FLANGES																																																																																																																																																																																																																																																																																																																																																																																																																																																														
										BARG. 76.5				PSIG. 1110																																																																																																																																																																																																																																																																																																																																																																																																																																																										
DESCRIPTION:		DRN.	HM/SMHA/MMA/BS	DESCRIPTION:		DRN.	DESCRIPTION:		DRN.																																																																																																																																																																																																																																																																																																																																																																																																																																																															
14 FOR TENDER		CHK.	WUS			CHK.			CHK.																																																																																																																																																																																																																																																																																																																																																																																																																																																															
		APP.	MAS			APP.			APP.																																																																																																																																																																																																																																																																																																																																																																																																																																																															
CONSULTANT:										DRAWN				CHECKED				APPROVED				MATERIAL : CARBON STEEL				RATING : 300 #																																																																																																																																																																																																																																																																																																																																																																																																																																														
Zishan Engineers (Pvt.) Ltd.										NAME		HM/SMHA/ MMA /BS		MIAH		MAS		CLIENT : Oil & Gas Development Company Ltd.																																																																																																																																																																																																																																																																																																																																																																																																																																																						
										DATE		16-02-2015		16-02-2015		16-02-2015		CORR. ALLOWANCE : 1.6 mm				SHEET : 17 OF 43																																																																																																																																																																																																																																																																																																																																																																																																																																																		
										PIPING MATERIAL SPECIFICATION										JOB NO. 165-4				PIPE WALL TOLERANCE : ± 12.5%				SPEC. B1 REV. 14																																																																																																																																																																																																																																																																																																																																																																																																																																												
																				Design Code: ASME B 31.3																																																																																																																																																																																																																																																																																																																																																																																																																																																				

NOMINAL PIPE SIZE		1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	90° BRANCH CONNECTIONS											
MIN. WALL THK.		SCH 160			SCH 80			SCH 40			NOMINAL BRANCH SIZE (in.)																		
PIPE		Carbon Steel ASTM A106-B SMLS, ASME 36.10,																											
		SW / Plain Ends				BW Beveled Ends																							
FLANGES		ASME B 16.5 Class 300 Raised Face, ASTM A105																											
		Socket Weld				Weld Neck, Bore to Match Pipe I.D.																							
FITTINGS		ASME B16.11 S.W.				ASME B16.9, Beveled Ends, Wall Thk. to Match Pipe																							
		Class 3000, ASTM A105				Seamless Steel, ASTM A234 Gr. WPB																							
BRANCH OUTLETS (Sockolet, Weldolet, etc.)		S.W. Ends, MSS-SP-97 Class 3000, ASTM A105				B.W. Ends, MSS-SP-97 ASTM A105																							
UNIONS		Class 3000, S.W.				Use Flange Connection																							
		Ground Joint, ASTM A105																											
PLUG		Square Head 3000# ASTM A 105																											
VENTS / DRAINS		1/2"	3/4"			3/4" / 1"			3/4" / 1 1/2"																				
		Use 'in spec.' branch connection with 4" long Nipple and Ball Valve with Square head Plug																											
THR'D NIPPLE & SWAGES		ASTM A106-B SMLS																											
		Class 3000, ASTM A - 105																											
GASKETS		Class 300, 1/8" THK. Flexible graphite W/ 304 or 316 SS corrugated insert, ASME B16.20																											
BOLTING		STUDS : ASTM A193 Gr. B7, Cadmium plated																											
		NUTS : ASTM A194 Gr. 2H, Heavy Hex, Cadmium plated																											
SPEC. PLATE / BLANK & SPACER						SPEC. PLATE ASTM A516 Gr. 60				BLANK & SPACER ASTM A516 Gr. 60																			
VALVES	GATE	VG-101				VG-212																							
	GLOBE	VGL-101				VGL-212																							
	CHECK	VC-101				VC-212																							
	BALL	VB-101				VB-212																							
	NEEDLE	VN-101				VN-212																							
	BUTTERFLY																												
FOR SPEC. NOTES SEE SHEET 43 OF 43																													
SERVICE: RAW GAS, LEAN AMINE, FUEL GAS, OPEN DRAIN / VENTS, CLOSED DRAIN, AMINE DRAIN									HYDROTEST LIMITED BY : FLANGES																				
									BARG. 76.5			PSIG. 1110																	
DESCRIPTION:	DRN.	HM/SMHA/MMA/BS	DESCRIPTION:	DRN.		DESCRIPTION:	DRN.		DESCRIPTION:	DRN.		DESCRIPTION:	DRN.		DESCRIPTION:	DRN.													
14 FOR TENDER	CHK.	WUS		CHK.			CHK.			CHK.			CHK.			CHK.													
	APP.	MAS		APP.			APP.			APP.			APP.			APP.													
CONSULTANT:			DRAWN			CHECKED			APPROVED			MATERIAL : CARBON STEEL			RATING : 300 #														
Zishan Engineers (Pvt.) Ltd.			NAME			MIAH			MAS			CORR. ALLOWANCE : 3.0 mm			SHEET : 18 OF 43														
			DATE			16-02-2015			16-02-2015			PIPE WALL TOLERANCE : ± 12.5%			SPEC. B2 REV. 14														
			PIPING MATERIAL SPECIFICATION			JOB NO. 165-4			CLIENT : Oil & Gas Development Company Ltd.			Design Code: ASME B 31.3																	

NOMINAL RUN PIPE SIZE (in.)

NOMINAL RUN PIPE SIZE (in.)	1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"
24	S	S	S	S	W	W	W	W	W	W	R	R	R	R	R	E
20	S	S	S	S	W	W	W	W	W	R	R	R	R	R	R	E
18	S	S	S	S	W	W	W	W	R	R	R	R	R	R	E	
16	S	S	S	S	W	W	W	R	R	R	R	R	E			
14	S	S	S	S	W	W	W	R	R	R	R	E				
12	S	S	S	S	W	W	W	R	R	R	E					
10	S	S	S	S	W	W	R	R	R	E						
8	S	S	S	S	W	W	R	R	E							
6	S	S	S	S	W	R	R	E								
4	S	S	S	S	R	R	E									
3	S	S	S	S	R	E										
2	TS	TS	TS	TS	E											
1 1/2	R	R	E	E												
1	R	R	E													
3/4	R	E														
1/2	E															

LEGEND:
R Reducing Tee
S Sockolet
E Equal Tee
W Weldolet
TS Equal Tee & Swage Nipple

NOTE : Reducing fittings thickness shall match heavier pipe thickness.

DESIGN CONDITIONS		STUD BOLTS		
TEMP.	PRESSURE	NOMINAL PIPE SIZE	DIA. .in. & LENGTH, mm	NO. OF BOLTS
° F	psig			
- 20 TO 100	740	1/2"	M14 x 65	4
200	675	3/4"	M16 x 75	4
300	655	1"	M16 x 80	4
400	635	1 1/2"	M20 x 90	4
500	600	2"	M16 x 90	8
600	550	3"	M20 x 110	8
650	535	4"	M20 x 110	8
700	535	6"	M20 x 125	12
° C	barg	8"	M24 x 140	12
-29 TO 38	51.02	10"	M27 x 155	16
93	46.54	12"	M30 x 170	16
149	45.16	14"	M30 x 175	20
204	43.78	16"	M33 x 190	20
260	41.37	18"	M33 x 195	24
316	37.92	20"	M33 x 205	24
343	36.89	24"	M39 x 230	24
371	36.89			

NOMINAL PIPE SIZE		1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	28"	30"	36"	90° BRANCH CONNECTIONS																																
MIN. WALL THK. (mm)		SCH 5S				SCH 10S				SCH 40S				SCH 80S		12.05	12.91	15.5	NOMINAL BRANCH SIZE (in.)																																		
PIPE		ASTM A 312 TP 316 SMLS, ASME 36.19								A 312 TP 316 WELDED												1/2	3/4	1	1 1/2	2	3	4	6	8	10	12	14	16	18	20	24	28	30	36													
		SW / Plain Ends				BW Beveled Ends																																															
FLANGES		ASME B 16.5 Class 300 Raised Face, ASTM A 182 F-316																A 182 F-316, B16.47																																			
		Socket Weld				Weld Neck, Bore to Match Pipe I.D.																																															
FITTINGS		ASME B16.11 S.W. CLASS 3000,ASTM A182-F316				ASME B16.9, Beveled Ends, Wall Thk. to Match Pipe												A403 WP-316,WELDED																																			
BRANCH OUTLETS (Sockolet,Weldolet,etc.)		S.W. Ends, MSS-SP-97 Class 3000, ASTM A182 F316				B.W. Ends, MSS-SP-97 ASTM A182 F316																																															
UNIONS		Class 3000, S.W. Ground Joint,																																																			
PLUG		Square Head 3000# ASTM A182-F316																																																			
VENTS / DRAINS		1/2"	3/4"			Use 'in spec.' branch connection with 4" long Nipple and Ball Valve with Square head Plug																																															
THR'D NIPPLE & SWAGES		ASTM A 312 Gr. TP 316 Class 3000, A182-F316																																																			
GASKETS		Class 300, 1/8" THK. Flexible graphite W/ 304 or 316 SS corrugated insert,ASME B16.20																																																			
BOLTING		STUDS : ASTM A193 Gr. B7M																																																			
		NUTS : ASTM A194 Gr. 8, Heavy Hex, Cadmium plated																																																			
SPEC. PLATE / BLANK & SPACER						SPEC. PLATE ASTM A-240 Gr. 316																																															
VALVES	GATE	VG-103				VG-213																																															
	GLOBE	VGL-103				VGL-214																																															
	CHECK	VC-103				VC-215																																															
	BALL	VB-104				VB-216																																															
	PLUG																																																				
	BUTTERFLY																																																				
	FOR SPEC. NOTES SEE SHEET 43 OF 43																																																				
SERVICE: LIQUIFIED GAS UNDER - 100 C, RICH AMINE, ACID GAS																						HYDROTEST LIMITED BY: FLANGES																															
																						BARG. 62				PSIG. 900																											
DESCRIPTION:		DRN.	HM/SMHA/MMA/BS	DESCRIPTION:		DRN.		DESCRIPTION:		DRN.																																											
14 FOR TENDER		CHK.	WUS			CHK.				CHK.																																											
		APP.	MAS			APP.				APP.																																											
CONSULTANT:		DRAWN				CHECKED				APPROVED				MATERIAL : STAINLESS STEEL (316 L)				RATING : 300 #																																			
Zishan Engineers (Pvt.) Ltd.		NAME				MIAH				MAS				CORR. ALLOWANCE: NIL				SHEET : 21 OF 43																																			
		DATE				16-02-2015				16-02-2015				16-02-2015				PIPE WALL TOLERANCE : ± 12.5%				SPEC. B6 REV. 14																															
		PIPING MATERIAL SPECIFICATION												JOB NO. 165-4				Design Code: ASME B 31.3																																			

NOMINAL RUN PIPE SIZE (in.)

36	S	S	S	S	W	W	W	W	W	W	W	W	W	R	R	R	R	R	R	R	E
30	S	S	S	S	W	W	W	W	W	W	W	W	R	R	R	R	R	R	R	R	E
28	S	S	S	S	W	W	W	W	W	W	W	R	R	R	R	R	R	R	R	R	E
24	S	S	S	S	W	W	W	W	W	W	R	R	R	R	R	R	R	R	R	R	E
20	S	S	S	S	W	W	W	W	W	R	R	R	R	R	R	R	R	R	R	R	E
18	S	S	S	S	W	W	W	W	R	R	R	R	R	R	R	R	R	R	R	R	E
16	S	S	S	S	W	W	W	R	R	R	R	R	R	R	R	R	R	R	R	R	E
14	S	S	S	S	W	W	W	R	R	R	R	R	R	R	R	R	R	R	R	R	E
12	S	S	S	S	W	W	W	R	R	R	R	R	R	R	R	R	R	R	R	R	E
10	S	S	S	S	W	W	R	R	R	R	R	R	R	R	R	R	R	R	R	R	E
8	S	S	S	S	W	W	R	R	R	R	R	R	R	R	R	R	R	R	R	R	E
6	S	S	S	S	W	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	E
4	S	S	S	S	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	E
3	S	S	S	S	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	E
2	TS	TS	TS	TS	E																
1 1/2	R	R	E	E																	
1	R	R	E																		
3/4	R	E																			
1/2	E																				

LEGEND:
R Reducing Tee
S Sockolet
E Equal Tee
W Weldolet
TS Equal Tee & Swage Nipple

NOTE : Reducing fittings thickness shall match heavier pipe thickness.

DESIGN CONDITIONS		STUD BOLTS		
TEMP.	PRESSURE	NOMINAL PIPE SIZE	DIA. ,in. & LENGTH, mm	NO. OF BOLTS
° F	psig			
- 325 TO 100	600	1/2"	M14 x 65	4
200	505	3/4"	M16 x 75	4
300	455	1"	M16 x 80	4
400	415	1 1/2"	M20 x 90	4
500	380	2"	M16 x 90	8
600	360	3"	M20 x 110	8
650	350	4"	M20 x 110	8
700	345	6"	M20 x 125	12
° C	barg	8"	M24 x 140	12
-200 TO 38	41.37	10"	M27 x 155	16
93	34.82	12"	M30 x 170	16
149	31.38	14"	M30 x 175	20
204	28.62	16"	M33 x 190	20
260	26.28	18"	M33 x 195	24
316	24.82	20"	M33 x 205	24
343	24.13	24"	M39 x 230	24
371	23.79	28"	M45 x 250	28
		30"	M48 x 286	28
		36"	M52 x 324	32



NOMINAL PIPE SIZE		1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	90° BRANCH CONNECTIONS													
MIN. WALL THK.		SCH 160						SCH 80												NOMINAL BRANCH SIZE (in.)											
PIPE		ASTM A 106 GR.B SMLS OR API 5L GR.B SMLS, ASME 36.10																													
		SW / Plain Ends						BW Beveled Ends																							
FLANGES		ASME B 16.5 Class 600 RF, ASTM A 105																													
		Socket Weld						Weld Neck, Bore to Match Pipe I.D.																							
FITTINGS		ASME B16.11 S.W. CLASS 6000, ASTM A 105						ASME B16.9, Beveled Ends, Wall Thk. to Match Pipe Seamless Steel, ASTM A 234 GR. WPB																							
BRANCH OUTLETS (Sockolet, Weldolet, etc.)		S.W. End, MSS-SP-97 Class 6000, ASTM A105						B.W. End, MSS-SP-97 ASTM A105																							
UNIONS		Class 6000, S.W. Ground Joint, A 105						X																							
PLUG		Square Head 6000# ASTM A 105						X																							
VENTS / DRAINS		1/2"	3/4"			3/4" / 1"			3/4" / 1 1/2"																						
		Use 'in spec.' branch connection with 4" long Nipple and Ball Valve with Square head Plug																													
THR'D NIPPLE & SWAGES		ASTM A106-B SMLS Class 6000, ASTM A - 105						X																							
GASKETS		Class 600, 1/8" THK. Flexible graphite W/ 304 or 316 SS corrugated insert, ASME B16.20																													
BOLTING		STUDS : ASTM A 193 Gr. B7, Cadmium plated NUTS : ASTM A194 Gr. 2H, Heavy Hex, Cadmium plated																													
SPEC. PLATE / BLANK & SPACER		X						SPEC. PLATE ASTM A516 Gr. 60						BLANK & SPACER ASTM A516 Gr. 60																	
VALVES	GATE	VG-121						VG-221																							
	GLOBE	VGL-121						VGL-221																							
	CHECK	VC-121						VC-221																							
	BALL	VB-121						VB-221																							
	PLUG	X						X																							
	BUTTERFLY	X						X																							
	FOR SPEC. NOTES SEE SHEET 43 OF 43																														
SERVICE: FUEL OIL, HOT OIL, INERT GAS, STABILIZED CONDENSATE,										HYDROTEST LIMITED BY : FLANGES																					
GLYCOL, FIREWATER (A/G), TREATED GAS (SALES GAS, LPG)										BARG: 153						PSIG: 2220															
DESCRIPTION:		DRN.	HM/SMHA/MMA/BS	DESCRIPTION:		DRN.			DESCRIPTION:		DRN.																				
14 FOR TENDER		CHK.	WUS			CHK.					CHK.																				
		APP.	MAS			APP.					APP.																				
CONSULTANT:		DRAWN		CHECKED		APPROVED		CLIENT : Oil & Gas Development Company Ltd.														MATERIAL : CARBON STEEL		RATING : 600 #							
Zishan Engineers (Pvt.) Ltd.		NAME		MIAH		MAS		JOB NO. 165-4														CORR. ALLOWANCE: 1.6 mm		SHEET : 22 OF 43							
		DATE		16-02-2015		16-02-2015																16-02-2015		PIPE WALL TOLERANCE : ± 12.5%		SPEC. D1		REV. 14			
		DATE		16-02-2015		16-02-2015																16-02-2015		Design Code: ASME B 31.3							

NOMINAL RUN PIPE SIZE (in.)

	1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"
24	S	S	S	S	W	W	W	W	W	W	R	R	R	R	R	E
20	S	S	S	S	W	W	W	W	W	R	R	R	R	R	R	E
18	S	S	S	S	W	W	W	W	W	R	R	R	R	R	R	E
16	S	S	S	S	W	W	W	W	W	R	R	R	R	R	R	E
14	S	S	S	S	W	W	W	W	W	R	R	R	R	R	R	E
12	S	S	S	S	W	W	W	W	W	R	R	R	R	R	R	E
10	S	S	S	S	W	W	W	W	W	R	R	R	R	R	R	E
8	S	S	S	S	W	W	W	W	W	R	R	R	R	R	R	E
6	S	S	S	S	W	W	W	W	W	R	R	R	R	R	R	E
4	S	S	S	S	W	W	W	W	W	R	R	R	R	R	R	E
3	S	S	S	S	W	W	W	W	W	R	R	R	R	R	R	E
2	TS	TS	TS	TS	W	W	W	W	W	R	R	R	R	R	R	E
1 1/2	R	R	E	E												
1	R	R	E													
3/4	R	E														
1/2	E															

LEGEND:
R Reducing Tee
S Sockolet
E Equal Tee
W Weldolet
TS Equal Tee & Swage Nipple

NOTE : Reducing fittings thickness shall match heavier pipe thickness.

DESIGN CONDITIONS		STUD BOLTS		
TEMP.	PRESSURE	NOMINAL PIPE SIZE	DIA. .in. & LENGTH, mm	NO. OF BOLTS
° F	psig			
- 20 TO 100	1480	1/2"	M14 x 80	4
200	1350	3/4"	M16 x 90	4
300	1315	1"	M16 x 90	4
400	1270	1 1/2"	M20 x 110	4
500	1200	2"	M16 x 110	8
600	1095	3"	M20 x 125	8
650	1075	4"	M24 x 145	8
700	1065	6"	M27 x 170	12
° C	barg	8"	M30 x 195	12
-29 TO 38	102.07	10"	M33 x 215	16
93	93.10	12"	M33 x 225	20
149	90.69	14"	M36 x 235	20
204	87.59	16"	M39 x 255	20
260	82.76	18"	M42 x 275	20
316	75.52	20"	M42 x 290	24
343	74.14	24"	M48 x 330	24
371	73.45			



NOMINAL PIPE SIZE		1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	90° BRANCH CONNECTIONS													
MIN. WALL THK.		SCH 160						SCH 80												NOMINAL BRANCH SIZE (in.)											
PIPE		ASTM A 106 GR.B SMLS OR API 5L GR.B SMLS, ASME 36.10																													
FLANGES		SW / Plain Ends						BW Beveled Ends																							
FITTINGS		ASME B 16.5 Class 600 RF, ASTM A 105																													
BRANCH OUTLETS (Sockolet, Weldolet, etc.)		S.W. End, MSS-SP-97 Class 6000, ASTM A105						B.W. End, MSS-SP-97 ASTM A105																							
UNIONS		Class 6000, S.W. Ground Joint, A 105						X																							
PLUG		Square Head 6000# ASTM A 105						X																							
VENTS / DRAINS		1/2"	3/4"				3/4" / 1"				3/4" / 1 1/2"				Use 'in spec.' branch connection with 4" long Nipple and Ball Valve with Square head Plug																
THR'D NIPPLE & SWAGES		ASTM A106-B SMLS Class 6000, ASTM A - 105						X																							
GASKETS		Class 600, 1/8" THK. Flexible graphite W/ 304 or 316 SS corrugated insert, ASME B16.20																													
BOLTING		STUDS : ASTM A 193 Gr. B7, Cadmium plated NUTS : ASTM A194 Gr. 2H, Heavy Hex, Cadmium plated																													
SPEC. PLATE / BLANK & SPACER		X						SPEC. PLATE ASTM A516 Gr. 60						BLANK & SPACER ASTM A516 Gr. 60																	
VALVES	GATE	VG-121						VG-222																							
	GLOBE	VGL-121						VGL-222																							
	CHECK	VC-121						VC-222																							
	BALL	VB-121						VB-222																							
	PLUG	X						X																							
	BUTTERFLY	X						X																							
	FOR SPEC. NOTES SEE SHEET 43 OF 43																														
SERVICE: RAW GAS, LEAN AMINE, FUEL GAS, OPEN DRAIN / VENTS, CLOSED DRAIN, AMINE DRAIN												HYDROTEST LIMITED BY : FLANGES																			
DESCRIPTION: 14 FOR TENDER												BARG: 153						PSIG: 2220													
DRN.	HM/SMHA/MMA/BS	DESCRIPTION:										DRN.	DESCRIPTION:																		
CHK.	WUS											CHK.																			
APP.	MAS											APP.																			
CONSULTANT: Zishan Engineers (Pvt.) Ltd.												DRAWN	CHECKED	APPROVED	CLIENT : Oil & Gas Development Company Ltd.																
												NAME	HM/SMHA/MMA/BS	MAH	MAS	MATERIAL : LOW. TEMP. CARBON STEEL RATING : 600 # CORR. ALLOWANCE: 3.0 mm SHEET : 23 OF 43 PIPE WALL TOLERANCE : ± 12.5% SPEC. D2 REV. 14 Design Code: ASME B 31.3															
												DATE	16-02-2015	16-02-2015	16-02-2015																
												PIPING MATERIAL SPECIFICATION																JOB NO. 165-4			

NOMINAL RUN PIPE SIZE (in.)

NOMINAL RUN PIPE SIZE (in.)	1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"
24	S	S	S	S	W	W	W	W	W	W	R	R	R	R	R	E
20	S	S	S	S	W	W	W	W	W	R	R	R	R	R	R	E
18	S	S	S	S	W	W	W	W	W	R	R	R	R	R	R	E
16	S	S	S	S	W	W	W	W	W	R	R	R	R	R	R	E
14	S	S	S	S	W	W	W	W	W	R	R	R	R	R	R	E
12	S	S	S	S	W	W	W	W	W	R	R	R	R	R	R	E
10	S	S	S	S	W	W	W	W	W	R	R	R	R	R	R	E
8	S	S	S	S	W	W	W	W	W	R	R	R	R	R	R	E
6	S	S	S	S	W	W	W	W	W	R	R	R	R	R	R	E
4	S	S	S	S	R	R	R	R	R	R	R	R	R	R	R	E
3	S	S	S	S	R	R	R	R	R	R	R	R	R	R	R	E
2	TS	TS	TS	TS	E	E	E	E	E	E	E	E	E	E	E	E
1 1/2	R	R	E	E	E	E	E	E	E	E	E	E	E	E	E	E
1	R	R	E	E	E	E	E	E	E	E	E	E	E	E	E	E
3/4	R	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
1/2	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E

LEGEND:
 R Reducing Tee
 S Sockolet
 E Equal Tee
 W Weldolet
 TS Equal Tee & Swage Nipple

NOTE : Reducing fittings thickness shall match heavier pipe thickness.

DESIGN CONDITIONS		STUD BOLTS		
TEMP.	PRESSURE	NOMINAL PIPE SIZE	DIA. in. & LENGTH, mm	NO. OF BOLTS
° F	psig			
- 50 TO 100	1480	1/2"	M14 x 80	4
200	1350	3/4"	M16 x 90	4
300	1315	1"	M16 x 90	4
400	1270	1 1/2"	M20 x 110	4
500	1200	2"	M16 x 110	8
600	1095	3"	M20 x 125	8
650	1075	4"	M24 x 145	8
700	1065	6"	M27 x 170	12
° C	barg	8"	M30 x 195	12
-45.5 TO 38	102.07	10"	M33 x 215	16
93	93.10	12"	M33 x 225	20
149	90.69	14"	M36 x 235	20
204	87.59	16"	M39 x 255	20
260	82.76	18"	M42 x 275	20
316	75.52	20"	M42 x 290	24
343	74.14	24"	M48 x 330	24
371	73.45			

NOMINAL PIPE SIZE		1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	90° BRANCH CONNECTIONS													
MIN. WALL THK.		SCH 160						SCH 80												NOMINAL BRANCH SIZE (in.)											
PIPE		ASTM A 106 GR.B SMLS OR API 5L GR.B SMLS, ASME 36.10																													
FLANGES		SW / Plain Ends						BW Beveled Ends																							
FITTINGS		ASME B 16.5 Class 600 RF, ASTM A 105						ASME B 16.5 Class 600 RF, ASTM A 105																							
BRANCH OUTLETS (Sockolet, Weldolet, etc.)		S.W. End, MSS-SP-97 Class 6000, ASTM A105						B.W. End, MSS-SP-97 ASTM A105																							
UNIONS		Class 6000, S.W. Ground Joint, A 105																													
PLUG		Square Head 6000# ASTM A 105																													
VENTS / DRAINS		1/2"	3/4"				3/4" / 1"				3/4" / 1 1/2"																				
THR'D NIPPLE & SWAGES		ASTM A106-B SMLS Class 6000, ASTM A - 105																													
GASKETS		Class 600, 1/8" THK. Flexible graphite W/ 304 or 316 SS corrugated insert, ASME B16.20																													
BOLTING		STUDS : ASTM A 193 Gr. B7, Cadmium plated NUTS : ASTM A194 Gr. 2H, Heavy Hex, Cadmium plated																													
SPEC. PLATE / BLANK & SPACER								SPEC. PLATE ASTM A516 Gr. 60						BLANK & SPACER ASTM A516 Gr. 60																	
VALVES	GATE	VG-121						VG-222																							
	GLOBE	VGL-121						VGL-222																							
	CHECK	VC-121						VC-222																							
	BALL	VB-121						VB-222																							
	PLUG																														
	BUTTERFLY																														
	FOR SPEC. NOTES SEE SHEET 43 OF 43																														
SERVICE: RAW GAS, LEAN AMINE, FUEL GAS, OPEN DRAIN / VENTS, CLOSED DRAIN, AMINE DRAIN										HYDROTEST LIMITED BY : FLANGES																					
DESCRIPTION: 14 FOR TENDER										BARG: 153 PSIG: 2220																					
DRN.		HM/SMHA/MMA/BS		DESCRIPTION:		DRN.		DESCRIPTION:		DRN.		DRN.		DRN.		DRN.		DRN.													
CHK.		WUS				CHK.				CHK.		CHK.		CHK.		CHK.		CHK.													
APP.		MAS				APP.				APP.		APP.		APP.		APP.		APP.													
CONSULTANT:		DRAWN		CHECKED		APPROVED		MATERIAL : LOW. TEMP. CARBON STEEL		RATING :		CORR. ALLOWANCE: 3.0 mm		SHEET :		PIPE WALL TOLERANCE : ± 12.5%		SPEC. D2 (S) REV. 14													
Zishan Engineers (Pvt.) Ltd.		NAME		MIAH		MAS		CLIENT : Oil & Gas Development Company Ltd.		600 #		24 OF 43		Design Code: ASME B 31.3																	
		DATE		16-02-2015		16-02-2015		16-02-2015																							
PIPING MATERIAL SPECIFICATION										JOB NO. 165-4																					
NOMINAL RUN PIPE SIZE (in.)		24	S	S	S	S	W	W	W	W	W	W	R	R	R	R	R	R	E												
		20	S	S	S	S	W	W	W	W	W	W	R	R	R	R	R	R	E												
		18	S	S	S	S	W	W	W	W	W	W	R	R	R	R	R	R	E												
		16	S	S	S	S	W	W	W	W	W	W	R	R	R	R	R	R	E												
		14	S	S	S	S	W	W	W	W	W	W	R	R	R	R	R	R	E												
		12	S	S	S	S	W	W	W	W	W	W	R	R	R	R	R	R	E												
		10	S	S	S	S	W	W	W	W	W	W	R	R	R	R	R	R	E												
		8	S	S	S	S	W	W	W	W	W	W	R	R	R	R	R	R	E												
		6	S	S	S	S	W	W	W	W	W	W	R	R	R	R	R	R	E												
		4	S	S	S	S	R	R	R	R	R	R	R	R	R	R	R	R	E												
		3	S	S	S	S	R	R	R	R	R	R	R	R	R	R	R	R	E												
		2	TS	TS	TS	TS	E	E	E	E	E	E	E	E	E	E	E	E	E												
1 1/2	R	R	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E														
1	R	R	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E														
3/4	R	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E														
1/2	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E														

NACE - MR - 0175 (LATEST REVISION)

LEGEND:
R Reducing Tee
S Sockolet
E Equal Tee
W Weldolet
TS Equal Tee & Swage Nipple

NOTE : Reducing fittings thickness shall match heavier pipe thickness.

DESIGN CONDITIONS		STUD BOLTS		
TEMP.	PRESSURE	NOMINAL PIPE SIZE	DIA. in. & LENGTH, mm	NO. OF BOLTS
° F	psig			
- 50 TO 100	1480	1/2"	M14 x 80	4
200	1350	3/4"	M16 x 90	4
300	1315	1"	M16 x 90	4
400	1270	1 1/2"	M20 x 110	4
500	1200	2"	M16 x 110	8
600	1095	3"	M20 x 125	8
650	1075	4"	M24 x 145	8
700	1065	6"	M27 x 170	12
° C	barg	8"	M30 x 195	12
-45.5 TO 38	102.07	10"	M33 x 215	16
93	93.10	12"	M33 x 225	20
149	90.69	14"	M36 x 235	20
204	87.59	16"	M39 x 255	20
260	82.76	18"	M42 x 275	20
316	75.52	20"	M42 x 290	24
343	74.14	24"	M48 x 330	24
371	73.45			



NAME	HM/SMHA/MMA/BS	MIAH	MAS
DATE	16-02-2015	16-02-2015	16-02-2015

CLIENT : Oil & Gas Development Company Ltd.

MATERIAL : LOW. TEMP. CARBON STEEL
RATING : 600 #
CORR. ALLOWANCE: 3.0 mm
SHEET : 24 OF 43
PIPE WALL TOLERANCE : ± 12.5%
Design Code: ASME B 31.3
SPEC. D2 (S) REV. 14

PIPING MATERIAL SPECIFICATION JOB NO. 165-4

NOMINAL PIPE SIZE		1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	90° BRANCH CONNECTIONS															
MIN. WALL THK.		SCH 160				SCH 120				SCH 80				NOMINAL BRANCH SIZE (in.)																			
PIPE		ASTM A 333 GR.6 SMLS, ASME 36.10																															
FLANGES		SW / Plain Ends				BW Beveled Ends																											
FITTINGS		ASME B 16.5 Class 600 RF, ASTM A 350 LF2																															
BRANCH OUTLETS (Sockolet, Weldolet, etc.)		S.W. Ends, MSS-SP-97 Class 6000, ASTM A350 LF2				B.W. Ends, MSS-SP-97 ASTM A350 LF2																											
UNIONS		Class 6000, S.W.				Use Flange Connection																											
PLUG		Square Head				X																											
VENTS / DRAINS		1/2"	3/4"				3/4" / 1"				3/4" / 1 1/2"				LEGEND: R Reducing Tee S Sockolet E Equal Tee W Weldolet TS Equal Tee & Swage Nipple																		
THR'D NIPPLE & SWAGES		Use 'in spec.' branch connection with 4" long Nipple and Ball Valve with Square head Plug																															
GASKETS		Class 600, 1/8" THK. Flexible graphite W/ 304 or 316 SS corrugated insert, ASME B16.20																															
BOLTING		STUDS : ASTM A 320 Gr. L7, Cadmium plated NUTS : ASTM A194 Gr. 7, Heavy Hex, Cadmium Plated																															
SPEC. PLATE / BLANK & SPACER		X				SPEC. PLATE ASTM A516 Gr. 60				BLANK & SPACER ASTM A516 Gr. 60																							
VALVES	GATE	VG-121				VG-222																											
	GLOBE	VGL-121				VGL-222																											
	CHECK	VC-121				VC-222																											
	BALL	VB-122				VB-222																											
	PLUG	X				X																											
	BUTTERFLY	X				X																											
	FOR SPEC. NOTES SEE SHEET 43 OF 43																																
SERVICE: FLARE / VENT, PROCESS GAS, GLYCOL (COLD SERVICE)										HYDROTEST LIMITED BY: FLANGES																							
PROCESS LIQUID										BARG: 153					PSIG: 2220																		
DESCRIPTION:		DRN.	HM/SMHA/MMA/BS	DESCRIPTION:		DRN.	DESCRIPTION:		DRN.	DESCRIPTION:		DRN.	DESCRIPTION:		DRN.	DESCRIPTION:		DRN.	DESCRIPTION:														
14 FOR TENDER		CHK.	WUS			CHK.			CHK.			CHK.			CHK.			CHK.															
		APP.	MAS			APP.			APP.			APP.			APP.			APP.															
CONSULTANT:				DRAWN				CHECKED				APPROVED				MATERIAL: LOW TEMP. CARBON STEEL				RATING: 600 #													
Zishan Engineers (Pvt.) Ltd.				NAME				CHECKED				APPROVED				CORR. ALLOWANCE: 3.00 mm				SHEET: 25 OF 43													
				DATE				DATE				DATE				PIPE WALL TOLERANCE: ± 12.5%				SPEC. D3 REV. 14													
				DATE				DATE				DATE				Design Code: ASME B 31.3																	
PIPING MATERIAL SPECIFICATION										JOB NO. 165-4																							
		24	S	S	S	S	W	W	W	W	W	W	W	W	R	R	R	R	R	E													
		20	S	S	S	S	W	W	W	W	W	W	W	W	R	R	R	R	R	E													
		18	S	S	S	S	W	W	W	W	W	W	W	W	R	R	R	R	R	E													
		16	S	S	S	S	W	W	W	W	W	W	W	W	R	R	R	R	R	E													
		14	S	S	S	S	W	W	W	W	W	W	W	W	R	R	R	R	R	E													
		12	S	S	S	S	W	W	W	W	W	W	W	W	R	R	R	R	R	E													
		10	S	S	S	S	W	W	W	W	W	W	W	W	R	R	R	R	R	E													
		8	S	S	S	S	W	W	W	W	W	W	W	W	R	R	R	R	R	E													
		6	S	S	S	S	W	W	W	W	W	W	W	W	R	R	R	R	R	E													
		4	S	S	S	S	W	W	W	W	W	W	W	W	R	R	R	R	R	E													
		3	S	S	S	S	W	W	W	W	W	W	W	W	R	R	R	R	R	E													
		2	TS	TS	TS	TS	W	W	W	W	W	W	W	W	R	R	R	R	R	E													
		1 1/2	R	R	E	E																											
		1	R	R	E																												
		3/4	R	E																													
		1/2	E																														
NOTE : Reducing fittings thickness shall match heavier pipe thickness.																																	
DESIGN CONDITIONS										STUD BOLTS																							
TEMP.					PRESSURE					NOMINAL PIPE SIZE		DIA. ,in. & LENGTH, mm		NO. OF BOLTS																			
° F					psig																												
- 50 TO 100					1480					1/2"		M14 x 80		4																			
200					1350					3/4"		M16 x 90		4																			
300					1315					1"		M16 x 90		4																			
400					1270					1 1/2"		M20 x 110		4																			
500					1200					2"		M16 x 110		8																			
600					1095					3"		M20 x 125		8																			
650					1075					4"		M24 x 145		8																			
										6"		M27 x 170		12																			
° C					barg					8"		M30 x 195		12																			
-46 TO 38					102.04					10"		M33 x 215		16																			
93					93.08					12"		M33 x 225		20																			
149					90.67					14"		M36 x 235		20																			
204					87.56					16"		M39 x 255		20																			
260					82.74					18"		M42 x 275		20																			
316					75.50					20"		M42 x 290		24																			
343					74.12					24"		M48 x 330		24																			

NOMINAL PIPE SIZE		1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	90° BRANCH CONNECTIONS														
MIN. WALL THK.		SCH 10S			SCH 40S				SCH 80S					NOMINAL BRANCH SIZE (in.)																	
PIPE		22% Cr. Duplex Stainless Steel, ASTM A - 790, UNS S31803																													
		Plain Ends			Beveled Ends				BW Beveled Ends					1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"			
FLANGES		ASME B 16.5 Class 600 Raised Face, ASTM A 182 Gr. F-51																													
		Weld Neck, Bore to Match Pipe I.D.																													
FITTINGS		ASME B16.9, Beveled Ends, Wall Thk. to Match Pipe Seamless Steel, ASTM A 815 UNS S31803																													
BRANCH OUTLETS (Sockolet, Weldolet, etc.)		B.W. Ends, MSS-SP-97 ASTM A 815 UNS S31803																													
UNIONS		NOT PERMITTED																													
PLUG		NOT PERMITTED																													
VENTS / DRAINS		1/2"	3/4"			3/4" / 1"			3/4" / 1 1/2"																						
		Use 'in spec.' branch connection with 4" long Nipple and Ball Valve with Square head Plug																													
THR'D NIPPLE & SWAGES		NOT PERMITTED (USE BW REDUCER, CONC OR ECC, (AS REQUIRED))																													
GASKETS		Class 600, 1/8" Thk. Spiral Wound CS Ring 304 SS or 316 SS Winding, Flexible Graphite ASME B16.20																													
BOLTING		STUDS : ASTM A193 Gr. B7M NUTS : ASTM A194 Gr. 2HM																													
SPEC. PLATE / BLANK & SPACER		SPEC. PLATE : DUPLEX SS, AS PER ASTM A182 Gr.F51																													
VALVES	GATE																														
	GLOBE		VGL-223																												
	CHECK		VC-223			VC-224																									
	BALL		VB-224																												
	PLUG																														
	BUTTERFLY																														
FOR SPEC. NOTES SEE SHEET 43 OF 43																															
SERVICE: PRODUCED WATER (A / G), FLOWLINE (WITHOUT CORROSION INHIBITOR)										HYDROTEST LIMITED BY : FLANGES																					
										BARG. 155				PSIG. 2250																	
DESCRIPTION:		DRN.	HM/SMHA/MMA/BS	DESCRIPTION:		DRN.		DESCRIPTION:		DRN.		DESCRIPTION:		DRN.		DESCRIPTION:		DRN.													
14 FOR TENDER		CHK.	WUS			CHK.				CHK.				CHK.				CHK.													
		APP.	MAS			APP.				APP.				APP.				APP.													
CONSULTANT:				DRAWN				CHECKED				APPROVED				MATERIAL : DUPLEX STAINLESS STEEL				RATING : 600 #											
Zishan Engineers (Pvt.) Ltd.				NAME				HM/SMHA/ MMA /BS				MIAH				MAS				CLIENT : Oil & Gas Development Company Ltd.				CORR. ALLOWANCE: NIL				SHEET : 26 OF 43			
				DATE				16-02-2015				16-02-2015				16-02-2015				PIPE WALL TOLERANCE : ± 12.5%				SPEC. D5 REV. 14							
PIPING MATERIAL SPECIFICATION										JOB NO. 165-4								Design Code: ASME B 31.3													
Notes : Reducing fittings thickness shall match heavier pipe thickness.																		LEGEND:													
																		R Reducing Tee													
																		S Sockolet													
																		E Equal Tee													
																		W Weldolet													
																		TS Equal Tee & Swage Nipple													
																		DESIGN CONDITIONS						STUD BOLTS							
																		TEMP.			PRESSURE			NOMINAL PIPE SIZE	DIA. .in. & LENGTH, mm		NO. OF BOLTS				
																		° F			psig										
																		- 150 TO 100			1500			1/2"	M14 x 80		4				
																		200			1440			3/4"	M16 x 90		4				
																		300			1330			1"	M16 x 90		4				
400			1230			1 1/2"	M20 x 110		4																						
500			1150			2"	M16 x 110		8																						
600			1115			3"	M20 x 125		8																						
650			1100			4"	M24 x 145		8																						
700			1085			6"	M27 x 170		12																						
° C			barg			8"	M30 x 195		12																						
-101 TO 38			103.45			10"	M33 x 215		16																						
93			99.31			12"	M33 x 225		20																						
149			91.72			14"	M36 x 235		20																						
204			84.83			16"	M39 x 255		20																						
260			79.31			18"	M42 x 275		20																						
316			76.90			20"	M42 x 290		24																						
343			75.86																												
371			74.83																												

NOMINAL PIPE SIZE	1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	90° BRANCH CONNECTIONS																																																																																																																																																																															
MIN. WALL THK.	SCH 5S			SCH 10S			SCH 40S			SCH 80S			13.61	15.31	17.01	20.42	NOMINAL BRANCH SIZE (in.)																																																																																																																																																																															
PIPE	ASTM A 312 TP 316 SMLS, ASME 36.19										A312 TP316 WELDED						<table border="1"> <tr> <th></th> <th>1/2"</th> <th>3/4"</th> <th>1"</th> <th>1 1/2"</th> <th>2"</th> <th>3"</th> <th>4"</th> <th>6"</th> <th>8"</th> <th>10"</th> <th>12"</th> <th>14"</th> <th>16"</th> <th>18"</th> <th>20"</th> <th>24"</th> </tr> <tr> <th>24</th> <td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <th>20</th> <td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <th>18</th> <td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>W</td><td>W</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <th>16</th> <td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>W</td><td>R</td><td>R</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <th>14</th> <td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>W</td><td>R</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <th>12</th> <td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>W</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <th>10</th> <td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>W</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <th>8</th> <td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>W</td><td>R</td><td>E</td> </tr> <tr> <th>6</th> <td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>R</td><td>E</td> </tr> <tr> <th>4</th> <td>S</td><td>S</td><td>S</td><td>S</td><td>R</td><td>E</td> </tr> <tr> <th>3</th> <td>S</td><td>S</td><td>S</td><td>S</td><td>R</td><td>E</td> </tr> <tr> <th>2</th> <td>TS</td><td>TS</td><td>TS</td><td>TS</td><td>E</td> </tr> <tr> <th>1 1/2</th> <td>R</td><td>R</td><td>E</td><td>E</td> </tr> <tr> <th>1</th> <td>R</td><td>R</td><td>E</td> </tr> <tr> <th>3/4</th> <td>R</td><td>E</td> </tr> <tr> <th>1/2</th> <td>E</td> </tr> </table>																	1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	24	S	S	S	S	W	W	W	W	W	W	R	R	R	R	R	E	20	S	S	S	S	W	W	W	W	W	R	R	R	R	R	R	E	18	S	S	S	S	W	W	W	R	R	R	R	R	R	E	16	S	S	S	S	W	W	R	R	R	R	E	14	S	S	S	S	W	W	R	R	R	E	12	S	S	S	S	W	W	R	R	E	10	S	S	S	S	W	W	R	R	E	8	S	S	S	S	W	W	R	E	6	S	S	S	S	W	R	E	4	S	S	S	S	R	E	3	S	S	S	S	R	E	2	TS	TS	TS	TS	E	1 1/2	R	R	E	E	1	R	R	E	3/4	R	E	1/2	E
	1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"																																																																																																																																																																																
24	S	S	S	S	W	W	W	W	W	W	R	R	R	R	R	E																																																																																																																																																																																
20	S	S	S	S	W	W	W	W	W	R	R	R	R	R	R	E																																																																																																																																																																																
18	S	S	S	S	W	W	W	R	R	R	R	R	R	E																																																																																																																																																																																		
16	S	S	S	S	W	W	R	R	R	R	E																																																																																																																																																																																					
14	S	S	S	S	W	W	R	R	R	E																																																																																																																																																																																						
12	S	S	S	S	W	W	R	R	E																																																																																																																																																																																							
10	S	S	S	S	W	W	R	R	E																																																																																																																																																																																							
8	S	S	S	S	W	W	R	E																																																																																																																																																																																								
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3/4	R	E																																																																																																																																																																																														
1/2	E																																																																																																																																																																																															
FLANGES	ASME B 16.5 Class 600 Raised Face, ASTM A 182 F-316																																																																																																																																																																																															
	Socket Weld				Weld Neck, Bore to Match Pipe I.D.																																																																																																																																																																																											
FITTINGS	ASME B16.11 S.W. CLASS 3000,ASTM A182-F316				ASME B16.9, Beveled Ends, Wall Thk. to Match Pipe Seamless Steel, ASTM A 403 WP-316																																																																																																																																																																																											
BRANCH OUTLETS (Sockolet,Weldolet,etc.)	S.W. Ends, MSS-SP-97 Class 3000, ASTM A182 F316				B.W. Ends, MSS-SP-97 ASTM A182 F316																																																																																																																																																																																											
UNIONS	Class 3000, S.W. Ground Joint,																																																																																																																																																																																															
PLUG	Square Head 3000# ASTM A182-F316																																																																																																																																																																																															
VENTS / DRAINS	1/2"	3/4"			3/4" / 1"			3/4" / 1 1/2"																																																																																																																																																																																								
	Use 'in spec.' branch connection with 4" long Nipple and Ball Valve with Square head Plug																																																																																																																																																																																															
THR'D NIPPLE & SWAGES	ASTM A 312 Gr. TP 316 Class 3000, A182-F316																																																																																																																																																																																															
GASKETS	Class 600, 1/8" THK. Flexible graphite W/ 304 or 316 SS corrugated insert,ASME B16.20																																																																																																																																																																																															
BOLTING	STUDS : ASTM A193 Gr. B7M NUTS : ASTM A194 Gr. 8, Heavy Hex, Cadmium plated																																																																																																																																																																																															
SPEC. PLATE / BLANK & SPACER					SPEC. PLATE ASTM A-240 Gr. 316																																																																																																																																																																																											
VALVES					GATE	VG-123	VG-223																																																																																																																																																																																									
	GLOBE	VGL-124	VGL-224																																																																																																																																																																																													
	CHECK	VC-123	VC-225																																																																																																																																																																																													
	BALL	VB-126	VB-226																																																																																																																																																																																													
	PLUG																																																																																																																																																																																															
	BUTTERFLY																																																																																																																																																																																															
FOR SPEC. NOTES SEE SHEET 43 OF 43																																																																																																																																																																																																
SERVICE: LIQUIFIED GAS UNDER - 100 C, RICH AMINE, ACID GAS										HYDROTEST LIMITED BY : FLANGES																																																																																																																																																																																						
										BARG. 125				PSIG. 1800																																																																																																																																																																																		
DESCRIPTION:		DRN.	HM/SMHA/MMA/BS	DESCRIPTION:						DRN.																																																																																																																																																																																						
14 FOR TENDER		CHK.	WUS							CHK.																																																																																																																																																																																						
		APP.	MAS							APP.																																																																																																																																																																																						
CONSULTANT:				DRAWN		CHECKED		APPROVED		CLIENT : Oil & Gas Development Company Ltd.																																																																																																																																																																																						
Zishan Engineers (Pvt.) Ltd.				NAME	HM/SMHA/ MMA /BS	MAH		MAS																																																																																																																																																																																								
		DATE	16-02-2015	16-02-2015		16-02-2015		MATERIAL : STAINLESS STEEL (316 L)								RATING : 600 #																																																																																																																																																																																
		PIPING MATERIAL SPECIFICATION						JOB NO. 165-4		CORR. ALLOWANCE: NIL				SHEET : 27 OF 43																																																																																																																																																																																		
										PIPE WALL TOLERANCE : ± 12.5%				SPEC. D6 REV. 14																																																																																																																																																																																		
										Design Code: ASME B 31.3																																																																																																																																																																																						

NOMINAL RUN PIPE SIZE (in.)

LEGEND:
R Reducing Tee
S Sockolet
E Equal Tee
W Weldolet
TS Equal Tee & Swage Nipple

NOTE : Reducing fittings thickness shall match heavier pipe thickness.

DESIGN CONDITIONS		STUD BOLTS		
TEMP. °F	PRESSURE psig	NOMINAL PIPE SIZE	DIA. .in. & LENGTH, mm	NO. OF BOLTS
- 325 TO 100	1200	1/2"	M14 x 80	4
200	1015	3/4"	M16 x 90	4
300	910	1"	M16 x 90	4
400	825	1 1/2"	M20 x 110	4
500	765	2"	M16 x 110	8
600	720	3"	M20 x 125	8
650	700	4"	M24 x 145	8
700	685	6"	M27 x 170	12
°C	barg	8"	M30 x 195	12
-200 TO 38	82.76	10"	M33 x 215	16
93	70.00	12"	M33 x 225	20
149	62.76	14"	M36 x 235	20
204	56.90	16"	M39 x 255	20
260	52.76	18"	M42 x 275	20
316	49.66	20"	M42 x 290	24
343	48.28	24"	M48 x 330	24
371	47.24			

NOMINAL PIPE SIZE	1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	30"	36"	
MIN. WALL THK. (mm)	SCH 160				SCH 80										25.40	30.18			
PIPE	ASTM A 106 GR.B SMLS OR API 5L GR.B SMLS, ASME 36.10										API 5L - X60, HFW								
	SW / Plain Ends				BW Beveled Ends														
FLANGES	ASME B 16.5 Class 600 RF, ASTM A 105										ASME B 16.47, ASTM A694 F60								
	Socket Weld				Weld Neck, Bore to Match Pipe I.D.														
FITTINGS	ASME B16.11 S.W. CLASS 6000, MSS-SP-97				ASME B16.9, Beveled Ends, Wall Thk. to Match Pipe										ASTM A860 WPHY60				
	Class 6000, ASTM A 105				Seamless Steel, ASTM A 234 GR. WPB										ASTM A860 WPHY60				
BRANCH OUTLETS (Sockolet, Weldolet, etc.)	S.W. Ends, MSS-SP-97				B.W. Ends, MSS-SP-97														
	Class 6000, ASTM A105				ASTM A105										ASTM A694 F60				
UNIONS	Class 6000, S.W.																		
	Ground Joint, A 105																		
PLUG	Square Head 6000#																		
	ASTM A 105																		
VENTS / DRAINS	1/2"	3/4"			3/4" / 1"			3/4" / 1 1/2"											
	Use 'in spec.' branch connection with 4" long Nipple and Ball Valve with Square head Plug																		
THR'D NIPPLE & SWAGES	ASTM A106-B SMLS																		
	Class 6000, ASTM A - 105																		
GASKETS	Class 600, 1/8" THK. Flexible graphite W/ 304 or 316 SS corrugated insert, ASME B16.20																		
BOLTING	STUDS : ASTM A 193 Gr. B7, Cadmium plated																		
	NUTS : ASTM A194 Gr. 2H, Heavy Hex, Cadmium plated																		
SPEC. PLATE / BLANK & SPACER					SPEC. PLATE				BLANK & SPACER										
					ASTM A516 Gr. 60				ASTM A516 Gr. 60										
VALVES	GATE	VG-121			VG-222														
	GLOBE	VGL-121			VGL-222														
	CHECK	VC-121			VC-222														
	BALL	VB-121			VB-222														
	NEEDLE	VN-121			VN-222														
	BUTTERFLY																		

		90° BRANCH CONNECTIONS																										
		NOMINAL BRANCH SIZE (in.)																										
NOMINAL RUN PIPE SIZE (in.)		1/2	3/4	1	1 1/2	2	3	4	6	8	10	12	14	16	18	20	24	30	36									
		36	S	S	S	S	W	W	W	W	W	W	W	W	R	R	R	R	R	E								
		30	S	S	S	S	W	W	W	W	W	W	W	W	R	R	R	R	R	E								
		24	S	S	S	S	W	W	W	W	W	W	W	R	R	R	R	R	E									
		20	S	S	S	S	W	W	W	W	W	W	R	R	R	R	R	E										
		18	S	S	S	S	W	W	W	W	W	R	R	R	R	E												
		16	S	S	S	S	W	W	W	W	R	R	R	E														
		14	S	S	S	S	W	W	W	W	R	R	E															
		12	S	S	S	S	W	W	W	R	R	E																
		10	S	S	S	S	W	W	R	R	E																	
		8	S	S	S	S	W	W	R	E																		
		6	S	S	S	S	W	R	E																			
		4	S	S	S	S	R	E																				
		3	S	S	S	S	R	E																				
		2	TS	TS	TS	TS	E																					
1 1/2	R	R	E	E																								
1	R	R	E																									
3/4	R	E																										
1/2	E																											

LEGEND:
R Reducing Tee
S Sockolet
E Equal Tee
W Weldolet
TS Equal Tee & Swage Nipple

NOTE : Reducing fittings thickness shall match heavier pipe thickness.

DESIGN CONDITIONS		STUD BOLTS		
TEMP.	PRESSURE	NOMINAL PIPE SIZE	DIA. .in. & LENGTH, mm	NO. OF BOLTS
° F	psig			
- 50 TO 100	1480	1/2"	M14 x 80	4
200	1350	3/4"	M16 x 90	4
300	1315	1"	M16 x 90	4
400	1270	1 1/2"	M20 x 110	4
500	1200	2"	M16 x 110	8
600	1095	3"	M20 x 125	8
650	1075	4"	M24 x 145	8
700	1065	6"	M27 x 170	12
° C	barg	8"	M30 x 195	12
-45.5 TO 38	102.07	10"	M33 x 215	16
93	93.10	12"	M33 x 225	20
149	90.69	14"	M36 x 235	20
204	87.59	16"	M39 x 255	20
260	82.76	18"	M42 x 275	20
316	75.52	20"	M42 x 290	24
343	74.14	24"	M48 x 330	24
371	73.45	30"	2 x 356	28
		36"	2 1/2 x 400	28

FOR SPEC. NOTES SEE SHEET 43 OF 43

SERVICE: SLUG CATCHER				HYDROTEST LIMITED BY : FLANGES			
				BARG: 153		PSIG: 2220	
DESCRIPTION:	DRN.	HM/SMHA/MMA/BS	DESCRIPTION:	DRN.		DESCRIPTION:	DRN.
14 FOR TENDER	CHK.	WUS		CHK.			CHK.
	APP.	MAS		APP.			APP.

CONSULTANT:				DRAWN				CHECKED				APPROVED				MATERIAL : CARBON STEEL				RATING : 600 #							
Zishan Engineers (Pvt.) Ltd.				NAME				HM/SMHA/ MMA /BS				MIAH				MAS				CORR. ALLOWANCE: 6.0 mm				SHEET : 28 OF 43			
				DATE				16-02-2015				16-02-2015				16-02-2015				PIPE WALL TOLERANCE : -				SPEC. D8 REV. 14			
PIPING MATERIAL SPECIFICATION												JOB NO. 165-4				Design Code: ASME B 31.8											



NOMINAL PIPE SIZE	1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	30"	36"
MIN. WALL THK. (mm)	SCH 160				SCH 80												25.40	30.18
PIPE	ASTM A 106 GR.B SMLS OR API 5L GR.B SMLS, ASME 36.10												API 5L - X60, HFW					
	SW / Plain Ends				BW Beveled Ends													
FLANGES	ASME B 16.5 Class 600 RF, ASTM A 105												ASME B 16.47, ASTM A694 F60					
	Socket Weld				Weld Neck, Bore to Match Pipe I.D.													
FITTINGS	ASME B16.11 S.W. CLASS 6000, ASTM A 105				ASME B16.9, Beveled Ends, Wall Thk. to Match Pipe										ASTM A860 WPHY60			
	S.W. Ends, MSS-SP-97 Class 6000, ASTM A105				Seamless Steel, ASTM A 234 GR. WPB										ASTM A105			
BRANCH OUTLETS (Socokolet, Weldolet, etc.)	S.W. Ends, MSS-SP-97 Class 6000, ASTM A105				B.W. Ends, MSS-SP-97													
	Class 6000, S.W.				ASTM A105													
UNIONS	Ground Joint, A 105																	
	Square Head 6000#																	
PLUG	ASTM A 105																	
VENTS / DRAINS	1/2"	3/4"			3/4" / 1"			3/4" / 1 1/2"										
	Use 'in spec.' branch connection with 4" long Nipple and Ball Valve with Square head Plug																	
THR'D NIPPLE & SWAGES	ASTM A106-B SMLS																	
	Class 6000, ASTM A - 105																	
GASKETS	Class 600, 1/8" THK. Flexible graphite W/ 304 or 316 SS corrugated insert, ASME B16.20																	
BOLTING	STUDS : ASTM A 193 Gr. B7, Cadmium plated																	
	NUTS : ASTM A194 Gr. 2H, Heavy Hex, Cadmium plated																	
SPEC. PLATE / BLANK & SPACER					SPEC. PLATE				BLANK & SPACER									
					ASTM A516 Gr. 60				ASTM A516 Gr. 60									
VALVES	GATE	VG-121			VG-222													
	GLOBE	VGL-121			VGL-222													
	CHECK	VC-121			VC-222													
	BALL	VB-121			VB-222													
	NEEDLE	VN-121			VN-222													
	BUTTERFLY																	

NACE - MR - 0175 (LATEST REVISION)

90° BRANCH CONNECTIONS																		
NOMINAL BRANCH SIZE (in.)																		
	1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	30"	36"
NOMINAL RUN PIPE SIZE (in.)	36"	S	S	S	S	W	W	W	W	W	W	W	R	R	R	R	R	E
	30"	S	S	S	S	W	W	W	W	W	W	R	R	R	R	R	R	E
	24"	S	S	S	S	W	W	W	W	W	R	R	R	R	R	R	R	E
	20"	S	S	S	S	W	W	W	W	W	R	R	R	R	R	R	R	E
	18"	S	S	S	S	W	W	W	W	W	R	R	R	R	R	R	R	E
	16"	S	S	S	S	W	W	W	W	R	R	R	R	R	R	R	R	E
	14"	S	S	S	S	W	W	W	W	R	R	R	R	R	R	R	R	E
	12"	S	S	S	S	W	W	W	R	R	R	R	R	R	R	R	R	E
	10"	S	S	S	S	W	W	R	R	R	R	R	R	R	R	R	R	E
	8"	S	S	S	S	W	R	R	R	R	R	R	R	R	R	R	R	E
	6"	S	S	S	S	W	R	R	R	R	R	R	R	R	R	R	R	E
	4"	S	S	S	S	R	R	R	R	R	R	R	R	R	R	R	R	E
	3"	S	S	S	S	R	R	R	R	R	R	R	R	R	R	R	R	E
	2"	TS	TS	TS	TS	E	E	E	E	E	E	E	E	E	E	E	E	E
	1 1/2"	R	R	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
1"	R	R	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	
3/4"	R	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	
1/2"	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	

LEGEND:
R Reducing Tee
S Socokolet
E Equal Tee
W Weldolet
TS Equal Tee & Swage Nipple

NOTE : Reducing fittings thickness shall match heavier pipe thickness.

DESIGN CONDITIONS		STUD BOLTS		
TEMP.	PRESSURE	NOMINAL PIPE SIZE	DIA. ,in. & LENGTH, mm	NO. OF BOLTS
°F	psig			
- 50 TO 100	1480	1/2"	M14 x 80	4
200	1350	3/4"	M16 x 90	4
300	1315	1"	M16 x 90	4
400	1270	1 1/2"	M20 x 110	4
500	1200	2"	M16 x 110	8
600	1095	3"	M20 x 125	8
650	1075	4"	M24 x 145	8
700	1065	6"	M27 x 170	12
°C	barg	8"	M30 x 195	12
-45.5 TO 38	102.07	10"	M33 x 215	16
93	93.10	12"	M33 x 225	20
149	90.69	14"	M36 x 235	20
204	87.59	16"	M39 x 255	20
260	82.76	18"	M42 x 275	20
316	75.52	20"	M42 x 290	24
343	74.14	24"	M48 x 330	24
371	73.45	30"	2 x 356	28
		36"	2 1/2 x 400	28

FOR SPEC. NOTES SEE SHEET 43 OF 43																	
SERVICE: SLUG CATCHER						HYDROTEST LIMITED BY: FLANGES											
						BARG: 153						PSIG: 2220					
DESCRIPTION:	DRN.	HM/SMHA/MMA/BS	DESCRIPTION:	DRN.		DESCRIPTION:	DRN.		DESCRIPTION:	DRN.		DESCRIPTION:	DRN.		DESCRIPTION:	DRN.	
14 FOR TENDER	CHK.	WUS		CHK.			CHK.			CHK.			CHK.			CHK.	
	APP.	MAS		APP.			APP.			APP.			APP.			APP.	

CONSULTANT:				DRAWN				CHECKED				APPROVED				MATERIAL : CARBON STEEL				RATING : 600 #			
Zishan Engineers (Pvt.) Ltd.				NAME				MIAH				MAS				CORR. ALLOWANCE: 6.0 mm				SHEET : 29 OF 43			
				DATE				16-02-2015				16-02-2015				PIPE WALL TOLERANCE : -				SPEC. D8 (S) REV. 14			
				DATE				16-02-2015				16-02-2015				Design Code: ASME B 31.8							



NOMINAL PIPE SIZE	1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	90° BRANCH CONNECTIONS																																																																																																																																																																																										
MIN. WALL THK.	SCH 160								SCH 120								NOMINAL BRANCH SIZE (in.)																																																																																																																																																																																										
PIPE	ASTM A 106 GR.B SMLS OR API 5L GR.B SMLS, ASME 36.10																<table border="1"> <tr> <th></th> <th>1/2"</th> <th>3/4"</th> <th>1"</th> <th>1 1/2"</th> <th>2"</th> <th>3"</th> <th>4"</th> <th>6"</th> <th>8"</th> <th>10"</th> <th>12"</th> <th>14"</th> <th>16"</th> <th>18"</th> <th>20"</th> <th>24"</th> </tr> <tr> <th>24</th> <td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <th>20</th> <td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <th>18</th> <td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>W</td><td>W</td><td>W</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <th>16</th> <td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>W</td><td>W</td><td>W</td><td>R</td><td>R</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <th>14</th> <td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>W</td><td>W</td><td>W</td><td>R</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <th>12</th> <td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>W</td><td>W</td><td>R</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <th>10</th> <td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>W</td><td>R</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <th>8</th> <td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>W</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <th>6</th> <td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <th>4</th> <td>S</td><td>S</td><td>S</td><td>S</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <th>3</th> <td>S</td><td>S</td><td>S</td><td>S</td><td>R</td><td>E</td> </tr> <tr> <th>2</th> <td>TS</td><td>TS</td><td>TS</td><td>TS</td><td>E</td> </tr> <tr> <th>1 1/2</th> <td>R</td><td>R</td><td>E</td><td>E</td> </tr> <tr> <th>1</th> <td>R</td><td>R</td><td>E</td> </tr> <tr> <th>3/4</th> <td>R</td><td>E</td> </tr> <tr> <th>1/2</th> <td>E</td> </tr> </table>																	1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	24	S	S	S	S	W	W	W	W	W	W	R	R	R	R	R	E	20	S	S	S	S	W	W	W	W	W	R	R	R	R	R	R	E	18	S	S	S	S	W	W	W	W	R	R	R	R	R	R	E	16	S	S	S	S	W	W	W	W	R	R	R	R	E	14	S	S	S	S	W	W	W	W	R	R	R	E	12	S	S	S	S	W	W	W	R	R	R	E	10	S	S	S	S	W	W	R	R	R	E	8	S	S	S	S	W	W	R	R	E	6	S	S	S	S	W	R	R	E	4	S	S	S	S	R	R	E	3	S	S	S	S	R	E	2	TS	TS	TS	TS	E	1 1/2	R	R	E	E	1	R	R	E	3/4	R	E	1/2	E
	1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"																																																																																																																																																																																											
24	S	S	S	S	W	W	W	W	W	W	R	R	R	R	R	E																																																																																																																																																																																											
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18	S	S	S	S	W	W	W	W	R	R	R	R	R	R	E																																																																																																																																																																																												
16	S	S	S	S	W	W	W	W	R	R	R	R	E																																																																																																																																																																																														
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FLANGES	ASME B 16.5 Class 900 RTJ, ASTM A 105																																																																																																																																																																																																										
FITTINGS	ASME B16.11 S.W. CLASS								ASME B16.9, Beveled Ends, Wall Thk. to Match Pipe																																																																																																																																																																																																		
	6000, ASTM A 105								Seamless Steel, ASTM A 234 WPB																																																																																																																																																																																																		
BRANCH OUTLETS (Sockolet, Weldolet, etc.)	S.W. Ends, MSS-SP-97								B.W. Ends, MSS-SP-97																																																																																																																																																																																																		
	Class 6000, ASTM A105								ASTM A105																																																																																																																																																																																																		
UNIONS	Class 6000, S.W.																																																																																																																																																																																																										
	Ground Joint																																																																																																																																																																																																										
PLUG	Square Head 6000#																																																																																																																																																																																																										
	ASTM A 105																																																																																																																																																																																																										
VENTS / DRAINS	1/2"	3/4"				3/4" / 1"				3/4" / 1 1/2"				Use 'in spec.' branch connection with 4" long Nipple and Ball Valve with Square head Plug																																																																																																																																																																																													
THR'D NIPPLE & SWAGES	ASTM A 106 GR.B SMLS Class 6000, ASTM A 105																																																																																																																																																																																																										
GASKETS	OVAL RING, SOFT IRON, MAX BHN 90 ASME B16.20																																																																																																																																																																																																										
BOLTING	STUDS : ASTM A 193 GR.B7 CADMIUM PLATED																																																																																																																																																																																																										
	NUTS : ASTM A194 Gr. 2H, Heavy Hex, CADMIUM PLATED																																																																																																																																																																																																										
SPEC. PLATE / BLANK & SPACER																																																																																																																																																																																																											
VALVES	GATE	VG-121				VG-232																																																																																																																																																																																																					
	GLOBE	VGL-121				VGL-232																																																																																																																																																																																																					
	CHECK	VC-121				VC-232																																																																																																																																																																																																					
	BALL	VB-121				VB-232																																																																																																																																																																																																					
	NEEDLE	VN-151																																																																																																																																																																																																									
	BUTTERFLY																																																																																																																																																																																																										
	FFOR SPEC. NOTES SEE SHEET 43 OF 43																																																																																																																																																																																																										
SERVICE: RAW GAS, LEAN AMINE, FUEL GAS, OPEN DRAIN / VENTS, CLOSED DRAIN, AMINE DRAIN										HYDROTEST LIMITED BY: FLANGES																																																																																																																																																																																																	
										BARG: 230			PSIG 3335																																																																																																																																																																																														
DESCRIPTION: 14 FOR TENDER	DRN.	HM/SMHA/MMA/BS	DESCRIPTION:							DRN.																																																																																																																																																																																																	
	CHK.	WUS								CHK.																																																																																																																																																																																																	
	APP.	MAS								APP.																																																																																																																																																																																																	
CONSULTANT: Zishan Engineers (Pvt.) Ltd.										DRAWN	CHECKED	APPROVED	CLIENT : Oil & Gas Development Company Ltd.				MATERIAL : CARBON STEEL				RATING : 900 #																																																																																																																																																																																						
										NAME	HM/SMHA/ MMA /BS	MAH	MAS	SHEET : 31 OF 43 SPEC. E2 REV. 14																																																																																																																																																																																													
										DATE	16-02-2015	16-02-2015	16-02-2015																																																																																																																																																																																														
										PIPING MATERIAL SPECIFICATION								DESIGN CODE: ASME B 31.3																																																																																																																																																																																									
JOB NO. 165-4																																																																																																																																																																																																											

LEGEND:
 R Reducing Tee
 S Sockolet
 E Equal Tee
 W Weldolet
 TS Equal Tee & Swage Nipple

NOTE : Reducing fittings thickness shall match heavier pipe thickness.

DESIGN CONDITIONS		STUD BOLTS		
TEMP. °F	PRESSURE psig	NOMINAL PIPE SIZE	DIA. .in. & LENGTH, mm	NO. OF BOLTS
-20 TO 100	2220	1/2"	M20 x 105	4
200	2025	3/4"	M20 x 115	4
300	1970	1"	M24 x 125	4
400	1900	1 1/2"	M27 x 140	4
500	1795	2"	M24 x 145	8
600	1640	3"	M24 x 145	8
650	1610	4"	M30 x 170	8
700	1600	6"	M30 x 195	12
°C	barg	8"	M36 x 220	12
-29 TO 38	153.06	10"	M36 x 235	16
93	139.62	12"	M36 x 255	20
149	135.82	14"	M39 x 280	20
204	131.00	16"	M42 x 295	20
260	123.76	18"	M48 x 340	20
316	1113.07	20"	M52 x 360	20
343	111.00	24"	M64 x 455	20
371	110.31			

NOMINAL PIPE SIZE	1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"	90° BRANCH CONNECTIONS																																																																																																																																																																																																																																																																																																	
MIN. WALL THK.	SCH 160								SCH 120								NOMINAL BRANCH SIZE (in.)																																																																																																																																																																																																																																																																																																	
PIPE	ASTM A 333 GR. 6 SMLS, ASME 36.10																																																																																																																																																																																																																																																																																																																	
FLANGES	SW / Plain Ends																BW Beveled Ends																																																																																																																																																																																																																																																																																																	
	Socket Weld																Weld Neck, Bore to Match Pipe I.D.																																																																																																																																																																																																																																																																																																	
FITTINGS	ASME B16.11 S.W. Class 6000,ASTM A350 LF2				BW ASTM A 420 WPL6 PER ASME B16.9, WALL THICKNESS TO MATCH PIPE ID																																																																																																																																																																																																																																																																																																													
BRANCH OUTLETS (Sockolet,Weldolet,etc.)	S.W. Ends, MSS-SP-97 Class 6000, ASTM A350 LF2								B.W. Ends, MSS-SP-97 ASTM A350 LF2																																																																																																																																																																																																																																																																																																									
	Class 6000, S.W. Ground Joint, ASTM A 350-LF2				Use Flange Connection																																																																																																																																																																																																																																																																																																													
PLUG	Square Head																																																																																																																																																																																																																																																																																																																	
	Class 6000,ASTM A350 LF2																																																																																																																																																																																																																																																																																																																	
VENTS / DRAINS	1/2"		3/4"				3/4" / 1"				3/4" / 1 1/2"																																																																																																																																																																																																																																																																																																							
	Use 'in spec.' branch connection with 4" long Nipple and Ball Valve with Square head Plug																																																																																																																																																																																																																																																																																																																	
THR'D NIPPLE & SWAGES	ASTM A 333 GR-6 Class 6000, ASTM A350 LF2																																																																																																																																																																																																																																																																																																																	
GASKETS	OVAL RING, SOFT IRON, MAX BHN 90 ASME B16.20																																																																																																																																																																																																																																																																																																																	
BOLTING	STUDS : ASTM A 320 GR.L7 CADMIUM PLATED																																																																																																																																																																																																																																																																																																																	
	NUTS : ASTM A194 Gr. 7, Heavy Hex, Cadmium plated																																																																																																																																																																																																																																																																																																																	
SPEC. PLATE / BLANK & SPACER					SPEC. PLATE ASTM A516 Gr. 60								BLANK & SPACER ASTM A516 Gr. 60																																																																																																																																																																																																																																																																																																					
	VALVES	GATE	VG-121				VG-232																																																																																																																																																																																																																																																																																																											
GLOBE		VGL-121				VGL-232																																																																																																																																																																																																																																																																																																												
CHECK		VC-121				VC-232																																																																																																																																																																																																																																																																																																												
BALL		VB-122				VB-232																																																																																																																																																																																																																																																																																																												
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BUTTERFLY																																																																																																																																																																																																																																																																																																																		
FOR SPEC. NOTES SEE SHEET 43 OF 43																																																																																																																																																																																																																																																																																																																		
SERVICE: FLARE / VENT, PROCESS GAS, GLYCOL (COLD SERVICE)									HYDROTEST LIMITED BY : FLANGES																																																																																																																																																																																																																																																																																																									
PROCESS LIQUID									BARG. 230				PSIG. 3335																																																																																																																																																																																																																																																																																																					
DESCRIPTION:		DRN.	HM/SMHA/MMA/BS	DESCRIPTION:				DRN.		DESCRIPTION:		DRN.																																																																																																																																																																																																																																																																																																						
14 FOR TENDER		CHK.	WUS					CHK.				CHK.																																																																																																																																																																																																																																																																																																						
		APP.	MAS					APP.				APP.																																																																																																																																																																																																																																																																																																						
CONSULTANT:			DRAWN		CHECKED		APPROVED			MATERIAL : LOW TEMP CARBON STEEL			RATING : 900 #																																																																																																																																																																																																																																																																																																					
Zishan Engineers (Pvt.) Ltd.			HM/SMHA/ MMA /BS		MAH		MAS			CLIENT : Oil & Gas Development Company Ltd.			CORR. ALLOWANCE: 3.00 mm			SHEET : 33 OF 43																																																																																																																																																																																																																																																																																																		
			DATE 16-02-2015		16-02-2015		16-02-2015			PIPE WALL TOLERANCE : ± 12.5%			SPEC. E3 REV. 14																																																																																																																																																																																																																																																																																																					
PIPING MATERIAL SPECIFICATION									JOB NO. 165-4									Design Code: ASME B 31.3																																																																																																																																																																																																																																																																																																
<table border="1"> <tr> <th rowspan="10">NOMINAL RUN PIPE SIZE (in.)</th> <th>1/2</th> <th>3/4</th> <th>1</th> <th>1 1/2</th> <th>2</th> <th>3</th> <th>4</th> <th>6</th> <th>8</th> <th>10</th> <th>12</th> <th>14</th> <th>16</th> <th>18</th> <th>20</th> <th>24</th> </tr> <tr> <td>24</td> <td>S</td> <td>S</td> <td>S</td> <td>S</td> <td>W</td> <td>W</td> <td>W</td> <td>W</td> <td>W</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>E</td> </tr> <tr> <td>20</td> <td>S</td> <td>S</td> <td>S</td> <td>S</td> <td>W</td> <td>W</td> <td>W</td> <td>W</td> <td>W</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>E</td> </tr> <tr> <td>18</td> <td>S</td> <td>S</td> <td>S</td> <td>S</td> <td>W</td> <td>W</td> <td>W</td> <td>W</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>E</td> </tr> <tr> <td>16</td> <td>S</td> <td>S</td> <td>S</td> <td>S</td> <td>W</td> <td>W</td> <td>W</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>E</td> </tr> <tr> <td>14</td> <td>S</td> <td>S</td> <td>S</td> <td>S</td> <td>W</td> <td>W</td> <td>W</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>E</td> </tr> <tr> <td>12</td> <td>S</td> <td>S</td> <td>S</td> <td>S</td> <td>W</td> <td>W</td> <td>W</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>E</td> </tr> <tr> <td>10</td> <td>S</td> <td>S</td> <td>S</td> <td>S</td> <td>W</td> <td>W</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>E</td> </tr> <tr> <td>8</td> <td>S</td> <td>S</td> <td>S</td> <td>S</td> <td>W</td> <td>W</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>R</td> <td>E</td> </tr> <tr> <td>6</td> <td>S</td> <td>S</td> <td>S</td> <td>S</td> <td>W</td> <td>R</td> <td>E</td> </tr> <tr> <td>4</td> <td>S</td> <td>S</td> <td>S</td> <td>S</td> <td>R</td> <td>E</td> </tr> <tr> <td>3</td> <td>S</td> <td>S</td> <td>S</td> <td>S</td> <td>R</td> <td>E</td> </tr> <tr> <td>2</td> <td>TS</td> <td>TS</td> <td>TS</td> <td>TS</td> <td>E</td> </tr> <tr> <td>###</td> <td>R</td> <td>R</td> <td>R</td> <td>E</td> </tr> <tr> <td>1</td> <td>R</td> <td>R</td> <td>E</td> </tr> <tr> <td>3/4</td> <td>R</td> <td>E</td> </tr> <tr> <td>1/2</td> <td>E</td> </tr> </table> <p>LEGEND: R Reducing Tee S Sockolet E Equal Tee W Weldolet TS Equal Tee & Swage Nipple</p> <p>Note : Reducing fittings thickness shall match heavier pipe thickness.</p>																		NOMINAL RUN PIPE SIZE (in.)	1/2	3/4	1	1 1/2	2	3	4	6	8	10	12	14	16	18	20	24	24	S	S	S	S	W	W	W	W	W	R	R	R	R	R	R	E	20	S	S	S	S	W	W	W	W	W	R	R	R	R	R	R	E	18	S	S	S	S	W	W	W	W	R	R	R	R	R	R	R	E	16	S	S	S	S	W	W	W	R	R	R	R	R	R	R	R	E	14	S	S	S	S	W	W	W	R	R	R	R	R	R	R	R	E	12	S	S	S	S	W	W	W	R	R	R	R	R	R	R	R	E	10	S	S	S	S	W	W	R	R	R	R	R	R	R	R	R	E	8	S	S	S	S	W	W	R	R	R	R	R	R	R	R	R	E	6	S	S	S	S	W	R	R	R	R	R	R	R	R	R	R	E	4	S	S	S	S	R	R	R	R	R	R	R	R	R	R	R	E	3	S	S	S	S	R	R	R	R	R	R	R	R	R	R	R	E	2	TS	TS	TS	TS	E	E	E	E	E	E	E	E	E	E	E	E	###	R	R	R	E	E	E	E	E	E	E	E	E	E	E	E	E	1	R	R	E	E	E	E	E	E	E	E	E	E	E	E	E	E	3/4	R	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	1/2	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E
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- 50 TO 100		2220		1/2"		M20 x 105		4																																																																																																																																																																																																																																																																																																										
200		2025		3/4"		M20 x 115		4																																																																																																																																																																																																																																																																																																										
300		1970		1"		M24 x 125		4																																																																																																																																																																																																																																																																																																										
400		1900		1 1/2"		M27 x 140		4																																																																																																																																																																																																																																																																																																										
500		1795		2"		M24 x 145		8																																																																																																																																																																																																																																																																																																										
600		1640		3"		M24 x 145		8																																																																																																																																																																																																																																																																																																										
650		1610		4"		M30 x 170		8																																																																																																																																																																																																																																																																																																										
				6"		M30 x 195		12																																																																																																																																																																																																																																																																																																										
° C		barg		8"		M36 x 220		12																																																																																																																																																																																																																																																																																																										
-45.5 TO 38		153.10		10"		M36 x 235		16																																																																																																																																																																																																																																																																																																										
93		139.66		12"		M36 x 255		20																																																																																																																																																																																																																																																																																																										
149		135.86		14"		M39 x 280		20																																																																																																																																																																																																																																																																																																										
204		131.03		16"		M42 x 295		20																																																																																																																																																																																																																																																																																																										
260		123.79		18"		M48 x 340		20																																																																																																																																																																																																																																																																																																										
316		113.10		20"		M52 x 360		20																																																																																																																																																																																																																																																																																																										
343		111.03		24"		M64 x 455		20																																																																																																																																																																																																																																																																																																										

NOMINAL PIPE SIZE														90° BRANCH CONNECTIONS														
MIN. WALL THK.														NOMINAL BRANCH SIZE (in.)														
PIPE														NOMINAL RUN PIPE SIZE (in.)														
SCH 10S														SCH 40S														
SCH 80S																												
DUPLX SS, AS PER ASTM A790 UNS S31803, SEAMLESS																												
PLAIN END														BW BEVELED END														
ASME B 16.5 Class 900 RTJ, ASTM A 182 Gr. F-51																												
WELDING NECK, BORE TO MATCH PIPE I.D.																												
DUPLX SS, AS PER ASTM A - 815, UNS S31803, BEVELLED ENDS																												
B.W. Ends, MSS-SP-97																												
ASTM A 815 UNS S31803																												
NOT PERMITTED																												
NOT PERMITTED																												
1/2"														3/4"														
3/4"														1"														
1"														1 1/2"														
1 1/2"														2"														
2"														3"														
3"														4"														
4"														6"														
6"														8"														
8"														10"														
10"														12"														
12"														14"														
14"														16"														
16"														18"														
18"														20"														
20"																												
Use 'in spec.' branch connection with 4" long Nipple and Ball Valve with Square head Plug																												
NOT PERMITTED																												
OVAL RING, SOFT IRON, MAX BHN 90 ASME B16.20																												
STUDS : ASTM A193 Gr. B7M																												
NUTS : ASTM A194 Gr. 2HM																												
SPEC. PLATE / BLANK & SPACER														SPEC. PLATE : DUPLX SS, AS PER ASTM A182 Gr.F51														
VALVES	GATE																											
	GLOBE														VGL-233													
	CHECK														VC-233 VC-234													
	BALL														VB-234													
	PLUG																											
	BUTTERFLY																											
	FOR SPEC. NOTES SEE SHEET 43 OF 43																											
SERVICE: PRODUCED WATER (A / G), FLOWLINE (WITHOUT CORROSION INHIBITOR)														HYDROTEST LIMITED BY : FLANGES														
														BARG. 233 PSIG. 3375														
DESCRIPTION: 14 FOR TENDER														DESCRIPTION:														
DRN. CHK. APP.														DRN. CHK. APP.														
HM/SMHA/MMA/BS WUS MAS														DESCRIPTION: DRN. CHK. APP.														
CONSULTANT: Zishan Engineers (Pvt.) Ltd.														DRAWN CHECKED APPROVED														
NAME DATE														HM/SMHA/ MMA /BS MIAH MAS 16-02-2015 16-02-2015 16-02-2015														
PIPING MATERIAL SPECIFICATION														CLIENT : Oil & Gas Development Company Ltd.														
JOB NO. 165-4														MATERIAL : DUPLX STAINLESS STEEL RATING : 900 #														
														CORR. ALLOWANCE: NIL SHEET : 34 OF 43														
														PIPE WALL TOLERANCE : ± 12.5% SPEC. E5 REV. 14														
														Design Code: ASME B 31.3														

NOMINAL RUN PIPE SIZE (in.)

Run Pipe Size	1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	14"	16"	18"	20"
20"	W	W	W	W	W	W	W	W	W	R	R	R	R	R	E
18"	W	W	W	W	W	W	W	W	W	R	R	R	R	R	E
16"	W	W	W	W	W	W	W	W	W	R	R	R	R	R	E
14"	W	W	W	W	W	W	W	W	W	R	R	R	R	R	E
12"	W	W	W	W	W	W	W	W	W	R	R	R	R	R	E
10"	W	W	W	W	W	W	W	W	W	R	R	R	R	R	E
8"	W	W	W	W	W	W	W	W	W	R	R	R	R	R	E
6"	W	W	W	W	W	W	W	W	W	R	R	R	R	R	E
4"	W	W	W	W	W	W	W	W	W	R	R	R	R	R	E
3"	W	W	W	W	W	W	W	W	W	R	R	R	R	R	E
2"	W	W	W	W	W	W	W	W	W	R	R	R	R	R	E
1 1/2"	R	R	R	R	R	R	R	R	R	R	R	R	R	R	E
1"	R	R	R	R	R	R	R	R	R	R	R	R	R	R	E
3/4"	R	R	R	R	R	R	R	R	R	R	R	R	R	R	E
1/2"	R	R	R	R	R	R	R	R	R	R	R	R	R	R	E

LEGEND:
R Reducing Tee
S Sockolet
E Equal Tee
W Weldolet
TS Equal Tee & Swage Nipple

Notes : Reducing fittings thickness shall match heavier pipe thickness.

DESIGN CONDITIONS		STUD BOLTS		
TEMP.	PRESS.	NOMINAL PIPE SIZE	DIA. ,in. & LENGTH, mm	NO. OF BOLTS
° F	psig			
- 150 TO 100	2250	1/2"	M20 x 80	4
200	2160	3/4"	M20 x 90	4
300	1995	1"	M24 x 90	4
400	1845	1 1/2"	M27 x 110	4
500	1730	2"	M24 x 110	8
600	1670	3"	M24 x 125	8
650	1650	4"	M30 x 145	8
700	1625	6"	M30 x 170	12
° C	barg	8"	M36 x 195	12
-101 TO 38	155.17	10"	M36 x 215	16
93	148.97	12"	M36 x 225	20
149	137.59	14"	M39 x 235	20
204	127.24	16"	M42 x 255	20
260	119.31	18"	M48 x 275	20
316	115.17	20"	M52 x 290	24
371	113.79			



NOMINAL PIPE SIZE	1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"									90° BRANCH CONNECTIONS																																																																																																																																																																																																			
MIN. WALL THK.	SCH 10S			SCH 40S			SCH 80S			####	18.80																																																																																																																																																																																																												
PIPE	ASTM A 312 TP 316 SMLS, ASME 36.19																																																																																																																																																																																																																						
FLANGES	SW / Plain Ends									BW Beveled Ends																																																																																																																																																																																																													
	ASME B 16.5 Class 900 RTJ, ASTM A 182 F-316																																																																																																																																																																																																																						
FITTINGS	ASME B16.11 S.W. CLASS 6000,ASTM A182-F316									ASME B16.9, Beveled Ends, Wall Thk. to Match Pipe Seamless Steel, ASTM A 403 WP-316																																																																																																																																																																																																													
	S.W. Ends, MSS-SP-97 Class 6000, ASTM A182 F316									B.W. Ends, MSS-SP-97 ASTM A182 F316																																																																																																																																																																																																													
BRANCH OUTLETS (Sockolet,Weldolet,etc.)	Class 6000, S.W. Ground Joint,																																																																																																																																																																																																																						
UNIONS	Square Head 6000# ASTM A182-F316																																																																																																																																																																																																																						
PLUG	1/2"									3/4"																																																																																																																																																																																																													
	Use 'in spec.' branch connection with 4" long Nipple and Ball Valve with Square head Plug																																																																																																																																																																																																																						
VENTS / DRAINS	ASTM A 312 Gr. TP 316 Class 6000, A182-F316																																																																																																																																																																																																																						
THR'D NIPPLE & SWAGES	OVAL RING, SOFT IRON, MAX BHN 90 ASME B16.20																																																																																																																																																																																																																						
GASKETS	STUDS : ASTM A193 Gr. B7M									NUTS : ASTM A194 Gr. 8, Heavy Hex, Cadmium plated (Impact Tested)																																																																																																																																																																																																													
BOLTING	SPEC. PLATE									BLANK & SPACER																																																																																																																																																																																																													
	ASTM A-240 Gr. 316									ASTM A516 Gr. 60																																																																																																																																																																																																													
VALVES	GATE	VG-123				VG-233																																																																																																																																																																																																																	
	GLOBE	VGL-124				VGL-235																																																																																																																																																																																																																	
	CHECK	VC-123				VC-235																																																																																																																																																																																																																	
	BALL	VB-126				VB-236																																																																																																																																																																																																																	
	PLUG																																																																																																																																																																																																																						
	BUTTERFLY																																																																																																																																																																																																																						
	FOR SPEC. NOTES SEE SHEET 43 OF 43																																																																																																																																																																																																																						
SERVICE: LIQUIFIED GAS UNDER - 100 C, RICH AMINE, ACID GAS										HYDROTEST LIMITED BY : FLANGES																																																																																																																																																																																																													
DESCRIPTION: 14 FOR TENDER										BARG. 187					PSIG. 2700																																																																																																																																																																																																								
DRN.	HM/SMHA/MMA/BS	DESCRIPTION:	DRN.		DESCRIPTION:	DRN.		DESCRIPTION:	DRN.		316	74.48	20"	M52	x 360	20																																																																																																																																																																																																							
CHK.	WUS		CHK.			CHK.			CHK.		343	72.41	24"	M64	x 455	20																																																																																																																																																																																																							
APP.	MAS		APP.			APP.			APP.		371	71.03																																																																																																																																																																																																											
CONSULTANT: Zishan Engineers (Pvt.) Ltd.										DRAWN					CHECKED					APPROVED																																																																																																																																																																																																			
NAME										HM/SMHA/ MMA /BS					MIAH					MAS																																																																																																																																																																																																			
DATE										16-02-2015					16-02-2015					16-02-2015																																																																																																																																																																																																			
CLIENT : Oil & Gas Development Company Ltd.										MATERIAL : STAINLESS STEEL (316 L)										RATING : 900 #																																																																																																																																																																																																			
CORR. ALLOWANCE: NIL										PIPE WALL TOLERANCE : ± 12.5%										SHEET : 35 OF 43																																																																																																																																																																																																			
Design Code: ASME B 31.3										SPEC. E6										REV. 14																																																																																																																																																																																																			
																			<table border="1"> <tr> <th colspan="13">NOMINAL BRANCH SIZE (in.)</th> </tr> <tr> <th></th> <th>1/2</th> <th>3/4</th> <th>1</th> <th>1 1/2</th> <th>2</th> <th>3</th> <th>4</th> <th>6</th> <th>8</th> <th>10</th> <th>12</th> <th>14</th> <th>16</th> <th>18</th> <th>20</th> <th>24</th> </tr> <tr> <th>24</th> <td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <th>20</th> <td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>W</td><td>W</td><td>W</td><td>W</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <th>18</th> <td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>W</td><td>W</td><td>W</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <th>16</th> <td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>W</td><td>W</td><td>R</td><td>R</td><td>R</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <th>14</th> <td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>W</td><td>W</td><td>R</td><td>R</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <th>12</th> <td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>W</td><td>W</td><td>R</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <th>10</th> <td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>W</td><td>R</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <th>8</th> <td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>W</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <th>6</th> <td>S</td><td>S</td><td>S</td><td>S</td><td>W</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <th>4</th> <td>S</td><td>S</td><td>S</td><td>S</td><td>R</td><td>R</td><td>E</td> </tr> <tr> <th>3</th> <td>S</td><td>S</td><td>S</td><td>S</td><td>R</td><td>E</td> </tr> <tr> <th>2</th> <td>TS</td><td>TS</td><td>TS</td><td>TS</td><td>E</td> </tr> <tr> <th>1 1/2</th> <td>R</td><td>R</td><td>E</td><td>E</td> </tr> <tr> <th>1</th> <td>R</td><td>R</td><td>E</td> </tr> <tr> <th>3/4</th> <td>R</td><td>E</td> </tr> <tr> <th>1/2</th> <td>E</td> </tr> </table>													NOMINAL BRANCH SIZE (in.)														1/2	3/4	1	1 1/2	2	3	4	6	8	10	12	14	16	18	20	24	24	S	S	S	S	W	W	W	W	W	W	R	R	R	R	R	E	20	S	S	S	S	W	W	W	W	W	R	R	R	R	R	R	E	18	S	S	S	S	W	W	W	W	R	R	R	R	R	R	E	16	S	S	S	S	W	W	W	R	R	R	R	R	E	14	S	S	S	S	W	W	W	R	R	R	R	E	12	S	S	S	S	W	W	W	R	R	R	E	10	S	S	S	S	W	W	R	R	R	E	8	S	S	S	S	W	W	R	R	E	6	S	S	S	S	W	R	R	E	4	S	S	S	S	R	R	E	3	S	S	S	S	R	E	2	TS	TS	TS	TS	E	1 1/2	R	R	E	E	1	R	R	E	3/4	R	E	1/2	E
NOMINAL BRANCH SIZE (in.)																																																																																																																																																																																																																							
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18	S	S	S	S	W	W	W	W	R	R	R	R	R	R	E																																																																																																																																																																																																								
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14	S	S	S	S	W	W	W	R	R	R	R	E																																																																																																																																																																																																											
12	S	S	S	S	W	W	W	R	R	R	E																																																																																																																																																																																																												
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8	S	S	S	S	W	W	R	R	E																																																																																																																																																																																																														
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4	S	S	S	S	R	R	E																																																																																																																																																																																																																
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1/2	E																																																																																																																																																																																																																						
																			<p>LEGEND:</p> <p>R Reducing Tee S Sockolet E Equal Tee W Weldolet TS Equal Tee & Swage Nipple</p>																																																																																																																																																																																																				
																			NOTE : Reducing fittings thickness shall match heavier pipe thickness.																																																																																																																																																																																																				

NOMINAL PIPE SIZE	1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	14"
MIN. WALL THK. (mm)	SCH 160			SCH 120	7.14	8.74	11.13	12.70	14.27	14.27		
PIPE	ASTM A 106 GR.B / API 5L GR.B, SMLS, ASME 36.10			API 5L, X52, SMLS			API 5L, X52, ERW					
	Plain Ends			BW Beveled Ends								
FLANGES	ASME B 16.5 Class 900 RTJ, ASTM A 694 F52											
	Socket Weld			Weld Neck, Bore to Match Pipe I.D.								
FITTINGS	ASME B16.11 S.W. CLASS 6000, ASTM A 105			ASME B16.9, Beveled Ends, Wall Thk. to Match Pipe Seamless Steel, ASTM A 860 Gr WPHY 52								
BRANCH OUTLETS (Sockolet, Weldolet, etc.)	S.W. Ends, MSS-SP-97 Class 6000, ASTM A105			B.W. Ends, MSS-SP-97 ASTM A105								
	Class 6000, S.W. Ground Joint											
PLUG	Square Head 6000# ASTM A 105											
VENTS / DRAINS	1/2"	3/4"			3/4" / 1"			3/4" / 1 1/2"				
	Use 'in spec.' branch connection with 4" long Nipple and Ball Valve with Square head Plug											
THR'D NIPPLE & SWAGES	ASTM A 106 GR.B SMLS Class 6000, ASTM A 105											
GASKETS	OVAL RING, SOFT IRON, MAX BHN 90 ASME B16.20											
BOLTING	STUDS : ASTM A 193 GR.B7 CADMIUM PLATED											
	NUTS : ASTM A194 Gr. 2H, Heavy Hex, CADMIUM PLATED											
SPEC. PLATE / BLANK & SPACER				SPEC. PLATE			BLANK & SPACER					
				ASTM A515 Gr. 70			ASTM A515 Gr. 70					
VALVES	GATE											
	GLOBE			VGL-123			VGL-234					
	CHECK			VC-236								
	BALL			VB-124			REG. PORT: VB-238 FULL PORT: VB-239					
	PLUG											
	BUTTERFLY											
	FOR SPEC. NOTES SEE SHEET 43 OF 43											

NACE - MR - 0175 (LATEST REVISION)

90° BRANCH CONNECTIONS													
NOMINAL BRANCH SIZE (in.)													
	1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	8"	10"	12"	14"	
NOMINAL RUN PIPE SIZE (in.)	16	S	S	S	S	W	W	W	W	W	R	R	R
	14	S	S	S	S	W	W	W	W	R	R	R	E
	12	S	S	S	S	W	W	W	R	R	R	E	
	10	S	S	S	S	W	W	R	R	R	E		
	8	S	S	S	S	W	W	R	R	E			
	6	S	S	S	S	W	R	R	E				
	4	S	S	S	S	R	R	E					
	3	S	S	S	S	R	E						
	2	TS	TS	TS	TS	E							
	1 1/2	R	R	E	E								
1	R	R	E										
3/4	R	E											
1/2	E												

LEGEND:
R Reducing Tee
S Sockolet
E Equal Tee
W Weldolet
TS Equal Tee & Swage Nipple

NOTE : Reducing fittings thickness shall match heavier pipe thickness.

DESIGN CONDITIONS		STUD BOLTS		
TEMP.	PRESSURE	NOMINAL PIPE SIZE	DIA. .in. & LENGTH, mm	NO. OF BOLTS
° F	psig			
-20 TO 100	2220	1/2"	M20 x 105	4
200	2025	3/4"	M20 x 115	4
300	1970	1"	M24 x 125	4
400	1900	1 1/2"	M27 x 140	4
500	1795	2"	M24 x 145	8
600	1640	3"	M24 x 145	8
650	1610	4"	M30 x 170	8
700	1600	6"	M30 x 195	12
° C	barg	8"	M36 x 220	12
-29 TO 38	153.06	10"	M36 x 235	16
93	139.62	12"	M36 x 255	20
149	135.82	14"	M39 x 280	20
204	131.00			
260	123.76			
316	1113.07			
343	111.00			
371	110.31			

SERVICE : WELL HEAD FACILITIES AND FLOWLINES				HYDROTEST LIMITED BY : FLANGES			
				BARG: 230		PSIG 3335	
DESCRIPTION:	DRN.	HM/SMHA/MMA/BS	DESCRIPTION:	DRN.		DESCRIPTION:	DRN.
14 FOR TENDER	CHK.	WUS		CHK.			CHK.
	APP.	MAS		APP.			APP.

CONSULTANT:			DRAWN			CHECKED			APPROVED			CLIENT : Oil & Gas Development Company Ltd.					
Zishan Engineers (Pvt.) Ltd.			NAME			MAH			MAS			MATERIAL : CARBON STEEL (API-5L X52)					
			DATE			16-02-2015			16-02-2015			16-02-2015					
			CORR. ALLOWANCE: 3.00 mm			SHEET : 37 OF 43			PIPE WALL TOLERANCE : -			SPEC. E8 (S) REV. 14					
PIPING MATERIAL SPECIFICATION						JOB NO. 165-4						Design Code: ASME B 31.8					

NOMINAL PIPE SIZE											1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	90° BRANCH CONNECTIONS																																																												
MIN. WALL THK. (mm)											SCH 40S			SCH 40S			SCH 80S			NOMINAL BRANCH SIZE (in.)																																																											
PIPE											DUPLEX SS, AS PER ASTM A790 UNS S31803, SEAMLESS											<table border="1"> <tr> <th>6"</th> <th>W</th><th>W</th><th>W</th><th>W</th><th>W</th><th>R</th><th>R</th><th>E</th> <th>4"</th> <th>W</th><th>W</th><th>W</th><th>W</th><th>R</th><th>R</th><th>E</th> <th>3"</th> <th>W</th><th>W</th><th>W</th><th>R</th><th>R</th><th>E</th> <th>2"</th> <th>W</th><th>W</th><th>R</th><th>R</th><th>E</th> <th>1 1/2"</th> <th>R</th><th>R</th><th>R</th><th>E</th> <th>1"</th> <th>R</th><th>R</th><th>E</th> <th>3/4"</th> <th>R</th><th>E</th> <th>1/2"</th> <th>E</th> </tr> </table>														6"	W	W	W	W	W	R	R	E	4"	W	W	W	W	R	R	E	3"	W	W	W	R	R	E	2"	W	W	R	R	E	1 1/2"	R	R	R	E	1"	R	R	E	3/4"	R	E	1/2"	E
6"	W	W	W	W	W	R	R	E	4"	W	W	W	W	R	R	E	3"	W	W	W	R															R	E	2"	W	W	R	R	E	1 1/2"	R	R	R	E	1"	R	R	E	3/4"	R	E	1/2"	E																						
FLANGES											ASME B 16.5 Class 1500 RTJ, ASTM A 182 Gr. F-51																																																																				
FITTINGS											DUPLEX SS, AS PER ASTM A - 815, UNS S31803, BEVELLED ENDS																																																																				
BRANCH OUTLETS (Sockolet,Weldolet,etc.)											B.W. Ends, MSS-SP-97 ASTM A 815 UNS S31803																																																																				
UNIONS											NOT PERMITTED																																																																				
PLUG											NOT PERMITTED																																																																				
VENTS / DRAINS											1/2"	3/4"			Use 'in spec.' branch connection with 4" long Nipple and Ball Valve with Square head Plug																																																																
THR'D NIPPLE & SWAGES											NOT PERMITTED																																																																				
GASKETS											OCTAGONAL RING TYPE, SS316																																																																				
BOLTING											STUDS: ASTM A193 Gr. B7, PTFE Coated HEAVY HEX NUTS: ASTM A194 Gr. 2H, PTF																																																																				
SPEC. PLATE / BLANK & SPACER											SPEC. PLATE : DUPLEX SS, AS PER ASTM A182 Gr.F51																																																																				
VALVES	GATE										X																																																																				
	GLOBE										VGL-243																																																																				
	CHECK										VC-243					VC-244																																																															
	BALL										VB-244																																																																				
	NEEDLE										VN-243																																																																				
	BUTTERFLY										X																																																																				
	FOR SPEC. NOTES SEE SHEET 43 OF 43																																																																														
SERVICE: FLOWLINE (WITHOUT CORROSION INHIBITOR)											HYDROTEST LIMITED BY : FLANGES																																																																				
UPSTREAM OF AND INCLUDING CHOKE VALVE											BARG. 388					PSIG. 5625																																																															
DESCRIPTION:			DRN.	HM/SMHA/MMA/BS	DESCRIPTION:			DRN.	DESCRIPTION:			DRN.	DESCRIPTION:																																																																		
14 FOR TENDER			CHK.	WUS				CHK.				CHK.																																																																			
			APP.	MAS				APP.				APP.																																																																			
CONSULTANT:											DRAWN			CHECKED			APPROVED			MATERIAL : DUPLEX STAINLESS STEEL					RATING : 1500 #																																																						
Zishan Engineers (Pvt.) Ltd.											NAME			MIAH			MAS			CORR. ALLOWANCE: NIL					SHEET : 38 OF 43																																																						
											DATE			16-02-2015			16-02-2015			16-02-2015			PIPE WALL TOLERANCE : ± 12.5%					SPEC. F5 REV. 14																																																			
PIPING MATERIAL SPECIFICATION											JOB NO. 165-4											Design Code: ASME B 31.3																																																									

LEGEND:
R Reducing Tee
S Sockolet
E Equal Tee
W Weldolet
TS Equal Tee & Swage Nipple

Notes : Reducing fittings thickness shall match heavier pipe thickness.

NOMINAL RUN PIPE SIZE (in.)



NOMINAL PIPE SIZE		1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"	NACE - MR - 0175 (LATEST REVISION)											90° BRANCH CONNECTIONS												
MIN. WALL THK. (mm)		SCH 40S			SCH 40S			SCH 80S			NACE - MR - 0175 (LATEST REVISION)											NOMINAL BRANCH SIZE (in.)											
PIPE		DUPLEX SS, AS PER ASTM A790 UNS S31803, SEAMLESS										NOMINAL RUN PIPE SIZE (in.)	1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"													
		PLAIN END					BW BEVELED END						6"	W	W	W	W	W	R	R	E												
FLANGES		ASME B 16.5 Class 1500 RTJ, ASTM A 182 Gr. F-51											4"	W	W	W	W	R	R	E													
		WELDING NECK, BORE TO MATCH PIPE I.D.											3"	W	W	W	R	R	E														
FITTINGS		DUPLEX SS, AS PER ASTM A - 815, UNS S31803, BEVELLED ENDS											2"	W	W	R	R	E															
BRANCH OUTLETS (Sockolet, Weldolet, etc.)		B.W. Ends, MSS-SP-97 ASTM A 815 UNS S31803											1 1/2"	R	R	R	E																
UNIONS		NOT PERMITTED											1"	R	R	E																	
PLUG		NOT PERMITTED											3/4"	R	E																		
VENTS / DRAINS		1/2"	3/4"			Use 'in spec.' branch connection with 4" long Nipple and Ball Valve with Square head Plug										1/2"	E																
THR'D NIPPLE & SWAGES		NOT PERMITTED																															
GASKETS		OCTAGONAL RING TYPE, SS316																															
BOLTING		STUDS: ASTM A193 Gr. B7, PTFE Coated HEAVY HEX NUTS: ASTM A194 Gr. 2H, PTF																															
SPEC. PLATE / BLANK & SPACER		X					SPEC. PLATE : DUPLEX SS, AS PER ASTM A182 Gr.F51																										
VALVES	GATE		X																														
	GLOBE		VGL-243																														
	CHECK		VC-243					VC-244																									
	BALL		VB-244																														
	NEEDLE		VN-243																														
	BUTTERFLY		X																														
FOR SPEC. NOTES SEE SHEET 43 OF 43																																	
SERVICE: FLOWLINE (WITHOUT CORROSION INHIBITOR) UPSTREAM OF AND INCLUDING CHOKE VALVE											HYDROTEST LIMITED BY : FLANGES																						
											BARG. 388					PSIG. 5625																	
DESCRIPTION:		DRN.	HM/SMHA/MMA/BS	DESCRIPTION:							DRN.			DESCRIPTION:		DRN.																	
14 FOR TENDER		CHK.	WUS								CHK.					CHK.																	
		APP.	MAS								APP.					APP.																	
CONSULTANT:				DRAWN		CHECKED		APPROVED		CLIENT : Oil & Gas Development Company Ltd.										MATERIAL : DUPLEX STAINLESS STEEL					RATING : 1500 #								
Zishan Engineers (Pvt.) Ltd.				NAME		HM/SMHA/ MMA /BS	MIAH		MAS												CORR. ALLOWANCE: NIL					SHEET : 39 OF 43							
				DATE		16-02-2015	16-02-2015		16-02-2015												PIPE WALL TOLERANCE : ± 12.5%					SPEC. F5 (S) REV. 14							
				PIPING MATERIAL SPECIFICATION										JOB NO. 165-4					Design Code: ASME B 31.3														

NOMINAL RUN PIPE SIZE (in.)

LEGEND:
R Reducing Tee
S Sockolet
E Equal Tee
W Weldolet
TS Equal Tee & Swage Nipple

Notes : Reducing fittings thickness shall match heavier pipe thickness.

DESIGN CONDITIONS		STUD BOLTS		
TEMP.	PRESS.	NOMINAL PIPE SIZE	DIA. ,in. & LENGTH, mm	NO. OF BOLTS
° F	psig			
- 150 TO 100	3750	1/2"	M20 x 105	4
200	3600	3/4"	M20 x 115	4
300	3325	1"	M24 x 125	4
400	3070	1 1/2"	M27 x 140	4
500	2880	2"	M24 x 145	8
600	2785	3"	M30 x 180	8
650	2750	4"	M33 x 200	8
700	2710	6"	M36 x 265	12
° C	barg			
-101 TO 38	258.62			
93	248.28			
149	229.31			
204	211.72			
260	198.62			
316	192.07			
371	189.66			

NOMINAL PIPE SIZE											1/2" 3/4" 1" 1 1/2" 2" 3" 4" 6"											90° BRANCH CONNECTIONS													
MIN. WALL THK. (mm)											SCH 40S			SCH 40S			SCH 80S					NOMINAL BRANCH SIZE (in.)													
PIPE											DUPLEX SS, AS PER ASTM A790 UNS S31803, SEAMLESS											1/2 3/4 1 1 1/2 2 3 4 6													
FLANGES											PLAIN END					BW BEVELED END						6" W W W W W R R E													
FITTINGS											DUPLEX SS, AS PER ASTM A - 815, UNS S31803, BEVELLED ENDS											4" W W W W R R E													
BRANCH OUTLETS (Sockolet,Weldolet,etc.)											B.W. Ends, MSS-SP-97 ASTM A 815 UNS S31803											3" W W W R R E													
UNIONS											NOT PERMITTED											2" W W R R E													
PLUG											NOT PERMITTED											1 1/2" R R R E													
VENTS / DRAINS											1/2"		3/4"									1" R R E													
THR'D NIPPLE & SWAGES											NOT PERMITTED											3/4" R E													
GASKETS											OCTAGONAL RING TYPE, SS316											1/2" E													
BOLTING											STUDS: ASTM A193 Gr. B7, PTFE Coated HEAVY HEX NUTS: ASTM A194 Gr. 2H, PTF											Notes : Reducing fittings thickness shall match heavier pipe thickness.													
SPEC. PLATE / BLANK & SPACER											VALVES					SPEC. PLATE : DUPLEX SS, AS PER ASTM A182 Gr.F51					DESIGN CONDITIONS					STUD BOLTS									
GATE																TEMP.					PRESS.					NOMINAL PIPE SIZE					DIA. ,in. & NO. OF LENGTH, mm BOLTS				
GLOBE																° F					psig														
CHECK																- 150 TO 100					6250					1/2"					M20 x 120 4				
BALL																200					6000					3/4"					M20 x 125 4				
NEEDLE																300					5540					1"					M24 x 140 4				
BUTTERFLY																400					5120					1 1/2"					M30 x 170 4				
																500					4800					2"					M27 x 180 8				
FOR SPEC. NOTES SEE SHEET 43 OF 43											600					4640					3"					M33 x 230 8									
SERVICE: FLOWLINE (WITHOUT CORROSION INHIBITOR)											650					4580					4"					M39 x 260 8									
UPSTREAM OF AND INCLUDING CHOKE VALVE											700					4520					6"					M52 x 355 8									
DESCRIPTION: 14 FOR TENDER											° C					barg																			
DRN. HM/SMHA/MMA/BS											-101 TO 38					431.03																			
CHK. WUS											93					413.79																			
APP. MAS											149					382.07																			
DESCRIPTION: 14 FOR TENDER											204					353.10																			
DRN. _____											260					331.03																			
CHK. _____											316					320.00																			
APP. _____											371					315.86																			
CONSULTANT:											HYDROTEST LIMITED BY : FLANGES																								
Zishan Engineers (Pvt.) Ltd.											BARG. 646.5					PSIG. 9375																			
DRAWN											DESCRIPTION:																								
NAME											DRN. _____																								
DATE											CHK. _____																								
DATE											APP. _____																								
PIPING MATERIAL SPECIFICATION											MATERIAL : DUPLEX STAINLESS STEEL					RATING : 2500 #																			
CLIENT : Oil & Gas Development Company Ltd.											CORR. ALLOWANCE: NIL					SHEET : 41 OF 43																			
JOB NO. 165-4											PIPE WALL TOLERANCE : ± 12.5%					SPEC. G5 REV. 14																			
											Design Code: ASME B 31.3																								



NOMINAL PIPE SIZE		1/2"	3/4"	1"	1 1/2"	2"	3"	4"	6"											90° BRANCH CONNECTIONS										
MIN. WALL THK. (mm)		SCH 40S			SCH 40S			SCH 80S													NOMINAL BRANCH SIZE (in.)									
PIPE		DUPLEX SS, AS PER ASTM A790 UNS S31803, SEAMLESS																												
FLANGES		PLAIN END					BW BEVELED END																							
FITTINGS		ASME B 16.5 Class 2500 RTJ, ASTM A 182 Gr. F-51 WELDING NECK, BORE TO MATCH PIPE I.D.																												
BRANCH OUTLETS (Sockolet, Weldolet, etc.)		DUPLEX SS, AS PER ASTM A - 815, UNS S31803, BEVELLED ENDS																												
UNIONS		B.W. Ends, MSS-SP-97																												
PLUG		ASTM A 815 UNS S31803																												
VENTS / DRAINS		NOT PERMITTED																												
THR'D NIPPLE & SWAGES		NOT PERMITTED																												
GASKETS		OCTAGONAL RING TYPE, SS316																												
BOLTING		STUDS: ASTM A193 Gr. B7, PTFE Coated																												
SPEC. PLATE / BLANK & SPACER		HEAVY HEX NUTS: ASTM A194 Gr. 2H, PTFE Coated																												
VALVES		SPEC. PLATE : DUPLEX SS, AS PER ASTM A182 Gr.F51																												
GATE	GLOBE	CHECK	BALL	NEEDLE	BUTTERFLY																									
						VGL-253																								
						VC-253					VC-254																			
						VB-254																								
						VN-253																								
FOR SPEC. NOTES SEE SHEET 43 OF 43																														
SERVICE: FLOWLINE (WITHOUT CORROSION INHIBITOR)										HYDROTEST LIMITED BY : FLANGES																				
UPSTREAM OF AND INCLUDING CHOKE VALVE										BARG. 646.5					PSIG. 9375															
DESCRIPTION:		DRN.	HM/SMHA/MMA/BS	DESCRIPTION:		DRN.		DESCRIPTION:		DRN.		DESCRIPTION:		DRN.		DESCRIPTION:		DRN.												
14 FOR TENDER		CHK.	WUS			CHK.				CHK.				CHK.				CHK.												
		APP.	MAS			APP.				APP.				APP.				APP.												
CONSULTANT:		DRAWN		CHECKED		APPROVED		CLIENT : Oil & Gas Development Company Ltd.										MATERIAL : DUPLEX STAINLESS STEEL		RATING : 2500 #										
Zishan Engineers (Pvt.) Ltd.		NAME		HM/SMHA/ MMA /BS		MIAH		MAS												CORR. ALLOWANCE: NIL		SHEET : 42 OF 43								
		DATE		16-02-2015		16-02-2015		16-02-2015												PIPE WALL TOLERANCE : ± 12.5%		SPEC. G5 (S) REV. 14								
PIPING MATERIAL SPECIFICATION										JOB NO. 165-4					Design Code: ASME B 31.3															

NOMINAL RUN PIPE SIZE (in.)

6"	W	W	W	W	W	R	R	E
4"	W	W	W	W	R	R	E	
3"	W	W	W	R	R	E		
2"	W	W	R	R	E			
1 1/2"	R	R	R	E				
1"	R	R	E					
3/4"	R	E						
1/2"	E							

LEGEND:
R Reducing Tee
S Sockolet
E Equal Tee
W Weldolet
TS Equal Tee & Swage Nipple

Notes : Reducing fittings thickness shall match heavier pipe thickness.

DESIGN CONDITIONS		STUD BOLTS		
TEMP.	PRESS.	NOMINAL PIPE SIZE	DIA. ,in. & LENGTH, mm	NO. OF BOLTS
° F	psig			
- 150 TO 100	6250	1/2"	M20 x 120	4
200	6000	3/4"	M20 x 125	4
300	5540	1"	M24 x 140	4
400	5120	1 1/2"	M30 x 170	4
500	4800	2"	M27 x 180	8
600	4640	3"	M33 x 230	8
650	4580	4"	M39 x 260	8
700	4520	6"	M52 x 355	8
° C	barg			
-101 TO 38	431.03			
93	413.79			
149	382.07			
204	353.10			
260	331.03			
316	320.00			
371	315.86			

GENERAL NOTES:

- 1: ALL PIPING SHALL BE DESIGNED AND INSTALLED IN CONFORMANCE WITH ANSI B 31.3 UNLESS MODIFIED BY THE JOB SPECIFICATION.
- 2: INSERTED PIPING BRANCHES WITH REINFORCING PADS MAY NOT BE USED.
- 3: THE ANGLE BETWEEN ANY BRANCH AND HEADER SHALL NOT BE USED.
- 4: ALL INSTRUMENT AIR, STEAM AND FUEL GAS CONNECTIONS SHALL BE MADE FROM THE TOP OF THE HEADER.
- 5: HIGH POINT VENTS AND LOW POINT DRAINS SHALL BE PROVIDED TO FACILITATE HYDROSTATIC TESTING.
- 6: CERTAIN DRAINS AND VENTS SHALL BE EQUIPPED WITH PERMANENT VALVES AS DETERMINED BY ISSUER DURING FABRICATION. THE MINIMUM SIZE CONNECTION SHALL BE 1/2" NPS.
- 7: ALL BRANCH CONNECTIONS SHALL BE JOINED TO HEADER WITH FULL PENETRATION WELDS.
- 8: ALL PIPING COMPONENTS REQUIRING SERVICE SHALL BE LOCATED WHERE THEY CAN BE ACCESSED CONVENIENTLY.
- 9: PIPING ARRANGEMENTS AROUND EQUIPMENT SHALL PROVIDE FOR MAINTENANCE AND SERVICE OF THE EQUIPMENT WITH A MINIMUM DISMANTLING OF PIPING SYSTEMS.
- 10: PIPING, PIPE SUPPORTS, VALVES, VALVE HANDLES AND VALVE OPERATORS SHALL BE LOCATED SAFELY TO PREVENT STUMBLING OR STRIKING HAZARDS TO OPERATING PERSONNEL.
- 11: ALL PIPING SHALL BE ARRANGED IN AS NEAT AND SIMPLE A MANNER AS POSSIBLE. IN GENERAL, PROCESS PIPING SHOULD BE ARRANGED ON OVERHEAD RACKS.
- 12: PIPING HEADER SHOULD TERMINATE WITH FLANGES. FUTURE EXPANSION SHOULD BE CONSIDERED FOR ALL PIPING SYSTEMS.
- 13: PIPEWAYS SHALL BE DESIGNED WITH A MINIMUM OF 20% MORE PIPE SPACE THAN IS REQUIRED FOR INITIAL INSTALLATION, UNLESS OTHERWISE SPECIFIED IN THE JOB SPECIFICATION.
- 14: HOT AND COLD PIPING SHALL BE GROUPED WITH THE HOTTEST PIPING ON THE OUTSIDE. HEAVIER LINES SHALL BE LOCATED ON THE OUTSIDE OF PIPE RACKS AS CLOSE TO THE COLUMN AS PRACTICAL.
- 15: PIPING SHALL BE INSTALLED WITH SUPPORTS. PULSATION DAMPERS AND OTHER NECESSARY DEVICES AS REQUIRED TO PREVENT EXCESSIVE EQUIPMENT AND PIPING VIBRATION. EXCESSIVE VIBRATIONS ARE THOSE WHICH WOULD CAUSE DAMAGE TO THE EQUIPMENT. THE JOB SPECIFICATION WILL INDICATE THE ALLOWABLE VIBRATION LEVELS BASED ON THE ASSOCIATED EQUIPMENT. IN GENERAL, THE ALLOWABLE VIBRATION PEAK VELOCITY WILL BE TWICE THAT ALLOWED FOR THE INDICATED EQUIPMENT. IN LIEU OF ANY OTHER INFORMATION, THE MAXIMUM ALLOWABLE PEAK VELOCITY IN ANY PART OF THE PART OF THE PIPING SYSTEM SHALL BE 15 MM/S(0.6"/SEC.)
- 16: PIPING SHALL BE DESIGNED SO THAT PROCESS EQUIPMENT CONNECTIONS CAN BE ISOLATED FOR SAFE MAINTENANCE. THIS MAY BE ACCOMPLISHED BY PROVIDING FOR THE INSERTION OF BLANKS (BLINDS) OR SPECTACLE BLINDS AT STRATEGIC POINTS. THE BLINDS SHALL BE INSTALLED SO THAT INSERTION OR OPERATION CAN BE MADE FROM PERMANENT PLATFORMS WALKWAYS OR GRADE.
- 17: IF BLINDS ARE NOT PROVIDED IN THE DESIGN, THE PIPING ARRANGEMENT SHALL PROVIDE ISOLATION BY VALVE REMOVAL OR REMOVAL OF OTHER COMPONENTS TO ACCOMPLISH SAFE ISOLATION.
- 18: PIPING DESIGN SHALL PROVIDE ADEQUATE APACE TO ALLOW LINE-UP CLAMPS TO BE USED ON FIELD WELDS IF PRACTICAL.
- 19: PIPING SHALL BE ADEQUATELY SUPPORTED FOR THE DEAD WEIGHT OF PIPE. FILLED WITH WATER, INCLUDING ATTACHED UNSUPPORTED COMPONENTS, INSULATION AND OTHER EXTERNAL SUSTAINED LOADINGS. ANALYSIS OF SUPPORTS FOR PERIODIC LOADINGS SHALL BE IN ACCORDANCE WITH ANSI B 31.3.
- 20: THE MINIMUM SPACING FOR STANCHION SHALL BE SUCH THAT THE STRESS DEVELOPED BY THE PIPING SHALL BE LESS THAN THE ALLOWABLE STRESS FOR SUSTAINED LOADS PER ANSI B31.3 AND IN NO CASE SHALL THE DEFLECTION EXCEED 25 mm (1 INCH).
- 21: PIPING PASSING THROUGH FIREWALLS SHALL BE SEALED WITH A FIRE RETARDING SEAL.
- 23: CARBON STEEL AND LOW-ALLOY CARBON STEEL COMPONENTS SHALL HAVE A MAXIMUM HARDNESS OF 235 BHN (HRC 22), SHALL NOT HAVE MORE THAN 1.0% NICKEL CONTENT AND SHALL NOT INCLUDE HARDENABLE STEEL SUCH AS AISI – 4140
- 24: ALL WELDS MUST BE STRESS RELIEVED SO THAT WELD METAL, HEAT AFFECTED ZONE AND BASE METAL HAVE HARDNESS LESS THAN HRC 22
- 25: USE PTFE FILLED GASKETS WHERE LINE DESIGN TEMPERATURE FOR CONTINUOUS SERVICE IS BELOW -50°F (-46°C)
- 26: THE MATERIAL SHALL BE IMPACT TESTED FOR SERVICES LESS THAN -20 °F(-29 °C).
- 27: IN SPEC. E8, THICKNESS ARE BASED ON DESIGN PRESSURE OF 1580psig FOR FLOW LINES.
- 27: IN SPEC. F5 & G5, THICKNESS ARE BASED ON DESIGN PRESSURE OF 3500 psig FOR WELLHEAD PIPING.
- 28: **SPECIAL REQUIREMENTS FOR SOUR SERVICE:**
 - a) (S) DENOTES SOUR SERVICE. ALL MATERIALS TO NACE MR-01-75 (LATEST REVISION).
 - b) ALL WELDS MUST BE STRESS RELIEVED SO THAT WELD METAL, HEAT AFFECTED ZONE BASE METAL HAVE HARDNESS LESS THAN HRC 22.
 - c) CARBON STEEL AND LOW-ALLOY CARBON STEEL COMPONENTS SHALL HAVE A MAX. HARDNESS OF 235 BHN (HRC 22), SHALL NOT HAVE MORE THAN 1.0% NICKLE CONTENT AND SHALL INCLUDE HARDENABLE STEEL SUCH AS AISI-4140.
 - d) ALL VALVES WITH SOUR SERVICE SHALL BE SUPPLIED WITH CERTIFICATION FROM THE MANUFACTURER THAT COMPONENTS AND MANUFACTURING TECHNIQUES MEET THE REQUIREMENTS OF NACE MR-01-75 (LATEST REVISION) FOR SOUR SERVICE.
 - e) BOLTING WHICH IS BURIED, INSULATED, EQUIPED WITH FLANGE PROTECTORS SHALL BE ASTM A193-B7M WITH A194-2M NUTS.
 - f) BOLTING MATERIALS ON VALVES MUST BE ASTM A193-B7M.

CONSULTANT:

Zishan Engineers (Pvt.) Ltd.



X	DRAWN	CHECKED	APPROVED
NAME	HM/SMHA/ MMA /BS	MAH	MAS
DATE	16-02-2015	16-02-2015	16-02-2015

CLIENT : Oil & Gas Development Company Ltd.

SHEET : 43 OF 43

PIPING MATERIAL SPECIFICATION

JOB NO. 165-4

DESIGN CODE : ASME B.31.3

GENERAL NOTES REV. 14

ANNEXURE – I

VALVE SELECTION GUIDE

C O N T E N T S

<u>S. NO.</u>	<u>D E S C R I P T I O N</u>	<u>P A G E N O.</u>
1.0	GATE VALVE	03
2.0	GLOBE VALVE	09
3.0	CHECK VALVE	18
4.0	BALL VALVE	26
5.0	NEEDLE VALVE	39

1.0 **GATE VALVE**

1.1 **VG-101**

Gate valve with stem protector.

Rating: Class 800
 Ends: Socket weld
 Style: OS&Y, bolted bonnet, bolted gland, solid wedge, renewable seats.
 Operator: Handwheel
 Materials:
 Body: Forged Steel Bolting: Cadmium Plated
 Stem: Type 316 S.S. Packing: Mfr. Std.
 Seats: Type 316 S.S.
 Design and Test: API Std. 602

1.2 **VG-102**

Gate valve with stem protector.

Rating: Class 800
 Ends: Threaded
 Style: OS&Y, bolted bonnet, bolted gland, solid wedge, renewable seats.
 Operator: Handwheel
 Materials:
 Body: Forged Steel Bolting: Cadmium Plated
 Stem: 13% Cr. S.S. Packing: Mfr. Std.
 Seats: Hard Faced 13%
 Cr. S.S.
 Design and Test: API Std. 602

1.3 **VG-103**

Gate valve with stem protector.

Rating: Class 800 per API Std. 602
 Ends: Socket Weld per ANSI B16.11
 Style: OS&Y, bolted bonnet, bolted gland, solid wedge, renewable seats.
 Operator: Handwheel
 Materials:
 Body: Type 316 S.S. Bolting: Cadmium Plated
 Stem: Type 316 S.S. Packing: Mfr. Std.
 Seats: Type 316 S.S.
 Design and Test: API Std. 598

1.4 **VG-121**

Gate valve with stem protector.

Rating: Class 1500
 Ends: Socket weld
 Style: OS&Y, bolted bonnet, bolted gland, solid wedge, renewable seats.
 Operator: Handwheel
 Materials:
 Body: Forged Steel Bolting: Cadmium Plated
 Stem: Type 316 S.S. Packing: Mfr. Std.
 Seats: Type 316 S.S.
 Design and Test: API Std. 602

1.5 **VG-122**

Gate valve with stem protector.

Rating: Class 1500
 Ends: Threaded
 Style: OS&Y, bolted bonnet, bolted gland, solid wedge, renewable seats.
 Operator: Handwheel
 Materials:
 Body: Forged Steel Bolting: Cadmium Plated
 Stem: 13% Cr. S.S. Packing: Mfr. Std.
 Seats: Hard Faced 13%
 Cr. S.S.
 Design and Test: API Std. 602

1.6 **VG-123**

Gate valve with stem protector.

Rating: Class 1500 per API Std. 602
 Ends: Socket Weld per ANSI B16.11
 Style: OS&Y, bolted bonnet, bolted gland, solid wedge, renewable seats.
 Operator: Handwheel
 Materials:
 Body: Type 316 S.S. Bolting: Cadmium Plated
 Stem: Type 316 S.S. Packing: Mfr. Std.
 Seats: Type 316 S.S.
 Design and Test: API Std. 598

1.7 **VG-201**

Gate valve with stem protector.

Rating: Class 150
 Ends: Raised face flange.
 Style: OS&Y, bolted bonnet, bolted gland, solid wedge, renewable seats.
 Operator: Handwheel
 Materials:
 Body: Steel Bolting: Cadmium Plated
 Stem: 13% Cr. S.S. Packing: Mfr. Std.
 Seats: Hard Faced 13%
 Cr. S.S.
 Design and Test: API Std. 600

1.8 **VG-202**

Gate valve with stem protector.

Rating: Class 150
 Ends: Raised face flange.
 Style: OS&Y, bolted bonnet, bolted gland, solid wedge, renewable seats.
 Operator: Handwheel
 Materials:
 Body: Steel Bolting: Cadmium Plated
 Stem: Type 316 S.S. Packing: Mfr. Std.
 Seats: Type 316 S.S.
 Design and Test: API Std. 600

1.9 **VG-203**

Gate valve with stem protector.

Rating: Class 150
 Ends: Raised face flange.
 Style: OS&Y, bolted bonnet, bolted gland, solid wedge, renewable seats.
 Operator: Handwheel
 Materials:
 Body: Type 316 S.S. Bolting: Cadmium Plated
 Stem: Type 316 S.S. Packing: Mfr. Std.
 Seats: Type 316 S.S.
 Design and Test: API Std. 600

1.10 **VG-211**

Gate valve with stem protector.

Rating: Class 300
 Ends: Raised face flange.
 Style: OS&Y, bolted bonnet, bolted gland, solid wedge, renewable seats.
 Operator: Handwheel
 Materials:
 Body: Steel Bolting: Cadmium Plated
 Stem: 13% Cr. S.S. Packing: Mfr. Std.
 Seats: Hard Faced 13%
 Cr. S.S.
 Design and Test: API Std. 600

1.11 **VG-212**

Gate valve with stem protector.

Rating: Class 300
 Ends: Raised face flange.
 Style: OS&Y, bolted bonnet, bolted gland, solid wedge, renewable seats.
 Operator: Handwheel
 Materials:
 Body: Steel Bolting: Cadmium Plated
 Stem: Type 316 S.S. Packing: Mfr. Std.
 Seats: Type 316 S.S.
 Design and Test: API Std. 600

1.12 **VG-213**

Gate valve with stem protector.

Rating: Class 300
 Ends: Raised face flange.
 Style: OS&Y, bolted bonnet, bolted gland, solid wedge, renewable seats.
 Operator: Handwheel
 Materials:
 Body: Type 316 S.S. Bolting: Cadmium Plated
 Stem: Type 316 S.S. Packing: Mfr. Std.
 Seats: Type 316 S.S.
 Design and Test: API Std. 600

1.13 **VG-221**

Gate valve with stem protector.

Rating: Class 600
 Ends: Raised face flange.
 Style: OS&Y, bolted bonnet, bolted gland, solid wedge, renewable seats.
 Operator: Handwheel
 Materials:
 Body: Steel Bolting: Cadmium Plated
 Stem: 13% Cr. S.S. Packing: Mfr. Std.
 Seats: Hard Faced 13%
 Cr. S.S.
 Design and Test: API Std. 600

1.14 **VG-222**

Gate valve with stem protector.

Rating: Class 600
 Ends: Raised face flange.
 Style: OS&Y, bolted bonnet, bolted gland, solid wedge, renewable seats.
 Operator: Handwheel
 Materials:
 Body: Steel Bolting: Cadmium Plated
 Stem: Type 316 S.S. Packing: Mfr. Std.
 Seats: Type 316 S.S.
 Design and Test: API Std. 600

1.15 **VG-223**

Gate valve with stem protector.

Rating: Class 600
 Ends: Raised face flange.
 Style: OS&Y, bolted bonnet, bolted gland, solid wedge, renewable seats.
 Operator: Handwheel
 Materials:
 Body: Type 316 S.S. Bolting: Cadmium Plated
 Stem: Type 316 S.S. Packing: Mfr. Std.
 Seats: Type 316 S.S.
 Design and Test: API Std. 600

1.16 **VG-231**

Gate valve with stem protector.

Rating: Class 900
 Ends: RTJ.
 Style: OS&Y, bolted bonnet, bolted gland, solid wedge, renewable seats.
 Operator: Handwheel
 Materials:
 Body: Steel Bolting: Cadmium Plated
 Stem: 13% Cr. S.S. Packing: Mfr. Std.
 Seats: Hard Faced 13%
 Cr. S.S.
 Design and Test: API Std. 600

1.17 **VG-232**

Gate valve with stem protector.

Rating: Class 900
 Ends: RTJ.
 Style: OS&Y, bolted bonnet, bolted gland, solid wedge, renewable seats.
 Operator: Handwheel
 Materials:
 Body: Steel Bolting: Cadmium Plated
 Stem: Type 316 S.S. Packing: Mfr. Std.
 Seats: Type 316 S.S.
 Design and Test: API Std. 600

1.18 **VG-233**

Gate valve with stem protector.

Rating: Class 900
 Ends: RTJ.
 Style: OS&Y, bolted bonnet, bolted gland, solid wedge, renewable seats.
 Operator: Handwheel
 Materials:
 Body: Type 316 S.S. Bolting: Cadmium Plated
 Stem: Type 316 S.S. Packing: Mfr. Std.
 Seats: Type 316 S.S.
 Design and Test: API Std. 600

2.0 **GLOBE VALVE**

2.1 **VGL-101**

Globe valve with stem protector.

Rating: Class 800
 Ends: Socket weld
 Style: OS&Y, bolted bonnet, bolted gland, renewable seats.
 Operator: Handwheel
 Materials:
 Body: Steel Bolting: Cadmium Plated
 Stem: Type 316 S.S. Packing: Mfr. Std.
 Seats: Type 316 S.S. + Stellite 6
 Dimensions: Mfr. Std.
 Design and Test: MSS SP-84

2.2 **VGL-102**

Globe valve with stem protector.

Rating: Class 800
 Ends: Threaded
 Style: OS&Y, bolted bonnet, bolted gland, solid wedge, renewable seats, loose disc.
 Operator: Handwheel
 Materials:
 Body: Steel Bolting: Cadmium Plated
 Stem: 13% Cr. S.S. Packing: Mfr. Std.
 Seats: Hard Faced 13%
 Cr. S.S
 Dimensions: Mfr. Std.
 Design and Test: MSS SP-84

2.3 **VGL-103**

Globe Valve with stem protector

Rating: Class 800 #
 Ends: Socket Weld
 Style: OS&Y, bolted bonnet, bolted gland, renewable seats, loose disc.
 Operator: Handwheel
 Materials:
 Body: A182-F316 Packing: Mfr. Std.
 Stem: 13% Cr. S.S. Bolting: Cadmium Plated
 Seats: Hard Faced 13%
 Design and Test: MSS SP-84

2.4 VGL-121

Globe valve with stem protector.

Rating: Class 1500
 Ends: Socket weld
 Style: OS&Y, bolted bonnet, bolted gland, renewable seats.
 Operator: Handwheel
 Materials:
 Body: Steel Bolting: Cadmium Plated
 Stem: Type 316 S.S. Packing: Mfr. Std.
 Seats: Type 316 S.S. + Stellite 6
 Dimensions: Mfr. Std.
 Design and Test: MSS SP-84

2.5 VGL-122

Globe valve with stem protector.

Rating: Class 1500
 Ends: Threaded
 Style: OS&Y, bolted bonnet, bolted gland, solid wedge, renewable seats, loose disc.
 Operator: Handwheel
 Materials:
 Body: Steel Bolting: Cadmium Plated
 Stem: 13% Cr. S.S. Packing: Mfr. Std.
 Seats: Hard Faced 13%
 Cr. S.S.
 Dimensions: Mfr. Std.
 Design and Test: MSS SP-84

2.6 VGL-123

Globe Valve with stem protector

Rating: Class 1500 #
 Ends: Socket Weld
 Style: OS&Y, bolted bonnet, bolted gland, renewable seats, loose disc.
 Operator: Handwheel
 Materials:
 Body: A216 Gr WCB Packing: Mfr. Std.
 Stem: ASTM A 182 F 6 Bolting: Cadmium Plated
 Seats: A 105 N + Stellite GR.6
 Design and Test: MSS SP-84

2.10 VGL-203

Globe valve with stem protector.

Rating: Class 150
 Ends: Raised face flange.
 Style: OS&Y, bolted bonnet, bolted gland, renewable seats, loose disc.
 Operator: Handwheel
 Materials:
 Body: Duplex SS 22% Bolting: Cadmium Plated
 Stem: Duplex SS 22% Packing: Mfr. Std.
 Seats: Duplex SS 22%
 Design and Test: ANSI B16.34

2.11 VGL-204

Globe valve with stem protector.

Rating: Class 150
 Ends: Raised face flange.
 Style: OS&Y, bolted bonnet, bolted gland, renewable seats.
 Operator: Handwheel (Gear above 8")
 Materials:
 Body: A351 CF8M/CF3M Bolting: Cadmium Plated
 Stem: Type 316 S.S. Packing: Mfr. Std.
 Seats: Type 316 S.S.
 Design and Test: ANSI B16.34

2.12 VGL-211

Globe valve with stem protector.

Rating: Class 300
 Ends: Raised face flange.
 Style: OS&Y, bolted bonnet, bolted gland, renewable seats, loose disc.
 Operator: Handwheel
 Materials:
 Body: Steel Bolting: Cadmium Plated
 Stem: 13% Cr. S.S. Packing: Mfr. Std.
 Seats: Hard Faced 13%
 Cr. S.S.
 Design and Test: ANSI B16.34

2.13 **VGL-212**

Globe valve with stem protector.

Rating: Class 300
 Ends: Raised face flange.
 Style: OS&Y, bolted bonnet, bolted gland, renewable seats.
 Operator: Handwheel
 Materials:
 Body: Steel Bolting: Cadmium Plated
 Stem: Type 316 S.S. Packing: Mfr. Std.
 Seats: Type 316 S.S.
 Design and Test: ANSI B16.34

2.14 **VGL-213**

Globe valve with stem protector.

Rating: Class 300
 Ends: Raised face flange.
 Style: OS&Y, bolted bonnet, bolted gland, renewable seats.
 Operator: Handwheel
 Materials:
 Body: Duplex SS 22% Cr. Bolting: Cadmium Plated
 Stem: Duplex SS 22% Cr. Packing: Mfr. Std.
 Seats: Duplex SS 22% Cr.
 Design and Test: ANSI B16.34

2.15 **VGL-214**

Globe valve with stem protector.

Rating: Class 300
 Ends: Raised face flange.
 Style: OS&Y, bolted bonnet, bolted gland, renewable seats.
 Operator: Handwheel (Gear above 8")
 Materials:
 Body: A351 CF8M/CF3M Bolting: Cadmium Plated
 Stem: Type 316 S.S. Packing: Mfr. Std.
 Seats: Type 316 S.S.
 Design and Test: ANSI B16.34

2.19 VGL-224

Globe valve with stem protector.

Rating: Class 600
 Ends: Raised face flange.
 Style: OS&Y, bolted bonnet, bolted gland, renewable seats.
 Operator: Handwheel
 Materials:
 Body: A351 CF8M/CF3M Bolting: Cadmium Plated
 Stem: Type 316 S.S. Packing: Mfr. Std.
 Seats: Type 316 S.S.
 Design and Test: ANSI B16.34

2.20 VGL-231

Globe valve with stem protector.

Rating: Class 900
 Ends: RTJ
 Style: OS&Y, bolted bonnet, bolted gland, renewable seats, loose disc.
 Operator: Handwheel
 Materials:
 Body: Steel Bolting: Cadmium Plated
 Stem: 13% Cr. S.S. Packing: Mfr. Std.
 Seats: Hard Faced 13%
 Cr. S.S.
 Design and Test: ANSI B16.34

2.21 VGL-232

Globe valve with stem protector.

Rating: Class 900
 Ends: RTJ
 Style: OS&Y, bolted bonnet with pressure self-sealing, bolted gland, renewable seats.
 Operator: Handwheel (Gear for 4 inches & above)
 Materials:
 Body: Steel Bolting: Cadmium Plated
 Stem: Type 316 S.S. Packing: Mfr. Std.
 Seats: Type 316 S.S. + Stellite 6
 Design and Test: ANSI B16.34

2.22 VGL-233

Globe valve with stem protector.

Rating: Class 900
 Ends: RTJ
 Style: OS&Y, bolted bonnet, bolted gland, renewable seats, loose disc.
 Operator: Handwheel
 Materials:
 Body: Duplex SS 22% Cr. Bolting: Cadmium Plated
 Stem: Duplex SS 22% Cr. Packing: Mfr. Std.
 Seats: Duplex SS 22% Cr.
 Design and Test: ANSI B16.34

2.23 VGL-234

Globe Valve with stem protector

Rating : Class 900
 Ends: RTJ
 Style: OS&Y, bolted bonnet, bolted gland, renewable seats, loose disc.
 Operator: Handwheel
 Materials:
 Body: A216 Gr WCB Packing: Mfr. Std.
 Stem: ASTM A 182 F 6 Bolting: Cadmium Plated
 Seats: A 105 N + Stellite GR.6
 Design and Test: ANSI B16.34

2.24 VGL-235

Globe valve with stem protector.

Rating: Class 900
 Ends: Raised face flange.
 Style: OS&Y, bolted bonnet, bolted gland, renewable seats.
 Operator: Handwheel
 Materials:
 Body: A351 CF8M/CF3M Bolting: Cadmium Plated
 Stem: Type 316 S.S. Packing: Mfr. Std.
 Seats: Type 316 S.S.
 Design and Test: ANSI B16.34

2.25 VGL-243

Globe valve with stem protector.

Rating: Class 1500
 Ends: RTJ
 Style: OS&Y, bolted bonnet with pressure self-sealing, bolted gland, renewable seats, loose disc.
 Operator: Handwheel (Gear for 3 inches & above)
 Materials:
 Body: Duplex SS 22% Cr. Bolting: Cadmium Plated
 Stem: Duplex SS 22% Cr. Packing: Mfr. Std.
 Seats: Duplex SS 22% Cr. + Stellite 6
 Design and Test: ANSI B16.34

2.26 VGL-251

Globe valve with stem protector.

Rating: Class 2500
 Ends: RTJ
 Style: OS&Y, bolted bonnet, bolted gland, renewable seats, loose disc.
 Operator: Handwheel
 Materials:
 Body: Steel Bolting: Cadmium Plated
 Stem: 13% Cr. S.S. Packing: Mfr. Std.
 Seats: Hard Faced 13%
 Cr. S.S.
 Design and Test: ANSI B16.34

2.27 VGL-253

Globe valve with stem protector.

Rating: Class 2500
 Ends: RTJ
 Style: OS&Y, bolted bonnet with pressure self-sealing, bolted gland, renewable seats, loose disc.
 Operator: Handwheel (Gear for 3 inches & above)
 Materials:
 Body: Duplex SS 22% Cr. Bolting: Cadmium Plated
 Stem: Duplex SS 22% Cr. Packing: Mfr. Std.
 Seats: Duplex SS 22% Cr. + Stellite 6
 Design and Test: ANSI B16.34

3.9 **VC-203**

Rating: Class 150
 Ends: Raised face flange
 Style: Bolted bonnet, swing type, renewable seats
 Materials:
 Body: Duplex SS 22% Cr Bolting: Cadmium Plated
 Seats: Duplex SS 22% Cr Seals: Mfr. Std.
 Pin: Duplex SS 22% Cr Disc: Duplex SS 22% Cr
 Design and Test: ANSI B16.34

3.10 **VC-204**

Rating: Class 150
 Ends: Raised Face Flange
 Style: Wafer, dual plate, resilient seal
 Materials:
 Body: Duplex SS 22% Cr Bolting: Cadmium Plated
 Pin: Duplex SS 22% Cr Seals: Mfr. Std.
 Seats: Duplex SS 22% Cr Plate: Duplex SS 22% Cr
 Design and Test: API Std. 594

3.11 **VC-205**

Rating: Class 150
 Ends: Raised face flange
 Style: Bolted bonnet, swing type, renewable seats
 Materials:
 Body: Type 316 S.S. Bolting: Cadmium Plated
 Pin: Type 316 S.S. Seal: Mfr. Std.
 Seats: Type 316 S.S. Disc: Type 316 S.S.
 Design and Test: ANSI B16.34

3.12 **VC-211**

Rating: Class 300
 Ends: Raised face flange
 Style: Bolted bonnet, swing type, renewable seats
 Materials:
 Body: Steel Bolting: Cadmium Plated
 Pin: 13% Cr. S.S. Seal: Mfr. Std.
 Seats: Hard Faced 13%
 Cr. S.S. Disc: Steel
 Design and Test: ANSI B16.34

3.21 **VC-225**

Rating: Class 600
 Ends: Raised face flange
 Style: Bolted bonnet, swing type, renewable seats
 Materials:
 Body: Type 316 S.S. Bolting: Cadmium Plated
 Pin: Type 316 S.S. Seal: Mfr. Std.
 Seats: Type 316 S.S. Disc: Type 316 S.S.
 Design and Test: ANSI B16.34

3.22 **VC-231**

Rating: Class 900
 Ends: RTJ
 Style: Bolted bonnet, swing type, renewable seats
 Materials:
 Body: Steel Bolting: Cadmium Plated
 Pin: 13% Cr. S.S. Seal: Mfr. Std.
 Seats: Hard Faced 13% Cr. S.S. Disc: Steel
 Design and Test: ANSI B16.34

3.23 **VC-232**

Rating: Class 900
 Ends: RTJ
 Style: Bolted bonnet, non-slam, piston type, renewable seats
 Materials:
 Body: Steel Bolting: Cadmium Plated
 Seats: Type 316 S.S. + Stellite 6 Seals: Mfr. Std.
 Piston: Type 316 S.S.
 Design and Test: ANSI B16.34

3.24 **VC-233**

Rating: Class 900
 Ends: RTJ
 Style: Bolted bonnet, swing type, renewable seats
 Materials:
 Body: Duplex SS 22% Cr Bolting: Cadmium Plated
 Seats: Duplex SS 22% Cr Seals: Mfr. Std.
 Pin: Duplex SS 22% Cr Disc: Duplex SS 22% Cr
 Design and Test: ANSI B16.34

3.25 **VC-234**

Rating: Class 900
 Ends: RTJ
 Style: Wafer, dual plate, resilient seal
 Materials:
 Body: Duplex SS 22% Cr Bolting: Cadmium Plated
 Pin: Duplex SS 22% Cr Seals: Mfr. Std.
 Seats: Duplex SS 22% Cr Plate: Duplex SS 22% Cr
 Design and Test: API Std. 594

3.26 **VC-235**

Rating: Class 900
 Ends: RTJ
 Style: Bolted bonnet, swing type, renewable seats
 Materials:
 Body: Type 316 S.S. Bolting: Cadmium Plated
 Pin: Type 316 S.S. Seal: Mfr. Std.
 Seats: Type 316 S.S. Disc: Type 316 S.S.
 Design and Test: ANSI B16.34

3.27 **VC-236**

Rating: Class 900
 Ends: RTJ
 Style : Bolted bonnet, swing type, fire safe.seats, renewable seats.
 Materials:
 Body: A216 WCB Bolting: Cadmium Plated
 Pin: 13% Cr. Packing: Mfr. Std.
 Seats: A 105 N+Stellite GR 6 Disc: A216 WCB + A182 F6
 Design and Test: ANSI B16.34

3.28 **VC-243**

Rating: Class 1500
 Ends: RTJ
 Style: Bolted bonnet, swing type, renewable seats
 Materials:
 Body: Duplex SS 22% Cr Bolting: Cadmium Plated
 Seats: Duplex SS 22% Cr Seals: Mfr. Std.
 Pin: Duplex SS 22% Cr Disc: Duplex SS 22% Cr
 Design and Test: ANSI B16.34

3.29 **VC-244**

Rating: Class 1500
 Ends: RTJ
 Style: Wafer, dual plate, resilient seal
 Materials:
 Body: Duplex SS 22% Cr Bolting: Cadmium Plated
 Pin: Duplex SS 22% Cr Seals: Viton / PEEK
 Seats: Duplex SS 22% Cr Plate: Duplex SS 22% Cr
 Design and Test: API Std. 594

3.30 **VC-251**

Rating: Class 2500
 Ends: RTJ
 Style: Bolted bonnet, swing type, renewable seats
 Materials:
 Body: Steel Bolting: Cadmium Plated
 Pin: 13% Cr. S.S. Seal: Mfr. Std.
 Seats: Hard Faced 13% Cr. S.S. Disc: Steel
 Design and Test: ANSI B16.34

3.31 **VC-253**

Rating: Class 2500
 Ends: RTJ
 Style: Bolted bonnet, swing type, renewable seats
 Materials:
 Body: Duplex SS 22% Cr Bolting: Cadmium Plated
 Seats: Duplex SS 22% Cr Seals: Mfr. Std.
 Pin: Duplex SS 22% Cr Disc: Duplex SS 22% Cr
 Design and Test: ANSI B16.34

3.32 **VC-254**

Rating: Class 2500
 Ends: RTJ
 Style: Wafer, dual plate, resilient seal
 Materials:
 Body: Duplex SS 22% Cr Bolting: Cadmium Plated
 Pin: Duplex SS 22% Cr Seals: Viton / PEEK
 Seats: Duplex SS 22% Cr Plate: Duplex SS 22% Cr
 Design and Test: API Std. 594

4.4 **VB-104**

Rating: Class 800 (2000 psig @ 100°F – 1740 psig @ 350°F)
 Ends: Socket weld per ANSI B16.11
 Style: Bolted body, replaceable seats, full port.
 Operator: Lever
 Materials:
 Body: Type 316 SS Bolting: Cadmium Plated
 Stem: Type 316 SS Seal: PTFE
 Seats: PTFE Ball: 316 SS, Floating Ball
 Dimensions: Mfr. Std.
 Design and Test: ANSI B16.34

4.5 **VB-121**

Rating: Class 1500 (3750 psig @ 100°F – 3327 psig @ 350°F)
 Ends: Socket weld per ANSI B2.1
 Style: Bolted body, replaceable seats, full port.
 Operator: Lever
 Materials:
 Body: Steel Bolting: Cadmium Plated
 Stem: Type 316 S.S. Seal: Filled PTFE
 Seats: Filled PTFE Ball: 316 S.S.
 Dimensions: Mfr. Std.
 Test: API Std. 598

4.6 **VB-122**

Rating: Class 1500 (3750 psig @ 100°F – 3327 psig @ 350°F)
 Ends: Socket weld per ANSI B16.11
 Style: Bolted body, replaceable seats, regular port.
 Operator: Lever
 Materials:
 Body: Steel ASTM A350 LF2. Bolting: Cadmium Plated
 Stem: Type 316 S.S. Seal: Filled TFE.
 Seats: Filled TFE Ball: 316 S.S.
 Dimensions: Mfr. Std.
 Test: API Std. 598

4.7 **VB-123**

Rating: Class 1500 (3750 psig @ 100°F – 3327 psig @ 350 °F)
 Ends: Threaded per ANSI B2.1
 Style: Bolted body, replaceable seats, full port.
 Operator: Lever
 Materials:
 Body: Steel Bolting: Cadmium Plated
 Stem: 13% Cr. S.S. Seal: Filled TFE
 Seats: Filled TFE Ball: 13% Cr. S.S.
 Dimensions: Mfr. Std.
 Design and Test: ANSI B16.34

4.8 **VB-124**

Rating: Class 1500 (3750 psig @ 100°F – 3327 psig @ 350 °F)
 Ends: Socket weld per ANSI B16.11
 Style: Bolted body, replaceable seats, full port, fire safe
 Operator: Lever
 Materials:
 Body: Steel Bolting: Cadmium Plated
 Stem: 13% Cr. Seal: Filled PTFE
 Seats: Filled PTFE Ball: Chrome Plated Steel
 Design and Test: API Std. 598

4.9 **VB-125**

Rating: Class 1500 (2000 psig @ 100°F – 1740 psig @ 350 °F)
 Ends: Socket weld per ANSI B16.11
 Style: Bolted body, replaceable seats, full port.
 Operator: Lever
 Materials:
 Body: Type 316 SS Bolting: Cadmium Plated
 Stem: Type 316 SS Seal: PTFE
 Seats: PTFE Ball: 316 SS, Floating Ball
 Dimensions: Mfr. Std.
 Design and Test: ANSI B16.34

4.10 **VB-126**

Rating: Class 1500 (3750 psig @ 100°F – 3327 psig @ 350 °F)
 Ends: Socket weld per ANSI B2.1
 Style: Bolted body, replaceable seats, regular port.
 Operator: Lever
 Materials:
 Body: A182-F316 Bolting: Cadmium Plated
 Stem: Type 316 S.S. Seal: PTFE
 Seats: PTFE Ball: 316 S.S.
 Dimensions: Mfr. Std.
 Test: API Std. 598

4.11 **VB-201**

Rating: Class 150 (285 psig @ 100°F – 215 psig @ 350 °F)
 Ends: Raised face flange.
 Style: Bolted body, replaceable seats, regular port, trunnion mounted ball over 4 inch.
 Operator: Lever (Gear over 8’’)

Materials:	
Body: Steel	Bolting: Cadmium Plated
Stem: 13% Cr. S.S.	Seal: Filled TFE
Seats: Filled TFE	Ball: Chrome Plated Steel

 Design and Test: ANSI B16.34

4.12 **VB-202**

Rating: Class 150 (285 psig @ 100°F – 215 psig @ 350 °F)
 Ends: Raised face flange.
 Style: Bolted body, replaceable seats, regular port, trunnion mounted ball over 4 inch.
 Operator: Lever (Gear over 6’’)

Materials:	
Body: Steel	Bolting: Cadmium Plated
Stem: Type 316 S.S.	Seal: Filled TFE
Seats: Filled TFE	Ball: Type 316 S.S.

 Design and Test: ANSI B16.34

4.13 **VB-203**

Rating: Class 150 (285 psig @ 100°F – 215 psig @ 350 °F)
 Ends: Raised face flange.
 Style: Bolted body, replaceable seats, regular port, trunnion mounted ball over 4 inch.
 Operator: Lever (Gear over 8’’)

Materials:	
Body: Steel	Bolting: Cadmium Plated
Stem: Nickel Plated Steel	Seal: Filled TFE
Seats: Filled TFE	Ball: Nickel Plated Steel

 Design and Test: ANSI B16.34

4.14 **VB-204**

Rating: Class 150 (290 psig @ 100°F – 215 psig @ 350 °F)
 Ends: Raised face flange.
 Style: Bolted body, replaceable seats, regular port, trunnion mounted ball over 4 inch.
 Operator: Lever (Gear over 8’’)

Materials:	
Body: Duplex SS 22% Cr.	Bolting: Cadmium Plated
Stem: Duplex SS 22% Cr.	Seal: Filled TFE
Seats: Filled TFE	Ball: Duplex SS 22% Cr.

 Design and Test: ANSI B16.34

4.15 **VB-205**

Rating: Class 150 (290 psig @ 100°F – 215 psig @ 350°F)
 Ends: Raised face flange.
 Style: Bolted body, replaceable seats, full port, trunnion mounted ball over 4 inch.
 Operator: Lever (Gear over 8")
 Materials:
 Body: Duplex SS 22% Cr. Bolting: Cadmium Plated
 Stem: Duplex SS 22% Cr. Seal: Filled TFE
 Seats: Filled TFE Ball: Duplex SS 22% Cr.
 Design and Test: ANSI B16.34

4.16 **VB-206**

Rating: Class 150 (285 psig @ 100°F – 215 psig @ 350°F)
 Ends: Raised faced Flange.
 Style: Bolted body, replaceable seats, regular port, trunnion mounted ball over 4 inch.
 Operator: Lever (Gear over 6")
 Materials:
 Body: Type 316 S.S. Bolting: Cadmium Plated
 Stem: Type 316 S.S. Seal: Filled TFE.
 Seats: Filled TFE Ball: Type 304 S.S.
 Design and Test: ANSI B16.34

4.17 **VB-207**

Rating: Class 150 (285 psig @ 100°F – 215 psig @ 350°F)
 Ends: Raised face flange.
 Style: Bolted body, replaceable seats, full port, trunnion mounted ball over 4 inch.
 Operator: Lever (Gear over 8")
 Materials:
 Body: Steel Bolting: Cadmium Plated
 Stem: 13% Cr. S.S. Seal: Filled TFE
 Seats: Filled TFE Ball: Chrome Plated Steel
 Design and Test: ANSI B16.34

4.21 **VB-214**

Rating: Class 300 (740 psig @ 100°F – 640 psig @ 350°F)
 Ends: Raised face flange.
 Style: Bolted body, replaceable seats, regular port, trunnion mounted ball over 4 inch.
 Operator: Lever (Gear over 8")
 Materials:
 Body: Duplex SS 22% Cr. Bolting: Cadmium Plated
 Stem: Duplex SS 22% Cr. Seal: Filled TFE
 Seats: Filled TFE Ball: Duplex SS 22% Cr.
 Design and Test: ANSI B16.34

4.22 **VB-215**

Rating: Class 300 (740 psig @ 100°F – 640 psig @ 350°F)
 Ends: Raised face flange.
 Style: Bolted body, replaceable seats, full port, trunnion mounted ball over 4 inch.
 Operator: Lever (Gear over 8")
 Materials:
 Body: Duplex SS 22% Cr. Bolting: Cadmium Plated
 Stem: Duplex SS 22% Cr. Seal: Filled TFE
 Seats: Filled TFE Ball: Duplex SS 22% Cr.
 Design and Test: ANSI B16.34

4.23 **VB-216**

Rating: Class 300 (740 psig @ 100°F – 640 psig @ 350°F)
 Ends: Raised faced Flange.
 Style: Bolted body, replaceable seats, regular port, trunnion mounted ball over 4 inch.
 Operator: Lever (Gear over 6")
 Materials:
 Body: Type 316 S.S. Bolting: Cadmium Plated
 Stem: Type 316 S.S. Seal: Filled TFE.
 Seats: Filled TFE Ball: Type 304 S.S.
 Design and Test: ANSI B16.34

4.30 **VB-226**

Rating: Class 600 (1480 psig @ 100°F – 1280 psig @ 350°F)
 Ends: Raised faced Flange.
 Style: Bolted body, replaceable seats, regular port, trunnion mounted ball over 4 inch.
 Operator: Lever (Gear over 6")
 Materials:
 Body: Type 316 S.S. Bolting: Cadmium Plated
 Stem: Type 316 S.S. Seal: Filled TFE.
 Seats: Filled TFE Ball: Type 304 S.S.
 Design and Test: ANSI B16.34

4.31 **VB-227**

Rating: Class 600 (1480 psig @ 100°F – 1280 psig @ 350°F)
 Ends: Raised face flange.
 Style: Bolted body, replaceable seats, full port, trunnion mounted ball over 4 inch.
 Operator: Lever (Gear over 8")
 Materials:
 Body: Steel Bolting: Cadmium Plated
 Stem: 13% Cr. S.S. Seal: Filled TFE
 Seats: Filled TFE Ball: Chrome Plated Steel
 Design and Test: ANSI B16.34

4.32 **VB-231**

Rating: Class 900 (2220 psig @ 100°F – 1920 psig @ 350°F)
 Ends: RTJ.
 Style: Bolted body, replaceable seats, regular port, trunnion mounted ball over 4 inch.
 Operator: Lever (Gear over 8")
 Materials:
 Body: Steel Bolting: Cadmium Plated
 Stem: 13% Cr. S.S. Seal: Filled TFE
 Seats: Filled TFE Ball: Chrome Plated Steel
 Design and Test: ANSI B16.34

4.33 **VB-232**

Rating: Class 900 (2220 psig @ 100°F – 1920 psig @ 350 °F)
 Ends: RTJ.
 Style: Bolted body, replaceable seats, regular port, trunnion mounted ball
 2 inches & above.
 Operator: Lever (Gear for 4 inches & above)
 Materials:
 Body: Steel Bolting: Cadmium Plated
 Stem: Type 316 S.S. Seal: 316+Devlon V-API
 Seats: 316+Devlon V-API Ball: Type 316 S.S.
 Design and Test: ANSI B16.34

4.34 **VB-233**

Rating: Class 900 (2220 psig @ 100°F – 1920 psig @ 350 °F)
 Ends: RTJ.
 Style: Bolted body, replaceable seats, regular port, trunnion mounted ball
 over 4 inch.
 Operator: Lever (Gear over 8")
 Materials:
 Body: Steel Bolting: Cadmium Plated
 Stem: Nickel Plated Steel Seal: Filled TFE
 Seats: Filled TFE Ball: Nickel Plated Steel
 Design and Test: ANSI B16.34

4.35 **VB-234**

Rating: Class 900 (2220 psig @ 100°F – 1920 psig @ 350 °F)
 Ends: RTJ.
 Style: Bolted body, replaceable seats, regular port, trunnion mounted ball
 over 4 inch.
 Operator: Lever (Gear over 8")
 Materials:
 Body: Duplex SS 22% Cr. Bolting: Cadmium Plated
 Stem: Duplex SS 22% Cr. Seal: Filled TFE
 Seats: Filled TFE Ball: Duplex SS 22% Cr.
 Design and Test: ANSI B16.34

4.36 **VB-235**

Rating: Class 900 (2220 psig @ 100°F – 1920 psig @ 350 °F)
 Ends: RTJ.
 Style: Bolted body, replaceable seats, full port, trunnion mounted ball
 over 4 inch.
 Operator: Lever (Gear over 8")
 Materials:
 Body: Duplex SS 22% Cr. Bolting: Cadmium Plated
 Stem: Duplex SS 22% Cr. Seal: Filled TFE
 Seats: Filled TFE Ball: Duplex SS 22% Cr.
 Design and Test: API 6D & ANSI B16.34

4.37 **VB-236**

Rating: Class 900 (2220 psig @ 100°F – 1920 psig @ 350 °F)
 Ends: RTJ.
 Style: Bolted body, replaceable seats, regular port, trunnion mounted ball over 4 inch.
 Operator: Lever (Gear over 6’’)

Materials:

Body: Type 316 S.S.	Bolting: Cadmium Plated
Stem: Type 316 S.S.	Seal: Filled TFE.
Seats: Filled TFE	Ball: Type 304 S.S.

Design and Test: ANSI B16.34

4.38 **VB-237**

Rating: Class 900 (2220 psig @ 100°F – 1920 psig @ 350 °F)
 Ends: RTJ.
 Style: Bolted body, replaceable seats, full port, trunnion mounted ball over 4 inch.
 Operator: Lever (Gear over 8’’)

Materials:

Body: Steel	Bolting: Cadmium Plated
Stem: 13% Cr. S.S.	Seal: Filled TFE
Seats: Filled TFE	Ball: Chrome Plated Steel

Design and Test: ANSI B16.34

4.39 **VB-238**

Rating: Class 900 (2220 psig @ 100°F – 1920 psig @ 350 °F)
 Ends: RTJ.
 Style: Bolted Body, replaceable seats, regular port, Trunion mounted fire safe.
 Operator: Gear

Materials:

Body: Steel	Bolting: Cadmium Plated
Stem: 316 S.S.	Seal: 316+Devlon V-API
Seats: 316+Devlon V-API	Ball: 316 S.S.

Design and Test: API 6D & ANSI B16.34

4.40 **VB-239**

Rating: Class 900 (2220 psig @ 100°F – 1920 psig @ 350 °F)
 Ends: RTJ.
 Style: Bolted Body, replaceable seats, full port, Trunion mounted fire safe.
 Operator: Gear
 Materials:
 Body: Steel Bolting: Cadmium Plated
 Stem: 316 S.S. Seal: 316+Devlon
 Seats: 316+Devlon V-API Ball: 316 S.S.
 Design and Test: API 6D & ANSI B16.34

4.41 **VB-244**

Rating: Class 1500 (3720 psig @ 100°F – 3195 psig @ 350 °F)
 Ends: RTJ.
 Style: Bolted body, replaceable seats, regular port, trunnion mounted ball 2 inches & above.
 Operator: Lever (Gear for 3 inches & above)
 Materials:
 Body: Duplex SS 22% Cr. Bolting: Cadmium Plated
 Stem: Duplex SS 22% Cr. Seal: PEEK
 Seats: PEEK Ball: Duplex SS 22% Cr.

4.42 **VB-251**

Rating: Class 2500 (6140 psig @ 100°F – 5375 psig @ 350 °F)
 Ends: RTJ
 Style: Bolted body, replaceable seats, regular port, trunnion mounted ball over 4 inch.
 Operator: Lever (Gear over 8")
 Materials:
 Body: Steel Bolting: Cadmium Plated
 Stem: 13% Cr. S.S. Seal: Filled TFE
 Seats: Filled TFE Ball: Chrome Plated Steel
 Design and Test: ANSI B16.34

4.43 **VB-254**

Rating: Class 2500 (6220 psig @ 100°F – 5330 psig @ 350 °F)
 Ends: RTJ.
 Style: Bolted body, replaceable seats, regular port, trunnion mounted ball 2 inches & above.
 Operator: Lever (Gear for 3 inches & above)
 Materials:
 Body: Duplex SS 22% Cr. Bolting: Cadmium Plated
 Stem: Duplex SS 22% Cr. Seal: PEEK
 Seats: PEEK Ball: Duplex SS 22% Cr.

5.0 NEEDLE VALVE

5.1 VN-101

Needle valve with stem protector.

Rating:	Class 800		
Ends:	Socket weld per ANSI B16.11		
Style:	Bolted bonnet, Needle disc.		
Operator:	Handwheel		
Materials:			
	Body: Steel	Bolting:	Cadmium Plated
	Stem: Type 316 S.S	Packing:	Mfr. Std.
	Disc: Type 316 S.S		
Dimensions:	Mfr. Std.		
Design & Test:	ANSI B16.34		

5.2 VN-121

Needle valve with stem protector.

Rating:	Class 1500		
Ends:	Socket weld per ANSI B16.11		
Style:	Bolted bonnet, Needle disc.		
Operator:	Handwheel		
Materials:			
	Body: Steel	Bolting:	Cadmium Plated
	Stem: Type 316 S.S	Packing:	Mfr. Std.
	Disc: Type 316 S.S		
Dimensions:	Mfr. Std.		
Design & Test:	ANSI B16.34		

5.3 VN-151

Needle valve with stem protector.

Rating:	Class 6000		
Ends:	Socket weld per ANSI B16.11		
Style:	Bolted bonnet, Needle disc, Inconel UNS N06625.		
Operator:	Handwheel		
Materials:			
	Body: Steel	Bolting:	Cadmium Plated
	Stem: 13% Cr. S.S	Packing:	Mfr. Std.
	Disc: Inconel UNS N06625		
Dimensions:	Mfr. Std.		
Design & Test:	ANSI B16.34		

5.4 **VN-212**

Needle valve with stem protector.

Rating: Class 300
 Ends: RF
 Style: Bolted bonnet, Needle disc.
 Operator: Handwheel
 Materials:
 Body: Steel
 Stem: Type 316 S.S
 Disc: Type 316 S.S
 Dimensions: Mfr. Std.
 Design & Test: ANSI B16.34

Bolting: Cadmium Plated
 Packing: Mfr. Std.

5.5 **VN-222**

Needle valve with stem protector.

Rating: Class 600
 Ends: RF
 Style: Bolted bonnet, Needle disc.
 Operator: Handwheel
 Materials:
 Body: Steel
 Stem: Type 316 S.S
 Disc: Type 316 S.S
 Dimensions: Mfr. Std.
 Design & Test: ANSI B16.34

Bolting: Cadmium Plated
 Packing: Mfr. Std.

5.6 **VN-243**

Needle valve with stem protector.

Rating: Class 1500
 Ends: RTJ
 Style: Bolted bonnet, Needle disc, Inconel UNS N06625.
 Operator: Handwheel
 Materials:
 Body: Duplex SS 22% Cr.
 Stem: Duplex SS 22% Cr.
 Disc: Inconel UNS N06625
 Dimensions: Mfr. Std.
 Design & Test: ANSI B16.34

Bolting: Cadmium Plated
 Packing: Mfr. Std.

5.7 **VN-253**

Needle valve with stem protector.

Rating: Class 2500

Ends: RTJ

Style: Bolted bonnet, Needle disc, Inconel UNS N06625.

Operator: Handwheel

Materials:

Body: Duplex SS 22% Cr.

Bolting: Cadmium Plated

Stem: Duplex SS 22% Cr.

Packing: Mfr. Std.

Disc: Inconel UNS N06625

Dimensions: Mfr. Std.

Design & Test: ANSI B16.34



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OIL & GAS DEVELOPMENT COMPANY LTD.

SPECIFICATION FOR CENTRIFUGAL PUMPS



Rev.	Date	Description	Prepared By	Checked By	Approved By
1	08-06-12	Re-issued for Tender	MIAH	MAJ	MAS
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1.0 **INTRODUCTION**

1.1 **Scope**

This specification covers the minimum technical requirements for the design manufacture, supply, inspection, testing and commissioning of Centrifugal pumps

1.2 **Definitions**

Following definitions apply throughout this document:

- **COMPANY:** Oil & Gas Development Company Ltd. (OGDCL)
- **CONSULTANT:** M/s. Zishan Engineers (Pvt.) Ltd. (ZEL).
ZEL have been awarded the work of Engineering, Procurement Assistance and Project Management.
- **CONTRACTOR:** Means the construction company to be engaged by the COMPANY to perform the Construction work.
- **SUPPLIER/VENDOR:** The organization, firm or agency with who order for the supply of equipment and or material has been placed. SUPPLIER shall solely be responsible for the quality and satisfactory performance of all the items included in his scope of supply.

1.3 **Errors or Omissions**

1.3.1 The review and comment by the COMPANY of any SUPPLIER's drawings, procedures or documents shall only indicate acceptance of general requirements and shall not relieve the SUPPLIER of its obligations to comply with the requirements of this specification and other related parts of the Contract Documents.

1.3.2 Any errors or omissions noted by the SUPPLIER in this Specification shall be immediately brought to the attention of the COMPANY.

1.4 **Deviations**

All deviations to this Specification, other related specifications or attachments shall be brought to the knowledge of the COMPANY as a section in the bid. All deviations made during the procurement, design, manufacturing, testing and inspection shall be with written approval of the COMPANY prior to execution of Work. Such deviations shall be shown in the documentation prepared by the SUPPLIER.

1.5 **Conflicting Requirements**

In the event of any conflict, inconsistency or ambiguity between the SUPPLIER's scope of work, this Specification, National Codes and Standards, referenced in the Project Specification or any other documents, the SUPPLIER shall refer to the COMPANY whose decision shall prevail.

1.6 **Reporting Procedure**

1.6.1 A reporting and documentation system shall be agreed between the SUPPLIER and the COMPANY/ CONSULTANT for the status of procurement, design, manufacturing, inspection, testing and shipment of the equipment/material to be supplied under this specification. SUPPLIER shall provide reports and summaries for production performance and testing operations in conformance with a manufacturing schedule approved by COMPANY.

1.6.2 Daily, weekly, monthly and run summaries of all major aspects of the production process shall be provided as reports to the COMPANY/ CONSULTANT.

1.6.3 **Third Party Inspection**

In addition to the inspection and witnessing of tests by the inspectors to be appointed by the COMPANY during the manufacturing and shipment of the equipment/material, COMPANY may appoint a third party or its own inspector for witnessing of the inspection and tests to be carried out at SUPPLIER's facility under this specification.

1.7 **Unit Responsibility**

The SUPPLIER shall be responsible for the complete design, manufacture, supply, inspection and testing of the Centrifugal Pump units, including full compliance with all applicable design codes and standards, including those listed in Section 2.0 of this document and the requirements of the certifying authority, if applicable. The SUPPLIER shall handle and expedite drawings and data, and supervise and coordinate all inspection and testing.

SUPPLIER shall guarantee that all material and parts included in construction of the specified Centrifugal pump shall be new, unused and of the required/ specified grade.

1.8 **Documentation**

a) Documents, calculation sheets, drawings, etc., to be submitted to the COMPANY shall be in English Language.

- b) Unless otherwise specified, the metric units shall be used in documents and drawings, except that pipe sizes, flange sizes and bolts/nuts shall be indicated in inches.
- c) The form of drawings and documents may be as per the SUPPLIER's Standards. However, the format of the data sheet will be submitted to COMPANY for approval.
- d) Variations from or additions to this specification shall be called to the attention of the COMPANY and approved in writing by the COMPANY prior to starting fabrication.
- e) Information for installation, operating, maintenance or inspection purposes shall be submitted to COMPANY.

2.0 **CODES AND STANDARDS**

2.1 **Codes, Standards and Regulations**

The Centrifugal Pump(s) shall be designed, manufactured and tested in accordance with the requirements of this specification, other referenced Project Specifications and the Latest Editions of following Codes, Standards and Statutory Regulations (where applicable):

- API Standard 610 Centrifugal Pumps for General Refinery Services.
- API Standard 614 Lubrication, Shaft Sealing and Control Oil Systems for Special Purpose Applications
- API Standard 615 Sound Control of Mechanical Equipment for Refinery Services
- API Standard 670 Non-Contacting Vibration and Axial Position Monitoring Systems
- API Standard 678 Accelerometer Based Vibration and Axial Position Monitoring Systems.
- ASME VIII DIV I Pressure Vessels
- ANSI B.1.20. 1 Pipe Threads General Purpose (inch)
- ANSI B.16.5 Pipe Flanges and Flanged Fittings
- ANSI B.31.3 Petroleum Refinery Piping
- ISO Standard No.1940 Balance Quality of Rotating Rigid Bodies

2.2 In addition to the requirements of this General Specification, all requirements of the governing Statutory Authority, i.e., in the country and/or its subdivision where pumps are to be installed, shall be met.

2.3 **Project Specifications**

Piping Specification	165-4-SPM-046
Specification for Export Packing & Crating	165-4-SPM-031
Specification for Electrical Requirement for Packaged Equipments	165-4-SPE-009

3.0 **ENVIRONMENTAL DESIGN CRITERIA**

3.1 **General**

The design life of the equipment shall be 25 years minimum. Unless otherwise stated on the data sheets the centrifugal pump unit(s) will be located in an open exposed area.

3.2 **Area Classification**

The area classification for the Centrifugal Pump will be as indicated in datasheets for respective pumps.

3.3 **Environmental Data**

Environmental conditions for the equipment covered by this specification shall be in accordance with Specification 'Site, Environment & Utility Data' (165-4-SPG-011).

4.0 **TECHNICAL**

The SUPPLIER shall furnish the Centrifugal Pumps, controls, valves and auxiliaries in accordance with the requirements mentioned herein, in other project specifications and data sheets.

The SUPPLIER shall be directly responsible for ensuring the proper operation of any Sub-SUPPLIER ancillary equipment supplied with the equipment package. The SUPPLIER's on-site representative is expected to be fully knowledgeable of the equipment and shall be capable of trouble shooting and correcting problems should this equipment not perform per design specifications

4.1 **Drawings, Calculations and Documentation**

SUPPLIER shall provide all information specified in the Supplier Data Requirements Schedule supplied with the requisition documentation.

In addition, SUPPLIER shall provide a comprehensive Operations & Maintenance Manual to cover the entire supplied system. The manual will include but not limited to the following details:

- Detailed outline and cross-sectional drawings of Centrifugal Pump
- Name of Pump manufacturer and country of manufacturing
- Load data and Anchor bolt plan
- Anchor bolt sizes and location
- Itemized weights, including maintenance weights
- Shaft coupling assembly drawing with details of allowable misalignment tolerances style of coupling guard
- Primary and auxiliary sealing schematic
- Cooling schematic
- Lube oil schematic
- Lube oil system arrangement drawing including sizes and, ratings.
- Lube oil component drawings and data.
- Driver.
- Electrical and instrumentation schematics and list of components
- Performance curves.
- Materials of construction
- Noise levels
- Dimensional drawing of motor
- Name of motor manufacturer and country of manufacturing
- Motor performance data
- Motor hazardous area classification
- Motor start details
- Recommended method for starting motor driven pump
- Flexible coupling, complete with suitable guard (non-sparking).
- Inspection and test reports
- Spare parts suitable for two year's operation
- Maintenance schedules
- Overhaul/ Maintenance Spare parts
- Commissioning/ Start-up tools & spare parts
- Operation and maintenance manual of complete Centrifugal Pump
- Complete load data required for foundation and anchor bolts design
- Complete process and utility piping within the package
- Rigid Coupling
- All special tools required for maintenance of the pump unit.

SUPPLIER connection drawings complete with detailed nozzle schedule.

The assembly drawings shall contain all pertinent information relating to the standards, codes and specifications used in the design, manufacture, inspection and testing of the equipment, including the materials used, plus the total weight.

Review of drawings, calculations and other documents by the COMPANY does not relieve the SUPPLIER of his responsibility for the suitability of the design to suit the stated conditions.

4.2 **Motors**

SUPPLIER shall provide suitable motors as integral to the pump assembly and as per Specification for Motors '165-4-SPE-010'.

5.0 **DESIGN**

5.1 **General Design Specification**

5.1.1 Except where amended by this specification, the design of centrifugal pumps shall be in accordance with the requirements of API 610, Centrifugal Pumps for General Refinery Service.

5.1.2 For general service applications, where API 610 is not specifically requested, the SUPPLIER may offer his standard design for consideration, provided it is guaranteed for the specified duties and approved by the COMPANY. The rated capacity of the pump shall not be less than 80% and not greater than 110% of the capacity at the best efficiency point for optimum performance.

The following sections indicate amendments and additions to the various requirements of API 610 (1995) with the relevant paragraph numbers of that standard cross referenced in brackets, where appropriate. The SUPPLIER is to review the following amendments/additions in light of the latest edition of API 610.

5.2 (2.1) **General**

(2.1.3) **Addition**

The SUPPLIER shall not use impellers with vanes on the back for balancing axial thrust without specific approval by the COMPANY. Balancing of axial thrust shall be achieved by means of individually balanced impellers, opposed impeller arrangements or the use of balance pistons/drums. However, balance pistons shall not be used on applications involving the pumping of liquids containing abrasives.

(2.1.4) **Addition**

The NPSH required shall be at least 1.0 meter less than the NPSH available.

(2.1.7) **Amendment**

Pumps shall have stable head/capacity curves, which rise continuously to shut-off. The head rise shall be at least 10 per cent of the rated head.

(2.1.8) **Amendment**

Pumps with rated capacity to the right of the best efficiency point on the head/capacity curve are not acceptable.

5.3 (2.2) **General**

(2.2.2) **Addition**

The suction side of all pumps handling hydrocarbons shall be designed for the full discharge pressure unless otherwise approved.

(2.2.7) **Addition**

Radially split casings shall have confined solid metal, or confined spiral wound gaskets.

5.4 (2.3) **Nozzles and Pressure Casing Connections**

(2.3.2.1) **Amendment**

All pumps shall have suction and discharge flanges of the same pressure and temperature rating.

(2.3.2) **Addition**

Vertical pumps shall be supplied with flanged column pipes and, depending on the type of pump, either flanged and bolted bowls or a bolted casing assembly. Column and bowl bolting shall be corrosion resistant for the intended service.

5.5 (2.4) **External Forces and Moments**

(2.4.3) **Addition**

Pumps with nozzles NPS 16 and smaller in size, with casings constructed of steel or alloy steel, shall be capable of satisfactory operation when subjected to forces and moments.

5.6 (2.5) **General**

(2.5.3) **Addition**

Impellers shall have solid hubs.

(2.5.6) **Addition**

Shaft sleeves shall be coated with Colmonoy 6 or Stellite 6 over the seal contact area.

5.7 (2.7) **Seals**

(2.7.1.2) **Addition**

The pump SUPPLIER shall be responsible for the engineering and installation of the mechanical seal and its ancillary equipment.

(2.7.1.3) **Addition**

As a minimum requirement, the seal end plates shall be of the same material as the pump casing. Carbon steel gland plates shall be supplied with ductile iron pump casings (if approved by COMPANY). Any special material requirements will be specified on the pump data sheet.

(2.7.1.4) **Addition**

When recirculation to seal from pump discharge is required API Plan-I shall not be used.

All vertical pumps with mechanical seals shall be equipped with a vent connection and valve at the highest point of the seal space.

Pump for the service of LPG exporting shall have the double mechanical seal.

(2.7.2.1) **Addition**

Seal cages shall be equipped with tapped holes or other means to facilitate their removal. Pumps handling liquids containing abrasives shall have provision(s) for injection of a flushing liquid.

5.8 (2.8) **Dynamics**

(2.8.1.4) **Addition**

Single stage overhung horizontal pumps shall preferably be of stiff shaft construction with torsional and lateral critical speeds at least 20% above the maximum pump operating speed.

(2.8.1.5) **Addition**

When a torsional analysis is performed, a detailed report shall be provided to the COMPANY for approval.

(2.84.1) **Amendment (first sentence)**

The assembled rotor(s) shall be dynamically balanced.

Addition

Balancing shall be generally in accordance with the requirements of ISO 1940, Grade 6.3 (or equivalent)

5.9 (2.10) **Lubrication**

(2.10.3) **Addition**

The pressure lubrication system shall be in accordance with the requirements of API 614 (where applicable).

5.10 (2.11) **Materials**

(2.11.1.1) **Amendment**

Materials for pump parts shall be in accordance with those listed in Appendix E.

The SUPPLIER may propose equivalent or superior alternatives if, based on his experience, these would render equal or better service.

Supplementary acceptance criteria required by the COMPANY for individual components of the pump(s) shall be as specified in the purchase requisition and attachments.

(2.11.1.4) **Addition**

Cast Iron shall not be used for pressure containing parts without prior approval by the COMPANY.

(2.11.1.7) **Amendment**

The SUPPLIER shall provide material certificates giving chemical composition and mechanical data for pressure - containing parts and all main components of the pump.

(2.11.4) **Addition**

Materials, for pressure retaining parts for pumps in cold service, shall be as given in the following Table - 1:

TABLE – 1**Material for Pumps Casing for Cold Service**

Material	Min. Design Temperature °C	Impact Tested
A-352 LCB	0 to -46	Yes
A-352 LC2	-46 to -73	No
A-352 LC3	-73 to -100	No

The other parts of pump shall be in fully compliance of API 610

The bolts and nuts for the pumps shall be as given in following Table – 2

TABLE – 2**Material for Bolts and Nuts in Pumps for Cold Service**

Carbon Steel	Min. Design Temperature °C	Impact Tested
Bolts and Nuts	-100	SA 320 Gr. L7 and SA 194 Gr. 7 Cadmium Plated

5.11 (3.1) **Drivers**(3.1.1) **Addition**

Unless otherwise, approved drivers for pumps shall be mounted in the pump SUPPLIER's works, aligned and match marked.

For vertical pumps, SUPPLIER shall assemble and dowel motor or gear to the pump in its shop to assure proper unit fit-up and shaft mating.

(3.1.2) **Addition**

All electrical components, including electric motor drivers, shall be supplied in accordance with the requirements of the Project Specification for Electrical Equipment (165-4-SPE-001).

(3.1.7) Amendment

Solid shaft, vertical motors with integral support skirts suitable for spigot mounting direct to the pump casings or motor pedestals are preferred. The use of hollow shaft motors is not acceptable without prior approval by the Company.

5.12 (3.2) Couplings and Guards**(3.2.7) Amendment (first sentence)**

Couplings on pumps operating at speeds above 4000 rpm shall be dynamically balanced in accordance with ISO 1940 (or equivalent).

(3.2.13) Addition

Coupling guards shall meet all codes designated herein and any Government Statutory Requirements and shall be designed to permit ease of installation and removal. Coupling guards shall be constructed of non-sparking material. (Brass or equal, Aluminum is not permitted).

5.13 (3.3) Baseplates**(3.3.2.2) Amendment**

All vertical pumps, other than double case or canned type, shall be furnished with a separate sole plate by the SUPPLIER.

5.14 (3.5) Piping and Appurtenances**(3.5.1.1) Addition**

All ancillary pipe work and valves supplied with the pump(s) shall comply with the requirements of the Project Piping Specification (165-4-SPM-046).

Instrumentation shall conform to the requirements of the relevant sections of the Project Specification for Instrumentation (165-4-SPI-005).

(3.5.1.11) Amendment

Change "1/2" " to read "3/4" .

(3.5.4.3) **Amendment**

Sight flow indicators of the closed, 'see-through' type shall be furnished by the SUPPLIER in each cooling water return line.

5.15 (4.0) **Inspection, Testing and Preparation for Shipment**

(4.1) **General**

(4.1.3) **Addition**

Each individual pump of a series of identical units shall be inspected and tested. Random inspection and testing is not permitted.

(4.3) **Testing**

(4.3.2.1) **Addition**

All hydrostatic tests shall be carried out before any painting or preparation for painting is done.

(4.3.2.4) **Amendment (second sentence)**

The hydrostatic test shall be considered satisfactory when no casing or casing joint seepage or leaks are observed for a minimum of 60 minutes.

(4.3.3.1) **Amendment**

The SUPPLIER shall operate the pump in the shop for a minimum of 4 hours with a period at rated point of at least 1 hour. The test shall comprise at least five points of complete test data, including head, capacity and power with vibration measurements taken in accordance with paragraph 2.8.2.2. The data points shall normally be at shut off (zero flow), minimum continuous stable flow, midway between minimum and rated flows, rated flow and 110 per cent of rated flow.

(4.3.3.2) **Addition**

Test data shall be corrected for the speed, viscosity and specific gravity conditions specified on the data sheet, where appropriate.

(4.3.4.1) **Amendment (first sentence)**

NPSHR data shall be taken at four points as defined in 4.3.3.1 (excluding shut off) and presented as a curve on the test curves.

(4.3.4.1.2) Amendment (first sentence)

For multistage pumps, or other specified critical service units, a 1 percent drop in head shall determine the NPSH required.

Addition

No plus tolerance on NPSH required shall be permitted at the rated flow point.

(4.4) Preparation for Shipment**(4.4.3) Amendment**

After completion of all inspection and testing requirements, the equipment shall be prepared and painted in accordance with the requirements of the Project Specification for Painting and Surface Preparation (165-4-SPM-058). Additionally pump internals shall be drained and dried.

5.17 (6.0) Supplier's Data**Addition**

The SUPPLIER shall, in addition, furnish drawings and data in accordance with the requirements of the COMPANY's procurement documentation.

6.0 INSPECTION AND TESTING**6.1 General**

Inspection and testing shall be carried out at the SUPPLIER's works and shall be witnessed by the COMPANY representatives and/or certifying authority.

The responsibility for inspection rests with the SUPPLIER. However, the COMPANY and their authorized representative reserve the right to inspect the equipment at any time during manufacture to ensure that materials and workmanship are in accordance with this specification, other project specifications, the equipment data sheets and/or drawings.

The SUPPLIER shall provide a projected shop schedule with appropriate fabrication stages at the time drawings are submitted for approval, to highlight the inspection activity schedule.

The approval of any work by the COMPANY, or their authorized representative, shall in no way relieve the SUPPLIER of any responsibility for carrying out the provisions of this specification.

SUPPLIER shall submit the Performance Test report.

All pumps shall be inspected and tested in accordance with API Standard 610, Section 4, Inspection, testing and preparation for shipment.

The vibration data of pump unit to be taken during Performance Test of the package at rated speed and full capacity. SUPPLIER shall submit vibration data record along with complete spectrum trend.

Certified reports on in-plant tests run on the pump shall be submitted to the COMPANY, by the SUPPLIER for approval prior to shipment of the pumps.

6.2 **Testing**

The following tests shall be performed as a minimum:

- Hydrostatic test at 150 percent for design pressure.
- Performance test including a functional test of all controls, alarm and trips and electrical items shall be done in accordance to section 4.3.3 of API Standard 610.
- Complete unit test shall be done in accordance to section 4.3.4.2 of API Standard 610.
- Equipment noise measurement

Within 15 calendar days of the final successful tests, the SUPPLIER must send to COMPANY one (1) original, eight (8) hard and three (3) soft copies of all material and test certificates.

Hydrostatic tests shall be carried out in the presence of COMPANY representative and/or of the certifying authority, when applicable.

Hydrostatic testing shall be in accordance section 4.3.2.3 requirements of API Standard 610.

Fresh water only shall be used for testing. When testing items manufactured from stainless steel, the chloride ion content of the test water shall not exceed 30ppm.

During testing the temperature of the vessel and test water shall not be lower than 7°C and not more than 25°C.

Hydro test pressure shall be held for a minimum of 60 minutes, irrespective of design code requirements.

The complete alignment of the motor pump unit shall be ensured at the time of setting up by the Pump Manufacturer, assisted by the competent and responsible staff of the motor SUPPLIER.

6.3 **Reports and Acceptance Certificates**

Preliminary and final dossiers shall be prepared as described in the requisition document. Other relevant certificates shall also be provided together with equipment release note.

6.4 **Material Inspection**

The SUPPLIER shall provide the certification of materials such as mill test reports, for review of the COMPANY. Material test reports shall demonstrate the compliance of the material specifications. Any non-compliance, not previously approved by the COMPANY, shall be at the risk of the SUPPLIER.

Radiographic, ultrasonic, magnetic particle or liquid penetrant inspection of weld or material shall comply with section 4.2.2 of API Standard 610.

6.5 **Mechanical Inspection**

COMPANY may inspect the equipment and all piping and appurtenances before assembly. Hardness of parts, welds and heat-affected zones shall be verified, as being within the allowable values, by testing. Results shall be submitted to the COMPANY. Mechanical inspection by COMPANY shall comply with Section 4.2.3 of API Std. 610.

6.6 **Sound Level Test**

Test shall be performed according to section 4.3.4.3 of API Standard 610.

6.7 **NPSHR Test**

Test shall comply with section 4.3.4.1 of API Standard 610.

6.8 **Auxiliary Equipment test.**

Auxiliary system including control system shall be tested in Pump Manufacturer's shop with section 4.3.4.4 of API Standard 610.

6.9 **Bearing Housing Resonance Test**

Bearing housing resonance test shall be carried out in accordance with the requirement of section 4.3.4.5 of API 610.

7.0 **MARKING**

Stainless steel marking shall be permanently affixed to the each pump. The marking for the motor shall contain the minimum data specified in the motor specification. Marking for pumps shall contain the following data:

7.1 **Pumps**

- Name of manufacturer:
- Date of manufacturer:
- Model No:
- Equipment Tag No.:
- Body material:
- Design code:
- Pressure rating:
- Capacity:
- Pump head
- Casing hydrostatic test pressure.
- Horse Power
- Speed
- Weight of Skid
- Pump Serial No.:
- Fluid Viscosity:
- Rated Temperature:
- Fluid Specific Gravity:

Direction of rotation shall be affixed at a visible place on the pump.

8.0 **PAINTING AND SURFACE PREPARATION**

Internal and external surfaces shall be cleaned to remove all scale, rust, grease, dirt, weld spatter and foreign objects. The painting shall be under taken only when all the tests have been performed and accepted.

The painting will consists of:

- Careful cleaning and degreasing.
- The painting will consists of appropriate coating system, which shall be specified by Pump Manufacturer / Supplier.
- Painting shall be according to the General Specification for Painting and Surface Preparation (165-4-SPM-058).

9.0 **PREPARATION FOR SHIPMENT**

After the final test, the unit shall be dried and cleaned thoroughly of all grease, loose scale, and rust (both internally and externally). The preparation for shipment shall meet the requirement as detailed in Specification for Export Crating and Packaging (165-4-SPM-031).

9.1 **Preparation for Shipment**

- Each pump and its component shall be shipped in the same consignment.
- All openings such as nozzles, vents and field connections shall be properly sealed to avoid entrance of foreign particles and protected during shipment.
- All fragile items shall be removed and crated in rigid packing crates with sufficient padding to prevent damage during shipment and shall be properly tagged for ease of field installation.
- The SUPPLIER shall provide corrosion protection for all internal and external machine parts for sea shipment and six months outdoor storage and which can be easily removable at site.
- The water-tested parts, which are likely to contain residual water shall be properly drained and dried, so that the damage of the same by freezing during transportation and storage can be avoided.

9.2 **Operating and Maintenance Manuals**

- Five (5) sets of operating and maintenance manuals from the original equipment manual shall be provided to enable the COMPANY to install, operate and maintain the complete equipment ordered.
- The information and material supplied shall pertain directly to the unit purchased. Generalized or typical material shall not be included.

9.3 **Spare Parts**

The SUPPLIER shall submit a priced list of recommended two years spare parts with his commercial bid. This list shall include original manufacturer and local representative name, address and phone number for each item.

10.0 **GUARANTEE & WARRANTY**

The warranty shall be for a period of 12 months from date of initial commissioning or for a period of not less than 18 months from the date of shipment/dispatch, whichever is earlier. The SUPPLIER will warrant the equipment to be free of defects in material and workmanship, and that it is of adequate size and capability to fulfill the design and operating conditions specified herein. The SUPPLIER shall replace and install, without cost to the Company, any materials, supplies, or equipment, which fails under design conditions due to defects in material or workmanship. If the defect is observed and/or such failure occurs within warranty. Acceptance of this order will signify acceptance of all conditions of this warranty.

The SUPPLIER shall guarantee that the system provided meets the requirements of the functional performance of this specification, other project specifications, data sheets and P & IDs.

All equipment shall be guaranteed as follows:

- All equipment shall perform satisfactorily under the specific operating conditions as detailed on the data sheet and shall be fit for the intended purpose.
- Tests shall confirm the SUPPLIER's guaranteed performance.

The SUPPLIER shall guarantee the mechanical and structural integrity, workmanship and the materials of construction used in accordance with the requisition and requirements of this specification.



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1.0 **INTRODUCTION**

1.1 **Scope**

This specification covers the minimum requirements for the manufacture, supply and installation of insulation for piping and equipment.

1.2 **Definitions**

Following definitions apply throughout this document:

- **COMPANY:** Oil & Gas Development Company Ltd. (OGDCL)
- **CONSULTANT:** M/s. Zishan Engineers (Pvt.) Ltd. (ZEL).
ZEL have been awarded the work of Engineering, Procurement Assistance and Project Management.
- **CONTRACTOR:** Means the construction company to be engaged by the COMPANY to perform the Construction work.
- **SUPPLIER:** The organization, firm or agency with whom order for the supply of equipment and or material has been placed. Supplier shall be solely responsible for the quality and satisfactory performance of all the items included in his scope of supply.

1.3 **Errors or Omissions**

- 1.3.1 The review and comment by the COMPANY of any CONTRACTOR's or its SUPPLIER's drawings, procedures or documents shall only indicate acceptance of general requirements and shall not relieve the CONTRACTOR/SUPPLIER of its obligations to comply with the requirements of this specification and other related parts of the Contract Documents.
- 1.3.2 Any errors or omissions noted by the CONTRACTOR/SUPPLIER in this Specification shall be immediately brought to the attention of the COMPANY.

1.4 **Deviations**

All deviations from the requirement of this specification, its attachment and the referenced codes and standards shall be stated in the Tender. In the absence of such a statement, full compliance will be assumed.

Compliance by the CONTRACTOR/SUPPLIER with the provisions of this specification does not relieve him of his responsibility to furnish equipment and accessories of a proper mechanical design suited to meet the specified service conditions and/or local codes governing health and safety

1.5 **Conflicting Requirements**

In the event of any conflict, inconsistency or ambiguity between the Contract scope of work, this Specification, National Codes and Standards referenced in this Specification or any other documents, the CONTRACTOR/SUPPLIER shall refer to the COMPANY whose decision shall prevail.

1.6 **Work Procedure**

1.6.1 The CONTRACTOR/SUPPLIER shall submit for approval to the COMPANY detailed procedures for:

- a) Surface cleaning / preparation
- b) Paint material storage and preparation procedure
- c) Primer application
- d) Intermediate and finish coat application
- e) Inspection and data recording procedures
- f) Paint repair procedure
- g) Painted equipment/material transportation, storage and handling procedure
- h) Type of abrasive to be used

The above procedure shall include the application equipment/tools. All procedures shall meet the minimum requirement stated in this specification.

1.6.2 Material specification for the cleaning and painting, and mixing materials, shall be submitted to the COMPANY for approval. Detailed supplier's/manufacturer's data shall be submitted with these specification. Material shall not be procured prior to approval of the COMPANY.

2.0 **CODES AND STANDARDS**

2.1 **Codes, Standards and Regulations**

All insulation material, installation and inspection shall, as a minimum, comply with the requirements of this specification, its attachments and the latest editions of following Codes, Standards and Regulations (where applicable):

BS 874	Methods for determining insulating properties with definitions of thermal insulating terms.
BS 5422	Specification for the use of thermal insulating materials.
BS 5970	Thermal insulation of Pipework and Equipment

CONTRACTOR/SUPPLIER may offer insulation supplied in accordance with other Codes and Standards provided that they are equal to the above and that COMPANY gives full approval prior to commencement of work.

3.0 **SCOPE OF SUPPLY**

3.1 **General**

3.1.1 This Specification covers the minimum requirements for the supply and installation of all elevated and low temperature insulation and shall be adhered to in all respects unless deviations are specifically noted on the procurement documentation or agreed and approved in writing by the COMPANY.

3.1.2 CONTRACTOR/SUPPLIER to provide insulation supports and rings.

3.1.3 CONTRACTOR/SUPPLIER shall start insulation job on piping and equipment after issuance of clearance certificate. COMPANY shall issue the clearance certificate after completion of successful testing, treatment, cleaning/flushing and painting.

3.2 **Scope of Supply**

3.2.1 CONTRACTOR/SUPPLIER to provide all required facilities for the supply and installation of the works. This shall include, but not necessarily be limited to, all categories of labor, supervisory and administrative staff, materials, equipment, scaffolding, tools, buildings, transportation and other services as necessary to complete the installation in accordance with the project schedule.

3.2.2 The CONTRACTOR/SUPPLIER shall be responsible for the material take-off for insulation.

- 3.2.3 The CONTRACTOR/SUPPLIER shall submit details of the intended method of application, fabrication and installation, including expansion and contraction joints, to COMPANY for approval.
- 3.2.4 Provision shall be made for the acceptance, dry storage, control and issue of materials delivered to the job site.
- 3.2.5 Site cleanliness, with regard to insulation materials and work shall be ensured by regular cleaning of work areas, particularly if so requested by the COMPANY'S representative. Areas allocated for temporary storage, buildings and work areas shall be cleared to the COMPANY'S satisfaction on completion of the work.
- 3.2.6 CONTRACTOR/SUPPLIER to clear the surfaces in order to remove all oil and dirt deposits prior to insulation.
- 3.2.7 Insulation shall be kept completely dry prior to completion of the specified permanent weather barrier. If insulation should become wet or stained, it shall be removed and replaced by dry material and all costs for replacement shall be the responsibility of the CONTRACTOR/SUPPLIER.

3.3 **Materials, Workmanship and Suitability**

- 3.3.1 All materials shall be new and of the best quality. The quality and workmanship shall conform to the Codes and Standards listed in Section 2.0.
- 3.3.2 All deviations to this specification or Codes and Standards listed in Section 2.0 shall be brought to the knowledge of the COMPANY as a section in the bid. All deviations made during the procurement, design, manufacturing and inspection shall be with written approval of the COMPANY prior to execution of the work. Such deviations shall be shown in the documentation prepared by the CONTRACTOR/SUPPLIER.
- 3.3.3 Any work or material found to be defective or which does not meet the requirements of this Specification shall be replaced by the CONTRACTOR/SUPPLIER at his own expense.
- 3.3.4 Equipment, structures and piping etc., shall be protected from splashing and debris of materials. Items damaged shall be repaired and cleaned at the CONTRACTOR / SUPPLIER's cost, to the COMPANY's satisfaction.

4.0 **DESIGN**

- 4.1 For personnel protection, all metallic surfaces, which could be contacted in the course of normal operating duties, where the design temperature (hot or cold) is excessive, shall be insulated or otherwise guarded or screened as specified in Section 7.0.
- 4.2 Tables I and II give typical thicknesses of hot insulation for various ranges of operating temperature; these thicknesses do not include the finishing, the insulating effect of which is neglected. If significant differences in 'K' values are used, the thicknesses shall be adjusted accordingly. Table II thicknesses are to be used when personnel protection is the only criterion for the provision of insulation.
- 4.3 Piping and Equipment shall be insulated for heat conservation or process control.
- 4.4 Insulation materials and accessories shall be packed in substantial shipping containers, which shall be constructed so as to ensure safe delivery and handling of materials in a condition to the satisfaction of the COMPANY.
- 4.5 All containers shall be legibly marked with the name of the Manufacturer, insulation class, size, type, density, quantity contained and gross weight in kilograms.
- 4.6 Where stainless steel piping or equipment is to be insulated, the material shall be protected from stress corrosion cracking. Prior to application of the insulation, the CONTRACTOR/SUPPLIER shall completely shield the stainless steel from the insulation.
- 4.7 The use of dissimilar materials subject to corrosion as a result of Electrolytic action is not permitted.
- 4.8 The cutting of insulation and cladding around protrusions and pipe supports, or the shaping required for closely adjacent piping and equipment shall be considered normal practice within the CONTRACTOR's /SUPPLIER's prices and/or unit rates.
- 4.9 Where supports, other than those provided on equipment, are required for the correct installation of insulation, such supports shall be supplied and fitted by the CONTRACTOR/SUPPLIER, at his own cost, after obtaining approval in writing from the COMPANY. The CONTRACTOR/SUPPLIER shall provide proposals for such supports prior to installation.
- 4.10 Support rings for vertical piping runs shall be supplied by the CONTRACTOR/SUPPLIER and shall be of bolted construction.
- 4.11 Provision shall be made for expansion and contraction of piping and equipment in the insulation system.

- 4.12 Insulation support rings and vessel stiffening rings shall be fully insulated and clad so that they will accommodate vertical and circumferential expansion, where applicable.
- 4.13 All name-plates on insulated equipment shall remain visible without impairing the weathering protection of the insulation.
- 4.14 Unless otherwise agreed, pipe bends exposed to the weather shall be covered by segmental cladding having either swaged joints or a sufficient overlap to exclude moisture. Particular attention shall be paid to the overlapping and sealing where the bend and straight pipe adjoin.
- 4.15 Provision shall be made to prevent seepage of water down pipe hangers and on to the insulation.
- 4.16 On vertical exchangers and pipework, flashing and sealing shall be incorporated to prevent leakage at joints penetrating the insulation, Particular attention shall be paid to effective sealing around nozzles, etc. The CONTRACTOR/SUPPLIER shall ensure that no sharp corners are left and that exposed cut edges are folded.

5.0 **INSPECTION**

The COMPANY'S Inspector shall have the right to inspect all work and materials on site or at the Contractor's works. Such inspection shall not relieve the CONTRACTOR/SUPPLIER from full responsibility for the quality and correctness of the materials or work.

6.0 **APPLICATION REQUIREMENTS: HEAT CONSERVATION – CLASS H**

6.1 **Application to Piping and Equipment.**

- 6.1.1 Fittings, flange and valve insulation covers shall be fabricated from the same material and insulation thickness as specified for the adjacent piping. The covers shall be of the two-piece removable type (except as specified in 6.1.18), and shall be secured with the required specified bands and seals.
- 6.1.2 Valves and flanges shall not be insulated until permission is obtained from the COMPANY'S representative.
- 6.1.3 The insulation of bends and fittings shall be continuous from the adjacent pipe. Erection of metal elbows etc., and filling the void between cladding and pipe with loose insulation is permitted.
- 6.1.4 On vertical insulated pipe, the CONTRACTOR/SUPPLIER shall supply and install insulation supports at 3700 mm pitch. Welding is not permitted on any lines or equipment. Tee branches and pipe support brackets may be utilized as insulation supports.

- 6.1.5 Supports on tanks and vessels should be spaced to suit the insulation but in no case should exceed 3700 mm vertical pitch and should be an integral part of the equipment as delivered.
- 6.1.6 The insulation on vertical tanks shall terminate at 100 to 150 mm above the bottom of the tank shell and 75 to 100 mm above the wind girder. Adequate means of support for the insulation materials shall be provided.
- 6.1.7 Electrical tracing will be installed and tested by the CONTRACTOR/SUPPLIER before insulation. The extent of Electrical tracing shall be as indicated on the isometrics.
- 6.1.8 Suitably oversized insulation material shall be used on traced services to ensure that no burying of the tracer occurs in the insulation. A layer of 0.06 mm aluminium foil shall be applied to the line prior to the application of the insulation.
- 6.1.9 Unless otherwise noted, insulation shall not normally be applied to fans, compressors, pumps and other rotating equipment, valves and flanges, vessel manway covers, nozzles and flanges on equipment.
- The exception to this shall be:
- a) Heat traced lines and equipment.
 - b) Where operating temperature exceeds 95°C
- 6.1.10 Bonnet and channel flanges on heat exchangers shall be insulated by means of a removable double skin box. On large exchangers boxes shall be in two or more parts and no part shall weigh more than 25 kg.
- 6.1.11 For heat exchangers in CO₂ service the tube sheet and channel flanges shall not be instated, but a simple removable galvanized sheet metal protecting shroud shall be placed over the bolts to protect them from the effect of thermal shock from rain storms. A suitable gap should be left between the bolts and the shroud to allow adequate ventilation.
- 6.1.12 The insulation surrounding equipment nameplates which indicate design and/or operating data shall be neatly trimmed and sealed so that the nameplates are clearly visible.
- 6.1.13 For the purpose of taking shell or pipe thickness measurements a removable section of insulation shall be provided as and where indicated by the COMPANY'S Inspector. The CONTRACTOR/SUPPLIER shall supply design details for approval

6.1.14 Single layer insulation shall be applied to pipe and vessels with lateral joints in a staggered arrangement. All joints shall be tightly butted and fitted together so as to eliminate voids. Large voids shall be eliminated by refitting or replacing insulation. Additional layers of pipe insulation, where required, shall be applied in the same manner as the first layer, with lateral and end joints staggered over the preceding layer so that no joints coincide, except where they cross at right angles. The outer layer of insulation shall be secured with specified bands and seals on approximately 600 mm centers. Inside layers shall be secured with wire on approximately 600 mm centers. With double layer insulation, the thickness of any single layer shall not exceed 50mm.

6.1.15 Where flanges or flanged fittings are not being insulated, the insulation shall be cut to a 45 bevel and sealed to the pipe adjacent to each side of the flange or flanged fittings to allow bolt removal without damaging the insulation.

6.1.16 Expansion joints shall be installed in insulation for horizontal and vertical straight run piping and vessels in increments of not more than 12 metres. When flanged fittings or valves are installed within this limit, the joint shall be provided for in flange or valve cover only.

Expansion joints shall have a 12 mm space between adjoining pipe insulation sections. Insulation cover over the joint shall be of a specified thickness of insulation and shall extend one and one-half times the insulation thickness on each side of the 12 mm space.

6.1.17 Specified sheet cladding shall be applied over all pipe and vessel insulation. The cladding shall be installed with seams and laps arranged to shed water. The cladding on vessels shall be secured with specified bands on 1000 mm centers and hardened steel screws on ISO mm centers. Pipe cladding shall be secured with hardened screws on 150 mm centers. All-joints in the cladding shall have an overlap of 50 mm minimum and shall be sealed with non-setting mastic.

On vertical piping and vessels the cladding shall be supported with 50 mm 'S' clips secured to the next lower section. The 'S' clips shall be made from the specified banding. Cladding shall not be installed over any insulation that is not thoroughly dry. Spring buckles or bands which will allow for expansion shall be used on vessels where necessary.

6.1.8 Polyvinyl acetate weather-barrier coating may be applied to insulated surfaces of screwed or socket weld valves in preference to cladding.

The surface of insulation shall receive an adhesive coat of polyvinyl acetate mastic. While still tacky, glass reinforcing cloth per clause 6.2.5 shall be stretched taut and thoroughly embedded in the coating, care being exercised that the weave is not stretched and that the cloth is overlapping approximately 40 mm. Before the surface becomes dry to touch, a second coating shall be applied and allowed to dry. Total dry thickness of coating shall be 3.5 mm minimum.

Cloth shall not be visible on the finished surface. Weather coating shall extend 75 mm under cladding adjacent to fittings prior to application of the galvanized sheet cladding.

All sharp corners of insulation shall be rounded and the weather coating provided with a double layer of reinforcing cloth.

Coating shall not be applied when the atmospheric temperature is such that condensation of moisture and ultimate freezing may occur on the finished surface within 24 hours from time of application. Polyvinyl acetate weather-coating shall not be thinned with water.

6.2 Materials for Hot Services

6.2.1 Insulation – Class H

<u>Material</u>	<u>Temp. Range</u>	<u>Application</u>
Mineral Wool preformed Section (100 kg/m ³)	Up to 350°C	Piping and Equipment below 36" OD
Mineral Wool slabs (65-80 kg/m ³)	Up to 350°C	Equipment above 36" OD
Mineral Wool sections slabs, (144 kg/m ³)	Up to 650°C	Equipment and Piping
Mineral Wool wired blanket (90 kg/m ³)	Up to 450°C	Removable boxes Equip. and irregular surfaces
Mineral Wool wired blanket (48 kg/m ³)	Up to 50°C	Irregular surfaces
Mineral Wool slabs (48 kg/m ³)	Up to 250°C	Rectangular Equip.

6.2.2 Insulation Securement – Class H

<u>Material</u>	<u>Spacing</u>	<u>Application</u>
1.6mm Soft Annealed Stainless Steel Wire	600mm	Equipment and Piping upto 1500mm OD Inner Layer
12mm Wide by 0.5m Stainless Steel - Type 316 Bonding	600mm	Equipment and Piping 250mm OD to 600mm OD
18mm Wide by 0.5m Stainless Steel - Type 316 Bonding	600mm	Equipment and Piping above 600mm OD upto 1500mm OD
25mm Wide by 0.5m Stainless Steel - Type 316 Bonding	600mm	Equipment above 1500mm OD
9mm dia. weld pins and self adhesive double prong clips	As necessary	Irregular surfaces or as required

6.2.3 Insulation Cladding – Class H

<u>Material</u>	<u>Application</u>
Stainless steel Type 316 Sheet 0.5mm thick.	Piping and Equipment upto 300mm OD
Stainless steel Type 316 Sheet 0.5mm	Piping and Equipment 350mm to 1500mm OD
Corrugated stainless steel Type 316 Sheet	Equipment above 1500mm OD

6.2.4 Cladding Securement – Class H

<u>Material</u>	<u>Spacing</u>	<u>Application</u>
12mm × No. 10 hardened steel self tapping screws, cadmium plated.	150mm	Equipment and Piping
Stainless Steel Type 316 Banding 12mm wide × 0.5mm thick.	1000mm	Equipment and Piping above 300mm OD TO 1500mm OD
Stainless steel Type 316 Banding 25mm wide × 0.5 thick	1500mm	Equipment and Piping above 1500mm Od

6.2.5 Coating and Mastics – Class H

Material

Flare resistive mastic and glass cloth, natural or impregnated with material compatible with the mastic

Non Setting Mastic

Sealing Mastics

Application

Piping insulation terminations at flanges and valves etc.
Insulation finish on horizontal equipment heads, screwed and socket weld fittings

Sealing against water ingress on removal items

Sealing against water ingress of sheeting joints/laps/cutouts, etc.

TABLE – I
TYPICAL ECONOMIC THICKNESS FOR HOT INSULATION MATERIAL
HEAT CONSERVATION - CLASS H

Thickness of Insulation mm at Hot Face Temperature (°C)

Nominal Dimensions of Pipe mm (in)	Up to 100	150	200	250	300	350	400	450	500	550	600	650
25 (1)	40	50	50	63	63	75	75	75	88	88	100	100
40 (1½)	40	50	63	63	63	88	88	88	100	100	113	113
50 (2)	40	50	63	63	63	75	78	88	100	113	125	125
80 (3)	40	50	63	63	63	88	100	113	125	125	138	150
100 (4)	50	50	63	75	88	100	113	125	125	138	150	150
150 (6)	50	63	75	75	100	113	125	138	150	150	150	150
200 (8)	63	63	63	75	113	113	125	138	150	150	150	150
250 (10)	63	63	63	100	113	125	138	138	150	150	150	
300 (12)	63	63	63	100	113	125	138	150	150	150		
350 (14)	63	63	63	100	113	125	138	150	150	150		
400 (16)	63	63	63	100	113	125	138	150	150			
450 (18)	75	75	75	100	125	125	150	150				
500 (20)	75	75	100	100	125	125	150	150				
550 (22)	75	75	100	100	125	125	150					
600 (24)	75	75	100	100	125	125	150					
And above												

The thickness given above are based on the use of preformed mineral wool and calculations based on BS.54.22

Hot face Temperature, for Personnel Protection, is defined as the design temperature.

7.0 **APPLICATION REQUIREMENTS: PERSONNEL PROTECTION CLASS P**

7.1 Where personnel protection is specified on the Piping Line List, all piping, valves, flanges, nozzles and equipment within 2 metres height and one metre reach of walkways, working platforms, ladders etc., shall be insulated, or otherwise guarded or screened.

7.1.1 Where design temperature is at 55°C and above, the protection shall be by means of either:

* A suitable guard or screen (eg. extended handrailing or weldmesh shield)

OR

* Application of hot insulation

This shall be in accordance with sections 6.1 and 6.2 of this specification with the exception of the insulation thickness, which shall be in accordance with Table II.

7.1.2 Where the design temperature is -25°C and below, the protection shall be by means of a suitable guard or screen, (e.g. Extended handrailing or weldmesh shield).

TABLE – II
INSULATION THICKNESS REQUIRED FOR PERSONNEL
PROTECTION - CLASS P

Thickness of Insulation mm at Hot Face Temperature (°C)

Pipe Nom Bore	Up to 205	260	315	375	425	480	540	590	650
UP TO									
1”	25	25	25	38	38	38	50	63	63
1/1/2”	25	25	38	38	38	50	50	63	63
2”	25	25	38	38	50	50	63	63	75
3”	25	25	38	38	50	50	75	75	75
4”	25	38	38	38	50	63	75	75	100
6”	38	38	38	50	50	63	75	75	100
8”	38	38	38	50	50	63	75	100	100
10”	38	38	38	50	50	63	75	100	100
12”	38	38	38	50	63	63	75	100	100
14”OD	38	38	38	50	63	63	75	100	100
16”OD	38	38	38	50	63	63	75	100	100
18”OD	38	38	38	50	63	75	75	100	100
And above									

NB: The above table is based on the same data as Table 1 and on that basis the above thicknesses will reduce insulation surface temperature to 55°C or lower.

Hot face temperature, for Personnel Protection, is defined as the maximum design temperature.

8.0 **APPLICATION REQUIREMENTS: FROST PROTECTION – CLASS C**

- 8.1 Tanks, flow lines and instrumentation lines carrying fluids subject to freezing conditions shall be insulated against freezing to (minus) -15°C.
- Flanges and valves shall not be insulated unless otherwise indicated on the isometrics and other COMPANY procurement documentation.
- 8.2 Insulating thickness required
- 40mm thick for lines below 8" N.B.
25mm thick for lines 8" and above
- 8.3 Application and materials shall be in accordance with 6.1 and 6.2, except as noted above.
- 8.4 Lines where the movement of fluid subject to freezing is very slow or static shall be electrically traced. (Refer paragraph 6.1.7).

9.0 **APPLICATION REQUIREMENTS: COLD SERVICES – CLASS K**

9.1 **Application to Piping and Equipment**

- 9.1.1 Equipment and piping operating at a temperature of 10°C or less shall be insulated when required for process reasons, conservation of refrigeration, or control of condensation, as indicated on the Piping Line List and other COMPANY procurement documentation.
- 9.1.2 Manholes, hand holes, nozzles and equipment flanges shall be insulated to the specified thickness.
- 9.1.3 Flanges, valves and fittings on insulated lines shall be fully insulated to the specified thickness.
- 9.1.4 Insulation of manways, flanges and valves, hand holes and any item that may need to be accessible, shall be constructed in such a manner as to enable removal of the insulation without disturbance to adjacent insulation.
- 9.1.5 All insulated protrusions on insulated lines and equipment shall be insulated to a distance equal to four times the insulation thickness.
- 9.1.6 Surfaces to be insulated, shall be cleaned, dried and free of all foreign matter and moisture before the application of insulation.
- 9.1.7 After the surface is cleaned and prepared, the insulation shall be applied as soon as possible. Cleaned areas shall not be left unprotected overnight.
- 9.1.8 Insulation shall not be applied to unprotected areas during rain or when high humidity is likely to cause moisture filming on equipment or mastics.

- 9.1.9 Piping and equipment shall be insulated with preformed sections, mattress or slab as appropriate. Refer to the appropriate materials and thickness tables
- 9.1.10 Single layer insulation shall be applied to pipe and equipment with lateral joints in a staggered arrangement. All joints shall be tightly butted and fitted together so as to eliminate voids. Large voids shall be eliminated by refitting or replacing the insulation. Additional layers of pipe insulation, where required, shall be applied in the same manner as the first layer, with lateral and end joints staggered over the preceding layer so that no two joints coincide, except where they cross at right angles. Inside layer of insulation shall be secured with wire on 600mm centers, outer layers shall be secured with specified bands on 600mm centers approximately. With double layer insulation no layer shall exceed 50mm thickness.
- 9.1.11 Flange and valve covers requiring insulation shall be fabricated from the same material and insulation thickness as specified for the adjacent piping. The covers shall be of the removable type and shall be secured with required specified bands and sealed with vapor barrier mastic or tape as required.
- 9.1.12 Contraction Joints shall be installed in insulation for horizontal and vertical straight run piping and vessels in increments of 12 metres. When flanged fittings or valves occur within this limit, the joint shall be provided for in flange or valve cover only.
- 9.1.13 Cladding shall be installed on all external insulation.
- 9.1.14 The circumferential joints in cladding for piping and vessels shall be ball swage type. All cladding joints shall have a lap of 50mm minimum.
- 9.1.15 Cladding shall be secured with specified bands at 600mm or 1000mm internals as applicable. Screw or pop rivets shall not be used.
- 9.1.16 Cladding shall not be applied until the COMPANY'S Inspector has inspected piping/equipment insulation and vapor barrier. Such inspection will not relieve the CONTRACTOR/SUPPLIER from his responsibility concerning insulation soundness.
- 9.1.17 Pipe supports on lines with cold insulation should not be in direct contact with the pipe. They shall be isolated from the line by means of a suitable insulation material and any voids shall be vapor sealed with mastic.

9.2 **Refrigeration Conservation – Class K**

- 9.2.1 Equipment and piping operating at a temperature below 10°C shall be insulated with foam glass pre-formed sections or slabs as appropriate. Refer to materials and thickness tables Section 9.3.1 and Table III.

- 9.2.2 Butting edges of insulation shall be coated with the appropriate mastic as provided for in the material section vapor seal at the joints.
- 9.2.3 All outer insulation layers shall be secured with specified bands on 600mm centers. Inner layers are to be secured with stainless steel wire.
- 9.2.4 Insulation on equipment heads or other difficult contours shall be secured with suitable fire resistant mastic.
- 9.2.5 Contraction joints shall be installed at fixed points or at insulation supports as required to ensure the proper functioning of the insulation. Vapor tight sliding joints shall be provided in the insulation by the use of non-setting sealant.
- 9.2.6 All piping and equipment insulation shall have cladding installed in accordance with Clauses 9.1.14 to 9.1.16.
- 9.2.7 Where it is more practical for insulation of equipment on self-contained packages to be affected by complete boxing on of the packaged unit, alternative materials may be utilized e.g. loose fill insulation. In such instances, the CONTRACTOR/SUPPLIER shall provide full details of all insulating and cladding materials including thermal insulating properties, and obtain prior approval from the COMPANY.

9.3 **Material for Cold Services**

9.3.1 **Materials for Refrigeration Conservation - Class K (see Cl. 9.2.7)**

<u>Insulation Material</u>	<u>Temp Range</u>	<u>Application</u>
Foam Glass	-160°C to +250°C	All low temperature Piping and Equipment

9.3.2 **Insulation Securement – Class K**

<u>Material</u>	<u>Spacing</u>	<u>Application</u>
0.7mm stainless wire	600mm	Inner layers of multiple layer System
12mm wide × 0.5mm thick stainless steel Type 316 Bands and Seals	600mm	Equipment and Piping up to 600mm OD
18mm wide × 0.5mm thick stainless steel Type 316 Bands and Seals	600mm	Equipment and Piping above 600mm OD up to 1500mm OD
25mm wide × 0.5mm thick stainless steel Type 316 Bands and Seals	600mm	Equipment over 1500mm OD

9.3.3 Coatings and Mastics – Class K

<u>Material</u>	<u>Application</u>
Fire resistant mastic and glass cloth. Natural or impregnated with material compatible with the mastic	Piping insulation terminations at flanges and valves etc. insulation finish on horizontal equipment heads, screwed and socket weld fittings.
Non Setting Mastic	Sealing against water and vapor ingress on removable items.
Sealing Mastics	Sealing against water and vapor ingress at sheeting joints/laps/cutouts, etc.

9.3.4 Cladding – Class K

<u>Material</u>	<u>Application</u>
Stainless Steel Type 316 0.5mm thick	Piping and Equipment up to 300mm OD
Stainless Steel Type 316 0.5mm thick	Piping and Equipment 350mm to 1500mm OD
Corrugated Stainless Steel Type 316	Piping and Equipment above 1500mm OD

9.3.5 Cladding Securement – Class K

<u>Material</u>	<u>Temp Range</u>	<u>Application</u>
12mm wide × 0.5mm thick Stainless Steel Type 316 banding and seal	600mm	Equipment and Piping up to 1500mm OD
25mm wide × 0.5mm thick stainless steel Type 316 Banding and Seals	600mm	600mm Equipment and Piping up to 600mm OD

TABLE – III**COLD INSULATION THICKNESS SCHEDULE - CLASS K**
FOAM GLASS**Minimum Cold Surface Temperature (°C)**

NOMINAL INSULATION THICKNESS (mm)											
PIPE SIZE	SINGLE LAYER						DOUBLE LAYER				
	25	40	50	65	75	90	100	115	130	140	150
½"	-2	-26	-51	-67	-99						
¾"	3	-17	-40	-54	-83	-130					
1"	0	-17	-40	-54	-80	-126					
1½"	4	-12	-22	-42	-66	-90	-118				
2"	5	-11	-22	-42	-66	-90	-118				
3"	8	-6	-18	-35	-54	-75	-101	-125	-154	-186	
4"	8	-4	-18	-33	-52	-70	-90	-110	-141	-167	-193
6"	10	0	-14	-27	-41	-61	-78	-97	-117	-139	-161
8"	10	0	-11	-27	-40	-55	-71	-87	-106	-125	-145
10"	12	0	-11	-23	-35	-49	-63	-78	-95	-112	-131
12"	12	0	-10	-21	-33	-46	-59	-74	-89	-106	-123
14"	12	3	-7	-18	-29	-41	-54	-68	-83	-98	-115
16"	12	3	-6	-16	-27	-39	-52	-65	-79	-95	-111
18"	13	4	-6	-16	-26	-38	-50	-63	-77	-92	-107
20"	13	4	-5	-15	-26	-37	-49	-61	-75	-89	-104
24"	13	4	-5	-14	-25	-36	-47	-59	-72	-85	-100
32"	15	5	-4	-14	-23	-33	-44	-56	-68	-80	-94
36"	13	5	-4	-13	-23	-33	-43	-55	-66	-70	-91
FLAT	14	6	-3	-11	-18	-29	-36	-45	-55	-66	-74

Appendix – A: Details for Pipe Insulation for Hot Service

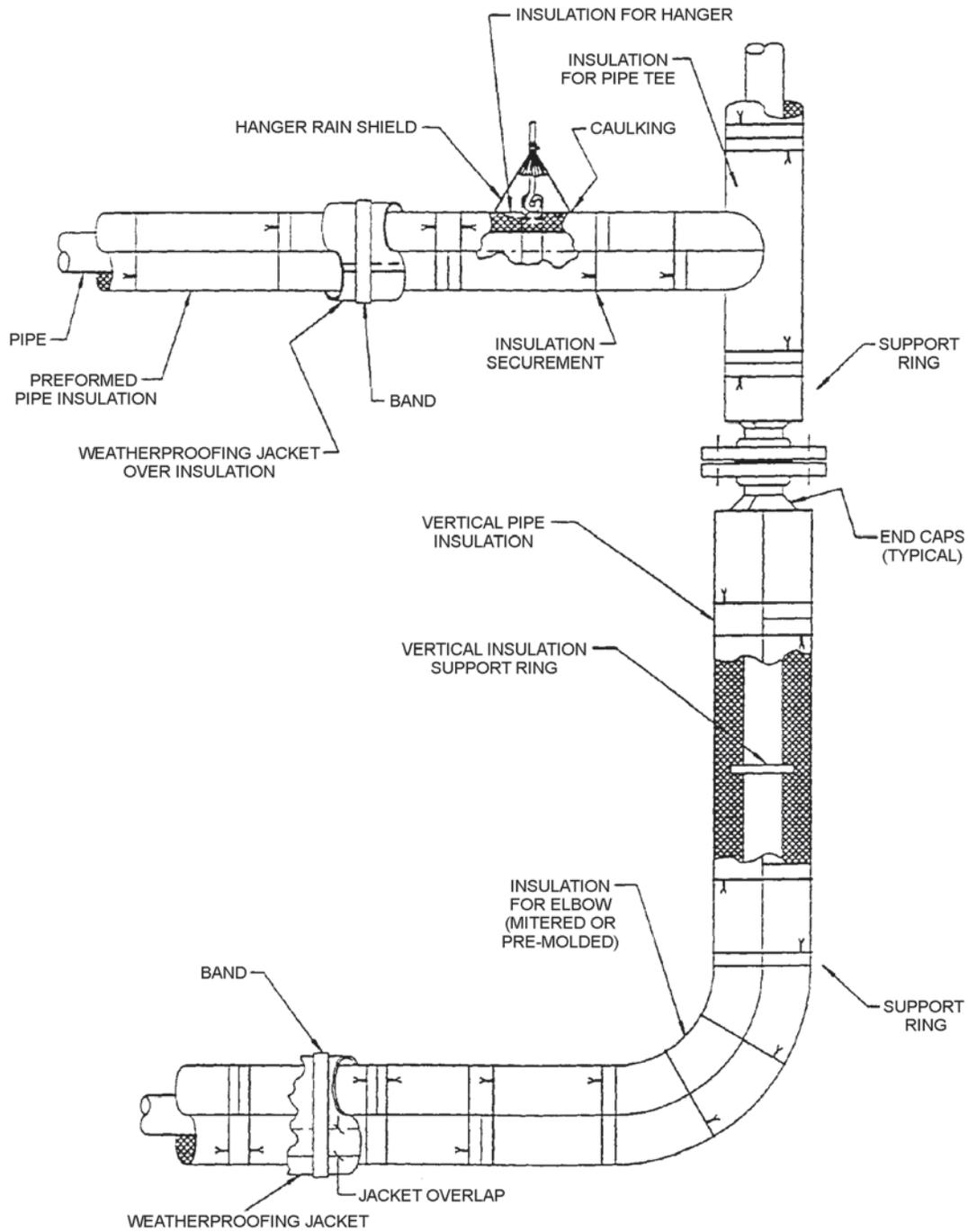


Figure A-1: Pipe Insulation for Hot Service

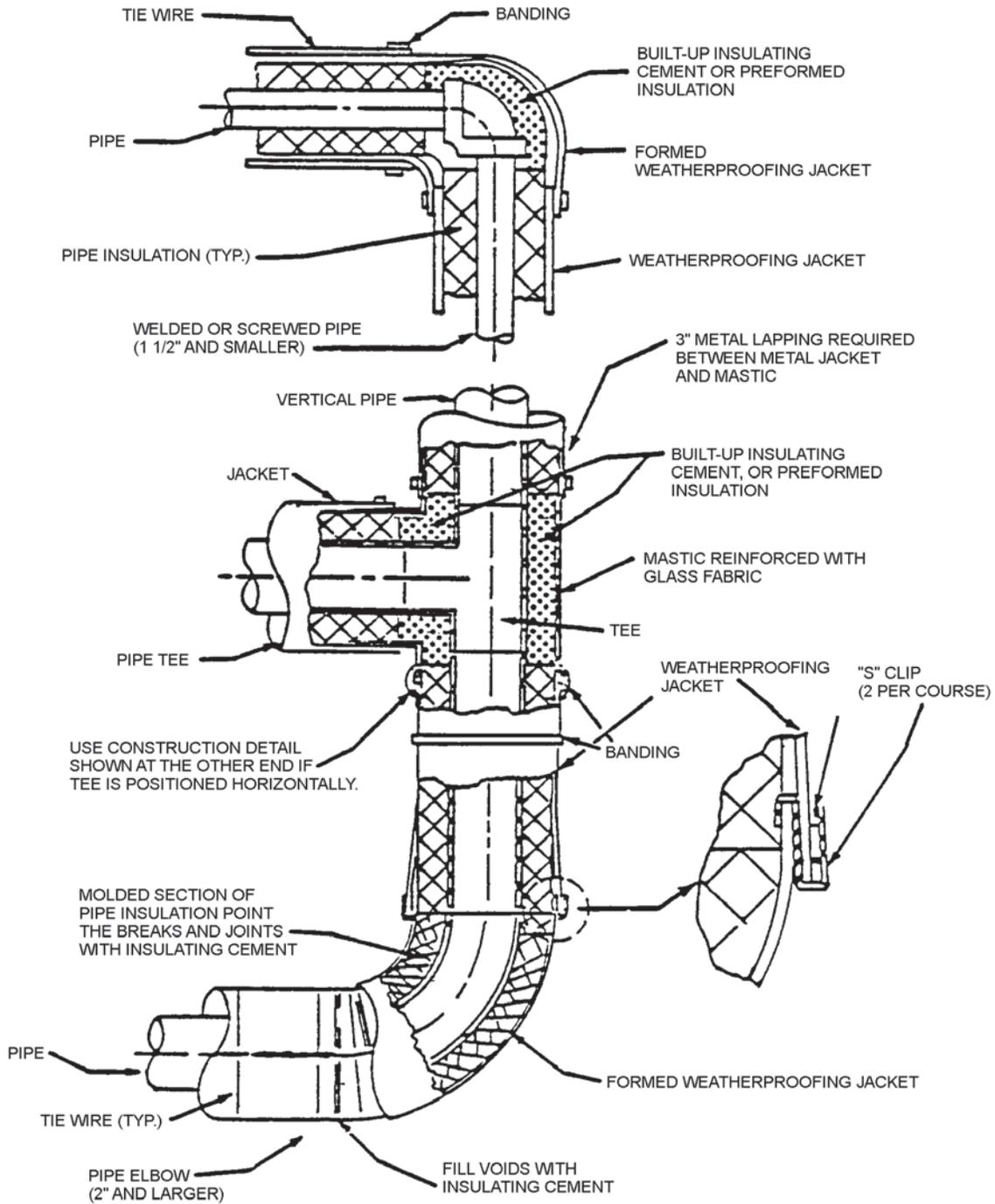


Figure A-2: Details Insulation and Weatherproofing of Pipe Fittings for Hot Service

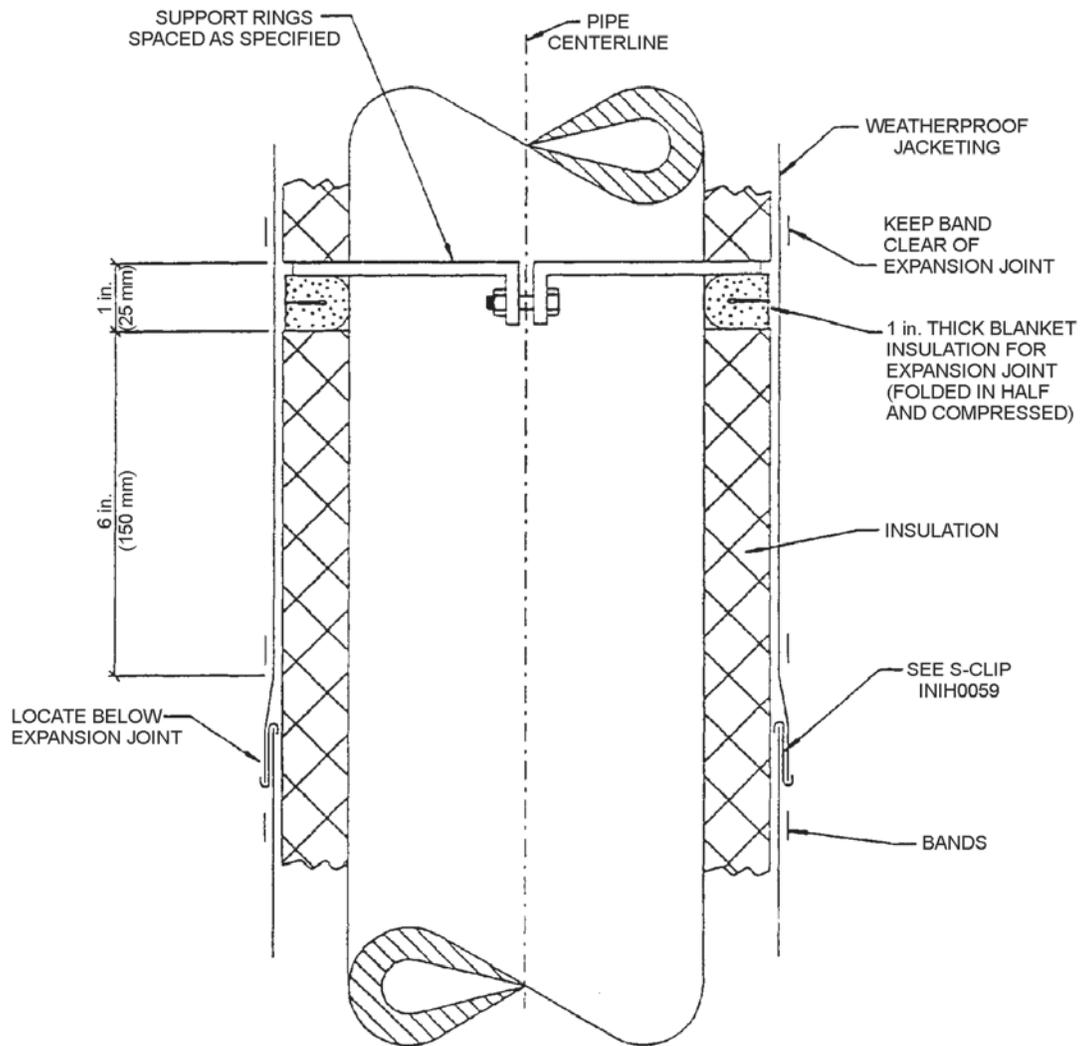


Figure A-3: Piping-Vertical Insulation Support, Single Layer for Hot Service

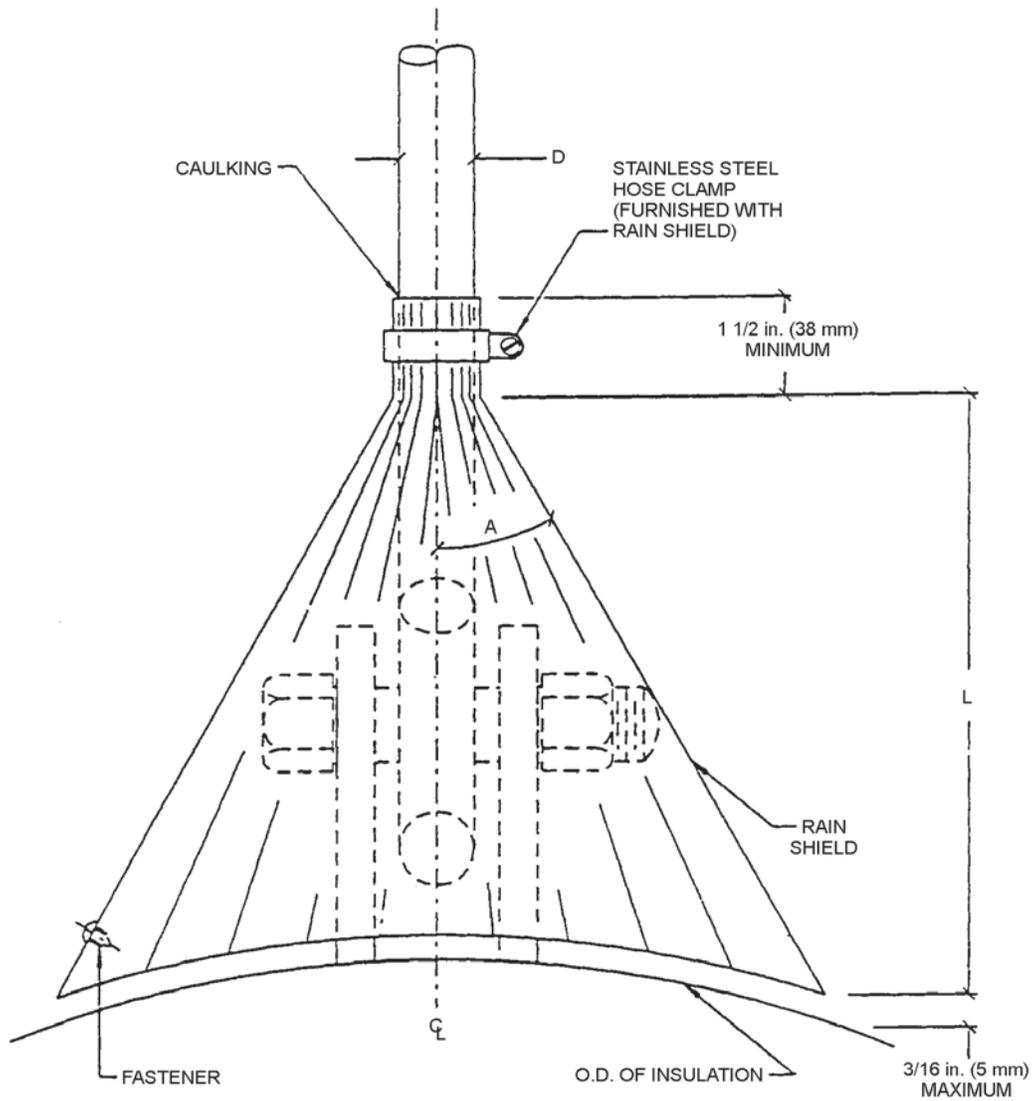


Figure A-4: Hanger Rod Rain Shield for Hot Service

Hanger Rod Dia. D (in) (mm)	Flare Angle A	Skirt Length L (in) (mm)
$\frac{3}{8}$ (10) - $\frac{1}{2}$ (10)	20°	6 $\frac{3}{4}$ (171)
$\frac{5}{8}$ (16) - $\frac{3}{4}$ (19)	30°	6 $\frac{3}{4}$ (171)
$\frac{7}{8}$ (22) - $1\frac{1}{8}$ (29)	40°	7 $\frac{1}{2}$ (190)
$1\frac{1}{4}$ (32) - $1\frac{1}{2}$ (38)	50°	8 $\frac{1}{2}$ (216)

NOTE: All dimensions are approximate.

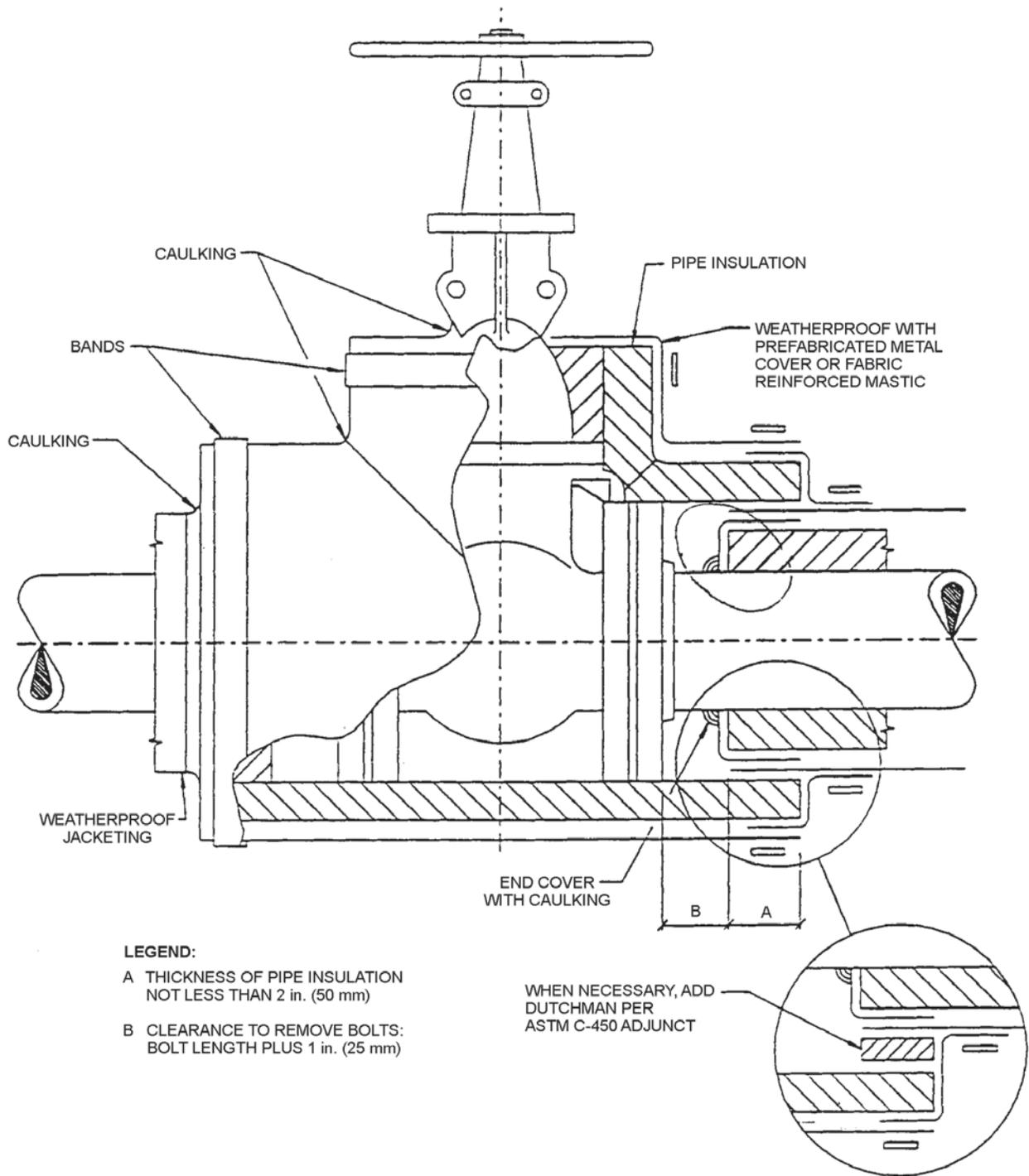


Figure A-5: Valve Insulation Detail for Hot Service

NOTE: Insulate from the bonnet flange to a point below the packing gland where damage will not occur to the insulation when servicing the packing gland.

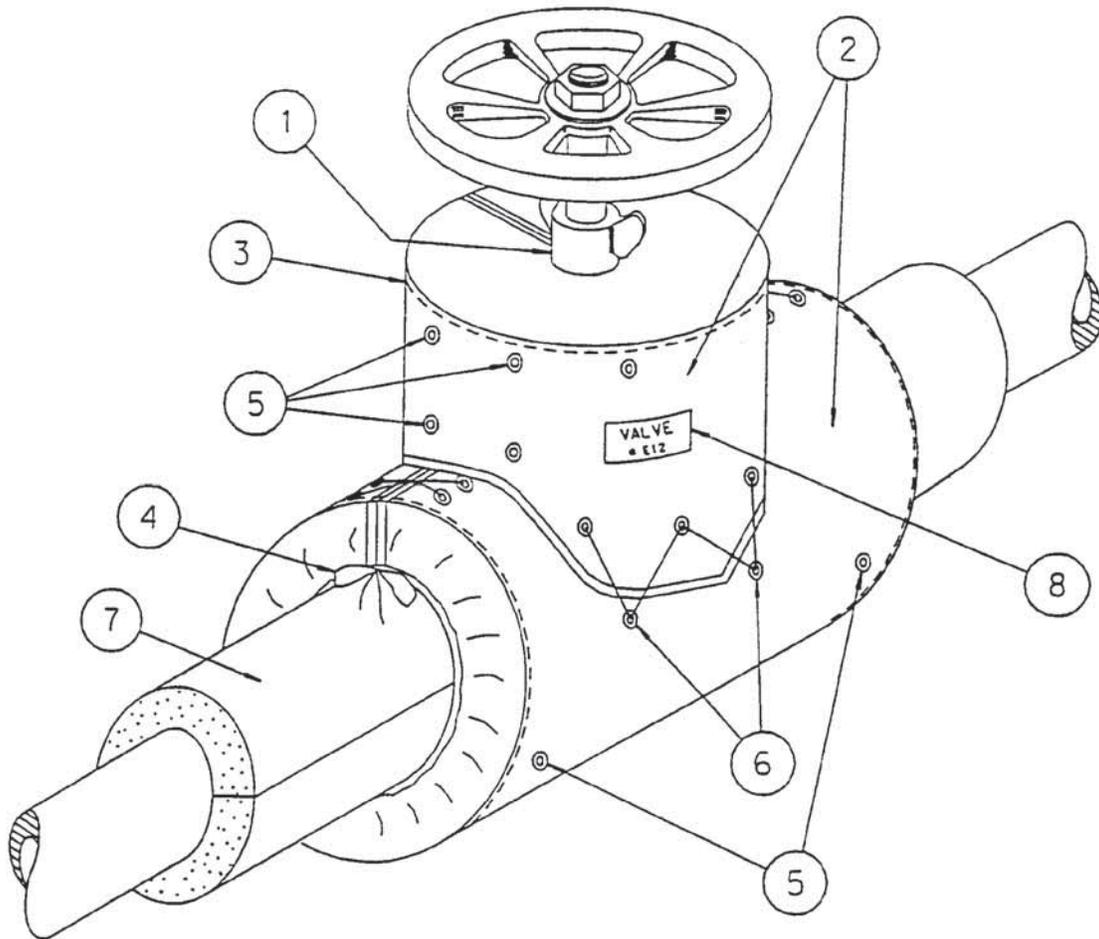


Figure A-6: Removable and Reusable Insulation-Flexible for Hot Service

NOTE: Valves are insulated to a point below the packing gland to prevent damage to the insulation when servicing.

Materials	
1	Packing Gland
2	Removable Cover (2 piece shown)
3	Machine Stitching
4	Ties
5	Quilting Pin
6	Lacing Hooks and Wire (or Velcro straps)
7	Adjacent Insulation
8	Identification Tag

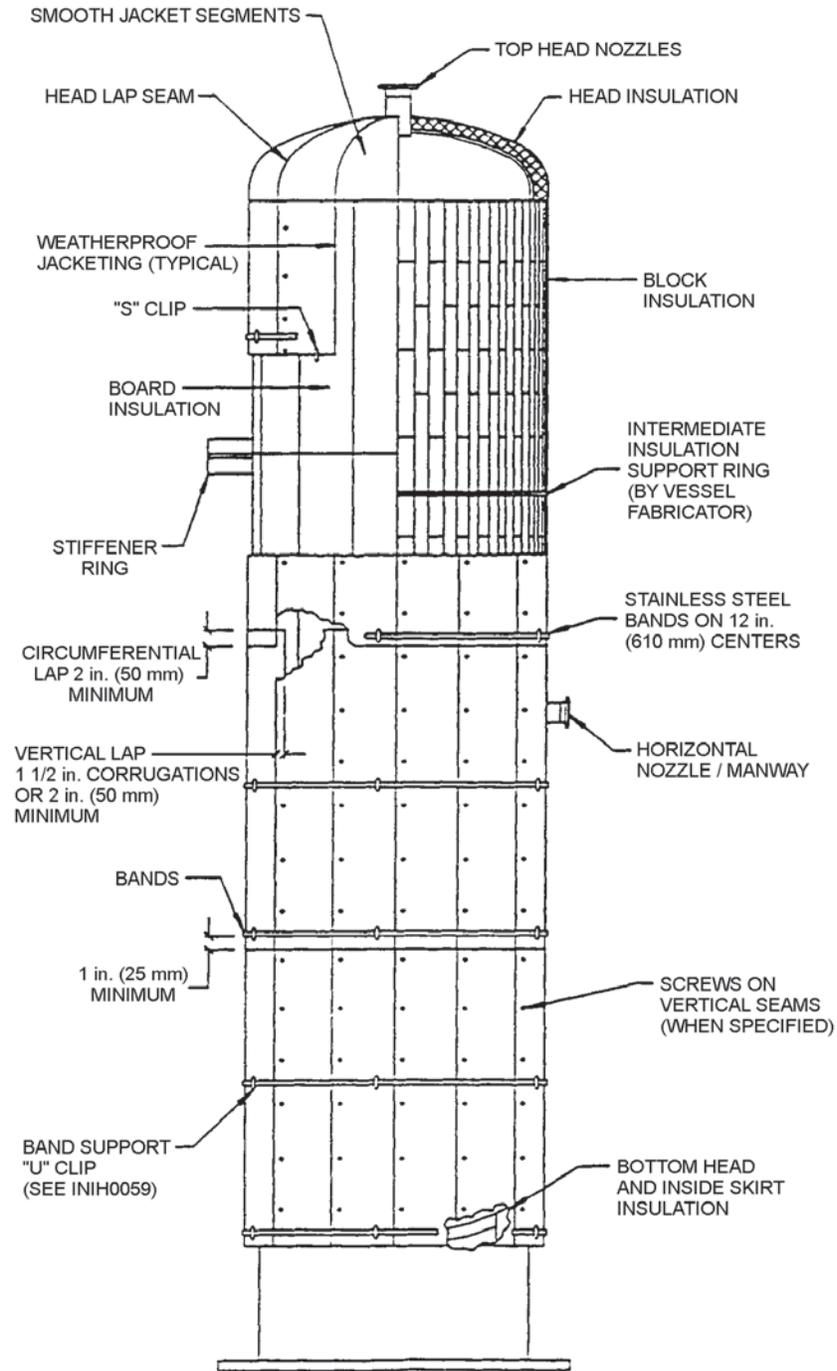


Figure A-7: Vessel Insulation for Hot Service

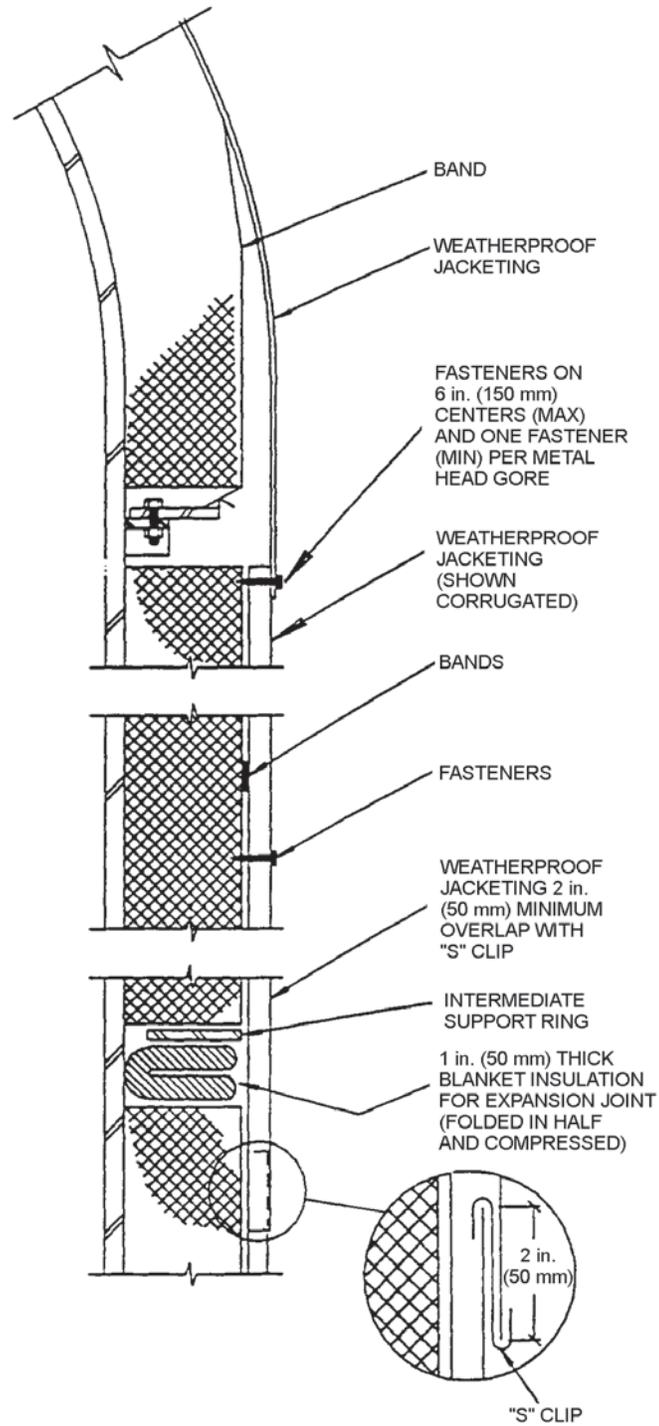


Figure A-8: Vertical Vessel Insulation Detail for Hot Service

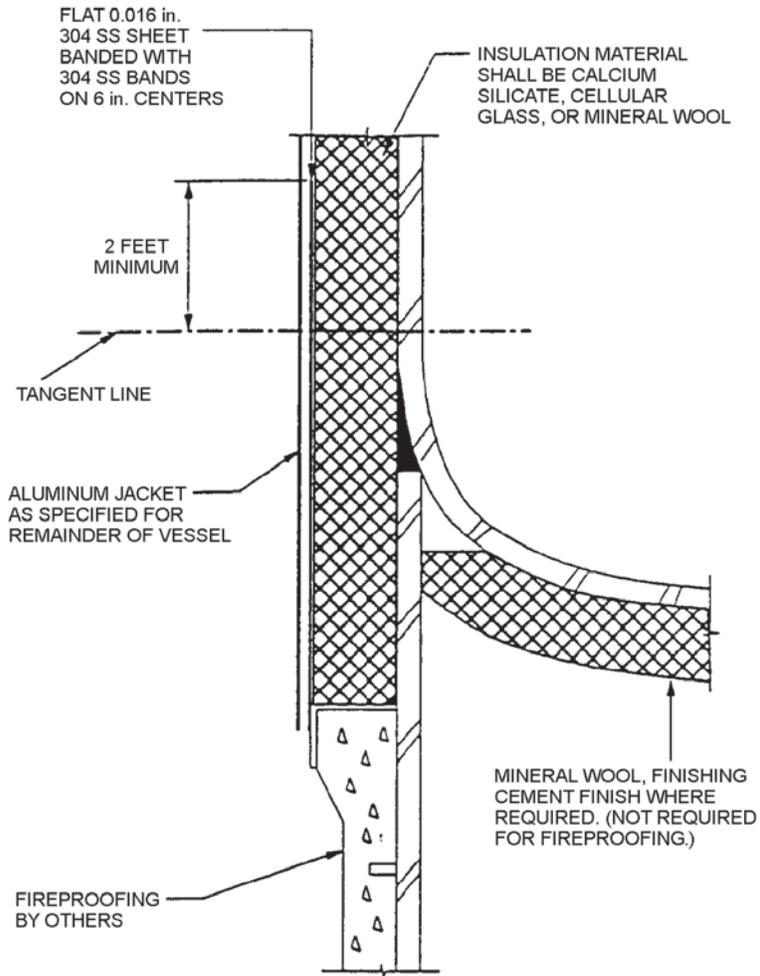


Figure A-9: Vertical Vessel Skirt Insulation Detail for Hot Service

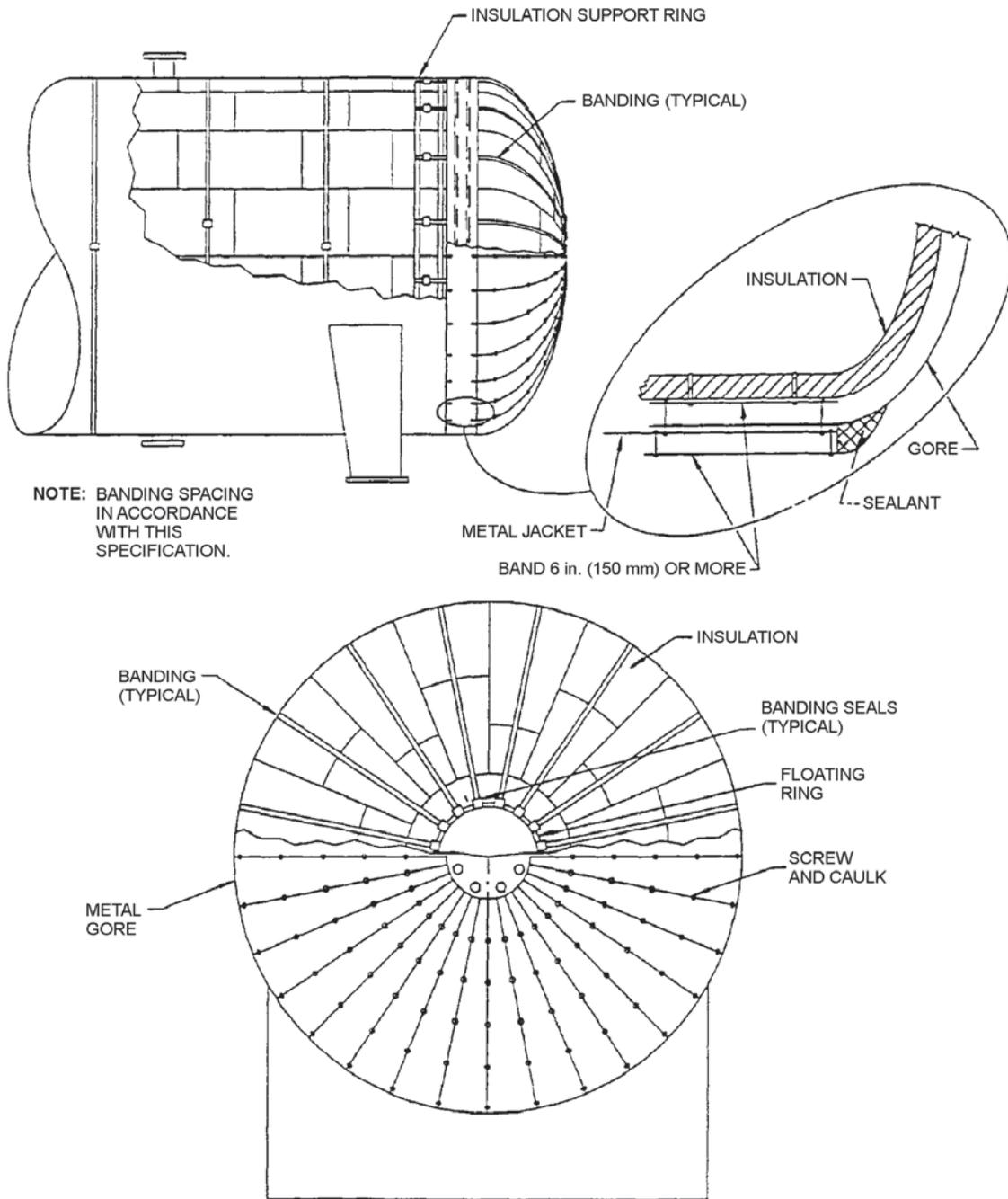


Figure A-10: Application of Metal Gores on Horizontal Vessel Heads for Hot Service

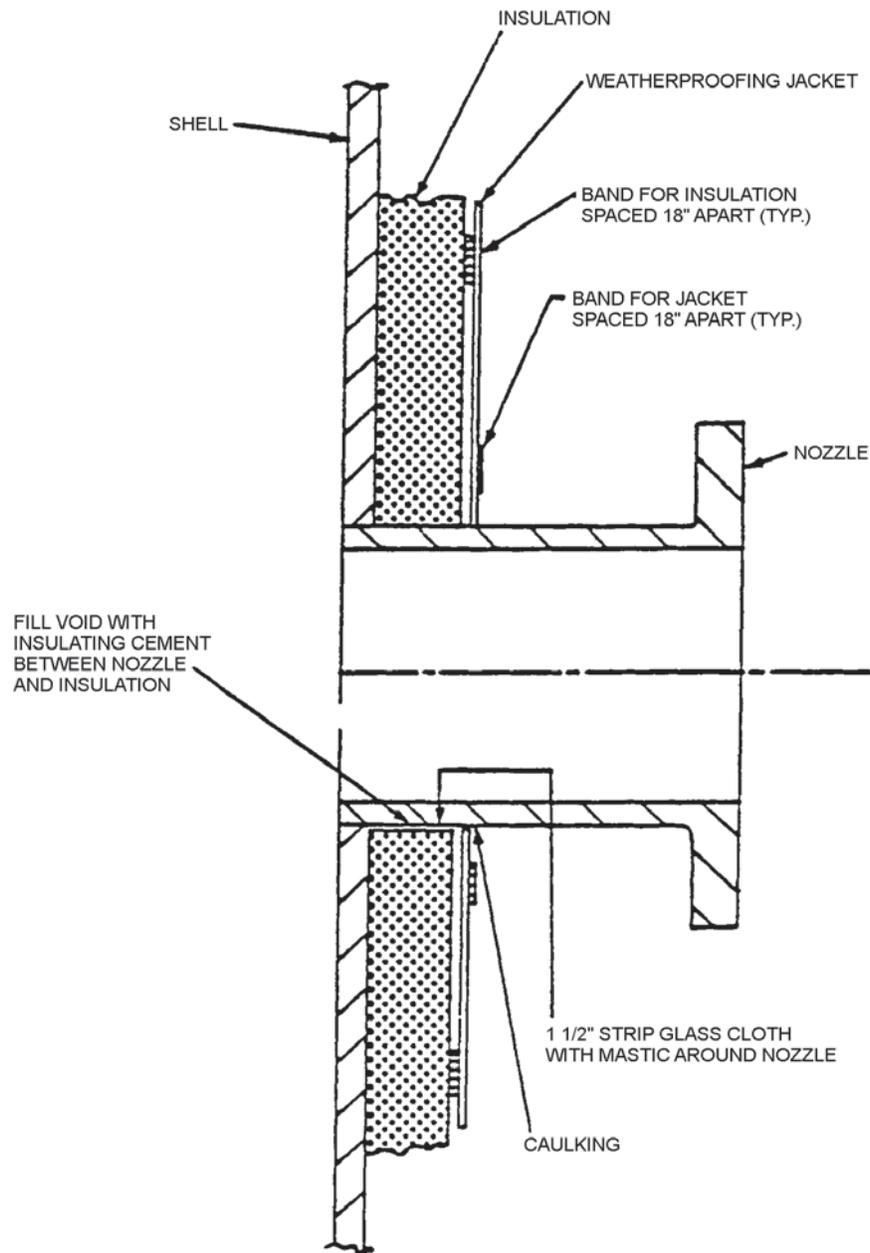


Figure A-11: Insulation and Weatherproofing for Nozzles at Shell for Hot Service

Appendix B: Insulation Details for Vertical Vessels for Cold Service

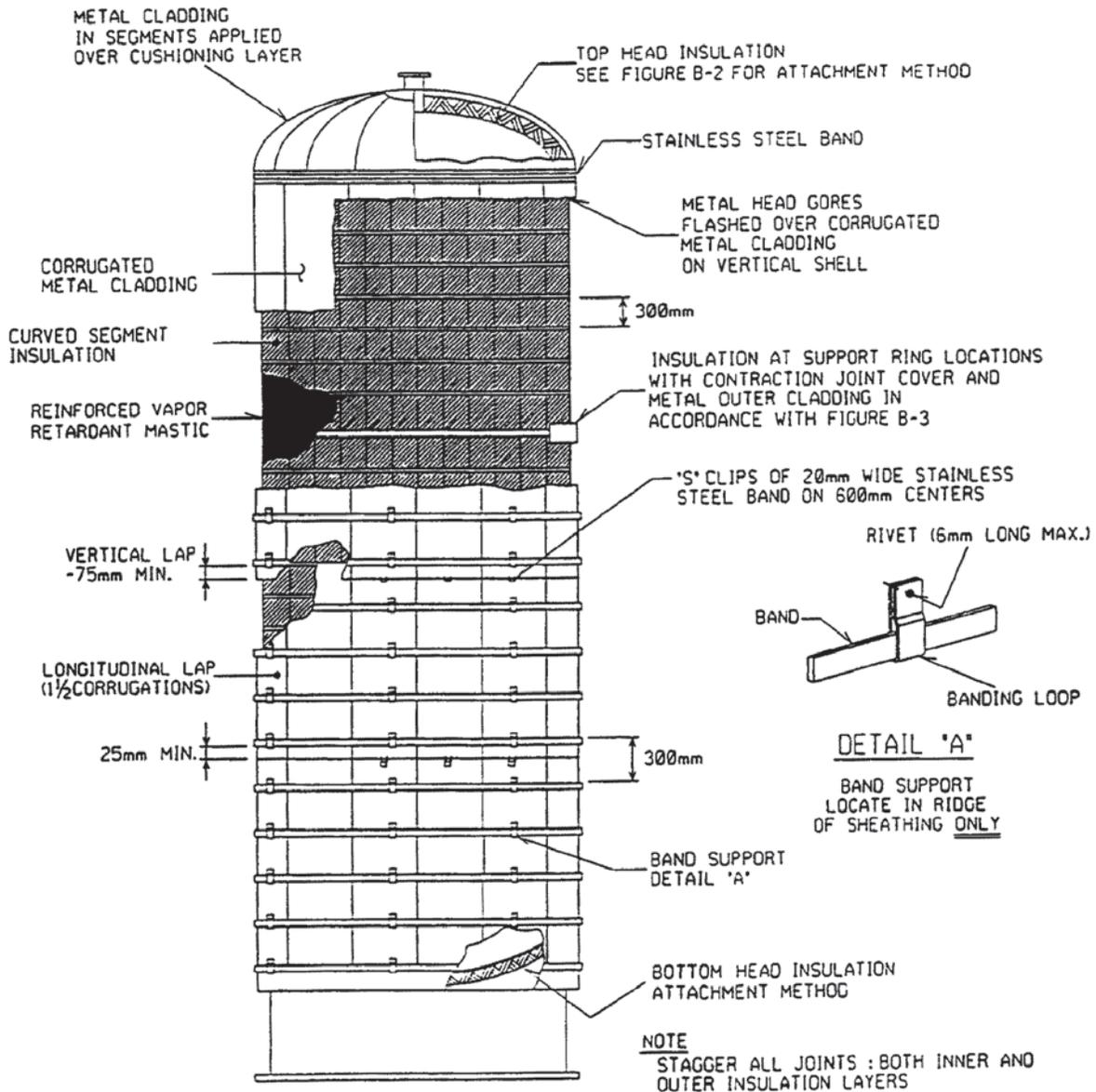


Figure B-1: Typical Insulation on Vertical Vessels for Cold Service

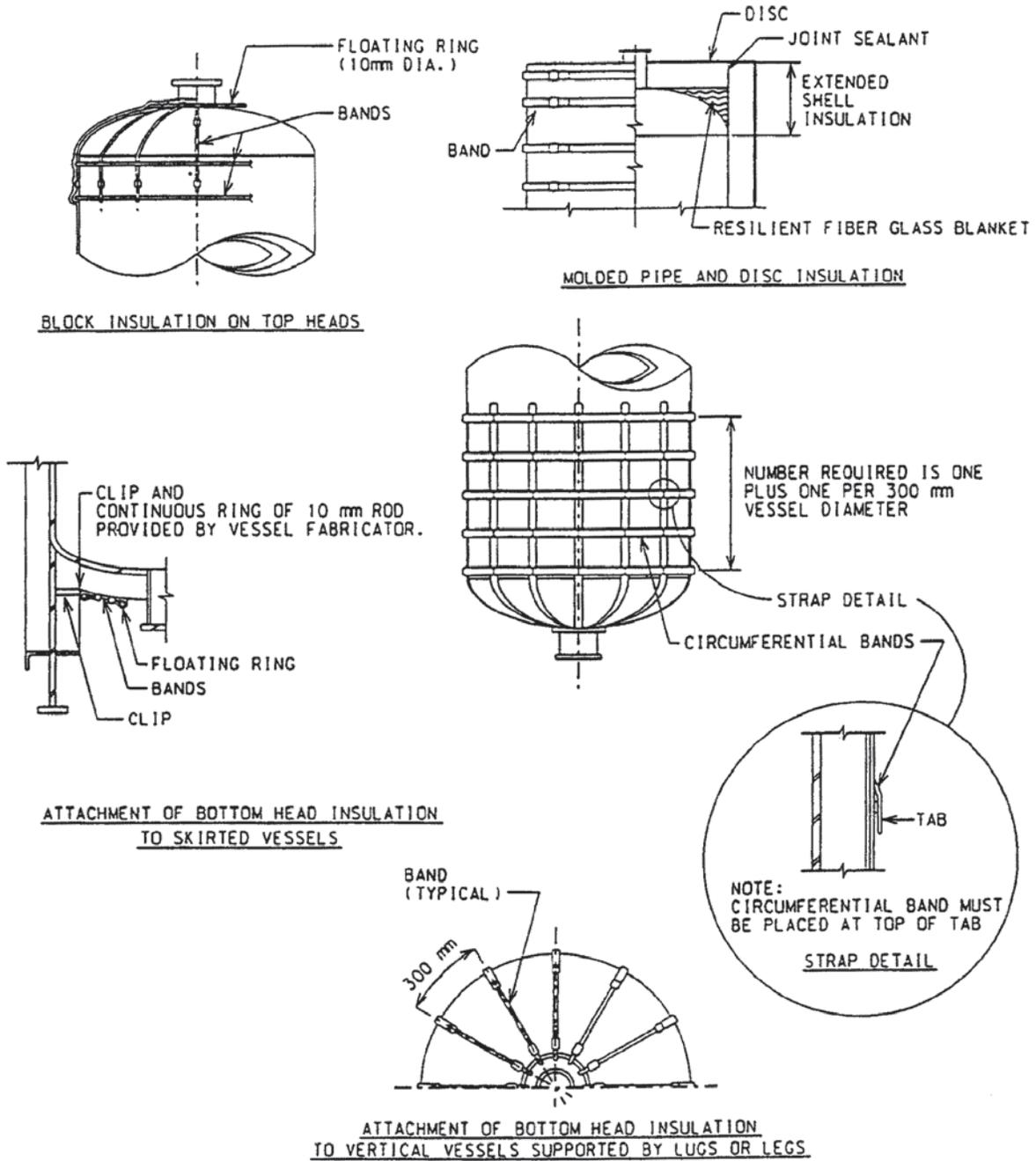


Figure B-2: Insulation Attachment Methods on Heads of Vertical Equipment for Cold Service

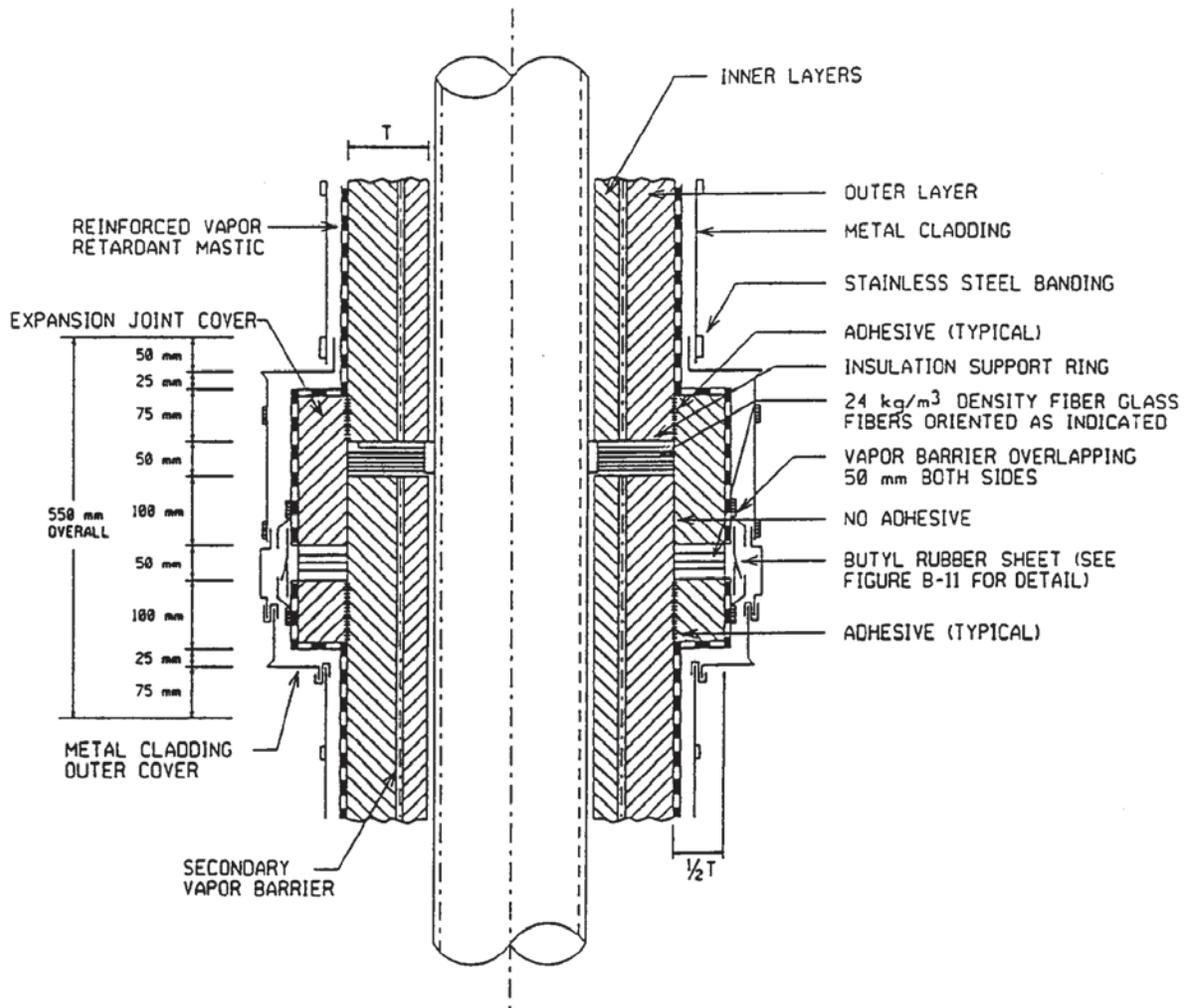


Figure B-3: Arrangement of Expansion/Contraction Joint at Insulation Support Rings on Vertical Equipment and Piping for Cold Service

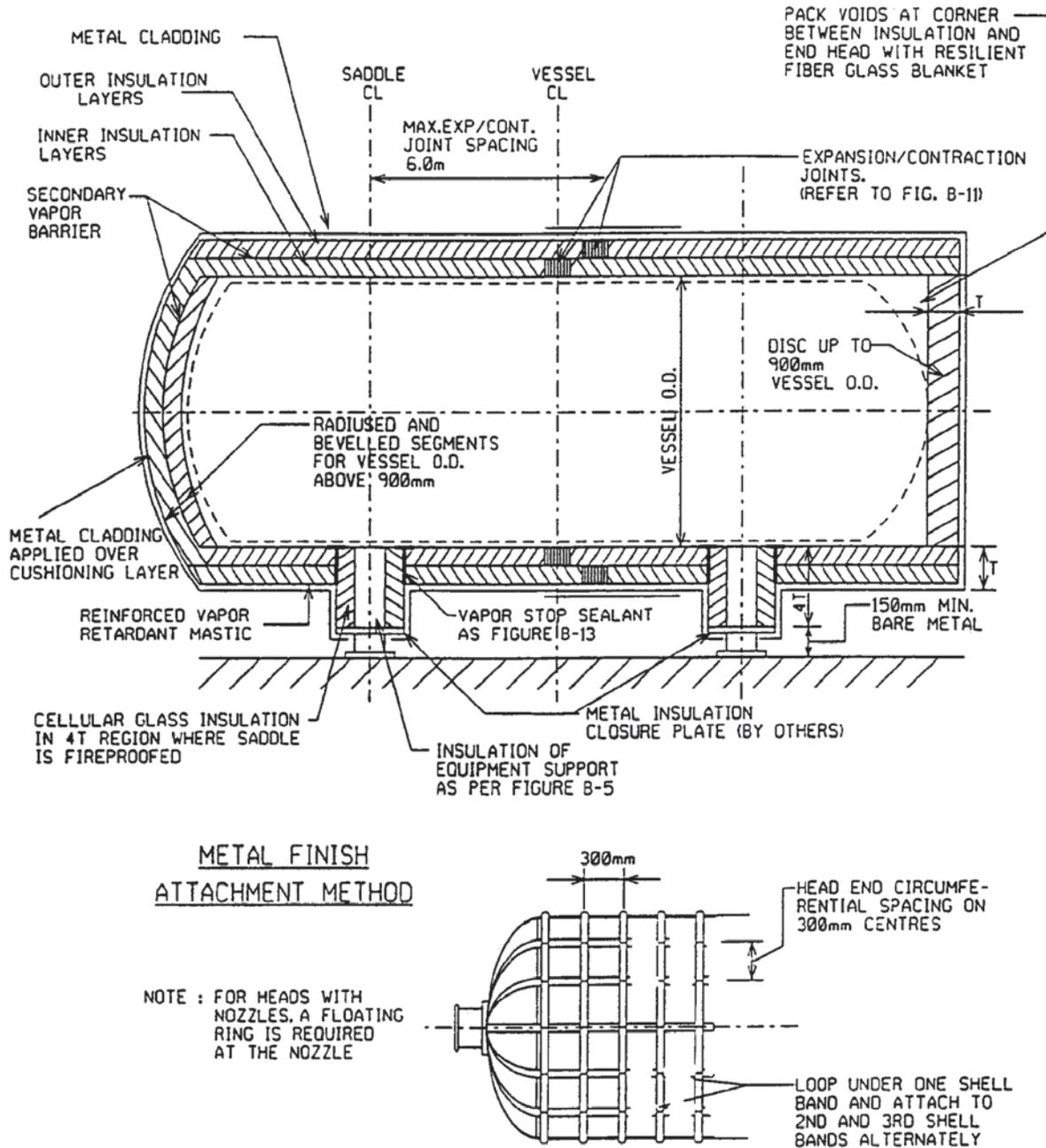


Figure B-4: Insulation of Horizontal Equipment for Cold Service

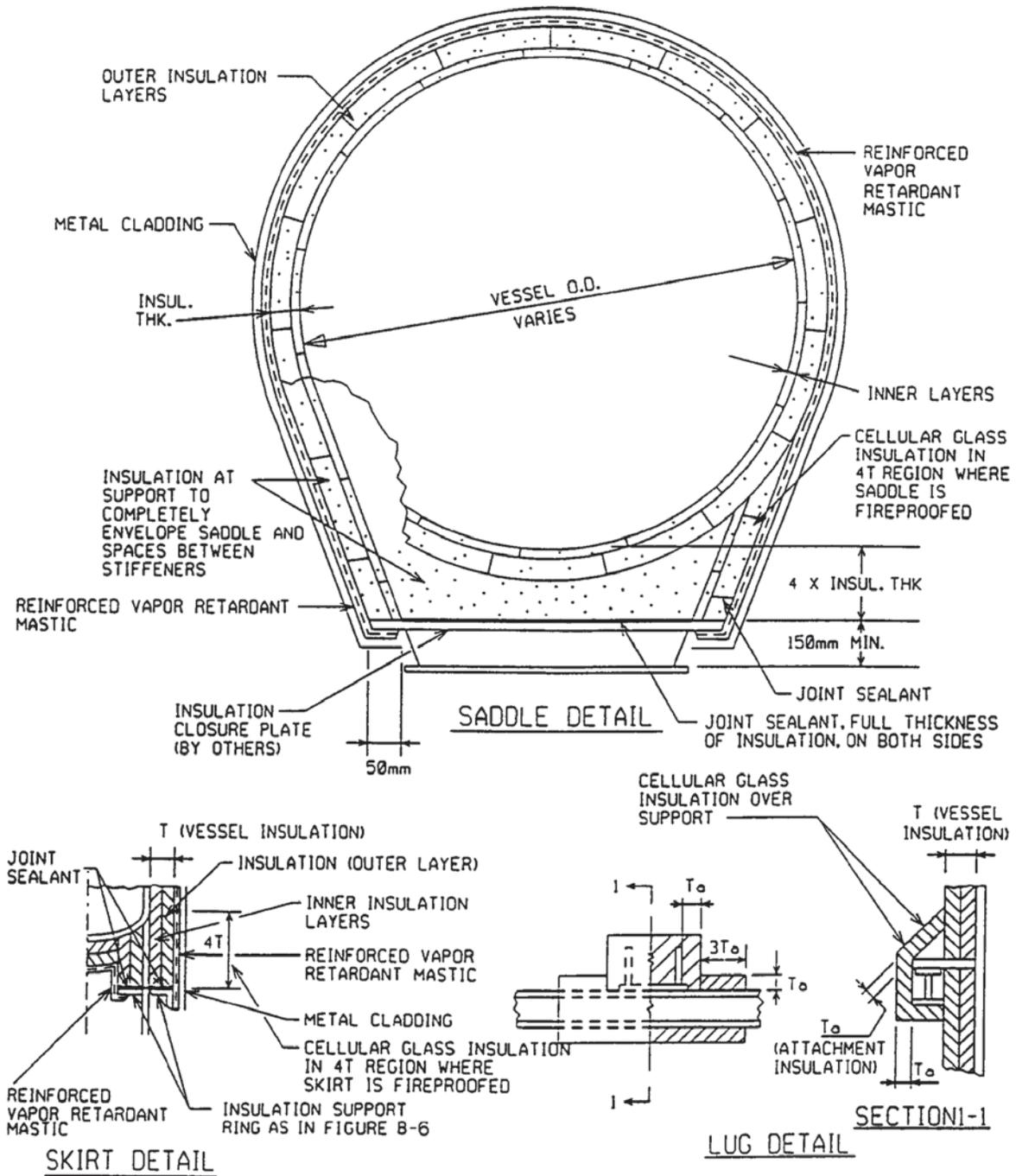


Figure B-5: Insulation Extension along Equipment Supports for Cold Service

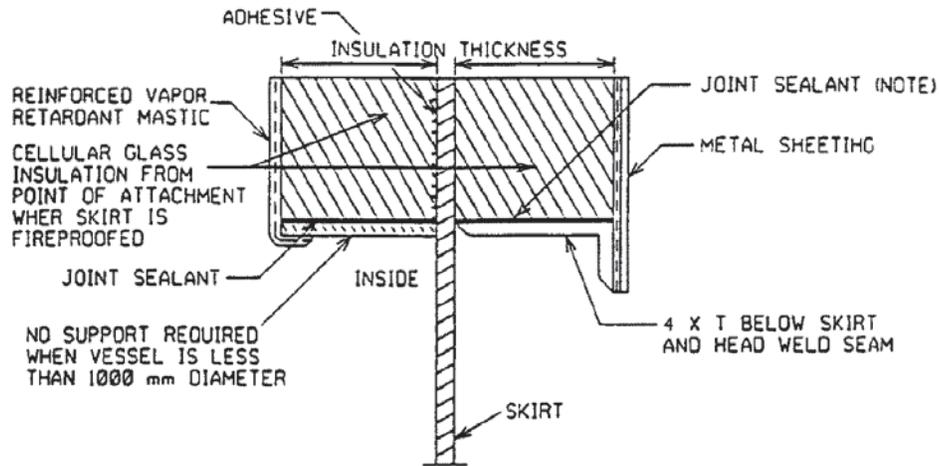


Figure B-6: Insulation Support for Vertical Vessel Skirts for Cold Service

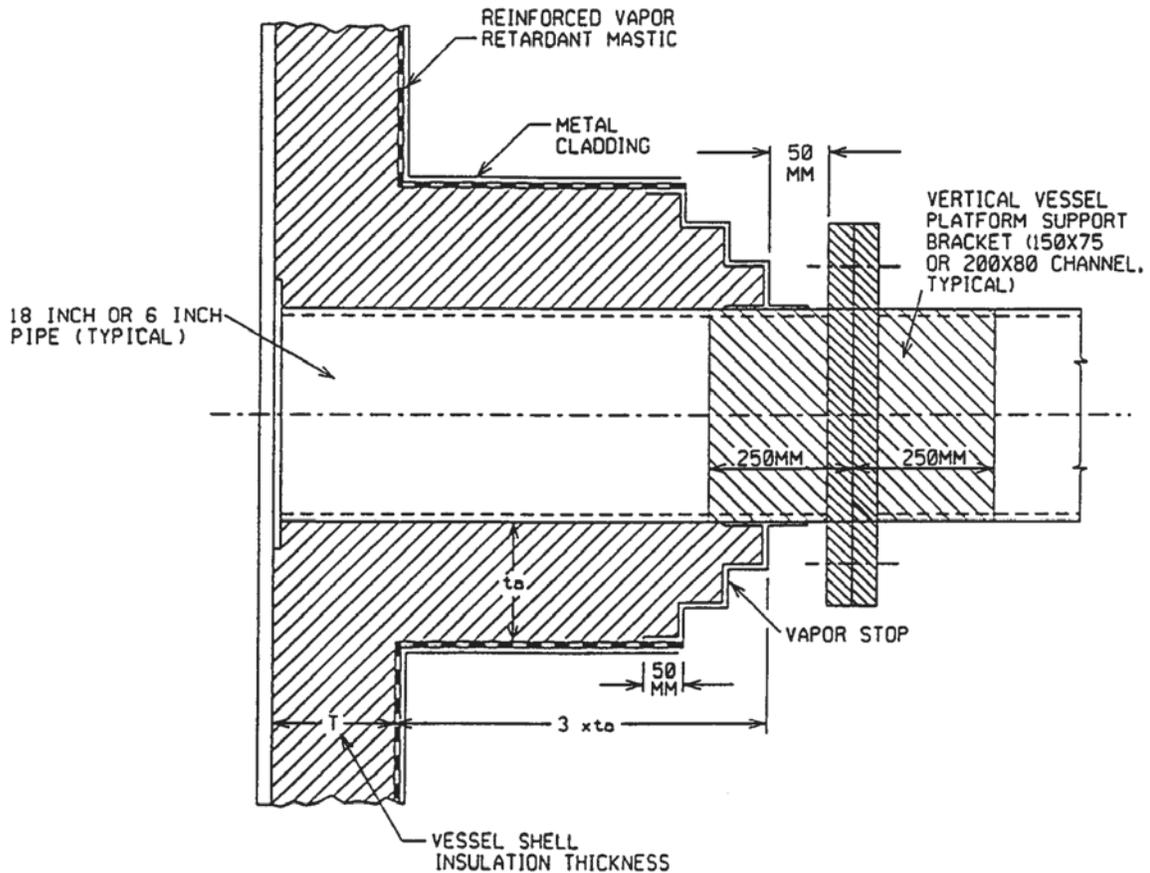


Figure B-7: Insulation for Cold Vessel Clips

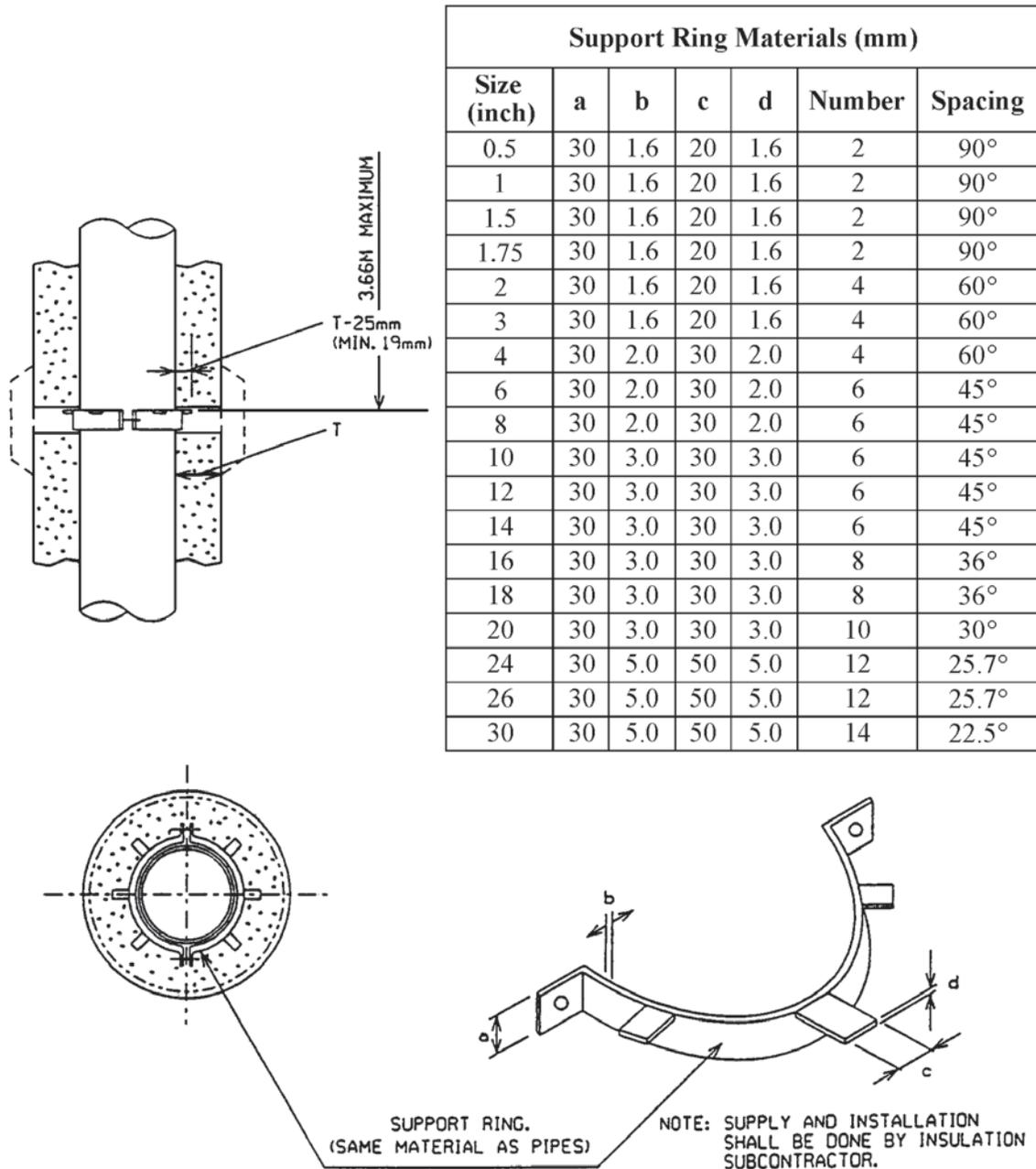


Figure B-8: Details of Insulation Support Rings on Vertical Piping for Cold Service

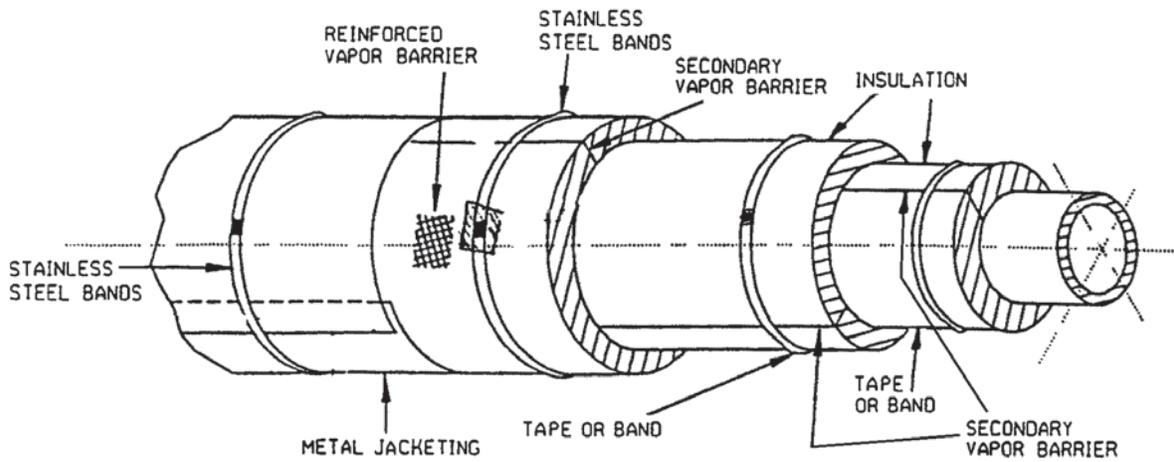


Figure B-9: Insulation/Cladding Detail for Cold Service

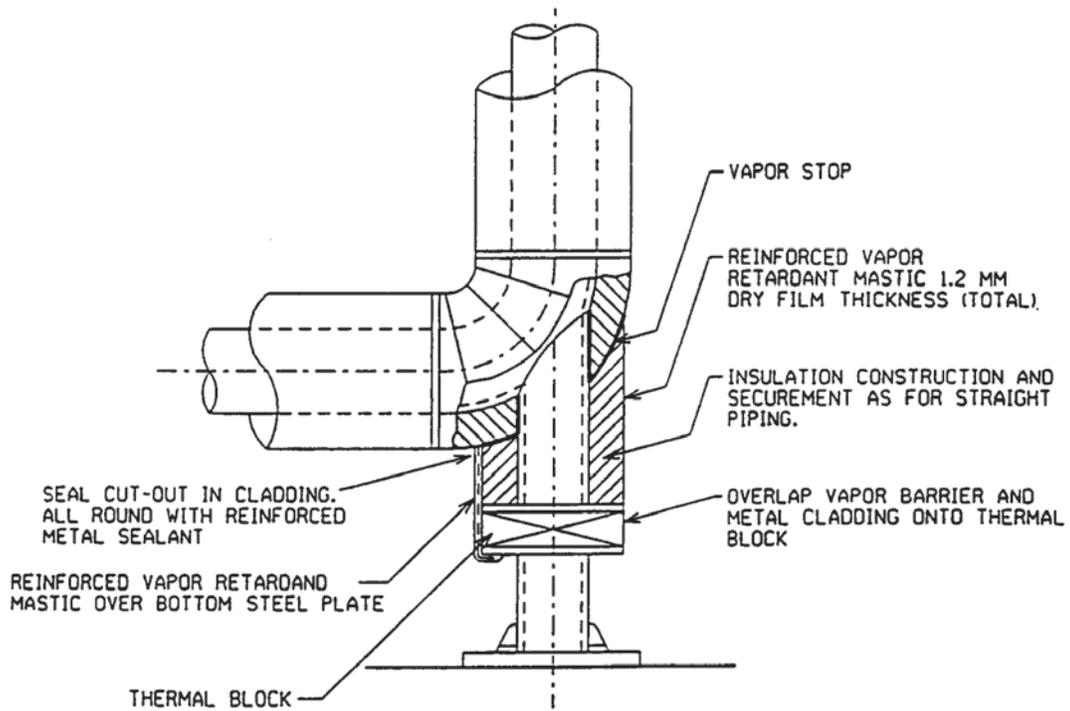
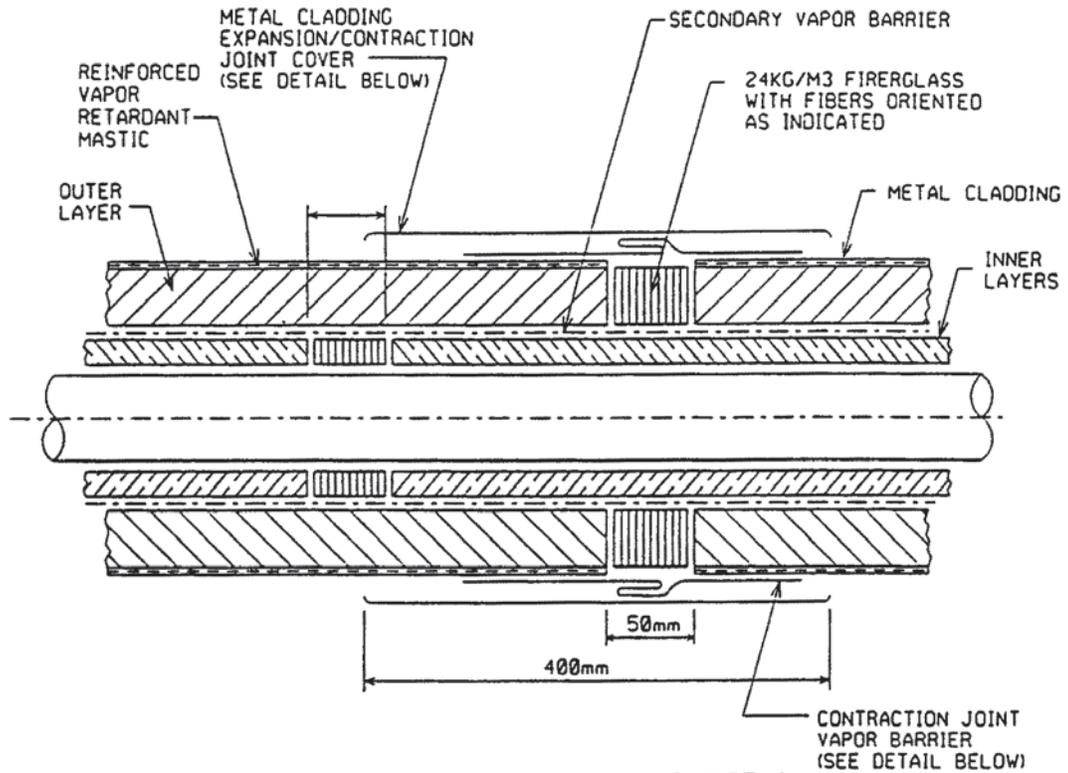


Figure B-10: Elbow Anchor/Trunion Support for Cold Service



BUTYL RUBBER VAPOR BARRIER DETAIL

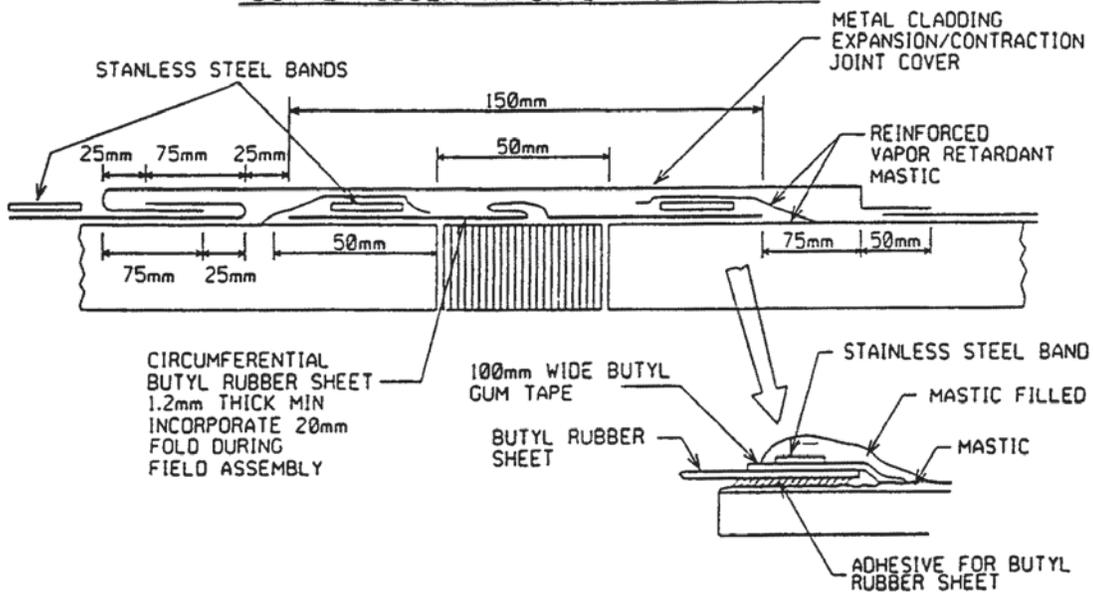


Figure B-11: Arrangement of Expansion/Contraction Joint on Horizontal Equipment and Piping for Cold Service

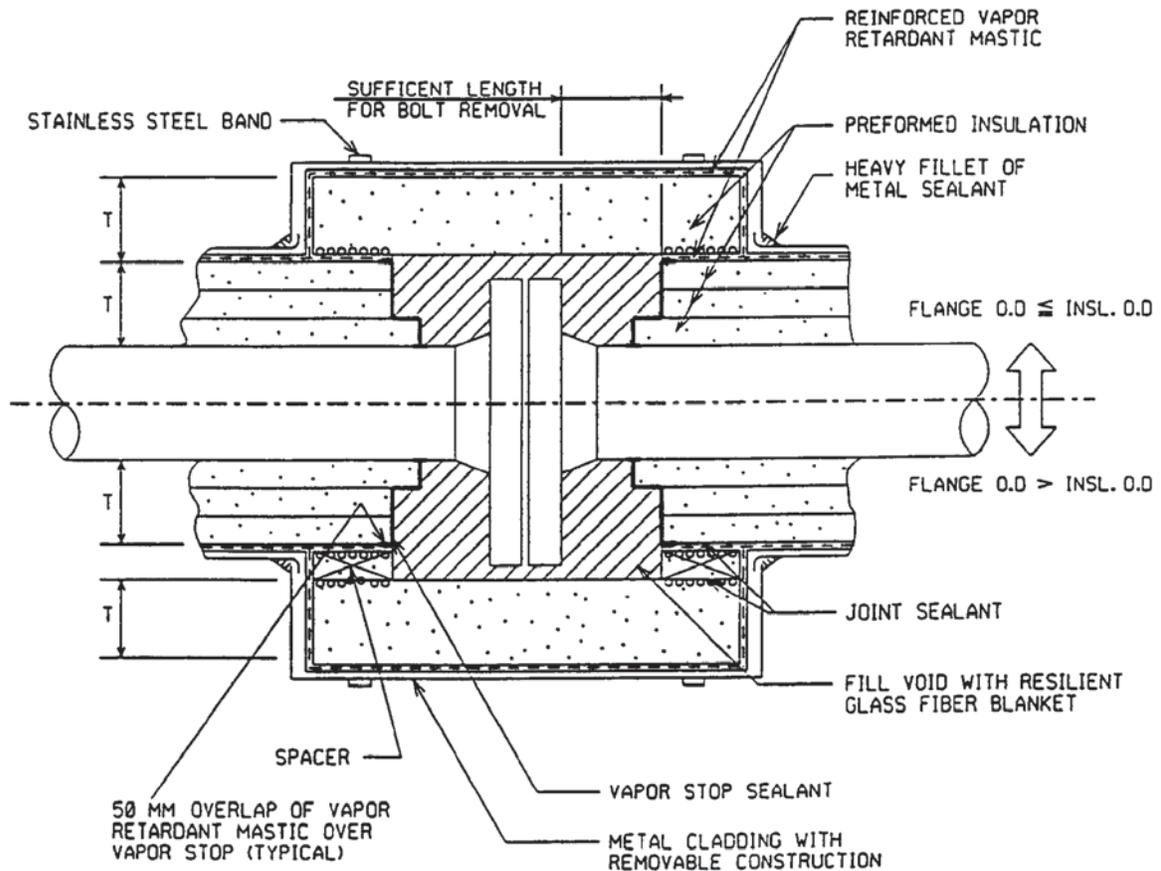


Figure B-12: Insulation Detail-Flanged Joint for Cold Service

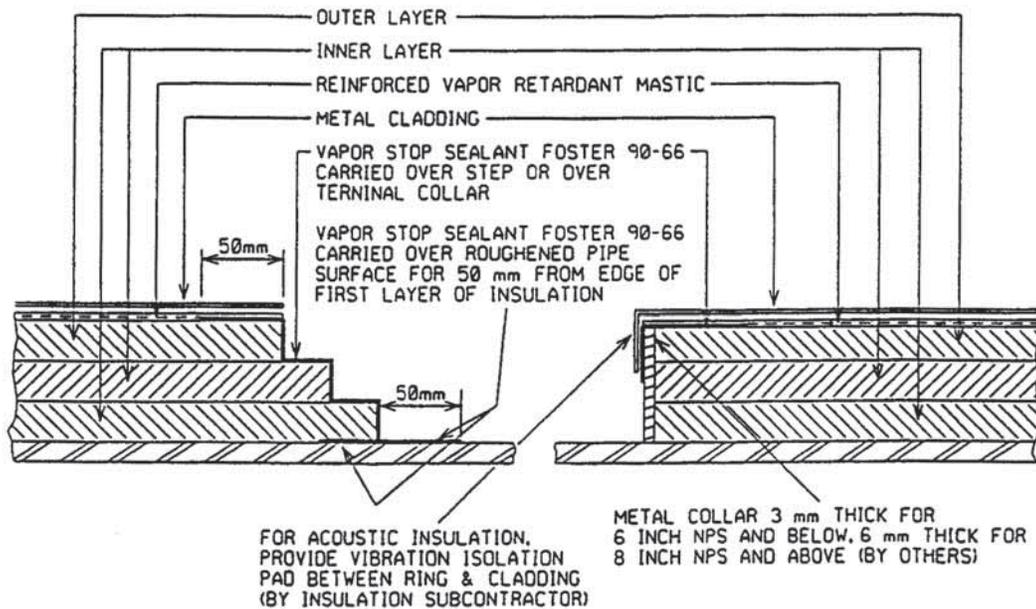


Figure B-13: Details of Vapor Stops and Insulation Terminations for Cold Service

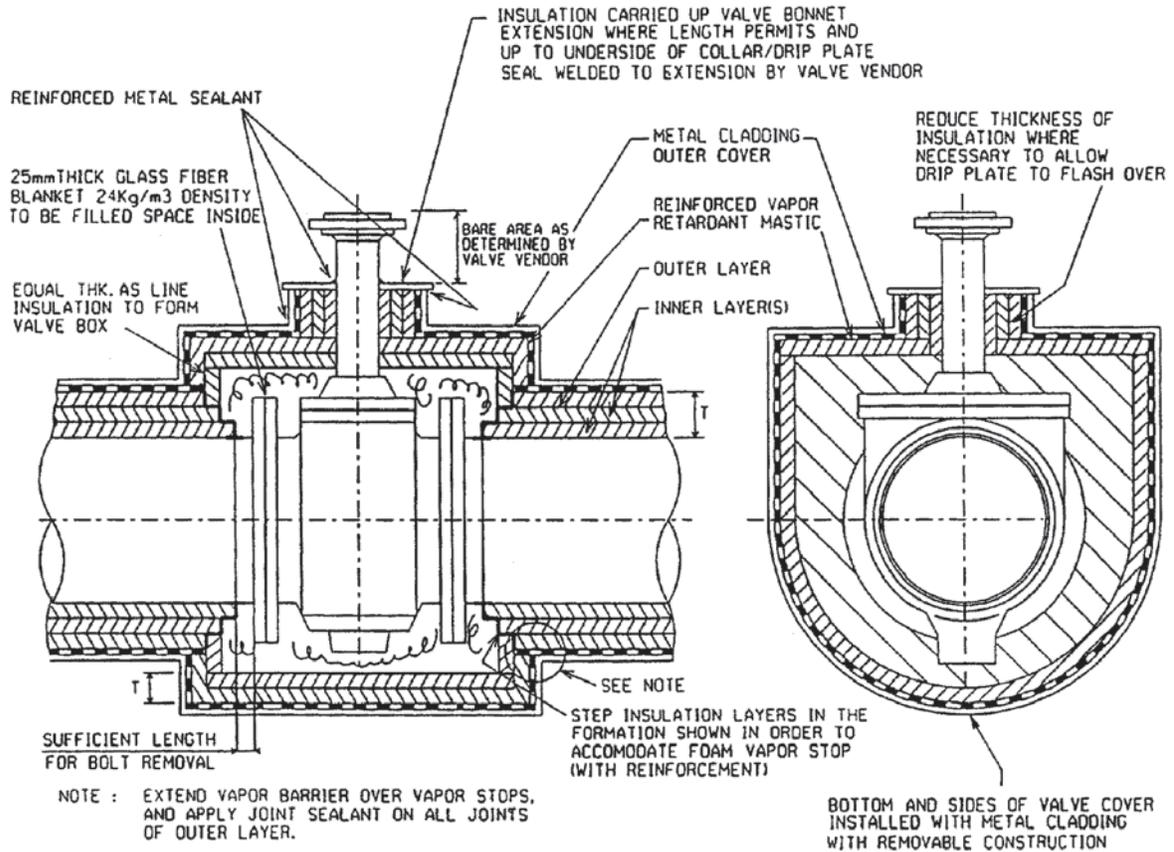


Figure B-14: Installed Insulation for Cryogenic Valves with Extended Bonnets for



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OIL & GAS DEVELOPMENT COMPANY LTD.

SPECIFICATION FOR

SKID MOUNTED PACKAGES



1	23-05-2012	Issued for Tender	MIAH	MAJ	MAS
Rev.	Date	Description	Prepared By	Checked By	Approved By

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1.0 **INTRODUCTION**

1.1 **General**

This specification covers the minimum requirements for the design, manufacture, supply, inspection and testing of skid mounted packages.

1.2 **Definitions**

Following definitions apply throughout this document:

OWNER / COMPANY: Oil & Gas Development Company Ltd. (OGDCL)

CONSULTANT M/s. Zishan Engineers (Pvt.) Ltd. (ZEL).ZEL has been awarded the work of Engineering, Procurement Assistance and Project Management.

CONTRACTOR: Means the construction company to be engaged by the COMPANY to perform the Construction work.

VENDOR / SUPPLIER: The organization, firm or agency with whom order for the supply of equipment and or material has been placed.

1.3 **Errors or Omissions**

1.3.1 The review and comment by the COMPANY of any drawings, procedures or documents referred to in this Specification shall only indicate acceptance of general requirements and shall not relieve the SUPPLIER of its obligations to comply with the requirements of the purchase order.

1.3.2 Any errors or omissions noted by the SUPPLIER in this Specification shall be immediately brought to the attention of the COMPANY.

1.4 **Deviations**

All deviations to Technical Requirements shall be made in writing and communicated to COMPANY at the bidding stage. Written approval of the COMPANY shall be obtained prior to executing the work.

1.5 **Conflicting Requirements**

In the event of conflict, inconsistency or ambiguity between the contract scope of work, this Specification, National Codes and Standards referenced in the Project Specification or any other documents, the SUPPLIER shall refer to the COMPANY whose decision shall prevail.

1.6 **Reporting Procedure**

1.6.1 A full reporting and recording system, to be agreed with the COMPANY, shall be implemented and maintained throughout the duration of the Contract. SUPPLIER shall provide reports and summaries for production performance and testing operations in conformance with a manufacturing schedule approved by COMPANY.

1.6.2 Daily, weekly monthly and run summaries of all major aspects of the production process shall be provided as reports to the COMPANY.

Further, the SUPPLIER shall make testing records available for inspection at any time upon request.

1.6.3 **Third Party Inspection**

In addition to the inspection and witnessing of tests by the inspectors to be appointed by the SUPPLIER during the manufacturing and shipment of the Equipment Material, COMPANY may appoint a third party or its own inspector for witnessing of the inspection and tests to be carried out at manufacturer's facility under this specification.

1.7 **Unit Responsibility**

The SUPPLIER shall be responsible for the complete design, manufacture supply, inspection and testing of the skid mounted packages, including full compliance with all applicable design codes and standards, including those listed in Section 2.0 of this document, and the requirements of the certifying authority (if applicable).

3.0 **SCOPE OF SUPPLY**

- 3.1 The overall scope of supply for each Skid Mounted Package(s) shall be as indicated in the appropriate requisition.
- 3.2 Each package shall be supplied as a self-contained unit mounted on a structural steel skid base, complete with the following as a minimum:
- All necessary interconnecting pipework and valves, terminating at the one edge of the skid, complete with any heat tracing, insulation and supports.
 - All necessary instrumentation and controls.
 - All necessary electric cabling and cable trays.
 - All necessary start-up and commissioning spares.
 - All special tools required for maintenance of the package.
 - All necessary noise suppression equipment.
 - All documentation as requested in this specification and its attachments.
 - Inspection and testing as called for in this specification and its attachments.
- 3.3 The SUPPLIER shall be responsible for the complete design, engineering, coordination, inspection, testing, delivery and proper functioning of the equipment, notwithstanding any omissions from this specification.

To enable the SUPPLIER to offer performance and mechanical guarantees in accordance with the requirements of this specification and the appropriate section of the other referenced specifications, the SUPPLIER, as a minimum, shall be responsible for:

- Sizing of all equipment.
- Selection of materials of construction together with design temperatures and pressures.
- Layout of items of equipment within the specified skid dimensions.
- Procurement and testing of individual items of equipment.
- Assembly and testing of the skid mounted package.
- Full compliance with the requirements of any nominated certifying authority and the supply of all documentation as required to obtain final acceptance certification.
- Confirmation of the final weight, centre of gravity position and dimensions of the skid mounted assembly and its suitability for transportation.

SUPPLIER shall provide at the bidding stage, statement of complete compliance with COMPANY supplied approved Vendor list.

SUPPLIER shall provide a detailed schedule and programme of work for the design, procurement and manufacturing phases of the contract and shall mention explicitly the delivery period for the complete scope of supply.

4.0 **DESIGN**

4.1 **Item Definition**

A skid package is a self-contained, skid-mounted, operational piece of equipment with all interconnecting piping and wiring installed for connecting to utility and process systems. A skid package includes the following items:

- Major equipment
- Auxiliary equipment
- Control panels
- Pressure vessels
- Instrumentation and controls
- Electrical Equipment
- Structural skid base

4.2 **Characteristics**

4.2.1 **Performance**

- a) A skid package shall be suitable for the operating conditions and design life specified in the Technical Requirements.
- b) A skid package shall have a minimum service life of 25 years in the specified environment.
- c) In addition to the design operating point of major equipment, SUPPLIER shall also guarantee performance at the alternate or "off " operating conditions; i.e., additional cases, minimum turndown, or upsets.

4.2.2 **Protection of Equipment**

Protection of equipment during manufacture shall be in accordance with Technical Requirements.

4.2.3 **Reliability**

Reliability shall be in accordance with Technical Requirements. The package / complete skid mounted equipment shall be designed for high reliability and minimum downtime.

4.3 **Design and Construction**

4.3.1 **General**

- a) The skid package shall be designed and constructed to ensure maximum compatibility with other process and/or utility equipment of the plant.
- b) The skid package shall be designed to minimize installation, pre-commissioning, and start-up time.
- c) The skid package shall be laid out to provide for easy access to all equipment and appurtenances. Permanent maintenance and safe access must be provided to all equipment, instruments, electrical items, etc. on the skid.
- d) Changes in process conditions may occur during the life of the equipment. The possibility for changes shall be taken into consideration in determining operational flexibility, layout, and sizing of equipment.

4.3.2 **Equipment Layout and Installation**

- a) Major equipment such as drivers, driven machinery, pressure vessels, and heat exchangers shall include a base plate or another structural support system in accordance with Technical Requirements.
- b) Unless otherwise specified by the individual equipment specification, all equipment shall be attached to the main skid members with high-strength bolts as appropriate.
- c) The placement of all major and auxiliary equipment shall provide sufficient clearance for safe and easy operation and maintenance of the entire package.
- d) If the equipment is fully enclosed, hazard detection and protection equipment and a cooling/ventilating air supply shall be included within the enclosure.
- e) Equipment enclosures shall include access doors, removable sidewalls, or roof panels for operation/maintenance access.
- f) Coolers shall be located to avoid the intake of engine exhaust gases and recirculation of cooler discharge air.
- g) No cabling piping or instrument tubing shall be routed within the skid base.
- h) All equipment shall be located within the package so as to afford easy access for maintenance and personnel safety. No part of the equipment shall overhang the boundaries of the skid.

4.4 **Skid Base**

The complete package (including all major components, vessels, auxiliary equipment, and local controls) shall be mounted on a rigid structural-steel skid. Interconnecting piping and wiring shall be installed and ready for operation. Individual skids for packaged equipment shall not exceed the dimensions specified in the Technical Requirements without prior written approval of COMPANY.

If more than one skid is necessary to mount equipment packages, the skids shall be designed to be rigid when joined. The design shall be submitted to the COMPANY for approval.

Where the skid is too large for handling or transportation on land, it may be subdivided into sections for re-joining and bolting together on site. In such cases, all equipment upon the skid, including interconnecting piping and cabling, shall be preassembled and match marked before disassembly to assist re-assembly on site.

Skids shall be designed in full accordance with sound structural engineering principles and the American Institute of Steel Construction (AISC) specifications, where applicable. Skids shall be of all welded construction.

The skid shall be fabricated in accordance with the Technical Requirements.

When a single lift point from the skid base is impractical due to location of on-skid equipment, SUPPLIER shall supply suitable spreader beams or lifting frame, complete with all slings and shackles. Spreader beams/lifting frames shall be of all welded construction using full penetration welds and shall be designed for the same load factor as skid lifting lugs.

The primary beams (longitudinal base members) shall be considered to be simply supported with the support locations occurring at the extreme ends of the beams. The maximum allowable deflection of any primary beam shall be 1/500 of the span between supports under conditions of dead, plus superimposed, loads.

Cross members shall be designed on a similar basis and sized such that the top faces are in line and flush with the top faces of the primary beams, whilst the lower faces shall be such so as to give a minimum of 40mm ground clearance.

The spacing of cross members shall not exceed the maximum allowable unbraced length of compression flange for the primary beams (defined in the AISC specification).

Slots shall be provided within the skid base members to allow retained liquids to drain away e.g. during wash-down.

The primary members shall be adequately cross-braced to prevent flexing or distortion of the skid during transportation and installation. Equipment mounted on the skid shall not be considered as contributing to the structural strength or bracing of the skid.

The underside of skid frames shall be left flat to provide a continuous bearing surface and bolt holes or bearing pads shall only be provided where so indicated on the data sheet.

Where alignment of machinery is critical SUPPLIER shall propose a point-mounted skid, using bearing pads, as an alternative to his standard. The position of the support parts shall be agreed with the COMPANY. Where required all machinery shall have suitable anti-vibration mounts provided between the machine and the skid or between the skid and the deck.

Where required flexible bellows shall be fitted to prevent vibration transmission through ducting or piping.

All other types of skids should be reviewed against the calculated or known deflection of the platform deck and the exciting forces.

Foundation bolts shall be supplied by SUPPLIER. SUPPLIER shall provide full details of the size and number required.

The skid base, associated steelwork and all equipment shall be designed for a basic wind speed of 50 m/s at 10 m above sea level. Wind pressure and stress analysis shall be computed in accordance with ANSI A58.1.

Skids shall have hot dipped galvanized steel bar floor grating covering the entire top surface with cutouts for supports and/or equipment. Floor grating shall not be used as a mounting surface for equipment or supports. Floor grating shall be fully located by side and end stops and suitably bolted or clipped.

Grating to be in removable sections, each section and all cutouts to be completed with flat edging bars. Where grating sections are cutout around equipment and edging bars welded in to suit, complete section of flooring shall be re-galvanized to original specification. Cold galvanizing of re-worked areas is not acceptable.

Metal thicknesses at the point of equipment bolting shall not be less than 10mm.

Pad-eye type lifting lugs shall be welded to the skid with full penetration welds. The pad-eyes shall be designed for a minimum load factor of 2.0, with no increase in AISC permissible stresses, on the calculated force and for all sling angles between 45 and 75 degrees to the horizontal, as obtained from a single point lift.

Jacking screws, of robust design and construction shall be provided on all skids supporting heavy machinery in order to facilitate lateral and axial movement of each equipment during alignment.

Skid bases shall be provided with two earthing bosses suitable for termination of 70 sq. mm earth cable.

All items such as equipment, valves, controls, instruments, and piping forming a part of the skidded assembly shall be installed such that they are located entirely within the confines of the skid base. The projection of such items beyond the edge of the skid base is strictly prohibited, unless approved in writing by COMPANY.

Valve hand wheels and equipment requiring frequent or regular maintenance shall be positioned on the skid for easy access.

Additional details such as the deck-support structures and weight control requirements shall be furnished to COMPANY as required.

4.5 **Ancillary Structures**

All ancillary support structures shall be designed so as to withstand all superimposed loads, including wind loadings in accordance with the AISC specifications.

Access ways, handrails and ladders shall conform to the requirements of API RP 2A, and shall be provided for operating and maintenance access to all instruments, controls and valves when located more than 1.5m above the skid floor.

All piping and cabling shall be suitably supported for service and shipment. The support and installation shall be designed to allow for piping and cabling to be removed without the cutting of structural members.

Where filter type units with removable heads and/or internal elements form part of the package equipment, permanent handling facilities shall be provided on the package for removal of head/elements. This requirement applies when the weight of any single component exceeds 25kg or where easy access is not available.

4.6 **Vessels**

All vessels shall comply with the Technical Requirements.

Vessel internals shall be designed in accordance with the particular service of the vessel and shall be readily removable through a convenient manway. The internals shall be designed so that the performance of the vessel will meet the minimum requirements specified in the data sheet and shall be suitably fixed in position by the provision of bolts or clamps. Loose internal equipment is not permitted.

Any internals, which require periodic maintenance or are liable to heavy wear shall be designed for ease of removal from the unit and shall be provided with permanent access facilities.

All liquid outlet nozzles shall be fitted with vortex breakers unless otherwise stated in the data sheet.

4.7 **Exchangers and Fired Heaters**

Thermal and mechanical design of exchangers, including vibration analysis for shell and tube type shall be provided by the SUPPLIER. Fouling factors used shall be specified on the data sheets.

Fired Heaters, Shell and tube exchangers and other equipments shall comply with the Technical Requirements.

4.8 **Piping, Valves and Fittings**

Piping shall provide proper flexibility and shall be easily accessible for operation, maintenance, and thorough cleaning.

Piping systems shall be routed and supported so as to have sufficient flexibility to allow for thermal expansion and contraction, and for platform movement. SUPPLIER shall demonstrate to the COMPANY that suitable flexibility analyses has been carried out.

SUPPLIER shall minimize forces and movements imposed on Offskid pipework and shall provide a complete set of forces and moments at each Termination point in order that COMPANY may complete analysis of adjacent piping systems. Alternatively, piping which interfaces with off-skid piping shall be anchored such that it places no resultant forces or moments on the off-skid piping.

Piping within the package shall be installed, fabricated, inspected and tested in compliance with Technical Requirements.

Piping and tubing shall be firmly mounted in a neat and orderly arrangement. Piping and tubing shall not obstruct access for operation, maintenance, or adjustment.

Where appropriate all piping on the skid that is common, i.e. drains or vents should be piped together and terminate with a single flange at the skid edge.

Interconnecting piping and fittings shall be prefabricated and mounted permanently within the package prior to testing and acceptance.

Interconnecting skids shall be joined by flanged piping and such piping shall be checked for proper fit-up by assembly in the SUPPLIER'S shop.

Package piping connections to plant Off-skid process and utility systems shall be grouped at a single location at the skid edge.

All piping shall be routed to provide a neat and economical layout, to have the shortest run consistent with Good Engineering Practice and to ensure easy access to all in-line valves and instrumentation. No piping shall be routed across walkways or access-ways unless they are elevated a minimum of 2.13m above the top of grating level.

Sufficient space shall be allowed between lines to permit ready access for removal/repair but in no instance shall there be a distance of less than 25mm between a pipe and the outside of the largest flange or fitting in the adjoining pipe. Insulation thicknesses and thermal movement of piping shall be taken into account when determining these spacings.

The minimum vertical clearance for all piping systems from top of flooring shall be 200mm.

Piping at all equipment shall be supported so that equipment, control valves etc can be readily removed without provision of temporary piping supports and arranged so as to minimize pipework dismantling.

Pipe supports shall be provided adjacent to skid edge for all external piping connections. Plate type supports with rigid fixing through pipework flange bolting are not acceptable.

All access platforms and walkways shall have a minimum clear width of 800mm. No piping, instrumentation or cable runs shall impinge on this minimum requirement. Equipment and piping shall be installed with supports so as to prevent vibration.

All piping termination points, including inlets, outlets, utilities and drains shall terminate in ANSI B.16.5 flanges of the appropriate rating having a minimum size of 2 in unless otherwise approved by the COMPANY. The pipework shall be constructed to allow complete draining of equipment and shall have plugged vents at high points to facilitate venting and hydro testing.

All piping connections shall terminate at the edge of the skid. SUPPLIER shall provide a suitable termination flange schedule with the general arrangement drawing(s). Final orientation of termination points shall be subject to COMPANY'S approval.

If standby components are provided, valves shall be installed as necessary to bypass and/or allow removal of the components for maintenance without the necessity of draining systems or shutting down the driver or driven equipment.

Piping supports shall comply with the Technical Requirements. Piping supports shall allow piping to be removed without cutting the main structural members.

4.9 **Materials of Construction**

SUPPLIER shall ensure that the design and selection of materials of construction for equipment are chosen to avoid the possibility of galvanic corrosion where necessary by the use of suitable insulation gaskets or spools.

4.10 **Instrumentation & Control**

Unless otherwise specified, the package control and instrumentation systems shall provide sequential start-up, stable operation, warning of abnormal conditions, monitoring of operating conditions, and shutdown of the associated equipment in the event of impending damage to the equipment or operating personnel.

System shall be designed for failsafe operation. The package control system shall be pneumatic and/or electrical, as specified.

SUPPLIER shall supply all piping, tubing, valves, and fittings for all instruments and instrument panels.

All instrumentation and controls shall be furnished in accordance with the Technical Requirements as mentioned in clause 1.2.

Where instrument air is required on the package, a galvanized carbon steel air header in accordance with Technical Requirements shall be provided. Air header shall be 1" NB minimum and shall be mounted adjacent to all instrument air users. Each user shall be connected to the main header using suitable tubing, fittings or adapter as required. The main header shall also have 2 Nos. spare connections with block valves. All take-offs shall be from the top of header.

All instrument cables shall be run in cable trays or conduits on the skid. Sizing of tray conduit and routing shall be decided by the SUPPLIER as per the skid layout requirements.

Trays and conduits shall be installed with proper supports and all necessary accessories complete in all respects. All instrument cables shall be terminated properly using proper lugs.

Cables from all instruments shall be terminated in a skid mounted Junction Boxes, (and terminal block in PLC cabinet, wherever PLC is included in the package).

The junction box shall be explosion proof suitable for Class I, Div. 1 with proper glanded cable entries and standard earthing terminal sails.

Where a Local Control Panel or Annunciation is provided the equipment shall be protected with a suitable weather hood.

Control panels shall be locally mounted on the skid or remotely mounted in a nonhazardous control room as defined in the Technical Requirements.

Independent control panels shall be provided for each equipment package.

Locally mounted electrical and pneumatic control panels shall be in accordance with the Technical Requirements. Control panels shall be suitable for an uncontrolled environment and the area classification specified.

Control panels and controls shall be completely piped, wired, and tested.

The necessary alarms and shutdown devices for each piece of equipment in the package shall be installed on control panels.

Alarms and shutdown devices shall include fail-safe circuitry.

Status indicators shall be provided to indicate running, service functions, and fault conditions with first out indication dependent on the equipment contained within the package. Status indicators shall be provided as specified by the Technical Requirements as mentioned in clause 1.2.

All non in-line instruments shall be provided with suitable stands. Instruments may be supported on Package Steelwork where location and access is suitable. Instruments shall not be supported off Process Pipework.

SUPPLIER shall supply Instrument location drawing separate from Package General Arrangement, highlighting true positions of all instruments in both Plan and Elevation.

Tubing shall be in accordance with the Technical Requirements and shall comprise of Swagelok or similar fittings. Mixing of fitting manufacturers is not allowed.

Tubing connections from the package to the platform controls or control panels shall be completely piped to a bulkhead plate. The bulkhead plate shall be located at the skid edge. Tubing connections shall be terminated with bulkhead fittings.

Bulkhead fittings shall have Female National Pipe Threads (FNPT).

Tubing shall not block equipment requiring access for operation and maintenance, and shall permit easy removal of items for servicing.

Flexible stainless steel braided hose shall be installed in applications requiring adjustment or flexibility such as belt tensioning, equipment alignment, or vibration isolation.

4.11 **Electrical**

Electrical wiring within the package shall comply with Technical Requirement. Unless otherwise specified, wiring shall be metal-clad cable installed in copper-free aluminum or fiberglass cable trays. Mineral-insulated cable shall not be accepted unless specified by the Technical Requirement.

All cabling requiring to be connected to COMPANY'S supplies/cabling, shall be provided with junction boxes adjacent to the skid edge and located to suit the COMPANY'S layout requirements. Junction boxes shall be positioned at the edge of the skid to facilitate connecting with external services and control systems. Where Local Control Panel or Annunciation is provided complete hook-up to Panel shall be carried out by SUPPLIER.

Electrical cable shall be routed to minimize the likelihood of mechanical damage.

Electrical lines greater than 208 VAC, such as power leads and motor starters, shall have empty cable tray running to the skid edge. Cable trays shall be of heavy duty type with deep flange to further protect cable runs. The cable will be installed and interconnected at the fabrication site by others.

All electrical equipment provided on skid including electrical heaters, fan coolers and pump motors shall be provide with explosion proof terminal block suitable for Class I, Div. 1.

The power equipment voltage rating for all skid mounted electrical equipment shall be communicated to the COMPANY by the SUPPLIER.

Power supplies available to the package shall be as specified in the equipment requisition or attachments. If any voltages outside this supply are required these must be generated by the Package Equipment from these supplies.

Electrical equipment, which requires external support shall be provided with purpose built stands or may be supported from Package Steelwork where suitable. Electrical equipment shall not be supported off Process Pipework.

Where junction box/control panel cable glands are bottom entry (preferred arrangement) equipment shall be so located as to allow adequate space for routing and glanding off cables.

4.12 **Bolting**

All internal bolts shall be provided with double locking nuts or other suitable securing device approved by the COMPANY.

All external bolting shall be cadmium plated for protection.

4.13 **Insulation**

Unless otherwise agreed the SUPPLIER shall be responsible for the provision of all necessary insulation for heat conservation or the safety and protection of personnel in accordance with the applicable statutory requirements. This shall include the provision of suitable lagging and cladding on hot & cold surfaces within easy reach of operatives. The insulation shall comply with the Technical Requirements.

In no circumstances shall insulation materials contain asbestos.

4.14 **Lubrication**

Each piece of equipment in the package shall be provided with the necessary lubrication system and fittings.

4.15 **Noise**

The noise levels from each skid shall comply with the requirements of API 615 but shall not exceed 85 dBA at 1 m unless stated otherwise on the data sheets, or separately approved by the COMPANY.

4.16 **Painting and Protective Coatings**

Painting and application of protective coatings shall be done in accordance with project painting specification (165-4-SPM-058)

4.17 **Identification and Marking**

Corrosion-resistant, 316L stainless steel nameplates or tags shall be securely attached to all identifiable pieces of equipment.

Rotating equipment shall have arrows indicating the direction of rotation. Rotation shall be cast into the equipment or stamped on 316L stainless steel plates and mounted with 316L stainless steel fasteners.

Major equipment such as pumps and compressors shall be supplied with a permanently attached, 316L stainless steel nameplate with the following information as a minimum:

- Manufacturer
- Manufacturer's type
- Serial number
- Item or tag number
- Size

- Maximum allowable design conditions - pressure, flow, temperature and speed.
- Equipment Weight in Kg
- Power rating or kilowatt (KW)
- Year of production

Nameplates on engine drivers shall include the following information as a minimum:

- Manufacturer
- Manufacturer's type
- Serial number
- Rated speeds
- Trip speeds
- Ambient ratings
- Power rating (KW)
- Year of manufacturer
- Weight in Kg

Instrumentation shall include securely attached stainless steel tags. Each tag shall include the identification shown on the process and instrumentation drawings as a minimum.

Piping connections shall be tagged for identification as designated on the flowsheet diagram.

Bulkhead fittings shall have numbered identification tags to facilitate field hook-up.

Nameplates and tags shall be attached to equipment with stainless steel screws or rivets. Adhesive shall not be acceptable. Tags may be attached to items with stainless steel wire only if screws or rivets are impractical.

Field connections shall be identified with a stamped or engraved stainless steel tag attached with stainless steel wire. The tag shall be painted red and shall identify connection points and applicable reference drawings.

Instrument tubing shall be clearly identified at both ends and at junction points. Instrument and electrical cables shall be clearly identified at both ends and at junction points.

4.18 **Safety**

Safety precautions shall be in accordance with the internationally accepted standards with the following additional requirements:

The noise under normal operating conditions shall not exceed 85dB.

Sufficient instrumentation shall be provided for safe operation of the package. The instrumentation shall include an automatic shutdown system.

SUPPLIER shall pay particular attention to ensure that all electrical equipment and installations are suitable for specified area classifications.

Metal guards shall be provided. The guards shall not be more than 13 mm (1/2 inch) away from stationary housings adjacent to all moving parts. This includes parts such as drive belts, cooler fans, and extension shafts. Wood or plastic shall not be acceptable guard materials.

Exposed surfaces subject to temperatures in excess of 60°C shall be insulated for personnel protection. The thermal insulation shall be suitable for extended service life in the specified environment and shall be in accordance with Technical Requirements.

Asbestos and asbestos products shall be specifically prohibited.

4.19 **Supplier Requirement**

SUPPLIER requirements shall be in accordance with the Technical Requirement with the additional qualification that the SUPPLIER shall assume full responsibility for engineering coordination of the major equipment, auxiliary equipment, piping, and other appurtenances within the package.

4.20 **Documentation Requirements**

Documentation shall be provided in accordance with the following requirements:

General

SUPPLIER shall provide documentation that verifies:

- Equipment of similar size and configuration has been supplied within the past 7 years.
- The equipment has been performing satisfactorily for at least one year.
- Equipment list, comprehensive startup, operating and maintenance documentation for all equipment shall be provided in hard copy and electronically to COMPANY. The number of required hard copies and electronic versions shall be determined within the Tender document.

A lubrication schedule shall be provided to ensure maximum equipment service life. The lubricating schedule shall detail the location, type, and frequency of service requirements for each system.

Drawings

SUPPLIER shall provide the COMPANY with drawings showing the number, type, and location (in plan and elevation) of all piping, electrical, and instrumentation connections and associated sizing and specifications. Skid connections shall be referenced on the drawings from one common reference point. SUPPLIER shall provide piping drawings with bills of material and verify compliance with the piping and instrumentation diagrams and the piping and instrumentation specifications. All dimensions shall be in metric units. The drawings shall also include the following:

Arrangement, location, and method of fastening all equipment to skids or base plates.

Center of gravity for:

- Lift condition. This is comprised of the total weight of the skid package ready for shipment.
- Nonoperating, dry in-place condition. This shall encompass the total weight of the skidded package when installed but not operating. No live loads are to be considered and all vessels and piping are to be empty.
- Operating in-place condition. This shall encompass the total weight of the installed skid and all live loads that will occur during normal operation of the unit. The weight of fluids and solids in the process equipment and piping shall be included.
- Hydrostatic test in-place condition. This condition applies only to skidded units that will be hydrostatically tested. It does not apply to equipment that will be pressure tested with air. Weights to be considered shall be those for the nonoperating in-place condition plus the weight of water when all vessels and piping are filled.

SUPPLIER shall determine the total weight of the package for each of the conditions indicated above. SUPPLIER shall indicate the units of weight measured in metric. This data shall be included on the drawing showing the locations of the centers of gravity.

5.0 **FABRICATION AND ASSEMBLY**

5.1 **General**

Approval of all SUPPLIER'S drawings, weld procedures, calculations, etc. is required by the COMPANY and the certifying authority, where applicable, prior to the commencement of fabrication.

5.2 **Welding**

All welding shall be in accordance with the requirements of the appropriate code i.e.:

- Structural ANSI/AWS-D1.1
Project Specification for Structural Steel and the
Welding and Inspection of offshore structures.
- Piping ANSI B31.3
- Vessels/Exchangers ASME VIII DIV 1, ASME IX

Welders shall be suitably qualified for the work undertaken.

5.3 **Assembly**

The Supplier shall be required to submit an assembly procedure for the skid mounted assembly detailing the order of erection.

5.4 **Materials**

Materials of construction of the skid shall comply with the requirements of the Project Specification for Steel Structural, where applicable.

6.0 **QUALITY ASSURANCE PROVISIONS**

Quality assurance provisions shall comply with the following requirements.

6.1 **Tests**

6.1.1 **Responsibility for Tests and Inspections**

The overall installation and testing program shall be incorporated in the master schedule. SUPPLIER shall notify the COMPANY in writing at least 30 calendar days prior to the following events:

- Initiation of fabrication
- Completion of final assembly
- Final inspection
- Pressure tests
- Shipping of equipment
- Mechanical tests

SUPPLIER shall inform SUB-SUPPLIERS of the project inspection requirements. SUPPLIER shall be responsible for furnishing COMPANY with all specified certification on materials and with shop test data verifying that the specifications are being met.

SUPPLIER shall maintain a record of shop test data for at least 18 months after the date of shipment. If specified, certified copies of test data shall be submitted to COMPANY prior to shipment.

6.1.2 Tests and Inspections for Components and Systems

The mechanical operation of all equipment shall be satisfactory during the running test. Speed governors, alarm and trip functions, and overspeed shutdown devices shall be tested to verify proper operation.

Pressure parts shall not be painted until inspections are complete. Parts, material, and equipment purchased by SUPPLIER shall be subject to the shop inspection.

Equipment installed on skid-mounted packages shall receive a mechanical running test prior to shipment as per details given in Technical Requirements. The proper mechanical operation of all auxiliary equipment, prime movers, and driven equipment shall be confirmed during testing.

Welding of piping and vessels shall be inspected in accordance with the Technical Requirements.

Hydrostatic and mechanical testing procedures should be submitted to CONSULTANT and subject to the approval by COMPANY.

Component quantities, description, and test data shall be checked for compliance with the Technical Requirements.

Point-to-point electrical continuity tests shall be conducted.

Equipment shall be checked for proper voltage, phase, and frequency.

Equipment shall be energized and equipment functional tests shall be conducted, including the running of all motors. The final operational tests shall cause relays and solenoids to function by simulation of control actions. This test shall demonstrate the functional integrity of all control circuits.

In cases involving explosion proof equipment, seals shall not be poured until inspection is completed and approval to pour has been granted by COMPANY.

Proper installation of grounding points shall be verified.

6.1.3 Special Tests and Examinations

Piping on assembled skid units shall be pressure tested.

Tanks fabricated into the skid shall be pressurized with air to 0.05 barg and tested for leaks with a soap bubble test.

Drip pans shall be filled with water and checked for leaks and proper drainage.

Minimum standards for pressure testing shall be in accordance with the Technical Requirements.

6.1.3.1 Hydrostatic Tests

Hydrostatic tests shall be performed on vessels, tanks, and piping as required by the Technical Requirements.

All pressure vessels and piping shall be hydro tested in accordance with the appropriate project specification and code requirements.

Process piping or tubing shall be tested with water after shop fabrication into subassemblies.

The normal test pressure for piping shall be 1.5 times the adjusted cold pressure rating of the valves, fitting, expansion joints or other limiting elements in the line. The normal test pressure for vessels and tanks shall be as per requirements governed by applicable codes or standards.

Pressure testing shall be maintained long enough to permit complete inspection but shall not be less than 60 minutes.

6.1.3.2 Equipment Performance Tests

All equipment shall be subjected to an individual performance test where appropriate in accordance with the Technical Requirements as mentioned in clause 1.2.

Performance test curves and certificates shall be provided.

When required by the COMPANY'S Inspector, all equipment, after performance testing shall be dismantled for a visual inspection of the internals.

6.1.3.3 Assembled Skid Testing

Piping on assembled skid units shall be pressure tested as per requirements given in ASME B31.3. Hydrostatic tests shall be witnessed by the CONSULTANT and/or any 3rd Party appointed by the COMPANY.

Minimum standards for pressure testing shall be in accordance with the Technical Requirements.

The completed pipe work assembled on the package shall be subject to leak test to a pressure as proposed by the SUPPLIER and approved by the COMPANY in the SUPPLIERs works to verify integrity of all joints. Drip pans shall be filled with water and checked for leaks and proper drainage.

The completed assembly shall be given a full functional test including instrumentation and electrical equipment at the SUPPLIER's works. During the test all alarms, shutdown and remote signals shall be simulated.

The SUPPLIER shall be required to submit a full testing procedure, including a check list in accordance with API 700, at least 6 weeks prior to the commencement of testing and covering the full extent of testing on the completed assembly. The testing procedure shall be approved by the COMPANY prior to the commencement of testing and shall be complete with all equipment procedures and check lists. The SUPPLIER shall be responsible for providing all necessary utility services to conduct the tests.

6.1.3.4 Functional Tests

The SUPPLIER shall be responsible for ensuring all calibration and test equipment has valid certification.

All instrument functions shall be verified by using water or instrument quality air as a substitute for the process liquid/gas to prove the integrity of the control equipment/instrumentation.

6.1.4 Cleanliness Inspections

COMPANY reserves the right to a final inspection for cleanliness of all equipment components and all piping and appurtenances furnished by or through SUPPLIER prior to final assembly of any of the components. SUPPLIER shall provide 5 days prior written notice to COMPANY that the equipment is clean and ready for inspection.

Special care shall be taken to wash fingerprints from highly polished machine surfaces prior to the application of rust preventatives. Equipment shall be promptly closed after acceptance of the equipment.

Pressure lubrication systems shall meet the cleanliness requirements of API 614 paragraphs 4.3.3.7 and 4.3.3.8.

6.2 **Quality Conformance Inspections by Supplier**

6.2.1 Structural

All structural members shall be designed to comply with the Technical Requirements.

Welds shall be examined by magnetic particle or other approved inspection methods in accordance with the Technical Requirements.

Pad eyes shall be designed in accordance with Technical Requirements and with the International standards and codes.

6.2.2 Final Inspection and Test

6.2.2.1 General

The package shall be complete in all respects before inspections and tests. The functional operation of the complete package shall be tested.

6.2.2.2 Final Inspection

Unless otherwise advised by COMPANY in writing, final inspections and hydrostatic testing shall not be performed unless COMPANY Representatives are present, or has waived right to inspection in writing. Such inspections and testing made in the COMPANY'S absence without COMPANY waiver shall be repeated in the COMPANY'S presence at the SUPPLIER's expense.

The dimensions of all components including interconnecting piping shall be checked for compliance with the Technical Requirement. COMPANY shall be notified if a component is not found to be within the tolerances allowed by the Technical Requirement.

The adequacy of piping and equipment supports, lifting lugs, slings, and clamps, including size and location, shall be verified. Painting inspection shall be comprised of the following:

- SUPPLIER shall verify that painting complies with the Technical Requirement.
- SUPPLIER shall check general appearance.
- SUPPLIER shall verify that paint has been removed from all control valve stems, instrument glass, nameplates, flange faces, and other machined surfaces, and other items that are not specified to be painted.

Miscellaneous checks shall comprise the following:

- SUPPLIER shall check adequacy of the compartment or skid drains.
- SUPPLIER shall check general appearance, workmanship, and operability for things such as correct height of push button stations.
- SUPPLIER shall check for safety hazards such as conduit installed over walking surfaces (tripping), and burrs on surface of handrails.

6.3 **Material Testing and Certification Requirements**

Material requirements shall be as detailed in the Technical Requirement.

Inspection procedures and acceptance criteria shall be in accordance with the requirements of the applicable design code and the certifying authority (where applicable).

7.0 **PERFORMANCE GUARANTEES**

The Supplier shall be required to guarantee that the completed assembly will meet the minimum performance requirements as stated in the data sheets, when operating under the stated design conditions.

The SUPPLIER may, at the option of the COMPANY, be required to be present at, or to perform, site tests on the assembly in order to prove its performance.

8.0 **PAINTING AND PREPARATION FOR SHIPMENT**

8.1 **Painting and Protective Coating**

Painting and protective coating and the procedures for preparation for painting shall be in accordance with the Technical Requirements.

8.2 **Preparation for Shipment**

Preparation for shipping and storage shall be in accordance with the Technical Requirements, with the following additional requirements.

8.2.1 **General**

Each skidded component shall be either securely anchored to the skid or removed to prevent damage during shipment. All instruments and any equipment removed from the skid for shipment shall be tagged and crated in waterproof boxes constructed from 51 mm (2-inch) lumber. Instruments shall be packed with sufficient desiccant for protection in transit and during storage at the job site. Boxes shall be securely attached to the skid for shipment. The contents of each box shall be clearly stated on the outside of that box.

Any equipment extending beyond the skid edge together with any other equipment or component parts removed for shipment purposes shall be tagged and crated in waterproof boxes constructed from 51mm (2-inch) lumber.

Exposed machined and threaded surfaces shall be coated with an easily removable rust preventative.

All flanged openings shall be protected with steel plate covers attached by proper bolting and sealed with a plastic compound.

Openings, threaded connections, wires, valve stems, and other component parts subject to mechanical damage or corrosion shall be adequately protected. Such protection shall consist of, but not be limited to, bolted metal flange covers, sealing with waterproof tape, enclosing with temporary metal housings, and coating all machined and threaded surfaces with a rust preventative. This protection shall be applied to all components, those removed and boxed and those remaining in place on the skid assembly.

Piping and handrails removed for shipment shall be properly tagged and secured to the skid from which it was removed.

Doors and windows in modules shall be protected from damage by covering with 19 mm (3/4-inch) plywood.

Overhead cranes shall be secured with a temporary locking device and bolted shipping blocks to prevent movement during shipment.

8.2.2 Inventories

Inventories as indicated below shall be made by SUPPLIER and submitted to COMPANY prior to shipment. Such inventories shall account for all items deliverable according to the governing equipment specification.

An inventory of all major or tagged items installed on the skid for shipment

An inventory of all items removed and secured to the skid for shipment

A complete inventory of all boxes and the detailed inventory of the contents of each box.

Each crate, bag or package shall be clearly identified with the purchase order number and identification symbol and shall be securely fastened to the skid.

8.2.3 Approval

The skid shall not be shipped before compliance with the Technical Requirements has been verified, and released by COMPANY. If components are dismantled during preparation for shipment, instructions for their reassembly shall be included.



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OIL & GAS DEVELOPMENT COMPANY LTD.

SPECIFICATION FOR

UNFIRED PRESSURE VESSELS



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1.0 **INTRODUCTION**

1.1 **General**

This specification is a standard specification for Unfired Pressure Vessels and outlines the minimum requirements of the COMPANY.

1.2 **Definitions**

Following definitions apply throughout this document:

OWNER / COMPANY: Oil & Gas Development Company Ltd. (OGDCL)

CONSULTANT: M/s. Zishan Engineers (Pvt.) Ltd. (ZEL).ZEL have been awarded the work of Engineering, Procurement Assistance and Project Management.

CONTRACTOR: Means the construction company to be engaged by the COMPANY to perform the Construction work.

VENDOR / SUPPLIER: The organization, firm or agency with whom order for the supply of equipment and or material has been placed.

1.3 **Errors or Omissions**

1.3.1 The review and comment by the COMPANY / CONSULTANT of any SUPPLIER's or its manufacturer's drawings, procedures or documents shall only indicate acceptance of general requirements and shall not relieve the SUPPLIER of its obligations to comply with the requirements of this specification and other related parts of the contract documents.

1.3.2 Any errors or omissions noted by the SUPPLIER in this Specification shall be immediately brought to the attention of the COMPANY.

1.4 **Deviations**

All deviations to this specification, other specifications or attachments shall be brought to the knowledge of the COMPANY as a section in the bid. All deviations made during the procurement, design, manufacturing, testing and inspection shall be with written approval of the COMPANY prior to execution of the work. Such deviations shall be shown in the documentation prepared by the SUPPLIER.

1.5 **Conflicting Requirements**

In the event of conflict, inconsistency or ambiguity between the contract scope of work, this Specification, National Codes and Standards referenced in this Specification or any other documents, the SUPPLIER shall refer to the COMPANY whose decision shall prevail.

1.6 **Reporting Procedure**

1.6.1 A reporting and documentation system shall be agreed between the COMPANY and the SUPPLIER for the status of procurement, design, manufacturing, inspection, testing and shipment of the equipment/material to be supplied under this specification. SUPPLIER'S manufacturer shall provide reports and summaries for production performance and testing operations in conformance with a manufacturing schedule approved by COMPANY.

1.6.2 Weekly, monthly and run summaries of all major aspects of the production process shall be provided as reports to the COMPANY.

1.7 **Unit Responsibility**

The SUPPLIER shall be responsible for the complete design, manufacture supply, inspection and testing of the vessels, including full compliance with all applicable design codes, and standards, including those listed in Section 2.0 of this document and with the requirements of the independent certifying authority, where applicable.

2.0 **REFERENCE CODES & STANDARDS (LATEST EDITIONS)**

a) **ASME Codes ***

Section VIII	Division I & Division II (Pressure Vessels)
Section IX	Welding Qualifications
Section V	Non-destructive Examination
Section II	Materials
Section II, (Part C)	Welding Rods, Electrodes and Filler Materials

b) **ANSI Standards (Latest Editions)**

B16.5	Steel Pipe Flanges
B.16.20	Metallic Gasket for pipe Flanges
B16.9	Factory Made Wrought Steel Butt-Welding Fittings
B36.10	Wrought Steel Pipes
B36.19	Stainless Steel Pipes
A58.1	Building Code Requirement for Minimum Design Loads in Building and Other Structures.
MSS SP-44 or ANSI B16.47	Steel pipe line flanges for Dia > 24"

- c) Steel Structures Painting Council Specification for Surface Preparation and Painting System
- d) In addition to the requirements of this specification, all requirements of the governing authority, i.e. the country and/or its sub-divisions, where the vessel is to be installed shall be met.
- e) Project Specifications
 - Specification for Welding : 165-4-SPM-034
 - Specification for Painting, Lining and Surface Preparation : 165-4-SPM-058
 - Specification for Insulation : 165-4-SPM-054
 - Specification for Equipment with Low Temperature Service and Their Materials of Construction : 165-4-SPM-045

() Pressure vessels shall be fabricated in accordance with ASME code by 'U' stamp fabricator. Bidder to confirm the name of fabricator in the bid and provide his 'U' stamp certification from ASME. Waiver from this requirement must be obtained from COMPANY.*

3.0 **SCOPE OF SUPPLY**

3.1 **General**

This specification sets forth the minimum acceptable standards governing the design, fabrication, material requirements, inspection, testing, identification and preparation for shipping of unfired pressure vessels.

3.2 **Material, Workmanship and Suitability**

All materials and parts included in the construction of the specified vessel shall be new, unused and of the highest grade being free from all defects or imperfections likely to affect their performance.

4.0 **ENVIRONMENTAL DATA**

Environmental conditions for the equipment covered by this specification shall be in accordance with Specification 'Site, Environment & Utility Data' (165-4-SPG-011).

5.0 **GENERAL REQUIREMENTS**

5.1 **COMPANY's Requirements**

The design life of equipment shall be 25 years.

Requests for substitutions of any kind shall be complete with all pertinent engineering information required for the COMPANY's evaluation of the proposed substitution.

Vessel outline drawings and/or data sheet sketches submitted by the CONSULTANT to the SUPPLIER are not intended to cover complete details. The SUPPLIER shall make detailed calculations for the design of the pressure vessels and shall prepare detailed shop drawings.

The SUPPLIER shall concurrently submit to the COMPANY, fabrication drawings, weld procedures and detailed calculations for approval. Shop work shall not start until the SUPPLIER has received drawings and weld procedures approved by the COMPANY. No subsequent revision may be issued to the fabrication shop unless it is approved by the COMPANY. Weld procedures shall be accompanied by a weld procedure index and weld map for each vessel.

5.2 **Earthing**

Each vessel shall be supplied with a minimum of two earthing bosses suitable for termination of 70 sq. mm earth cable.

5.3 **Tolerances & Dimensions**

SUPPLIER shall comply with the requirements as per ASME VIII.

5.4 **Nozzle Projection**

Unless specified otherwise, the nozzle projections shall comply with the requirements as per ASME VIII.

5.5 **Insulation**

Requirements for insulation are covered in specification for insulation, Document No.165-4-SPM-054.

6.0 **DESIGN**

6.1 **Design Conditions**

The design pressure shall be in accordance with the code, but shall be at least 10% above the maximum operating pressure or 1.0 barg (14.5 psig) plus maximum operating pressure, whichever the larger.

Internal pressure due to static head of liquid in columns and vessels shall be added to the internal design pressure.

For vessels operating above 0°C, the design temperature shall be 13°C above the maximum continuous operating temperature, but not less than 60 °C.

All vessels, regardless of operating temperature, shall be designed for a low temperature condition, which shall be the lowest of the following:

- 3°C below the minimum operating temperature
- The minimum ambient temperature
- The blow down temperature

6.2 **Design Loadings**

The Vessel(s) shall be self-supporting and designed to withstand a wind loading based on the projected area of curved surfaces. The area of ladders, platforms and pipework shall be assumed as equivalent to one and one-half times the wind loading of the insulated vessel.

Pressure vessel components, their supports and anchorages, shall be designed to withstand the results of the following combinations of loads and forces within the limits of stress set by the code, and the deflections set by Section 6.4 of this specification:

- Erection Condition (The empty weight plus the weight of any internals present during erection).
- Initial Site Test Condition (The empty weight plus weight of water to fill the vessel).
- Operating and Design Conditions (The empty weight plus the weight of all internals packing, insulation and operating liquid).
- Hot Shut Down Condition (As for the Operating and Design Condition, but excluding the operating liquid).
- Transportation/Dynamic Loading Condition
- Continuous monitoring of vessel conditions by mechanical testing during operation conducted by operating and maintenance team after start-up and handing over.

- Any other condition, which would affect the safety of the vessel e.g. cyclic loading.

6.3 Design Stress

Allowable Stress

Shall be the maximum stresses permitted by the basic design code.

Test Condition

The allowable general membrane stress shall be the maximum of 90% of the minimum specified yield or proof stress of the material of construction.

Anchorage

Foundation bolts for vessels shall have a maximum allowable tensile stress of 110 N/mm².

6.4 Deflection Limits Due to Applied Loads

The static deflection of vertical vessels in the corroded condition due to the full wind load shall be limited to 1 in 200 of the vessel length.

The deflection due to applied load and self weight of distributors, gratings, etc. and their supports, in the corroded condition, shall be limited to 1 in 500 of their span.

Vertical vessels with a ratio of overall height to diameter exceeding 15 shall be designed for dynamic stability under wind induced vibrations.

6.5 Nozzle Loading

Nozzle Size	Resultant Force (N)	Resultant Moment (NM)
2"	1435	380
3"	2930	1140
4"	4100	2080
6"	7000	5230
8"	10190	9800
10"	13950	16510
12"	16500	22820
14"	17500	26110
16"	19350	32310
18"	21000	38310
20"	22450	44260
24" – 30"	24750	54880

The above table gives the resultant forces and moments induced from pipework systems, which are to be allowed.

SUPPLIER shall consider the force acting radially together with the moment acting either in a longitudinal or circumferential direction.

The above table does not apply to equipment nozzles within packaged units where actual loading conditions should be applied.

SUPPLIER shall ensure that the above nozzle loadings will not induce unacceptable stress levels in the vessel shell or head, in compliance with the relevant vessel design code.

6.6 **Drawings and Calculations**

Shop details shall be complete with all dimensions, thicknesses and details of construction, including dimensional location of circumferential and longitudinal seams, and all nozzle locations and orientations. All material thicknesses shall be shown, including spherical radius and knuckle radius of heads. All welds shall be detailed or fully described by notes or weld symbols, and annotated to the relevant weld procedure specification.

The assembly drawings shall contain all pertinent information relating to the standards, codes and specifications used in the design, fabrication, inspection and testing of the vessel, including the materials used, plus the total weight of the vessel empty, operating and full of water.

A detail of the skirt, base ring and chairs for vertical vessels or saddles for horizontal vessels shall be provided, complete with all dimensions and descriptions of material, including number, diameter, and location of anchor bolt holes. If this information is furnished by the CONSULTANT it shall be checked by the SUPPLIER and so noted on the appropriate drawing. Foundation loading data shall also be provided by the Supplier.

SUPPLIER shall submit detailed calculations establishing the compliance of design with the requirements of this specification, the certifying authority if applicable and all statutory regulations. Methods of calculations which are not in accordance with the relevant code or established procedures shall be subject to approval by the COMPANY for its applicability to the design.

All calculations shall be complete, giving all references and showing all working methods. Computer printouts will not be accepted without the program flow chart, input data and complete printout, and then only by prior written agreement with the COMPANY at the quotation stage.

Review of drawings, calculations and other documents by the COMPANY, does not relieve the SUPPLIER of his responsibility for the correctness of the design to suit the stated conditions.

7.0 MECHANICAL REQUIREMENTS

7.1 Minimum Thickness

After forming, the minimum thickness of shell and head shall, for carbon steel and low alloy steel vessels, be as follows:

Vessel I.D.	Minimum Thickness (including corrosion allowance)
1500mm and below	6mm
1501-2500mm	8mm
2501mm	10mm

Minimum thickness of materials other than carbon steel shall be based on the structural stability of the vessel in addition to the requirements of pressure and other mechanical loading. However, the minimum thickness of high alloy (austenitic) steel vessels and their components shall not be less than 6mm.

Minimum wall thicknesses of carbon steel and low alloy nozzle necks, including corrosion allowance, shall be the greater of the code requirement or the following:

- 2" through 6" - Sch. 80.
- 8" through 24" - Std. Wall

Skirts shall be designed for load conditions, but shall not be less than 6mm wall thickness. Minimum thickness of internal carbon steel attachments shall not be less than 6mm excluding corrosion allowance.

7.2 Corrosion Allowance

Unless otherwise specified on the data sheet, carbon steel vessels and internals shall have 3mm corrosion allowance applied to all pressure retaining parts and all surfaces of non-removable internals exposed to the process fluid. Removable internals shall have half the specified corrosion allowance on all surfaces exposed to process fluid.

No corrosion allowance is required on stainless steel materials or materials protected by stainless steel unless otherwise specified.

When corrosion allowance is provided by a corrosion resistant metallic lining, a minimum thickness of 3mm of lining material shall be used.

Vessel parts, which are subjected to erosion e.g. due to impingement by the process stream, shall be protected with wear plates, or impingement baffles. Flaked glass lining may be provided on the inner surface of inlet separator vessels to avoid erosion due to high velocity inlet fluid, which may contain abrasives/solid particles etc. and also to avoid corrosion effect in water boot section.

7.3 **Heads**

Vessel heads shall be one-piece semi-ellipsoidal (ratio 2:1) unless otherwise specified. Pressure vessels having design pressure 150 psig & above, shall have one piece hemispherical heads.

Torispherical and hemispherical heads may be used provided all pertinent dimensions and information is submitted to the COMPANY for approval before the heads are ordered.

Heads shall have straight flange of not less than 50mm or two times the thickness, whichever is greater.

All heads, which have been formed cold or below final tempering temperature, shall be subsequently heat treated in accordance with clause UCS-56 of ASME VIII Div 1.

Heads produced from more than one plate shall have the welds 100% radiographed after forming.

7.4 **Supports**

Horizontal vessels shall be supported on two steel saddles only. Saddles shall be furnished by SUPPLIER. There shall be two (2) ½" NPT tapped tell-tale holes at outer extremities in each saddle pad. Saddle pads shall have rounded corners. Saddles shall provide support for at least 120° arc at the circumference of vessel shell (As per ASME VIII).

Calculations shall be provided for the effect of support saddles on the vessel shell and heads.

Vertical vessels shall be supported on steel skirts. Small vertical vessels less than 1200mm inside diameter may be supported on structural legs, or lugs, where advantageous to plant layout. Skirts are however mandatory for all vertical vessels with a height to diameter ratio greater than 5.

All vessels shall be designed to be self-supporting without benefit of guys or braces. Vessel skirts shall be of the height required to provide a clearance not less than 480mm between the bottom of the head and the deck/foundation.

All vessels provided with skirts shall have a reinforced access opening of 400mm minimum diameter. Skirts for vessels smaller than 920mm nominal diameter shall be provided with at least one 200mm access opening. Desired orientation of openings shall be shown on the vessel drawing, or affixed on SUPPLIER's approval drawings.

Vessel skirts shall be provided with 3" diameter reinforced vent holes at approximately 920mm intervals on the circumference, located as near the vessel head as permitted by insulation or other attachments. No skirts shall have less than two such vent holes.

The following joint factors should be applied to vessel skirts:

- Circumferential seams - 0.7
- Skirt to shell joint - 0.55
- Skirt to base ring joint - 1.0

7.5 **Manholes, Nozzles and Inspection Openings**

Manholes, hand holes, cleanout openings and end flanges shall be provided as required for operation and maintenance and to meet Code requirements for inspection.

Cleanout openings shall be 4" minimum inside diameter, and shall be complete with blind flanges, bolting and gaskets and hinged, if not accessible to ground or a platform, for ease in maintenance.

Where inspection openings are required the minimum size shall be 4" nominal.

Trayed or packed towers shall be served by adequate internal and external access openings and shall have at least a top and bottom manhole. Packed towers shall have a manhole above the top level of the packing and below each support grid. A minimum 12" nominal opening shall be provided above each grid to permit removal of packing. Where the centerline of the lowest manhole is more than 1525mm above the vessel bottom, ladder access shall be provided to the interior vessel bottom.

Manholes shall be at least 480mm clear inside diameter, and are to be complete with blind flanges, bolting, gaskets, and davits or hinges. No bolts smaller than M 16 diameter may be used.

The minimum connection size welded into a vessel shall be 2" NB, swaged if required to the specific line size and terminating with a flanged connection. Alternatively, an appropriate long welding neck forging may be used for the connection provided it has a 2" or greater diameter hub.

The only exception to the above shall be nozzles for vessels in water, air and steam (if applicable) service in which the pressure does not exceed 13.50 barg and the temperature does not exceed 160°C.

Full penetration welds shall be used for all body flange, nozzle and manhole attachments. Other attachment weld details are not acceptable without specific approval of the COMPANY.

All flanges for external nozzles and manholes of 24" diameter and smaller shall be in accordance with ANSI B16.5 and shall be raised face unless otherwise shown on the individual vessel data sheets and/or drawings. Pressure-temperature ratings of ANSI B16.5 shall apply for the design condition.

Flanges over 24" diameter shall be in accordance with MSS Standard Practice SP-44. Non-standard size flanges shall be calculated in accordance with ASME Code Rules.

Raised face flanges for use with spiral wound or soft metal jacketed asbestos gaskets shall have a smooth finish (125 RMS).

Raised face flanges for use with compressed asbestos gaskets shall have contact surfaces as follows:

- Nominal size 12" and smaller - A continuous spiral groove generated by a 1.8mm radius round-nose tool at a feed of approximately 0.9mm per revolution.
- Nominal size above 12" - A continuous spiral groove generated by a 3mm radius round-nose tool at a feed of approximately 1.3mm per revolution All nozzles shall be flush with inside of vessel wall unless otherwise indicated on vessel data sheets.

Where two or more openings are provided for installation of equipment, such as gouge glasses, level controls, etc. they shall be set with a Jig to prevent tolerance from being additive.

No threaded connections shall be screwed directly into any part of the vessel except for tell-tale holes in reinforcing pads.

All bolt holes in manholes, hand holes and nozzles and anchor bolts on supports shall straddle the normal vessel centerline unless otherwise specified.

Pad type nozzles, hand holes etc. shall not be used unless written approval is obtained from the COMPANY.

Nozzles may be either integral forgings or fabricated from seamless pipe and welding neck flange joined by full penetration welds. Other type built-up nozzles are not acceptable without approval of COMPANY. Flanges for internal non-pressure piping may be slip-on-type.

Set-on type nozzles shall only be used with prior agreement from the COMPANY and provided that 100% Ultrasonic Examination of the shell plate is carried out adjacent to the opening. Examination is to be in accordance with ASTM A-435 to cover a minimum of two times the opening diameter.

7.6 **Reinforcement**

Reinforcement of nozzles and manholes shall be designed to provide 100% compensation for the as built thickness of the shell/head, in accordance with the specified design code.

The reinforcement for openings shall be provided by either self reinforcing type nozzles or built-up, seamless pipe and WN flange with pad reinforcement as necessary.

Reinforcing pads when applied shall have a minimum width of 2" or three times the pad thickness, whichever is greater. Reinforcing pads shall be made in one piece if possible. Large reinforcing pads may be made from two pieces provided that written approval is obtained from the COMPANY.

Integral reinforcement of openings shall be provided for vessels in the following categories. Reinforcing pads shall not be used in these instances:

- Vessels in lethal service
- Vessels designed for temperatures below 0°C
- Vessels with shell thickness exceeding 50mm

All rectangular reinforcing pads when used for external or internal attachments shall be radiused 25mm minimum.

7.7 **Internal Attachments**

The vessel fabricator shall furnish and install all internal support rings, down comer supports, bars, gratings, grating supports, tray lifting, tray leveling device, vortex breakers, piping and all other internals as and where required by the appropriate drawings. Internals shall be fixed by bolting to cups or rings for ease of maintenance.

Mitred joints shall not be used, unless otherwise specified on drawings and agreed by the COMPANY.

Major internal piping shall be flanged for ease of removal through vessel manholes.

All removable internals shall be fabricated so as to pass through the vessel manholes.

Support and fixed internals welded to shell/head, shall be seal welded to prevent crevice corrosion. Seal and strength welds shall carry the appropriate corrosion allowance.

All internal crevices where supports and fixed internals are welded to the shell/heads shall be seal welded to exclude process fluids. Seal and strength welds shall carry the appropriate corrosion allowance.

7.8 **External Attachments**

Vessel fabricator shall furnish and attach all insulation support rings, external pressure stiffeners, lifting lugs, ladder and platform lugs, and pipe supports unless otherwise specified. Reinforcing pads shall be continuously welded to vessel beneath all attachments where the welding of such attachments would cause excessive concentration of stress on vessel at those points. Each pad shall contain at least one ½" NPT tapped tell-tale hole.

All vessels greater than 3600mm installed height shall be fitted with a full length ladder. Platforms for maintenance shall be provided as necessary for safe access to manholes, relief valves, control valves, controllers, etc. Sample connections, thermometers, thermo wells, gauges and control instruments shall be accessible from a platform or a ladder.

Tower davits shall be provided as necessary for proper maintenance.

All attachments shall be continuously welded.

All vessels, vertical or horizontal, shall be furnished with a minimum of two lifting lugs, which shall be designed for a load equal to two times the shipping weight.

7.9 **Vibration Analysis**

A dynamic wind analysis shall be performed for all towers taller than 100 ft (30 m) with a height-to-diameter ratio greater than 15. The following conditions shall be met:

- a) Vessel diameter (d) shall be the predominant outside shell diameter of the top one-third of the vessel.
- b) Vessel height (H) shall be the total height of vessel from base of skirt to top of head.
- c) The maximum single amplitude (deflection) at the top of the vessel due to dynamic wind load, including rotation of the concrete foundation or structure, shall not exceed 0.5 percent of H.

8.0 ADDITIONAL REQUIREMENTS FOR FLANGED GIRTH JOINTS

- 8.1 Flanged girth joints shall be designed for through bolting. Proposals for alternative joint design shall be submitted to the COMPANY for approval.
- 8.2 Flanges for girth joints shall conform to the following:
- a) Flanges shall be according to ASME B16.5, ASME B16.47 Series B, or designed according to ASME SEC VIII Div.1 with allowable stresses determined according to that code.
 - b) Welding neck flanges shall be used where the pressure-temperature design conditions require an ASME Class 300 or greater flange.
 - c) Slip-on flanges shall not be used if any of the following conditions are exceeded:
 - Pressure-temperature design conditions require an ASME Class 300 or greater flange.
 - Design temperature exceeds 750°F (400°C).
 - Specified corrosion allowance for the vessel is greater than 1/8 in. (3 mm).
 - The vessel is in hydrogen service.
 - d) Girth flanges larger than NPS 24 that are not in accordance with ASME B16.47 Series B shall be designed to meet the flange rigidity recommendations in ASME SEC VIII Div.1.
- 8.3 Unless otherwise specified, gasket contact surfaces shall have a finish in accordance with reference Codes and Standards.
- 8.4 Allowable flatness tolerances of gasket contact surfaces for the appropriate service condition shall be as per reference Codes and Standards.
- 8.5 For confined joint construction (peripheral gasket confined on OD):
- a) Nubbins, if provided, shall be located on the female (grooved) flange.
 - b) The clearance between flanges after assembly shall be not less than 3/16 in. (5 mm). This clearance shall extend from the periphery of the flange to within the bolt circle.

9.0 **MATERIALS**

9.1 **General Specification**

Materials of construction for pressure parts shall be in accordance with the design code. Alternative materials may be used if advantageous with the approval of the COMPANY. Proposed substitutions must be clearly defined:

- Vessels having design temperature below 0°C are considered as cold vessels.
- Vessels having design temperature over 0°C considered as warm vessels.

9.2 **Shell / Heads**

Unless otherwise specified in drawings or data sheets, materials for shell/heads shall be as under:

a) Material for warm service pressure vessel shell/heads shall be:

- ASTM A-515 for Intermediate & High Temperature Service.
- ASTM A-516 for Moderate & Lower Temperature Service.

b) Material for cold service pressure vessel shell/heads shall be:

- ASTM A-516 for Pressure Vessel having Design Temperature upto -46°C with impact test.
- ASTM A-203 Gr. D for Pressure Vessel having Design Temperature upto -101°C with impact testing corresponding to vessel design temperature.
- ASTM A-240 Gr. 304 for Pressure Vessel having Design Temperature upto -178°C without impact testing.

9.3 **Supports and Miscellaneous Parts**

Any material welded directly to the pressure retaining parts shall be of similar quality as the vessel plate, including impact requirements if any, for a length measured from the vessel wall of at least 150mm. The material of such items beyond this point may be structural quality A283 Gr. C, or equal.

ASTM A-203 Gr. D or ASTM A-240 Gr. 304 shall be used for cold vessels.

9.4 **Bolting**

Bolts and nuts shall be furnished by the SUPPLIER for all cover plates, manholes, blind flanges and bolted attachments supplied with vessels. Bolts and nuts shall be new.

External bolting shall be alloy steel stud type and selected for maximum and minimum design temperatures.

For warm vessels; all external bolting shall be cadmium plated to ASTM A-193 Gr. B7 c/w ASTM A-194 Gr. 2H nuts.

For cold vessels; all external bolting shall be cadmium plated to ASTM A-320 Gr. L7 c/w ASTM A-194 Gr. 7 nuts.

All internal bolting to be stainless steel.

Flange bolting of nominal size 1½" and above shall be subject to bolt tensioning. SUPPLIER to supply flange stud-bolts over length by one nut thickness and complete with 3 nuts to facilitate bolt tensioning for all flanged connections for which SUPPLIER supplies a mating flange. Bolt tensioning will be carried out on site by Contractor.

9.5 **Flanges**

Flange material shall be of a similar quality to the vessel shell including impact properties where applicable. Forgings shall be supplied in the normalized condition.

For warm vessels; all flanges material shall be ASTM A-105.

For cold vessels; all flanges material shall be ASTM A-182 Gr. 316 for Stainless Steel Vessels or ASTM A-350 Gr. LF2 for Carbon Steel (with impact test) Vessels.

9.6 **Gaskets**

Gaskets shall be furnished by the SUPPLIER for all bolted attachments i.e. cover-plates, Manways, and blind flanges supplied with vessels.

Unless otherwise specified, gaskets shall be in accordance with ANSI B16.5 as follows:

- **For Flat Face, 150 LB ANSI flange:** Full Face, 1.6mm thick compressed non-asbestos.
- **For Raised Face, 150 LB ANSI flanges:** Flat ring compressed non asbestos, 1.6 mm thick.

- **For Raised Face, 300 & 600LB ANSI flanges:** Spiral wound stainless steel, non-asbestos filled with spacer rings.
- **For Ring Joint, 900, 1500 and 2500 LB ANSI flanges:** Oval Ring per ANSI B16.20, Armco soft iron or equal. (90 Brinell Max).

Gasket material for nozzles connected to external pipework and valving shall be in accordance with the Project Specification for Piping Design and Materials.

9.7 **Impact Test Requirements**

Charpy V-notch impact testing is required in accordance with the code except that this shall apply to all vessels with a design temperature below 0°C. These vessels shall meet the requirements of ASME Section 11 Part A, SA20 and Clause UG-84 of ASME VIII Division 1.

10.0 **FABRICATION**

10.1 **Start of Fabrication**

No manufacture may begin until SUPPLIER has received written approval of his detailed fabrication drawings from the COMPANY or their authorized representative.

The SUPPLIER shall notify the COMPANY or their authorized representative in reasonable time before actual fabrication begins.

10.2 **Forming**

Shell plates shall not be formed until actual head dimensions are known.

Plates shall be formed in the same direction as the final roll given in manufacture.

10.3 **Welding**

All welding shall be in accordance with the code, standard and welding specification for this project. The SUPPLIER shall submit proposed weld procedures and weld details for the COMPANY'S review and approval prior to commencing any production welding.

Submerged arc welding is preferred on all vessel seams.

For materials with yield strength exceeding 330 N/mm² and/or thickness exceeding 20mm, consumables for manual metallic arc welding shall be of the basic low hydrogen type.

SUPPLIER shall establish a procedure for maintaining proper control of welding consumables.

Low hydrogen electrodes shall be dried or baked at the temperature level and times specified by the manufacturer, and shall be used within 8 hours when stored in quivers. Electrodes stored in quivers, but not used within the specified times, shall be restored in ovens.

No electrodes shall be left lying about the site, or in workshops. Electrodes so left shall be scrapped.

Submerged arc flux shall be stored in moisture-proof containers in a dry location, at a temperature of above 20°C.

Submerged arc consumables shall be withdrawn from store only when required for immediate use. Used consumables shall be returned to store on completion of the welding operation.

Submerged arc flux may be recycled but shall be free from fused flux, mill scale, dirt or other foreign matter.

The SUPPLIER shall provide proof to the satisfaction of the COMPANY'S Inspector that the welder has been using the process for which he is qualified within the previous 3 months. If not, then the welder shall be required to re-qualify. Backing rings shall be used only with approval of the COMPANY.

Adjacent longitudinal seams shall be staggered to give between seams a minimum of 60° orientation or 2000mm whichever is greater. Shell seams shall be located to miss long internal attachment welds (trays, down comers, etc.) and all nozzles and manhole openings and their reinforcing pad.

Longitudinal and circumferential seams in shells and all seams in heads shall be full penetration single or double butt-welds of the 'V' or 'U' type. Lap welds are not permitted.

All weld procedure numbers shall be shown on drawings.

All welding without subsequent post-weld heat treatment is prohibited on the following:

- Materials and thickness criteria defined within the design code.
- Chrome-moly alloy steels containing more than 2% Cr or more than 0.6% Mo.

Production test plates shall be conducted on longitudinal shell seams and head seams (if any) where run-off tabs shall be used. This shall apply to vessels with a design temperature below 0°C and thickness greater than 25mm. One production test plate shall be provided per vessel for each weld procedure and shall be subject to full mechanical testing in accordance with ASME IX.

Production control test plates shall be post-weld heat treated with the vessel where applicable.

The weld ligament, i.e. the distance between the edges of weld preparations for any two nozzle welds, or between nozzle welds and seam welds and attachment welds, shall be twice the shell/head thickness plus 25mm.

No welding shall be allowed after PWHT. All attachments including ladder and platform clips must be welded before PWHT.

All fillet welds shall be continuous.

10.4 **Weld Repairs**

All repairs welding shall be in accordance with procedures previously approved by the COMPANY.

The repaired weld shall be subjected, as a minimum requirement, to the same testing and inspection as the original weld.

The cost of all repairs and subsequent inspection shall be the responsibility of the SUPPLIER.

Weld repairs shall take place before hydro-testing and care shall be taken to ensure that the wall thickness is not reduced below the specified minimum design thickness.

Surface defects, and areas of weld resulting from the removal of temporary attachments shall be ground smooth and the area subjected to 100% crack detection.

10.5 **Welding Procedure Qualification Record (WPQR)**

Each weld procedure shall be covered by a suitable procedure qualification tested in accordance with the requirements of ASME IX.

10.6 **Preheat Requirements**

The minimum preheat for Ferritic steels shall be in accordance with Appendix R of ASME VIII DIV I. Calculations of preheat temperature to suit particular combined plate thickness, chemical composition, heat input, consumables and restraint can however be made by reference to the following:

Welding Steels without Hydrogen Cracking, international Institute of Welding 1973.

Note: This guide is primarily suitable for carbon, carbon manganese fine grain and carbon molybdenum steel with less than 0.6% Mo.

The require preheat temperature shall be established before commencing welding, and held until welding is complete.

Preheat temperatures shall be controlled by temperature indicating crayons or contact pyrometer.

10.7 **Post Weld Heat Treatment Requirements**

Vessels shall be post-weld heat treated when required by the design code depending on the combination of material, thickness and design temperature.

All vessels in lethal service shall be post-weld heat treated.

Post-weld heat treatment shall also be considered for vessels subjected to large amounts of welding and where pressure parts have been formed from thick plate into tight radii.

Field post-weld heat treatment procedures must be reviewed by the COMPANY.

The SUPPLIER shall include in his material sub-order(s), how many heat treatments are likely to be carried out during fabrication, and he shall ensure that he receives a guarantee from the mill that the steel supplied can be heat treated as proposed, without detrimental effect on the minimum guaranteed mechanical properties.

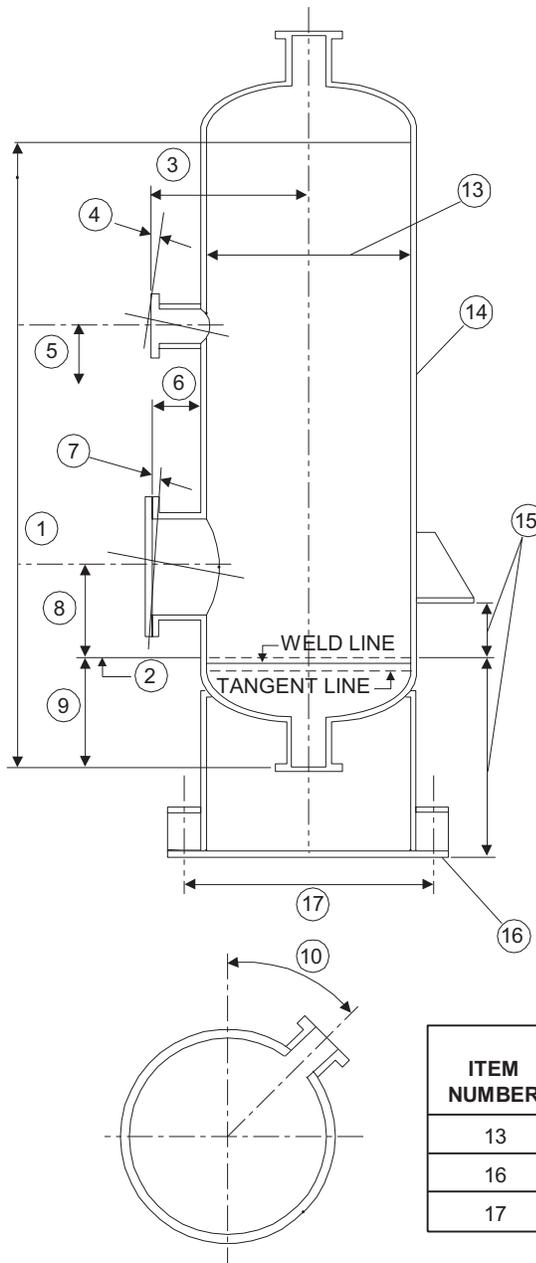
The use of manually operated gas torches or gas rings shall not be permitted for PWHT.

During PWHT, a minimum of six thermocouples per furnace load shall be used to ensure that uniform temperature is achieved throughout the heat treatment cycle. The thermocouples shall be used to record metal skin temperature.

If welded repairs are made to a vessel, which has been heat treated, the vessel shall again be heat treated. This treatment shall form part of the repair procedure.

All heat treatments shall be recorded and documented by a temperature recording chart. The welding and associated heat treatment of stainless steels shall take into account the ease with which this material can be sensitized and its corrosion resistant properties thereby impaired.

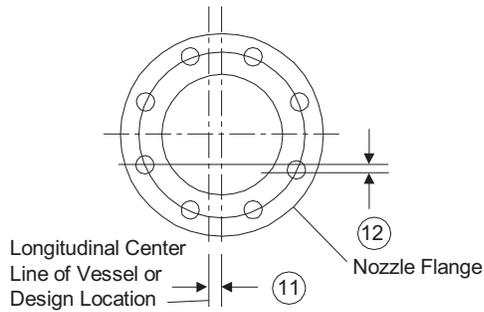
Figure 1: Pressure Vessel Tolerances



- ① Tolerance on longitudinal dimensions from the reference plane shall be the smaller of 1/64 in. per foot of length or 1/2 in., unless noted otherwise.
- ② REFERENCE PLANE Punch mark inside and out 3 in. from root land of bottom course.
- ③ Flange face of nozzle from centerline of vessel $\pm 1/8$ in.
- ④ Flange face of nozzle shall be parallel with the indicated plane in any direction $\pm 1/2^\circ$, but not to exceed 3/16 in.
- ⑤ Location of nozzle from reference plane $\pm 1/4$ in.; exception shall be liquid level controller nozzles $\pm 1/16$ in. and nozzles related to tray, draw-off pans, etc., so dimensioned on drawings, distance from support ring $\pm 1/8$ in.
- ⑥ Flange face of manhead from outside of tower $\pm 1/4$ in.
- ⑦ Flange face of manhead shall be parallel with the indicated plane in any direction $\pm 1^\circ$.
- ⑧ Location of manhead from reference plane $\pm 1/2$ in.
- ⑨ Flange face of top or bottom nozzle to reference plane $\pm 1/4$ in.
- ⑩ Orientation of nozzle and other attachments shall be within $\pm 1/8$ in.
- ⑪ 1/8 in. max. lateral translation.
- ⑫ 1/16 in. max. rotation of flanges from the indicated position, measured as shown.
- ⑬ In addition to ASME code tolerances, tolerances from nominal inside shell diameter as measured by external strapping shall be as given in table below.
- ⑭ Maximum deviation from straight applied to shell shall be: 1/8 in. in any 10 ft or 1/2 in. per 50 ft of length. In addition, distortion caused by welding of longitudinal or circumferential joints shall not exceed 1/4 in. maximum depth in a 36 in. length of shell centered on the weld.
- ⑮ Distance from reference plane to base + 0 in., - 1/4 in. or lug + 1/4 in., 0 in.
- ⑯ Base or support lug out of level over any diameter shall be as given in table below.
- ⑰ Bolt hole circle tolerance shall be as given in table below.

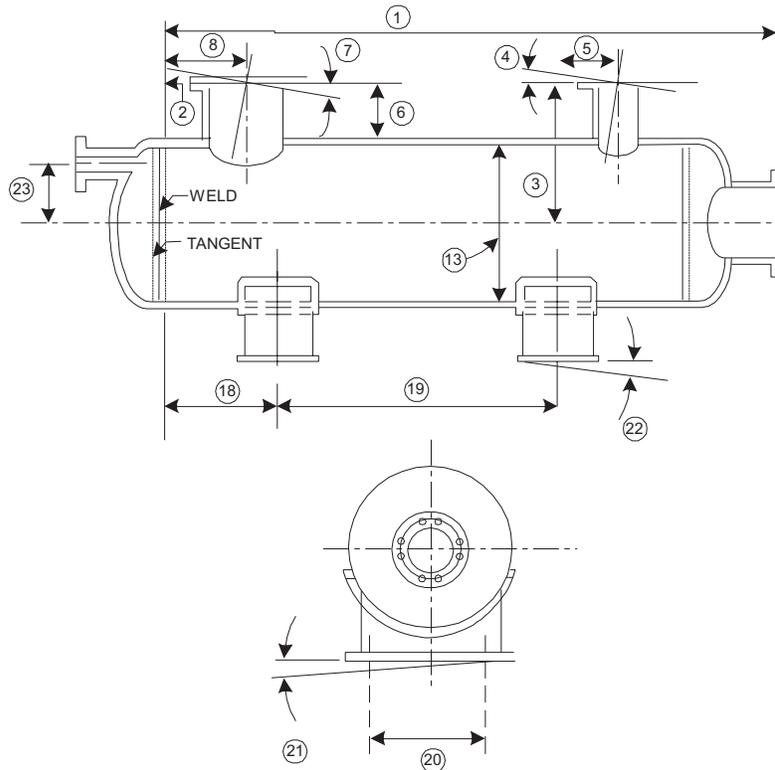
ITEM NUMBER	INSIDE DIAMETER SPECIFIED			
	< 4' -0"	> 4' -0" to 7' -0"	> 7' -0" to 16' -0"	> 16' -0"
13	$\pm 1/8"$	$\pm 3/16"$	$\pm 1/4"$	$\pm 5/16"$
16	$\pm 1/8"$	$\pm 3/16"$	$\pm 1/4"$	$\pm 1/4"$
17	$\pm 1/8"$	$\pm 1/8"$	$\pm 1/4"$	$\pm 1/4"$

Figure 1 Continued



Acceptable Metric Equivalents

in.	mm	ft	mm
1/16	1.5	4	1200
1/8	3	7	2100
3/16	5	16	4800
5/16	8		
1/4	6		
1/2	13		
1/64 in. per foot		0.4 mm per 300 mm	
1/8 in. in any 10 ft		3 mm in any 3,000 mm	
1/2 in. per 50 ft		13 mm per 15,000 mm	



- ⑱ Distance from reference plane to the centerline of the saddle 1/8 in. (3 mm).
- ⑲ Distance between the centerline of the saddle 1/8 in. (3 mm).
- ⑳ Distance between the centerline of the support bolt holes across width 1/8 in. (3 mm).
- ㉑ Saddle base plate out of level shall be the same as for item 16.
- ㉒ Saddle base plate out of level slope 1/16 in. (1.5 mm), across the width of the saddle.
- ㉓ Location of nozzle from vessel centerline 1/4 in. (6 mm).

11.0 **INSPECTION, TESTING AND CERTIFICATION**

11.1 **General**

All non-destructive examination shall be carried out in accordance with the design code as a minimum. All personnel involved in non-destructive testing shall be qualified to a nationally recognized standard.

Inspection and testing shall be carried out at the SUPPLIER'S works and shall be witnessed by the COMPANY'S authorized representatives and/or the certifying authority if applicable.

The responsibility for inspection rests with the CONSULTANT. However, the COMPANY reserves the right to inspect vessels at any time during fabrication to ensure that materials and workmanship are in accordance with this specification, and/or the approved drawings.

The SUPPLIER shall provide a projected shop schedule with appropriate fabrication stages at the time drawings are submitted for approval, to highlight the inspection activity schedule.

The approval of any work by the COMPANY or their authorized representative and the release of a vessel for shipment shall in no way relieve the SUPPLIER of any responsibility for carrying out the provisions of this specification.

The SUPPLIER shall inform the COMPANY at the time of placing the order of any tests, which cannot be adequately performed.

11.2 **Radiographic Inspection**

Except where amplified in this specification the extent of radiography shall be in accordance with the design code.

When 100% radiography is specified for all welds, including flange butt welds and nozzle to shell connecting welds, shall be fully radio-graphed. Where radiography is considered to be impractical ultrasonic inspection may be substituted with prior approval of the COMPANY.

For vessels requiring radiography where heat treatment is required, the radiography must be carried out after heat treatment. The SUPPLIER may at his discretion carry out radiography prior to heat treatment.

The COMPANY'S appointed inspector shall see all radiographs and shall be advised of any defects found in any welds.

11.3 **Ultrasonic Inspection**

Ultrasonic inspection may be substituted for radiography with prior approval of the COMPANY in areas that are inaccessible for radiography.

For vessels requiring U/T examination where heat treatment is required, the examination must be carried out after heat treatment. The SUPPLIER may, at his discretion carry out U/T examination prior to heat treatment.

11.4 **Magnetic Particle and Dye Penetrant Inspection**

All magnetic particle and Dye Penetrant inspection shall be performed in accordance with the design code.

As a minimum, the following applies at all nozzles, Manways, and reinforcing pads:

- Load bearing fillet welds shall be checked at root runs and finished welds by magnetic particle or dye penetrant method.
- All full penetration attachment welds shall be magnetic particle inspected at the bevel-chipped surface and on all finished weld surfaces.

Crack detection of finished welds shall be carried out after hydro-test and PWHT (where applicable).

Magnetic particle inspection is preferred particularly after post-weld heat treatment.

Vessels of low chrome alloy with plates over 50mm thick shall receive this inspection of all weld seams after post-weld heat treatment.

11.5 **Acceptance Criteria**

The acceptance standard for Non-Destructive examination of welds shall be in accordance with the design code.

11.6 **Support and Reinforcing Pod Inspection**

Welds of reinforcing pads shall be tested to 1 barg with dry air after fabrication (but prior to the hydrostatic test of the vessel) using suitable materials for the detection of leaks.

11.7 **Hydrostatic Tests**

Hydrostatic tests shall be carried out in presence of the COMPANY appointed inspector and a representative of the certifying authority, when applicable.

Hydrostatic testing shall be in accordance with the design code.

Fresh water only shall be used for testing. For vessels manufactured from stainless steel the chloride ion content of the test water shall not exceed 30ppm.

During testing the temperature of the vessel and test water shall not be lower than 7°C and not more than 25°C.

Adequate support shall be provided for vertical vessels tested in the horizontal position to ensure that they are not subjected to excessive local loadings and bending stresses.

Hydro-test pressure shall be held for a minimum of 60 minutes, irrespective of design code requirements.

11.8 **Test Bolting**

After the successful completion of the hydrostatic test, the bolting used during testing shall be replaced. Service bolts; nuts and gaskets furnished by the SUPPLIER shall not be used for testing. The test bolts shall form part of the total equipment supply.

11.9 **Nameplate**

11.9.1 **General**

Each complete vessel shall be provided with a type 316 stainless steel nameplate securely attached to the vessel shell and located so that it is clearly visible after installation. Nameplates shall be riveted to a bracket welded on the vessel and the inspection authority then over stamps one rivet. Insulated vessels shall have nameplate brackets with enough projection to clear insulation by at least 25mm

11.9.2 **Stamped Data**

The following information shall be stamped on the nameplate:

- Manufacturer's Name.
- Manufacturer's Serial Number.
- Tag Number.
- Purchase Order Number.
- Equipment Title.
- Maximum allowable working pressure (Hot and Corroded) barg at °C.
- Maximum test Pressure (Corroded) in barg.
- Year Built.
- Size I.D./O.D. × T to T in mm.
- Service.

- Corrosion Allowance in mm.
- Design Code/Code Symbol showing degree of radiography and/or stress relieved and type of construction.
- Weight empty/operating/hydro-test in kg.
- Inspection authority and date of inspection.
- Code symbol showing if the unit is x-rayed and stress relieved.
- Design temperature and pressure.
- Operating temperature and pressure.

11.10 **Report and Acceptance Certificates**

With regard to witnessed tests the SUPPLIER shall prepare a report on the tests and the results, these shall be included in the 'Certification Data Books'. All Data Books produced shall be complete and copies submitted to the COMPANY for review not later than 4 weeks after the date of completion of the tests.

11.11 **Certification Documents**

The CONSULTANT shall store in good order all material certificates, fully catalogued and indexed NDT test records, mechanical test certificates, welding qualification certificates, heat treatment certificates and hydrostatic test certificates for a minimum of 5 years after acceptance of the complete and fully certified vessel by the COMPANY.

All certificates shall be available for counter signature by the certification authority.

12.0 **PAINTING AND PREPARATION FOR SHIPMENT**

12.1 **Painting and Protective Coatings**

Painting, protective coatings and the procedures used for the preparation of surfaces shall be as specified in the Project Specification for Painting and Protective Coatings.

Where painting is specified, the entire vessel shall be painted, including inside of skirt, outside of bottom head, entire base ring and all skirt attachments. Nozzles shall be painted on the flange edges, inside bolt holes, and up to the gasket surface.

Fireproofed/Insulated surfaces shall be shot blasted and given one coat of primer only.

The SUPPLIER shall stencil in a prominent position in 50mm high characters the dry lifting weight of the vessel and for stress relieved vessels the words "NO WELDING PERMITTED".

12.2 **Preparation of Shipment**

After the final hydrostatic test, the vessel shall be dried and cleaned thoroughly of all grease, loose scale, rust, flux and weld spatter, both internally and externally.

All machined surfaces and threaded connections shall be protected by coating with rust preventative.

Flanged openings shall be protected with steel plate covers attached by proper bolting or strapping and sealed with a plastic compound.

Screwed connections shall be protected with threaded forged steel plugs.

The SUPPLIER shall be responsible for loading and anchoring vessels to prevent any damage during shipment.

When shipped loose, all instruments, valves, parts, etc., of a vessel shall be tagged with vessel number and purchase order number to facilitate match-up with appropriate vessel in the field. Tags and wire shall be stainless steel. All such items shall be boxed and where possible attached to the inside of the skirt or saddle.

SUPPLIER shall state in the proposal his recommendations for long term storage (up to 12 months) for both indoor and open-air storage in a marine environment.

13.0 **SPECIFIC REQUIREMENTS FOR CLAD VESSELS**

13.1 **Design**

Design calculation shall be based on the nominal thickness of the base material i.e. shall not include any allowance for the cladding thickness.

The thickness of corrosion resistant linings applied to nozzles shall not be less than the thickness specified for the vessel.

The principle shall be satisfied that the design of a cladding or lining accounts for the effect of differential thermal expansion and has sufficient ductility to accommodate any strain likely to be imposed during service.

13.2 **Materials**

Pressure vessel parts constructed of integrally clad plate, and vessel parts fully or partially lined by welding after forming, shall satisfy the requirements of ASME Section VIII DIV I Part UCL.

The use of linings other than those obtained by using integrally clad plate or overlay weld deposits shall be avoided and requires special approval of the COMPANY.

Integrally clad plate shall be of the homogeneously clad type as obtained by roll cladding or explosive bonding. The clad plates shall conform to ASTM A-263, ASTM A-264 & ASTM A-265, as applicable, irrespective of the design calculation method used.

Integrally clad plate shall be ultrasonically tested to check the quality of the bond in accordance with the requirements of ASTM A579, acceptance level S6.

The branches in clad vessels shall be cut from tubing or fabricated from clad plate. Alternatively, the branches may be protected by corrosion resistance weld overlays.

Solid alloy nozzles may be offered as an alternative to clad nozzles in the smaller sizes where it is considered to be advantageous.

Flange facings on clad vessels shall be provided with an overlay weld deposit protection unless otherwise specified by the COMPANY.

Overlay weld deposits of austenitic stainless steel weld metal on carbon and low-alloy steels shall be applied in a minimum of two layers. For the first layer type 309 weld material shall be used, and the top layer as specified.

13.3 **Fabrication**

Weld overlay deposits on clad vessels shall be performed in accordance with procedures qualified to ASME IX. The proposed procedure for relevant application shall be submitted with the bid.

The procedure for PWHT shall be submitted to the COMPANY for approval. It shall be demonstrated that no deleterious effects on the corrosion resistance of the cladding or weld overlay will occur during PWHT.

13.4 **Inspection and Testing**

Clad plate formed into dished ends shall be ultrasonically retested for soundness after forming.

Linings applied by overlay weld deposit, shall be ultrasonically examined for gross lack of fusion in accordance with ASTM A578 acceptance level S6. This also applies to clad restoring of welds in clad plate, where a bond of 50mm on each side of the weld shall be examined.

Vessels protected with a cladding or lining of stainless steel, or having stainless steel internals shall be hydrostatically tested as if they were of solid stainless steel, refer to clause No. 6 of this specification.

14.0 **DRAWINGS AND DATA REQUIRED**

SUPPLIER information shall be supplied in accordance with the COMPANY's procurement documentation and shall include, as a minimum, the following:

- Completed data sheets.
- General arrangement and cross-sectional drawings complete with parts list, materials and equipment description.
- Materials and thickness of principal parts, not covered by the data sheet.
- Itemized weights, including maintenance weights, plus withdrawal dimensions.
- Foundation Loading Data.
- SUPPLIER connection drawings complete with detailed nozzle schedule.
- Itemized list of SUPPLIER's deviations from Specification. SUPPLIER shall advise separate prices for the following:
 - Supply & installation of additional nozzles, rated as per data sheet, with and without reinforcement for the following nominal bores:

2", 3", 4", 6", 8", 10", 12", 14" & 16".

20" & 24" Manways complete with blind flanges, bolting, gasket and davit.

Per kg of all support clips and lugs
- Proposed test procedure and erection details
- Priced list of recommended commissioning spares.
- Priced list of spare parts for two years operation.
- Priced list of special tools.



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OIL & GAS DEVELOPMENT COMPANY LTD.

SPECIFICATION FOR

PAINTING, LINING & SURFACE PREPARATION



Rev.	Date	Description	Prepared By	Checked By	Approved By
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1.0 **GENERAL**

1.1 **Scope**

This specification covers the minimum requirements for the selection of material, surface preparation, supply and application of the painting system to be used on the external surfaces of pipeline, process plant, storage tanks, buildings and production facilities, including structural steel, piping, equipment, internal surface of storage tanks and its structure. This specification is applicable to both shop and field/site painting works.

The painting works to be performed shall include all supply of painting material, material required for application of painting, surface preparation, protection of other works, application of primer, intermediate and top coat, repair of damages to painting works, cleaning of the working area as well as all intermediate and final inspection works. Vendor may propose superior painting system subject to Company Consultant's approval.

1.2 The following surfaces are not required to be coated:

- Nonferrous materials (stainless steels, aluminium, etc.) unless specifically required.
- Plastic or plastic-coated materials not susceptible to ultra-violet deterioration.

1.3 Machined and threaded surfaces shall be protected with a temporary rust preventative.

1.4 Any deviation from this specification shall be approved in writing by the Company / Consultant. Failure of CONTRACTOR/SUPPLIER to consult with the Company / Consultant to clarify any item in the specification will, in no way, relieve the CONTRACTOR/SUPPLIER of his responsibility of satisfactory compliance with this specification.

1.5 **Definitions**

Following definitions apply throughout this document:

OWNER / COMPANY: Oil & Gas Development Company Ltd. (OGDCL)

CONSULTANT M/s. Zishan Engineers (Pvt.) Ltd. (ZEL).
ZEL have been awarded the work of Engineering, Procurement Assistance and Project Management.

CONTRACTOR: Means the construction company to be engaged by the COMPANY to perform the Construction work.

VENDOR / SUPPLIER: The organization, firm or agency with whom order for the supply of equipment and or material has been placed.

1.6 **Errors or Omissions**

1.6.1 Review and comment by the Company / Consultant of any CONTRACTOR/SUPPLIER'S drawings, procedures or documents shall only indicate acceptance of general requirements and shall not relieve the CONTRACTOR/SUPPLIER of its obligations to comply with the requirements of this specification and other related parts of the Contract Documents.

1.6.2 Any errors or omissions noted by the CONTRACTOR/SUPPLIER in this Specification shall be immediately brought to the attention of Company / Consultant.

1.7 **Deviations**

All deviations to this Specification, other related specifications or attachments shall be brought to the knowledge of the Company / Consultant in the bid. All deviations made during the procurement, design, manufacturing, testing and inspection of the Works shall be with written approval of the Company / Consultant prior to execution of work. Such deviations shall be shown in the documentation prepared by the Company / Consultant.

1.8 **Conflicting Requirements**

In the event of any conflict, inconsistency or ambiguity between the Contract scope of work, this Specification, National Codes & Standards referenced in this Specification or any other documents, the CONTRACTOR/SUPPLIER shall refer to the Company / Consultant whose decision shall prevail.

1.9 **Work Procedure**

1.9.1 The CONTRACTOR/SUPPLIER shall submit detailed procedures for approval to the Company / Consultant:

- Surface Preparation
- Paint material storage and preparation procedure
- Primer application
- Intermediate and finish coat application
- Inspection and data recording procedures
- Paint repair procedure
- Painted equipment/material transportation, storage and handling procedure
- Type of abrasive to be used

The above procedure shall include the application equipment/tools. All procedures shall meet the minimum requirement stated in this specification.

- 1.9.2 Material specification for the surface preparation and painting, and mixing materials, shall be submitted to the Company / Consultant for approval. Detailed manufacturers data shall be submitted with these specifications. Material shall not be procured prior to approval of the Company / Consultant.

2.0 **CODES, STANDARDS & SPECIFICATIONS**

The codes and rules to be taken into consideration are:

- The SSPC (Steel Structures Painting Council)
 - Volume 1: good painting practice
 - Volume 2: systems and specifications
- The SIS 05 59 00
Swedish standard - Pictorial surface preparation Standards for painting steel surface.
- ASTM E337 Standard Test Method for Measuring Humidity with a Psychrometer (the Measurement of Wet and Dry-Bulb Temperature).

3.0 **SURFACE PREPARATION**

3.1 **Ferrous Structures and Equipment**

- 3.1.1 All rough welds, burrs, weld spatter, indentations and all other sharp surface projections shall be ground smooth prior to further surface preparation. Any grinding on piping surface is forbidden after blast cleaning.
- 3.1.2 All bolt holes shall be drilled and smoothed before blast cleaning.
- 3.1.3 All surfaces to be coated shall be blast cleaned to:
- SSPC-SP 10 “Near white blast cleaning” per Steel Structures Painting Council (SSPC) surface preparation specification SP-10-63T.
 - S.A. 2.5 of Swedish Standards Institution SIS 05 5900.
- 3.1.4 All surfaces shall be blast cleaned to achieve the desired surface profile. Material used for blast cleaning shall be submitted to the Company / Consultant for approval. Company / Consultant will have the right to select most appropriate material. CONTRACTOR/SUPPLIER shall provide a surface profile meter at site for the inspection of achieved surface profile.

- 3.1.5 Any oil, grease, dust or foreign matter deposited on the surface shall be removed prior to the surface preparation. In the event rusting occurs after completion of surface preparation, surfaces shall again be cleaned in accordance with the specified method.
- 3.1.6 Cleaning shall be discontinued each day in sufficient time to permit the surfaces cleaned to be primed before the end of the working day.
- 3.1.7 Dry blast cleaning operations shall not be conducted on surfaces that will be wet after blasting and before painting. If relative humidity is greater than 80%, permission to blast shall be obtained from Company / Consultant.
- 3.1.8 Extreme care shall be exercised to prevent damage when blasting near nameplates, machined surfaces and factory-coated items. These surfaces shall be adequately protected.
- 3.1.9 Mill scales, rust scales, old paints marking, slags and sediments, weld spatter and other foreign materials shall be thoroughly removed.
- 3.1.10 Cloth is not allowed to be used on blasted surfaces for cleaning the sand dust which accumulated due to blasting operation, soft brush shall be used for the purpose.
- 3.1.11 Blasted and cleaned surfaces shall be inspected and approved by the Company / Consultant, prior to priming/painting works.
- 3.1.12 Sand particle size and abrasive contamination shall be regularly checked.

3.2 **Non-Ferrous Structures**

Surface preparation for non ferrous structures shall consists of two separate operations, surface cleaning and eventual pretreatment of the surface to be painted with the proper priming coat.

3.2.1 Cement, Concrete, Masonry

a) Surface Cleaning

The surface cleaning shall be undertaken by means of one or all of the following processes, depending on the initial state of the surfaces to be painted:

- The surface shall be roughened by power or hand weathering or abrasion.
- In all cases removing of oil or grease is mandatory.
- In all cases the surfaces are to be dried.

3.2.2 Lead

a) Surface Cleaning

Surface cleaning shall be performed by one of the following processes:

- solvent cleaning
- light wire brushing or sanding

b) Pretreatment

None, provided that the surface cleaning is carefully performed.

3.2.3 Plaster

a) Surface Preparation

After allowing the plaster to completely cure, surface shall be prepared for final coating by use of emulsion paints or resin emulsion paints on new or damp plaster.

b) Pretreatment

None After the above preparation, the plaster surfaces are ready for priming and painting, provided the preparation coats are allowed to dry.

3.2.4 Wood

a) Surface Preparation

All cracks, crevices and holes shall be scraped out, primed and made good with proper products of approved manufacturer, faced up and rubbed down to an even surface.

All knots shall be treated to prevent bleeding. Large or loose knots shall be cut out, removed and replaced with sound wood or cut back and the surfaces made good with stoppers.

All previously painted woodwork, if any, shall be washed with soap and water, will rinses with clean water and rubbed down with waterproof abrasive paper before re-painting works being undertaken.

b) Pretreatment

None, provided that surface preparation has been properly performed.

4.0 **PAIN MIXING, THINNING & STORAGE**

- 4.1 All containers of coating material shall remain unopened until required for use and shall be stored under cover. Painting materials shall be stored in accordance with the instructions of the paint manufacturer/supplier.
- 4.2 Painting material which has jelled or otherwise deteriorated during storage shall not be used.
- 4.3 All ingredients in any container shall be thoroughly mixed before use to a smooth and uniform consistency. Mechanical agitation during application shall be sufficient to keep pigment in solution.
- 4.4 Where a skin has formed in the container, the skin shall be cut loose and discarded. If such skins are sufficiently thick to have a practical effect on the composition and quality, the paint shall not be used.
- 4.5 All pigmented material shall be strained after mixing except where application equipment is provided with adequate strainers. Strainers shall be capable of passing the pigment and removing any skin.
- 4.6 Painting material which does not have a limited life or does not deteriorate on standing may be mixed any time before using and shall not remain in spray pots or buckets overnight, but shall be gathered in to a closed container and remixed before use.
- 4.7 No thinner shall be added unless necessary for proper application. Thinning shall not exceed limitations established by Manufacturer/Supplier.
- 4.8 Type of thinner shall comply with Manufacturer's/Supplier's instructions.
- 4.9 When use of thinner is permissible, it shall be added during the mixing process. Painters shall not add thinner after it has been thinned to the proper consistency. All thinning shall be done under supervision of someone acquainted with the correct amount and type to be added.
- 4.10 All painting materials shall have prior approval of the Company / Consultant.

5.0 COATING PROCEDURE

5.1 Ferrous Structures and Equipment

5.1.1 Painting System

- a) The type of paint, number of coats and thickness shall be applied as outlined in Sections–7.1 to 7.8 other painting materials can be used only with Company / Consultant prior approval.
- b) Primers and finish coats for any particular system shall be from the same Manufacturer/Supplier to ensure material compatibility.
- c) Manufacturer/Supplier’s instructions, including safety precautions, are a part of this specifications. In case of conflict, the Manufacturer/Supplier’s mandatory instructions shall govern.

5.1.2 Application

- a) Surfaces shall not be painted in rain, wind, snow, fog, mist in areas where injurious airborne elements exist, when the steel surface temperature is less than 3°C above dew-point, when the relative humidity is greater than 80% or when the temperature is below 5°C.
- b) To the maximum extent practical, each coat of material shall be applied as a continuous film of uniform thickness free of pores. Any thin spots or areas missed in the application shall be recoated and permitted to dry before the next coat is applied.
- c) Each coat shall be in a proper state of cure or dryness before the application of the succeeding coat. Material shall be considered dry for re-coating when an additional coat can be applied without the development of any detrimental film irregularities such as lifting or loss of adhesion of the undercoat.
- d) When successive coats of the same color have been specified, alternate coats shall be tinted when practical, sufficiently to produce enough contrast to indicate complete coverage of the surface.

When the material is the color of the steel or when the tinting of the final coat is objectionable, the first coat to be applied shall be tinted. The tinting material shall be compatible with the material and not detrimental to its service life.

- e) All blast cleaned surfaces shall be coated with the specified primer within four hours after blasting, before rusting occurs. No acid washes or other cleaning solutions or solvents shall be used on metal surfaces after they are blasted.
- f) Brush application of paint shall be in accordance with the following:

- Brushes shall be of a style and quality that will enable proper application of paint. Round or oval brushes are most suitable for rivets, bolts, irregular surfaces and rough or pitted steel, wide, flat brushes are suitable for large flat areas, but they shall not have a width over one hundred and twenty five (125) millimeters.
 - The brushing shall be done so that a smooth coat as nearly uniform in thickness as possible is obtained.
 - Paint shall be worked into all corners.
 - Any runs or sags shall be brushed out.
 - There shall be a minimum of brush marks left in the applied paint.
 - Surfaces not accessible to brushes shall be painted by spray, daubers or sheepskin.
- g) Roller application of paint could also be used. Rollers of different length of maps should be selected as per the requirement.
- h) Airless spray application shall be in accordance with the following:
- The equipment used shall be suitable for the intended purpose and shall be capable of properly atomizing the paint to be applied. The nozzles shall be those recommended by the Manufacturer of the equipment for the material being sprayed. The equipment shall be kept in satisfactory condition to permit proper paint application.
 - Most suitable spray tip and pressure should be selected and used.
 - The spray fan should be kept at right angle to the surface and the gun should be triggered off at the end of each pass.
 - Proper distance should be maintained for holding an airless spray gun from the surface being coated, in order to avoid pin holing, dry spraying and over-spraying.
 - When in use, avoid placing hands or fingers in front of the gun, as contact with the pressurized point can cause serious injury.
 - Spray trigger-locking device should be in working order and only released during spraying operation.
 - Spray equipment shall be kept sufficiently clean so that dirt, dried paint and other foreign materials are not deposited in the paint film. Any solvents left in the spray equipment shall be completely removed before applying paint to the surfaces being painted.

- Paint shall be applied in a uniform layer with overlapping at the edge of the spray pattern. The spray pattern shall be adjusted so that the paint is deposited uniformly.
 - Areas inaccessible to the spray gun shall be painted by brush; if not accessible by brush, daubers or sheepskins shall be used. Brushes shall be used to work paint into cracks, crevices and blind spots which are not adequately painted by spray.
 - Particular precautions are necessary in spraying inorganic zinc.
- i) All nameplates, Supplier's identification tags, machined surfaces, instrument glass, finished flange faces, control valve stems and similar items shall be masked to prohibit coating deposition. If these surfaces are coated, the component shall be cleaned and restored to its original condition.
 - j) Edges of structural shapes and irregular coated surfaces shall be coated first and an extra full pass made later.
 - k) Contact surfaces of all components (bottom of skids, mounting surfaces of equipment etc.) are included in the scope of work to be coated.
 - l) Wet paint shall be protected against contamination from dust or other foreign matter.
 - m) Sand blasting yard and painting yard shall be appropriately apart or if close shall be segregated by a proper partition.
 - n) Second primer coat and finish coats, as specified, shall be applied after fabrication, erection and welding activities.

5.1.3 Drying of Coated Surfaces

- a) No coat shall be applied until the preceding coat has dried. Material shall be considered dry for re-coating when another coat can be applied without the development of any film irregularities such as lifting or loss of adhesion to under coats and the drying time of the applied coat does not exceed the maximum specified for it as a first coat.
- b) No paint shall be forced dried under conditions which will cause checking wrinkling, blistering, formation of pores or detrimentally affect the condition of the paint.
- c) No drier shall be added to a paint on the job unless specifically called for in the manufacturer's specification for the paint.
- d) Paint shall be protected from rain, condensation, contamination, snow and freezing until dry to the fullest extent practical.

5.1.4 Repair of Damaged Paint Surface

Run, sags, voids, drips, over spray, loss of adhesion, blistering, peeling, mud-cracking, crazing, inadequate cure, or rusting of the substrate shall not be acceptable. Where shop painting has been damaged in transit or where damage has occurred to field coats, the following shall apply:

- a) All damaged and loosely adhering paint shall be removed and the surface thoroughly cleaned.
- b) Edges of the breaks shall be feathered and the designated number of prime and finish paint applied.
- c) Paint shall match the original color and gloss.
- d) Cure and thickness check shall be carried out.
- e) Repair area shall be fully documented and traceable.

CONTRACTOR/SUPPLIER shall submit proposals to Company / Consultant for the preparation of painting and paint repair of grating tie down spots, i.e. spot weld, stud welds, tack welds etc. in between the panels and panel slats and also the grating panels.

5.2 Non Ferrous Structures and Facilities

5.2.1 Coating System

The surface painting of the non ferrous structures shall be carried out after the surface preparation has been performed in a proper way and accepted by the Company / Consultant.

Surface painting consists of two separate coats, primer coat and final coat which shall be applied and after drying of the primer coat.

6.0 INSPECTION

- 6.1 CONTRACTOR/SUPPLIER shall deploy a qualified team for the Quality Control of the painting Works. Detailed QC procedures shall be developed by the CONTRACTOR/SUPPLIER and submitted to the Company / Consultant for approval. All painting Works shall be carried out only in accordance with the approved procedure.
- 6.2 All materials supplied and Works performed under this specification shall be subject to inspection by inspectors nominated by the CONTRACTOR/SUPPLIER.
- 6.3 All parts of the work shall be readily accessible to the Company / Consultant inspector.
- 6.4 Approval of each of the following shall be obtained before proceeding with any subsequent phase:

- Weather Conditions
 - Location of work
 - Surface Preparation and painting of Equipment and Material
 - First coat
 - Each subsequent coats
- 6.5 Company / Consultant shall have the authority to reject any Work that does not conform to the specifications. Applicator shall correct work found defective under this specification.
- 6.6 Painting work inspection shall be undertaken in five (5) steps according to the hereunder sequence:
- 6.6.1 Blast cleaning required grade shall be checked by means of pictorial surface standards.
- 6.6.2 Surface cleanliness, result of the surface preparation.
- 6.6.3 An in-process checking will be given to check the wet film thickness by means of the wet film thickness gauge.
- 6.6.4 After coating, the dry film thickness shall be measured by means of 9 DFT meter. In case minimum dry film thickness as specified in this specification are not achieved due to whatever reasons, the number of coats will be increased accordingly to achieve the only specified DFT.
- 6.6.5 Coating integrity testing will be achieved by the use of a holiday detector. In case of lack of paint detection, the CONTRACTOR/SUPPLIER shall mark the holiday to indicate the location of repair work to be performed.
- 6.7 All equipment necessary to measure the performance of painting shall be provided by the CONTRACTOR/SUPPLIER.

7.0 **PAINTING SYSTEMS**

The painting system to be applied for each type of equipment/structure and facilities shall be according to the system described hereunder. The CONTRACTOR/SUPPLIER shall obtain written approval of color scheme to be followed by Company / Consultant. The CONTRACTOR/SUPPLIER shall check the dry film thicknesses by DFT meter in the presence of Company / Consultant.

7.1 **Tank External Surfaces (Shell & Roof)**

Tank shell

First Coat	Inorganic Zinc Silicate	40-50 microns DFT
Second Coat	Inorganic Zinc Silicate	40-50 microns DFT
Third Coat	Alkyd Enamel	20-25 microns DFT
Fourth Coat	Alkyd Enamel	20-25 microns DFT
Total Thickness		120 microns minimum 150 microns maximum

Tank Roof Surfaces

First Coat	Coal Tar Epoxy (Black)	65-75 Microns
Second Coat	Coal Tar Epoxy (Brown)	65-75 Microns
Third Coat	Hi-Build Epoxy Finish	45-55 Microns
Fourth Coat	Hi-Build Epoxy Finish	45-55 Microns
Total Thickness		220 microns minimum 260 microns maximum

Tank Appurtenances

For all appurtenances such as nozzles, manholes, staircase, handrail etc., the system given below shall be followed:

First Coat	Inorganic Zinc Silicate	40-50 microns DFT
Second Coat	Inorganic Zinc Silicate	40-50 microns DFT
Third Coat	Alkyd Enamel	20-25 microns DFT
Fourth Coat	Alkyd Enamel	20-25 microns DFT
Total Thickness		120 microns minimum 150 microns maximum

Tank Internal Surface

Topside of the bottom plates, and lower 2 meter of shell plate, and equal height of the internal piping/structure columns shall be painted as under:

First Coat	Epoxy Zinc Phosphate Primer	75-80 microns DFT
Second Coat	High Build Epoxy White	125-130 microns DFT
Third Coat	High Build Epoxy White	125-130 microns DFT
Total Thickness		325 microns minimum 340 microns maximum

Underside of The Tank Bottom Plates

First Coat	Coaltar Epoxy	75-80 microns DFT
Second Coat	Coaltar Epoxy	75-80 microns DFT
Third Coat	Coaltar Epoxy	75-80 microns DFT
Total Thickness		225-240 microns

7.2 **Piping & Steel Structure**

Primer Coat	Inorganic Zinc Silicate	1 Coat 40-50 microns DFT
Intermediate Coat	Micaceous Iron Oxide (MIO)	1 Coat 125-130 microns DFT
Finish Coat	Polly Urethane Enamel	1 Coat 40-50 microns DFT
Total Thickness		225-230 microns

7.3 **Un-insulated Equipment**

(Heat Exchangers, Air Fin Coolers, Vessels, Furnace etc. Including external attachment) (up to 90°C)

Primer Coat	Double build Alkyd Zinc Phosphate Primer.	1 Coat 40-50 microns DFT
Intermediate Coat	Double build Alkyd Zinc Phosphate Primer.	1 Coat 40-50 microns DFT
Intermediate Coat	Synthetic alkyd enamel.	1 Coat 25-30 microns DFT
Finish Coat	Synthetic alkyd enamel.	1 Coat 25-30 microns DFT
Total Thickness		130 microns minimum

7.4 **Un-insulated Equipment**

(Heat Exchangers, Air Fin Coolers, Vessels, Furnace etc. Including external attachment) (up to 91°C to 400°C)

Primer Coat	Inorganic Zinc Silicate Primer	1 Coat 50-55 microns DFT
Intermediate Coat	Heat Resisting Paint (Silicone Resin)	1 Coat 25 microns DFT
Finish Coat	Heat Resisting Paint (Silicone Resin)	1 Coat 25 microns DFT
Total Thickness		100 microns minimum

7.5 **Low temperature equipment & Piping**

(Piping, vessels and equipments) (Cryogenic services)

First Coat	Inert Multipolymeric Matrix	1 Coat 100 microns DFT
Second Coat	Inert Multipolymeric Matrix	1 Coat 100 microns DFT
Total Thickness		200 microns minimum

7.6 **Cabinets and Instrument Panels**

For carbon steel surfaces of cabinets and control panels for instrument and electrical equipment etc.

7.6.1 Exterior surfaces of cabinets, panels, etc....

Type	Prime Coat Wash Primer	Intermediate & Finish Coats Aliphatic Polyurethane
Number of coats	1	2
DFT, microns/coat	15	25

7.6.2 Interior Surface of cabinets, panels, etc. same as exterior surfaces, but with only one finish coat.

7.7 Hot-dipped Galvanized Structures

- 7.7.1 Structural steel galvanized coating shall be per ASTM specification A-123, except coating weight in grammess per square meter shall not average less than 700 grammes (92.3 ounces per square foot), individual specimen shall show less than 615 grammes (2.0 ounces).
- 7.7.2 Pipe galvanized coating shall be per ASTM A.120 or as specified above for structural steel.
- 7.7.3 All cuttings, shaping and welding shall be done before galvanizing.
- 7.7.4 Any areas damaged in handling shall be cleaned and coated with galvoweld or equivalent product.
- 7.7.5 Galvanized component surfaces shall be degreased and sand swepted to remove surface film and provide an anchor pattern for paint before applying coating.

Material to be galvanized shall be cleaned of dirt oil and other contaminants that could interface with adherence of galvanized.

- 7.7.6 Dry film thickness of the galvanized surface shall be as follows:

Type	Prime Coat	Finish Coats
Number of coats	1	1
DFT, microns/coat	50	50

7.8 Non Ferrous Structures

Material to be painted	Prime Coat	Finish Coats
Cement, concrete and masonry. (See Note 1)	<ul style="list-style-type: none"> – Oil paints or – Styreos butadiene copolymer paints or – Polyvinyl acetate emulsion paints. or – Resin emulsion paints. or – Chlorinated rubber paints or – Epoxy or – Urethane <p>One coat of the selected paint Depending on the use of the coated surface</p>	<ul style="list-style-type: none"> – Same as priming. <p>One coat</p>

Material to be painted	Prime Coat	Finish Coats
Copper	<ul style="list-style-type: none"> – Any good oil or alkyd paint. <p style="text-align: center;">One coat</p>	<ul style="list-style-type: none"> – Any paint compatible with service, environment and priming paint. <p style="text-align: center;">One coat</p>
Lead	<ul style="list-style-type: none"> – Any good oil or alkyd paint. <p style="text-align: center;">One coat</p>	<ul style="list-style-type: none"> – Any paint compatible with service, environment and priming paint. <p style="text-align: center;">One coat</p>
Plaster	<ul style="list-style-type: none"> – Primer sealer or – Styrene butadiene emulsion paint or – Polyvinyl acetate emulsion paint or – Non-penetrating oil or alkyd paint. <p style="text-align: center;">One coat of the selected paint depending on the needs to be met</p>	<ul style="list-style-type: none"> – Same paints used for priming except that. <p>Primer Sealer, if used as finishing coat, will consist of one coat with semi-gloss or gloss Oleoresinous finish paint.</p>
Wood (Exterior and interior)	<ul style="list-style-type: none"> – New wood – Wood primer or – Add up to 25 % of raw linseed oil in commercial house paint. – Previously painted – Use finish paint as primer 	<ul style="list-style-type: none"> – Latex Paints or – Oil paints

Note:

- 1) As a guide for paints selection, the following shall be taken into consideration:
 - Surface such as concrete, cement, masonry and plaster are alkaline. Good results are achieved by using alkali resistant paints such as chlorinated rubber, styrene butadiene copolymer, polyvinyl acetate, acrylic emulsions, epoxies or urethanes. The finish paint color shall comply with the color schedule requirements.

8.0 LININGS

8.1 Alloy Linings

Alloy linings shall be one of the following types:

8.1.1 Integrally Clad:

- a) Hot rolled.
- b) Explosion bonded.

Clad material shall conform to ASME SEC II A SA-263, ASME SEC II A SA-264 or ASME SEC II A SA-265, whichever is applicable, based on the material of lining and shall show minimum shear strength of 20,000 psi. One shear test shall be made on each such clad plate, as rolled, and the results shall be reported on the certified mill test report.

8.1.2 Alloy Weld Overlay.

Even if the cladding material cannot be included in the pressure calculations, it is always advisable to perform a shear strength test. Doing this will help eventual vessel re-rating.

Connections, manways and inspection openings in alloy-lined portions of vessels shall conform to one of the following methods of construction (loose-sleeve liners are not permitted):

- a) Connections of all sizes shall be fabricated from integrally clad plate or protected with deposited alloy weld metal.
- b) Solid, stabilized austenitic nozzles and other connections shall be welded to ferritic base material in noncyclic service with COMPANY approval.
- c) Flanges of ferritic base material with alloy weld overlay shall be welded to alloy nozzles with COMPANY approval.

9.0 COLOUR SCHEDULE AND MARKING

Requirement for colors and marking for piping systems as vessels, tanks, structural steel and miscellaneous other items are described in this Section. Final colors scheme shall be selected by the Company / Consultant prior to painting of the equipment/system.

9.1 Definitions

9.1.1 Piping System

Piping systems shall include pipes of any kinds and, in addition, fittings valves and other miscellaneous devices involved in the piping field (not buried).

9.1.2 Tanks and Vessels

Tanks and vessels shall include all liquid containers, pressurized or not, vertical or horizontal, provided that they are not buried, and allowing storage of the different fluids handled for operational and safety purpose.

9.1.3 Structural Steel

Structural steel works shall include all platforms, gangway, ladders, safety cages, building structures, as well as skids, supports, etc. foreseen for access and/or safety purposes and mechanical needs of the project.

It shall include all cranes, davits, overhead traveling cranes.

9.2 **Method of Identification**

9.2.1 Marking

Positive identification of the content of a piping systems or vessel tanks shall be by lettered and numbered legend. Arrows shall be used to indicate direction of flow. The identification of piping marking shall refer to the line number shown in the P&ID.

The content of vessels and tanks shall be indicated. P&ID and the tank or vessel identification number shall be painted at a prominently visible location. Depending on the size of the tanks, two to four markings shall be required, at equal distance on the circumference.

Marking shall be applied close to valves and adjacent to changes in direction, branches and where the pipes pass through walls floors, and at frequent intervals on straight pipe runs. Not less than (5) five meters.

9.2.2 Color Coding

Standardization shall be accomplished in all facilities as follows:

9.2.2.1 All process equipment and pipework apart from Fire Fighting System shall be finished in either Light Grey (RAL 7035) or White along its entire length as the decorative colour.

9.2.2.2 The fluid contents of all flow-lines shall be identified by tapes which are appropriately colored; the nature of the pipe contents shall be identified by means of a Three Band Colour Code Identification Band System (CCIB). The outer bands, which will be the same colour, are the Basic/Primary Identification Bands (PIB) and the middle band is the Safety / Secondary Identification Band (SIB).

- a. The Basic/Primary Identification Band (PIB) Colour determines the type of fluid, e.g. Oil, Gas, Chemical or Water.

Type of Fluid	Basic/Primary Identification Band (PIB) Colour	
	Colour	RAL Code
Water (Raw; Potable; Storm; Treated; Produced)	Green	RAL 6037
Steam	Crimson Red	RAL 3020
Firefighting	Signal Red	RAL 3010

Type of Fluid	Basic/Primary Identification Band (PIB) Colour	
	Colour	RAL Code
Oils (Combustible Liquids)	Dark Brown	RAL 8002
Chemicals	Orange	RAL 2004
Gases (Gaseous or Liquefied)	Yellow	RAL 1026
Acids & Alkalis	Purple	RAL 4001
Air (Utility; Service, Instrument)	Light Blue	RAL 5012
Process Effluents (Drain; Vent; Flare)	Black	RAL 9005

- b. A Safety / Secondary Identification Band (SIB) colour is added to the middle of the PIB, to identify the fluid conveyed more precisely. The SIB, used in conjunction with the PIB's, is designed to provide a unique combined Colour Code identification Band (CCIB) for each fluid that is being conveyed.

Hazard / Sign	Safety / Secondary Identification Band (SIB) Colour	
	Colour	RAL Code
Safety	Grass Green	RAL 6010
Attention	Golden Yellow	RAL 1004
Danger	Signal Red	RAL 3001
Mandatory	Blue	RAL 5017
Alert	Yellow	RAL 1026
Electrical Service	Orange	RAL 2004
Traffic Lines	White	RAL 9010

9.2.3 Visibility

Attention shall be given to visibility with reference to pipe markings, where the pipes are located above or under the normal line of vision, the marking shall be placed above or under the pipe centerlines.

9.2.4 Type and Size of Markings

1) General

Maximum contrast shall be provided between color field and markings for readability. The enclosed color schedule gives the requirements for piping and equipment painting.

The stripes or bands foreseen for the marking of piping system shall not interfere with the pipe marking.

2) Size of Letter and Numbers

Unless specifically indicted by the material particular specification, the size of marking letters and numbers will be as follows:

Outside Diameter of Pipe or Equipment	Size of Letters and Numbers
¾" to 1¼" (19 to 32mm)	15mm
1½" to 2" (38 to 61mm)	20mm
3" to 6" (90 to 170mm)	35mm
8" to 10" (22 to 275mm)	65mm
12" to 16" (320 to 410mm)	90mm
18" to 24" (455 to 610mm)	100mm
Over 24" (over 610mm)	150mm for piping 200mm for equipment

10.0 LABOUR AND SAFETY

10.1 Labor

All steps pertaining to painting works shall only be performed by skilled personnel duly qualified to do so. The CONTRACTOR/SUPPLIER shall have its own supervision personnel working in relation with the Company / Consultant quality personnel.

10.2 Protection Of Works

10.2.1 Works Under Progress

All necessary protection steps shall be taken to protect works under progress from dust and a sufficient supply of clean drop clothes shall be maintained. The CONTRACTOR/SUPPLIER shall lay such drop clothes in all areas where the painting works under progress are to be protected.

10.2.2 Other Works

The CONTRACTOR/SUPPLIER shall lay drop clothes in all areas where painting is being done, to protect floors, machinery and equipment as well as other work, from damage during the prosecution of painting works.

As a general rule, spilled paint should be cleaned up immediately.

10.3 Safety at Work

10.3.1 Personnel Safety

CONTRACTOR/SUPPLIER shall take all necessary safety measures for the personnel, equipment and material.

For personnel safety special personal safety equipment shall be provided to the workers during the works. This will include but not limited to:

- Splash-proof goggles to be worn during chipping, wire brushing, sandblasting, spraying etc.
- Rubber gloves to be worn when using paint removers, acid treatment, cleaning compounds, etc.
- Safety belts when working inside tanks, on high equipment such as bridges, structural steel works, water towers, etc.
- Air line mask when sandblasting, spraying toxic products, etc.
- The CONTRACTOR/SUPPLIER shall provide required safety gears to Company / Consultant personnel during the inspection of work.

10.3.2 Safety Equipment

a) Ladders

All extension and straight ladders should be equipped with safety shoes.

All ladders shall be inspected once a month and the defectuous units shall be removed from the Site.

No metal ladders are allowed to be used where electric cables or sources are installed.

It is remind that neither piping nor equipment is to be used to support painters, ladders or scaffolding.

b) Swinging Stages and Scaffoldings

Swinging stages and scaffoldings shall always have a backrail. They shall be tested with twice the load they will be expected to bear in service.

Provision shall be included in the back of the backrail for providing suitable support for all hand tools that may be used. All tools shall be kept in this support when not in use.

10.3.3 General Precautions

Other requirements:

- When working around pulleys, gears, drive shafts, other moving parts, or inside tanks, fuses should be pulled or drive belts removed. Then working in any vessels, all lines coming to or leading from the vessel should be blanked or plugged.
- Overhead danger signs should be used when working near walkways, over doorways, platforms or roadways.
- Do not use paints containing a volatile solvent in enclosed areas where welders are at work.
- Use chemical type respirators when doing any spray painting except when in front of proper spray booth.
- Face shields should be worn when using power cleaning tools and chipping hammers.
- Manila or hemp ropes are not be used for scaffolds more than 7 meters away from the center of road tracks.
- Wear rubber gloves when using spark tester for locating breaks or pores in coatings.
- Do not seal paint cans of ready-to-mix paints after they have been mixed. The materials are not stable when mixed. For temporary storage punch a hole in the lid.
- No lead base paint or primer should be used.



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OIL & GAS DEVELOPMENT COMPANY LTD.

SPECIFICATION FOR INTERNALS FOR PRESSURE VESSELS



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1.0 **SCOPE**

- 1.1 This specification covers the design, fabrication, inspection, testing, handling and storage of beams, trays, grids, shrouds, thermowells and other internals for fractionating and extraction towers, separators, drums, and similar vessels.

The requirement set-out in this specification shall not be construed to eliminate consideration of the SUPPLIER's standard design and its responsibility to furnish equipment and accessories of a proper mechanical design suited to meet the specified service conditions.

1.2 **Definitions**

Following definitions apply throughout this document:

- COMPANY: Oil & Gas Development Company (OGDCL)
- CONSULTANT: M/s. Zishan Engineers (Pvt.) Ltd. (ZEL).
ZEL have been awarded the work of Engineering, Procurement Assistance and Project Management.
- CONTRACTOR: Means the construction company to be engaged by the COMPANY to perform the Construction work.

1.3 **Errors or Omissions**

1.3.1 The review and comment by the COMPANY of any SUPPLIER's drawings, procedures or documents shall only indicate acceptance of general requirements and shall not relieve the SUPPLIER of its obligations to comply with the requirements of this specification and other related parts of the Contract Documents.

1.3.2 Any errors or omissions noted by the SUPPLIER in this Specification shall be immediately brought to the attention of the COMPANY.

1.4 **Deviations**

All deviations to this Specification, other related specifications or attachments shall be brought to the knowledge of the COMPANY as section in the bid. All deviations made during the procurement, design, manufacturing, testing and inspection shall be with written approval of the COMPANY prior to execution of Work. Such deviations shall be shown in the documentation prepared by the SUPPLIER.

1.5 **Conflicting Requirements**

In the event of any conflict, inconsistency or ambiguity between the SUPPLIER's scope of work, this Specification, National Codes & Standards, referenced in the Project Specification or any other documents, the SUPPLIER shall refer to the COMPANY whose decision shall prevail.

1.6 **Reporting Procedure**

1.6.1 A reporting and documentation system shall be agreed between the SUPPLIER and the COMPANY / CONSULTANT for the status of procurement, design, manufacturing, inspection, testing and shipment of the equipment/material to be supplied under this specification. SUPPLIER shall provide reports and summaries for production performance and testing operations in conformance with a manufacturing schedule approved by COMPANY.

1.6.2 Daily, weekly, monthly and run summaries of all major aspects of the production process shall be provided as reports to the COMPANY/ CONSULTANT.

1.6.3 **Third Party Inspection**

In addition to the inspection and witnessing of tests by the COMPANY during the manufacturing and shipment of the equipment/material, COMPANY may appoint a third party or its own inspector for witnessing of the inspection and tests to be carried out at SUPPLIER's facility under this specification.

1.7 **Unit Responsibility**

The SUPPLIER shall be responsible for the complete design, supply, fabrication inspection and testing of the internals of pressure vessels, including full compliance with all applicable design codes and standards listed in Section 2.0, of this document, all project specifications, datasheets, P&IDs and with the requirements of the certifying authority, if applicable. The SUPPLIER shall handle and expedite drawings and data, and supervise and coordinate all inspection and testing.

SUPPLIER shall guarantee that all materials and parts included in construction of pressure vessels shall be new, unused and of the required/ specified grade.

1.8 **Documentation**

- a) Documents, calculation sheets, drawings, etc., to be submitted to the COMPANY shall be in the English Language.
- b) Unless otherwise specified, the metric units shall be used in documents and drawings, except that pipe sizes, flange sizes and bolts/nuts shall be indicated in inches.
- c) The form of fabrication drawings and documents may be as per the SUPPLIER's Standards. However, the format of the data sheet will be submitted to COMPANY for approval.
- d) Fabrication drawings and documents shall be submitted for the approval of the COMPANY. But, such approval of the COMPANY shall in no way relieve the SUPPLIER of his obligations with respect to such drawings and documents.

- e) Variations from or additions to this specification shall be called to the attention of the COMPANY and approved in writing by the COMPANY prior to starting fabrication.
- f) Welding procedure specification and welding qualification record shall be submitted to the COMPANY prior to the start of fabrication.
- g) Information for installation, operating, maintenance or inspection purposes shall be submitted to COMPANY.

2.0 **SPECIFICATION AND CODES**

2.1 **AISC Specification**

Manual of Steel Construction (ASD) – Specification for Structural Steel Buildings

2.2 **ASME Codes**

Section VIII Division 1	Boiler and Pressure Vessel
Section II, Part D	Material Properties
Section IX	Welding and Brazing Qualifications
B31.3	Process Piping

2.3 SUPPLIER's drawings shall show all assembly and process details and the following data:

- a. Design temperature and design loads
- b. Extent of ultrasonic, radiography, magnetic-particle inspection, or other nondestructive tests.
- c. Stress relieving and special welding procedures
- d. All material specifications including bolting and gaskets.
- e. Actual total corrosion allowance for internals (i.e., total new metal thickness minus thickness required for strength).
- f. Location and assembly details for all internals, including all tray details, and tray sectional elevations showing two or more adjacent trays. All components in the section shall be identified.
- g. All necessary instructions and piece numbers for all parts to facilitate shop or field installation.
- h. Positive material identification testing requirements.

2.4 For items that cannot be completely shop fabricated, the SUPPLIER shall submit design drawings clearly designating field welds for approval by COMPANY/CONSULTANT.

- 2.5 Two copies of design calculations made by SUPPLIER shall be furnished with or prior to submission of prints for approval. Structural design calculations for trays and internal supports shall be included. Where calculations are made on a computer, all input data, assumptions, and summary of results shall be furnished.
- 2.6 Final Data - After final approval of drawings, fabricator shall supply the following certified data:
- a. Certified drawings containing all information required by Paragraphs. 2.3 and 2.4.
 - b. Data reports executed in accordance with the applicable code shall be supplied to COMPANY/CONSULTANT.
- 2.7 SUPPLIER certification of leakage rate. SUPPLIER shall certify that all bubble cap trays will meet the specified leakage rate when installed, the gasket material and gasket to metal seal designs, if permitted, have been successfully used in similar services.

3.0 **DEFINITIONS**

3.1 **Major Beams**

Beams 10 ft (3000 mm) and longer, or beams regardless of length that extend across a vessel without interruption. All other beams shall be considered to be minor beams.

3.2 **Non-Structural Components**

Trays, decks, pans, integral minor beams, liquid redistributors, downcomers, grids, holddown grids and internal non-pressure piping.

3.3 **Structural Components**

All major beams, grid support beams, bed support beams, non-integral beams, inlet distributors, outlet collector rings, tray support rings and other load bearing components welded to the shell.

3.4 **Total Corrosion Allowance**

Corrosion allowance for all internals which are exposed to corrosion on all surfaces.

3.5 **Tray Accessories**

Valve trays, bubble caps, chimneys, weirs, baffles and entrainment screen supports.

4.0 **MATERIALS**

- 4.1 Materials for internals shall be specified.
- 4.2 Acceptable ASTM grades and specifications for a number of standard internal materials are listed in Table 1.
- 4.3 Free machining grades of steel are not permitted, except that Type 416 nuts furnished to ASTM A 194 / A 194M Gr6F with Selenium are acceptable for use with ASTM A 193 / A 193M B6 bolts.
- 4.4 Gasket and packing material for other than acid or caustic services shall be an asbestos substitute suitable for the process fluid and temperature to which it will be exposed.
- 4.5 All bolting hardware shall be of the same nominal chemistry as the internals which they are connecting. However, 12Cr bolting hardware shall be used for carbon steel internals when the specified corrosion allowance for the internal structural component is greater than 1/8 in. (3 mm).
- 4.6 Bolting hardware for manways in grids, decks and trays shall be corrosion resistant material to facilitate opening for inspection and maintenance.
- 4.7 Crinkled wire mesh entrainment screens (CWMS) shall meet the following requirements:
 - a. Materials of the supports, rods, or straps shall be at least equivalent in terms of corrosion resistance to that of the other vessel internals.
 - b. Mesh shall be Type 304 stainless steel, Alloy 400, or Alloy 600.
- 4.8 Baffle plate and wear plate material shall be of the same nominal composition as the internal structural components unless otherwise specified.

TABLE – 1 - MATERIALS SPECIFICATIONS

MATERIALS	ASTM STANDARDS					
	PLATE	SHEET	STRIP	BARS	BOLTS & NUTS	
Carbon Steel	A 36, A 283, A 285 / A 285M A 515 / A 515M A 516 / A 516M	A 414, A 569	A 570	A 675	A 307, Gr B	
Low and Intermediate Alloy Steels	As specified for High Alloy Steels					
C-1/2Mo						A 204/A 204M
1-1/4Cr-1/2Mo through 5Cr-1/2Mo						A 387 / A 387M
High Alloy Steels	A 176 and A 240, Types 405 and 410S		A 276 Type 405		A 193 / A 193M B6; and A 194 / A 194M Gr6F (with Selenium), or Gr6	
12Cr welded components						
12Cr non-welded components	A 176 and A 240, Types 405, 410 or 410S		A 276 Type 405 or 410			
18Cr 8Ni: Types 304, 316, 321, 347	A 167 and A 240		A 276		A 193 / A 193M B8 and A 194 / A 194M Gr8	
Non-Ferrous	B 127		B 164		B 164	
Nickel Copper (Monel)						
Titanium	B 265 Gr2		B 348 Gr2		B 348 Gr4	

5.0 DESIGN

5.1 General

5.1.1 All internals, except shrouds and outlet collectors, shall be removable with vertical thermowells in place, and shall be designed to pass through the nearest manhole above their level unless otherwise specified.

5.1.2 All parts which are to be installed after vessel fabrication is complete shall be designed to pass through the manways provided on the vessel.

5.2 Corrosion Allowance

The total corrosion allowance (TCA) to be used for all internals shall be specified. The TCA is normally calculated as follows:

$$TCA = 2 Cr Ld$$

where:

TCA = total corrosion allowance. Note that this value may be either more or less than the default value shown below.

Cr = the corrosion rate anticipated for the material specified.

Ld = the design life for the internal component.

- a. For structural components, the design life should equal that specified for the vessel unless otherwise specified.
- b. For non-structural components and tray accessories and internal piping, the design life should equal 1/3 the value specified for the vessel unless otherwise specified.

The factor of 2 accounts for the fact that corrosion of the internal occurs from both sides.

If not specified, the default total corrosion allowance shall be as follows:

TYPE OF INTERNAL	MATERIAL OF INTERNAL	DEFAULT TOTAL CORROSION ALLOWANCE	
		Inches	mm
Structural Component	CS	0.12	3.0
	Alloy (1)	0.02	0.5
Non-Structural Component or Tray Accessory	CS	0.04	1.0
	Alloy (1)	0.007	0.2

Note:

- (1) Alloy designates stainless steels (300 and 400 series), Nickel alloys, Copper alloys, Aluminum alloys.

5.3 Minimum Metal Thickness

A fully corroded thickness in excess of the minimum may be used if required based on other mechanical design considerations or if increased thickness results in a more economical design.

Load bearing calculations shall be carried out based on the following fully thicknesses.

Minimum acceptable fully corroded thicknesses are as follows:

- a) For Structural and Non-Structural Components, the minimum required metal thickness (fully corroded) is 0.074 in. (1.9 mm).
- b) For tray accessories, the minimum required metal thickness (fully corroded) is 0.060 in. (1.5 mm).

5.4 Loads and Stresses

5.4.1 Where live loads are not specified, structural components, non-structural components and tray accessories shall be designed to support their own weight plus the following live loads at the design temperature.

- a. **Fractionating Distillation Trays:** Design live load shall be the greater of 20 psf (98 kg/m²) or the weight of water 2 in. (50 mm) over the highest weir setting.
- b. **Areas under downcomers:** Design live load shall be the greater of 64 psf (314 kg/m²) or a head of water one-half of the height of the downcomer.
- c. **Pans (drawoff and accumulation):** Design live load shall be the greater of 1 psi (700 kg/m²) or the weight of water at the maximum operating level of the pan.
- d. Baffles (including shed rows, disc, and donuts) with no normal operating liquid level shall use a design live load of 1 psi (700 kg/m²) on the projected horizontal area.
- e. Entrainment screen components shall be designed for a differential pressure of 0.1 psi (70 kg/m²) unless otherwise specified. The need for a higher differential pressure shall be based on anticipated fouling or upset conditions.

5.4.2 Allowable unit stresses for non pressure containing internals shall be per ASME Code Section VIII, Div. 2. For stresses beyond the temperature range listed in ASME Section VIII, Div. 2, ASME B31.3 shall be used.

5.4.3 Maximum deflection from the horizontal for trays, distributors and liquid distributor trays under specified operating conditions shall not exceed 1/900 of the vessel diameter.

- 5.4.4 Maintenance loads, Structural components shall be designed for a concentrated live load of 300 lb (135 kg) at any point based on the allowable stress at 100°F (38°C). This design shall be based on the fully corroded thickness of the structural components (i.e., thickness excluding total corrosion allowance). Deflection does not need to be considered for maintenance loads.

5.5 **Dimensional Requirements**

- 5.5.1 Bolt spacing in downcomers shall not exceed 6 in. (150 mm).
- 5.5.2 Maximum unsupported length (minor dimension only) of trays, baffles, and pans shall be as limited by any access manways
- 5.5.3 For all trays except cartridge and pedestal tray assemblies, the nominal tray diameter shall be determined to the nearest 1/4 in. (6 mm) per the following:
- Tray diameter = Vessel ID - [1% Vessel ID + 3/4 in. (19 mm)]
- 5.5.4 A minimum of 3/4 in. (19 mm) overlap shall be provided between the support ring and the OD of trays, decks, and grids.
- 5.5.5 Bolt hole or clamp spacing around the edge of tray, deck, or grid sections shall not exceed 7 in. (177 mm).
- 5.5.6 Tray or deck areas blanked by structural components shall not exceed 3 in. (75 mm) in width for minor beams and support rings, and 8 in. (200 mm) in width for major beams.
- 5.5.7 The projected cross sectional area of the packing hold down plate, if required, shall be a maximum of 5% of the vessel cross sectional area.

5.6 **Structural**

- 5.6.1 The depth of supporting members normal to the direction of liquid flow on the tray below shall not exceed 20% of the vertical distance between trays.
- 5.6.2 Baffle plates and wear plates to be used with tangential nozzles for atmospheric towers shall include the design and fabrication details shown in Figure 4.
- 5.6.3 Grid support beams shall be fabricated “T” sections or fabricated back to back channels with the flanges downward and webs intruding into the catalyst bed. The beam flanges shall be used to support bed grids and screens.
- 5.6.4 Slotted oversize holes shall be used to permit thermal expansion where structural components are bolted to seat pads or clips. Bolts shall be installed “hand tight”, and then secured to prevent subsequent loosening.

5.7 **Internal Pipes and Thermowells**

- 5.7.1 Internal distribution pipes shall have flanged and gasketed connections and shall have their ends blanked.
- 5.7.2 Expansion guides shall be provided for vertical thermowell installation, per Figure 5.
- 5.7.3 Tray guides, per Figure 6 shall be provided to minimize liquid leakage at points where thermowells or catalyst dump tubes pass through trays. Highest liquid level (HLL) will be specified.
- 5.7.4 All bolting for internals shall be a minimum of 3/8 in. (10 mm) nominal diameter.

5.8 **Access Through Trays, Grids And Decks**

- 5.8.1 Access through trays, grids and decks shall be provided as follows:
 - a. All trays, grids and decks in towers 3-1/2 ft (1050 mm) in diameter and larger shall be equipped with manways.
 - b. All trays, grids and decks in towers smaller than 3-1/2 ft (1050 mm) in diameter shall be either split or equipped with manways.
 - c. Trays, grids and decks having 2 or more liquid passes shall contain manways on each pass.
- 5.8.2 Tray manways shall be as follows:
 - a. Manways shall provide a minimum rectangular opening of 15 x 18 in. (380 x 460 mm).
 - b. If opening under or through major support beams is less than that in Subpar. a, tray manways shall be installed on both sides of the beam.
 - c. Tray manways shall not form a part of the downcomer seal area.
- 5.8.3 Accesses and manways at all levels shall be vertically aligned unless otherwise specified.

5.9 **Drain Holes**

For internals requiring liquid drainage, drain holes of 1/2 in. (13 mm) diameter shall be provided as follows:

- a. One hole in each tray recessed seal pan.
- b. One hole per 5 ft (1500 mm) of length in the base of each inlet weir.
- c. Holes shall be located downstream of downcomer apron to prevent vapor from rising through downcomer liquid.

- d. All boxes and pans from which liquid is normally withdrawn shall be equipped with nozzle(s) that will insure complete drainage of the box or pan. Drain holes shall not be provided in water drawoff boxes.
- e. Drain holes for tray or deck areas shall be:

TRAY OR DECK AREA		NUMBER OF DRAIN HOLES PER TRAY
ft ²	m ²	
≤ 30	≤ 3	1
> 30 to 100	> 3 to 9	2
> 100	> 9	3

6.0 **ADDITIONAL DESIGN REQUIREMENTS FOR INTERNALS OF TOWERS AND DRUMS**

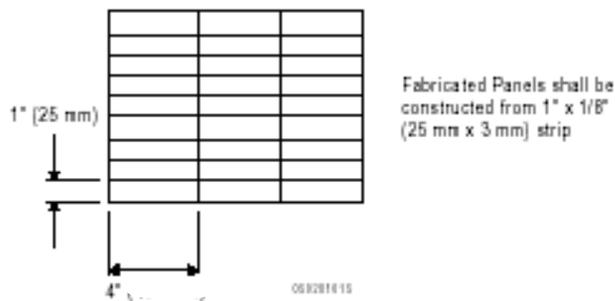
6.1 **Downcomer Anti-Jump Baffles and Anti-Vortex Baffles**

6.1.1 Downcomer anti-jump baffles shall be designed with the following provisions:

- a. Baffles shall extend across the full width of the downcomer and be parallel to the edges of the downcomer.
- b. The bottom edge of the baffle shall be level with the top of the outlet weir (where used) or level with the tray if no weir is used.
- c. Baffles shall contain at least one accessway, 22 in. (560 mm) long by the height of the baffle.

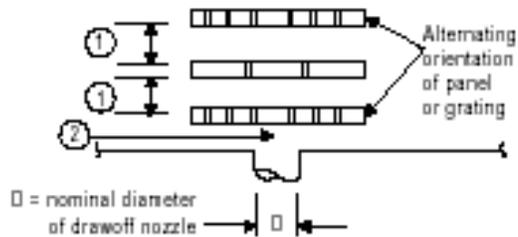
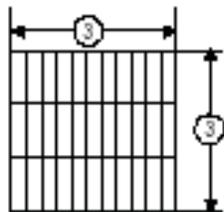
6.1.2 Anti-vortex baffles shall be designed and installed per the following criteria:

- a. Acceptable baffle construction: “Subway” grating or panel strip per the configuration shown below.



- b. Baffle design and installation shall comply with the following table and figure below:

APPLICATION > CRITICAL DIMENSIONS	VERTICAL DRUMS	BOTTOM DRAWOFFS	HORIZONTAL DRUMS	ACCUMULATOR TRAY DRAWOFFS	TOWER DRAWOFF BOXES (OTHER THAN ON ACCUMULATOR TRAYS)
Number of Tiers >	3	3	3	3	
1 Spacing between tiers	6 in. (150 mm) max. Tiers too be equally spaced and located between the drawoff nozzle D and the low liquid level. Distance from top tier to low liquid level shall be minimized within the above constraints.				
2 Clearance between bottom of Tiers and Outlet Nozzle	D/2, or greater as required to accommodate baffle size		2 in. (50 mm) approx.		Will be specified
3 Baffle size (length of sides)	4D or 1/2 Drum (tower) diameter, whichever is the smaller value			Will be specified	



6.2 Downcomers, Seal Pans, Drawoff Boxes, Accumulator Stacks, Feed Inlets, Reboiler Returns

- 6.2.1 Downcomers shall be installed with bolted joints, and shall be designed so that no vapor bypassing will occur. Stiffeners must be provided as needed to limit the horizontal movement of the bottom edge of the downcomer at any point to $\pm 1/4$ in. (± 6 mm).
- 6.2.2 All joints in areas under downcomers, including the joint to the tray support ring, shall be continuously seal welded after installation of the tray. The joint with the contacting area of the tray shall not be welded. Bolted and gasketed construction shall not be used in areas under downcomers except in towers 3 ft (900 mm) in diameter and smaller, where removal of the downcomer seal area is required to permit access.
- 6.2.3 All joints in pans and drawoff boxes, shall have continuous welds to prevent leakage.
- 6.2.4 Accumulator stacks on drawoff pans shall be seal welded to the pans. Any joints in the stacks shall be seal welded.
- 6.2.5 Feed inlets and reboiler returns, where a stream enters a vessel, the stream shall impinge on a smooth, unobstructed surface regardless of whether it discharges against a downcomer apron or a specially provided baffle.
- 6.2.6 Trough type distributors which are hung by a bolt/nut arrangement (rather than supported from below by a tray support ring or truss) shall be provided with lock washers, lock nuts or double nuts.

6.3 Fabrication

- 6.3.1 Tolerances for fabrication and assembly shall be as shown in Figure 7.
- 6.3.2 All internals shall be marked, with corresponding markings provided on assembly drawings, to permit rapid assembly.
- 6.3.3 Non-lead paint shall be used for marking.
- 6.3.4 Slot and hole edges in the outlet collector ring shall be smoothly ground to prevent damage to screening and to reduce stress concentration points.
- 6.3.5 When castable lining is used, the shroud shall be installed after castable dryout is complete.
- 6.3.6 All major load bearing internal members welded to vessels shall be attached with full penetration welds. A major load bearing connection shall be defined as when the internal member being welded to the shell is greater than or equal to $1/2$ " (13 mm) in thickness at the connection weld. Bids to use fillet welds for members greater than or equal to $1/2$ " (13 mm) in thickness shall be approved by COMPANY.

6.3.7 Shroud joints shall be butt-welded using backing strips, except the circumferential joints of shrouds in cylindrical reactors may be lap welded.

6.3.8 The surfaces and edges shall be finished as follows:

- a. Edges of all surfaces shall be free of burrs.
- b. Edges of tray accessways shall be beveled or rounded.

6.4 Trays

6.4.1 Jet, sieve, or valve trays. Gaskets and packing shall not be used between tray decks and support rings or beams when installing jet, sieve, or valve trays.

6.4.2 For perforated plate distributor trays, all holes shall be punched in the direction of liquid flow.

6.4.3 Hole punching and layout on sieve, jet, valve and bubble cap trays shall be as follows:

- a. Holes shall be punched to avoid a continuous rectangular or square pitch pattern parallel to liquid flow. Square or rectangular pitch can be used if the die is offset every 3 or 4 rows of holes perpendicular to flow.
- b. Holes on sieve trays shall be 1/2 in. (13 mm) diameter unless otherwise specified.
- c. Hole area per tray shall be within $\pm 2\%$ of the area specified.
- d. Holes on sieve and valve trays, and tabs on jet trays shall not be located within 2 in. (50 mm) of any downcomer, inlet weir or recessed seal pan. Unpunched areas shall not exceed 8 in. (200 mm) in width above major beams or 3 in. (75 mm) above minor beams or next to the vessel shell.
- e. On sieve, jet, and valve trays, the hole area shall be uniformly distributed in the contacting area (i.e., the number of holes per sq ft of contacting area shall be constant over the entire tray).

6.4.4 Valve trays shall incorporate an anti-rotation feature that will prevent spinning of the element. In addition, the float element shall be crimped to prevent full peripheral contact of the element with the tray deck.

6.4.5 Blanking on sieve, jet or valve trays shall be done as follows:

- a. For valve trays, valves shall be removed prior to blanking.
- b. Blanking strips shall be distributed uniformly in the perforated area and should be 1.5 to 5.0 in. (38 to 125 mm) wide.

7.0 **INSPECTION AND TESTING**

7.1 **General**

Inspection and testing shall be carried out at the SUPPLIER's works and shall be witnessed by the COMPANY's authorised and/or certifying authority, if required.

The responsibility for inspection rests with the SUPPLIER. However, the COMPANY and their authorised representative reserve the right to inspect the equipment at any time during fabrication to ensure that materials and workmanship are in accordance with this specification, Project Specifications, the equipment data sheets and drawings.

The SUPPLIER shall provide a projected shop schedule with appropriate fabrication stages at the time drawings are submitted for approval, to highlight the inspection activity schedule.

The approval of any work by the COMPANY, or their authorised representative, shall in no way relieve the SUPPLIER of any responsibility for carrying out the provisions of this specification.

7.2 **Inspection**

7.2.1 All materials, fabrication, and packaging shall be subject to inspection by the COMPANY during all stages of manufacture.

7.2.2 Diameter of cartridge and pedestal tray assemblies shall be checked to ensure that the assemblies can be inserted and withdrawn from the vessel shell without binding or interference taking into account an allowable tolerance of 1/8 in. (3 mm) on vessel ID. The maximum permissible radial gap between tray periphery and vessel shell is 3/16 in. (5 mm).

7.2.3 All shroud welds shall be vacuum box tested.

7.2.4 Fit-up. One tray, grid, and deck of each diameter and type shall be assembled in the vessel at the SUPPLIER's shop to the extent necessary to check fit-up.

7.2.5 Shroud joints shall be 100 percent examined by liquid penetrant. Test fluids shall be chloride free.

7.2.6 Magnetic particle examination and acceptance criteria shall be per ASME Code Section VIII, Appendix VI. Ultrasonic examination and acceptance criteria shall be per ASME Code Section VIII, Appendix XII.

7.3 **Leakage and Flow Measurement Tests**

7.3.1 Leakage tests shall not be performed on jet, sieve, valve, cartridge or pedestal trays.

7.3.2 Fresh water shall be used for testing. When testing items manufactured from stainless steel, the chloride iron content of the test water shall not exceed 30ppm.

8.0 **PREPARATION FOR SHIPMENT**

After the final test, the unit shall be dried and cleaned thoroughly of all grease, loose scale, and rust (both internally and externally). The preparation for shipment of the Packages shall meet the Preparation For Shipment as detail in Specification for Skid-Mounted Packages (165-4-SPM-055), Specification for Export Packing & Crating (165-4-SPM-031).

Tower packing shall be packaged to effect protection against corrosion or degradation during shipping and storage at site.

Protection from salt water. Austenitic stainless steel components shall not be exposed to wetting by salt water or salt spray. Protective coating or coverings used to prevent such exposure shall be approved by COMPANY.

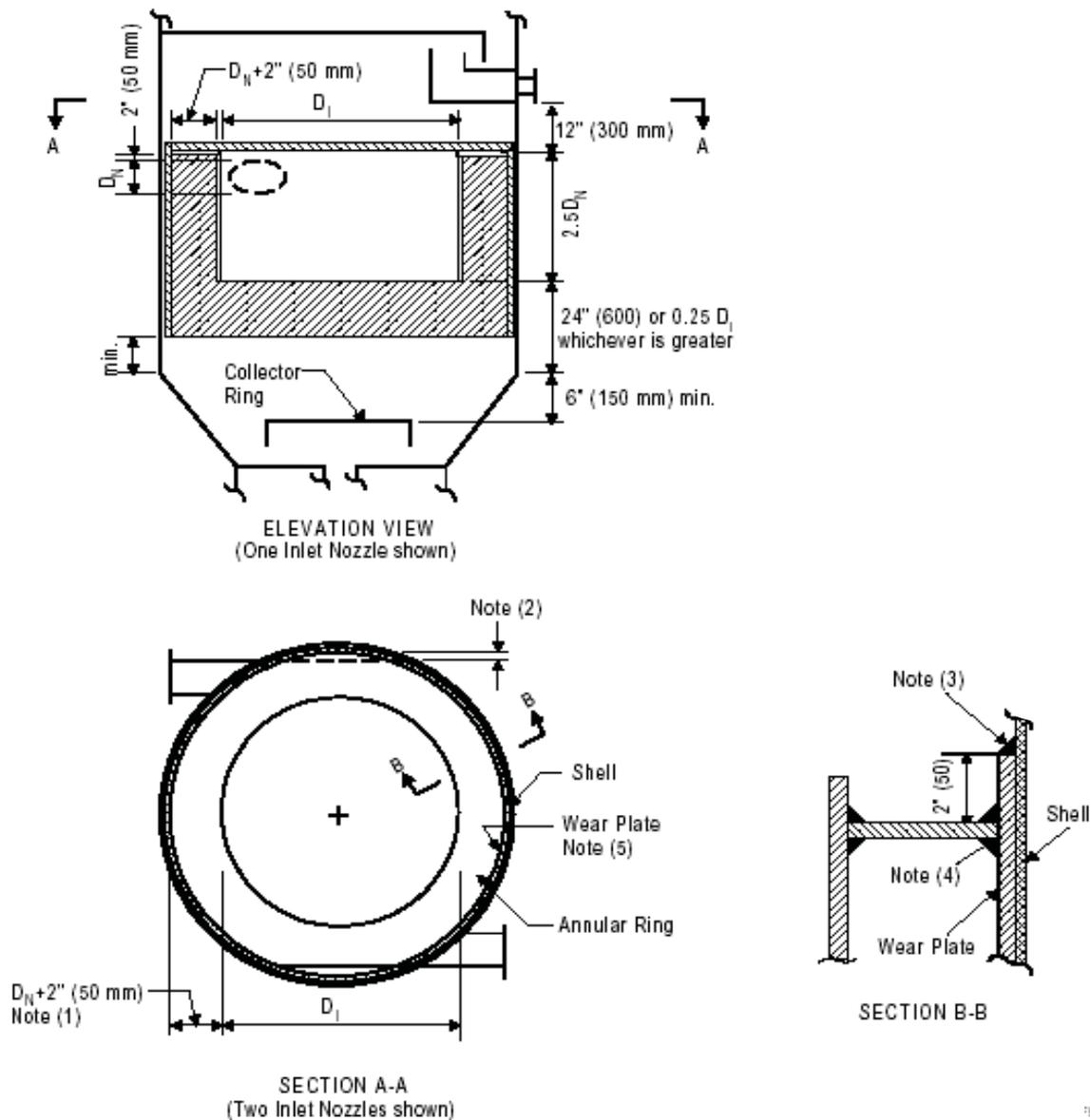
FIGURE – 1**ANNULAR RING AND WEAR PLATE FOR
USE WITH TANGENTIAL INLET NOZZLE(S)**

FIGURE – 2

REACTOR THERMOWELL EXPANSION GUIDE

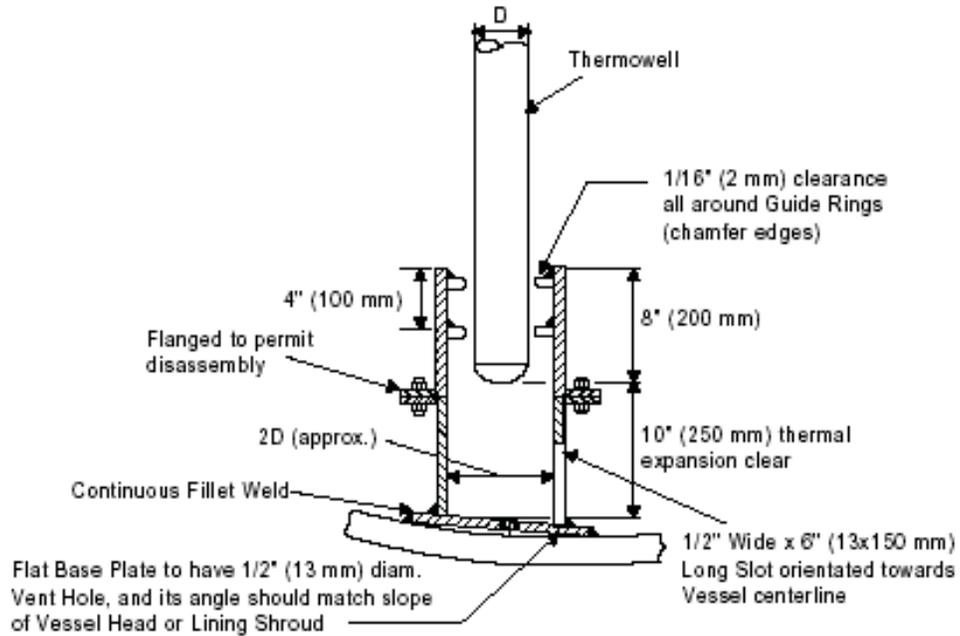


FIGURE – 3

TRAY GUIDE FOR THERMOWELL OR DUMP TUBE

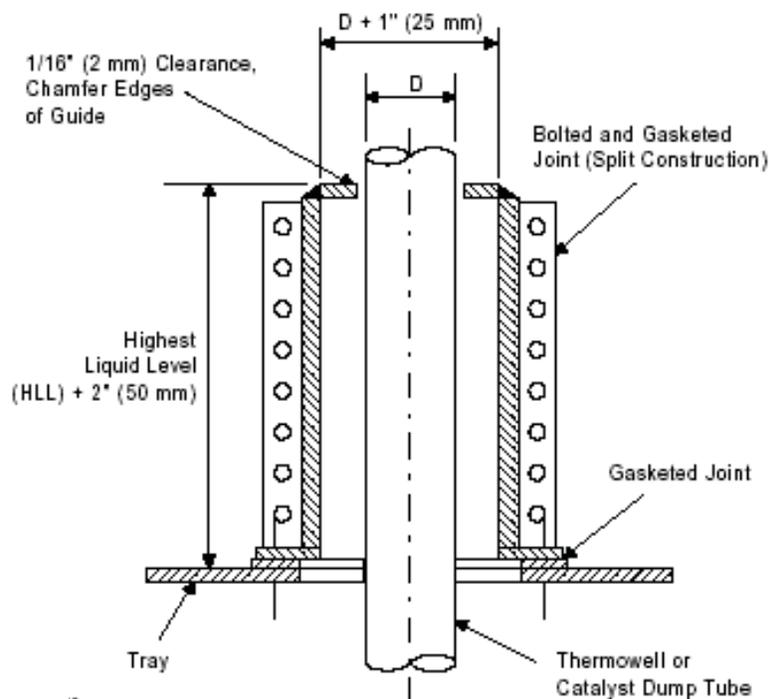


FIGURE – 4

VESSEL INTERNALS
TOLERANCES FOR FABRICATION AND ASSEMBLY

- ① Height of weir above tray deck: $\pm 1/8$ in. (3.2 mm)
- ② Top of weir plate out of level across length of weir:
Tolerance per Item ⑧
- ③ Maximum joint opening between deck plates and beams or support rings for perforated, bubble cap, jet or valve trays (to limit gas passage): $1/64$ in. (0.4 mm)
- ④ Height of slots in bubble caps above top of tray: $\pm 1/16$ in. (1.6 mm)
- ⑤ Height of bubble cap chimney above top of tray: $\pm 1/16$ in. (1.6 mm)
- ⑥ Downcomer horizontal clearances (measured from bottom edge of downcomer to recessed seal pan or inlet weir): $\pm 1/8$ in. (3.2 mm)
- ⑦ Bottom of downcomer above tray or seal pan: $\pm 1/4$ in. (6.4 mm)
- ⑧ Tray supports must present a flat surface for metal to metal contact between tray and support. Support shall be flat within $1/32$ in. (0.8 mm) on any 12 in. (300 mm) chord. For tray supports and tray decks, out of level tolerance over any diameter shall be:

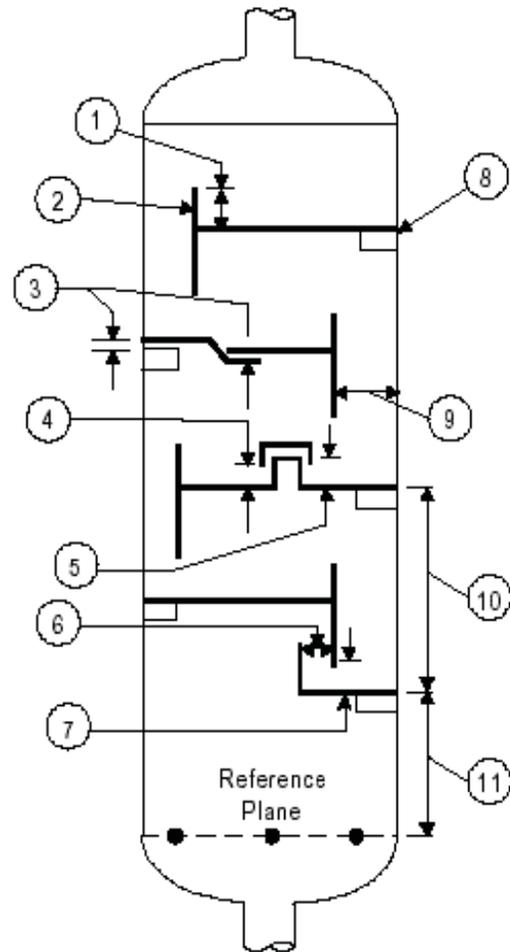
TOWER DIAMETER		TOLERANCE
ft	mm	in. (mm)
Diam < 4	Diam < 1220	1/8 (3.2)
4 ≤ Diam ≤ 7	1220 ≤ Diam ≤ 2130	3/16 (4.8)
7 ≤ Diam ≤ 16	2130 ≤ Diam ≤ 4875	1/4 (6.4)
Diam > 4	Diam > 4875	5/16 (8)

- ⑨ Downcomer opening measurements:

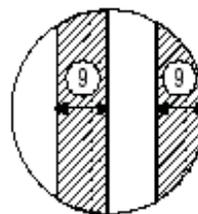
TOWER DIAMETER		TOLERANCE
ft	mm	in. (mm)
Diam < 4	Diam < 1220	$\pm 1/8$ (3.2)
4 ≤ Diam ≤ 7	1220 ≤ Diam ≤ 2130	$\pm 3/16$ (4.8)
7 ≤ Diam ≤ 16	2130 ≤ Diam ≤ 4875	$\pm 1/4$ (6.4)
Diam > 4	Diam > 4875	$\pm 5/16$ (8)

- ⑩ Tolerance top of support to top of support ring of tray or related parts: $\pm 1/8$ in. (3.2 mm)
- ⑪ Location of tray support ring from reference plane: $\pm 1/4$ in. (6.4 mm)
- ⑫ Miscellaneous:

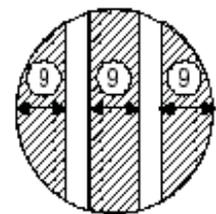
DESCRIPTION	TOLERANCE, in. (mm)
Location of parts bolted to clips or brackets welded to vessel by others	$\pm 1/8$ (3.2)
Height of tubes, chimneys, or weir notches above top of tray	$\pm 1/16$ (1.6)
Tolerances not shown on drawing:	$\pm 1/8$ (3.2)



Single or 3-Pass



2 or 4-Pass





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OIL & GAS DEVELOPMENT COMPANY LTD.

SPECIFICATION FOR INSTALLATION OF EQUIPMENT, MACHINERY AND PIPING



Rev.	Date	Description	Prepared By	Checked By	Approved By
0	23-05-12	Issued for Tender	MIAH	MIK	MAS

C O N T E N T S

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1.0 **INTRODUCTION**

1.1 **Scope**

This specification covers the minimum requirements for supply, fabrication, installation erection, inspection and testing of piping including pipe supports; installation, erection and alignment of equipment and machinery involved in the installation of piping, equipment and ancillary works.

1.2 **Definitions**

Following definitions apply throughout this document:

- **COMPANY:** Oil & Gas Development Company Ltd. (OGDCL).
- **CONSULTANT:** M/s. Zishan Engineers (Pvt.) Ltd. (ZEL).
ZEL have been awarded the work of Engineering, Procurement Assistance and Project Management.
- **CONTRACTOR:** Means the construction company to be engaged by the COMPANY to perform the Construction work.
- **SUPPLIER/VENDOR:** The organization, firm or agency with who order for the supply of equipment and or material has been placed. SUPPLIER shall solely be responsible for the quality and satisfactory performance of all the items included in his scope of supply.

2.0 **SCOPE**

The Contractor's scope of work shall include, among others, the following items of work:

- Preparation of working area as required to bring the pipes, equipment / material at job site.
- Transportation of pipes, equipment / material from any location within the premises to the job site.
- Supply and fixing of anchor bolts.
- Checking & preparation of foundation prior to erection work.

- Supply of all erection materials, such as temporary connections, blinds and spacers for hydrotesting, temporary strainers, temporary supports, scaffolding, shims required for levelling, pumps and piping for hydrotesting, etc., required for satisfactory completion of work.
- Supply of all consumables and erection equipment.
- Supply and storage of water for hydrotesting.
- Welding shall be carried out according to qualified welding procedures. All charges pertaining to these qualifications shall be borne by the Contractor.
- Only qualified welders shall be allowed to work on the job. Welder's qualification tests shall be arranged by the Contractor, before commencement of work. All charges pertaining to this Qualification shall be borne by the Contractor.
- Removal of all temporary facilities and cleaning the job site after completion of work.
- Supply of fuel water and electricity for construction purposes.
- Field bending and pipe threading where required.

3.0 **APPLICABLE STANDARDS/SPECIFICATIONS**

Where specific details about the execution of any item of work are not included, work shall be carried out according to the requirements of the latest editions of the following standards and specifications:

ANSI B-31.3	Chemical Plant Piping
ASME Section IX	Welding and Brazing Qualification

4.0 **STORAGE AND HANDLING**

- 4.1 All piping material shall be stored by the Contractor in areas demarcated for this purpose.
- 4.2 Pipes, valves, fittings, bolts, gaskets, instrument and equipment shall be stored in covered locked premises. In no case shall the marking on the equipment be removed. Valves and other equipment provided with protective caps shall be stored with the caps upto the moment they are installed.
- 4.3 Handling of material shall be done with suitable mechanical equipment and safety of workers shall be given top priority.

5.0 **FABRICATION**

5.1 **General**

Fabrication of all piping shall be in accordance with the requirements of piping drawings and specifications.

5.2 **Pipe Cutting**

- a) Pipe below 2" diameter shall be cut by pipe cutter only; flame cutting is not allowed.
- b) It would be preferable to cut the larger sizes also with pipe cutter, but flame cutting is also acceptable, provided after cutting, the edges are prepared by grinding or machining.

5.3 **Flanges**

- a) All necessary action shall be taken to avoid damage to the flange face.
- b) Bolt holes shall straddle the axis of pipe for all flanged connections. Where flanges are to be fastened to equipment flanges, the bolt holes shall match the equipment flange orientation.

5.4 **Welding Joints**

- a) Contractor shall take precautions during all pipe handling operations to prevent damage to piping components including pipe, fittings, valve and prefabricated items.

Normally, piping components containing surface defects or damage that may affect their strength or reduce their serviceability shall not be welded in the piping. Such surface defects and damage include but are not limited to gouges, dents, buckles, dented or nicked bevels, split ends, seam cracks and pits or any other stress concentrator.

- b) **Cleaning**

Before welding the two lengths (pieces) of pipes, the contractor will remove all dust scales or any other material by blowing compressed air through the pipes. The contractor will ensure that inside of pipe is free from any foreign material before welding the ends of pipes.

c) **End Preparation**

Butt welding Bevel ends shall be prepared according to the dimensions given in the welding procedure specifications. Where dimensions are not given, the following shall be used:

Bevel 30 deg, plus 7.1/2 deg, minus 0 degree

Land 1/16," plus 1/32", - 0"

Gap 1/16," plus 1/32", - 0"

Bevelling shall be done by Bevelling and the finished bevel shall be free of nicks or grooves. Prior to welding, the bevelled surface and the inside surface of the pipe, within 1/4" of the weld joint shall be cleaned of all foreign material.

d) **Weld Joint Alignment**

Pipes to be welded shall be aligned by suitable means such as external clamps, yokes etc. Yokes, if used, shall be tack welded using electrodes compatible with parent metal. After joint fit-up, yokes shall be hammered off and tacks shall be ground flush with the outside surface of the pipe.

Misalignment in piping joints shall not exceed 1/16" and this will be preserved during welding. Hammering shall not be carried out to compensate for dimensional variations.

The distance between two adjacent welds shall not be less than 2".

Tack welding shall be done by qualified welders only and shall conform to the quality of root weld.

Longitudinally welded seams in adjacent lengths of pipe, shall be offset by a minimum distance equal to one fourth pipe diameter.

Approval of joint fit-up by Engineer shall be required prior to the welding operations.

4.5 **Threaded Pipe**

- a) The contractor shall use good quality cutters and dies when cutting and threading pipe. The ends of cut pipe shall be square and true.
- b) Threaded joints shall be properly aligned. Pipe entering unions shall be true to centerline so that the union does not have to be forced to make-up.

- c) Threaded pipe shall not project through fittings to cause interference with valves or other operating mechanisms.
- d) Threaded connections may be made tight by making use of the sealing tape.
- e) All threaded joints that leak during testing, shall be replaced.
- f) Pipe wrenches shall not excessively scar the pipe.
- g) Threaded joints shall be seal welded wherever indicated in the drawings. Seal welding shall be carried out after hydrostatic testing and seal welds shall not be used to stop hydrostatic test leaks.

6.0 **PIPING INSTALLATION**

- 6.1 Flange protections on equipment nozzles shall be left in place until piping is connected.
- 6.2 All valves provided with protective caps shall be stored with the caps up to the moment they are actually installed.
- 6.3 Before fastening, the faces of flanges shall be cleaned.
- 6.4 All piping and equipment connections shall be accurately aligned and the Contractor shall ensure that all flange faces are parallel and correctly centered before bolting. Force shall not be used in attaining alignment.
- 6.5 Gaskets of specified material and proper size shall be installed in each joint.
- 6.6 Globe and non-return valves shall be installed according to the direction of flow marked on the valve. If no direction is marked, it shall be checked and painted on the valve prior to installation.
- 6.7 Flange bolts shall be tightened evenly to impose equal pressure on the gasket at all times.
- 6.8 Piping shall be installed true and level or plumb; where slope is required, it shall be maintained without sags in the piping run.

7.0 **EQUIPMENT/MACHINERY INSTALLATION AND ERECTION**

7.1 **General**

The Contractor shall set, level, align and properly grout to the foundation all equipment/machinery in strict compliance with the location, dimensions and elevations as shown in the drawings and in accordance with the manufacturer's recommendations and instructions.

Prior to installation, the Contractor shall remove any temporary protective coating, such as rust inhibitors applied for ocean shipment, in accordance with the information supplied by the manufacturer. Machinery shall be drained and flushed of factory lubricants and replaced with new lubricant.

7.2 **Preparation of Foundation for installation**

The foundations for equipment & pipe supports shall be checked for location and level prior to start of erection. The erection Contractor shall provide all material and workmanship for preparing the finished level of foundations and elevation adjustments needed at the time of the erection of the equipment, machinery and piping.

7.3 **Erection & Alignment**

- a) Protective flanges, covers or caps on the equipment and machinery shall not be removed until piping connections are ready to be made. Vent and drain connection of the equipment and machinery shall be cleaned before start-up.
- b) Foundation bolts shall not be fully tightened until grout has Cured / hardened.
- c) The center lines of equipment/machinery to be installed shall be accurately aligned with reference to the coordinates established for the plant, using bench marks.

The suction and discharge flanges of pump shall be checked for level and verticality and adjustments made if necessary by placing thin steel shims under the base plate.

- d) The Contractor shall perform alignment checks for alignment of the driven machinery to its drive in the cold condition, according to the manufacturer's instructions.

- e) The alignment of the driven machinery to its drive shall also be carried out for the hot or operating condition. A hot alignment check shall be made after the machine has been operated and has reached the operating temperature. This check shall be made immediately after the machine has been stopped and before it has been allowed to cool and shrink to the cold position.

7.4 **Grouting**

- a) The Contractor shall supply grouting material and carry out all grouting work related to equipment and machinery foundations.
- b) Grout material shall consist of one part cement and three parts of sand.
- c) Equipment under vibration shall be grouted with approved non-shrinkable grouting material.
- d) Once setting and preliminary alignment has been approved by the Engineer, the Contractor shall grout the equipment/machinery base plates.
- e) Steel surface that will be in contact with the grout shall be clean and dry.
- f) Concrete surfaces shall be clean, dry and free of oil, dirt or grease. The concrete shall have the top layer chipped to expose a uniform, thoroughly cured surface.

8.0 **WELDING**

8.1 **Specification**

Welding shall be carried out according to the requirements of specification for Production Welding.

8.2 **Inspection**

- a) The quality of welding shall be checked visually and by non-destructive methods, in accordance with ANSI B 31.3.
- b) The Contractor shall be solely responsible for coordinating inspection work with construction activities.

8.3 **Repair & Removal of Defects**

a) Welds which do not meet the acceptance standards of this specification, shall be cut out by removing a cylinder of pipe containing the weld, or with the prior approval of the Engineer, repaired.

b) **Allowable Repairs**

Repairs may normally be allowed, at the Engineer's discretion, if there are no cracks in the weld and if the segment of weld to be repaired was not previously repaired.

c) **Repair Procedure**

i. Defect removal: Weld defects shall be removed by grinding. The repair cavity shall be of sufficient size to allow adequate access for welding.

ii. Cleaning: Scale and slag shall be removed from each weld bead and groove before depositing the next weld bead.

d) **Arc Burns**

Arc burns shall be removed by grinding. Grinding shall have a smooth contour. After grinding, the remaining wall thickness in the area shall not be less than 90% of the nominal wall thickness.

9.0 **PIPE SUPPORTS**

9.1 **Supply/fabrication/installation of steel support.**

a) The Contractor shall supply all material, fabricate and install all supports as required.

b) All temporary supports necessary for erection work shall be provided by the Contractor and removed when permanent supports have been installed.

9.2 **Grouting of Supports**

a) Grout pads shall be constructed for the supports where necessary.

b) Grout material shall consist of one part of cement and three parts of sand.

c) Pads, iron bars etc. shall not be loaded until grout has cured for at least seven days.

10.0 HYDROSTATIC TESTING

- 10.1 After completion of welding of each pipeline system, hydrostatic test shall be performed at pressures indicated by the Engineer as per ANSI B 31.3.
- 10.2 Before starting hydrostatic testing operations, the lines shall be purged by compressed air so as to clear the lines of any foreign materials.
- 10.3 Contractor shall inform the Engineer well in advance about the performance of hydrostatic tests.
- 10.4 Contractor shall keep a record of all hydrostatic tests performed on complete piping system or on sections of piping. He shall record the date of test, test conditions, and results. These reports will be signed by the Contractor and witnessed by the owner's Representative / Engineer.
- 10.5 All material and labour required for hydrostatic testing shall be provided by the Contractor.
- 10.6 Pumps shall not be subjected to hydrostatic pressure and shall be isolated from the piping system during the test.
- 10.7 Pressure gauges mounted on piping may be tested together with the piping if the test pressure does not exceed the pressure gauge range. Pressure gauges shall be blocked off from piping during blowing or flushing operations.
- 10.8 Pressure test shall not be carried out against closed valves. Valve seats shall not be subjected to pressures exceeding their specified pressures.
- 10.9 After pressurizing the line upto the specified pressure, all welded and flanged joints shall be inspected by the Contractor's Engineer and Owner's Representative. During this period, the line shall be maintained under pressure.
- 10.10 If leaks are detected, the line shall be completely drained and the leak repaired by the contractor in the manner specified for repairs. After repair the line shall be retested at the same pressure following the above procedure.
- 10.11 After successful completion of hydrostatic testing, all equipment/lines shall be completely drained by the Contractor.
- 10.12 Lines which are normally open to atmosphere may not be pressure tested. These lines shall, however, be visually inspected to ensure proper workmanship.

11.0 **CLEANING**

- 11.1 After successful completion of hydrostatic testing, all lines shall be cleaned by flushing, blowing or swabbing, as approved by Owner's engineer.
- 11.2 The Contractor shall provide all equipment required and shall carry out all operations involved in cleaning.
- 11.3 All foreign material, including but not limited to scale, rust, dirt, moisture, welding rods and particles shall be removed from the inside of all piping systems.
- 11.4 Equipment like pumps, strainers etc. shall be removed before cleaning operations. The Contractor shall provide temporary connections to bypass these items. After cleaning the Contractor shall install these items in the piping system using new gaskets, if required.
- 11.5 All piping shall be flushed with water until clean.
- 11.6 All lines shall be thoroughly dried by blowing compressed air.
- 11.7 Cleaning operations shall be performed until the Engineer is satisfied that the piping systems are thoroughly clean and dry.



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OIL & GAS DEVELOPMENT COMPANY LTD.

SPECIFICATION FOR

WELDING

(NACE COMPLIANT)



			WUS	MIAH	MAS
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1.0 **GENERAL**

1.1 **Scope**

This Specification covers the basic requirements for welding, heat treating, and non-destructive examination of certain pressure-containing components. This includes piping, pressure vessels, steam generators, fired heater coils, heat exchangers, pumps and compressors etc. requirements also apply to structural attachment welds in such equipment.

1.2 **Definitions**

Following definitions apply throughout this document:

OWNER / COMPANY: Oil & Gas Development Company Ltd. (OGDCL)

CONSULTANT M/s. Zishan Engineers (Pvt.) Ltd. (ZEL).ZEL have been awarded the work of Engineering, Procurement Assistance and Project Management.

CONTRACTOR: Means the construction company to be engaged by the COMPANY to perform the Construction work.

VENDOR / SUPPLIER: The organization, firm or agency with whom order for the supply of equipment and or material has been placed.

1.3 **Errors or Omissions**

1.3.1 Review and comment by the CONSULTANT / COMPANY of any CONTRACTOR / SUPPLIER's drawings, procedures or documents shall only indicate acceptance of general requirements and shall not relieve the CONTRACTOR/SUPPLIER of its obligations to comply with the requirements of this specification and other related parts of the contract documents.

1.3.2 Any errors or omissions noted by the CONTRACTOR/SUPPLIER in this Specification shall be immediately brought to the attention of the CONSULTANT / COMPANY.

1.4 **Deviations**

All deviations to this specification, other specifications or attachments shall be brought to the knowledge of the CONSULTANT / COMPANY in the bid. All deviations made during the procurement, design, manufacturing, testing and inspection shall be with written approval of the CONSULTANT prior to execution of the work. Such deviations shall be shown in the documentation prepared by the CONTRACTOR/SUPPLIER.

1.5 **Conflicting Requirements**

In the event of conflict, inconsistency or ambiguity between the contract scope of work, this Specification, National Codes & Standards referenced in this Specification or any other documents, the CONTRACTOR/ SUPPLIER shall refer to the CONSULTANT whose decision shall prevail.

2.0 **REFERENCES**

The following Guides and industry publications are referenced herein and shall be considered a part of this Specification. Refer to the latest editions unless otherwise specified.

2.1 ASME - American Society of Mechanical Engineers

- ASME B31.3 Process Piping
- ASME SEC I BPVC SECTION I Rules for Construction of Power Boilers
- ASME SEC II-C Material Specifications - Welding Rods, Electrodes and Filler Metals
- ASME SEC V BPVC SECTION V Nondestructive Examination
- ASME SEC V B SE-94 STANDARD GUIDE FOR RADIOGRAPHIC EXAMINATION
- ASME SEC VIII Rules for Construction of Pressure Vessels
- ASME SEC IX Qualification Standard for Welding and Brazing Procedures, Welding and Brazing Operators

2.2 AWS - American Welding Society

2.3 NACE – MR-0175 (Latest Revision)

3.0 **WELDING PROCEDURE AND WELDER QUALIFICATIONS**

3.1 **Welding Procedures**

3.1.1 Welding procedures shall be in writing and shall be qualified in accordance with ASME SEC IX, NACE MR-0175 (Latest Revision) and this Specification, using the latest revision in effect on the date of the purchase order for the equipment being fabricated. All welding procedures shall include a weld procedure specification (WPS) and a procedure qualification record (PQR).

- 3.1.2 Complete welding procedures for all materials to be welded shall be submitted to the CONSULTANT for review and approval prior to use. These procedures shall include the following: Welding Procedure Specifications, Procedure Qualification Test Records, ranges of variables qualified, a weld map or description identifying which welding procedure will be used for each weld and the method and extent of inspection. The CONTRACTOR/SUPPLIER shall furnish complete information for each applicable item, as required. For piping a typical drawing representing all applicable weld procedures to be used on the work shall be submitted to the CONSULTANT for approval prior to work commencing.
- 3.1.3 Complete welding procedures shall be submitted for approval sufficiently in advance of the actual welding, so as to allow for adequate review and approval. A typical weld map (or specific weld map) where each procedure will be used shall be included with this submittal. No welding shall be performed until all such welding procedures are approved by the CONSULTANT.
- 3.1.4 The information contained in each welding procedure specification and in the procedure qualification test records shall include, but not be limited to, the information contained on forms QW 482 and QW 483 shown in ASME SEC IX.
- 3.1.5 All welding procedures shall be identified by number and referenced on all applicable fabrication drawings.

3.2 **Qualification of Welding Procedures**

- 3.2.1 P-number shall be considered an essential variable for all welding processes. Materials that do not have P-numbers (not listed in QW 422 of ASME SEC IX) shall be qualified individually.
- 3.2.2 Welding position shall be considered an essential variable for groove welds in all automatic welding processes.
- 3.2.3 All welding consumables not listed in ASME SEC II-C shall be individually qualified.
- 3.2.4 For submerged arc welding, brand name and grade of flux shall be considered an essential variable, together with changes in speed or heat input beyond the range qualified. The procedure qualification test record shall indicate the name of the manufacturer, plus the trade name of the wire and flux used to qualify the procedure.
- 3.2.5 Postweld heat treatment (time and temperature) shall be considered an essential variable for P-3, P-4, P-5, and P-6 materials. A decrease in time of more than 15 percent and/or in temperature of 10 percent or more, from the range qualified, will require a separate welding procedure qualification.

- 3.2.6 Impact testing of welds and heat-affected zones (HAZ) for ferritic materials at minimum design temperature is required for welding procedure qualification under the following conditions:
- a) When the base material requires impact testing
 - b) When the base material does not require impact testing, but the material thickness exceeds 12.7 mm (1/2 in) and the minimum design temperature is 0°C (32°F) or lower.
 - c) When the base metal does not require impact testing, but the submerged arc welding process is used with weld pass thickness greater than 9.5 mm (3/8 in).
- 3.2.7 When impact testing is required, the Charpy V-notch impact values for parent material, weld metal, and heat-affected zones shall be not less than those specified in ASME B31.3, Table 323.2.2. The impact test shall be performed on the same type (ASTM or other similar specification) and grade of material as will be used in fabrication.
- 3.2.8 Procedure qualifications for weld overlay deposits shall include a complete chemical analysis of the overlay, procedure qualification test record, and unless specifically waived by the CONSULTANT, a sample of the overlay. Specimens taken for chemical analysis shall be representative of material 2.5 mm (0.1 in) below the surface. The weld metal chemical composition shall be within the nominal range specified for the alloy. Monel overlays shall have a maximum iron content of 4.5 percent. The procedure qualification tests shall include the following:
- a) Dye penetrant examination of the completed weld
 - b) Side bend tests per QW 453 for weld metal soundness
 - c) Chemical composition analysis per QW 462.
- 3.2.9 Excessive fissuring shall be caused for rejection. Fissures shall not exceed four per specimen, nor shall they exceed 1.6 mm (1/16 in) in length. Cracks in corners shall not be considered part of the examination.
- 3.2.10 The welding procedure qualification tests shall include hardness tests of base, HAZ, and weld for the following materials:
- a) Quenched and tempered carbon steel
 - b) High-strength, low-alloy (HSLA) steel
 - c) Carbon-molybdenum (C-Mo), manganese-molybdenum (Mn-Mo), and chromium-molybdenum (Cr-Mo) steels.
 - d) Other air-hardenable materials.

- 3.2.11 Procedure qualification tests for welding carbon steel shall also include a hardness survey, if any of the following conditions exist:
- a) Submerged arc welding is performed with F8XX or higher flux designation.
 - b) Shielded metal arc welding is performed with covered electrodes of E80XX or higher classification.
 - c) Filler metal contains at least 1.6 percent manganese, or manganese and silicon exceed 1.4 and 0.8 percent, respectively.
 - d) The job specifications or data sheets require a maximum specified hardness in the weld and/or heat-affected zone.
 - e) Process conditions (wet hydrogen sulfide, amine, caustic) require production hardness testing.
- 3.2.12 The hardness testing for welding procedure qualification shall be performed on the base metal, weld, and heat-affected zone, with an instrument having an indenter not larger than 1.6 mm (1/16 in) in diameter. The hardness shall be reported as Brinell (HB) or Vickers (HV) equivalent numbers. Hardness surveys shall be performed along two lines parallel to the outer and inner surfaces of the weld and located approximately 2 mm (0.08 in) below them. The type of hardness test instrument shall be reported and the test results shall meet the hardness requirement in accordance with ASME B31.3.
- 3.2.13 Welding procedure tests shall demonstrate that all details are capable of producing satisfactory full-penetration butt welds, unless the weld joints are specifically designated as fillet welds.
- 3.2.14 For gas tungsten arc and gas metal arc welding, the qualification record shall include the composition and flow rate of the shielding and inert gas backing, if used.
- 3.2.15 For the gas metal arc process, the electrode diameter and extension, amperage, voltage, wire feed rate, and travel speed shall be specified in the welding procedure.
- 3.2.16 Base material used in qualification tests shall have the nominal chemistry and mechanical properties of the material to be welded. For carbon steel, the carbon content of base material shall be at the higher end of the specification range.

3.3 **Qualification of Welders and Welding Operators**

- 3.3.1 Welders and welding operators shall be qualified in accordance with ASME SEC IX and local requirements, as a minimum. Qualification shall be completed prior to start of fabrication. Performance qualification records shall be made available to the CONSULTANT / COMPANY upon request. At the CONSULTANT / COMPANY option, witnessing of performance qualification, welding, and testing may be required.
- 3.3.2 Qualification of welders and welding operators solely by means of radiography of a weld sample is subject to the COMPANY approval.
- 3.3.3 Qualification of welders using the GMAW process shall be by mechanical testing only.

4.0 **WELDING PROCESSES**

- 4.1 Welds shall be made by the shielded metal arc, gas tungsten arc, gas metal arc, or submerged arc welding process. All other welding processing, including electro-gas, electro-slag, oxyacetylene and the flux cored process, require prior to the CONSULTANT / COMPANY approval.
- 4.2 The flux cored arc welding (FCAW) process may be used, subject to the CONSULTANT / COMPANY review and approval (proposal to use FCAW must be submitted prior to order placement), provided the following conditions exist:
 - 4.2.1 Gas shielding is used.
 - 4.2.2 Material to be welded is carbon steel or for application of weld overlay on carbon steel or low alloy steel.
 - 4.2.3 FCAW process is not "short arc"
 - 4.2.4 FCAW process is not used for the root pass in single-sided welding.
 - 4.2.5 Production consumables are restricted to the manufacturer and grade qualified.
 - 4.2.6 Only EXXT-1 or EXXT-5 (flat or horizontal position only) welding wires are used.
 - 4.2.7 Service is not hot hydrogen [over 260°C (500°F)], wet hydrogen sulfide, or hydrogen fluoride
 - 4.2.8 At least five percent of the individual welds are 100 percent radiographed or ultrasonically examined.

4.2.9 Ten percent of the nozzle to shell or head welds (including at least one of each size) shall be 100 percent radiographed or ultrasonically examined.

4.2.10 Low hydrogen electrodes are used

For all other applications not meeting the above conditions, FCAW process may be considered on a case-by-case basis. The review will include the evaluation of the specific application, verification of the fabricator's experience, additional qualification and/or NDE requirements, and the CONSULTANT / COMPANY witnessing of welding procedure and/or welder qualification.

4.3 The gas metal arc process (GMAW) in the "short circulating transfer" (short arc) mode may be used for the following purposes:

4.3.1 Root pass welding in a combination process.

4.3.2 Fit-up welding that will subsequently be completely removed by back gouging, chipping, or grinding

4.3.3 Weld metal overlays made in the flat position

4.3.4 Non-pressure retaining fillet welds made in the flat, horizontal, or vertical-up positions.

4.4 The short arc process shall not be used under the following conditions:

4.4.1 Where the joint geometry or large mass can affect the integrity of the weld; for example, on nozzles, couplings, slip-on flanges, socket-welded flanges, O-type branch fittings, or extended surface (FIN) attachments.

4.4.2 With ferritic or martensitic filler metal for design service below 0°C (32°F).

4.5 During GMAW short arc welding of the root pass, the root gap (including tolerance) shall not be less than 2.4 mm (0.1 in) wide. The root face thickness (including tolerance) shall not exceed 0.8 mm (3/32 in). All tack welds shall have both ends ground to feather edge.

4.6 Except for piping, double-welded butt joints shall be used wherever possible in pressure-containing equipment. Where access or wall thickness precludes the use of double-welded butt joints, single-welded joints may be made. This requires a root pass deposited by the GTAW process or (subject to the CONSULTANT approval) by the GMAW process.

4.7 A gas tungsten arc root pass is required for the following circumstances:

4.7.1 Single-welded, full-penetration butt joints in C-Mo, Mn-Mo, and Cr-Mo steels; in all non-ferrous alloys; and in carbon steel for hydrogen fluoride service.

- 4.7.2 All heater tubes
- 4.7.3 All carbon steel single-welded, full-penetration butt joints over 38 mm (1.5 in) thick.
- 4.8 In an inert gas welding process, inert gas backing (argon or helium) is not required for carbon steels, carbon-molybdenum steels, or low-alloy chromium-molybdenum steels with a chromium content not exceeding 1½ percent by weight. Inert gas backing shall be used for all other alloy materials, including aluminum and copper alloys. The use of nitrogen, however, for gas shielding of stainless steel shall not be allowed.
- 4.9 The following restrictions and limitations apply to all welding processes.
 - 4.9.1 All welding processes shall be protected from wind, rain, and other harmful weather conditions that can affect weld quality. CONTRACTOR/SUPPLIER shall provide habitat arrangements that afford full weather protection as approved by the CONSULTANT.
 - 4.9.2 Welding techniques shall be selected to ensure that specified tolerances for straightness and out-of-roundness are not exceeded. If such tolerances are not stated in the drawings, standards, or specifications, the applicable section of the relevant code shall govern.
 - 4.9.3 Welded joints shall be made by completing each layer before succeeding layers are deposited. Block welding is prohibited.
 - 4.9.4 Vertical welding shall be performed vertically up, downward vertical position welding shall not be permitted unless specifically approved in writing by the CONSULTANT.
- 4.10 The following limitations shall apply when welding aluminum:
 - 4.10.1 The gas tungsten arc process shall not use thoriated tungsten electrodes. Electrode configuration shall be shown in the welding procedure and shall be considered an essential welding variable.
 - 4.10.2 Except for piping, the gas metal arc process shall employ run on and run off tabs in all groove welding.
 - 4.10.3 For all processes, the welding procedure shall contain a detailed cleaning treatment indicating joint preparation prior to welding. All full-penetration joints shall be back-purged with argon or helium.

5.0 MATERIALS

5.1 Filler Materials and Flux

5.1.1 Filler metal for welding similar materials shall be of the same nominal analysis as the base material, except as follows:

- a) AWS Type 347 filler metal shall be used for welding Type 321 stainless steel material.
- b) AWS Type 308 filler metal shall be used for welding Type 304 stainless steel material. (Type 308L shall be used for Type 304L.)
- c) The following filler metals shall be used for welding 11 to 13 percent chromium steels: Inco-Weld A; Inconel 82 or 182; AWS E309, E410, or E410Cb. However, for 11 to 13 percent steels in cyclic service, or for design temperatures over 350°C (660°F), only Inco-Weld A, Inconel 82, or Inconel 182 are acceptable.
- d) For chromium-molybdenum steel, filler materials such as Inconel 82 or 182 or Inco-Weld A may be used, if approved by CONSULTANT.

5.1.2 Filler metals for welds joining dissimilar materials shall be in accordance with Table 1. Filler metals for combinations of materials other than those in Table 1 shall be submitted to CONSULTANT / COMPANY for approval.

Table 1: Filler Metal for Welds Joining Dissimilar Materials

Base Matl Num	Nominal Analysis of Base Materials	Base Material Number																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	Carbon Steel		A	A	A	A	A	A	A	A	A	B	B	B	B	B	B	B	B	B	B	B	C	D	C
2	Carbon-Molybdenum Steel	A		E	C	E	E	E	E	E	E	B	B	B	B	B	B	B	B	B	B	B	C	D	C
3	2 1/2% Nickel & 3 1/2% Nickel Steel	A	E		C										B	B	B	B	B	B	B	B	C	C	C
4	9% Nickel Steel	A	C	C											C	C	C	C	C	C	C	C	C	C	C
5	1% Cr-1/2% Mo Steel	A	E				F	F	F	F	F				B	B	B	B	B	B	B	B	C	D	C
6	1 1/4% Cr-1/2% Mo Steel	A	E			F		F	F	F	F				B	B	B	B	B	B	B	B	C	D	C
7	2 1/4% Cr - 1% Mo Steel	A	E			F	F		F	G	G				B	B	B	B	B	B	B	B	C	C	C
8	5% Cr-1/2% Mo Steel	A	E			F	F	H	H		H	H			B	B	B	B	B	B	B	B	C	C	C
9	7% Cr-1/2% Mo Steel	A	E			F	F	G	H		I				B	B	B	B	B	B	B	B	C	C	C
10	9% Cr-1% Mo Steel	A	E			F	F	G	H	I			J	J	B	B	B	B	B	B	B	B	C	C	C
11	Type 405 Stainless Steel	B	B										K	K	B	B	B	B	B	B	B	B	C	C	C
12	Type 410S Stainless Steel	B	B								J	K		K	B	B	B	B	B	B	B	B	C	C	C
13	Type 410 Stainless Steel	B	B								J	K	K		B	B	B	B	B	B	B	B	C	C	C
14	Type 304 Stainless Steel	B	B	B	C	B	B	B	B	B	B	B	B	B		L	L	P	L	L	O	O	C	C	C
15	Type 304L Stainless Steel	B	B	B	C	B	B	B	B	B	B	B	B	B	L		M	M	L	M	O	O	C	C	C
16	Type 321 Stainless Steel	B	B	B	C	B	B	B	B	B	B	B	B	B	L	M		N	L	M	O	O	C	C	C

Base Matl Num	Nominal Analysis of Base Materials	Base Material Number																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
17	Type 347 Stainless Steel	B	B	B	C	B	B	B	B	B	B	B	B	B	P	M	N		P	M	P	P	C	C	C
18	Type 316 Stainless Steel	B	B	B	C	B	B	B	B	B	B	B	B	B	L	L	L	P		Q	O	O	C	C	C
19	Type 316L Stainless Steel	B	B	B	C	B	B	B	B	B	B	B	B	B	L	M	M	M	Q		O	O	C	C	C
20	Type 309 Stainless Steel	B	B	B	C	B	B	B	B	B	B	B	B	B	O	O	O	P	O	O		R	C	C	C
21	Type 310 Stainless Steel	B	B	B	C	B	B	B	B	B	B	B	B	B	O	O	O	P	O	O	R		C	C	C
22	Alloy 800 (Incoloy 800)	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
23	Monel 400	D	D	C	C	D	D	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
24	Inconel 625	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C

Legend (Table 1)

- A AWS A5.1, classification EXX15, EXX16, or EXX18.
- B AWS A5.4 and AWS A5.11, classification E309-XX, ENiCrFe-3 (Inconel182), or ENiCrFe-2 (Inco-Weld A).
- C AWS A5.11, classification ENiCrFe-3 (Inconel 182) or ENiCrFe-2 (Inco-Weld A).
- D AWS A5.11, classification ENiCrFe-3 (Inconel 182), ENiCrFe-2 (Inco-Weld A), or ENiCr-7 (Monel 190).
- E AWS A5.5, classification E7015-A1, E7016-A1, or E7018-A1.
- F AWS A5.5, classification E8016-B2, E8018-B2, or E8015-B2L, E8018-B2L.
- G AWS A5.5, classification E9015-B3, E9016-B3, E9018-B3, or E9015-B3L, E9018-B3L.
- H AWS A5.4, classification E502-XX.
- I AWS A5.4, classification E7Cr-XX.
- J AWS A5.4, classification E505-XX.
- K AWS A5.4 and AWS A5.11, classification E410-XX, E410 Cb-XX, E309-XX, ENiCrFe-3 (Inconel 182), or ENiCrFe-2 (Inco-Weld A).
- L AWS A5.4, classification E308-XX.
- M AWS A5.4, classification E308L-XX.
- N AWS A5.4, classification E347-XX.
- O AWS A5.4, classification E309-XX or E308-XX.
- P AWS A5.4, classification E308-XX or E347-XX.
- Q AWS A5.4, classification E316-XX or E316L-XX.
- R AWS A5.4, classification E309-XX.

Notes:

1. Blank spaces in Table 1 indicate combinations that are considered unlikely or unsuitable. For these combinations, consult COMPANY / CONSULTANT to approval.
2. Table 1 refers to coated electrodes. For bare wire welding (SAW, GMAW, GTAW), use equivalent electrode classifications (AWS A5.9, AWS A5.14, AWS A5.18, AWS A5.20, AWS A5.23, and AWS A5.28).
 - 5.1.3 Filler metals for welds shall meet the same minimum impact test requirements as those imposed on the base metal.
 - 5.1.4 In all welding processes, the filler wire shall contain all alloying elements and shall meet all chemical composition requirements for the wire classification. Exceptions are subject to CONSULTANT approval.
 - 5.1.5 For gas metal arc welding of carbon steels, base wire filler metals shall conform to AWS A5.18.
 - 5.1.6 For gas tungsten arc welding of carbon steels, the filler metal shall meet the chemical and physical test requirements of AWS A5.18.
 - 5.1.7 For flux cored arc welding of carbon steels (when permitted by Section 5.2), the electrodes shall conform to AWS A5.20. These electrodes shall be used with an external shielding gas.
 - 5.1.8 Carbon steels shall not be welded with C-1/2 Mo weld metal, unless the weld is post weld heat treated and the procedure qualification record includes weld hardness data. These data shall show that the weld and heat-affected zone have not exceeded with reference Codes and Standards.
 - 5.1.9 Filler metals and consumable inserts for austenitic stainless steel welds shall be selected to produce weld deposits, which fall within the ferrite ranges and numbers, in accordance with reference Codes and Standards. This restriction is intended to prevent problems associated with sigma-phase formation and micro-fissuring in fully austenitic welds.
 - 5.1.10 For cryogenic service with temperatures of -100°C (-150°F) and lower, the ferrite content of all austenitic stainless steel welding materials shall be in the range 2 to 5 percent (FN2 to FN5).
 - 5.1.11 Austenitic stainless steel filler metals for service temperatures -100°C (-150°F) and below shall meet the impact requirements.
 - 5.1.12 For welding carbon steel, submerged arc welding wires shall be limited to AWS classifications ELXX and EMXXX.

- 5.1.13 All completed weld joints (except for 5 through 9 percent nickel steels) shall be within the mechanical property limits specified for the base materials to be joined.
- 5.1.14 All welding consumables shall be used within the limits recommended by their manufacturers. The welding parameters shall be as used in the welding procedure qualification.
- 5.1.15 Low-hydrogen electrodes are required for all shielded metal arc welding when any of the following conditions apply:
- Design temperature is below 0°C (32°F).
 - Valve or flange rating is Class 400 or higher.
 - Base metal has a carbon equivalent exceeding 0.43 percent, based on:

$$CE = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}$$

- Base metal has a minimum specified tensile strength greater than 415 Mpa (60,000 psi).
 - Thickness of butt welds and fillet welds (throat) exceeds 12.7 mm (1/2 in).
 - Castings are weld repaired.
- 5.1.16 For root pass welding of P-1 and P-3 steel piping materials, AWS cellulose electrode shall be used.
- 5.1.17 Electrodes, filler wires, and fluxes shall be kept clean, dry, and properly stored according to the manufacturer's recommendation.
- 5.1.18 For welding 5 through 9 percent nickel steels, the filler materials shall be reviewed and approved by CONSULTANT and qualified by procedure testing in the maximum plate thickness specified for each job.
- 5.1.19 Equivalency to AWS specifications of other national specifications for welding consumables shall be verified. The basis for equivalence shall be subject to CONSULTANT approval. Equivalence may be determined by review of consumables (electrodes and fluxes) and manufacturers' catalogs, and/or by chemical analysis and mechanical testing of weld deposits.

5.2 **Backing Rings and Consumable Inserts**

Permanently installed backing rings or strips shall not be used. Consumable inserts shall be used only with prior CONSULTANT / COMPANY approval.

6.0 **JOINT PREPARATION, SPACING, AND ALIGNMENT**

6.1 **Edge Preparation**

- 6.1.1 Welding bevels shall be suitable for the welding process to be used. For pressure-containing welds, the contour shall permit complete fusion throughout the joint. Bevels shall conform reasonably to those used in the procedure qualification.
- 6.1.2 All weld bevels and weld surfaces shall be free from cracks, porosity, slag inclusions, and other defects indicative of inferior workmanship.
- 6.1.3 Weld bevels shall be made by machining, grinding, or thermal cutting, and the surfaces shall be smooth, free of burning dross or fluting and true. Materials that require preheat for welding (refer to Section 10.1) shall be preheated in the same manner for thermal cutting or gouging.
- 6.1.4 Special weld bevel preparation is required for quenched and tempered carbon steels, HSLA steels, and steels containing more than 1/2 percent chromium. The steels shall be machined or ground back to clean and sound metal if they are flame or arc cut. At least 1.6 mm (1/16 in) of metal shall be removed.
- 6.1.5 Socket-welded joints shall have a gap between the bottom of the socket and the end of the pipe to be welded. The gap opening shall be at least 1.6 mm (1/16 in). The pipe for socket welding shall be square cut.

6.2 **Cleaning**

- 6.2.1 All surfaces to be welded shall be clean and free from paint, oil, dirt, scale, oxides, and other contaminants detrimental to welding. Cleaning shall be performed in a manner that will not lead to additional contamination of the weld or adjoining base metal.
- 6.2.2 Only stainless steel brushes and tools shall be used on stainless steel and nickel-alloyed materials.
- 6.2.3 Grinding disks containing sulfur (iron sulfide) shall not be used on steels with 5 through 9 percent nickel, stainless and alloy steels, or on non-ferrous materials.
- 6.2.4 Cleanliness shall be maintained after completion of welding. All stubs, rods, flux, slag, and foreign material shall be removed from the vicinity of the equipment or piping.

6.3 **Butt Joints**

- 6.3.1 Full penetration welds are required for single-sided welded joints.
- 6.3.2 Double-welded joints shall be prepared for back welding by grinding, arc-air gouging and grinding or chipping, so as to allow complete penetration and fusion. The depth of the back cut shall be sufficient to remove all the initial 1st pass welds but not deep enough to cause distortion in the welded joint by excess 2nd side welding.

6.4 **Tack Welds**

- 6.4.1 All tacks in the weld groove shall be performed by qualified welders (in conformance with ASME SEC IX), according to an approved welding procedure. Tack welding procedures, including for bridge and bullet tacks shall be qualified prior to fabrication operations.
- 6.4.2 Non-groove tack welds to be incorporated into the main weld seams shall have the ends ground and feathered.
- 6.4.3 Tack welds made by non-ASME SEC IX welders shall be completely ground out. The ground areas shall be examined by the magnetic particle or dye penetrant method prior to completing the permanent weld.

7.0 **WELD CONTOUR AND FINISH**

- 7.1 Weld beads shall be contoured to permit complete fusion at the sides of the bevel and to eliminate inter run and side wall slag inclusions. Flux and slag shall be removed completely from weld beads and from the surface of completed welds and adjoining base material. The flux removal shall be performed in a manner that will not cause the weld or adjoining base material to become contaminated or overheated.
- 7.2 Weld reinforcement and finish shall be as required by the applicable codes and standards. Undercutting of base metal is prohibited, except for piping fabricated according to ASME B31.3, undercutting shall be removed by smooth profile toe grinding, where allowed.
- 7.3 After removal of temporary welded attachments on all materials, except carbon steel (P-1) and austenitic stainless steel (P-8), the weld area shall be dressed and examined by magnetic particle or dye penetrant for the detection of cracks. Any defects found shall be removed and repaired.
- 7.4 Peening of partial or completed welds shall not be permitted, unless prior approval is given by CONSULTANT and the CONTRACTOR/SUPPLIER can demonstrate that the final weld joint integrity has not been affected.
- 7.5 All arc strikes, starts, and stops shall be confined to the welding groove. Arc strikes outside the welding groove shall be removed by grinding and examined by magnetic particle or liquid dye penetrant.

8.0 ALLOY LINING

- 8.1 VENDOR/SUPPLIER approval is required for any proposed alloy overlay system.
- 8.2 For both integrally clad plate and weld overlay, the surface of base plate welds that would be exposed to the corrosive environment shall be protected by depositing not less than two layers of corrosion-resistant weld metal.
- 8.3 In austenitic stainless steel overlays, where the base metal requires PWHT or the design temperature exceeds 450°C (840°F), the first weld layer shall be made with Type 309L. Subsequent layers of deposit shall be made with low-carbon, 18 Cr-8 Ni stainless steel, or stabilized grades of austenitic stainless steel, depending upon service conditions.
- 8.4 For Monel overlays on carbon or low-alloy steel, the first layer shall be made with a high-nickel consumable (nickel or Inconel). The second and any successive layers shall be made with a filler metal that nominally matches the Monel chemistry. The first layer of high-nickel deposit shall be applied over bright, clean, oxide-free steel.
- 8.5 When integrally clad stainless plates are being joined, the following shall apply:
 - 8.5.1 The clad layer shall be stripped for a minimum distance of 8 mm (0.31 in) from the bevel. In addition, the base material shall be etched with nitric acid or copper sulfate to ensure prevention of austenitic weld dilution.
 - 8.5.2 When the cladding is removed, the base material thickness shall not be reduced below the design thickness by more than 1 mm (0.04 in).
 - 8.5.3 The procedure for back-cladding of internal attachments and nozzle welds requires approval by CONSULTANT. This procedure shall include base metal examination, welding sequence, and final inspection.
- 8.6 All internal exposed alloy welds joining clad components, and all alloy weld overlays inside vessels and heat exchangers shall be fully examined by the liquid dye penetrant method.
- 8.7 A certified report of the chemical analysis of production as-deposited alloy weld overlays, or alloy welds covering base metal welds in clad plates, shall be furnished to CONSULTANT. The weld metal chemistry shall be within the nominal range specified for the alloy. At least three drillings from each vessel section (vessel can), each heat exchanger, and each head shall be made to obtain sample material for analysis. One sample shall be taken at the beginning of the overlay and two samples at locations to be designated by the inspector. The samples shall be taken 2.5 mm (0.1 in) below the surface of the material.

Welding overlays shall be qualified in accordance with the WPS and PQR requirements specified herein. The Procedure Qualification Record shall also include corrosion testing of the weld overlays, specifically the ASTM G48 test and the ASTM A262 test. The G48 test shall yield a corrosion rate of 5 mpy or less. The A262 test shall show no evidence of cracking or pitting at 100x magnification.

9.0 THERMAL TREATMENT

9.1 Preheat and Interpass Temperature

The minimum preheat temperatures for thermal cutting, arc-air gouging, and welding (including butt, fillet, socket, seal, and tack welds) shall be in accordance with the requirements of the applicable code. Exceptions are as follows:

- 9.1.1 No welding shall be performed when metal temperature is 0°C (32°F) or lower.
- 9.1.2 Carbon steel shall be preheated to 10°C (50°F) , minimum, unless low-hydrogen electrodes are to be used.
- 9.1.3 Carbon steel shall be preheated to 93°C (200°F), minimum, when any of the following conditions apply:
 - a) Base metal thickness exceeds 25.4 mm (1 in)
 - b) Carbon content exceeds 0.30 percent
 - c) Carbon equivalent exceeds 0.43 percent, based on:

$$CE = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}$$

- d) The material is highly restrained; for example, nozzles or major attachments.
 - e) All ferritic alloy materials shall be preheated in accordance with Table 2.
 - f) The maximum interpass temperature for austenitic stainless steels shall be 180°C (350°F).
- 9.1.4 The maximum preheat and inter-pass temperature for carbon steel and low-alloy steel shall be 300°C (572°F), unless otherwise approved by CONSULTANT.
 - 9.1.5 During the welding of a casting, an area extending 300 mm (12 in) on either side of the weld shall be maintained at the approved preheat and inter-pass temperature.
 - 9.1.6 The preheat and inter-pass temperature shall be determined by temperature-indicating crayons, contact pyrometers, thermocouples, or other equally suitable means. Temperature-indicating crayons used on austenitic stainless steels and nickel-base alloys shall cause no corrosive or other harmful effects. They shall not contain more than one percent by weight of total halogens or sulfur, or 200 ppm by weight of inorganic halogens. It is the fabricator's responsibility to determine suitable brands and melting temperatures that may be used. This information shall be made available to CONSULTANT upon request.

- 9.1.7 When the specified preheat temperature is 150°C (300°F) or higher, the metal shall be maintained at preheat temperature until the welds are completed. The preheat temperature shall be maintained until the start of post weld heat treatment or unless an intermediate tempering treatment is performed, for welds in thickness over 50 mm (2 in) or under a high degree of restraint (at nozzles, branch connections, and the like). CONSULTANT shall be consulted if uncertainties exist regarding the degree of restraint. An intermediate tempering heat treatment shall consist of heating to 600°C (1100°F), minimum, holding for a minimum of 15 minutes, and cooling slowly to the ambient temperature.
- 9.1.8 As an alternative for butt welds only, a hydrogen out-gassing treatment can be substituted for the intermediate tempering treatment. The hydrogen out-gassing procedure shall consist of either raising the preheat temperature to 260°C - 300°C (500°F - 570°F) and holding for four hours, or raising the preheat temperature to 325°C - 400°C (620°F - 750°F) and holding for two hours. All other pressure welds, such as nozzle and manhole attachment welds, shall be given the full 600°C (1100°F) tempering treatment. The foregoing out-gassing procedure does not apply to 5 through 9 percent nickel steels.

Table No. 2: Minimum Preheat Temperatures for Ferritic Materials

Material (Nominal Analysis)	P-No.	Minimum Preheat Temperature	
		°C	°F
Carbon Steel	1	(Refer to Paragraph 10.1)	
Manganese-Molybdenum	3	150	300
C - 1/2 Mo	3	95	200
1/2 Cr - 1/2 Mo	3	95	200
1 Cr - 1/2 Mo	4	150	300
1 1/4 Cr - 1/2 Mo	4	150	300
2 1/4 Cr - 1 Mo	5	200	400
3 Cr - 1 Mo	5	200	400
5 Cr - 1/2 Mo	5	200	400
7 Cr - 1/2 Mo	5	200	400
9 Cr - 1 Mo	5	200	400
12 Cr (martensitic)	6	200	400
12 Cr (ferritic)	7	10	50
2 1/4 Ni	9A	150	300
3 1/2 NI	9B	150	300
5 Ni	11A	150	300
9 Ni	11A	150	300

9.2 Postweld Heat Treatment (PWHT)

9.2.1 PWHT shall conform to the applicable construction code, except as follows:

- a) Minimum PWHT of ferric materials shall conform to Table 3.
- b) All ferritic piping materials, except carbon steel piping with wall thickness 19 mm (3/4 in) or less (nominal thickness), shall be post-weld heat treated.
- c) The PWHT for welds joining austenitic stainless steels to dissimilar materials shall be as specified in the qualified welding procedure and approved by CONSULTANT prior to the start of fabrication.
- d) Under special circumstances (non-critical service), PWHT of field welds in low-alloy steels (C-Mo, Mn-Mo, and Cr-Mo) made with Inconel filler metal may be omitted, subject to CONSULTANT approval.
- e) For P-6 materials, the PWHT temperature used shall be the lowest possible to avoid overheating and hardening on cooling.
- f) Holding time at PWHT temperatures shall be one hour per 25.4 mm (1 in) of thickness, with a one-hour minimum. For chromium-molybdenum steels (1/2 to 9 percent chromium) and 12 percent chromium stainless steels, the minimum holding time shall be two hours.
- g) For P-3, P-4, P-5, and P-6 materials, the production PWHT (time and temperature) shall be essentially the same as in the welding procedure qualifications.
- h) A sufficient number of thermocouples or other acceptable measuring devices shall be attached, so as to accurately indicate metal temperature in all critical areas during PWHT.
- i) Direct flame impingement by torch or furnace burner during PWHT is not permitted.
- j) No exothermic heat treatment shall be allowed without prior written approval from CONSULTANT.

Table No. 3: Post Weld Heat Treatment for Ferritic Materials

Material (Nominal Analysis)	P-No.	PWHT Temperature Range	
		°C	°F
Carbon Steel	1	610 - 665	1130 - 1230
Manganese-Molybdenum	3	620 - 720	1150 - 1325
C - 1/2 Mo	3	620 - 720	1150 - 1325
1/2 Cr - 1/2 Mo	3	620 - 720	1150 - 1325
1 Cr - 1/2 Mo	4	705 - 745	1300 - 1375
1 1/4 Cr - 1/2 Mo	4	705 - 745	1300 - 1375
2 1/4 Cr - 1 Mo	5	720 - 760	1325 - 1400
3 Cr - 1 Mo	5	720 - 760	1325 - 1400
5 Cr - 1/2 Mo	5	720 - 760	1325 - 1400
7 Cr - 1/2 Mo	5	720 - 760	1325 - 1400
9 Cr - 1 Mo	5	720 - 760	1325 - 1400
12 Cr (martensitic)	6	720 - 790	1325 - 1450
12 Cr (ferritic)	7	None	None
2 1/4 Ni	9A	595 - 635	1100 - 1175
3 1/2 Ni	9B	595 - 635	1100 - 1175
5 Ni	11A	550 - 585	1025 - 1085
9 Ni	11A	550 - 585	1025 - 1085

Notes:

1. The temperature of any part of weldment during PWHT shall not be less than shown above. The minimum holding time at temperature shall be one hour.
2. This table does not apply to normalized and tempered materials or to quenched and tempered materials. The PWHT of such materials shall be approved by CONSULTANT. It shall be such that the weld and HAZ hardnesses do not exceed with ASME B31.1, and the mechanical properties are not less than the specification minimum.

- 9.2.2 The maximum Brinell hardness of welds and heat-affected zones in all steels after heat treatment shall be in accordance with ASME B31.3. If welds are furnace heat treated, a sufficient number (10 percent) shall be tested to verify that the hardness criterion has been met. If local heat treatment has been applied, each weld shall be tested.

10.0 INSPECTION AND EXAMINATION

10.1 General

Examinations of welds shall conform to procedures and acceptance standards required by the ASME Code. The exception is piping, which shall be in accordance with specification for fabrication/installation of piping and the paragraphs of this section.

Table 4: Weld Examination Procedures and Acceptance Standards

Method	Standard, ASME Code	
	Section I	Section VIII
Radiography: - Complete - Random	PW-51	Par. UW 51 Par. UW 52
Magnetic particle	N/A	Appendix 6
Liquid penetrant	N/A	Appendix 8
Ultrasonic	PW-52	Appendix 12

Notes:

1. Examination of piping welds fabricated in accordance with ASME B31.3 shall be in accordance with Specification for Fabrication/Installation of Piping.
2. Detailed weld inspection procedures and acceptance criteria shall be reviewed and approved by CONSULTANT.

10.2 All inspection and non-destructive examination (NDE) procedures shall be in writing and submitted to CONSULTANT for approval. All inspections and NDE shall be performed in accordance with the approved procedures. The NDE operators shall be at least ASNT Level – II certified for the examination they are performing.

10.3 Welds that are to be examined by non-destructive methods shall be finished as required by the applicable code.

10.4 **Radiographic Examination**

The following are additional requirements for radiographic examination:

- 10.4.1 ASME SEC V-B-2-SE-94 Type 1 fine-grain film (Kodak AA or equivalent) shall be used.
- 10.4.2 Only lead screens shall be used.
- 10.4.3 Use of penetrameters other than those specified in ASME SEC V-B-2-SE-94, Article 2 and 22 (ASTM SE 94), (such as DIN/IIW wires) is permissible. However, the thickness sensitivity and hole sensitivity shall be equivalent to those required by the applicable ASME Code, and prior approval shall be obtained from CONSULTANT.
- 10.4.4 Suitable film density shall be used.
- 10.4.5 Radiography of welds in NPS 2½ pipe or smaller may be performed by the elliptical projection technique. At least two separate exposures are required at locations 90 degrees apart.

10.5 **Magnetic Particle Examination**

Following are additional requirements for magnetic particle examination:

- 10.5.1 Only the yoke method shall be used after final postweld heat treatment.
- 10.5.2 Permanent magnets or yokes shall be used on air-hardening steels.
- 10.5.3 In examination by the prod method, the control switch shall be built into the prod handles, so as to prevent arcing.
- 10.5.4 Severe arc strikes resulting from magnetic particle examination shall be removed by grinding and the area subject to 100% MPI or DPI.
- 10.5.5 Magnetic particle inspection shall not be used on 5 through 9 percent nickel steels.

10.6 **Liquid Penetrant Examination**

Following are additional requirements for liquid penetrant examination:

- 10.6.1 Except for piping, liquid penetrant shall only be used for non-magnetic materials and 5 through 9 percent nickel steels, unless otherwise approved by CONSULTANT.
- 10.6.2 Cleaning and developing solutions with a combined total residual sulfur and halogen content of one percent by weight or greater shall not be used.

10.7 **Ultrasonic Examination**

Following are additional requirements for ultrasonic examination:

- 10.7.1 The weld shall be examined from at least two different probe angles.
- 10.7.2 Welds are not acceptable if the echoes from discontinuities exceed the reference curve. Each weld groove face shall be completely examined from both sides of the joint. If, however, complete examination can be performed from one side only, echoes that exceed 50 percent of the reference curve are not acceptable. Echoes exceeding 20 percent of the reference curve shall be fully evaluated and accurately sized.
- 10.7.3 All echoes from discontinuities that exceed 50 percent of the reference curve shall be recorded in the examination report and transmitted to CONSULTANT. This record shall locate each area, the echo height, the dimensions, the depth below the surface, and the classification.

10.8 **Extent of Inspection**

The minimum inspection shall be as follows:

- 10.8.1 All welds shall be visually inspected after completion and inspected per the construction code and this specification.
- 10.8.2 For piping, the extent and type of examination shall be as required in accordance with reference Codes and Standards.
- 10.8.3 All final non-destructive examinations shall be performed after post weld heat treatment, unless otherwise approved by CONSULTANT. Final radiography or ultrasonic examination for vessels shall be performed no sooner than 48 hours after the vessel has cooled to ambient temperature. In special cases, based on equipment type, materials, and process conditions, NDE examination may be separated; some performed before PWHT and some after.
- 10.8.4 Where CONSULTANT allows non-destructive examination to be performed before the final post weld heat treatment, the welds shall also be examined on all accessible surfaces by the magnetic particle method (dye penetrant method for non-magnetic materials and all piping) after PWHT.
- 10.8.5 The attachment welds between structural components and pressure parts of quenched and tempered carbon steel, HSLA steel, and ferritic alloy materials shall be examined by the magnetic particle method (dye penetrant for piping) after PWHT. This requirement does not apply to 5 through 9 percent nickel steels.
- 10.8.6 All pressure-containing equipment designed with 100 percent joint efficiency, irrespective of material, shall have all nozzle and reinforcing pad attachment welds examined by the magnetic particle or liquid penetrant method, as applicable. Inspection shall be performed on all accessible weld surfaces (inside and outside).

- 10.8.7 After completion of welding. This final inspection shall be made after post weld heat treatment, if any.
- 10.8.8 When examination by radiography is specified but is not practical, ultrasonic examination or an alternative non-destructive test method shall be proposed for CONSULANT approval.
- 10.8.9 For all piping and heater coils requiring radiography, the minimum number of shots per circumferential seam shall be as follows:
- a) Up to and including NPS 2 1/2 diameter: two shots (90 degrees apart)
 - b) Over 2 1/2 NPS diameter: three shots (120 degrees apart)
- 10.8.10 Where random non-destructive examination is specified, at least one weld shall be examined for every material grouping, each welding process, and each welder. For each weld found to be defective, two additional representative welds shall be examined. If these additional welds are free from defects, only the defects indicated in the first examination shall be repaired and re-examined. However, if either of the two additional welds shows defects, all welds represented shall be either (1) fully non-destructively examined and repaired as necessary, or (2) completely replaced.
- 10.8.11 For spot radiography, at least one of each type and position of weld made by each welder shall be examined.

10.9 **Hardness Tests**

- 10.9.1 The hardness of welds and HAZ, when used in the as-welded condition or after post weld heat treatment, shall not exceed with reference Codes and Standards.
- 10.9.2 Where the following conditions occur, hardness tests of P-1 and P-3 materials shall be taken on the center of the inside surface of weld seams, where possible; otherwise, on the outside surface of the weld seams at the weld centre line and also the HAZ interface between the weldmetal and base material. (including nozzle, manhole, and attachment welds):
- a) Submerged arc welding is performed with F70 or higher flux classification.
 - b) Shielded metal arc welding is performed with covered electrodes of E80XX or higher classification.
 - c) Filler metal contains at least 1.6 percent manganese, or when manganese and silicon exceed 1.4 and 0.8 percent, respectively.
- 10.9.3 For carbon steel in critical service, such as wet H₂S, amine, HF, and caustic, the hardness of deposited weld metal shall not exceed 200 HB.

11.0 **REJECTION AND REPAIR**

- 11.1 Defects that are outside the limits of the codes, job specifications, or other requirements stated on the purchase order shall be cause for rejection. The CONTRACTOR/SUPPLIER shall provide rectification procedures and take such remedial action as is necessary to re-establish the weld integrity and secure acceptance by CONSULTANT. The cost of the remedial action shall be borne by the CONTRACTOR/SUPPLIER. The CONTRACTOR/SUPPLIER shall only attempt 2 repairs of a defective weldment before the complete weld is removed and replaced.
- 11.2 Repairs of major defects, and all repairs in plate or forgings, require prior approval by CONSULTANT. Repairs of weld defects are considered major when the defect size exceeds one-half the wall thickness and the thickness of the component is over 25.4 mm (1 in); or when the defect resulted in leakage during a hydrostatic test. The repair procedure shall be in writing and shall include information on methods used for defect removal, inspection of cavity, welding procedures, welding techniques and details of non-destructive examination of the excavated and repaired area.
- 11.3 All welds (including weld overlays) that are found by inspection to be unsound or that are deposited by procedures differing from those properly qualified shall be rejected. They shall be completely removed from the equipment and replaced in accordance with an approved procedure or be repaired, subject to CONSULTANT written approval.
- 11.4 Repair of local cavities in overlay welds that penetrate the base metal by more than 10 percent or 4.8 mm (3/16 in), whichever is the smaller, shall include having the base metal re-welded. The welding procedure and materials used shall be compatible with the original base metal.
- 11.5 Removal of defects by chipping, grinding, or gouging shall be done in such a manner as to avoid reducing the adjacent base material thickness. If the adjacent material thickness is reduced, it shall be restored to its original condition. Complete removal of defects shall be verified by non-destructive examination before repair is started. Repair welding shall be performed only by qualified welders using qualified procedures.
- 11.6 When a welder's or welding operator's welding is judged unsatisfactory by CONSULTANT, the welder shall be removed from the work. All such welding by that welder or operator shall be inspected by non-destructive examination and removed or repaired at CONTRACTOR/SUPPLIER expense, as directed by CONSULTANT. The welder may be reassigned after additional training and the completion of satisfactory re-qualification tests, but only with the approval of CONSULTANT.

12.0 **REPAIRS AND ALTERATIONS**

All repairs or alterations of existing welded equipment shall be done in accordance with the latest addition of the applicable code for new construction. For pressure vessels, both code and non-code repairs and alterations shall conform to ANSI NB-23 or other national requirements.

13.0 **WELD IDENTIFICATION**

In field and shop welding, each qualified welder or welding operator shall have an identification symbol assigned to him to ensure all production welds are traceable to the welder, WPS and NDE report. The welder shall permanently mark each pressure weld with this identification symbol. If more than one welder welds a joint, each shall apply his symbol in such a manner as to indicate the part of the joint he welded. Alternatively, subject to CONSULTANT written approval, an accurate record keeping system shall be established and maintained to identify welds and the welders that fabricate them.

14.0 **DOCUMENTATION**

All CONTRACTOR/SUPPLIER as built data reports for new construction, alteration, and repairs shall be furnished to CONSULTANT upon completion of the fabrication. Such documentation may include, but not be limited to, the following elements: assembly and spool drawings, welding procedures, heat treating charts, inspection records, and appropriate code documents. For details on as built documentation requirements, refer to specific equipment guides and Contract requirements. Sub CONTRACTOR/SUPPLIER shall provide a typical as built documentation index to CONSULTANT prior to work commencing.

Appendix – A - Explanation of Abbreviations

FCAW	Flux Cored Arc Welding
FIN	Ferrite Index Number
GMAW	Gas Metal Arc Welding
GTAW	Gas Tungsten Arc Welding
HAZ	Heat Affected Zone
HB	Brinnell Hardness
HSLA	High Strength, Low Alloy
HV	Vickers Hardness
NDE	Non-Destructive Examination
PWHT	Post Weld Heat Treatment
SAW	Submerged Arc Welding
SMAW	Shielded Metal Arc Welding
WRC	Welding Research Council

ATTACHMENT A: Inspection and Testing Requirements Sheet							
Facility Name:				Purchase Order No.:			
Location:				Requisition No.:			
Item Name: Pressure Containing Equipment				Project No.:			
Item No.:							
INSPECTION or TESTING		Supplier Inspection and Testing			ADDITIONAL COMMENTS		
		Contractor	Witness	Documented Results of Inspection or Test			
1 Fabrication and manufacturing procedures							
2	WPS	X	X	X	Review and Approval		
3	Welding (Each Operator)	X		X			
4	PMI	X		X	Review and Approval		
5	Welder or Welding Operator Qualification Record	X		X			
5	Quality Assurance / Control Manual	X	X	X	Review and Approval		
6	NDE Operator Records	X		X			
7	PWHT Procedures	X	X	X	Review and Approve procedure and PWHT charts		
8	Standard manufacturing checks and tests	X		X	Inspections/tests as per approved ITP		
9 Other Examination							
10	Radiographic Examination	X	X	X	Review of radiographs		
11	Ultrasonic Examination	X		X	As built records		
12	Magnetic Particle Examination	X		X	As built records		
13	Liquid Penetrant Examination	X		X	As built records		
14 Leak Testing							
15	Hydrostatic Leak Test	X	X	X	As built records / test charts		
16	Pneumatic Leak Test	X		X	As built records / test charts		
17	Special Leak Test	X		X	As built records / test charts		
18 Hardness Testing							
19	Welds	X		X	If PWHT is required by Code		
20	Heat Affected Zone	X		X	If PWHT is required by Code		
21 Impact Testing							
22	Welds and HAZ	X		X	As required to qualify WPS or materials		
23	Forged fittings	X		X	As required to qualify WPS or materials		
24 Prior to shipment							
25	Packaging and preservation				In accordance with shipping spec		
26	Fabrication/manufacturing record book	X	X	X	Review and sign off prior to shipping		
27	Issue of IRN	X	X	X	To release item (to include any OWL)		
Detailed Inspection and Testing Requirements:							
All CONTRACTOR/SUPPLIER HOLD inspection and test points will be identified during pre-construction meetings and formal mark up of the Inspection and Test Plan for the WORK.							
Notes:							
CONTRACTOR/SUPPLIER inspection/hold points shall be confirmed during prefabrication meeting.							
COMPANY at its option and with prior notification, shall be permitted free access to the CONTRACTOR/SUPPLIER facilities during all phases of the work for performing visual inspections and for routine checking of documentation and work progress.							
Revision Log							
Rev	Date	Aprvl	Description	Rev	Date	Aprvl	Description



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OIL & GAS DEVELOPMENT COMPANY LTD.

SPECIFICATION FOR CARBON AND STAINLESS STEEL PIPES (NACE COMPLIANT)



0	08-10-2013	Issued for Tender	SMHA	MIAH	MAS
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C O N T E N T S

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1.0 **GENERAL**

1.1 **Scope**

This specification defines the minimum requirements for manufacturing, testing, inspection, packing & shipping of Carbon and Stainless Steel Pipes.

1.2 **Definitions**

Following definitions apply throughout this document:

COMPANY: Oil & Gas Development Company Ltd. (OGDCL)

CONSULTANT: M/s. Zishan Engineers (Pvt.) Ltd. (ZEL).ZEL have been awarded the work of Engineering, Procurement Assistance and Project Management.

CONTRACTOR: Means the construction company to be engaged by the COMPANY to perform the Construction work.

VENDOR / SUPPLIER: The organization, firm or agency with whom order for the supply of equipment and or material has been placed.

1.3 **Errors or Omissions**

1.3.1 The review and comment by the COMPANY of any SUPPLIER'S drawings, procedures or documents shall only indicate acceptance of general requirements and shall not relieve the SUPPLIER of its obligations to comply with the requirements of this specification and other related parts of the Contract Documents.

1.3.2 Any errors or omissions noted by the SUPPLIER in this Specification shall be immediately brought to the attention of the COMPANY.

1.4 **Deviations**

All deviations made during the procurement, design, manufacturing, testing and inspection shall be with written approval of the COMPANY prior to execution of work. Such deviations shall be shown in the documentation prepared by the Supplier.

1.5 **Conflicting Requirements**

In the event of any conflict, inconsistency or ambiguity between the SUPPLIER scope of work, this Specification, National Codes and Standards, referenced in the Project Specification or any other documents, the SUPPLIER shall refer to the COMPANY whose decision shall prevail.

1.6 **Supplier's Responsibility**

The SUPPLIER shall be responsible for the complete design, manufacture, supply, inspection and testing of all the Carbon and Stainless Steel pipes in full compliance with the applicable design codes and standards stated in section 2.0 of this document, all other project specifications and with the requirements of the COMPANY.

1.7 **Reporting Procedure**

1.7.1 A reporting and documentation system shall be agreed between the SUPPLIER and the COMPANY for the status of procurement, design, manufacturing, inspection, testing and shipment of the equipment/material to be supplied under this specification. SUPPLIER shall provide reports and summaries for production performance and testing operations in conformance with a manufacturing schedule approved by COMPANY.

1.7.2 Daily, weekly, monthly and run summaries of all major aspects of the production process shall be provided as reports to the COMPANY.

1.7.3 **Third Party Inspection**

In addition to the inspection and witnessing of tests by the SUPPLIER's inspectors during the manufacturing and shipment of the equipment/material, COMPANY may appoint a third party or its own inspector for witnessing of the inspection and tests to be carried out at SUPPLIER'S facility under this specification.

1.8 **Documentation**

1.8.1 Documents, drawings, etc., to be submitted to the COMPANY shall be in English Language.

1.8.2 Unless otherwise specified, metric units shall be used in documents and drawings.

1.8.3 Variations from or additions to this specification shall be called to the attention of the COMPANY and approved in writing by the COMPANY prior to starting fabrication.

1.8.4 Information for installation, inspection purposes shall be submitted to COMPANY.

2.0 **CODES & STANDARDS**

All Latest codes, standards and regulations mentioned below have been considered for the design basis:

API–American Petroleum Institute

- API 5L Specification for Line Pipe, 44th or Latest Edition

ASME–American Society of Mechanical Engineers

- ASME B36.10 Welded and Seamless Wrought Steel Pipe
- ASME B31.3 Process Piping
- ASME B16.47 Large Diameter Steel Flanges NPS 26 Through NPS 60
- ASME B1.20.1 Pipe Threads, General Purpose (Inch)
- ASME B16.25 Butt Welding Ends.
- Section IX Welding and Brazing Qualifications.

ASTM–American Society of Testing and Materials

- ASTM A106 Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
- ASTM A153 Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.
- ASTM A312/A312M Standard Specification for Seamless, Welded and Heavily Cold Worked Austenitic Stainless Steel Pipes E1-1996
- ASTM A333/A333M Standard Specification for Seamless and Welded Steel Pipe for Low-Temperature Service.
- ASTM A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

MSS-Manufacturers Standardization Society

- MSS SP-25 Standard Marking System for Valves, Fittings, Flanges and Unions.

National Association of Corrosion Engineers

- NACE MR0175 Petroleum and Natural Gas Industries
/ISO 15156

3.0 PROJECT SPECIFICATION

- 165-4-SPM-046 Specification for Piping Class Material
- 165-4-SPM-031 Specification for Export Packing & Crating
- 165-4-SPM-034 Specification for Welding

4.0 GENERAL REQUIREMENTS

- 4.1 Carbon Steel, seamless and welded pipes for high temperature services as per ASTM specification of A 106 Gr. B or API 5L Gr. B.
- 4.2 Carbon Steel, seamless pipes for Low temperature services as per ASTM specification of A-333 Gr.B.
- 4.3 Carbon Steel Seamless, Galvanized, Screwed ended as per ASTM specification of A-106 Gr.B.
- 4.4 Austenitic Stainless Steel Seamless Pipes as per ASTM specifications A-312 Gr. TP-304.
- 4.5 The design, dimensions and weight of Carbon and Stainless Steel pipes shall comply with ASME B.36.10 upto 24" Size and ASME B16.47 for size above 24".
- 4.6 Unless specified otherwise, Pipes NPS ¼" through NPS 26 shall be furnished in single random length.
- 4.7 Except where threaded pipe is specified, NPS 1 ½" and smaller pipe shall be furnished with plain ends, Cut Square.
- 4.8 Pipes NPS 2 and larger shall be furnished with beveled ends to an angle of 30° + 5° - 0° measured from a perpendicular drawn to the axis of the pipe with a root face of 1.6 mm ± 0.5mm.
- 4.9 Threaded pipe shall be furnished with taper-threaded ends in accordance with ASME B1.20.1.
- 4.10 For a distance of 100mm both ends of the pipe, variation in outside diameter shall not be more than +0.5% or-0.1% max.
- 4.11 In case of wall thickness variation, wall thickness shall not deviate from the nominal thickness by more than 12.5% or-12.5%.

- 4.12 The weight of finished length of pipe shall not be less than 98.5%.
- 4.13 Pipe not in accordance with the purchase order and this specification shall be subject to rejection.
- 4.14 The SUPPLIER shall refer all conflicts between the requirements of the purchase order and this Specification to the COMPANY in writing, for clarification and resolution before proceeding with the manufacture and or procurement of the affected pipe.
- 4.15 Any substitution to, or variance from, this specification or purchase order require written approval from the COMPANY before implementation.
- 4.16 The SUPPLIER shall have an established, routine, and documented quality control program. When requested, the SUPPLIER shall submit this quality control program to the COMPANY for approval.

5.0 **MATERIAL**

- 5.1 Material used in the manufacturing of pipes shall be new and unused.
- 5.2 The Steel shall be made by one or more of the following processes: open-hearth, electric-furnace or basic-oxygen process, and shall be fully killed and made to fine grain practice.
- 5.3 Carbon Steel / Stainless Steel pipes shall conform to the requirements of chemical composition prescribed in Table 1 of the relevant ASTM Specifications.
- 5.4 At the request of the COMPANY an analysis for chemical composition shall be done. For this analysis, two pipes from each lot made by the SUPPLIER. The result of these analyses shall be reported to the COMPANY.
- 5.5 All material should be compliant to NACE MR0175 (Latest Revision) for items indicated in bill of quantities.

6.0 **TESTING & INSPECTION**

- 6.1 All Supplier facilities, materials, and fabrication work shall be subject to inspection by the COMPANY.
- 6.2 Pipe containing defects originating with the SUPPLIER design, materials, or workmanship, or which are not in complete compliance with the requirements of the purchase order and referenced documents will be subject to rejection.
- 6.3 Inspection and acceptance of the pipe by the COMPANY does not relieve the SUPPLIER of the responsibility to comply with the requirements of this specification and the purchase order.

- 6.4 The Pipes SUPPLIER shall perform all testing and examination required by the referenced standards and the purchase order.
- 6.5 Impact testing, when required, shall meet the requirements of ASME B31.3, Paragraph 323.3.

7.0 **MARKING**

- 7.1 All Marking Shall be in English.
- 7.2 Both ends of each pipe length shall be externally hard die stamped as a minimum with following information or according to the marking requirements of MSS-SP-25 and any additional requirements contained in the applicable material specifications:
- Heat/Cast no
 - Material/Manufacturer's Name
 - Outside diameter/ wall thickness
 - Work Inspector/Inspection Authority
- 7.3 Marking shall be stenciled on the inside of the pipe within 200mm of the beveled ends.
- 7.4 The pipes may be carefully die stamped on the Beveled end.

8.0 **ENGINEERING DATA REQUIREMENTS**

8.1 **General**

- 8.1.1 All records indicated herein shall be fully identified with the specific materials they represent. All records shall be available for examination to the COMPANY by the SUPPLIER at the time and place of inspection.
- 8.1.2 If Engineering data beyond those listed in this Practice are required, a statement of those requirements shall be included in the request for quotation and/or the purchase order.
- 8.1.3 All required engineering data shall be in English.

8.2 **Welding Procedures**

Welding Procedure Specifications (WPS) and Procedure Qualification Records (PQR), if applicable, shall be in accordance with ASME Boiler and Pressure Vessel Code, Section IX, NACE MR0175 (Latest Revision). Individual WPSs and PQRs shall be available for examination upon request.

8.3 **Material Test Reports**

SUPPLIER shall furnish Material Test Reports (MTRs) that show actual results of chemical analyses, mechanical tests, impact test results (if applicable), and heat treatment (if applicable) in compliance with the referenced material specification. The test reports shall be traceable to each production lot. These documents shall be identified with COMPANY order number and shall be signed by the SUPPLIER.

8.4 **Certificate**

SUPPLIER shall be liable to provide certificates of the manufactured pipes. This certificate in addition to the information required by specification A530/A 530M, the certification shall state whether or not the material was hydraulically tested. In case of nondestructively tested, the certificate shall so state.

9.0 **SHIPPING AND HANDLING**

- 9.1 Pipe shall be prepared for shipment in a manner that damages or atmospheric corrosion of internal or external surfaces is avoided during storage and transport.
- 9.2 Pipe ends shall be protected with wood, plastic, or metal covers. These covers shall protect the ends and prevent dirt and other foreign matter from entering the interior. Butt welding bevels are protected with metal covers, a layer of nonmetallic material shall also be provided between the butt-welding bevel and the metal cover. Tape shall not be used as the sole covering method.
- 9.3 Machined or threaded surfaces of Ferritic pipe shall be coated with an easily removable rust preventative compound, unless otherwise specified by purchaser. Pipe cleaned for special service shall not have rust preventative compound applied.
- 9.4 The SUPPLIER shall give assurance of required vapor-proof barrier material for Austenitic Stainless Steel pipe.
- 9.5 The Packing of the pipes shall also meet the packing requirements as detailed in specification for Export Crating and Packing (165-4-SPM-031).



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OIL & GAS DEVELOPMENT COMPANY LTD.

SPECIFICATION FOR CARBON AND STAINLESS STEEL FITTINGS (NACE COMPLIANT)



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1.0 **GENERAL**

1.1 **Scope**

This specification alongwith defines the minimum requirements for manufacturing, testing, inspection, packing and shipping of factory-made Butt-welded, Socket Welded and threaded fittings of following material:

- 1.1.1 Carbon Steel for moderate and high temperature services as per ASTM A-234 Gr. WPB.
- 1.1.2 Carbon steel for Low temperature services as per ASTM-420 Gr. WPL 6.
- 1.1.3 Austenitic Stainless Steel as per ASTM A-403 Gr. WP304S.
- 1.1.4 Forged or Rolled alloy steel as per ASTM A182.F304.
- 1.1.5 Carbon Steel Forging Fittings as per ASTM A-105.

1.2 **Definitions**

Following definitions apply throughout this document:

COMPANY:	Oil & Gas Development Company Ltd. (OGDCL)
CONSULTANT:	M/s. Zishan Engineers (Pvt.) Ltd. (ZEL).ZEL have been awarded the work of Engineering, Procurement Assistance and Project Management.
CONTRACTOR:	Means the construction company to be engaged by the COMPANY to perform the Construction work.
VENDOR / SUPPLIER:	The organization, firm or agency with whom order for the supply of equipment and or material has been placed.

1.3 **Errors or Omissions**

- 1.3.1 The review and comment by the COMPANY of any SUPPLIER'S drawings, procedures or documents shall only indicate acceptance of general requirements and shall not relieve the SUPPLIER of its obligations to comply with the requirements of this specification and other related parts of the Contract Documents.
- 1.3.2 Any errors or omissions noted by the SUPPLIER in this Specification shall be immediately brought to the attention of the COMPANY.

1.4 **Deviations**

All deviations made during the procurement, design, manufacturing, testing and inspection shall be with written approval of the COMPANY prior to execution of work. Such deviations shall be shown in the documentation prepared by the SUPPLIER.

1.5 **Conflicting Requirements**

In the event of any conflict, inconsistency or ambiguity between the SUPPLIER'S scope of work, this Specification, National Codes and Standards, referenced in the Project Specification or any other documents, the SUPPLIER shall refer to the COMPANY whose decision shall prevail.

1.6 **SUPPLIER'S Responsibility**

The SUPPLIER shall be responsible for the complete design, manufacture, supply, inspection and testing of all the fittings in full compliance with the applicable design codes and standards stated in section 2.0 of this document, all other project specifications and with the requirements of the COMPANY.

1.7 **Reporting Procedure**

1.7.1 A reporting and documentation system shall be agreed between the SUPPLIER and the COMPANY for the status of procurement, design, manufacturing, inspection, testing and shipment of the equipment/material to be supplied under this specification. SUPPLIER shall provide reports and summaries for production performance and testing operations in conformance with a manufacturing schedule approved by COMPANY.

1.7.2 Daily, weekly, monthly and run summaries of all major aspects of the production process shall be provided as reports to the COMPANY.

1.7.3 **Third Party Inspection**

In addition to the inspection and witnessing of tests by the SUPPLIER inspectors during the manufacturing and shipment of the fittings, COMPANY may appoint a third party or its own inspector for witnessing of the inspection and tests to be carried out at SUPPLIER'S facility under this specification.

1.8 **Documentation**

1.8.1 Documents, drawings, etc., to be submitted to the COMPANY shall be in the English Language.

1.8.2 Unless otherwise specified, the metric units shall be used in documents and drawings.

1.8.3 Variations from or additions to this specification shall be called to the attention of the Company and approved in writing by the COMPANY prior to starting fabrication.

1.8.4 Information for installation, inspection purposes shall be submitted to COMPANY.

2.0 **CODES & STANDARDS**

All fittings shall be manufactured in accordance with the latest edition of the American Codes, standards & reference documents listed below and the requirements of this specification.

ASME-American Society of Mechanical Engineers

- ASME B16.9 Factory Made Wrought Steel Butt-welding Fittings.
- ASME B16.11 Forged fittings, Socket-Welding and Threaded.
- ASME B1.20.1 Pipe threads, General purpose (Inch)
- ASME B16.25 Butt welding Ends
- ASME B31.3 Process Piping

ASTM-American Society for Testing and Materials

- ASTM A153 Standard Specification for Zinc coating (Hot-Dip) on Iron and Steel Hardware.

MSS-Manufacturers Standardization Society

- MSS SP-25 Standard Marking system for valves, fittings, flanges and unions

National Association of Corrosion Engineers

- NACE MR0175 Petroleum and Natural Gas Industries
/ISO 15156

Project Specifications

- Specification for Export Packing & Crating 165-4-SPM-031
- Specification for Welding 165-4-SPM-034
- Piping Class Specifications 165-4-SPM-046

3.0 **DESIGN**

Each condition of fittings shall be furnished in accordance with the following:

- 3.1 Butt Weld Ends – ASME B16.25
- 3.2 Socket Weld Ends- ASME B16.11
- 3.3 Threaded Ends-taper-threaded per ASME B1.20.1
- 3.4 All material should be compliant to NACE MR0175 (Latest Revision) for items indicated in bill of quantities.

4.0 **MATERIALS**

All material should be compliant to NACE MR0175 (Latest Revision) for items indicated in bill of quantities.

4.1 **Carbon Steel Fittings**

Steel used in the manufacture of fittings to this specification shall be fully killed and made by the Open-hearth, Electric-furnace or Basic-oxygen processes.

The chemical composition of each heat of steel shall be determined by the Manufacturer, and shall have maximum carbon content 0.30%, and maximum sulphur content 0.04%. and 0.30% and 0.058% for High temperature carbon steel.

The carbon equivalent shall not exceed 0.43% as determined by the following formula:

$$C.E. = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Cu + Ni}{15}$$

4.2 **Stainless Steel Fittings**

The Steel used in manufacturing of fittings to this specification shall be melted by one of the process Electric Furnace or Vacuum furnace.

The Chemical composition shall be determined by the manufacturer and shall have Maximum Carbon content 0.08% and sulphur 0.03%.

5.0 **HEAT TREATMENT**

All Carbon steel and Stainless steel Fittings shall be furnished in the heat treated condition

All material should be compliant to NACE MR0175 (Latest Revision) for items indicated in bill of quantities.

6.0 **DIMENSIONS**

- 6.1 Dimensions shall be generally in accordance with ASME B16.9
- 6.2 In all cases fittings shall be suitable for butt-welding into the adjacent pipe work with the internal diameter of ends and outlets matching that of the pipe.

7.0 **TRANSITION PIECES**

Where pipes of different material grades, or of different wall thickness (or both) are to be jointed, and where the miss-match of wall thickness cannot be rectified by grinding in accordance with the tolerances of ANSI B31.3, then a transition piece shall be used.

The transition piece shall have a length of at least 2 pipe diameters and shall have minimum specified yield strength equivalent to the thinner of the two pipes to be joined. The ends of the transition pieces shall be machined to suit the respective pipe wall thickness.

8.0 **TESTING, INSPECTION AND REJECTION**

- 8.1 All SUPPLIER facilities, materials and fabrication work shall be subject to inspection by the COMPANY.
- 8.2 The Supplier shall afford the COMPANY's representative all reasonable facilities necessary to satisfy him the material is being produced and furnished in accordance with the specification.
- 8.3 Fittings supplied shall be examined visually. The surfaces of fittings shall be free from surface discontinuities more than 5% of specified wall thickness, finish scale and mechanical marks. General appearance, workmanship and fit-up shall be acceptable in accordance with ASME B31.3 paragraph 344.2. Dimensions of the fitting shall be checked against ASME B16.9 or approved SUPPLIER'S drawing.
- 8.4 Fittings containing defects originating with the SUPPLIER design, materials, or workmanship or which are not in complete compliance with the requirement of the purchased order and referenced documents will be subject to rejection.
- 8.5 Inspection and acceptance of the fittings by the COMPANY does not relieve the SUPPLIER of the responsibility to comply with the requirements of this specification and the purchase order.
- 8.6 The fittings SUPPLIER shall perform all testing and examination required by the referenced standards and the purchase order.
- 8.7 Impact testing, when required, shall meet the requirements of ASME B31.3, paragraph 323.3

9.0 **ENGINEERING DATA REQUIREMENTS**

- 9.1 All records indicated herein shall be fully identified with the specific materials they represent. All records shall be available for examination by the COMPANY.
- 9.2 All required engineering data shall be in English.
- 9.3 Welding Procedure Specification (WPS) and Procedure Qualification Records (PQR), if applicable, shall be in accordance with the ASME Boiler Vessel Code, Section IX. Individual WPSs and PQRs shall be available for examination by COMPANY'S request.
- 9.4 When requested by COMPANY, SUPPLIER shall furnish Material Test Reports (MTR) that show actual results of chemical analyses, mechanical tests, impact test results (if applicable) , and the heat treatment in compliance with the referenced material specification. The test report shall be traceable to each production lot. These documents shall be identified with the Company' purchase order number and shall be signed by the SUPPLIER'S authorized agent.
- 9.5 The SUPPLIER shall provide a certification of compliance with ASME B16.9, and the relevant ASTM standards and with the requirements of this specification.

10.0 **PRODUCT MARKING, COATING AND PACKING**

- 10.1 Each fitting shall have prescribed information stamped or otherwise suitably marked. The prescribed information for fittings shall be at least:
 - Manufacturer's name or trademark.
 - Schedule No.
 - Nominal Wall Thickness.
 - Size, Class, grade, Length.
 - Fitting designation.
 - Heat No.
- 10.2 Fittings shall be supplied with a protective coating that does not hide marking or surface defects. This temporary coating combined with appropriate packing, must protect against corrosion during Ocean shipment. The coating shall be hard and dry. It can be either a clear coating or a thin opaque coating. Except for clear coating, the maximum dry film thickness shall be 0.076 mm. The fitting's normal stamped markings must be readable.
- 10.3 The welding ends shall be coated with an Aluminum-flake weld able primer or a coating that is easily strippable and does not leave a residue that interferes with welding. The maximum dry film thickness of a weld able coating shall not exceed 0.050 mm. A welding end strippable coating is allowed to be any thickness. Example of strippable coatings include high build vinyl, urethane, PVC or strippable tape applied before coating.

- 10.4 A fitting must be protected from mechanical damage. Welding ends must be protected with suitable wood, plastic or metal covers. Fittings must be packed in steel-banded wooden crates or secured to skids.
- 10.5 The Packing of the Fittings shall also meet the packing requirements as detailed in the specifications for Export Packing & Crating (165-4-SPM-031)

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**OIL & GAS DEVELOPMENT COMPANY LTD.**

SPECIFICATION FOR
STEEL FLANGES
(NACE COMPLIANT)



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1.0 **INTRODUCTION**

1.1 **General**

This specification is a standard specification for Steel Flanges and outlines the minimum requirements of the COMPANY.

This specification covers the manufacture, testing, and inspection of steel pipeline flanges, for use in pipelines and associated installations.

Flanges such as weld neck flanges and blind flanges shall conform to the requirements of ASME B16.5 upto sizes (24") and MSS-SP-44 for sizes (26") and above.

Spectacle blind and spacer & blind shall conform to the requirements of ASME B 16.48 upto sizes (24"). For sizes (26") and above, spectacle blind and spacer & blind shall conform to Manufacturer's standard.

Design and manufacture shall be in accordance with ANSI B16.5/MSS-SP-44, Steel Pipe Flanges and Flanged Fittings, the relevant ASTM standards, and with the requirements of this specification.

1.2 **Definitions**

Following definitions apply throughout this document:

COMPANY: Oil & Gas Development Company Ltd. (OGDCL)

CONSULTANT: M/s. Zishan Engineers (Pvt.) Ltd. (ZEL).ZEL have been awarded the work of Engineering, Procurement Assistance and Project Management.

CONTRACTOR: Means the construction company to be engaged by the COMPANY to perform the Construction work.

VENDOR / SUPPLIER: The organization, firm or agency with whom order for the supply of equipment and or material has been placed.

1.3 **Errors or Omissions**

1.3.1 The review and comment by the COMPANY / CONSULTANT of any SUPPLIER's or its manufacturer's drawings, procedures or documents shall only indicate acceptance of general requirements and shall not relieve the SUPPLIER of its obligations to comply with the requirements of this specification and other related parts of the contract documents.

1.3.2 Any errors or omissions noted by the SUPPLIER in this Specification shall be immediately brought to the attention of the COMPANY.

1.4 **Deviations**

All deviations to this specification, other specifications or attachments shall be brought to the knowledge of the COMPANY as a section in the bid. All deviations made during the procurement, design, manufacturing, testing and inspection shall be with written approval of the COMPANY prior to execution of the work. Such deviations shall be shown in the documentation prepared by the SUPPLIER.

1.5 **Conflicting Requirements**

In the event of conflict, inconsistency or ambiguity between the contract scope of work, this Specification, National Codes and Standards referenced in this Specification or any other documents, the SUPPLIER shall refer to the COMPANY whose decision shall prevail.

1.6 **Reporting Procedure**

1.6.1 A reporting and documentation system shall be agreed between the COMPANY and the SUPPLIER for the status of procurement, design, manufacturing, inspection, testing and shipment of the equipment/material to be supplied under this specification. SUPPLIER'S manufacturer shall provide reports and summaries for production performance and testing operations in conformance with a manufacturing schedule approved by COMPANY.

1.6.2 Weekly, monthly and run summaries of all major aspects of the production process shall be provided as reports to the COMPANY.

1.7 **Unit Responsibility**

The SUPPLIER shall be responsible for the complete design, manufacture supply, inspection and testing of the steel flanges, including full compliance with all applicable design codes, and standards, including those listed in Section 2.0 of this document and with the requirements of the independent certifying authority, where applicable.

2.0 **REFERENCE CODES & STANDARDS (LATEST EDITIONS)**

a) **Codes**

ANSI B 16.5, latest edition,	Steel Pipe Flanges and Flanged Fittings
MSS-SP-44, latest edition,	Steel Pipeline Flanges
ASTM Standards	
NACE MR0175/ISO 15156	Petroleum and Natural Gas Industries

b) Project Specifications

- Piping Class Specification 165-4-SPM-046
- Specification for Seamless Carbon & Stainless Steel Pipes 165-4-SPM-035

3.0 GENERAL REQUIREMENTS

Welding neck/slip-on flanges covered by this specification shall be in the range of nominal sizes as follows:

- Welding neck/slip-on flanges (2" to 24") incl as per ASME B 16.5.
- Welding neck flanges (26" and above) as per MSS-SP-44
- Blind flanges (2" to 24") incl. as per ASME B 16.48
- Blind flanges (26" and above) incl. as per Manufacturer's Standard

4.0 TEMPERATURE AND PRESSURE RATINGS

Class	Operating Pressure	Test Pressure
150	19.65 barg	29.50 barg
300	51.0 barg	76.5 barg
400	68.2 barg	102.3 barg
600	102.0 barg	153.0 barg

5.0 FLANGE FACINGS

Flanges shall be provided with Raised Faced (RF) unless otherwise specified in the Purchase Order.

Ring Type Joint (RTJ) flanges will be provided for Rating 900# or above.

6.0 MATERIAL

- 6.1 The steel used shall be suitable welding quality carbon steel, low grade as per ASTM A-105 / MSS-SP-44.

The steel shall be of such quality as to properly respond to the intended heat treatment, and shall be fully killed. Steel shall be made by the open hearth, basic oxygen, or electric furnace processes, and shall be suitable for field welding to other project fittings, flanges and pipe.

6.2 Chemical composition of the steel, as determined by ladle analysis, shall conform with the following:

Carbon	0.20% Max.
Sulphur	0.02% Max.

6.3 The Carbon equivalent shall be determined by formula:

$$\text{C.E.} = \text{C} + \frac{\text{Mn}}{6} + \frac{\text{Cr} + \text{Mo} + \text{V}}{5} + \frac{\text{Cu} + \text{Ni}}{15}$$

and shall not exceed a value of 0.42% on check analysis.

6.4 All material should be compliant to NACE MR0175 (Latest Revision) for items indicated in bill of quantities.

7.0 **TENSILE PROPERTIES**

In order to provide satisfactory transitions of flange hubs to adjacent pipe-work, materials of sufficiently high yield strength shall be selected.

8.0 **HEAT TREATMENT**

All flanges shall be furnished in the heat treated condition.

Details of the heat treatment employed shall be reported on the manufacturers material test certificates.

All material should be compliant to NACE MR0175 (Latest Revision) for items indicated in bill of quantities.

9.0 **DIMENSIONS**

9.1 All flange dimensions shall be in accordance with the requirements of the relevant standards

9.2 All flanges furnished to this specification shall be supplied with hub inside diameter uniformly bored to suit dimensions of matching pipe and shall not exceed $1.5 \times t$, where t is the run pipe thickness at the bevel of welding ends.

10.0 **INSPECTION, NON-DESTRUCTIVE TESTING, REPAIR OF DEFECTS**

- 10.1 Flanges shall be examined internally and externally for surface defects.
- 10.2 Repair by welding of injurious defects shall not be permitted after final heat treatment.
- 10.3 All flanges shall be subject to inspection at Suppliers works by the Purchaser or his representative.

11.0 **MARKING**

Marking shall be in accordance with the requirements of the relevant specifications and as may be further specified in the purchase order.

12.0 **CERTIFICATION**

The Supplier shall furnish test certificates covering all tests carried out and shall certify compliance with relevant specifications.



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OIL & GAS DEVELOPMENT COMPANY LTD.

SPECIFICATION FOR GASKETS (NACE COMPLIANT)



0	08-10-2013	Issued for Tender	SMHA	MIAH	MAS
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C O N T E N T S

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1.0 **GENERAL**

1.1 **Scope**

This specification covers the following types of gaskets:

Non-metallic type consisting of a flat continuous non-metallic ring.

Combination type consisting of either a metallic core and non-metallic casing or a metallic retainer with non-metallic inserts for use in a High Pressure Gas pipeline and its associated equipment.

1.2 **Definitions**

Following definitions apply throughout this document:

COMPANY: Oil & Gas Development Company Ltd. (OGDCL)

CONSULTANT: M/s. Zishan Engineers (Pvt.) Ltd. (ZEL).ZEL have been awarded the work of Engineering, Procurement Assistance and Project Management.

CONTRACTOR: Means the construction company to be engaged by the COMPANY to perform the Construction work.

VENDOR / SUPPLIER: The organization, firm or agency with whom order for the supply of equipment and or material has been placed.

1.3 **Errors or Omissions**

1.3.1 The review and comment by the COMPANY of any Supplier's drawings, procedures or documents shall only indicate acceptance of general requirements and shall not relieve the SUPPLIER of its obligations to comply with the requirements of this specification and other related parts of the Contract Documents.

1.3.2 Any errors or omissions noted by the SUPPLIER in this Specification shall be immediately brought to the attention of the COMPANY.

1.4 **Deviations**

All deviations made during the procurement, design, manufacturing, testing and inspection shall be with written approval of the COMPANY prior to execution of work. Such deviations shall be shown in the documentation prepared by the Supplier.

1.5 **Conflicting Requirements**

In the event of any conflict, inconsistency or ambiguity between the SUPPLIER's scope of work, this Specification, National Codes and Standards, referenced in the Project Specification or any other documents, the SUPPLIER shall refer to the COMPANY whose decision shall prevail.

1.6 **Supplier's Responsibility**

The SUPPLIER shall be responsible for the complete design, manufacture, supply, inspection and testing of all the fittings including full compliance with the applicable design codes and standards stated described in this document, all other project specifications and with the requirements of the COMPANY.

1.7 **Reporting Procedure**

1.7.1 A reporting and documentation system shall be agreed between the SUPPLIER and the COMPANY for the status of procurement, design, manufacturing, inspection, testing and shipment of the equipment/material to be supplied under this specification. SUPPLIER shall provide reports and summaries for production performance and testing operations in conformance with a manufacturing schedule approved by COMPANY

1.7.2 Daily, weekly monthly and run summaries of all major aspects of the production process shall be provided as reports to the COMPANY.

1.7.3 **Third Party Inspection**

In addition to the inspection and witnessing of tests by the SUPPLIER's inspectors during the manufacturing and shipment of the equipment / material, COMPANY may appoint a third party or its own inspector for witnessing of the inspection and tests to be carried out at SUPPLIER's facility under this specification.

1.8 **Documentation**

1.8.1 Documents, drawings, etc., to be submitted to the COMAPNY shall be in the English Language.

1.8.2 Unless otherwise specified, the metric units shall be used in documents and drawings.

1.8.3 Variations from or additions to this specification shall be called to the attention of the COMPANY and approved in writing by the COMPANY prior to manufacturing.

1.8.4 Information for installation and inspection purposes shall be submitted to COMPANY.

2.0 **REFERENCE CODES & STANDARDS (LATEST EDITIONS)**

ASME B16.20 Metallic Gaskets for Pipe Flanges-Ring-Joint, Spiral-Wound, and Jacketed.

NACE MR0175 Petroleum and Natural Gas Industries
/ISO 15156

3.0 **GENERAL REQUIREMENTS**

3.1 Type: The gaskets covered by this specification shall be suitable for use with RF Flanges ANSI Class 150, 300, 400 & 600.

3.2 Size: 50 mm (2 inch) and above.

4.0 **PRESSURE TEMPERATURE RATING**

All gaskets covered by this specification shall be suitable for use with natural gas at the maximum operating pressure and temperature.

5.0 **GOVERNING SPECIFICATIONS**

5.1 Gaskets up to and including 609.6mm (24 inch) size shall conform to ANSI B16.5 Annex E latest edition, except as allowed for, in sub-clause 16.6.4 (b).

5.2 If a proprietary combination gasket offered does not conform entirely to the standards called for in sub-clause 16.6.4 (a) then the Manufacturer must provide sufficient substantiating evidence with his tender to enable the Purchaser to satisfy himself of the gaskets suitability for use under all the conditions specified.

5.3 Spiral wound gasket as per ASME B 16.20 shall match flanges to ASME B 16.5 upto 24" and for 22" inch and 26" inch and above shall comply with MSS-SP 44

5.4 Non metallic gasket as per ASME B 16.21 shall match flanges to ASME B 16.5 upto 24" and for 22" inch and 26" inch and above shall comply with MSS-SP 44.

5.5 All material should be compliant to NACE MR0175 (Latest Revision) for items indicated in bill of quantities.

6.0 **DIMENSIONS**

6.1 **Non-metallic and combination type**

- Gaskets up to (24 inches) in size excluding (22 inches) shall conform to ANSI B 16.5 Latest edition.
- Gaskets including 22(inches) and (26 inches) and above in size shall conform to MSS-SP44 Latest edition.

- I.D. of Gasket (G) shall be as listed.
- O. D. of Gasket (R) shall be increased to the bolt P.C.D minus one bolt diameter of the flange.

6.2 All gaskets shall be of the thickness and finish suitable for use at the design and service conditions specified.

6.3 All gaskets shall offer a continuous face to their adjacent flanges.

7.0 **MATERIALS**

7.1 **Non-metallic gaskets**

Shall be made either from Klingerite, or other similar proprietary material recommended by the manufacturer as suitable for use at the specified design and service conditions.

7.2 **Combination gaskets**

All metallic components shall be spiral wound 316L.

All non-metallic components must be either creep resistant or suitably restrained by the metallic parts, and free from any age hardening properties which would ultimately impair their sealing properties.

8.0 **INSPECTION**

Visual inspection only, at the Purchaser's option, will be required.

9.0 **MARKING**

Each gasket shall be clearly tagged by the Manufacturer with:

- Flange size
- Flange rating

10.0 **PACKING**

Gaskets shall be packed so as to prevent damage during shipment.



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OIL & GAS DEVELOPMENT COMPANY LTD.

SPECIFICATION FOR STUD BOLTS & NUTS (NACE COMPLIANT)



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C O N T E N T S

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1.0 **GENERAL**

1.1 **Scope**

This specialization cover the requirements for stud bolts and nuts connecting carbon and low alloy steel pipe flanges on high pressure pipelines and associated facilities.

1.2 **Definitions**

Following definitions apply throughout this document:

COMPANY:	Oil & Gas Development Company Ltd. (OGDCL)
CONSULTANT:	M/s. Zishan Engineers (Pvt.) Ltd. (ZEL).ZEL have been awarded the work of Engineering, Procurement Assistance and Project Management.
CONTRACTOR:	Means the construction company to be engaged by the COMPANY to perform the Construction work.
VENDOR / SUPPLIER:	The organization, firm or agency with whom order for the supply of equipment and or material has been placed.

1.3 **Errors or Omissions**

1.3.1 The review and comment by the COMPANY of any Supplier's drawings, procedures or documents shall only indicate acceptance of general requirements and shall not relieve the SUPPLIER of its obligations to comply with the requirements of this specification and other related parts of the Contract Documents.

1.3.2 Any errors or omissions noted by the SUPPLIER in this Specification shall be immediately brought to the attention of the COMPANY.

1.4 **Deviations**

All deviations made during the procurement, design, manufacturing, testing and inspection shall be with written approval of the COMPANY prior to execution of work. Such deviations shall be shown in the documentation prepared by the Supplier.

1.5 **Conflicting Requirements**

In the event of any conflict, inconsistency or ambiguity between the SUPPLIER scope of work, this Specification, National Codes and Standards, referenced in the Project Specification or any other documents, the SUPPLIER shall refer to the COMPANY whose decision shall prevail.

1.6 **Supplier's Responsibility**

The SUPPLIER shall be responsible for the complete design, manufacture, supply, inspection and testing of all the studs and nuts in full compliance with the applicable design codes and standards stated described in this document, all other project specifications and with the requirements of the COMPANY.

1.7 **Reporting Procedure**

1.7.1 A reporting and documentation system shall be agreed between the SUPPLIER and the COMPANY for the status of procurement, design, manufacturing, inspection, testing and shipment of the equipment/material to be supplied under this specification. SUPPLIER shall provide reports and summaries for production performance and testing operations in conformance with a manufacturing schedule approved by COMPANY

1.7.2 Daily, weekly, monthly and run summaries of all major aspects of the production process shall be provided as reports to the COMPANY.

1.7.3 **Third Party Inspection**

In addition to the inspection and witnessing of tests by the SUPPLIER's inspectors during the manufacturing and shipment of the material. COMPANY may appoint a third party or its own inspector for witnessing of the inspection and tests to be carried out at SUPPLIER's facility under this specification.

1.8 **Documentation**

1.8.1 Documents, drawings, etc., to be submitted to the COMAPNY shall be in the English Language.

1.8.2 Unless otherwise specified, the metric units shall be used in documents and drawings.

1.8.3 Variations from or additions to this specification shall be called to the attention of the COMPANY and approved in writing by the COMPANY prior to manufacturing.

1.8.4 Information for installation and inspection purposes shall be submitted to COMPANY.

2.0 **SIZES**

This specification covers sizes from 12.7 to 89 mm ($1/2$ " to 3-1/2") bolt diameter.

3.0 **TYPE**

Each stud bolt shall be threaded full length and supplied with two hexagonal head nuts and two washers

4.0 **DIMENSIONS**

Dimensions shall be in accordance with ANSI B18.2.

5.0 **MATERIALS**

- Stud bolts shall be alloy steel in accordance with ASTM A 193 Grade B7, Galvanized.
- Nuts shall be carbon steel to ASTM A 194 Grade 2H. Galvanized
- Washers shall be in accordance with ASTM A-307

Nuts machined from bar stock in such a manner that the axis will be parallel to the direction of rolling of the bar are not acceptable.

- All material should be compliant to NACE MR0175 (Latest Revision) for items indicated in bill of quantities.

6.0 **THREADS**

All bolting supplied to this specification shall be threaded in accordance with ANSI B 1.20.1.

Stud bolts shall have Class 2A dimension. Nuts shall have Class 2B dimensions.

7.0 **PACKING**

All stud bolts shall be suitably protected so as to prevent rust and/or mechanical damage during transit.

The method of protection shall be approved by the Purchaser.

8.0 **INSPECTION**

Unless otherwise indicated in the Purchase Order all material shall be subject to inspection by the Purchaser or his representative.

9.0 **CERTIFICATION**

The Supplier shall furnish certificates of compliance with the relevant specification and of chemical analyses and mechanical tests carried out.



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OIL & GAS DEVELOPMENT COMPANY LTD.

SPECIFICATION FOR STEEL GATE, PLUG, BALL AND CHECK VALVES (NACE COMPLIANT)



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C O N T E N T S

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1.0 **INTRODUCTION**

1.1 **Scope**

This specification covers flanged and welding end steel gate, plug, ball and check valves for use in gas pipeline, pipe work and associated facilities.

1.2 **Definitions**

Following definitions apply throughout this document:

- **COMPANY:** Oil & Gas Development Company Ltd. (OGDCL)
- **CONSULTANT:** M/s. Zishan Engineers (Pvt.) Ltd. (ZEL).
ZEL have been awarded the work of Engineering, Procurement Assistance and Project Management.
- **CONTRACTOR:** Means the construction company to be engaged by the COMPANY to perform the Construction work.
- **SUPPLIER/VENDOR:** The organization, firm or agency with who order for the supply of equipment and or material has been placed. SUPPLIER shall solely be responsible for the quality and satisfactory performance of all the items included in his scope of supply.

2.0 **SCOPE**

The CONTRACTOR / SUPPLIER scope of work shall include, among others, the following items of work:

- 2.1 All valves shall comply with the requirements of ANSI B16.10.
- 2.2 Valves shall be made in accordance with API STD 6D, Specification for steel gate, plug, ball and check valves. latest edition. and with the requirements of this specification.
- 2.3 Valve size, type, and rating, material connection type and, where possible, dimensions for operating mechanisms will be specified on the Purchase order.
- 2.4 Where indicated on the specifications/data sheets, valves shall be actuated.
- 2.5 Requirements for ball valves, laid down in the specification for mainline Ball valves, Spec No. 165-4-SPM-044, shall also be applicable.

3.0 **GENERAL SERVICE CONDITIONS**

3.1 Fluid handled: Natural Gas (Sour Service)

3.2 Valves may be installed:

- Underground with dirt cover over the pipe.
- Underground in covered sump.
- Above ground unsheltered.

3.3 Valve stem may be positioned:

- Vertically
- Horizontally

4.0 **MATERIAL**

4.1 Bodies, including end flanges and welding ends, bonnets and covers of valves shall be made of materials conforming to the specifications listed in API STD 6D, and as further specified in this specification.

4.2 Material selected for welding ends shall have a guaranteed minimum yield strength of not greater than 36,000 psi (Grade B).

4.3 Material selected for welding shall have a carbon content of 0.20% maximum, 0.02% sulphur maximum and maximum carbon equivalent of 0.43% as determined by the formula:

$$\text{C.E.} = \text{C} + \frac{\text{Mn}}{6} + \frac{\text{Cr} + \text{Mo} + \text{V}}{5} + \frac{\text{Cu} + \text{Ni}}{15}$$

4.4 Steel castings used for valves bodies shall be of X-ray quality, Class 2, as specified in ASTM Specification E71 'Industrial Radiographic Standards for Steel Casting'.

4.5 All material should be compliant to NACE 0175 (Latest Revision).

5.0 **DESIGN AND CONSTRUCTION**

- 5.1 The design and construction of valves shall comply with the requirements of the latest editions of API Standard 6D, ANSI B16.10 and this specification..
- 5.2 Welding ends shall be beveled for welding to pipe or fittings in accordance with ANSI B31.3, Fig. 327.3.1 unless otherwise specified, and shall be bored to the inside diameters as specified in the purchase order.
- 5.3 Due consideration of difference in SMYS shall be taken when calculating wall thickness at welding ends.
- 5.4 Flanged valve dimensions shall be in accordance with ANSI B16.5 ‘Steel Pipe Flanges and Flanged Fittings’ for sizes 2(inch) to 24 (inch) excluding 22 (inch) size , and in accordance with MSS-SP44 for 22 (inch) and 26 (inch) and above.
- 5.5 Valve operating mechanisms shall be fitted with suitable locking device.
- 5.6 Ball valves greater than 8" size shall be pinion supported.
- 5.7 Plug valves shall be of the lubricated type. Lubrication systems shall be fitted with ‘button head’ type lubrication fittings. Valves shall be shipped with a lubricant suitable for operation in the specified service conditions. The lubricant shall resist dissolving, gumming, or chemical change in service.
- 5.8 Valves shall be fitted with renewable seats. Welding end Ball valves shall have body configurations which allow complete maintenance of the valve without its removal from the line. Top entry design shall be utilized to meet this requirements. Ball valves shall also be fire safe to appropriate API or BS code.
- 5.9 All welding shall be in accordance with the requirements of ASME Boiler and Pressure Vessel Code, latest edition, sections VIII & IX.

6.0 **TESTING**

- 6.1 All valves size 3” and above shall be subjected to a shell hydrostatic pressure test in accordance with API STD 6D requirements. Three certified copies of this chart shall be supplied to the purchaser.
- 6.2 Hydrostatic seat tests shall be carried out as required by API STD 6D for gate, ball and plug valves, while the test pressure is on each side of the valve, it shall be operated at least twice to demonstrate satisfactory mechanical operation as well as continued tightness after operation under differential pressure conditions.

- 6.3 Valves shall be subjected to air seat tests in accordance with API STD 6D requirements.
- 6.4 The valve manufacturer shall give sufficient advance notice satisfactory to the purchaser of the time and place at which testing is to be performed.

7.0 **INSPECTION**

- 7.1 All welds shall be 100% radiographed to meet the acceptance standards of ASME Boiler and Pressure Vessel Code, Latest Edition, Section VIII.
- 7.2 Where X-ray quality steel casting are specified, records of test shall be furnished to the purchaser.

8.0 **DATA AND DRAWINGS**

The manufacturer shall provide the following information:

- Outline dimensions and mechanical details for the valve.
- Number of complete revolutions of hand wheel or other operating device to close or open the valve.
- The maximum permissible torque and the rated torque required to close or open the valve at the maximum pressure differential.
- Actual time to fully open or close the valve.
- Head loss curve and data for the valve.

9.0 **MARKING**

Each valve shall be marked in accordance with API 6D requirements and as may be further specified in the purchase order.



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OIL & GAS DEVELOPMENT COMPANY LTD.

SPECIFICATION FOR MAINLINE BALL VALVES (NACE COMPLIANT)



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C O N T E N T S

<u>S. NO.</u>	<u>D E S C R I P T I O N</u>	<u>P A G E N O.</u>
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1.0 **INTRODUCTION**

1.1 **Scope**

- This specification establishes the technical manufacturing requirements for mainline valves with manual or power operators.
- All valves shall conform to API Standard 6D, latest edition, and as hereafter specified.

1.2 **Definitions**

Following definitions apply throughout this document:

- **COMPANY:** Oil & Gas Development Company Ltd. (OGDCL)
- **CONSULTANT:** M/s. Zishan Engineers (Pvt.) Ltd. (ZEL).
ZEL have been awarded the work of Engineering, Procurement Assistance and Project Management.
- **CONTRACTOR:** Means the construction company to be engaged by the COMPANY to perform the Construction work.
- **SUPPLIER/VENDOR:** The organization, firm or agency with who order for the supply of equipment and or material has been placed. SUPPLIER shall solely be responsible for the quality and satisfactory performance of all the items included in his scope of supply.

2.0 **DESIGN DETAILS**

2.1 Pipeline valves shall be full bore, trunnion mounted and spherical ball valves and shall be designed to pass cleaning and batching pigs.

2.2 The medium to be handled by the valves will be natural gas of the following characteristics:

- Molecular weight of the gas: 19-20 typical
- Specific Gravity 0.69 typical
- Gross calorific Value: 900-1150 Btu/SCF
- Delivery Pressure: 19.6 barg
- Temperature: 55°C Max, 20°C Min
- Gas Velocity: 20m/s

- 2.3 The valves and operators shall be suitable for below-ground or above-ground installation in the vertical or horizontal position for operation with ambient temperature ranging from 10 deg. C to +55 deg. C.
- 2.4 The valves shall be flanged as per requirements in accordance with ANSI B16.5 for sizes 2" to 24" excluding 22" size, and in accordance with MSS-SP44 for 22", 26" and above.
- 2.5 The valves shall be designed in such a manner as to insure that failure, due to malfunctioning of operators or their controls, shall take place in the operator gear train and that such parts are replaceable without requiring the removal of the stem bonnet.
- 2.6 Valves with manual operators shall be designed to provide for mounting power operator at a later stage.
- 2.7 If not specified otherwise in the purchase order, power operators shall be furnished in accordance with manufacturer's specifications as approved by the Company. These specifications, including proof testing shall be considered a part of this specification.
- 2.8 A spoked type, side mounted hand wheel is required on all power operated valves.
- 2.9 The valves shall be so designed that operation under full pressure can be accomplished by one man. Furthermore, means shall be provided for operation of the valves with manual operators with auxiliary hand held power equipment driving the pinion shaft.
- 2.10 Lifting lugs, and resting legs on the under side of the assembly will be required for 8" valves and larger.
- 2.11 All valves to be provided with a locking device suitable for the use of standard padlocks.
- 2.12 All valves to be provided with standard block and bleed connections.
- 2.13 All material should be compliant to NACE MR0175 (Latest Revision) for items indicated in bill of quantities.

3.0 **PROCESS OF MANUFACTURE**

The valve manufacturer shall manufacture the valves in accordance with a qualified procedure as determined by Section 5.0 **Fabrication and Welding Procedure**.

4.0 STEEL SPECIFICATION

- 4.1 The material specifications shall be selected by the manufacturer and approved by the Company and the governing authorities, when applicable.
- 4.2 The chemical composition of the weld ends shall not exceed the following:
- | | | | |
|----|----------------------------|-------|------|
| a. | Carbon | 0.25 | max. |
| b. | Manganese | 1.50 | max. |
| c. | Nitrogen | 0.012 | max. |
| d. | Calcium (Residual) | 0.004 | max. |
| e. | Niobium (Columbium) | 0.04 | max. |
| f. | Soluble Aluminium Nitrogen | 2:1 | min. |
| g. | Aluminium | 0.05 | max. |

Also the Carbon equivalent as determined by the formula:

$$CE = C + \frac{Mn}{6} + \frac{(Cr + Mo + V)}{5} + \frac{(Ni + Cu)}{15}$$

Shall not exceed 0.42 per cent.

- 4.3 When specified in the purchase order, impact tests will be required on each pressure carrying part or groups of parts when from the same heat of steel.
- 4.4 Steel specification should be compliant to NACE MR0175 (Latest Revision).

5.0 FABRICATION AND WELDING PROCEDURE

5.1 Procedure

The manufacturer shall perform all fabrication and welding, including repair welding, in accordance with established procedures for each valve size and series.

Welding, including repair welding shall be done by submerged arc or manual shielded metal -arc welding using low hydrogen procedures. The procedures shall be prepared in written form in the English language and shall include but not be limited to the following:

1. Material
2. Joint Design
3. Welding procedure:
 - a) Type, size and grade of filler metal and flux.
 - b) Speed of welding
 - c) Electrical Characteristics
 - d) Number of weld passes, size depth of fusion and penetration of each weld pass.

4. Dimensions of finished weld.
5. Post weld heat treatment when applicable.
6. Fabrication and Welding Procedure should be compliant to NACE MR0175 (Latest Revision) for items indicated in bill of quantities.

5.2 **Procedure Qualification Tests**

The manufacturer shall furnish certificates on procedure and welder qualifications for Company's approval before commencement of production welding. Qualifications shall be to ASME Section IX.

5.3 **Record of Procedure Qualification Tests**

The manufacturer shall submit to the Company a procedure qualification report giving the results of all tests and the radiographic film of the weld.

- 5.4 Major weld repairs on valve body castings shall be made only after approval by Company. A major weld repair is as defined in ASTM A216 Clause 10.3.

6.0 **TESTING PROCEDURES AND TEST REQUIREMENTS**

6.1 **Testing Procedures**

6.1.1 **Radiography**

Radiography where applicable shall be done in accordance with API 5L Section 9 using ISO penetrameters, and techniques capable of 2.0% minimum sensitivity. Prior to beginning production radiography the manufacturer shall prepare a set of test films which shall be accepted as the standard for quality, sensitivity and interpretation.

6.1.2 **Ultrasonic Testing (Alternative)**

As an alternative to Radiography, Ultrasonic Testing in accordance with API 5L Section 9 may be used.

The inspection shall be full volumetric examination of weld metal and heat affected zones. The equipment shall be calibrated at least once per shift or at the request of the Company's inspector.

6.1.3 **Pressure Testing**

Pressure and time shall be recorded using automatic recording devices. Chart test results shall be clearly identified as to date and type of test, person supervising test, and that no leakage or detrimental permanent deformation occurred.

6.2 Production Test Requirements

6.2.1 The manufacturer shall establish, implement and maintain a quality control system to cover all phases of manufacturing, assembly, final inspection and testing.

6.2.2 The manufacturer shall submit a test report on each valve. This report shall include all test results such as chemical and mechanical tests, certificates of radiographic inspection, certificates of ultrasonic testing, pressure-time charts for air and hydrostatic tests and a complete description of cyclic opening and closing tests.

6.2.3 The manufacturer shall inspect and test all valves in accordance with the following:

6.2.3.1 Furnish chemical and mechanical test reports on all pressure carrying members of each valve.

6.2.3.2 Perform 100% non-destructive testing of weld ends intended for field welding as follows:

1. Castings

a) Radiography either before or after final machining.

b) Magnetic particle or dye penetrant inspection after final machining.

2. Pipe

Ultrasonic inspection before or after final machining and magnetic particle or dye penetrant inspection after final machining.

6.2.3.3 Perform 100% radiography of longitudinal welds of weld ends.

6.2.3.4 Perform random 10% non-destructive testing of all other welding using the most applicable method for the particular configuration of the weld cross-section.

6.2.3.5 If not specified otherwise in the purchase order, perform hydrostatic testing in accordance with API Standard 6D latest editions. The shell test shall be performed prior to the seat tests. Testing times shall be as follows:

Shell	3 hrs.
Seats	1-1/2 hrs. Per side
Seats (air)	1 hr. per side.

The seat testing procedures shall be as follows:

Pressure shall be applied successively on each side of the gate or ball valves while the opposite side and the shell or body is open to the atmosphere.

- 6.2.3.6 Perform cyclic opening and closing of valve using its own operator for a sufficient period or number of times to assure operation or functioning as intended and for a continuous period of 1/2 hr. for motor controlled operators.
- 6.2.4 In addition to the requirements of paragraph 6.2 the first valve manufactured in each diameter and class which shall represent the first lot of 10 valves or less and one valve from each subsequent lot of 10 valves or less shall be tested and inspected in accordance with the requirements given below.
 - 6.2.4.1 Furnish chemical and mechanical test reports on each component part or group of parts when from the same heat of steel, but results shall be shown on all reports covering the heat of steel.
 - 6.2.4.2 Perform complete radiography of casting weld ends intended for shop welding.
 - 6.2.4.3 There shall be at least 4 radiographs on critical sections of body castings. These sections may be chosen by Company at his discretion.
 - 6.2.4.4 Perform 100% non-destructive testing of all welds joining pressure carrying members using the most appropriate method for the particular configuration of the weld cross-section.
 - 6.2.4.5 Perform complete non-destructive testing of seat ring areas, radiography for castings and ultrasonic for fabrications.
- 6.2.5 All repair welds shall be 100% non-destructively tested by the same NDE method applied originally to the section.
- 6.2.6 All radiographs shall be identifiable with the particular valve and the respective areas and shall be retained by the manufacturer for the duration of the manufacturer's guarantee period.

7.0 **STANDARDS OF ACCEPTABILITY**

These standards apply to all inspection and tests specified above.

7.1 **Dimensional**

7.1.1 **Diameter**

The internal diameter measured with an internal diameter steel tape at any place within 4" from each end shall not vary more than +/- 0.08" from the nominal internal diameter.

7.1.2 **Bulges, Dents and Flat Areas**

All surfaces shall be free of dents, gouges, laminations, arc burns and other detrimental surface defects.

7.1.3 **Ovality**

The Ovality of the weld ends shall not exceed 1% of the nominal diameter.

7.2 **Non - Destructive Testing**

Radiographic and ultrasonic testing of all welds and parent metal shall be done in accordance with Section 6.0 **Testing Procedures and Test Requirements**. The valve shall not be acceptable if as a result of non-destructive testing any of the following defects are evident:

1. Cracks
2. Lack of penetration
3. Laminations
4. Individual gas pockets exceeding 1/16" in any direction and/or concentrations of gas pockets exceeding 4 per 1 sq. inch. Adjacent groups of two or more gas pockets which exceed 0.04" in any direction shall be separated by at least 4" of sound weld material.
5. Inclusions exceeding 0.08" in width or 1/4" in length.
6. Undercut exceeding one half the specified nominal wall thicknesses in length and 10% of the nominal all thickness in depth or 0.04" whichever the smaller. Not more than two undercuts are permissible in any 12" of weld length.
7. Continual occurrence of undercutting, inclusions, porosity, gas pockets or lack of weld reinforcements regardless of dimensions.

8. Since non-destructive test methods give two dimensional results only, Company may reject welds which appear to meet these standards of acceptability if there are reasonable grounds to believe the depth of the defect may be detrimental to the strength of the weld.
9. Special consideration should be given to NACE MR0175 (Latest Revision) for NDT for items indicated in bill of quantities.

8.0 **COMPANY'S INSPECTION**

- 8.1 Company reserves the right to witness any or all of the inspection and testing required of manufacturer.
- 8.2 Company reserves the right to require additional testing at any time. If defects are confirmed, the cost shall be to the manufacturer's account.
- 8.3 The manufacturer shall afford the Company all reasonable facilities necessary for determining compliance with this specification.

9.0 **DATA AND DRAWINGS**

- (a) The manufacturer shall provide the following information.
 - (i) Outline dimensions and mechanical details for the valve.
 - (ii) Number of complete revolutions of hand wheel or other operating device to close or open the valve.
 - (iii) The maximum permissible torque and the rated torque required to or open the valve at the maximum pressure differential.
 - (iv) Actual time to fully open or close the valve.
 - (v) Head loss curve and data for the valve.

10.0 **PAINTING AND MARKING**

The valves will be supplied with manufacturer's standard paint suitable for temperatures as per 165-4-SPM-046.



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OIL & GAS DEVELOPMENT COMPANY LTD.

SPECIFICATION FOR LARGE RADIUS FACTORY MADE BENDS (NACE COMPLIANT)



0	08-10-2013	Issued for Tender	SMHA	MIAH	MAS
Rev.	Date	Description	Prepared By	Checked By	Approved By

C O N T E N T S

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1.0 **INTRODUCTION**

1.1 **General**

This specification is a standard specification for manufacture and supply of factory made large radius pipe bends and outlines the minimum requirements of the COMPANY.

1.2 **Definitions**

Following definitions apply throughout this document:

OWNER / COMPANY: Oil & Gas Development Company Ltd. (OGDCL)

CONSULTANT: M/s. Zishan Engineers (Pvt.) Ltd. (ZEL).ZEL have been awarded the work of Engineering, Procurement Assistance and Project Management.

CONTRACTOR: Means the construction company to be engaged by the COMPANY to perform the Construction work.

VENDOR / SUPPLIER: The organization, firm or agency with whom order for the supply of equipment and or material has been placed.

1.3 **Errors or Omissions**

1.3.1 The review and comment by the COMPANY / CONSULTANT of any SUPPLIER's or its manufacturer's drawings, procedures or documents shall only indicate acceptance of general requirements and shall not relieve the SUPPLIER of its obligations to comply with the requirements of this specification and other related parts of the contract documents.

1.3.2 Any errors or omissions noted by the SUPPLIER in this Specification shall be immediately brought to the attention of the COMPANY.

1.4 **Deviations**

All deviations to this specification, other specifications or attachments shall be brought to the knowledge of the COMPANY as a section in the bid. All deviations made during the procurement, design, manufacturing, testing and inspection shall be with written approval of the COMPANY prior to execution of the work. Such deviations shall be shown in the documentation prepared by the SUPPLIER.

1.5 **Conflicting Requirements**

In the event of conflict, inconsistency or ambiguity between the contract scope of work, this Specification, National Codes and Standards referenced in this Specification or any other documents, the SUPPLIER shall refer to the COMPANY whose decision shall prevail.

4.0 **MATERIALS**

The large radius pipe bends are to be made from SMLS pipe, ASTM A 860 Gr. WPHY 52 for 4"NPS, 6" NPS Line Pipe and 12"NPS line Pipe or equivalent, nominal diameters, thicknesses and sizes as indicated on the drawings. Bend radius shall be 5D, i.e. 1.67 feet (20 in.) for 4" ND, 2.5 feet (30 in.) for 6" ND and 5 feet (60 in.) for 12" ND Line Pipe.

All material should be compliant to NACE MR0175 (Latest Revision) for items indicated in bill of quantities.

5.0 **MANUFACTURING PROCESS**

The pipe bends will be made by High Frequency Induction heating method. Special consideration should be given to NACE MR0175 (latest edition) for the items indicated in bill of quantities.

6.0 **MANUFACTURING TOLERANCES**

The Ovality and wall thinning rates of the pipe bends will be within the following limits:

Ovality : 2% Max.

Wall thinning rate : 5% Max.

7.0 **TECHNICAL DOCUMENTS**

The Vendor shall submit three sets of following inspection and test certificates along with the supply.

- Hydrostatic tests
- Chemical analysis
- Mechanical properties (yield strength, ultimate tensile strength and elongation).
- Dimensional checks.

Vendor shall indicate the make/origin of pipe used for large radius bends in their quotation.



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OIL & GAS DEVELOPMENT COMPANY LTD.

SPECIFICATION FOR

UNFIRED PRESSURE VESSELS

(NACE COMPLIANT)



0	07-10-2013	Issued for Tender	WUS	MAIH	MAS
Rev.	Date	Description	Prepared By	Checked By	Approved By

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1.0 **INTRODUCTION**

1.1 **General**

This specification is a standard specification for Unfired Pressure Vessels and outlines the minimum requirements of the COMPANY.

1.2 **Definitions**

Following definitions apply throughout this document:

OWNER / COMPANY: Oil & Gas Development Company Ltd. (OGDCL)

CONSULTANT: M/s. Zishan Engineers (Pvt.) Ltd. (ZEL).ZEL have been awarded the work of Engineering, Procurement Assistance and Project Management.

CONTRACTOR: Means the construction company to be engaged by the COMPANY to perform the Construction work.

VENDOR / SUPPLIER: The organization, firm or agency with whom order for the supply of equipment and or material has been placed.

1.3 **Errors or Omissions**

1.3.1 The review and comment by the COMPANY / CONSULTANT of any SUPPLIER's or its manufacturer's drawings, procedures or documents shall only indicate acceptance of general requirements and shall not relieve the SUPPLIER of its obligations to comply with the requirements of this specification and other related parts of the contract documents.

1.3.2 Any errors or omissions noted by the SUPPLIER in this Specification shall be immediately brought to the attention of the COMPANY.

1.4 **Deviations**

All deviations to this specification, other specifications or attachments shall be brought to the knowledge of the COMPANY as a section in the bid. All deviations made during the procurement, design, manufacturing, testing and inspection shall be with written approval of the COMPANY prior to execution of the work. Such deviations shall be shown in the documentation prepared by the SUPPLIER.

1.5 **Conflicting Requirements**

In the event of conflict, inconsistency or ambiguity between the contract scope of work, this Specification, National Codes and Standards referenced in this Specification or any other documents, the SUPPLIER shall refer to the COMPANY whose decision shall prevail.

1.6 **Reporting Procedure**

- 1.6.1 A reporting and documentation system shall be agreed between the COMPANY and the SUPPLIER for the status of procurement, design, manufacturing, inspection, testing and shipment of the equipment/material to be supplied under this specification. SUPPLIER'S manufacturer shall provide reports and summaries for production performance and testing operations in conformance with a manufacturing schedule approved by COMPANY.
- 1.6.2 Weekly, monthly and run summaries of all major aspects of the production process shall be provided as reports to the COMPANY.

1.7 **Unit Responsibility**

The SUPPLIER shall be responsible for the complete design, manufacture supply, inspection and testing of the vessels, including full compliance with all applicable design codes, and standards, including those listed in Section 2.0 of this document and with the requirements of the independent certifying authority, where applicable.

2.0 **REFERENCE CODES & STANDARDS (LATEST EDITIONS)**

a) **ASME Codes** *

Section VIII	Division I & Division II (Pressure Vessels)
Section IX	Welding Qualifications
Section V	Non-destructive Examination
Section II	Materials
Section II, (Part C)	Welding Rods, Electrodes and Filler Materials

b) **ANSI Standards (Latest Editions)**

B16.5	Steel Pipe Flanges
B.16.20	Metallic Gasket for pipe Flanges
B16.9	Factory Made Wrought Steel Butt-Welding Fittings
B36.10	Wrought Steel Pipes
B36.19	Stainless Steel Pipes
A58.1	Building Code Requirement for Minimum Design Loads in Building and Other Structures.
MSS SP-44 or ANSI B16.47	Steel pipe line flanges for Dia > 24"
NACE MR-0175	Petroleum and natural gas industries materials for use in H2S-containing environments in oil and gas production.

- c) Steel Structures Painting Council Specification for Surface Preparation and Painting System
- d) In addition to the requirements of this specification, all requirements of the governing authority, i.e. the country and/or its sub-divisions, where the vessel is to be installed shall be met.
- e) Project Specifications
 - Specification for Welding : 165-4-SPM-034
 - Specification for Painting, Lining and Surface Preparation : 165-4-SPM-058
 - Specification for Insulation : 165-4-SPM-054
 - Specification for Equipment with Low Temperature Service and Their Materials of Construction : 165-4-SPM-045

() Pressure vessels shall be fabricated in accordance with ASME code by 'U' stamp fabricator. Bidder to confirm the name of fabricator in the bid and provide his 'U' stamp certification from ASME. Waiver from this requirement must be obtained from COMPANY.*

3.0 **SCOPE OF SUPPLY**

3.1 **General**

This specification sets forth the minimum acceptable standards governing the design, fabrication, material requirements, inspection, testing, identification and preparation for shipping of unfired pressure vessels.

3.2 **Material, Workmanship and Suitability**

All materials and parts included in the construction of the specified vessel shall be new, unused and of the highest grade being free from all defects or imperfections likely to affect their performance.

4.0 **ENVIRONMENTAL DATA**

Environmental conditions for the equipment covered by this specification shall be in accordance with Specification 'Site, Environment & Utility Data' (165-4-SPG-011).

5.0 **GENERAL REQUIREMENTS**

5.1 **COMPANY's Requirements**

The design life of equipment shall be 25 years.

Requests for substitutions of any kind shall be complete with all pertinent engineering information required for the COMPANY's evaluation of the proposed substitution.

Vessel outline drawings and/or data sheet sketches submitted by the CONSULTANT to the SUPPLIER are not intended to cover complete details. The SUPPLIER shall make detailed calculations for the design of the pressure vessels and shall prepare detailed shop drawings.

The SUPPLIER shall concurrently submit to the COMPANY, fabrication drawings, weld procedures and detailed calculations for approval. Shop work shall not start until the SUPPLIER has received drawings and weld procedures approved by the COMPANY. No subsequent revision may be issued to the fabrication shop unless it is approved by the COMPANY. Weld procedures shall be accompanied by a weld procedure index and weld map for each vessel.

5.2 **Earthing**

Each vessel shall be supplied with a minimum of two earthing bosses suitable for termination of 70 sq. mm earth cable.

5.3 **Tolerances & Dimensions**

SUPPLIER shall comply with the requirements as per ASME VIII.

5.4 **Nozzle Projection**

Unless specified otherwise, the nozzle projections shall comply with the requirements as per ASME VIII.

5.5 **Insulation**

Requirements for insulation are covered in specification for insulation, Document No.165-4-SPM-054.

6.0 **DESIGN**

6.1 **Design Conditions**

The design pressure shall be in accordance with the code, but shall be at least 10% above the maximum operating pressure or 1.0 barg (14.5 psig) plus maximum operating pressure, whichever the larger.

Internal pressure due to static head of liquid in columns and vessels shall be added to the internal design pressure.

For vessels operating above 0°C, the design temperature shall be 13°C above the maximum continuous operating temperature, but not less than 60 °C.

All vessels, regardless of operating temperature, shall be designed for a low temperature condition, which shall be the lowest of the following:

- 3°C below the minimum operating temperature
- The minimum ambient temperature
- The blow down temperature

6.2 **Design Loadings**

The Vessel(s) shall be self-supporting and designed to withstand a wind loading based on the projected area of curved surfaces. The area of ladders, platforms and pipework shall be assumed as equivalent to one and one-half times the wind loading of the insulated vessel.

Pressure vessel components, their supports and anchorages, shall be designed to withstand the results of the following combinations of loads and forces within the limits of stress set by the code, and the deflections set by Section 6.4 of this specification:

- Erection Condition (The empty weight plus the weight of any internals present during erection).
- Initial Site Test Condition (The empty weight plus weight of water to fill the vessel).
- Operating and Design Conditions (The empty weight plus the weight of all internals packing, insulation and operating liquid).
- Hot Shut Down Condition (As for the Operating and Design Condition, but excluding the operating liquid).
- Transportation/Dynamic Loading Condition
- Continuous monitoring of vessel conditions by mechanical testing during operation conducted by operating and maintenance team after start-up and handing over.
- Any other condition, which would affect the safety of the vessel e.g. cyclic loading.

6.3 **Design Stress**

Allowable Stress

Shall be the maximum stresses permitted by the basic design code.

Test Condition

The allowable general membrane stress shall be the maximum of 90% of the minimum specified yield or proof stress of the material of construction.

Anchorage

Foundation bolts for vessels shall have a maximum allowable tensile stress of 110 N/mm².

6.4 **Deflection Limits Due to Applied Loads**

The static deflection of vertical vessels in the corroded condition due to the full wind load shall be limited to 1 in 200 of the vessel length.

The deflection due to applied load and self weight of distributors, gratings, etc. and their supports, in the corroded condition, shall be limited to 1 in 500 of their span.

Vertical vessels with a ratio of overall height to diameter exceeding 15 shall be designed for dynamic stability under wind induced vibrations.

6.5 **Nozzle Loading**

Nozzle Size	Resultant Force (N)	Resultant Moment (NM)
2"	1435	380
3"	2930	1140
4"	4100	2080
6"	7000	5230
8"	10190	9800
10"	13950	16510
12"	16500	22820
14"	17500	26110
16"	19350	32310
18"	21000	38310
20"	22450	44260
24" – 30"	24750	54880

The above table gives the resultant forces and moments induced from pipework systems, which are to be allowed.

SUPPLIER shall consider the force acting radially together with the moment acting either in a longitudinal or circumferential direction.

The above table does not apply to equipment nozzles within packaged units where actual loading conditions should be applied.

SUPPLIER shall ensure that the above nozzle loadings will not induce unacceptable stress levels in the vessel shell or head, in compliance with the relevant vessel design code.

6.6 Drawings and Calculations

Shop details shall be complete with all dimensions, thicknesses and details of construction, including dimensional location of circumferential and longitudinal seams, and all nozzle locations and orientations. All material thicknesses shall be shown, including spherical radius and knuckle radius of heads. All welds shall be detailed or fully described by notes or weld symbols, and annotated to the relevant weld procedure specification.

The assembly drawings shall contain all pertinent information relating to the standards, codes and specifications used in the design, fabrication, inspection and testing of the vessel, including the materials used, plus the total weight of the vessel empty, operating and full of water.

A detail of the skirt, base ring and chairs for vertical vessels or saddles for horizontal vessels shall be provided, complete with all dimensions and descriptions of material, including number, diameter, and location of anchor bolt holes. If this information is furnished by the CONSULTANT it shall be checked by the SUPPLIER and so noted on the appropriate drawing. Foundation loading data shall also be provided by the Supplier.

SUPPLIER shall submit detailed calculations establishing the compliance of design with the requirements of this specification, the certifying authority if applicable and all statutory regulations. Methods of calculations which are not in accordance with the relevant code or established procedures shall be subject to approval by the COMPANY for its applicability to the design.

All calculations shall be complete, giving all references and showing all working methods. Computer printouts will not be accepted without the program flow chart, input data and complete printout, and then only by prior written agreement with the COMPANY at the quotation stage.

Review of drawings, calculations and other documents by the COMPANY, does not relieve the SUPPLIER of his responsibility for the correctness of the design to suit the stated conditions.

7.0 MECHANICAL REQUIREMENTS

7.1 Minimum Thickness

After forming, the minimum thickness of shell and head shall, for carbon steel and low alloy steel vessels, be as follows:

Vessel I.D.	Minimum Thickness (including corrosion allowance)
1500mm and below	6mm
1501-2500mm	8mm
2501mm	10mm

Minimum thickness of materials other than carbon steel shall be based on the structural stability of the vessel in addition to the requirements of pressure and other mechanical loading. However, the minimum thickness of high alloy (austenitic) steel vessels and their components shall not be less than 6mm.

Minimum wall thicknesses of carbon steel and low alloy nozzle necks, including corrosion allowance, shall be the greater of the code requirement or the following:

- 2" through 6" - Sch. 80.
- 8" through 24" - Std. Wall

Skirts shall be designed for load conditions, but shall not be less than 6mm wall thickness. Minimum thickness of internal carbon steel attachments shall not be less than 6mm excluding corrosion allowance.

7.2 Corrosion Allowance

Unless otherwise specified on the data sheet, carbon steel vessels and internals shall have 3mm corrosion allowance applied to all pressure retaining parts and all surfaces of non-removable internals exposed to the process fluid. Removable internals shall have half the specified corrosion allowance on all surfaces exposed to process fluid.

No corrosion allowance is required on stainless steel materials or materials protected by stainless steel unless otherwise specified.

When corrosion allowance is provided by a corrosion resistant metallic lining, a minimum thickness of 3mm of lining material shall be used.

Vessel parts, which are subjected to erosion e.g. due to impingement by the process stream, shall be protected with wear plates, or impingement baffles. Flaked glass lining may be provided on the inner surface of inlet separator vessels to avoid erosion due to high velocity inlet fluid, which may contain abrasives/solid particles etc. and also to avoid corrosion effect in water boot

section.

7.3 **Heads**

Vessel heads shall be one-piece semi-ellipsoidal (ratio 2:1) unless otherwise specified. Pressure vessels having design pressure 150 psig & above, shall have one piece hemispherical heads.

Torispherical and hemispherical heads may be used provided all pertinent dimensions and information is submitted to the COMPANY for approval before the heads are ordered.

Heads shall have straight flange of not less than 50mm or two times the thickness, whichever is greater.

All heads, which have been formed cold or below final tempering temperature, shall be subsequently heat treated in accordance with clause UCS-56 of ASME VIII Div 1.

Heads produced from more than one plate shall have the welds 100% radiographed after forming.

7.4 **Supports**

Horizontal vessels shall be supported on two steel saddles only. Saddles shall be furnished by SUPPLIER. There shall be two (2) ½" NPT tapped tell-tale holes at outer extremities in each saddle pad. Saddle pads shall have rounded corners. Saddles shall provide support for at least 120° arc at the circumference of vessel shell (As per ASME VIII).

Calculations shall be provided for the effect of support saddles on the vessel shell and heads.

Vertical vessels shall be supported on steel skirts. Small vertical vessels less than 1200mm inside diameter may be supported on structural legs, or lugs, where advantageous to plant layout. Skirts are however mandatory for all vertical vessels with a height to diameter ratio greater than 5.

All vessels shall be designed to be self-supporting without benefit of guys or braces. Vessel skirts shall be of the height required to provide a clearance not less than 480mm between the bottom of the head and the deck/foundation.

All vessels provided with skirts shall have a reinforced access opening of 400mm minimum diameter. Skirts for vessels smaller than 920mm nominal diameter shall be provided with at least one 200mm access opening. Desired orientation of openings shall be shown on the vessel drawing, or affixed on SUPPLIER's approval drawings.

Vessel skirts shall be provided with 3" diameter reinforced vent holes at approximately 920mm intervals on the circumference, located as near the vessel head as permitted by insulation or other attachments. No skirts shall have less than two such vent holes.

The following joint factors should be applied to vessel skirts:

- Circumferential seams - 0.7
- Skirt to shell joint - 0.55
- Skirt to base ring joint - 1.0

7.5 **Manholes, Nozzles and Inspection Openings**

Manholes, hand holes, cleanout openings and end flanges shall be provided as required for operation and maintenance and to meet Code requirements for inspection.

Cleanout openings shall be 4" minimum inside diameter, and shall be complete with blind flanges, bolting and gaskets and hinged, if not accessible to ground or a platform, for ease in maintenance.

Where inspection openings are required the minimum size shall be 4" nominal.

Trayed or packed towers shall be served by adequate internal and external access openings and shall have at least a top and bottom manhole. Packed towers shall have a manhole above the top level of the packing and below each support grid. A minimum 12" nominal opening shall be provided above each grid to permit removal of packing. Where the centerline of the lowest manhole is more than 1525mm above the vessel bottom, ladder access shall be provided to the interior vessel bottom.

Manholes shall be at least 480mm clear inside diameter, and are to be complete with blind flanges, bolting, gaskets, and davits or hinges. No bolts smaller than M 16 diameter may be used.

The minimum connection size welded into a vessel shall be 2" NB, swaged if required to the specific line size and terminating with a flanged connection. Alternatively, an appropriate long welding neck forging may be used for the connection provided it has a 2" or greater diameter hub.

The only exception to the above shall be nozzles for vessels in water, air and steam (if applicable) service in which the pressure does not exceed 13.50 barg and the temperature does not exceed 160°C.

Full penetration welds shall be used for all body flange, nozzle and manhole attachments. Other attachment weld details are not acceptable without specific approval of the COMPANY.

All flanges for external nozzles and manholes of 24" diameter and smaller shall be in accordance with ANSI B16.5 and shall be raised face unless otherwise shown on the individual vessel data sheets and/or drawings. Pressure-temperature ratings of ANSI B16.5 shall apply for the design condition.

Flanges over 24" diameter shall be in accordance with MSS Standard Practice SP-44. Non-standard size flanges shall be calculated in accordance with ASME Code Rules.

Raised face flanges for use with spiral wound or soft metal jacketed asbestos gaskets shall have a smooth finish (125 RMS).

Raised face flanges for use with compressed asbestos gaskets shall have contact surfaces as follows:

- Nominal size 12" and smaller - A continuous spiral groove generated by a 1.8mm radius round-nose tool at a feed of approximately 0.9mm per revolution.
- Nominal size above 12" - A continuous spiral groove generated by a 3mm radius round-nose tool at a feed of approximately 1.3mm per revolution. All nozzles shall be flush with inside of vessel wall unless otherwise indicated on vessel data sheets.

Where two or more openings are provided for installation of equipment, such as gouge glasses, level controls, etc. they shall be set with a Jig to prevent tolerance from being additive.

No threaded connections shall be screwed directly into any part of the vessel except for tell-tale holes in reinforcing pads.

All bolt holes in manholes, hand holes and nozzles and anchor bolts on supports shall straddle the normal vessel centerline unless otherwise specified.

Pad type nozzles, hand holes etc. shall not be used unless written approval is obtained from the COMPANY.

Nozzles may be either integral forgings or fabricated from seamless pipe and welding neck flange joined by full penetration welds. Other type built-up nozzles are not acceptable without approval of COMPANY. Flanges for internal non-pressure piping may be slip-on-type.

Set-on type nozzles shall only be used with prior agreement from the COMPANY and provided that 100% Ultrasonic Examination of the shell plate is carried out adjacent to the opening. Examination is to be in accordance with ASTM A-435 to cover a minimum of two times the opening diameter.

7.6 **Reinforcement**

Reinforcement of nozzles and manholes shall be designed to provide 100% compensation for the as built thickness of the shell/head, in accordance with the specified design code.

The reinforcement for openings shall be provided by either self reinforcing type nozzles or built-up, seamless pipe and WN flange with pad reinforcement as necessary.

Reinforcing pads when applied shall have a minimum width of 2" or three times the pad thickness, whichever is greater. Reinforcing pads shall be made in one piece if possible. Large reinforcing pads may be made from two pieces provided that written approval is obtained from the COMPANY.

Integral reinforcement of openings shall be provided for vessels in the following categories. Reinforcing pads shall not be used in these instances:

- Vessels in lethal service
- Vessels designed for temperatures below 0°C
- Vessels with shell thickness exceeding 50mm

All rectangular reinforcing pads when used for external or internal attachments shall be radiused 25mm minimum.

7.7 **Internal Attachments**

The vessel fabricator shall furnish and install all internal support rings, down comer supports, bars, gratings, grating supports, tray lifting, tray leveling device, vortex breakers, piping and all other internals as and where required by the appropriate drawings. Internals shall be fixed by bolting to cups or rings for ease of maintenance.

Mitred joints shall not be used, unless otherwise specified on drawings and agreed by the COMPANY.

Major internal piping shall be flanged for ease of removal through vessel manholes.

All removable internals shall be fabricated so as to pass through the vessel manholes.

Support and fixed internals welded to shell/head, shall be seal welded to prevent crevice corrosion. Seal and strength welds shall carry the appropriate corrosion allowance.

All internal crevices where supports and fixed internals are welded to the shell/heads shall be seal welded to exclude process fluids. Seal and strength welds shall carry the appropriate corrosion allowance.

7.8 **External Attachments**

Vessel fabricator shall furnish and attach all insulation support rings, external pressure stiffeners, lifting lugs, ladder and platform lugs, and pipe supports unless otherwise specified. Reinforcing pads shall be continuously welded to vessel beneath all attachments where the welding of such attachments would cause excessive concentration of stress on vessel at those points. Each pad shall contain at least one ½" NPT tapped tell-tale hole.

All vessels greater than 3600mm installed height shall be fitted with a full length ladder. Platforms for maintenance shall be provided as necessary for safe access to manholes, relief valves, control valves, controllers, etc. Sample connections, thermometers, thermo wells, gauges and control instruments shall be accessible from a platform or a ladder.

Tower davits shall be provided as necessary for proper maintenance.

All attachments shall be continuously welded.

All vessels, vertical or horizontal, shall be furnished with a minimum of two lifting lugs, which shall be designed for a load equal to two times the shipping weight.

7.9 **Vibration Analysis**

A dynamic wind analysis shall be performed for all towers taller than 100 ft (30 m) with a height-to-diameter ratio greater than 15. The following conditions shall be met:

- a) Vessel diameter (d) shall be the predominant outside shell diameter of the top one-third of the vessel.
- b) Vessel height (H) shall be the total height of vessel from base of skirt to top of head.
- c) The maximum single amplitude (deflection) at the top of the vessel due to dynamic wind load, including rotation of the concrete foundation or structure, shall not exceed 0.5 percent of H.

8.0 ADDITIONAL REQUIREMENTS FOR FLANGED GIRTH JOINTS

- 8.1 Flanged girth joints shall be designed for through bolting. Proposals for alternative joint design shall be submitted to the COMPANY for approval.
- 8.2 Flanges for girth joints shall conform to the following:
- a) Flanges shall be according to ASME B16.5, ASME B16.47 Series B, or designed according to ASME SEC VIII Div.1 with allowable stresses determined according to that code.
 - b) Welding neck flanges shall be used where the pressure-temperature design conditions require an ASME Class 300 or greater flange.
 - c) Slip-on flanges shall not be used if any of the following conditions are exceeded:
 - Pressure-temperature design conditions require an ASME Class 300 or greater flange.
 - Design temperature exceeds 750°F (400°C).
 - Specified corrosion allowance for the vessel is greater than 1/8 in. (3 mm).
 - The vessel is in hydrogen service.
 - d) Girth flanges larger than NPS 24 that are not in accordance with ASME B16.47 Series B shall be designed to meet the flange rigidity recommendations in ASME SEC VIII Div.1.
- 8.3 Unless otherwise specified, gasket contact surfaces shall have a finish in accordance with reference Codes and Standards.
- 8.4 Allowable flatness tolerances of gasket contact surfaces for the appropriate service condition shall be as per reference Codes and Standards.
- 8.5 For confined joint construction (peripheral gasket confined on OD):
- a) Nubbins, if provided, shall be located on the female (grooved) flange.
 - b) The clearance between flanges after assembly shall be not less than 3/16 in. (5 mm). This clearance shall extend from the periphery of the flange to within the bolt circle.

9.0 **MATERIALS**

9.1 **General Specification**

Materials of construction for pressure parts shall be in accordance with the design code. Alternative materials may be used if advantageous with the approval of the COMPANY. Proposed substitutions must be clearly defined:

- Vessels having design temperature below 0°C are considered as cold vessels.
- Vessels having design temperature over 0°C considered as warm vessels.

All material should be compliant to NACE 0175 (Latest Revision).

9.2 **Shell / Heads**

Unless otherwise specified in drawings or data sheets, materials for shell/heads shall be as under:

a) Material for warm service pressure vessel shell/heads shall be:

- ASTM A-515 for Intermediate & High Temperature Service.
- ASTM A-516 for Moderate & Lower Temperature Service.

b) Material for cold service pressure vessel shell/heads shall be:

- ASTM A-516 for Pressure Vessel having Design Temperature upto -46°C with impact test.
- ASTM A-203 Gr. D for Pressure Vessel having Design Temperature upto -101°C with impact testing corresponding to vessel design temperature.
- ASTM A-240 Gr. 304 for Pressure Vessel having Design Temperature upto -178°C without impact testing.

9.3 **Supports and Miscellaneous Parts**

Any material welded directly to the pressure retaining parts shall be of similar quality as the vessel plate, including impact requirements if any, for a length measured from the vessel wall of at least 150mm. The material of such items beyond this point may be structural quality A283 Gr. C, or equal.

ASTM A-203 Gr. D or ASTM A-240 Gr. 304 shall be used for cold vessels.

9.4 **Bolting**

Bolts and nuts shall be furnished by the SUPPLIER for all cover plates, manholes, blind flanges and bolted attachments supplied with vessels. Bolts and nuts shall be new.

External bolting shall be alloy steel stud type and selected for maximum and minimum design temperatures.

For warm vessels; all external bolting shall be cadmium plated to ASTM A-193 Gr. B7 c/w ASTM A-194 Gr. 2H nuts.

For cold vessels; all external bolting shall be cadmium plated to ASTM A-320 Gr. L7 c/w ASTM A-194 Gr. 7 nuts.

All internal bolting to be stainless steel.

Flange bolting of nominal size 1½" and above shall be subject to bolt tensioning. SUPPLIER to supply flange stud-bolts over length by one nut thickness and complete with 3 nuts to facilitate bolt tensioning for all flanged connections for which SUPPLIER supplies a mating flange. Bolt tensioning will be carried out on site by Contractor.

9.5 **Flanges**

Flange material shall be of a similar quality to the vessel shell including impact properties where applicable. Forgings shall be supplied in the normalized condition.

For warm vessels; all flanges material shall be ASTM A-105.

For cold vessels; all flanges material shall be ASTM A-182 Gr. 316 for Stainless Steel Vessels or ASTM A-350 Gr. LF2 for Carbon Steel (with impact test) Vessels.

9.6 **Gaskets**

Gaskets shall be furnished by the SUPPLIER for all bolted attachments i.e. cover-plates, Manways, and blind flanges supplied with vessels.

Unless otherwise specified, gaskets shall be in accordance with ANSI B16.5 as follows:

- **For Flat Face, 150 LB ANSI flange:** Full Face, 1.6mm thick compressed non-asbestos.
- **For Raised Face, 150 LB ANSI flanges:** Flat ring compressed non asbestos, 1.6 mm thick.

- **For Raised Face, 300 & 600LB ANSI flanges:** Spiral wound stainless steel, non-asbestos filled with spacer rings.
- **For Ring Joint, 900, 1500 and 2500 LB ANSI flanges:** Oval Ring per ANSI B16.20, Armco soft iron or equal. (90 Brinell Max).

Gasket material for nozzles connected to external pipework and valving shall be in accordance with the Project Specification for Piping Design and Materials.

9.7 **Impact Test Requirements**

Charpy V-notch impact testing is required in accordance with the code except that this shall apply to all vessels with a design temperature below 0°C. These vessels shall meet the requirements of ASME Section 11 Part A, SA20 and Clause UG-84 of ASME VIII Division 1.

10.0 **FABRICATION**

10.1 **Start of Fabrication**

No manufacture may begin until SUPPLIER has received written approval of his detailed fabrication drawings from the COMPANY or their authorized representative.

The SUPPLIER shall notify the COMPANY or their authorized representative in reasonable time before actual fabrication begins.

10.2 **Forming**

Shell plates shall not be formed until actual head dimensions are known.

Plates shall be formed in the same direction as the final roll given in manufacture.

10.3 **Welding**

All welding shall be in accordance with the code, standard and welding specification for this project. The SUPPLIER shall submit proposed weld procedures and weld details for the COMPANY'S review and approval prior to commencing any production welding.

Submerged arc welding is preferred on all vessel seams.

For materials with yield strength exceeding 330 N/mm² and/or thickness exceeding 20mm, consumables for manual metallic arc welding shall be of the basic low hydrogen type.

SUPPLIER shall establish a procedure for maintaining proper control of welding consumables.

Low hydrogen electrodes shall be dried or baked at the temperature level and times specified by the manufacturer, and shall be used within 8 hours when stored in quivers. Electrodes stored in quivers, but not used within the specified times, shall be restored in ovens.

No electrodes shall be left lying about the site, or in workshops. Electrodes so left shall be scrapped.

Submerged arc flux shall be stored in moisture-proof containers in a dry location, at a temperature of above 20°C.

Submerged arc consumables shall be withdrawn from store only when required for immediate use. Used consumables shall be returned to store on completion of the welding operation.

Submerged arc flux may be recycled but shall be free from fused flux, mill scale, dirt or other foreign matter.

The SUPPLIER shall provide proof to the satisfaction of the COMPANY'S Inspector that the welder has been using the process for which he is qualified within the previous 3 months. If not, then the welder shall be required to re-qualify. Backing rings shall be used only with approval of the COMPANY.

Adjacent longitudinal seams shall be staggered to give between seams a minimum of 60° orientation or 2000mm whichever is greater. Shell seams shall be located to miss long internal attachment welds (trays, down comers, etc.) and all nozzles and manhole openings and their reinforcing pad.

Longitudinal and circumferential seams in shells and all seams in heads shall be full penetration single or double butt-welds of the 'V' or 'U' type. Lap welds are not permitted.

All weld procedure numbers shall be shown on drawings.

All welding without subsequent post-weld heat treatment is prohibited on the following:

- Materials and thickness criteria defined within the design code.
- Chrome-moly alloy steels containing more than 2% Cr or more than 0.6% Mo.

Production test plates shall be conducted on longitudinal shell seams and head seams (if any) where run-off tabs shall be used. This shall apply to vessels with a design temperature below 0°C and thickness greater than 25mm. One production test plate shall be provided per vessel for each weld procedure and shall be subject to full mechanical testing in accordance with ASME IX.

Production control test plates shall be post-weld heat treated with the vessel where applicable.

The weld ligament, i.e. the distance between the edges of weld preparations for any two nozzle welds, or between nozzle welds and seam welds and attachment welds, shall be twice the shell/head thickness plus 25mm.

No welding shall be allowed after PWHT. All attachments including ladder and platform clips must be welded before PWHT.

All fillet welds shall be continuous.

10.4 **Weld Repairs**

All repairs welding shall be in accordance with procedures previously approved by the COMPANY.

The repaired weld shall be subjected, as a minimum requirement, to the same testing and inspection as the original weld.

The cost of all repairs and subsequent inspection shall be the responsibility of the SUPPLIER.

Weld repairs shall take place before hydro-testing and care shall be taken to ensure that the wall thickness is not reduced below the specified minimum design thickness.

Surface defects, and areas of weld resulting from the removal of temporary attachments shall be ground smooth and the area subjected to 100% crack detection.

10.5 **Welding Procedure Qualification Record (WPQR)**

Each weld procedure shall be covered by a suitable procedure qualification tested in accordance with the requirements of ASME IX.

10.6 **Preheat Requirements**

The minimum preheat for Ferritic steels shall be in accordance with Appendix R of ASME VIII DIV I. Calculations of preheat temperature to suit particular combined plate thickness, chemical composition, heat input, consumables and restraint can however be made by reference to the following:

Welding Steels without Hydrogen Cracking, international Institute of Welding 1973.

Note: This guide is primarily suitable for carbon, carbon manganese fine grain and carbon molybdenum steel with less than 0.6% Mo.

The require preheat temperature shall be established before commencing welding, and held until welding is complete.

Preheat temperatures shall be controlled by temperature indicating crayons or contact pyrometer.

10.7 **Post Weld Heat Treatment Requirements**

Vessels shall be post-weld heat treated when required by the design code depending on the combination of material, thickness and design temperature.

All vessels in lethal service shall be post-weld heat treated.

Post-weld heat treatment shall also be considered for vessels subjected to large amounts of welding and where pressure parts have been formed from thick plate into tight radii.

Field post-weld heat treatment procedures must be reviewed by the COMPANY.

The SUPPLIER shall include in his material sub-order(s), how many heat treatments are likely to be carried out during fabrication, and he shall ensure that he receives a guarantee from the mill that the steel supplied can be heat treated as proposed, without detrimental effect on the minimum guaranteed mechanical properties.

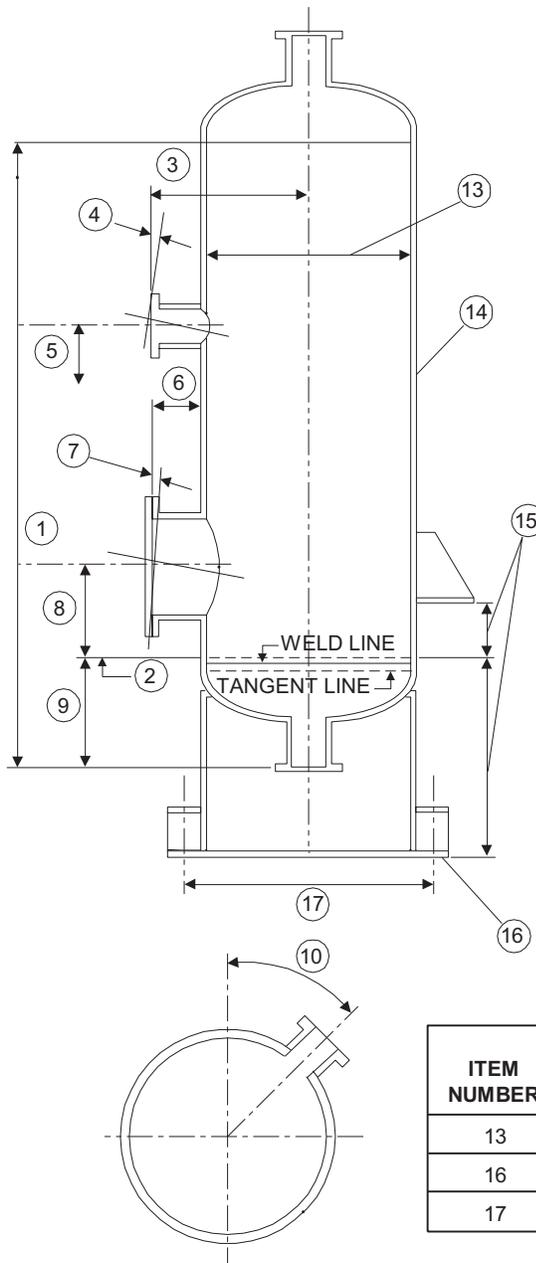
The use of manually operated gas torches or gas rings shall not be permitted for PWHT.

During PWHT, a minimum of six thermocouples per furnace load shall be used to ensure that uniform temperature is achieved throughout the heat treatment cycle. The thermocouples shall be used to record metal skin temperature.

If welded repairs are made to a vessel, which has been heat treated, the vessel shall again be heat treated. This treatment shall form part of the repair procedure.

All heat treatments shall be recorded and documented by a temperature recording chart. The welding and associated heat treatment of stainless steels shall take into account the ease with which this material can be sensitized and its corrosion resistant properties thereby impaired.

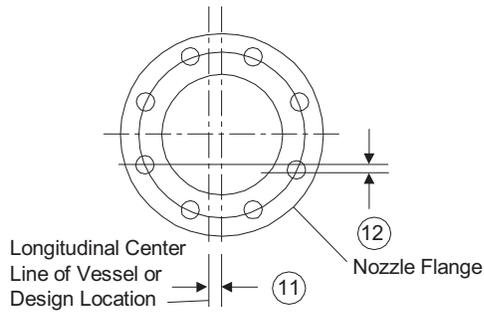
Figure 1: Pressure Vessel Tolerances



- ① Tolerance on longitudinal dimensions from the reference plane shall be the smaller of 1/64 in. per foot of length or 1/2 in., unless noted otherwise.
- ② REFERENCE PLANE Punch mark inside and out 3 in. from root land of bottom course.
- ③ Flange face of nozzle from centerline of vessel $\pm 1/8$ in.
- ④ Flange face of nozzle shall be parallel with the indicated plane in any direction $\pm 1/2^\circ$, but not to exceed 3/16 in.
- ⑤ Location of nozzle from reference plane $\pm 1/4$ in.; exception shall be liquid level controller nozzles $\pm 1/16$ in. and nozzles related to tray, draw-off pans, etc., so dimensioned on drawings, distance from support ring $\pm 1/8$ in.
- ⑥ Flange face of manhead from outside of tower $\pm 1/4$ in.
- ⑦ Flange face of manhead shall be parallel with the indicated plane in any direction $\pm 1^\circ$.
- ⑧ Location of manhead from reference plane $\pm 1/2$ in.
- ⑨ Flange face of top or bottom nozzle to reference plane $\pm 1/4$ in.
- ⑩ Orientation of nozzle and other attachments shall be within $\pm 1/8$ in.
- ⑪ 1/8 in. max. lateral translation.
- ⑫ 1/16 in. max. rotation of flanges from the indicated position, measured as shown.
- ⑬ In addition to ASME code tolerances, tolerances from nominal inside shell diameter as measured by external strapping shall be as given in table below.
- ⑭ Maximum deviation from straight applied to shell shall be: 1/8 in. in any 10 ft or 1/2 in. per 50 ft of length. In addition, distortion caused by welding of longitudinal or circumferential joints shall not exceed 1/4 in. maximum depth in a 36 in. length of shell centered on the weld.
- ⑮ Distance from reference plane to base + 0 in., - 1/4 in. or lug + 1/4 in., 0 in.
- ⑯ Base or support lug out of level over any diameter shall be as given in table below.
- ⑰ Bolt hole circle tolerance shall be as given in table below.

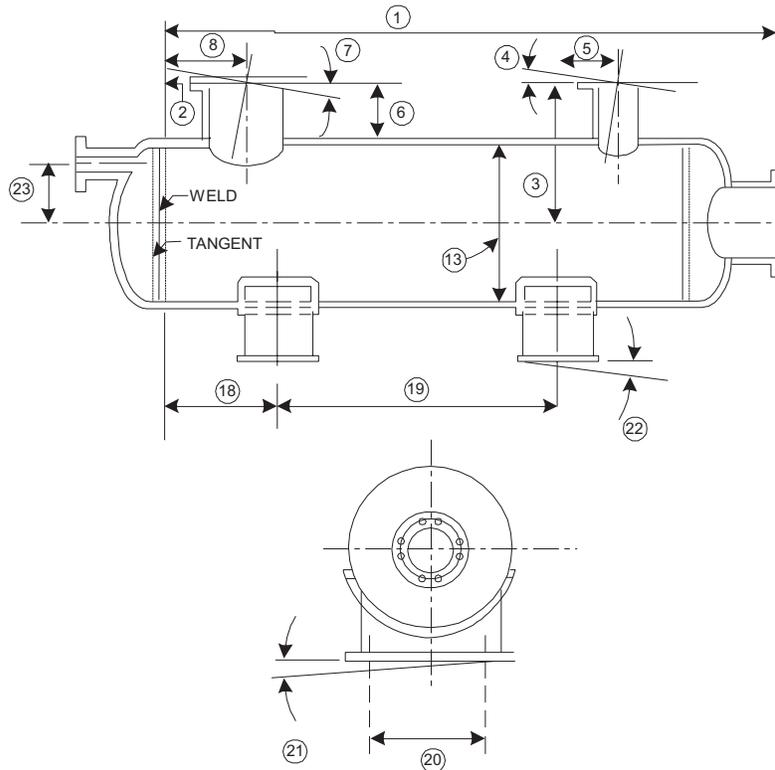
ITEM NUMBER	INSIDE DIAMETER SPECIFIED			
	< 4' -0"	> 4' -0" to 7' -0"	> 7' -0" to 16' -0"	> 16' -0"
13	$\pm 1/8"$	$\pm 3/16"$	$\pm 1/4"$	$\pm 5/16"$
16	$\pm 1/8"$	$\pm 3/16"$	$\pm 1/4"$	$\pm 1/4"$
17	$\pm 1/8"$	$\pm 1/8"$	$\pm 1/4"$	$\pm 1/4"$

Figure 1 Continued



Acceptable Metric Equivalents

in.	mm	ft	mm
1/16	1.5	4	1200
1/8	3	7	2100
3/16	5	16	4800
5/16	8		
1/4	6		
1/2	13		
1/64 in. per foot		0.4 mm per 300 mm	
1/8 in. in any 10 ft		3 mm in any 3,000 mm	
1/2 in. per 50 ft		13 mm per 15,000 mm	



- ⑱ Distance from reference plane to the centerline of the saddle 1/8 in. (3 mm).
- ⑲ Distance between the centerline of the saddle 1/8 in. (3 mm).
- ⑳ Distance between the centerline of the support bolt holes across width 1/8 in. (3 mm).
- ㉑ Saddle base plate out of level shall be the same as for item 16.
- ㉒ Saddle base plate out of level slope 1/16 in. (1.5 mm), across the width of the saddle.
- ㉓ Location of nozzle from vessel centerline 1/4 in. (6 mm).

11.0 **INSPECTION, TESTING AND CERTIFICATION**

11.1 **General**

All non-destructive examination shall be carried out in accordance with the design code as a minimum. All personnel involved in non-destructive testing shall be qualified to a nationally recognized standard.

Inspection and testing shall be carried out at the SUPPLIER'S works and shall be witnessed by the COMPANY'S authorized representatives and/or the certifying authority if applicable.

The responsibility for inspection rests with the CONSULTANT. However, the COMPANY reserves the right to inspect vessels at any time during fabrication to ensure that materials and workmanship are in accordance with this specification, and/or the approved drawings.

The SUPPLIER shall provide a projected shop schedule with appropriate fabrication stages at the time drawings are submitted for approval, to highlight the inspection activity schedule.

The approval of any work by the COMPANY or their authorized representative and the release of a vessel for shipment shall in no way relieve the SUPPLIER of any responsibility for carrying out the provisions of this specification.

The SUPPLIER shall inform the COMPANY at the time of placing the order of any tests, which cannot be adequately performed.

11.2 **Radiographic Inspection**

Except where amplified in this specification the extent of radiography shall be in accordance with the design code.

When 100% radiography is specified for all welds, including flange butt welds and nozzle to shell connecting welds, shall be fully radio-graphed. Where radiography is considered to be impractical ultrasonic inspection may be substituted with prior approval of the COMPANY.

For vessels requiring radiography where heat treatment is required, the radiography must be carried out after heat treatment. The SUPPLIER may at his discretion carry out radiography prior to heat treatment.

The COMPANY'S appointed inspector shall see all radiographs and shall be advised of any defects found in any welds.

11.3 **Ultrasonic Inspection**

Ultrasonic inspection may be substituted for radiography with prior approval of the COMPANY in areas that are inaccessible for radiography.

For vessels requiring U/T examination where heat treatment is required, the examination must be carried out after heat treatment. The SUPPLIER may, at his discretion carry out U/T examination prior to heat treatment.

11.4 **Magnetic Particle and Dye Penetrant Inspection**

All magnetic particle and Dye Penetrant inspection shall be performed in accordance with the design code.

As a minimum, the following applies at all nozzles, Manways, and reinforcing pads:

- Load bearing fillet welds shall be checked at root runs and finished welds by magnetic particle or dye penetrant method.
- All full penetration attachment welds shall be magnetic particle inspected at the bevel-chipped surface and on all finished weld surfaces.

Crack detection of finished welds shall be carried out after hydro-test and PWHT (where applicable).

Magnetic particle inspection is preferred particularly after post-weld heat treatment.

Vessels of low chrome alloy with plates over 50mm thick shall receive this inspection of all weld seams after post-weld heat treatment.

11.5 **Acceptance Criteria**

The acceptance standard for Non-Destructive examination of welds shall be in accordance with the design code.

11.6 **Support and Reinforcing Pod Inspection**

Welds of reinforcing pads shall be tested to 1 barg with dry air after fabrication (but prior to the hydrostatic test of the vessel) using suitable materials for the detection of leaks.

11.7 **Hydrostatic Tests**

Hydrostatic tests shall be carried out in presence of the COMPANY appointed inspector and a representative of the certifying authority, when applicable.

Hydrostatic testing shall be in accordance with the design code.

Fresh water only shall be used for testing. For vessels manufactured from stainless steel the chloride ion content of the test water shall not exceed 30ppm.

During testing the temperature of the vessel and test water shall not be lower than 7°C and not more than 25°C.

Adequate support shall be provided for vertical vessels tested in the horizontal position to ensure that they are not subjected to excessive local loadings and bending stresses.

Hydro-test pressure shall be held for a minimum of 60 minutes, irrespective of design code requirements.

11.8 **Test Bolting**

After the successful completion of the hydrostatic test, the bolting used during testing shall be replaced. Service bolts; nuts and gaskets furnished by the SUPPLIER shall not be used for testing. The test bolts shall form part of the total equipment supply.

11.9 **Nameplate**

11.9.1 **General**

Each complete vessel shall be provided with a type 316 stainless steel nameplate securely attached to the vessel shell and located so that it is clearly visible after installation. Nameplates shall be riveted to a bracket welded on the vessel and the inspection authority then over stamps one rivet. Insulated vessels shall have nameplate brackets with enough projection to clear insulation by at least 25mm

11.9.2 **Stamped Data**

The following information shall be stamped on the nameplate:

- Manufacturer's Name.
- Manufacturer's Serial Number.
- Tag Number.
- Purchase Order Number.
- Equipment Title.
- Maximum allowable working pressure (Hot and Corroded) barg at °C.
- Maximum test Pressure (Corroded) in barg.
- Year Built.
- Size I.D./O.D. × T to T in mm.
- Service.

- Corrosion Allowance in mm.
- Design Code/Code Symbol showing degree of radiography and/or stress relieved and type of construction.
- Weight empty/operating/hydro-test in kg.
- Inspection authority and date of inspection.
- Code symbol showing if the unit is x-rayed and stress relieved.
- Design temperature and pressure.
- Operating temperature and pressure.

11.10 **Report and Acceptance Certificates**

With regard to witnessed tests the SUPPLIER shall prepare a report on the tests and the results, these shall be included in the 'Certification Data Books'. All Data Books produced shall be complete and copies submitted to the COMPANY for review not later than 4 weeks after the date of completion of the tests.

11.11 **Certification Documents**

The CONSULTANT shall store in good order all material certificates, fully catalogued and indexed NDT test records, mechanical test certificates, welding qualification certificates, heat treatment certificates and hydrostatic test certificates for a minimum of 5 years after acceptance of the complete and fully certified vessel by the COMPANY.

All certificates shall be available for counter signature by the certification authority.

12.0 **PAINTING AND PREPARATION FOR SHIPMENT**

12.1 **Painting and Protective Coatings**

Painting, protective coatings and the procedures used for the preparation of surfaces shall be as specified in the Project Specification for Painting and Protective Coatings.

Where painting is specified, the entire vessel shall be painted, including inside of skirt, outside of bottom head, entire base ring and all skirt attachments. Nozzles shall be painted on the flange edges, inside bolt holes, and up to the gasket surface.

Fireproofed/Insulated surfaces shall be shot blasted and given one coat of primer only.

The SUPPLIER shall stencil in a prominent position in 50mm high characters the dry lifting weight of the vessel and for stress relieved vessels the words "NO WELDING PERMITTED".

12.2 **Preparation of Shipment**

After the final hydrostatic test, the vessel shall be dried and cleaned thoroughly of all grease, loose scale, rust, flux and weld spatter, both internally and externally.

All machined surfaces and threaded connections shall be protected by coating with rust preventative.

Flanged openings shall be protected with steel plate covers attached by proper bolting or strapping and sealed with a plastic compound.

Screwed connections shall be protected with threaded forged steel plugs.

The SUPPLIER shall be responsible for loading and anchoring vessels to prevent any damage during shipment.

When shipped loose, all instruments, valves, parts, etc., of a vessel shall be tagged with vessel number and purchase order number to facilitate match-up with appropriate vessel in the field. Tags and wire shall be stainless steel. All such items shall be boxed and where possible attached to the inside of the skirt or saddle.

SUPPLIER shall state in the proposal his recommendations for long term storage (up to 12 months) for both indoor and open-air storage in a marine environment.

13.0 **SPECIFIC REQUIREMENTS FOR CLAD VESSELS**

13.1 **Design**

Design calculation shall be based on the nominal thickness of the base material i.e. shall not include any allowance for the cladding thickness.

The thickness of corrosion resistant linings applied to nozzles shall not be less than the thickness specified for the vessel.

The principle shall be satisfied that the design of a cladding or lining accounts for the effect of differential thermal expansion and has sufficient ductility to accommodate any strain likely to be imposed during service.

13.2 **Materials**

Pressure vessel parts constructed of integrally clad plate, and vessel parts fully or partially lined by welding after forming, shall satisfy the requirements of ASME Section VIII DIV I Part UCL.

The use of linings other than those obtained by using integrally clad plate or overlay weld deposits shall be avoided and requires special approval of the COMPANY.

Integrally clad plate shall be of the homogeneously clad type as obtained by roll cladding or explosive bonding. The clad plates shall conform to ASTM A-263, ASTM A-264 & ASTM A-265, as applicable, irrespective of the design calculation method used.

Integrally clad plate shall be ultrasonically tested to check the quality of the bond in accordance with the requirements of ASTM A579, acceptance level S6.

The branches in clad vessels shall be cut from tubing or fabricated from clad plate. Alternatively, the branches may be protected by corrosion resistance weld overlays.

Solid alloy nozzles may be offered as an alternative to clad nozzles in the smaller sizes where it is considered to be advantageous.

Flange facings on clad vessels shall be provided with an overlay weld deposit protection unless otherwise specified by the COMPANY.

Overlay weld deposits of austenitic stainless steel weld metal on carbon and low-alloy steels shall be applied in a minimum of two layers. For the first layer type 309 weld material shall be used, and the top layer as specified.

13.3 **Fabrication**

Weld overlay deposits on clad vessels shall be performed in accordance with procedures qualified to ASME IX. The proposed procedure for relevant application shall be submitted with the bid.

The procedure for PWHT shall be submitted to the COMPANY for approval. It shall be demonstrated that no deleterious effects on the corrosion resistance of the cladding or weld overlay will occur during PWHT.

13.4 **Inspection and Testing**

Clad plate formed into dished ends shall be ultrasonically retested for soundness after forming.

Linings applied by overlay weld deposit, shall be ultrasonically examined for gross lack of fusion in accordance with ASTM A578 acceptance level S6. This also applies to clad restoring of welds in clad plate, where a bond of 50mm on each side of the weld shall be examined.

Vessels protected with a cladding or lining of stainless steel, or having stainless steel internals shall be hydrostatically tested as if they were of solid stainless steel, refer to clause No. 6 of this specification.

14.0 **DRAWINGS AND DATA REQUIRED**

SUPPLIER information shall be supplied in accordance with the COMPANY's procurement documentation and shall include, as a minimum, the following:

- Completed data sheets.
- General arrangement and cross-sectional drawings complete with parts list, materials and equipment description.
- Materials and thickness of principal parts, not covered by the data sheet.
- Itemized weights, including maintenance weights, plus withdrawal dimensions.
- Foundation Loading Data.
- SUPPLIER connection drawings complete with detailed nozzle schedule.
- Itemized list of SUPPLIER's deviations from Specification. SUPPLIER shall advise separate prices for the following:
 - Supply & installation of additional nozzles, rated as per data sheet, with and without reinforcement for the following nominal bores:

2", 3", 4", 6", 8", 10", 12", 14" & 16".

20" & 24" Manways complete with blind flanges, bolting, gasket and davit.

Per kg of all support clips and lugs
- Proposed test procedure and erection details
- Priced list of recommended commissioning spares.
- Priced list of spare parts for two years operation.
- Priced list of special tools.



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OIL & GAS DEVELOPMENT COMPANY LTD.

SPECIFICATION FOR

INTERNALS FOR PRESSURE VESSELS

(NACE COMPLIANT)



0	07-10-2013	Issued for Tender	WUS	MAIH	MAS
Rev.	Date	Description	Prepared By	Checked By	Approved By

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1.0 **SCOPE**

- 1.1 This specification covers the design, fabrication, inspection, testing, handling and storage of beams, trays, grids, shrouds, thermowells and other internals for fractionating and extraction towers, separators, drums, and similar vessels.

The requirement set-out in this specification shall not be construed to eliminate consideration of the SUPPLIER's standard design and its responsibility to furnish equipment and accessories of a proper mechanical design suited to meet the specified service conditions.

1.2 **Definitions**

Following definitions apply throughout this document:

- COMPANY: Oil & Gas Development Company (OGDCL)
- CONSULTANT: M/s. Zishan Engineers (Pvt.) Ltd. (ZEL).
ZEL have been awarded the work of Engineering, Procurement Assistance and Project Management.
- CONTRACTOR: Means the construction company to be engaged by the COMPANY to perform the Construction work.

1.3 **Errors or Omissions**

1.3.1 The review and comment by the COMPANY of any SUPPLIER's drawings, procedures or documents shall only indicate acceptance of general requirements and shall not relieve the SUPPLIER of its obligations to comply with the requirements of this specification and other related parts of the Contract Documents.

1.3.2 Any errors or omissions noted by the SUPPLIER in this Specification shall be immediately brought to the attention of the COMPANY.

1.4 **Deviations**

All deviations to this Specification, other related specifications or attachments shall be brought to the knowledge of the COMPANY as section in the bid. All deviations made during the procurement, design, manufacturing, testing and inspection shall be with written approval of the COMPANY prior to execution of Work. Such deviations shall be shown in the documentation prepared by the SUPPLIER.

1.5 **Conflicting Requirements**

In the event of any conflict, inconsistency or ambiguity between the SUPPLIER's scope of work, this Specification, National Codes & Standards, referenced in the Project Specification or any other documents, the SUPPLIER shall refer to the COMPANY whose decision shall prevail.

1.6 **Reporting Procedure**

1.6.1 A reporting and documentation system shall be agreed between the SUPPLIER and the COMPANY / CONSULTANT for the status of procurement, design, manufacturing, inspection, testing and shipment of the equipment/material to be supplied under this specification. SUPPLIER shall provide reports and summaries for production performance and testing operations in conformance with a manufacturing schedule approved by COMPANY.

1.6.2 Daily, weekly, monthly and run summaries of all major aspects of the production process shall be provided as reports to the COMPANY/ CONSULTANT.

1.6.3 **Third Party Inspection**

In addition to the inspection and witnessing of tests by the COMPANY during the manufacturing and shipment of the equipment/material, COMPANY may appoint a third party or its own inspector for witnessing of the inspection and tests to be carried out at SUPPLIER's facility under this specification.

1.7 **Unit Responsibility**

The SUPPLIER shall be responsible for the complete design, supply, fabrication inspection and testing of the internals of pressure vessels, including full compliance with all applicable design codes and standards listed in Section 2.0, of this document, all project specifications, datasheets, P&IDs and with the requirements of the certifying authority, if applicable. The SUPPLIER shall handle and expedite drawings and data, and supervise and coordinate all inspection and testing.

SUPPLIER shall guarantee that all materials and parts included in construction of pressure vessels shall be new, unused and of the required/ specified grade.

1.8 **Documentation**

- a) Documents, calculation sheets, drawings, etc., to be submitted to the COMPANY shall be in the English Language.
- b) Unless otherwise specified, the metric units shall be used in documents and drawings, except that pipe sizes, flange sizes and bolts/nuts shall be indicated in inches.
- c) The form of fabrication drawings and documents may be as per the SUPPLIER's Standards. However, the format of the data sheet will be submitted to COMPANY for approval.
- d) Fabrication drawings and documents shall be submitted for the approval of the COMPANY. But, such approval of the COMPANY shall in no way relieve the SUPPLIER of his obligations with respect to such drawings and documents.

- e) Variations from or additions to this specification shall be called to the attention of the COMPANY and approved in writing by the COMPANY prior to starting fabrication.
- f) Welding procedure specification and welding qualification record shall be submitted to the COMPANY prior to the start of fabrication.
- g) Information for installation, operating, maintenance or inspection purposes shall be submitted to COMPANY.

2.0 **SPECIFICATION AND CODES**

2.1 **AISC Specification**

Manual of Steel Construction (ASD) – Specification for Structural Steel Buildings

2.2 **ASME Codes**

Section VIII Division 1	Boiler and Pressure Vessel
Section II, Part D	Material Properties
Section IX	Welding and Brazing Qualifications
B31.3	Process Piping

2.3 **NACE Code**

NACE MR-0175 Petroleum and natural gas industries materials for use in H₂S-containing environments in oil and gas production.

2.4 SUPPLIER's drawings shall show all assembly and process details and the following data:

- a. Design temperature and design loads
- b. Extent of ultrasonic, radiography, magnetic-particle inspection, or other nondestructive tests.
- c. Stress relieving and special welding procedures
- d. All material specifications including bolting and gaskets.
- e. Actual total corrosion allowance for internals (i.e., total new metal thickness minus thickness required for strength).
- f. Location and assembly details for all internals, including all tray details, and tray sectional elevations showing two or more adjacent trays. All components in the section shall be identified.
- g. All necessary instructions and piece numbers for all parts to facilitate shop or field installation.
- h. Positive material identification testing requirements.

- 2.5 For items that cannot be completely shop fabricated, the SUPPLIER shall submit design drawings clearly designating field welds for approval by COMPANY/CONSULTANT.
- 2.6 Two copies of design calculations made by SUPPLIER shall be furnished with or prior to submission of prints for approval. Structural design calculations for trays and internal supports shall be included. Where calculations are made on a computer, all input data, assumptions, and summary of results shall be furnished.
- 2.7 Final Data - After final approval of drawings, fabricator shall supply the following certified data:
- a. Certified drawings containing all information required by Paragraphs. 2.3 and 2.4.
 - b. Data reports executed in accordance with the applicable code shall be supplied to COMPANY/CONSULTANT.
- 2.8 SUPPLIER certification of leakage rate. SUPPLIER shall certify that all bubble cap trays will meet the specified leakage rate when installed, the gasket material and gasket to metal seal designs, if permitted, have been successfully used in similar services.

3.0 **DEFINITIONS**

3.1 **Major Beams**

Beams 10 ft (3000 mm) and longer, or beams regardless of length that extend across a vessel without interruption. All other beams shall be considered to be minor beams.

3.2 **Non-Structural Components**

Trays, decks, pans, integral minor beams, liquid redistributors, downcomers, grids, holddown grids and internal non-pressure piping.

3.3 **Structural Components**

All major beams, grid support beams, bed support beams, non-integral beams, inlet distributors, outlet collector rings, tray support rings and other load bearing components welded to the shell.

3.4 **Total Corrosion Allowance**

Corrosion allowance for all internals which are exposed to corrosion on all surfaces.

3.5 **Tray Accessories**

Valve trays, bubble caps, chimneys, weirs, baffles and entrainment screen supports.

4.0 **MATERIALS**

- 4.1 Materials for internals shall be specified.
- 4.2 Acceptable ASTM grades and specifications for a number of standard internal materials are listed in Table 1.
- 4.3 Free machining grades of steel are not permitted, except that Type 416 nuts furnished to ASTM A 194 / A 194M Gr6F with Selenium are acceptable for use with ASTM A 193 / A 193M B6 bolts.
- 4.4 Gasket and packing material for other than acid or caustic services shall be an asbestos substitute suitable for the process fluid and temperature to which it will be exposed.
- 4.5 All bolting hardware shall be of the same nominal chemistry as the internals which they are connecting. However, 12Cr bolting hardware shall be used for carbon steel internals when the specified corrosion allowance for the internal structural component is greater than 1/8 in. (3 mm).
- 4.6 Bolting hardware for manways in grids, decks and trays shall be corrosion resistant material to facilitate opening for inspection and maintenance.
- 4.7 Crinkled wire mesh entrainment screens (CWMS) shall meet the following requirements:
 - a. Materials of the supports, rods, or straps shall be at least equivalent in terms of corrosion resistance to that of the other vessel internals.
 - b. Mesh shall be Type 304 stainless steel, Alloy 400, or Alloy 600.
- 4.8 Baffle plate and wear plate material shall be of the same nominal composition as the internal structural components unless otherwise specified.
- 4.9 All material should be compliant to NACE 0175 (Latest Revision).

TABLE – 1 - MATERIALS SPECIFICATIONS

MATERIALS	ASTM STANDARDS				
	PLATE	SHEET	STRIP	BARS	BOLTS & NUTS
Carbon Steel	A 36, A 283, A 285 / A 285M A 515 / A 515M A 516 / A 516M	A 414, A 569	A 570	A 675	A 307, Gr B
Low and Intermediate Alloy Steels		As specified for High Alloy Steels			
C-1/2Mo	A 204/A 204M				
1-1/4Cr-1/2Mo through 5Cr-1/2Mo	A 387 / A 387M				
High Alloy Steels	A 176 and A 240, Types 405 and 410S		A 276 Type 405		A 193 / A 193M B6; and A 194 / A 194M Gr6F (with Selenium), or Gr6
12Cr welded components					
12Cr non-welded components	A 176 and A 240, Types 405, 410 or 410S		A 276 Type 405 or 410		
18Cr 8Ni: Types 304, 316, 321, 347	A 167 and A 240		A 276		A 193 / A 193M B8 and A 194 / A 194M Gr8
Non-Ferrous	B 127		B 164		B 164
Nickel Copper (Monel)					
Titanium	B 265 Gr2		B 348 Gr2		B 348 Gr4

5.0 DESIGN

5.1 General

- 5.1.1 All internals, except shrouds and outlet collectors, shall be removable with vertical thermowells in place, and shall be designed to pass through the nearest manhole above their level unless otherwise specified.
- 5.1.2 All parts which are to be installed after vessel fabrication is complete shall be designed to pass through the manways provided on the vessel.

5.2 Corrosion Allowance

The total corrosion allowance (TCA) to be used for all internals shall be specified. The TCA is normally calculated as follows:

$$TCA = 2 Cr Ld$$

where:

TCA = total corrosion allowance. Note that this value may be either more or less than the default value shown below.

Cr = the corrosion rate anticipated for the material specified.

Ld = the design life for the internal component.

- a. For structural components, the design life should equal that specified for the vessel unless otherwise specified.
- b. For non-structural components and tray accessories and internal piping, the design life should equal 1/3 the value specified for the vessel unless otherwise specified.

The factor of 2 accounts for the fact that corrosion of the internal occurs from both sides.

If not specified, the default total corrosion allowance shall be as follows:

TYPE OF INTERNAL	MATERIAL OF INTERNAL	DEFAULT TOTAL CORROSION ALLOWANCE	
		Inches	mm
Structural Component	CS	0.12	3.0
	Alloy (1)	0.02	0.5
Non-Structural Component or Tray Accessory	CS	0.04	1.0
	Alloy (1)	0.007	0.2

Note:

- (1) Alloy designates stainless steels (300 and 400 series), Nickel alloys, Copper alloys, Aluminum alloys.

5.3 Minimum Metal Thickness

A fully corroded thickness in excess of the minimum may be used if required based on other mechanical design considerations or if increased thickness results in a more economical design.

Load bearing calculations shall be carried out based on the following fully thicknesses.

Minimum acceptable fully corroded thicknesses are as follows:

- a) For Structural and Non-Structural Components, the minimum required metal thickness (fully corroded) is 0.074 in. (1.9 mm).
- b) For tray accessories, the minimum required metal thickness (fully corroded) is 0.060 in. (1.5 mm).

5.4 Loads and Stresses

5.4.1 Where live loads are not specified, structural components, non-structural components and tray accessories shall be designed to support their own weight plus the following live loads at the design temperature.

- a. **Fractionating Distillation Trays:** Design live load shall be the greater of 20 psf (98 kg/m²) or the weight of water 2 in. (50 mm) over the highest weir setting.
- b. **Areas under downcomers:** Design live load shall be the greater of 64 psf (314 kg/m²) or a head of water one-half of the height of the downcomer.
- c. **Pans (drawoff and accumulation):** Design live load shall be the greater of 1 psi (700 kg/m²) or the weight of water at the maximum operating level of the pan.
- d. Baffles (including shed rows, disc, and donuts) with no normal operating liquid level shall use a design live load of 1 psi (700 kg/m²) on the projected horizontal area.
- e. Entrainment screen components shall be designed for a differential pressure of 0.1 psi (70 kg/m²) unless otherwise specified. The need for a higher differential pressure shall be based on anticipated fouling or upset conditions.

5.4.2 Allowable unit stresses for non pressure containing internals shall be per ASME Code Section VIII, Div. 2. For stresses beyond the temperature range listed in ASME Section VIII, Div. 2, ASME B31.3 shall be used.

5.4.3 Maximum deflection from the horizontal for trays, distributors and liquid distributor trays under specified operating conditions shall not exceed 1/900 of the vessel diameter.

- 5.4.4 Maintenance loads, Structural components shall be designed for a concentrated live load of 300 lb (135 kg) at any point based on the allowable stress at 100°F (38°C). This design shall be based on the fully corroded thickness of the structural components (i.e., thickness excluding total corrosion allowance). Deflection does not need to be considered for maintenance loads.

5.5 **Dimensional Requirements**

- 5.5.1 Bolt spacing in downcomers shall not exceed 6 in. (150 mm).
- 5.5.2 Maximum unsupported length (minor dimension only) of trays, baffles, and pans shall be as limited by any access manways
- 5.5.3 For all trays except cartridge and pedestal tray assemblies, the nominal tray diameter shall be determined to the nearest 1/4 in. (6 mm) per the following:
- Tray diameter = Vessel ID - [1% Vessel ID + 3/4 in. (19 mm)]
- 5.5.4 A minimum of 3/4 in. (19 mm) overlap shall be provided between the support ring and the OD of trays, decks, and grids.
- 5.5.5 Bolt hole or clamp spacing around the edge of tray, deck, or grid sections shall not exceed 7 in. (177 mm).
- 5.5.6 Tray or deck areas blanked by structural components shall not exceed 3 in. (75 mm) in width for minor beams and support rings, and 8 in. (200 mm) in width for major beams.
- 5.5.7 The projected cross sectional area of the packing hold down plate, if required, shall be a maximum of 5% of the vessel cross sectional area.

5.6 **Structural**

- 5.6.1 The depth of supporting members normal to the direction of liquid flow on the tray below shall not exceed 20% of the vertical distance between trays.
- 5.6.2 Baffle plates and wear plates to be used with tangential nozzles for atmospheric towers shall include the design and fabrication details shown in Figure 4.
- 5.6.3 Grid support beams shall be fabricated “T” sections or fabricated back to back channels with the flanges downward and webs intruding into the catalyst bed. The beam flanges shall be used to support bed grids and screens.
- 5.6.4 Slotted oversize holes shall be used to permit thermal expansion where structural components are bolted to seat pads or clips. Bolts shall be installed “hand tight”, and then secured to prevent subsequent loosening.

5.7 Internal Pipes and Thermowells

- 5.7.1 Internal distribution pipes shall have flanged and gasketed connections and shall have their ends blanked.
- 5.7.2 Expansion guides shall be provided for vertical thermowell installation, per Figure 5.
- 5.7.3 Tray guides, per Figure 6 shall be provided to minimize liquid leakage at points where thermowells or catalyst dump tubes pass through trays. Highest liquid level (HLL) will be specified.
- 5.7.4 All bolting for internals shall be a minimum of 3/8 in. (10 mm) nominal diameter.

5.8 Access Through Trays, Grids And Decks

- 5.8.1 Access through trays, grids and decks shall be provided as follows:
 - a. All trays, grids and decks in towers 3-1/2 ft (1050 mm) in diameter and larger shall be equipped with manways.
 - b. All trays, grids and decks in towers smaller than 3-1/2 ft (1050 mm) in diameter shall be either split or equipped with manways.
 - c. Trays, grids and decks having 2 or more liquid passes shall contain manways on each pass.
- 5.8.2 Tray manways shall be as follows:
 - a. Manways shall provide a minimum rectangular opening of 15 x 18 in. (380 x 460 mm).
 - b. If opening under or through major support beams is less than that in Subpar. a, tray manways shall be installed on both sides of the beam.
 - c. Tray manways shall not form a part of the downcomer seal area.
- 5.8.3 Accesses and manways at all levels shall be vertically aligned unless otherwise specified.

5.9 Drain Holes

For internals requiring liquid drainage, drain holes of 1/2 in. (13 mm) diameter shall be provided as follows:

- a. One hole in each tray recessed seal pan.
- b. One hole per 5 ft (1500 mm) of length in the base of each inlet weir.
- c. Holes shall be located downstream of downcomer apron to prevent vapor from rising through downcomer liquid.

- d. All boxes and pans from which liquid is normally withdrawn shall be equipped with nozzle(s) that will insure complete drainage of the box or pan. Drain holes shall not be provided in water drawoff boxes.
- e. Drain holes for tray or deck areas shall be:

TRAY OR DECK AREA		NUMBER OF DRAIN HOLES PER TRAY
ft ²	m ²	
≤ 30	≤ 3	1
> 30 to 100	> 3 to 9	2
> 100	> 9	3

6.0 **ADDITIONAL DESIGN REQUIREMENTS FOR INTERNALS OF TOWERS AND DRUMS**

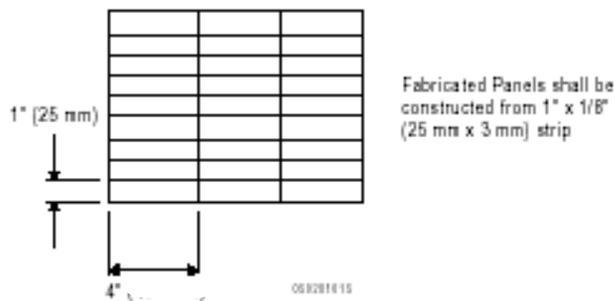
6.1 **Downcomer Anti-Jump Baffles and Anti-Vortex Baffles**

6.1.1 Downcomer anti-jump baffles shall be designed with the following provisions:

- a. Baffles shall extend across the full width of the downcomer and be parallel to the edges of the downcomer.
- b. The bottom edge of the baffle shall be level with the top of the outlet weir (where used) or level with the tray if no weir is used.
- c. Baffles shall contain at least one accessway, 22 in. (560 mm) long by the height of the baffle.

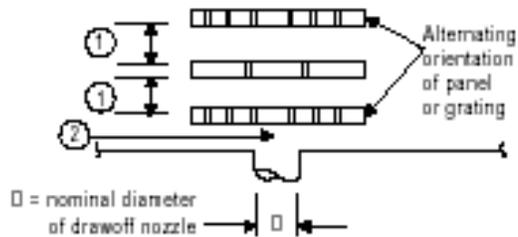
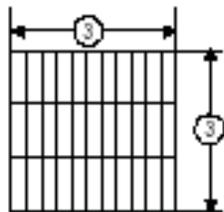
6.1.2 Anti-vortex baffles shall be designed and installed per the following criteria:

- a. Acceptable baffle construction: “Subway” grating or panel strip per the configuration shown below.



- b. Baffle design and installation shall comply with the following table and figure below:

APPLICATION > CRITICAL DIMENSIONS	VERTICAL DRUMS	BOTTOM DRAWOFFS	HORIZONTAL DRUMS	ACCUMULATOR TRAY DRAWOFFS	TOWER DRAWOFF BOXES (OTHER THAN ON ACCUMULATOR TRAYS)
Number of Tiers >	3	3	3	3	
1 Spacing between tiers	6 in. (150 mm) max. Tiers to be equally spaced and located between the drawoff nozzle D and the low liquid level. Distance from top tier to low liquid level shall be minimized within the above constraints.				
2 Clearance between bottom of Tiers and Outlet Nozzle	D/2, or greater as required to accommodate baffle size		2 in. (50 mm) approx.		Will be specified
3 Baffle size (length of sides)	4D or 1/2 Drum (tower) diameter, whichever is the smaller value			Will be specified	



6.2 Downcomers, Seal Pans, Drawoff Boxes, Accumulator Stacks, Feed Inlets, Reboiler Returns

- 6.2.1 Downcomers shall be installed with bolted joints, and shall be designed so that no vapor bypassing will occur. Stiffeners must be provided as needed to limit the horizontal movement of the bottom edge of the downcomer at any point to $\pm 1/4$ in. (± 6 mm).
- 6.2.2 All joints in areas under downcomers, including the joint to the tray support ring, shall be continuously seal welded after installation of the tray. The joint with the contacting area of the tray shall not be welded. Bolted and gasketed construction shall not be used in areas under downcomers except in towers 3 ft (900 mm) in diameter and smaller, where removal of the downcomer seal area is required to permit access.
- 6.2.3 All joints in pans and drawoff boxes, shall have continuous welds to prevent leakage.
- 6.2.4 Accumulator stacks on drawoff pans shall be seal welded to the pans. Any joints in the stacks shall be seal welded.
- 6.2.5 Feed inlets and reboiler returns, where a stream enters a vessel, the stream shall impinge on a smooth, unobstructed surface regardless of whether it discharges against a downcomer apron or a specially provided baffle.
- 6.2.6 Trough type distributors which are hung by a bolt/nut arrangement (rather than supported from below by a tray support ring or truss) shall be provided with lock washers, lock nuts or double nuts.

6.3 Fabrication

- 6.3.1 Tolerances for fabrication and assembly shall be as shown in Figure 7.
- 6.3.2 All internals shall be marked, with corresponding markings provided on assembly drawings, to permit rapid assembly.
- 6.3.3 Non-lead paint shall be used for marking.
- 6.3.4 Slot and hole edges in the outlet collector ring shall be smoothly ground to prevent damage to screening and to reduce stress concentration points.
- 6.3.5 When castable lining is used, the shroud shall be installed after castable dryout is complete.
- 6.3.6 All major load bearing internal members welded to vessels shall be attached with full penetration welds. A major load bearing connection shall be defined as when the internal member being welded to the shell is greater than or equal to $1/2$ " (13 mm) in thickness at the connection weld. Bids to use fillet welds for members greater than or equal to $1/2$ " (13 mm) in thickness shall be approved by COMPANY.

6.3.7 Shroud joints shall be butt-welded using backing strips, except the circumferential joints of shrouds in cylindrical reactors may be lap welded.

6.3.8 The surfaces and edges shall be finished as follows:

- a. Edges of all surfaces shall be free of burrs.
- b. Edges of tray accessways shall be beveled or rounded.

6.4 Trays

6.4.1 Jet, sieve, or valve trays. Gaskets and packing shall not be used between tray decks and support rings or beams when installing jet, sieve, or valve trays.

6.4.2 For perforated plate distributor trays, all holes shall be punched in the direction of liquid flow.

6.4.3 Hole punching and layout on sieve, jet, valve and bubble cap trays shall be as follows:

- a. Holes shall be punched to avoid a continuous rectangular or square pitch pattern parallel to liquid flow. Square or rectangular pitch can be used if the die is offset every 3 or 4 rows of holes perpendicular to flow.
- b. Holes on sieve trays shall be 1/2 in. (13 mm) diameter unless otherwise specified.
- c. Hole area per tray shall be within $\pm 2\%$ of the area specified.
- d. Holes on sieve and valve trays, and tabs on jet trays shall not be located within 2 in. (50 mm) of any downcomer, inlet weir or recessed seal pan. Unpunched areas shall not exceed 8 in. (200 mm) in width above major beams or 3 in. (75 mm) above minor beams or next to the vessel shell.
- e. On sieve, jet, and valve trays, the hole area shall be uniformly distributed in the contacting area (i.e., the number of holes per sq ft of contacting area shall be constant over the entire tray).

6.4.4 Valve trays shall incorporate an anti-rotation feature that will prevent spinning of the element. In addition, the float element shall be crimped to prevent full peripheral contact of the element with the tray deck.

6.4.5 Blanking on sieve, jet or valve trays shall be done as follows:

- a. For valve trays, valves shall be removed prior to blanking.
- b. Blanking strips shall be distributed uniformly in the perforated area and should be 1.5 to 5.0 in. (38 to 125 mm) wide.

7.0 INSPECTION AND TESTING

7.1 General

Inspection and testing shall be carried out at the SUPPLIER's works and shall be witnessed by the COMPANY's authorised and/or certifying authority, if required.

The responsibility for inspection rests with the SUPPLIER. However, the COMPANY and their authorised representative reserve the right to inspect the equipment at any time during fabrication to ensure that materials and workmanship are in accordance with this specification, Project Specifications, the equipment data sheets and drawings.

The SUPPLIER shall provide a projected shop schedule with appropriate fabrication stages at the time drawings are submitted for approval, to highlight the inspection activity schedule.

The approval of any work by the COMPANY, or their authorised representative, shall in no way relieve the SUPPLIER of any responsibility for carrying out the provisions of this specification.

7.2 Inspection

7.2.1 All materials, fabrication, and packaging shall be subject to inspection by the COMPANY during all stages of manufacture.

7.2.2 Diameter of cartridge and pedestal tray assemblies shall be checked to ensure that the assemblies can be inserted and withdrawn from the vessel shell without binding or interference taking into account an allowable tolerance of 1/8 in. (3 mm) on vessel ID. The maximum permissible radial gap between tray periphery and vessel shell is 3/16 in. (5 mm).

7.2.3 All shroud welds shall be vacuum box tested.

7.2.4 Fit-up. One tray, grid, and deck of each diameter and type shall be assembled in the vessel at the SUPPLIER's shop to the extent necessary to check fit-up.

7.2.5 Shroud joints shall be 100 percent examined by liquid penetrant. Test fluids shall be chloride free.

7.2.6 Magnetic particle examination and acceptance criteria shall be per ASME Code Section VIII, Appendix VI. Ultrasonic examination and acceptance criteria shall be per ASME Code Section VIII, Appendix XII.

7.3 Leakage and Flow Measurement Tests

7.3.1 Leakage tests shall not be performed on jet, sieve, valve, cartridge or pedestal trays.

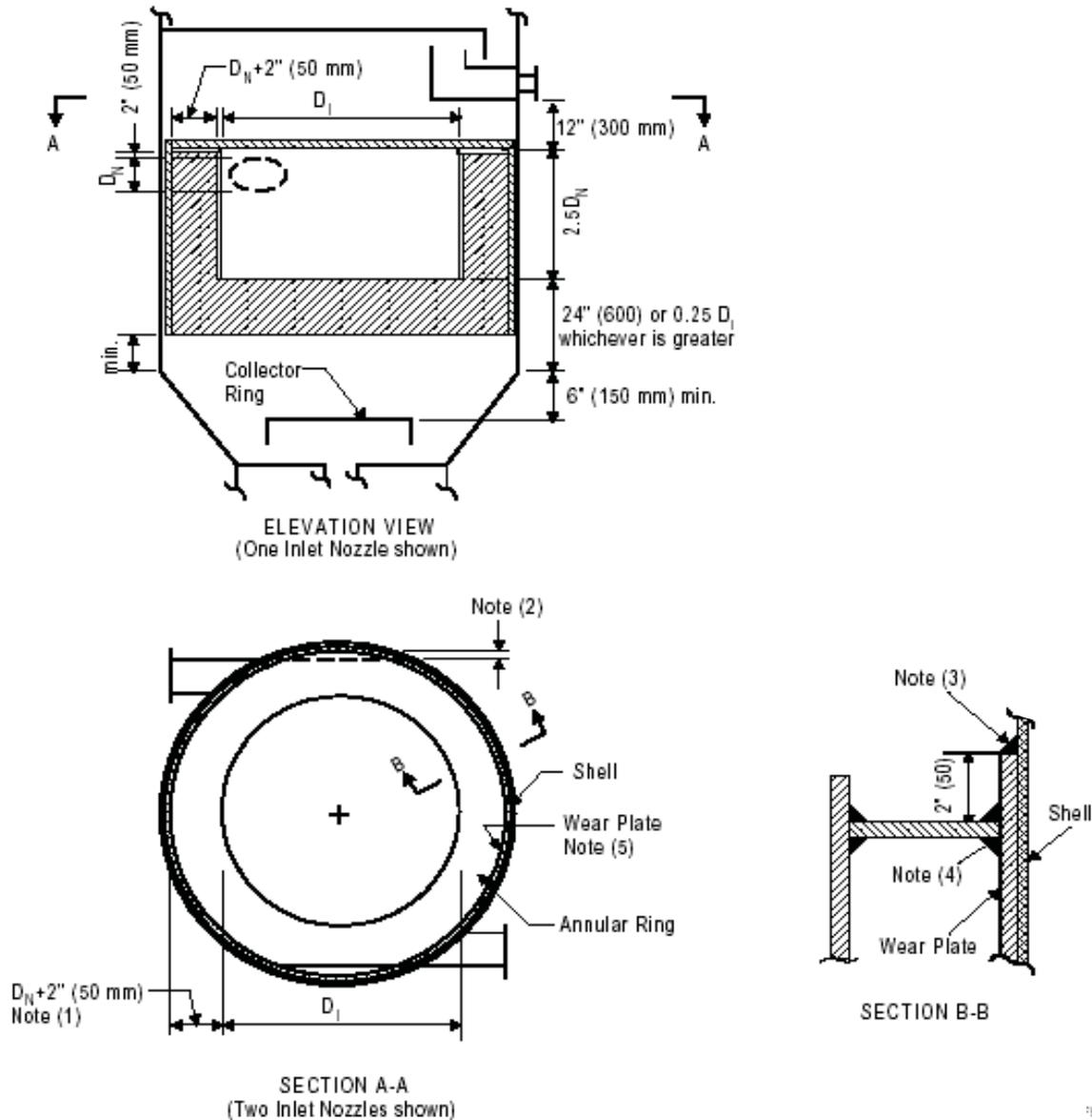
7.3.2 Fresh water shall be used for testing. When testing items manufactured from stainless steel, the chloride iron content of the test water shall not exceed 30ppm.

8.0 **PREPARATION FOR SHIPMENT**

After the final test, the unit shall be dried and cleaned thoroughly of all grease, loose scale, and rust (both internally and externally). The preparation for shipment of the Packages shall meet the Preparation For Shipment as detail in Specification for Skid-Mounted Packages (165-4-SPM-055), Specification for Export Packing & Crating (165-4-SPM-031).

Tower packing shall be packaged to effect protection against corrosion or degradation during shipping and storage at site.

Protection from salt water. Austenitic stainless steel components shall not be exposed to wetting by salt water or salt spray. Protective coating or coverings used to prevent such exposure shall be approved by COMPANY.

FIGURE – 1**ANNULAR RING AND WEAR PLATE FOR
USE WITH TANGENTIAL INLET NOZZLE(S)****Notes:**

- (1) No support members are permitted within the annular ring area.
- (2) Feed nozzles may be offset by up to 2 in. (50 mm).
- (3) The wear plate shall be fillet welded all around its perimeter. Wear plate shall be vented to the inside of the vessel with 1/4 in. (6 mm) diameter hole.
- (4) Weld to be full thickness of wear plate and annular ring.
- (5) The annular ring and wear plate shall be 1/2 in. (13 mm) thick unless otherwise specified. Supplier's detailed design of annular ring supports shall be submitted to Contractor for approval by Supplier. If the coefficient of thermal expansion is more than 10% different from that of the shell, the support design shall provide for thermal expansion.

FIGURE – 2

REACTOR THERMOWELL EXPANSION GUIDE

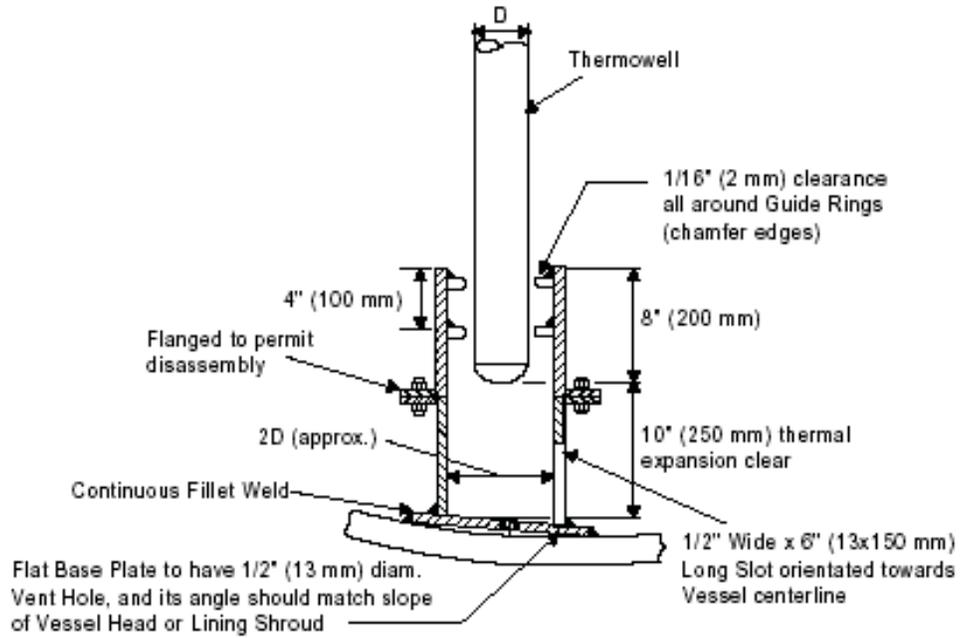


FIGURE – 3

TRAY GUIDE FOR THERMOWELL OR DUMP TUBE

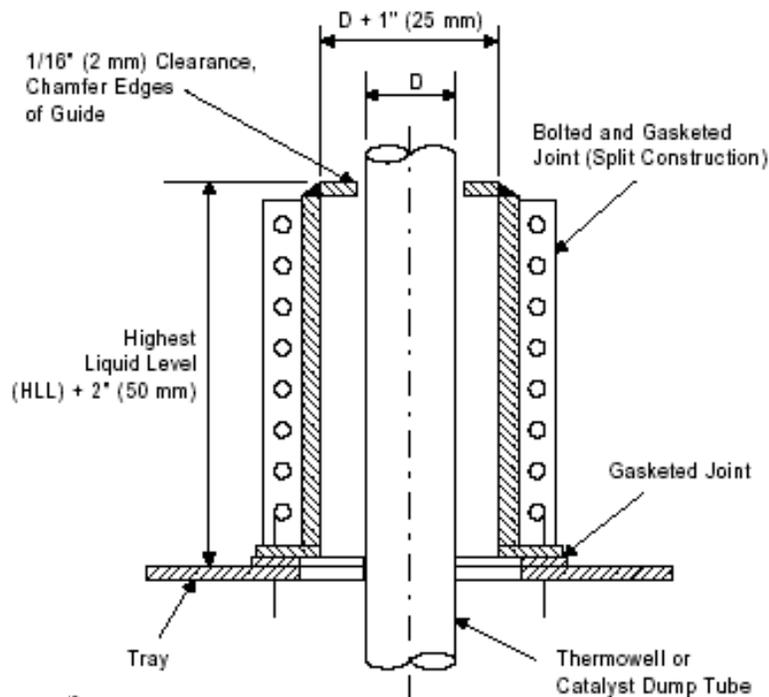


FIGURE – 4

VESSEL INTERNALS
TOLERANCES FOR FABRICATION AND ASSEMBLY

- ① Height of weir above tray deck: $\pm 1/8$ in. (3.2 mm)
- ② Top of weir plate out of level across length of weir:
Tolerance per Item ⑧
- ③ Maximum joint opening between deck plates and beams or support rings for perforated, bubble cap, jet or valve trays (to limit gas passage): $1/64$ in. (0.4 mm)
- ④ Height of slots in bubble caps above top of tray: $\pm 1/16$ in. (1.6 mm)
- ⑤ Height of bubble cap chimney above top of tray: $\pm 1/16$ in. (1.6 mm)
- ⑥ Downcomer horizontal clearances (measured from bottom edge of downcomer to recessed seal pan or inlet weir): $\pm 1/8$ in. (3.2 mm)
- ⑦ Bottom of downcomer above tray or seal pan: $\pm 1/4$ in. (6.4 mm)
- ⑧ Tray supports must present a flat surface for metal to metal contact between tray and support. Support shall be flat within $1/32$ in. (0.8 mm) on any 12 in. (300 mm) chord. For tray supports and tray decks, out of level tolerance over any diameter shall be:

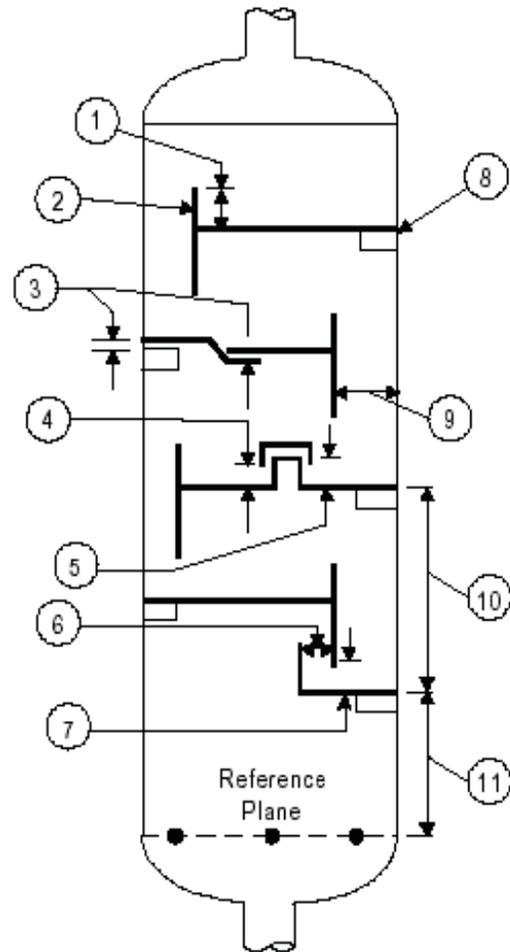
TOWER DIAMETER		TOLERANCE
ft	mm	in. (mm)
Diam < 4	Diam < 1220	1/8 (3.2)
4 ≤ Diam ≤ 7	1220 ≤ Diam ≤ 2130	3/16 (4.8)
7 ≤ Diam ≤ 16	2130 ≤ Diam ≤ 4875	1/4 (6.4)
Diam > 4	Diam > 4875	5/16 (8)

- ⑨ Downcomer opening measurements:

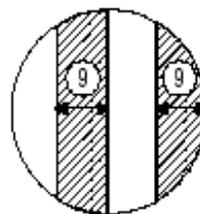
TOWER DIAMETER		TOLERANCE
ft	mm	in. (mm)
Diam < 4	Diam < 1220	$\pm 1/8$ (3.2)
4 ≤ Diam ≤ 7	1220 ≤ Diam ≤ 2130	$\pm 3/16$ (4.8)
7 ≤ Diam ≤ 16	2130 ≤ Diam ≤ 4875	$\pm 1/4$ (6.4)
Diam > 4	Diam > 4875	$\pm 5/16$ (8)

- ⑩ Tolerance top of support to top of support ring of tray or related parts: $\pm 1/8$ in. (3.2 mm)
- ⑪ Location of tray support ring from reference plane: $\pm 1/4$ in. (6.4 mm)
- ⑫ Miscellaneous:

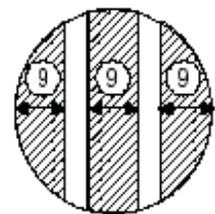
DESCRIPTION	TOLERANCE, in. (mm)
Location of parts bolted to clips or brackets welded to vessel by others	$\pm 1/8$ (3.2)
Height of tubes, chimneys, or weir notches above top of tray	$\pm 1/16$ (1.6)
Tolerances not shown on drawing:	$\pm 1/8$ (3.2)



Single or 3-Pass



2 or 4-Pass





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OIL & GAS DEVELOPMENT COMPANY LTD.

SPECIFICATION FOR INSTALLATION OF EQUIPMENT, MACHINERY AND PIPING (NACE COMPLIANT)



0	07-10-2013	Issued for Tender	WUS	MAIAH	MAS
Rev.	Date	Description	Prepared By	Checked By	Approved By

C O N T E N T S

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1.0 **INTRODUCTION**

1.1 **Scope**

This specification covers the minimum requirements for supply, fabrication, installation erection, inspection and testing of piping including pipe supports; installation, erection and alignment of equipment and machinery involved in the installation of piping, equipment and ancillary works.

1.2 **Definitions**

Following definitions apply throughout this document:

- **COMPANY:** Oil & Gas Development Company Ltd. (OGDCL).
- **CONSULTANT:** M/s. Zishan Engineers (Pvt.) Ltd. (ZEL).
ZEL have been awarded the work of Engineering, Procurement Assistance and Project Management.
- **CONTRACTOR:** Means the construction company to be engaged by the COMPANY to perform the Construction work.
- **SUPPLIER/VENDOR:** The organization, firm or agency with who order for the supply of equipment and or material has been placed. SUPPLIER shall solely be responsible for the quality and satisfactory performance of all the items included in his scope of supply.

2.0 **SCOPE**

The Contractor's scope of work shall include, among others, the following items of work:

- Preparation of working area as required to bring the pipes, equipment / material at job site.
- Transportation of pipes, equipment / material from any location within the premises to the job site.
- Supply and fixing of anchor bolts.
- Checking & preparation of foundation prior to erection work.

- Supply of all erection materials, such as temporary connections, blinds and spacers for hydrotesting, temporary strainers, temporary supports, scaffolding, shims required for levelling, pumps and piping for hydrotesting, etc., required for satisfactory completion of work.
- Supply of all consumables and erection equipment.
- Supply and storage of water for hydrotesting.
- Welding shall be carried out according to qualified welding procedures. All charges pertaining to these qualifications shall be borne by the Contractor.
- Only qualified welders shall be allowed to work on the job. Welder's qualification tests shall be arranged by the Contractor, before commencement of work. All charges pertaining to this Qualification shall be borne by the Contractor.
- Removal of all temporary facilities and cleaning the job site after completion of work.
- Supply of fuel water and electricity for construction purposes.
- Field bending and pipe threading where required.

3.0 **APPLICABLE STANDARDS/SPECIFICATIONS**

Where specific details about the execution of any item of work are not included, work shall be carried out according to the requirements of the latest editions of the following standards and specifications:

ANSI B-31.3	Chemical Plant Piping
ASME Section IX	Welding and Brazing Qualification
NACE MR-0175	Petroleum and natural gas industries materials for use in H2S-containing environments in oil and gas production.

4.0 **STORAGE AND HANDLING**

- 4.1 All piping material shall be stored by the Contractor in areas demarcated for this purpose.
- 4.2 Pipes, valves, fittings, bolts, gaskets, instrument and equipment shall be stored in covered locked premises. In no case shall the marking on the equipment be removed. Valves and other equipment provided with protective caps shall be stored with the caps upto the moment they are installed.
- 4.3 Handling of material shall be done with suitable mechanical equipment and safety of workers shall be given top priority.

5.0 **FABRICATION**

5.1 **General**

Fabrication of all piping shall be in accordance with the requirements of piping drawings, specifications and NACE MR-0175 (Latest Revision).

5.2 **Pipe Cutting**

- a) Pipe below 2" diameter shall be cut by pipe cutter only; flame cutting is not allowed.
- b) It would be preferable to cut the larger sizes also with pipe cutter, but flame cutting is also acceptable, provided after cutting, the edges are prepared by grinding or machining.

5.3 **Flanges**

- a) All necessary action shall be taken to avoid damage to the flange face.
- b) Bolt holes shall straddle the axis of pipe for all flanged connections. Where flanges are to be fastened to equipment flanges, the bolt holes shall match the equipment flange orientation.

5.4 **Welding Joints**

- a) Contractor shall take precautions during all pipe handling operations to prevent damage to piping components including pipe, fittings, valve and prefabricated items.

Normally, piping components containing surface defects or damage that may affect their strength or reduce their serviceability shall not be welded in the piping. Such surface defects and damage include but are not limited to gouges, dents, buckles, dented or nicked bevels, split ends, seam cracks and pits or any other stress concentrator.

- b) **Cleaning**

Before welding the two lengths (pieces) of pipes, the contractor will remove all dust scales or any other material by blowing compressed air through the pipes. The contractor will ensure that inside of pipe is free from any foreign material before welding the ends of pipes.

c) **End Preparation**

Butt welding Bevel ends shall be prepared according to the dimensions given in the welding procedure specifications. Where dimensions are not given, the following shall be used:

Bevel 30 deg, plus 7.1/2 deg, minus 0 degree

Land 1/16," plus 1/32", - 0"

Gap 1/16," plus 1/32", - 0"

Bevelling shall be done by Bevelling and the finished bevel shall be free of nicks or grooves. Prior to welding, the bevelled surface and the inside surface of the pipe, within 1/4" of the weld joint shall be cleaned of all foreign material.

d) **Weld Joint Alignment**

Pipes to be welded shall be aligned by suitable means such as external clamps, yokes etc. Yokes, if used, shall be tack welded using electrodes compatible with parent metal. After joint fit-up, yokes shall be hammered off and tacks shall be ground flush with the outside surface of the pipe.

Misalignment in piping joints shall not exceed 1/16" and this will be preserved during welding. Hammering shall not be carried out to compensate for dimensional variations.

The distance between two adjacent welds shall not be less than 2".

Tack welding shall be done by qualified welders only and shall conform to the quality of root weld.

Longitudinally welded seams in adjacent lengths of pipe, shall be offset by a minimum distance equal to one fourth pipe diameter.

Approval of joint fit-up by Engineer shall be required prior to the welding operations.

4.5 **Threaded Pipe**

- a) The contractor shall use good quality cutters and dies when cutting and threading pipe. The ends of cut pipe shall be square and true.
- b) Threaded joints shall be properly aligned. Pipe entering unions shall be true to centerline so that the union does not have to be forced to make-up.

- c) Threaded pipe shall not project through fittings to cause interference with valves or other operating mechanisms.
- d) Threaded connections may be made tight by making use of the sealing tape.
- e) All threaded joints that leak during testing, shall be replaced.
- f) Pipe wrenches shall not excessively scar the pipe.
- g) Threaded joints shall be seal welded wherever indicated in the drawings. Seal welding shall be carried out after hydrostatic testing and seal welds shall not be used to stop hydrostatic test leaks.

6.0 **PIPING INSTALLATION**

- 6.1 Flange protections on equipment nozzles shall be left in place until piping is connected.
- 6.2 All valves provided with protective caps shall be stored with the caps upto the moment they are actually installed.
- 6.3 Before fastening, the faces of flanges shall be cleaned.
- 6.4 All piping and equipment connections shall be accurately aligned and the Contractor shall ensure that all flange faces are parallel and correctly centered before bolting. Force shall not be used in attaining alignment.
- 6.5 Gaskets of specified material and proper size shall be installed in each joint.
- 6.6 Globe and non-return valves shall be installed according to the direction of flow marked on the valve. If no direction is marked, it shall be checked and painted on the valve prior to installation.
- 6.7 Flange bolts shall be tightened evenly to impose equal pressure on the gasket at all times.
- 6.8 Piping shall be installed true and level or plumb; where slope is required, it shall be maintained without sags in the piping run.

7.0 **EQUIPMENT/MACHINERY INSTALLATION AND ERECTION**

7.1 **General**

The Contractor shall set, level, align and properly grout to the foundation all equipment/machinery in strict compliance with the location, dimensions and elevations as shown in the drawings and in accordance with the manufacturer's recommendations and instructions.

Prior to installation, the Contractor shall remove any temporary protective coating, such as rust inhibitors applied for ocean shipment, in accordance with the information supplied by the manufacturer. Machinery shall be drained and flushed of factory lubricants and replaced with new lubricant.

7.2 **Preparation of Foundation for installation**

The foundations for equipment & pipe supports shall be checked for location and level prior to start of erection. The erection Contractor shall provide all material and workmanship for preparing the finished level of foundations and elevation adjustments needed at the time of the erection of the equipment, machinery and piping.

7.3 **Erection & Alignment**

- a) Protective flanges, covers or caps on the equipment and machinery shall not be removed until piping connections are ready to be made. Vent and drain connection of the equipment and machinery shall be cleaned before start-up.
- b) Foundation bolts shall not be fully tightened until grout has Cured / hardened.
- c) The center lines of equipment/machinery to be installed shall be accurately aligned with reference to the coordinates established for the plant, using bench marks.

The suction and discharge flanges of pump shall be checked for level and verticality and adjustments made if necessary by placing thin steel shims under the base plate.

- d) The Contractor shall perform alignment checks for alignment of the driven machinery to its drive in the cold condition, according to the manufacturer's instructions.

- e) The alignment of the driven machinery to its drive shall also be carried out for the hot or operating condition. A hot alignment check shall be made after the machine has been operated and has reached the operating temperature. This check shall be made immediately after the machine has been stopped and before it has been allowed to cool and shrink to the cold position.

7.4 **Grouting**

- a) The Contractor shall supply grouting material and carry out all grouting work related to equipment and machinery foundations.
- b) Grout material shall consist of one part cement and three parts of sand.
- c) Equipment under vibration shall be grouted with approved non-shrinkable grouting material.
- d) Once setting and preliminary alignment has been approved by the Engineer, the Contractor shall grout the equipment/machinery base plates.
- e) Steel surface that will be in contact with the grout shall be clean and dry.
- f) Concrete surfaces shall be clean, dry and free of oil, dirt or grease. The concrete shall have the top layer chipped to expose a uniform, thoroughly cured surface.

8.0 **WELDING**

8.1 **Specification**

Welding shall be carried out according to the requirements of specification for Production Welding.

8.2 **Inspection**

- a) The quality of welding shall be checked visually and by non-destructive methods, in accordance with ANSI B 31.3.
- b) The Contractor shall be solely responsible for coordinating inspection work with construction activities.

8.3 **Repair & Removal of Defects**

- a) Welds which do not meet the acceptance standards of this specification, shall be cut out by removing a cylinder of pipe containing the weld, or with the prior approval of the Engineer, repaired.

b) **Allowable Repairs**

Repairs may normally be allowed, at the Engineer's discretion, if there are no cracks in the weld and if the segment of weld to be repaired was not previously repaired.

c) **Repair Procedure**

- i. Defect removal: Weld defects shall be removed by grinding. The repair cavity shall be of sufficient size to allow adequate access for welding.
- ii. Cleaning: Scale and slag shall be removed from each weld bead and groove before depositing the next weld bead.

d) **Arc Burns**

Arc burns shall be removed by grinding. Grinding shall have a smooth contour. After grinding, the remaining wall thickness in the area shall not be less than 90% of the nominal wall thickness.

9.0 **PIPE SUPPORTS**

9.1 **Supply/fabrication/installation of steel support.**

- a) The Contractor shall supply all material, fabricate and install all supports as required.
- b) All temporary supports necessary for erection work shall be provided by the Contractor and removed when permanent supports have been installed.

9.2 **Grouting of Supports**

- a) Grout pads shall be constructed for the supports where necessary.
- b) Grout material shall consist of one part of cement and three parts of sand.
- c) Pads, iron bars etc. shall not be loaded until grout has cured for at least seven days.

10.0 **HYDROSTATIC TESTING**

- 10.1 After completion of welding of each pipeline system, hydrostatic test shall be performed at pressures indicated by the Engineer as per ANSI B 31.3.
- 10.2 Before starting hydrostatic testing operations, the lines shall be purged by compressed air so as to clear the lines of any foreign materials.
- 10.3 Contractor shall inform the Engineer well in advance about the performance of hydrostatic tests.
- 10.4 Contractor shall keep a record of all hydrostatic tests performed on complete piping system or on sections of piping. He shall record the date of test, test conditions, and results. These reports will be signed by the Contractor and witnessed by the owner's Representative / Engineer.
- 10.5 All material and labour required for hydrostatic testing shall be provided by the Contractor.
- 10.6 Pumps shall not be subjected to hydrostatic pressure and shall be isolated from the piping system during the test.
- 10.7 Pressure gauges mounted on piping may be tested together with the piping if the test pressure does not exceed the pressure gauge range. Pressure gauges shall be blocked off from piping during blowing or flushing operations.
- 10.8 Pressure test shall not be carried out against closed valves. Valve seats shall not be subjected to pressures exceeding their specified pressures.
- 10.9 After pressurizing the line upto the specified pressure, all welded and flanged joints shall be inspected by the Contractor's Engineer and Owner's Representative. During this period, the line shall be maintained under pressure.
- 10.10 If leaks are detected, the line shall be completely drained and the leak repaired by the contractor in the manner specified for repairs. After repair the line shall be retested at the same pressure following the above procedure.
- 10.11 After successful completion of hydrostatic testing, all equipment/lines shall be completely drained by the Contractor.
- 10.12 Lines which are normally open to atmosphere may not be pressure tested. These lines shall, however, be visually inspected to ensure proper workmanship.

11.0 CLEANING

- 11.1 After successful completion of hydrostatic testing, all lines shall be cleaned by flushing, blowing or swabbing, as approved by Owner's engineer.
- 11.2 The Contractor shall provide all equipment required and shall carry out all operations involved in cleaning.
- 11.3 All foreign material, including but not limited to scale, rust, dirt, moisture, welding rods and particles shall be removed from the inside of all piping systems.
- 11.4 Equipment like pumps, strainers etc. shall be removed before cleaning operations. The Contractor shall provide temporary connections to bypass these items. After cleaning the Contractor shall install these items in the piping system using new gaskets, if required.
- 11.5 All piping shall be flushed with water until clean.
- 11.6 All lines shall be thoroughly dried by blowing compressed air.
- 11.7 Cleaning operations shall be performed until the Engineer is satisfied that the piping systems are thoroughly clean and dry.

GENERAL SPECIFICATIONS



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OIL & GAS DEVELOPMENT COMPANY LTD.

KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE – II

PREFERRED VENDOR LIST FOR ACID GAS INCINERATOR PACKAGE



0	21-02-2017	Issued for Tender	AK	SMHA	MAS
Rev.	Date	Description	Prepared By	Checked By	Approved By

OIL & GAS DEVELOPMENT COMPANY LTD.**PREFERRED VENDOR LIST**

DESCRIPTION	NAME	COUNTRY
1. INSTRUMENTATION & CONTROLS		
INSTRUMENT CABLES	BATT	UK
	DRAKA	HOLLAND
	OMAN CABLE	OMAN
	BELDEN	USA
	BICC CABLES	UK
	PIRELLI	ITALY
	ERSE CABLO	TURKEY
	KERPEN	GERMANY
CABLE GLANDS	CLIPSAL	AUSTRALIA
	ATX	FRANCE
	CMP	UNITED KINGDOM
	COOPER CAPRI	IRELAND
	CORTEM	ITALY
	HAWKE INTERNATIONAL	UK
	PEPPERS CABLE GLANDS LTD.	UK
	CROUSE HINDS / COOPER INDUSTRIES	USA
R.STAHL	GERMANY	
2. ELECTRICAL		
POWER & CONTROL CABLES	FAST CABLES	PAKISTAN
	NEWAGE CABLES	PAKISTAN
	PAKISTAN CABLES	PAKISTAN
	DUCAB	UAE
	SAUDI CABLE	SAUDI ARABIA
	PIRELLI	ITALY / UK
	OMAN CABLES	OMAN
	AEI	UK
	PIONEER CABLES	PAKISTAN
ELECTRICAL MOTOR	ABB	INTERNATIONAL
	GE INDUSTRIAL SYSTEM	GERMANY
	LOHER (SIEMENS)	GERMANY
	SIEMENS	INTERNATIONAL/PAKISTAN
	BROOK CROMPTION	UK
	TOSHIBA	JAPAN
	GE INDUSTRIAL SYSTEM	GERMANY
	NANYANG EXPLOSION PROTECTION GROUP CO. LTD.	CHINA
	ASI ROBICON (ANSALDO)	GERMANY
	WEG	INTERNATIONAL
LIGHTING & SMALL POWER DISTRIBUTION PANEL (EXD)	APPLETON ELECTRIC CO.	USA
	COOPER CEAG CROUSE-HINDS	INTERNATIONAL
	KILLARK	USA
	LEGRAND ELECTRIC LTD.	UK
	R.STAHL	GERMANY

OIL & GAS DEVELOPMENT COMPANY LTD.**PREFERRED VENDOR LIST**

DESCRIPTION	NAME	COUNTRY
LV SWITCHGEAR AND MOTOR CONTROL (NON-EX)	AREVA	PAKISTAN
	PEL	PAKISTAN
	SIEMENS	PAKISTAN
	ABB	PAKISTAN
	SCHNEIDER ELECTRIC	FRANCE / PAKISTAN
PROTECTION RELAYS	ABB	GERMANY
	ALLEN BRADLEY	GERMANY
	GENERAL ELECTRIC	USA
	SCHNEIDER ELECTRIC	FRANCE
	SIEMENS	INTERNATIONAL
VARIABLE SPEED DRIVES	ABB	INTERNATIONAL
	ANSALDO	ITALY
	LOHER (SIEMENS)	GERMANY
	SIEMENS	INTERNATIONAL
	SCHNEIDER ELECTRIC	FRANCE
	WEG	BRAZIL
EARTHING & LIGHTING PROTECTION ACCESSORIES	ERICO	USA
	FURSE	UK
	LPI	AUSTRALIA
CABLE GLANDS	CLIPSAL	AUSTRALIA
	ATX	FRANCE
	CMP	UNITED KINGDOM
	COOPER CAPRI	IRELAND
	CORTEM	ITALY
	HAWKE INTERNATIONAL	UK
	PEPPERS CABLE GLANDS LTD.	UK
	CROUSE HINDS / COOPER INDUSTRIES	USA
	R.STAHL	GERMANY
LOCAL CONTROL STATIONS / PUSH BUTTONS (EX-PROOF)	CLIPSAL EX	AUSTRALIA
	ATX	FRANCE
	APPLETON	USA
	R. STAHL	GERMANY
	CEAG CROUSE-HINDS	USA
	CORTEM	ITALY
	KILLARK	USA
	GOVAN	AUSTRALIA
<u>3. PIPING (MECHANICAL)</u>		
ANCHOR BOLTS	AL RASHED FASTENERS	SAUDI ARABIA
	AL NAJIM	SAUDI ARABIA
	OME	ITALY
	SORCOM	FRANCE
	STEADFAST ENGINEERING	UK
BOLTS & NUTS	ASIA BOLT	UAE
	BEA SPA	ITALY
	ETS BECK-CRESPEL SA	FRANCE
	IML INDUSTRIAL MECCANICA LIGURE	ITALY
	ROLLSTUD	UK
	SINGHENG	SINGAPORE

OIL & GAS DEVELOPMENT COMPANY LTD.**PREFERRED VENDOR LIST**

DESCRIPTION	NAME	COUNTRY
CHECK VALVE WAFER TYPE	AMRI	FRANCE
	ASTAM	JAPAN
	GOODWIN	UK
	MARLIN VALVE COMPANY	USA
	STOCKHAM VALVE	UK/JAPAN
FITTINGS AND FLANGES	BONNEY FORGE INT.	UK
	EURO GUARCO S.P.A	ITALY
	ECONOSTO	NETHERLAND
	FLANGES LTD.	UK
	INTERFIT	FRANCE
	PHOCEENE DE METALLURGIE S.A	FRANCE
	SUMITOMO METAL IND. LTD.	JAPAN
	TECHNOFORGE	ITALY
	TROUVAY & CAUVIN	FRANCE
	VALLOUREC BENELUX SA/NV	BELGIUM
	VAN LEEUWEN	NETHERLAND
GASKET	EURO GUARCO S.P.A	ITALY
	FLEXITALLIC LIMITED	UK
	CHAMPION GASKET & RUBBER INC.	USA
	GARLOCK HELICOFLEX	UK
	JAMES WALKER	BELGIUM
	SAUDI GASKET	SAUDI ARABIA
	KLINGER	UK
	KOREA PILLAR	KOREA
CONNECTORS	CLEMONS SALES CORPORATION	UK
	NIKKISO (GRAYLOC)	JAPAN
	GALPERTI ENGINEERING	ITALY
	OTECO	USA
	REFLANGE	USA
PIPES	FLEXITALLIC	UK
	EURO GUARCO S.P.A	ITALY
	NKK CORPORATION	JAPAN
	NIPPON STEEL CORP	SINGAPORE
	MANNESMANN LINE PIPE GMBH	GERMANY
	US STEEL	USA
	SUMITOMO CORPORATION OF AMERICA	USA
	TECHINT	SUDAN
	VAN LEEUWEN PIPE & TUBE GROUP	THE NETHERLANDS
	HALL LONGMORE	SOUTH AFRICA
	HUFFAZ PIPE MILLS	PAKISTAN
	PHOCEENE DE METALLURGIE S.A	FRANCE
SUMITOMO METAL IND. LTD.	JAPAN	
TENARIS	JAPAN	

OIL & GAS DEVELOPMENT COMPANY LTD.**PREFERRED VENDOR LIST**

DESCRIPTION	NAME	COUNTRY
PIPES	TROUVAY & CAUVIN	JAPAN
	VALOUREC BENELUX SA/NV	BELGIUM
	JFE STEEL	JAPAN
	CORUS	UK
	VAN LEEUWEN PIPE & TUBE GROUP	THE NETHERLANDS
	VAN LEEUWEN	NETHERLANDS
SPRING SUPPORT	CARPENTER & PATERSON	UK
	ITT GRINNEL CORP.	GERMANY/FRANCE
	NHK SPRING CO	JAPAN
VALVES	AUDCO	USA
	AES, INC. - USA	USA
	ROBERTS ENGINEERING SALES CO.	USA
	ARM-TEX CORP.	USA
	OLIVER VALVES LIMITED	UK
	NEWCO	USA
	CAMERON	USA
	IFORTIM ENGG PTE LTD. (SUPPLIER)	SINGAPORE
	ANDERSON GREENWOOD	FRANCE
	BRAY INTERNATIONAL INC.	USA
	ASAHI-AMERICA	USA
	PARKER	SOUTH AFRICA
	DRESSER VALVE DIVISION (WHEATLEY)	USA
	BUTLER VALVES AND FITTINGS LIMITED	UK
	KITZ	USA
VALVES	ANVIL	THE NETHERLANDS
	JAMEBURY	RSA
	ARFLU	UK
	BONNEY FORGE	JAPAN
	CRANE VALVES	USA
	EURO GUARCO S.P.A	ITALY
	KITZ CORPORATION	JAPAN
	STEEL TRADE	-----
	TPS	ITALY
	NSV CORPORATION	KOREA
	VAN LEEUWEN	JAPAN
	TYCO VALVES & CONTROLS NV	JAPAN
	VELAN VALVE CORPORATION	USA/CANADA
PROTECTIVE COATINGS	CARBOLINE COMPANY	USA
	AMERON INTERNATIONAL PC&F EUROPE	THE NETHERLANDS
	JOTUN	SOUTH AFRICA
	HEMPEL	DENMARK
	INTERNATIONAL PAINT (PTY) LIMITED	RSA
	SIGMA COATINGS NIGERIA LTD	NIGERIA

OIL & GAS DEVELOPMENT COMPANY LTD.**PREFERRED VENDOR LIST**

DESCRIPTION	NAME	COUNTRY
TRAY & PACKING	AMITSCO	USA
	HAT INTERNATIONAL	UK
	KOCH GLITSCH	ITALY
	SULZER CHEMTECH	NETHERLANDS/SINGAPORE
WRAPPING MATERIALS	ALTA	----
	BERRY PLASTICS CORPORATION	USA
	GRAINGER CO.INC.	USA
	SHAIC	KOREA
	RAYCHEM S.P.A	ITALY
	TYCO ELECTRONICS	USA

NOTE:

1. As part of the Bid the Supplier/Packager shall include his list of proposed Suppliers, Sub-contractors and Process Licensors. The list above contains the names of OGDCL recommended companies; Supplier/Packager to submit his proposed list with the Bid. Any Suppliers/Vendors other than from the Preferred Vendor List shall require OGDCL's approval.



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OIL & GAS DEVELOPMENT COMPANY LTD.

SITE, ENVIRONMENT & UTILITY DATA



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2	25-05-2012	Re-issued for Tender	MIAH	MAJ	MAS
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Rev.	Date	Description	Prepared By	Checked By	Approved By

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ANNEXURE – I:	NATIONAL ENVIRONMENTAL QUALITY STANDARDS	

1.0 **INTRODUCTION**

Oil & Gas Development Company (OGDCL) is operating oil/gas fields in various parts of Islamic Republic of Pakistan. At one of the field OGDCL aims to construct a gas processing facility to process raw gas. The process sales gas from the facility will be supplied to gas transmission/distribution company operating in the area. The LPG will also be extracted from the gas stream. The facilities to be constructed will include:

- Wellhead Facilities
- Gas Gathering System
- Gas Processing Plant
- LPG and Condensate Recovery
- Produced Water Handling System
- LPG & Condensate Storage & handling System

The gas processing facility shall treat 250 MMSCFD raw gas with a margin of 10%. The 250 MMSCFD raw gas shall yield 225.2 MMSCFD sales gas 5058 bbls/day condensate and 413 MT/day LPG.

The design capacity of the plant is 250 MMSCFD for which two trains of 125 MMSCFD will be required.

OGDCL has engaged Zishan Engineers (Pvt.) Ltd. (ZEL) as Consultant for the project.

2.0 **ENVIRONMENTAL CONDITIONS**

2.1 **Ambient Temperature Data**

Ambient Temperature, Minimum Average	:	64 °F (18° C)
Ambient Temperature, Maximum Average	:	93 °F (34° C)
Ambient Temperature, Maximum	:	118 °F (48° C)
Ambient Temperature, Minimum	:	36 °F (2.2° C)
Wet Bulb Temperature	:	88 °F (31 °C)

2.2 **Rainfall Data**

Maximum Daily Rainfall (24 hours)	:	10 in (251 mm)
Highest Average Monthly Rainfall	:	11.26 in (286 mm)

2.3 Wind Data

Maximum Velocity : 100 mph

Design Velocity : 100 mph

Exposure factor C – flat open terrain, importance factor 1.15 – essential facility.

2.4 Humidity

Relative Humidity : 20% to 77%

2.5 Ice/Frost Data

Not applicable.

2.6 Elevation

69 ft. (21 m)

2.7 Earthquake Design Data

Zone 2A of Uniform Building Code UBC 1997.

3.0 UTILITY INFORMATION**3.1 Hot Oil**

Hot Oil Supply Temperature : 315 °F & 615 °F

3.2 Cooling Water

CW Supply Temperature : 93 °F

3.3 Fuel Gas

Note: Vendor to advice

3.4 Instrument Air

Instrument Air Normal Operating Pressure : 87 - 116 psig

Dew point : - 4 °F (- 20 °C)

3.5 Plant Air

Plant Air Normal Operating Pressure : 116 psig

3.6 Nitrogen

Normal Header Operating Pressure : 88 psig

3.7 Electrical Power

Power Generation / Main Distribution : 6.6KV, 3 Phase, 50Hz
Power for LV Motors : 400 V, 3 Phase, 50Hz
Power for MV Motors : 6.6KV, 3 Phase, 50Hz
Lighting : 230 VAC, 1 Phase, 50 Hz.
PLC / Control Panel : 230 VAC, 1 Phase, 50 Hz.
from UPS

3.8 Water Analysis

Note: Vendor to advice

4.0 NATIONAL ENVIRONMENTAL QUALITY STANDARDS (NEQS)

National environmental quality standards (NEQS) are attached as **Annexure-I.**

ANNEXURE – I

NATIONAL ENVIRONMENTAL QUALITY STANDARDS

REGISTERED No. M-302
L. 7646



EXTRAORDINARY
PUBLISHED BY AUTHORITY

ISLAMABAD, THURSDAY, AUGUST 10, 2000

PART-II

Statutory Notification (S.R.O)

GOVERNMENT OF PAKISTAN

MINISTRY OF ENVIRONMENT, LOCAL GOVERNMENT AND
RURAL DEVELOPMENT

NOTIFICATION

Islamabad, the 8th August 2000

S.R.O. 549 (I)/2000.___ In exercise of the powers conferred under clause (c) of sub-section (1) of section of 6 of the Pakistan environmental Protection Act. 1997 (XXXIV of 1997), the Pakistan Environmental Protection Agency, with the prior approval of the Pakistan Environmental Protection Council, is pleased to direct that the following further amendments shall be made in its Notification No. S.R.O. 742(I)/93, dated the 24th August, 1993, namely: ___

In the aforesaid Notification, in paragraph 2. _____

(1289)

[4138(2000)/Ex.GAZ]

Price : Rs. 5.00

1290 THE GAZETTE OF PAKISTAN, EXTRA, AUGUST 10, 2000 [PART-II]

(1) for Annex, I the following shall be substituted, namely: _____

Annex-I

“NATIONAL ENVIRONMENTAL QUALITY STANDARDS FOR MUNICIPAL AND LIQUID INDUSTRIAL EFFLUENTS (mg/l, UNLESS OTHERWISE DEFINED)

S. No.	Parameter	Revised Standards			
		Existing Standards	Into Inland Waters	Into Sewage Treatment ⁽⁵⁾	Into Sea ⁽¹⁾
1	2	3	4	5	6
1.	Temperature or Temperature Increase *	40°C	3°C	3°C	3°C
2.	pH value (H+) .	6-10	6-9	6-9	6-9
3.	Biochemical Oxygen Demand (BOD) ₅ at 20°C ⁽¹⁾	80	80	250	80**
4.	Chemical Oxygen Demand (COD) ⁽¹⁾ ..	150	150	400	400
5.	Total Suspended Solids (TSS) .. .	150	200	400	200
6.	Total Dissolved Solids (TDS)	3500	3500	3500	3500
7.	Oil and Grease	10	10	10	10
8.	Phenolic compounds (as phenol)	0.1	0.1	0.3	0.3
9.	Chloride (as Cl ⁻)	1000	1000	1000	SC***
10.	Fluoride (as F ⁻)	20	10	10	10
11.	Cyanide (as CN ⁻) total ..	2	1.0	1.0	1.0
12.	An-ionic detergents (as MBAS) ⁽²⁾	20	20	20	20
13.	Sulphate (SO ₄ ²⁻)	600	600	1000	SC***
14.	Sulphide (S ²⁻)	1.0	1.0	1.0	1.0
15.	Ammonia (NH ₃)	40	40	40	40
16.	Pesticides ⁽³⁾	0.15	0.15	0.15	0.15

1290 THE GAZETTE OF PAKISTAN, EXTRA, AUGUST 10, 2000 [PART-II]

S. No.	Parameter	Revised Standards			
		Existing Standards	Into Inland Waters	Into Sewage Treatment ⁽⁵⁾	Into Sea ⁽⁶⁾
1	2	3	4	5	6
17.	Cadmium ⁽⁴⁾ ...	0.1	0.1	0.1	0.1
18.	Chromium (trivalent and hexavalent ⁽⁴⁾ ..	1.0	1.0	1.0	1.0
19.	Cooper ⁽⁴⁾ ...	1.0	1.0	1.0	1.0
20.	Lead ⁽⁴⁾ ...	0.5	0.5	0.5	0.5
21.	Mercury ⁽⁴⁾ ...	0.01	0.01	0.01	0.01
22.	Selenium ⁽⁴⁾	0.5	0.5	0.5	0.5
23.	Nickel ⁽⁴⁾ ..	1.0	1.0	1.0	1.0
24.	Silver ⁽⁴⁾	1.0	1.0	1.0	1.0
25.	Total toxic metals ...	2.0	2.0	2.0	2.0
26.	Zinc ...	5.0	5.0	5.0	5.0
27.	Arsenic ⁽⁴⁾ ..	1.0	1.0	1.0	1.0
28.	Barium ⁽⁴⁾ ...	1.5	1.5	1.5	1.5
29.	Iron ...	2.0	8.0	8.0	8.0
30.	Manganese ...	1.5	1.5	1.5	1.5
31.	Boron ⁽⁴⁾ ...	6.0	6.0	6.0	6.0
32.	Chlorine ...	1.0	1.0	1.0	1.0

Explanations:

1. Assuming minimum dilution 1:10 on discharge, lower ratio would attract progressively stringent standards to be determined by the Federal Environmental Protection Agency. By 1:10 dilution means, for example that for each one cubic meter of treated effluent, the recipient water body should have 10 cubic meter of water for dilution of this effluent.
2. Methylene Blue Active Substances; assuming surfactant as biodegradable.
3. Pesticides include herbicides, fungicides, and insecticides.
4. Subject to total toxic metals discharge should not exceed level given at S. N. 25.

1290 THE GAZETTE OF PAKISTAN, EXTRA, AUGUST 10, 2000 [PART-II]

5. Applicable only when and where sewage treatment is operational and BOD₅=80mg/l is achieved by the sewage treatment system.
 6. Provided discharge is not at shore and not within 10 miles of mangrove or other important estuaries.
- * The effluent should not result in temperature increase of more than 30C at the edge of the zone where initial mixing and dilution take place in the receiving body. In case zone is not defined, use 100 meters from the point of discharge.
- ** The value for industry is 200 mg/l.

Discharge concentration at or below sea concentration (SC).

Note: _____

1. Dilution of liquid effluents to bring them to the NEQS limiting values is not permissible through fresh water mixing with the effluent before discharging into the environment.
 2. The concentration of pollutants in water being used will be subtracted from the effluent for calculating the NEQS limits” and for Annex-II the following shall be substituted, namely: _____
- (2) for Annex-II the following shall be substituted, namely: _____

Annex-II

“NATIONAL ENVIRONMENTAL QUALITY STANDARDS FOR INDUSTRIAL GASEOUS EMISSION (mg/Nm³, UNLESS OTHERWISE DEFINED).”

S. No.	Parameter	Source of Emission	Existing Standards	Revised Standards
1	2	3	4	5
1.	Smoke	Smoke opacity not to exceed	40% or 2 Ringlemann Scale	40% or 2 Ringlemann Scale or equivalent smoke number
2.	Particulate matter	(a) Boilers and Furnaces		
	(1)	(i) Oil fired	300	300
		(ii) Coal fired	500	500
		(iii) Cement Kilns	200	300
		(b) Grinding, crushing, Clinker coolers and Related processes, Metallurgical Processes, converter, blast furnaces and cupolas.	500	500

1293 THE GAZETTE OF PAKISTAN, EXTRA, AUGUST 10, 2000 [PART-II]

S. No.	Parameter	Source of Emission	Existing Standards	Revised Standards
1	2	3	4	5
3.	Hydrogen Chloride	Any	400	400
4.	Chlorine	Any	150	150
5.	Hydrogen Fluoride	Any	150	150
6.	Hydrogen Sulphide	Any	10	10
7.	Sulphur Oxides ⁽²⁾⁽³⁾	Sulfuric acid/Sulphonic acid plants Other Plants except power Plants operating on oil and coal	400	1700
8.	Carbon Monoxide	Any	800	800
9.	Lead	Any	50	50
10.	Mercury	Any	10	10
11.	Cadmium	Any	20	20
12.	Arsenic	Any	20	20
13.	Copper	Any	50	50
14.	Antimony	Any	20	20
15.	Zinc	Any	200	200
16.	Oxides of Nitrogen	Nitric acid manufacturing unit. Other plants except power plants operating on oil or coal:	400	3000
	(3)	Gas fired	400	400
		Oil fired	-	600
		Coal fired	-	1200

Explanations

1. Based on the assumption that the size of the particulate is 10 micron or more.
2. Based on 1 percent Sulphur content in fuel oil. Higher content of Sulphur will case standards to be pro-rated.
3. In respect of emissions of Sulphur dioxide and Nitrogen oxides, the power plants operating on oil and coal as fuel shall in addition to National Environmental Quality Standards (NEQS) specified above, comply with the following standards:-

1294 THE GAZETTE OF PAKISTAN, EXTRA, AUGUST 10, 2000 [PART-II]

A. Sulphur Dioxide

Sulphur Dioxide Background levels Micro-gram per cubic meter (ug/m³) Standards.

Background Air Quality (SO ² Basis)	Annual Average	Max. 24-hours Interval	Criterion I Max. SO ² Emission (Tons per Day Per Plant)	Criterion II Max. Allowable ground level increment to ambient (ug/m ³) (One year Average)
Unpolluted	<50	<200	500	50
Moderately Polluted*	50	200	500	50
Low	100	400	100	10
High	>100	>400	100	10
Very Polluted**	<50	<200	500	50

* For intermediate values between 50 and 100 ug/m³ linear interpolations should be used.

** No projects with Sulphur dioxide emissions will be recommended.

B. Nitrogen Oxide

Ambient air concentrations of Nitrogen oxides, expressed as NO_x should not be exceed the following:-

Annual Arithmetic Mean : 100ug/m³
(0.05 ppm)

Emission level for stationary source discharge before missing with the atmosphere, should be maintained as follows:-

For fuel fired steam generators as Nanogram (100-gram) per joule of heat input:

Liquid fossil fuel : 130
Solid fossil fuel : 300
Lignite fossil fuel : 260

Note:- Dilution of gaseous emissions to bring them to the NEQS limiting value is not permissible through excess air mixing blowing before emitting into the environment.

[File No. 14(3)/98-TO-PEPC.]

HAFIZ ABDULAH AWAN
DEPUTY SECRETARY (ADMN)



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OIL & GAS DEVELOPMENT COMPANY LTD.

KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE – II

ELECTRICAL POWER AND CONTROL CABLE SCHEDULE



0	21-02-2017	Issued for Tender	MF	NAK	MAS
Rev.	Date	Description	Prepared By	Checked By	Approved By

OIL & GAS DEVELOPMENT COMPANY LTD.
KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE – II
POWER AND CONTROL CABLE SCHEDULE

S.No.	Cable Tag	DESCRIPTION	Tag(From)	Tag(To)	Cable Gland	Type	No of Runs	No of Cores	size (mm ²)	Estimated Length (mtrs.)	Remarks
DB for Acid Gas incinerator Package Incoming and Outgoing Cables											
1	PC-ACIP-DB-01	Incoming Cable from existing MCC to AGIP	MCC-04A	ACIP-DB-01	-	Cu/PVC/PVC	2	4	185.0	60	
2	PC-C-101-A	C-101-A Pump	ACIP-DB-01	C-101-A	E1FW63	Cu/PVC/SWA/PVC	1	3	185.0	350	
3	PC-SH-C-101-A	Space Heater C-101-A	ACIP-DB-01	SH-C-101-A	E1FW20	Cu/PVC/SWA/PVC	1	2	2.5	350	
4	CC-LCS-C-101-A	Control Cable to LCS (C-101-A)	ACIP-DB-01	LCS-C-101-A	E1FW20	Cu/PVC/SWA/PVC	1	10	1.5	350	
5	CC-UCP-C-101-A	Control Cable to UCP	ACIP-DB-01	UCP	E1W20	Cu/PVC/SWA/PVC	1	10	1.5	70	
6	CC-SPC-C-101-A	Speed Control cable	ACIP-DB-01	UCP	E1W20	Cu/PVC/SWA/PVC	1	4	1.5	70	
7	CC-C-101-B	C-101-B Pump	ACIP-DB-01	C-101-B	E1FW63	Cu/PVC/SWA/PVC	1	3	185.0	360	
8	PC-SH-C-101-B	Space Heater C-101-B	ACIP-DB-01	SH-C-101-B	E1FW20	Cu/PVC/SWA/PVC	1	2	2.5	360	
9	CC-LCS-C-101-B	Control Cable to LCS (C-101-B)	ACIP-DB-01	LCS-C-101-B	E1FW20	Cu/PVC/SWA/PVC	1	10	1.5	360	
10	CC-UCP-C-101-B	Control Cable to UCP	ACIP-DB-01	UCP	E1W20	Cu/PVC/SWA/PVC	1	10	1.5	70	
11	CC-SPC-C-101-B	Speed Control cable	ACIP-DB-01	UCP	E1W20	Cu/PVC/SWA/PVC	1	4	1.5	70	
12	CC-C-102-A	C-102-A Pump	ACIP-DB-01	C-102-A	E1FW40	Cu/PVC/SWA/PVC	1	3	70.0	415	
13	PC-SH-C-102-A	Space Heater C-102-A	ACIP-DB-01	SH-C-102-A	E1FW20	Cu/PVC/SWA/PVC	1	2	2.5	415	
14	CC-LCS-C-102-A	Control Cable to LCS (C-102-A)	ACIP-DB-01	LCS-C-102-A	E1FW20	Cu/PVC/SWA/PVC	1	10	1.5	415	
15	CC-UCP-C-102-A	Control Cable to UCP	ACIP-DB-01	UCP	E1W20	Cu/PVC/SWA/PVC	1	10	1.5	70	
16	CC-SPC-C-102-A	Speed Control cable	ACIP-DB-01	UCP	E1W20	Cu/PVC/SWA/PVC	1	4	1.5	70	
17	CC-C-102-B	C-102-B Pump	ACIP-DB-01	C-102-B	E1FW40	Cu/PVC/SWA/PVC	1	3	70.0	420	
18	PC-SH-C-102-B	Space Heater C-102-B	ACIP-DB-01	SH-C-102-B	E1FW20	Cu/PVC/SWA/PVC	1	2	2.5	420	
19	CC-LCS-C-102-B	Control Cable to LCS (C-102-B)	ACIP-DB-01	LCS-C-102-B	E1FW20	Cu/PVC/SWA/PVC	1	10	1.5	420	
20	CC-UCP-C-102-B	Control Cable to UCP	ACIP-DB-01	UCP	E1W20	Cu/PVC/SWA/PVC	1	10	1.5	70	
21	CC-SPC-C-102-B	Speed Control cable	ACIP-DB-01	UCP	E1W20	Cu/PVC/SWA/PVC	1	4	1.5	70	
UPS CABLE											
20	PC-UCP-001	UPS Supply to ACIP UCP	ACIP-DB-01	UCP	E1W20	Cu/PVC/SWA/PVC	1	3	4.0	70	
20	PC-UCP-002	Redundant UPS Supply to ACIP UCP	ACIP-DB-01	UCP	E1W20	Cu/PVC/SWA/PVC	1	3	4.0	70	
Notes:											
1	All Cables to be Site Measured by Contractor Prior to Cutting from the Cable Drums.										
2	Cables left Coiled after Pulling are to be Suitably Protected and end Sealed against the Ingress of Moisture and Vermin.										
3	All identified Cable must have been Measured and Pulled from Cable Drums before any Apparent 'spare' can be Utilised for other Purposes.										
4	The length of the circuit mentioned are preliminary and will be finalized during detail engineering.										

DATA SHEETS



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OIL & GAS DEVELOPMENT COMPANY LTD.

KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE – II

DATA SHEET FOR ACID GAS INCINERATOR DISTRIBUTION BOARD



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 ZISHAN ENGINEERS (PVT.) LTD.				DATA SHEET FOR ACID GAS INCINERATOR DISTRIBUTION BOARD			
Client:				Document No.		Revision	DATE
 OIL & GAS DEVELOPMENT COMPANY LTD.				165-4-DSE-017		0	21-02-2017
				Prepared By	Checked By	Approved By	SHEET
				MF	NAK	MAS	2 OF 2
1	Pannel label reading		INCOMER	51	Service Conditions		
2	Pannel Identification number		MDB-01	52	Ambient Temperature		Min. 41 deg F
3	Type of Switching Device		MCCB, 3P	53			Max. 122 deg F
4	Rated Current Switching Device	A	400	54	Relative Humidity		Max./Min 77% / 20%
5	Rated Current LV fuses	A	-	55	Altitude		approx 50m above sea level
6	Rating of Generator/Transformer/Feeder	kVA	-	56	Installation		Indoor / Outdoor
7	VOLTAGE TRANSFORMERS			57	General Design Data		
8	Secondry	V	230	58	System Voltage and frequency		400V,50Hz,3-ph, 4W
9	Rating	VA	BY VENDOR	59	System neutral		Solidly earthed
10	Class		3	60	Rated current of busbar system		600 A
11				61	Rated Short-time withstand current		45 kA rms 3 sec
12	CURRENT TRANSFORMERS FOR METERING			62	Switchgear Control power		230V AC
13	Ratio	A	400/5	63	Closing and Tripping		230 V AC
14	Rating	VA	BY VENDOR	64	Auxiliary Power		230 V AC
15	Class		3	65	Motor/Feeder Circuits-Control power		230 V AC
16				66	Bus bar insulation		Air / Gas (SFG)
17	CURRENT TRANSFORMERS FOR PROTECTION			67	Type of enclosure		Metal-enclosed / Metal-clade
18	Ratio	A	400/5	68	MCC		
19	Rating	VA	BY VENDOR	69	Degree of Protection		IP 42
20	Class		5P (BY VENDOR)	70	Anti condensation heaters required		Yes, 230V, 1ph, 50Hz
21	RELAYS			71	Main incoming entry (switchgear)		Cable / Busduct / N.A.
22	Overcurrent	Type	50,50N,51,51N	72			Top / Bottom / N.A.
23	Earth Fault	Type	51G	73	MCC Cable Entry		Top / Bottom / N.A.
24	Undervoltage	Type	27	74	Cable gland plate		Drilled / Undrilled
25	Overvoltage	Type		75	Test equipment for SSTD		Required / Not-required
26	Intertrip	Type		76	Manufacturer and type		
27	Lock-out relay	Type		77	Manufacturer Order No.		
28	Synchro-check	Type		78	Serial No.		
29	Automatic Transfer Scheme	Type		79	Finishing Color		
30	MEASURING DEVICES AND OTHER ACCESSORIES			80	Total Weight of equipment		
31	Voltmeter AC	Type	Yes	81	Shipping Dimensions		
32	Ammeter AC	Type	Yes	82			
33	Frequency meter	Type		83			
34	Power-factor meter	Type		84			
35	Wattmeter	Type		85			
36	Watt-hour meter	Type		86			
37	Maximum-demand indicator	Type		87			
38	Operation counter	Type		88			
39	Manual Transfer Trip CB Selector Switch	Type		89			
40	Energy Analyzer	Type	Yes	90			
41	INDICATION LAMPS and OTHER ACCESSORIES			91			
42	RED PHASE		RED	92			
43	YELLOW PHASE		YELLOW	93			
44	BLUE PHASE		BLUE	94			
45	MAIN INCOMING TERMINAL			95			
46	Cable data		VTS	96			
47	Size		As per Cable schedule	97			
48	Specification		Cu/PVC/SWA/PVC	98			
49	Control Cable			99			
50	Size and Quantity			100			

Remarks:

Vendor shall complete DATA SHEET

BOQs / BID PRICE SCHEDULES
(Preamble to Bill of Quantities)

PREAMBLE TO BILL OF QUANTITIES

1. The items mentioned in the Bill of Quantities consist of furnishing all plant, labour, equipment, machinery, consumables and materials for completing the entire work scope. The work shall be done, complete in all respects in accordance with Specifications and Drawings within the stipulated time frame.
2. The Contractor shall be responsible for carrying out all work, complete in all respects, in accordance with the drawings, specifications and other conditions of contract without extra cost to the Owner. Any item of work required for completion but not expressly indicated in the Bill of Quantities shall be deemed to have been included in the unit rates quoted by the Contractor.
3. The Quantities contained in the Bill of Quantities for each work are estimated and liable to change (increase, decrease or omitted) when the work is actually executed. The Owner does not expressly or by implication guarantee that actual quantities of work to be performed will correspond to BOQ quantities. The payment to be made to the Contractor shall be based on the actual quantity of work performed.
4. The prices and rates to be quoted in the Bill of Quantities are to be full inclusive value of the Works described under specified items including all costs and expenses which may be required in and for the construction of the Works described, together with all risks, liabilities and obligations set forth and implied in all the documents referred to on which the tender is based. Rates and prices quoted by bidder shall be firm for the duration of the Contract. No extra payments on account of escalation in prices due to any reason, whatsoever, shall be admissible, unless specified elsewhere.
5. Unit rate is to be entered against each item in the Bill of Quantities where quantities are non entered. Items against which no price or rate is quoted in the BOQ shall be deemed to have been covered by rates or prices quoted in other BOQ items.
6. The BOQ shall be read in conjunction with conditions of contract, technical specification and the drawings.
7. The nomenclature used in BOQ is for identification of work only and is not intended to describe the complete work under that item which should be developed from Drawings, Specifications, Scope of Work and Conditions of Contract.
8. The contractor shall be responsible for arranging electricity and potable water for construction purposes at his own cost, inclusive of safety and security of the manpower, site Material, Transportation, handling and storage etc.
9. The works are to be carried out on a fast track basis therefore it is essential that the contractor shall be prepared to execute the work round the clock including Sundays and Holidays.
10. Any surplus or scrap materials remaining after the execution of work shall be reconciled and handed over to the Owner.

BOQs / BID PRICE SCHEDULES
(Mechanical Works)



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OIL & GAS DEVELOPMENT COMPANY LTD.

KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE – II

BOQ/BID PRICE SCHEDULE FOR INSTALLATION OF COMPANY SUPPLIED EQUIPMENT / PACKAGE (FREE-ISSUE)



Rev.	Date	Description	Prepared By	Checked By	Approved By
0	21-02-2017	Issued For Tender	AK	SMHA	MAS

OIL & GAS DEVELOPMENT COMPANY LTD.
BOQ/BID PRICE SCHEDULE FOR INSTALLATION OF COMPANY SUPPLIED EQUIPMENT & PACKAGES (FREE-ISSUE)

ITEM	MATERIAL DESIGNATION	QTY.	UNIT	SERVICES			Total Price (In Pak. Rs.)	Transportation and Unloading Cost to KPD-TAY Site (Pak Rs.) or Other Foreign Currency	Total Price (In Pak. Rs.)	REMARKS
				Unit Price (In Local Currency i.e. Pak. Rs.)	Total Price (In Local Currency i.e. Pak. Rs.)	Total Services (Pak. Rs.)				
1.0	ACID GAS INCINERATOR SYSTEM INSTALLATION, ERECTION, TESTING & COMMISSIONING ASSISTANCE OF ACID GAS INCINERATOR SYSTEM AS PER REFERENCED P&IDs, DATASHEETS & DRAWINGS COMPLETE IN ALL RESPECTS SUPPLIED TO THE CONTRACTOR AS FREE ISSUE (REFER TO <u>ATTACHMENT-1</u>).	1	UNIT							
Total										

NOTES:

- (1) PRICES SHALL BE QUOTED ON FOR BASIS
- (2) COPY OF THE SRO 678 (1)/2007 IS GIVEN IN ANNEXURE-XIV

ATTACHMENT-I**ACID GAS INCINERATOR PACKAGE**

NO.	EQUIP. NAME	QTY.	UNIT WEIGHT (KG)	TOTAL WEIGHT (KG)	TOTAL WEIGHT (METRIC TON)
1.	Incinerator K.O. Drum (V-101)	1	6622	6622	6.62
2.	Incinerator Stack (ST-101)	1	20675	20675	20.68
3.	Horizontal Thermal Incinerator (H101)	1	35948	35948	35.95
4.	Burner (B-101)	1	3295	3295	3.30
5.	Combustion Air Blowers (C-101A/B)	2	2095	4190	4.19
6.	Secondary Air Blowers (C-102A/B)	2	1386	2772	2.77
7.	Inlet Stack for Combustion Air Blowers	1	1213	1213	1.21
8.	SKID 1	1	8200	8200	8.20
9.	SKID 2	1	10100	10100	10.10



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OIL & GAS DEVELOPMENT COMPANY LTD.

KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE – II

BOQ/BID PRICE SCHEDULE FOR SUPPLY OF PIPING MATERIALS FOR INSTALLATION WORKS OF ACID GAS INCINERATOR PACKAGE



0	21-02-2017	Issued For Tender	AK	MMA	MAS
Rev.	Date	Description	Prepared By	Checked By	Approved By

OIL & GAS DEVELOPMENT COMPANY LTD.**KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE – II****BOQ/BID PRICE SCHEDULE FOR SUPPLY OF PIPING MATERIALS FOR INSTALLATION WORKS OF ACID GAS INCINERATOR PACKAGE**

S. NO.	DESCRIPTION	QTY.	UNIT	UNIT COST US\$	TOTAL US\$	REMARKS
1.0	PIPES					
a)	SEAMLESS CARBON STEEL PIPES CONFORMING TO ASTM A-106, Gr. B or API 5L Gr.B. DIMENSIONS ACCORDING TO ASME B36.10, IN DOUBLE RANDOM(12 METER) STD. LENGTHS. PIPE DIA 2" AND ABOVE TO BE SUPPLIED WITH BEVEL ENDS ACCORDING TO ASME B16.25. IN THE FOLLOWING SIZES AND QUANTITY:					
i)	4" NPS, SCH. 40	240	RM			
ii)	2" NPS, SCH. 80	12	RM			
b)	SEAMLESS CARBON STEEL PIPES CONFORMING TO ASTM A-333, Gr. 6. DIMENSIONS ACCORDING TO ASME B36.10, IN DOUBLE RANDOM(12 METER) STD. LENGTHS. PIPE DIA 2" AND ABOVE TO BE SUPPLIED WITH BEVEL ENDS ACCORDING TO ASME B16.25. IN THE FOLLOWING SIZES AND QUANTITY: (S) DENOTES SOUR SERVICE. ALL MATERIALS TO COMPLY WITH NACE MR-01-75 (LATEST REVISION).					
i)	16" NPS, SCH. STD (S)	324	RM			
ii)	8" NPS, SCH. 40 (S)	120	RM			
iii)	6" NPS SCH. 80 (S)	12	RM			
iv)	2" NPS SCH. 80 (S)	96	RM			
c)	SEAMLESS CARBON STEEL PIPES CONFORMING TO ASTM A-106,Gr.B (GALVANIZED) THREADED ENDS. DIMENSIONS ACCORDING TO ASME B36.10, IN DOUBLE RANDOM(12 METER) STD. LENGTHS. ABOVE TO BE SUPPLIED WITH SCREWED ENDS ACCORDING TO ASME B36.10. IN THE FOLLOWING SIZES AND QUANTITY:					
i)	2" NPS, SCH-80 (T.B.E)	96	RM			
2.0	90 DEGREE ELBOWS					
a)	ELBOW 90°, LONG RADIUS, B.W. ENDS, ASTM A-420, GR. WPL6 AS PER ANSI/ ASME B16.9, AS PER THE FOLLOWING SIZE & QUANTITY: (S) DENOTES SOUR SERVICE. ALL MATERIALS TO COMPLY WITH NACE MR-01-75 (LATEST REVISION).					
i)	16" NPS, SCH. STD (S)	12	NOS.			
ii)	8" NPS, SCH. 40 (S)	7	NOS.			
iii)	2" NPS, SCH. 80 (S)	4	NOS.			

OIL & GAS DEVELOPMENT COMPANY LTD.**KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE – II****BOQ/BID PRICE SCHEDULE FOR SUPPLY OF PIPING MATERIALS FOR INSTALLATION WORKS OF ACID GAS INCINERATOR PACKAGE**

S. NO.	DESCRIPTION	QTY.	UNIT	UNIT COST US\$	TOTAL US\$	REMARKS
b)	ELBOW 90°, LONG RADIUS, B.W. ENDS, ASTM A-234, GR. WPB AS PER ANSI/ ASME B16.9, AS PER THE FOLLOWING SIZE & QUANTITY:					
i)	4" NPS, SCH. 40	12	NOS.			
ii)	2" NPS, SCH. 80	1	NOS.			
c)	ELBOW 90°, THRD. CLASS 3000#, GALVANIZED ASTM A-105, ASME B16.11, AS PER THE FOLLOWING SIZE & QUANTITY:					
i)	2" NPS, THRD, CLASS 3000#	7	NOS.			
3.0	<u>45 DEGREE ELBOWS</u>					
a)	ELBOW 45°, LONG RADIUS, B.W. ENDS, ASTM A-234, GR. WPB AS PER ANSI/ ASME B16.9, AS PER THE FOLLOWING SIZE & QUANTITY:					
i)	4" NPS SCH. 40	2	NOS.			
4.0	<u>EQUAL TEES</u>					
a)	EQUAL TEE, B.W. ENDS, ASTM A-420, GR. WPL6 AS PER ANSI ASME B16.9 / B16.251. IN THE FOLLOWING SIZES AND QUANTITY: (S) DENOTES SOUR SERVICE. ALL MATERIALS TO COMPLY WITH NACE MR-01-75 (LATEST REVISION).					
i)	16" NPS, SCH.STD (S)	2	NOS.			
ii)	8" NPS, SCH.40 (S)	3	NOS.			
b)	EQUAL TEE, THRD, 3000#, GALVANIZED, ASTM A-105, ASME B16.11, AS PER THE FOLLOWING SIZE & QUANTITY:					
i)	2" NPS, THRD, CLASS 3000#	1	NOS.			
5.0	<u>REDUCING TEES</u>					
a)	REDUCING TEE, B.W. ENDS, ASTM A-234 GR. WPB. AS PER ANSI B16.9. IN THE FOLLOWING SIZES AND QUANTITY:					
i)	6" x 4", SCH. 40 x SCH.80	1	NOS.			
ii)	6" x 4", SCH. 40	1	NOS.			
iii)	4" x 2", SCH. 80	1	NOS.			
6.0	<u>WELDOLETS</u>					
a)	MATERIAL ASTM A-350, GR. LF2, DIMENSION ACCORDING TO ASME B 16.9/16.11/ 16.25 /ANSI B1.20.1 / MSS-SP-97. IN THE FOLLOWING SIZES AND QUANTITY: (S) DENOTES SOUR SERVICE. ALL MATERIALS TO COMPLY WITH NACE MR-01-75 (LATEST REVISION).					
i)	8" x 24", SCH. 40 (S)	1	NOS.			

OIL & GAS DEVELOPMENT COMPANY LTD.**KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE – II****BOQ/BID PRICE SCHEDULE FOR SUPPLY OF PIPING MATERIALS FOR INSTALLATION WORKS OF ACID GAS INCINERATOR PACKAGE**

S. NO.	DESCRIPTION	QTY.	UNIT	UNIT COST US\$	TOTAL US\$	REMARKS
7.0	<u>FLANGES</u>					
a)	FLANGES THREADED TYPE, CLASS 150#, RAISED FACE, ASTM A-105 (GALVANIZED) AS PER ASME B-16.5, IN THE FOLLOWING SIZES AND QUANTITY: <i>Note: Flanges Bore should match with Pipe Sch. / WallThk.</i>					
i)	2" NPS, THRD, RF	7	NOS.			
b)	FLANGES WELDING NECK, CLASS 300#, RAISED FACE, ASTM A-105 AS PER ASME B-16.5, IN THE FOLLOWING SIZES AND QUANTITY: <i>Note: Flanges Bore should match with Pipe Sch. / WallThk.</i>					
i)	4" NPS, WN, RF	2	NOS.			
c)	FLANGES, WELDING NECK, CLASS 150#, RF, ASTM A-350 LF2, AS PER ANSI B-16.5. IN THE FOLLOWING SIZES AND QUANTITY: <i>Note: Flanges Bore should match with Pipe Sch./ WallThk.</i> (S) DENOTES SOUR SERVICE. ALL MATERIALS TO COMPLY WITH NACE MR-01-75 (LATEST REVISION).					
i)	16" NPS, SCH. STD (S)	14	NOS.			
ii)	8" NPS, SCH. 40 (S)	14	NOS.			
iii)	6" NPS, SCH. 80 (S)	8	NOS.			
iv)	2" NPS, SCH. 80 (S)	2	NOS.			
d)	FLANGES, WELDING NECK RAISED FACE, CLASS 150#, RAISED FACE, ASTM A-105 AS PER ASME B-16.5, IN THE FOLLOWING SIZES AND QUANTITY: <i>Note: Flanges Bore should match with Pipe Sch. / WallThk.</i>					
i)	4" NPS, SCH. 40	8	NOS.			
ii)	2" NPS, SCH. 80	2	NOS.			
8.0	<u>BLIND FLANGES</u>					
a)	BLIND FLANGES, CLASS 150#, RAISED FACE, ASTM A-350 LF2 , AS PER ANSI B-16.5. IN THE FOLLOWING SIZES AND QUANTITY: (S) DENOTES SOUR SERVICE. ALL MATERIALS TO COMPLY WITH NACE MR-01-75 (LATEST REVISION).					
i)	8" NPS, RF (S)	1	NOS.			

OIL & GAS DEVELOPMENT COMPANY LTD.**KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE – II****BOQ/BID PRICE SCHEDULE FOR SUPPLY OF PIPING MATERIALS FOR INSTALLATION WORKS OF ACID GAS INCINERATOR PACKAGE**

S. NO.	DESCRIPTION	QTY.	UNIT	UNIT COST US\$	TOTAL US\$	REMARKS
9.0	<u>GASKETS</u>					
a)	Class 150, 1/8" THK. SPIRAL WOUND CS RING 304 SS OR 316 SS WINDING, FLEXIBLE GRAPHITE ASME B16.20, IN THE FOLLOWING SIZE & QUANTITIES:					
i)	16" NPS	10	NOS.			
ii)	8" NPS	13	NOS.			
iii)	6" NPS	8	NOS.			
iv)	2" NPS	6	NOS.			
b)	CORRUGATED FLEXIBLE GRAPHITE, Class 150, 1/8" THICK FLEXIBLE GRAPHITE WITH 304 OR 316 STAINLESS STEEL CORRUGATED INSERT, ASME B16.20 / B16.21 / B16.5					
i)	4" NPS	5	NOS.			
ii)	2" NPS	1	NOS.			
c)	GASKET, Class 300 , 1/8" THICK FLEXIBLE GRAPHITE WITH 304 OR 316 STAINLESS STEEL CORRUGATED INSERT, ASME B16.20 / B16.21 / B16.5					
i)	4" NPS	1	NOS.			
10.0	<u>STUD BOLTS</u>					
a)	STUD BOLTS WITH TWO HEXAGONAL NUTS & TWO WASHERS EACH, MATERIALS ARE AS FOLLOWS: STUD BOLTS: ASTM A-320 GR. L7 CADMIUM PLATED. HEX.NUTS:ASTM A-194 GR.7 HEAVY HEX CADMIUM PLATED.					
i)	1" x 145 mm	160	NOS.			
ii)	3/4" x 120 mm	152	NOS.			
iii)	5/8" x 95 mm	4	NOS.			
b)	STUD BOLTS WITH TWO HEXAGONAL NUTS & TWO WASHERS EACH, MATERIALS ARE AS FOLLOWS: STUD BOLTS: ASTM A-193 GR. B7, CADMIUM PLATED HEX.NUTS: ASTM A-194 GR.2H HEAVY HEXAGONAL, CADMIUM PLATED WITH WASHERS AS PER ASMEB18.2.1/18.2.2. REQUIRED NOMINAL SIZES AND LENGTHS ARE AS UNDER:					
i)	5/8" x 100 mm	64	NOS.			
ii)	3/4 x 114 mm	8	NOS.			

OIL & GAS DEVELOPMENT COMPANY LTD.**KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE – II****BOQ/BID PRICE SCHEDULE FOR SUPPLY OF PIPING MATERIALS FOR INSTALLATION WORKS OF ACID GAS INCINERATOR PACKAGE**

S. NO.	DESCRIPTION	QTY.	UNIT	UNIT COST US\$	TOTAL US\$	REMARKS
11.0	VALVES					
11.1	CAST STEEL BALL VALVE					
a)	BALL VALVES, BW ENDS,150#, RF, REG PORT, ASTM A-216 Gr. WCB AS PER SPECIFICATION OF PIPING MATERIAL (165-4-SPM-046).					
i)	2" NPS (VB-203)	1	NOS.			
b)	BALL VALVE, 150#, BOLTED BONNET, FLOATING TYPE (TRUNNION MOUNTED BALL OVER 4"), REGULAR PORT, FLANGE ENDS, RF, API 6D, ASME B16.34 / B16.10					
	(S) DENOTES SOUR SERVICE. ALL MATERIALS TO COMPLY WITH NACE MR-01-75 (LATEST REVISION).					
i)	16" NPS, VB-202 (S)	1	NOS.			
ii)	4" NPS, VB-202	1	NOS.			
TOTAL						

NOTES:

- (1) PRICES SHALL BE QUOTED ON FOR BASIS
- (2) COPY OF THE SRO 678 (1)/2007 IS GIVEN IN **ANNEXURE-XIV**

BOQs / BID PRICE SCHEDULES
(Electrical & Instrumentation Works)



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OIL & GAS DEVELOPMENT COMPANY LTD.

KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE – II

BOQ/BID PRICE SCHEDULE FOR ELECTRICAL WORKS



0	21-02-2017	Issued for Tender	MF	NAK	MAS
Rev.	Date	Description	Prepared By	Checked By	Approved By

OIL & GAS DEVELOPMENT COMPANY LTD.KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE – IIBOQ/BID PRICE SCHEDULE FOR ELECTRICAL WORKS

S.NO.	DESCRIPTION	QTY.	UNIT	RATE / UNIT (Rs.)	AMOUNT (Rs.)	REMARKS / REFERENCE DOCUMENTS
		A	B	C	D	
LOW VOLTAGE SWITCHGEAR / MCC / SUB DISTRIBUTION BOARDS						
1.0	SUPPLY, INSTALLATION, TESTING AND COMMISSIONING OF FLOOR MOUNTED 400 V, 50 Hz, IP42 LV MCC / SWITCHGEAR (DB-ACIP) ASSEMBLY AS PER REFERRED SLD, DATA SHEET, SPECIFICATION AND CONTROL SCHEMATICS COMPLETE IN ALL RESPECTS INCLUDING BUT NOT LIMITED TO SUPPLY, FABRICATION, FIXING / BOLTING OF GALVANIZED STEEL BASE FRAME AND ALL OTHER INSTALLATION AND MOUNTING ACCESSORIES RQUIRED FOR JOB COMPLETION.	1	SET			165-4-ELS-026 165-4-SCE-014 165-4-DSE-017
LOCAL CONTROL STATIONS						
2.0	<u>LOCAL CONTROL STATIONS (FOR HAZARDOUS AREA)</u> SUPPLY, INSTALLATION, TESTING AND COMMISSIONING OF LOCAL CONTROL STATION (OF FOLLOWING TYPE) FOR LV MOTORS, EEX'N' IIC T4, IP-65. GRP POLYCARBONATE ENCLOSURE, COMPLETE WITH CABLE ENTRY (WITH STOPPING PLUG) FOR 12C-1.5MM2 ARMoured CABLE. LOCAL CONTROL STATION SHALL BE SUPPLIED COMPLETE WITH ALL REQUIRED INTERNAL TERMINALS, EARTHING TERMINALS, GLAND PLATE, NUTS, BOLTS, WASHERS, ETC. COMPLETE IN ALL RESPECT AND AS PER REFERRED TYPICAL INSTALLATION DRAWING. THREE POSITION (I-O-II) ROTARY SELECTOR SWITCH FOR MANUAL-OFF-AUTO (MOA) SELECTION AND COMPRISING OF 1 NO. ON PUSH BUTTON (MOMENTARY CONTACT), 1 NO. MUSHROOM STAYPUT (LATCHED CONTACT) TYPE, OFF PUSH BUTTON AND 2 NO. GREEN AND RED INDICATION LAMP.	4	NOS			
CABLES						
3.0	SUPPLY, LAYING, DRESSING, TAGGING, TERMINATION, TESTING AND COMMISSIONING OF FOLLOWING ELECTRICAL POWER AND CONTROL CABLE (AS PER REFERRED CABLE SCHEDULES AND TYPICAL INSTALLATION DRAWINGS) AS DIRECT BURIED IN SOIL. COMPLETE IN ALL RESPECTS INCLUDING INSTALLATION OF CABLE LUGS, TERMINATION OF ARMOUR (IF AVAILABLE) THROUGH GLAND / PLATE UPTO THE EARTH TERMINAL OF EQUIPMENT, TAGGING WITH ALPHA NUMERIC PLASTIC FERRULES, ETC. COMPLETE IN ALL RESPECT					165-4-SPE-021
3.1	<u>MULTI CORE NON-ARMoured LOW VOLTAGE CABLES (FOR POWER APPLICATIONS)</u> MULTI CORE LOW VOLTAGE POWER CABLES, STRANDED COPPER CONDUCTOR AS PER IEC-60502, POLYVINYL CHLORIDE INSULATED 600/1000 VOLT GRADE, NON-HYGROSCOPIC FILLERS, EXTRUDED POLYVINYL CHLORIDE BEDDED AND POLYVINYL CHLORIDE SHEATHED OVERALL.					
3.1.1	4C - 185 SQMM (CU/PVC/PVC)	120	RMTRS.			
3.2	<u>MULTI CORE ARMoured LOW VOLTAGE CABLES (FOR POWER APPLICATIONS)</u> MULTI CORE LOW VOLTAGE POWER CABLES, STRANDED COPPER CONDUCTOR AS PER IEC-60502, POLYVINYL CHLORIDE INSULATED 600/1000 VOLT GRADE, NON-HYGROSCOPIC FILLERS, EXTRUDED POLYVINYL CHLORIDE BEDDED, SINGLE STEEL WIRE ARMoured AND POLYVINYL CHLORIDE SHEATHED OVERALL.					
3.2.1	2C - 2.5 SQMM (CU/PVC/SWA/PVC)	1545	RMTRS.			
3.2.2	3C - 4.0 SQMM (CU/PVC/SWA/PVC)	140	RMTRS.			
3.2.3	3C - 70.0 SQMM (CU/PVC/SWA/PVC)	835	RMTRS.			
3.2.4	3C - 185.0 SQMM (CU/PVC/SWA/PVC)	710	RMTRS.			
	<u>NOTE: THE COLOR CODING FOR THE ABOVE MULTI CORE CABLES SHALL BE AS FOLLOWS:</u> 4 CORE RED, YELLOW, BLUE, BLACK POWER CABLES 600/1000 VOLT GRADE 3 CORE RED, YELLOW, BLUE POWER CABLES 600/1000 VOLT GRADE					

OIL & GAS DEVELOPMENT COMPANY LTD.KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE – IIBOQ/BID PRICE SCHEDULE FOR ELECTRICAL WORKS

S.NO.	DESCRIPTION	QTY.	UNIT	RATE / UNIT (Rs.)	AMOUNT (Rs.)	REMARKS / REFERENCE DOCUMENTS
		A	B	C	D	
3.3	MULTI CORE ARMoured LOW VOLTAGE CABLES (FOR CONTROL APPLICATIONS). LOW VOLTAGE CONTROL CABLES, STRANDED COPPER CONDUCTOR, POLYVINYL CHLORIDE INSULATED, 600/1000 VOLT GRADE, POLYVINYL CHLORIDE BEDDED, SINGLE STEEL WIRE ARMoured AND POLYVINYL CHLORIDE SHEATHED OVERALL. (TO BS 6346 / IEC60502)					
3.3.1	4C - 1.5 SQMM (CU/PVC/SWA/PVC)	280	RMTRS.			
3.3.2	10C - 1.5 SQMM (CU/PVC/SWA/PVC)	1825	RMTRS.			
4.0	CABLE GLANDS (FOR HAZARDOUS AREA) SUPPLY, INSTALLATION, TESTING AND COMMISSIONING OF BRASS CABLE GLANDS OF FOLLOWING SIZES CONFORMING TO BS 6121 AND SUITABLE FOR CU/PVC/SWA/PVC LOW VOLTAGE CABLES. GLANDS TO BE SUPPLIED COMPLETE WITH PCP SHROUD AND SHALL BE, E1FW, DUAL CERTIFIED (EXE' / EXD') SUITABLE FOR CLASS I, ZONE 1 & 2, IP 66 APPLICATIONS. COMPLETE IN ALL RESPECT AND AS PER REFERRED CABLE SCHEDULE					
4.1	E1FW 20	8	NOS			
4.2	E1FW 40	2	NOS			
4.3	E1FW 63	2	NOS			
5.0	CABLE GLANDS (FOR NON HAZARDOUS AREA) SUPPLY, INSTALLATION, TESTING AND COMMISSIONING OF BRASS CABLE GLANDS OF FOLLOWING SIZES CONFORMING TO BS 6121 AND SUITABLE FOR LOW VOLTAGE CABLES. GLANDS TO BE SUPPLIED COMPLETE WITH PCP SHROUD AND SHALL BE E1W, WEATHERPROOF, SUITABLE FOR IP 66 APPLICATIONS. . COMPLETE IN ALL RESPECT AND AS PER REFERRED CABLE SCHEDULE					
5.1	E1W 20	10	NOS			
EARTHING AND ACCESSORIES						
6.0	SUPPLY, INSTALLATION, TESTING & COMMISSIONING OF 4M LONG EARTH ELECTRODE, COPPER CLADED, 3/4" DIA ROD, WITH 2 M LONG AND 2" DIA UPVC PIPE, EXTENDIBLE ON BOTH SIDES COMPLETE WITH DRIVING HEAD CAP ON TOP, 2 NOS. CLAMPS FOR 70 SQ.MM BARE CONDUCTOR CONNECTION, STAINLESS STEEL FASTENING ACCESSORIES ETC. COMPLETE IN ALL RESPECT. THE JOB INCLUDES CONSTRUCTION OF CONCRETE EARTH PIT WITH ALL MATERIALS AS SHOWN IN REFER DRAWING COMPLETE IN ALL RESPECT.	2	NOS			
7.0	SUPPLY, INSTALLATION, TESTING & COMMISSIONING OF EARTH BARS MADE OF HARD DRAWN COPPER (TINNED), SUITABLE FOR MOUNTING ON STEEL STRUCTURE, CONSISTING OF 10 NOS. EQUALLY SPACED M8 HOLES. EACH PLATE SHALL ALSO HAVE 2 NOS. M10 HOLES FOR MOUNTING. EACH PLATE SHALL BE SUPPLIED WITH 2 NOS. GALVANIZED MILD STEEL TUBE SPACERS, AND M10, ELECTROZINC PLATED NUTS, BOLTS AND STAR WASHERS, COMPLETE IN ALL RESPECTS.	2	NOS			
8.0	SUPPLY, INSTALLATION, TESTING & COMMISSIONING OF PVC-INSULATED, GREEN-YELLOW OUTER PVC SHEATHED, CIRCULAR, STRANDED ANNEALED COPPER CONDUCTOR CABLES, CONFIRMING TO BS-6004, (450 / 750 V) ON CABLE LADDER / RACK OR BURIED COMPLETE IN ALL RESPECTS INCLUDING SUPPLY AND INSTALLATION OF CRIMPED CONNECTORS FOR BRANCHING OF ABOVE GROUND EARTH CABLE, SUPPLY AND INSTALLATION CABLE LUGS AND TERMINATIONS ON EQUIPMENT AND EARTHING PHILOSOPHY DOCUMENTS.					
8.1	1C-240	200	RMtrs.			
8.2	1C-70	400	RMtrs.			
8.3	1C-6	100	RMtrs.			
9.0	SUPPLY AND INSTALLATION OF CAD WELD CONNECTIONS ON BURIED CABLE OF FOLLOWING SIZES:					
9.1	1C-240	2	Nos			
9.2	1C-70	2	Nos			

OIL & GAS DEVELOPMENT COMPANY LTD.KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE – IIBOQ/BID PRICE SCHEDULE FOR ELECTRICAL WORKS

S.NO.	DESCRIPTION	QTY.	UNIT	RATE / UNIT (Rs.)	AMOUNT (Rs.)	REMARKS / REFERENCE DOCUMENTS
		A	B	C	D	
CABLE TRAY AND ACCESSORIES						
10.0	SUPPLY AND INSTALLATION OF GALVANIZED STEEL CABLE LADDER AND ACCESSORIES WITH ALL REQUIRED BENDS, TEE, REDUCERS, EXPANDERS MADE UP OF STRUCTURAL QUALITY STEEL, HOT DIP GALVANIZED TO BS 729, AND SUITABLE FOR USE IN MARINE ENVIRONMENT. COMPLETE IN ALL RESPECTS INCLUDING SUPPLY AND INSTALLTION OF ALL REQUIRED SPLICE PLATES, HEX NUT, BOLTS AND WASHERS, ETC WITH ALL SUPPORT MATERIAL SUCH AS ANGLES ETC COMPLETE IN ALL RESPECT. NOTES: 1. THE MENTIONED QUANTITIES ARE COMBINED FOR BOTH ELECTRICAL & INSTRUMENT CABLE LADDER RACKS. 2. OVERALL LADDER RACK SIDE HEIGHT SHALL BE 127MM (MAX.) 3. NUTS BOLTS AND WASHERS SHALL BE GALVANISED AND SUITABLY SIZED. 4. RUNGS TO BE SLOTTED, INSTALLED FLAT SIDE UP AND SPACED AT 300MM CENTRES.					
10.1	600MM WIDE STRAIGHT LADDER RACK	20	RMTRS			
10.2	100MM WIDE STRAIGHT LADDER RACK	100	RMTRS			
TOTAL PRICE (Rs.)						

NOTE:

1. THE QUANTITIES MENTIONED IN THE BOQS ARE INDICATIVE AND MAY CHANGE AS DETAIL DESIGN PROGRESSES.
2. COPY OF THE SRO 678 (1)/2007 IS GIVEN IN ANNEXURE-XIV
3. PRICES SHALL BE QUOTED ON FOR BASIS.



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OIL & GAS DEVELOPMENT COMPANY LTD.

KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE – II

BOQ/BID PRICE SCHEDULE FOR SUPPLY OF PIPING MATERIALS FOR INSTALLATION WORKS OF ACID GAS INCINERATOR PACKAGE



0	21-02-2017	Issued For Tender	AK	MMA	MAS
Rev.	Date	Description	Prepared By	Checked By	Approved By

OIL & GAS DEVELOPMENT COMPANY LTD.**KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE – II****BOQ/BID PRICE SCHEDULE FOR SUPPLY OF PIPING MATERIALS FOR INSTALLATION WORKS OF ACID GAS INCINERATOR PACKAGE**

S. NO.	DESCRIPTION	QTY.	UNIT	UNIT COST US\$	TOTAL US\$	REMARKS
1.0	PIPES					
a)	SEAMLESS CARBON STEEL PIPES CONFORMING TO ASTM A-106, Gr. B or API 5L Gr.B. DIMENSIONS ACCORDING TO ASME B36.10, IN DOUBLE RANDOM(12 METER) STD. LENGTHS. PIPE DIA 2" AND ABOVE TO BE SUPPLIED WITH BEVEL ENDS ACCORDING TO ASME B16.25. IN THE FOLLOWING SIZES AND QUANTITY:					
i)	4" NPS, SCH. 40	240	RM			
ii)	2" NPS, SCH. 80	12	RM			
b)	SEAMLESS CARBON STEEL PIPES CONFORMING TO ASTM A-333, Gr. 6. DIMENSIONS ACCORDING TO ASME B36.10, IN DOUBLE RANDOM(12 METER) STD. LENGTHS. PIPE DIA 2" AND ABOVE TO BE SUPPLIED WITH BEVEL ENDS ACCORDING TO ASME B16.25. IN THE FOLLOWING SIZES AND QUANTITY: (S) DENOTES SOUR SERVICE. ALL MATERIALS TO COMPLY WITH NACE MR-01-75 (LATEST REVISION).					
i)	16" NPS, SCH. STD (S)	324	RM			
ii)	8" NPS, SCH. 40 (S)	120	RM			
iii)	6" NPS SCH. 80 (S)	12	RM			
iv)	2" NPS SCH. 80 (S)	96	RM			
c)	SEAMLESS CARBON STEEL PIPES CONFORMING TO ASTM A-106,Gr.B (GALVANIZED) THREADED ENDS. DIMENSIONS ACCORDING TO ASME B36.10, IN DOUBLE RANDOM(12 METER) STD. LENGTHS. ABOVE TO BE SUPPLIED WITH SCREWED ENDS ACCORDING TO ASME B36.10. IN THE FOLLOWING SIZES AND QUANTITY:					
i)	2" NPS, SCH-80 (T.B.E)	96	RM			
2.0	90 DEGREE ELBOWS					
a)	ELBOW 90°, LONG RADIUS, B.W. ENDS, ASTM A-420, GR. WPL6 AS PER ANSI/ ASME B16.9, AS PER THE FOLLOWING SIZE & QUANTITY: (S) DENOTES SOUR SERVICE. ALL MATERIALS TO COMPLY WITH NACE MR-01-75 (LATEST REVISION).					
i)	16" NPS, SCH. STD (S)	12	NOS.			
ii)	8" NPS, SCH. 40 (S)	7	NOS.			
iii)	2" NPS, SCH. 80 (S)	4	NOS.			

OIL & GAS DEVELOPMENT COMPANY LTD.
KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE – II

BOQ/BID PRICE SCHEDULE FOR SUPPLY OF PIPING MATERIALS FOR INSTALLATION WORKS OF ACID GAS INCINERATOR PACKAGE

S. NO.	DESCRIPTION	QTY.	UNIT	UNIT COST US\$	TOTAL US\$	REMARKS
b)	ELBOW 90°, LONG RADIUS, B.W. ENDS, ASTM A-234, GR. WPB AS PER ANSI/ ASME B16.9, AS PER THE FOLLOWING SIZE & QUANTITY:					
i)	4" NPS, SCH. 40	12	NOS.			
ii)	2" NPS, SCH. 80	1	NOS.			
c)	ELBOW 90°, THRD. CLASS 3000#, GALVANIZED ASTM A-105, ASME B16.11, AS PER THE FOLLOWING SIZE & QUANTITY:					
i)	2" NPS, THRD, CLASS 3000#	7	NOS.			
3.0	<u>45 DEGREE ELBOWS</u>					
a)	ELBOW 45°, LONG RADIUS, B.W. ENDS, ASTM A-234, GR. WPB AS PER ANSI/ ASME B16.9, AS PER THE FOLLOWING SIZE & QUANTITY:					
i)	4" NPS SCH. 40	2	NOS.			
4.0	<u>EQUAL TEES</u>					
a)	EQUAL TEE, B.W. ENDS, ASTM A-420, GR. WPL6 AS PER ANSI ASME B16.9 / B16.251. IN THE FOLLOWING SIZES AND QUANTITY: (S) DENOTES SOUR SERVICE. ALL MATERIALS TO COMPLY WITH NACE MR-01-75 (LATEST REVISION).					
i)	16" NPS, SCH.STD (S)	2	NOS.			
ii)	8" NPS, SCH.40 (S)	3	NOS.			
b)	EQUAL TEE, THRD, 3000#, GALVANIZED, ASTM A-105, ASME B16.11, AS PER THE FOLLOWING SIZE & QUANTITY:					
i)	2" NPS, THRD, CLASS 3000#	1	NOS.			
5.0	<u>REDUCING TEES</u>					
a)	REDUCING TEE, B.W. ENDS, ASTM A-234 GR. WPB. AS PER ANSI B16.9. IN THE FOLLOWING SIZES AND QUANTITY:					
i)	6" x 4", SCH. 40 x SCH.80	1	NOS.			
ii)	6" x 4", SCH. 40	1	NOS.			
iii)	4" x 2", SCH. 80	1	NOS.			
6.0	<u>WELDOLETS</u>					
a)	MATERIAL ASTM A-350, GR. LF2, DIMENSION ACCORDING TO ASME B 16.9/16.11/ 16.25 /ANSI B1.20.1 / MSS-SP-97. IN THE FOLLOWING SIZES AND QUANTITY: (S) DENOTES SOUR SERVICE. ALL MATERIALS TO COMPLY WITH NACE MR-01-75 (LATEST REVISION).					
i)	8" x 24", SCH. 40 (S)	1	NOS.			

OIL & GAS DEVELOPMENT COMPANY LTD.

KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE – II

BOQ/BID PRICE SCHEDULE FOR SUPPLY OF PIPING MATERIALS FOR INSTALLATION WORKS OF ACID GAS INCINERATOR PACKAGE

S. NO.	DESCRIPTION	QTY.	UNIT	UNIT COST US\$	TOTAL US\$	REMARKS
7.0	<u>FLANGES</u>					
a)	FLANGES THREADED TYPE, CLASS 150#, RAISED FACE, ASTM A-105 (GALVANIZED) AS PER ASME B-16.5, IN THE FOLLOWING SIZES AND QUANTITY: <i>Note: Flanges Bore should match with Pipe Sch. / WallThk.</i>					
i)	2" NPS, THRD, RF	7	NOS.			
b)	FLANGES WELDING NECK, CLASS 300#, RAISED FACE, ASTM A-105 AS PER ASME B-16.5, IN THE FOLLOWING SIZES AND QUANTITY: <i>Note: Flanges Bore should match with Pipe Sch. / WallThk.</i>					
i)	4" NPS, WN, RF	2	NOS.			
c)	FLANGES, WELDING NECK, CLASS 150#, RF, ASTM A-350 LF2, AS PER ANSI B-16.5. IN THE FOLLOWING SIZES AND QUANTITY: <i>Note: Flanges Bore should match with Pipe Sch./ WallThk.</i> (S) DENOTES SOUR SERVICE. ALL MATERIALS TO COMPLY WITH NACE MR-01-75 (LATEST REVISION).					
i)	16" NPS, SCH. STD (S)	14	NOS.			
ii)	8" NPS, SCH. 40 (S)	14	NOS.			
iii)	6" NPS, SCH. 80 (S)	8	NOS.			
iv)	2" NPS, SCH. 80 (S)	2	NOS.			
d)	FLANGES, WELDING NECK RAISED FACE, CLASS 150#, RAISED FACE, ASTM A-105 AS PER ASME B-16.5, IN THE FOLLOWING SIZES AND QUANTITY: <i>Note: Flanges Bore should match with Pipe Sch. / WallThk.</i>					
i)	4" NPS, SCH. 40	8	NOS.			
ii)	2" NPS, SCH. 80	2	NOS.			
8.0	<u>BLIND FLANGES</u>					
a)	BLIND FLANGES, CLASS 150#, RAISED FACE, ASTM A-350 LF2 , AS PER ANSI B-16.5. IN THE FOLLOWING SIZES AND QUANTITY: (S) DENOTES SOUR SERVICE. ALL MATERIALS TO COMPLY WITH NACE MR-01-75 (LATEST REVISION).					
i)	8" NPS, RF (S)	1	NOS.			

OIL & GAS DEVELOPMENT COMPANY LTD.**KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE – II****BOQ/BID PRICE SCHEDULE FOR SUPPLY OF PIPING MATERIALS FOR INSTALLATION WORKS OF ACID GAS INCINERATOR PACKAGE**

S. NO.	DESCRIPTION	QTY.	UNIT	UNIT COST US\$	TOTAL US\$	REMARKS
9.0	<u>GASKETS</u>					
a)	Class 150, 1/8" THK. SPIRAL WOUND CS RING 304 SS OR 316 SS WINDING, FLEXIBLE GRAPHITE ASME B16.20, IN THE FOLLOWING SIZE & QUANTITIES:					
i)	16" NPS	10	NOS.			
ii)	8" NPS	13	NOS.			
iii)	6" NPS	8	NOS.			
iv)	2" NPS	6	NOS.			
b)	CORRUGATED FLEXIBLE GRAPHITE, Class 150, 1/8" THICK FLEXIBLE GRAPHITE WITH 304 OR 316 STAINLESS STEEL CORRUGATED INSERT, ASME B16.20 / B16.21 / B16.5					
i)	4" NPS	5	NOS.			
ii)	2" NPS	1	NOS.			
c)	GASKET, Class 300 , 1/8" THICK FLEXIBLE GRAPHITE WITH 304 OR 316 STAINLESS STEEL CORRUGATED INSERT, ASME B16.20 / B16.21 / B16.5					
i)	4" NPS	1	NOS.			
10.0	<u>STUD BOLTS</u>					
a)	STUD BOLTS WITH TWO HEXAGONAL NUTS & TWO WASHERS EACH, MATERIALS ARE AS FOLLOWS: STUD BOLTS: ASTM A-320 GR. L7 CADMIUM PLATED. HEX.NUTS:ASTM A-194 GR.7 HEAVY HEX CADMIUM PLATED.					
i)	1" x 145 mm	160	NOS.			
ii)	3/4" x 120 mm	152	NOS.			
iii)	5/8" x 95 mm	4	NOS.			
b)	STUD BOLTS WITH TWO HEXAGONAL NUTS & TWO WASHERS EACH, MATERIALS ARE AS FOLLOWS: STUD BOLTS: ASTM A-193 GR. B7, CADMIUM PLATED HEX.NUTS: ASTM A-194 GR.2H HEAVY HEXAGONAL, CADMIUM PLATED WITH WASHERS AS PER ASMEB18.2.1/18.2.2. REQUIRED NOMINAL SIZES AND LENGTHS ARE AS UNDER:					
i)	5/8" x 100 mm	64	NOS.			
ii)	3/4 x 114 mm	8	NOS.			

OIL & GAS DEVELOPMENT COMPANY LTD.**KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE – II****BOQ/BID PRICE SCHEDULE FOR SUPPLY OF PIPING MATERIALS FOR INSTALLATION WORKS OF ACID GAS INCINERATOR PACKAGE**

S. NO.	DESCRIPTION	QTY.	UNIT	UNIT COST US\$	TOTAL US\$	REMARKS
11.0	VALVES					
11.1	CAST STEEL BALL VALVE					
a)	BALL VALVES, BW ENDS,150#, RF, REG PORT, ASTM A-216 Gr. WCB AS PER SPECIFICATION OF PIPING MATERIAL (165-4-SPM-046).					
i)	2" NPS (VB-203)	1	NOS.			
b)	BALL VALVE, 150#, BOLTED BONNET, FLOATING TYPE (TRUNNION MOUNTED BALL OVER 4"), REGULAR PORT, FLANGE ENDS, RF, API 6D, ASME B16.34 / B16.10					
	(S) DENOTES SOUR SERVICE. ALL MATERIALS TO COMPLY WITH NACE MR-01-75 (LATEST REVISION).					
i)	16" NPS, VB-202 (S)	1	NOS.			
ii)	4" NPS, VB-202	1	NOS.			
TOTAL						

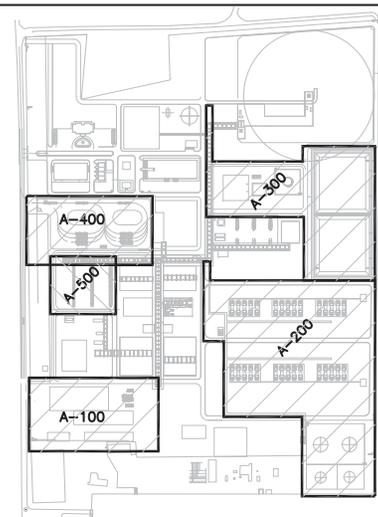
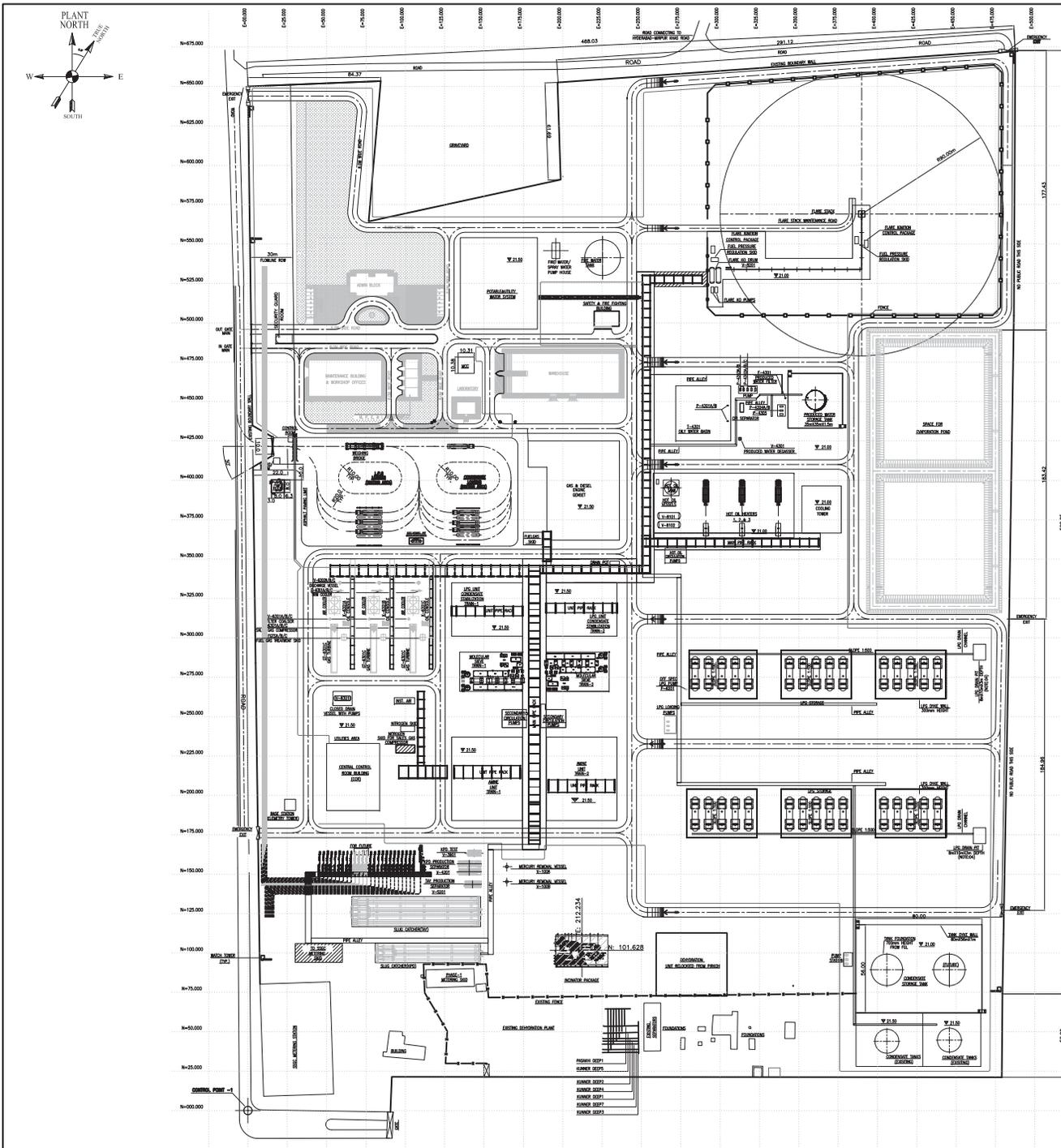
NOTES:

(1) PRICES SHALL BE QUOTED ON FOR BASIS

(2) COPY OF THE SRO 678 (1)/2007 IS GIVEN IN **ANNEXURE-XIV**

DRAWINGS

PLOT PLAN



REFERENCE DRAWINGS			
DESCRIPTION	DWG. NO.		
GAS PROCESSING PLANT TOPOGRAPHICAL SURVEY DRAWING	165-4-SUR-001-RA		
GAS PROCESSING PLANT TOPOGRAPHICAL SURVEY CONTOUR DRAWING	165-4-SUR-002-RA		
GAS PROCESSING PLANT TOPOGRAPHICAL SURVEY LEVEL DRAWING	165-4-SUR-003-RA		
CONTROL POINT -1			
SURVEY DRAWING	N	E	REFERENCE
GENERAL PLOT PLAN	000.00	000.00	LOCAL

- LEGENDS:**
- PROPOSED FENCE
 - EXISTING FENCE
 - EXISTING ROAD
 - ROAD CROSSING BRIDGE
 - EXISTING BOUNDARY WALL
 - NEW BOUNDARY WALL
 - CONTRACTOR'S SCOPE

ISSUED FOR TENDER

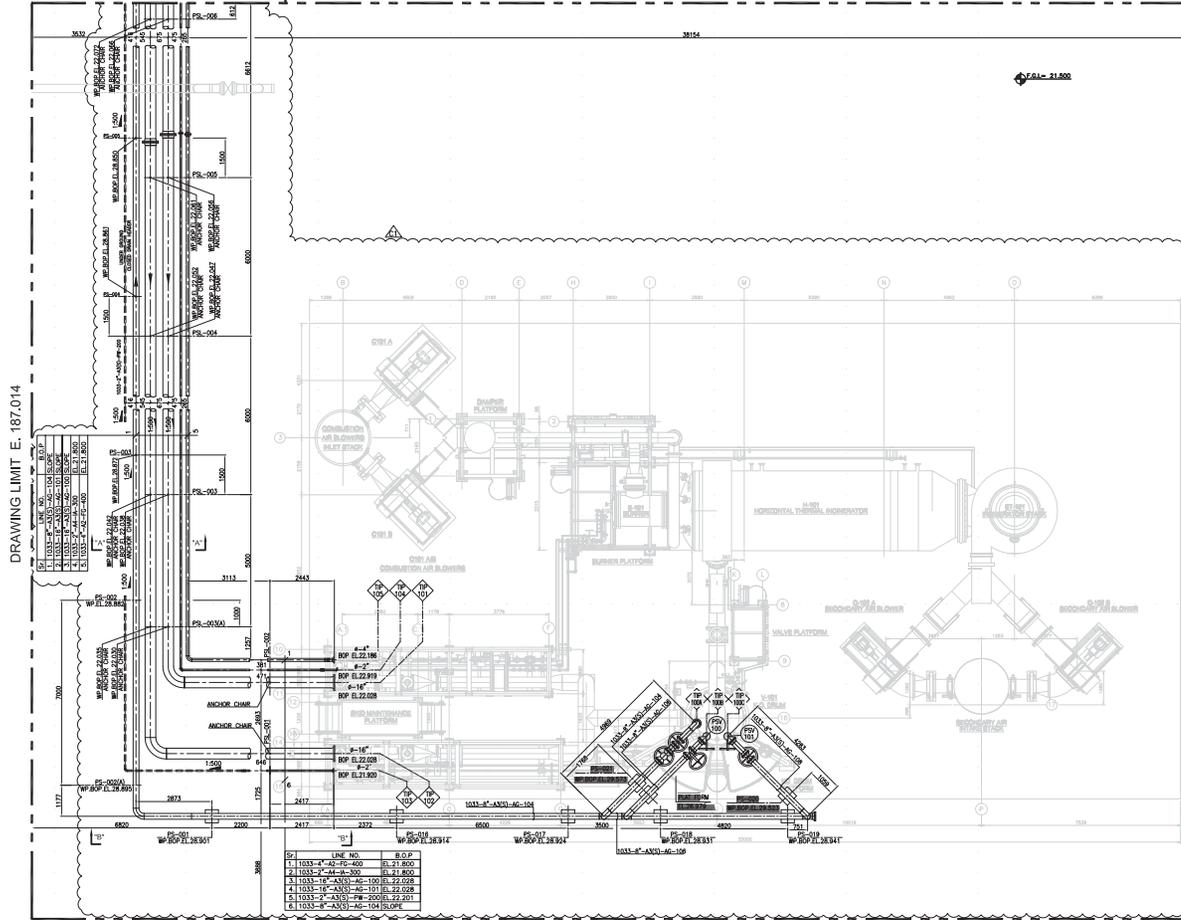
- NOTES:**
- ALL DIMENSIONS ARE IN METERS, UNLESS OTHERWISE STATED.
 - ALL COORDINATES ARE IN METERS.
 - EXISTING PARKING AREA OF KUNNER LPS PLANT WILL BE UTILIZED FOR KPVD TAY PHASE-II FACILITY.
 - LPS DRAIN FITS WILL BE CONNECTED TO STORM WATER NETWORK.

0	16-02-2016	ISSUED FOR TENDER	UMA	MMA	M.A.S.
REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHECKED	APPR.
CLIENT: OIL & GAS DEVELOPMENT COMPANY LTD. <small>OGDCL HOUSE TORONIA, FIRST FLOOR, 15/05, BLUE AREA, BRAWAN AVENUE, BILAHANG PAKISTAN FAX: +92 21 2623033, PHONE: +92 21 2623033</small>					
CONSULTANT: Zishan Engineers (Pvt.) Ltd. <small>An ISO 9001-2008 certified company 478 SOGIL & PICHAY, KHANPUR PAKISTAN Tel: (92-21) 3433245-46 & 34310151-54, Fax: (92-21) 3433231 & 34510156 E-Mail: zishan@zishanengineers.com Website: www.zishanengineers.com</small>					
PROJECT : KPVD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE-II			DWG. NO. 165-4-GPP-009		
TITLE : GENERAL PLOT PLAN FOR INCINERATOR INSTALLATION			REV. 0		
JOB NO. 165-4			JOB NO. 165-4		
SIZE A1 SCALE 1:1300 SHEET 1 OF 1					

MECHANICAL DRAWINGS

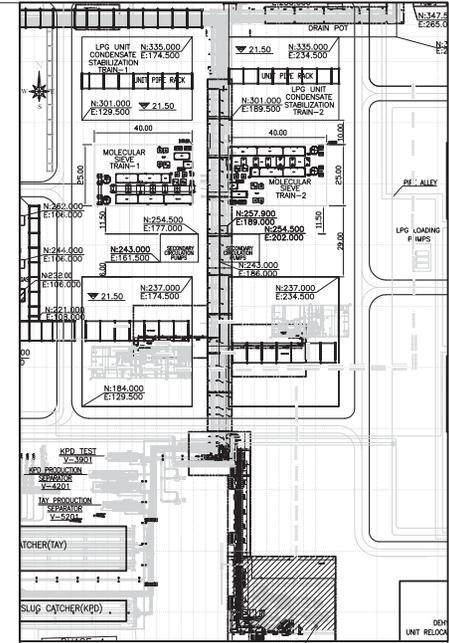
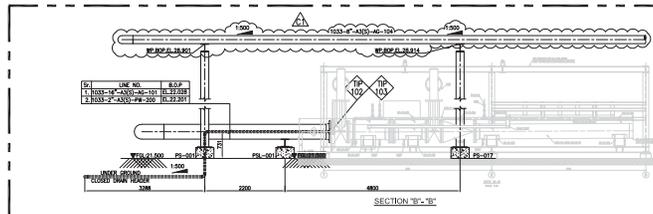
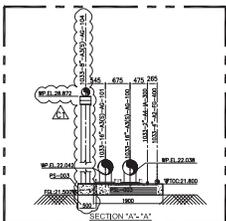


CONT. ON DWG NO. 165-4-MPL-003 DRAWING LIMIT N. 122.575



DRAWING LIMIT N. 92.819
ACID GAS INCINERATOR SKID PACKAGE

SP	LINE NO.	B.O.P.
1	1033-4-AN3-PC-400	E1.21.600
2	1033-2-AN3-PC-200	E1.21.600
3	1033-10-AN3-PC-100	E1.22.028
4	1033-1-AN3-PC-100	E1.22.028
5	1033-2-AN3-PC-200	E1.22.201
6	1033-4-AN3-PC-400	E1.22.201



KEY PLAN

NOTES

1. ALL DIMENSIONS ARE IN MM, UNLESS OTHERWISE STATED.
2. ALL COORDINATES ARE IN METERS.
3. WORK POINT ELEVATION REFERS TO THE BOP OF THE PIPE.
4. FOR ELEVATION DETAILS OF SUPPORTS, REFER DRAWING 165-4-SKT-041.

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHECKED	APPR.
C1	25-09-2016	ISSUED FOR CONSTRUCTION	MMA	MMA	MAS
C2	18-09-2016	ISSUED FOR CONSTRUCTION	MMA	MMA	MAS

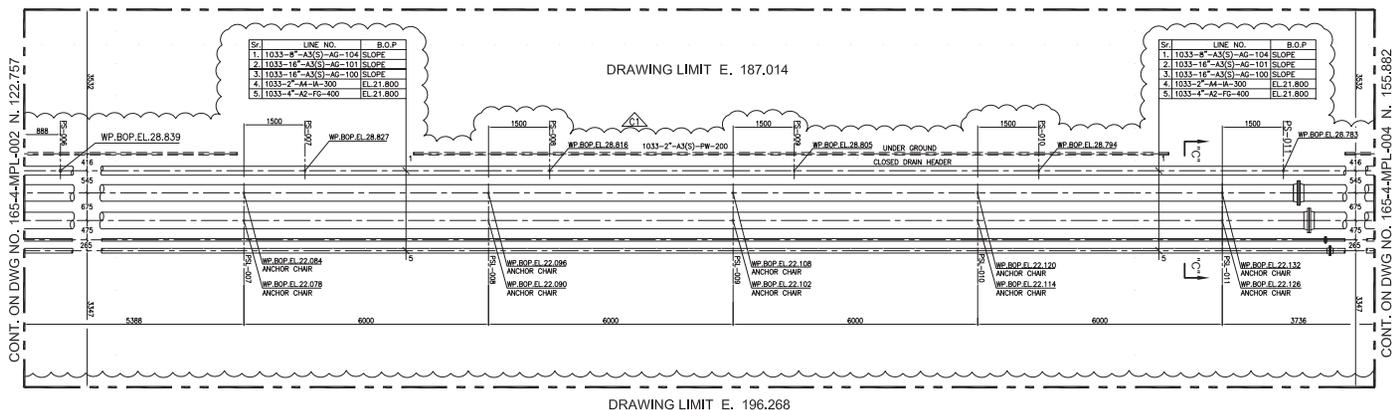
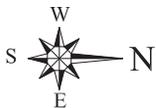
CLIENT: **OIL & GAS DEVELOPMENT COMPANY LTD.**
0500, HOURE TOWNSHIP, FIRST FLOOR, BEIGE BUILDING, BANGSA AVENUE, SELAYANG, PAKISTAN
 FAX: +92 51 9923033, PHONE: +9241-6028959

CONSULTANT: **Zishan Engineers (Pvt.) Ltd.**
An ISO 9001-2008 certified company
 Plot No. 6, Phase II, G-9/2, Islamabad
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 E-Mail: zishan@zishanengineers.com, Website: www.zishanengineers.com

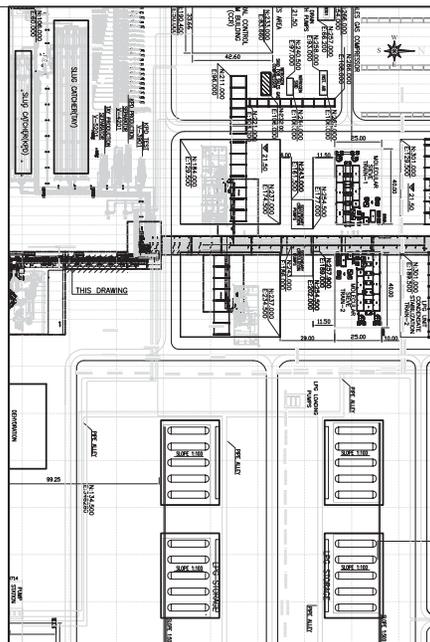
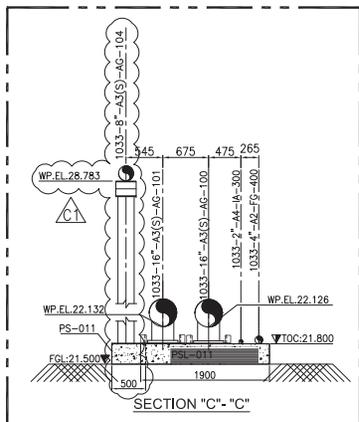
PROJECT: **KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE-II**

TITLE: **MECHANICAL PIPING LAYOUT FOR INCINERATOR SKID**

DWG. NO.	165-4-MPL-002
REV. C1	
JOB NO.	165-4
SIZE	A1
SCALE	1:80
SHEET	1 OF 1



PIPE ALLEY



- NOTES.**
1. ALL DIMENSIONS ARE IN mm, UNLESS OTHERWISE STATED.
 2. ALL COORDINATES ARE IN METERS.
 3. WORK POINT ELEVATION REFERS TO THE BOP OF THE PIPE.
 4. FOR ELEVATION DETAILS OF SUPPORTS, REFER DRAWING 165-4-SKT-041.

REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHECKED	APPR.
C1	27-09-2016	ISSUED FOR CONSTRUCTION	MVA	MVA	MAS
C2	10-09-2016	ISSUED FOR CONSTRUCTION	MVA	MVA	MAS

CLIENT
OIL & GAS DEVELOPMENT COMPANY LTD.
OSCO, HOUSE TOWER 4, FIRST FLOOR, RING ROAD AREA, BANNA AVENUE, ELAMBARA, KHARTOUM
 FAX: +91 21 9023033, PHONE: +91 21 9023055

CONSULTANT:
Zishan Engineers (Pvt.) Ltd.
An ISO 9001-2008 certified company
 4/F, Block E, 25/26, 26th Avenue
 Tel: (91 21) 3420340-48 & 3421015/14, Fax: (91 21) 3423330 & 3421016
 E-MAIL: zsheng@zishanengineers.com, Website: www.zishanengineers.com

PROJECT : KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE-II

TITLE : MECHANICAL PIPING LAYOUT FOR PIPE ALLEY

DWG. NO. 165-4-MPL-003

REV. C1

JOB NO. 165-4

SIZE SCALE SHEET

A1 1:80 1 OF 1



FABRICATION MATERIALS

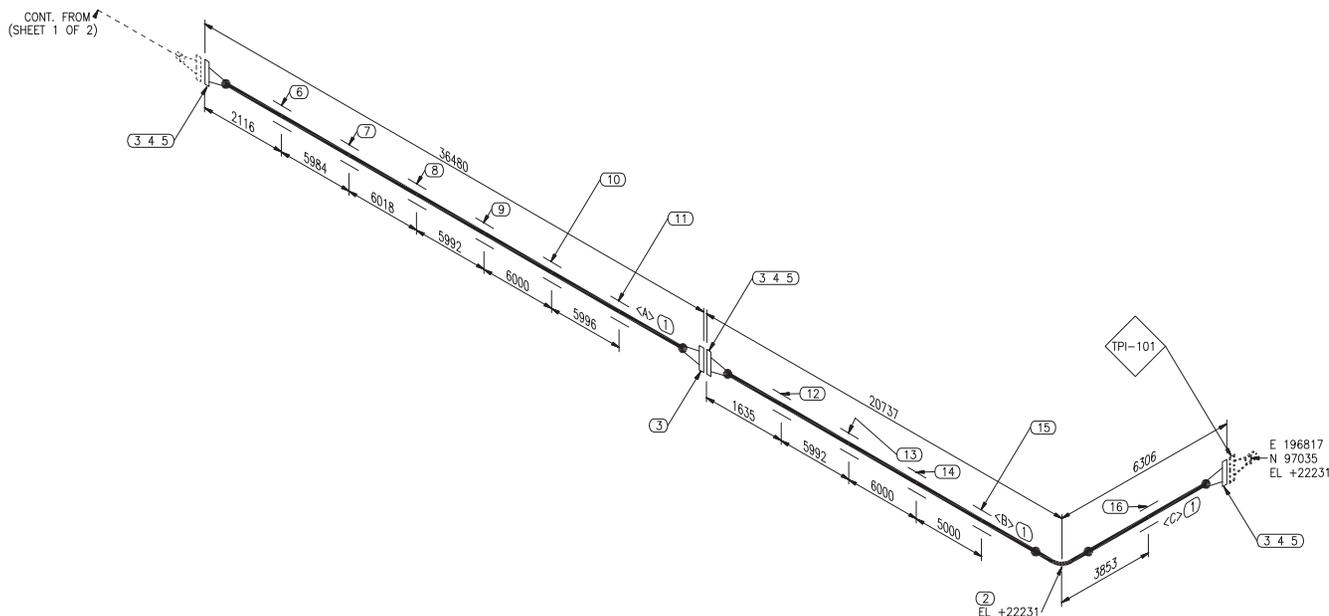
BILL OF MATERIAL

MARK	SIZE	DESCRIPTION	QTY	WEIGHT
PIPE				
1	16	PIPE, SCH.STD, SEAMLESS, BW, ASTM A-333 GR.6, ASME B36.10 (NACE COMPLIANT)	61795	5755.0
FITTINGS				
2	16	ELBOW 90, LONG RADIUS, SCH.STD, SEAMLESS, BW, ASTM A-420 GR.WPL6, ASME B16.9 / B16.25 (NACE COMPLIANT)	1	94.4
FLANGES				
3	16	FLANGE, WELD NECK, 150 LB, SCH.STD, RF, ASTM A-350 GR.LF2, ASME B16.5 (NACE COMPLIANT)	4	230.5
GASKETS				
4	16	GASKET, SPIRAL WOUND, 150 LB, 1/8" THICK SPIRAL WOUND, CARBON STEEL RING 304 OR 316 STAINLESS STEEL WINDING, FLEXIBLE GRAPHITE, ASME B16.20 / B16.21 / B16.5 (NACE COMPLIANT)	3	3.0
BOLTS				
5	1X140	(16) STUD BOLTS WITH TWO HEXAGONAL NUTS & TWO WASHERS EACH, STUD BOLTS: ASTM A-320 GR.L7 (CADMIUM PLATED), NUTS: ASTM A-194 GR.7 (HEAVY HEXAGONAL, CADMIUM PLATED), ASME B18.2.1 / B18.2.2 / B16.5 (NACE COMPLIANT)	3	3.0
SUPPORTS				
6	16	PSL-011(GUID WITH 5mm GAP)	1	-
7	16	PSL-010	1	-
8	16	PSL-009(GUID WITH 5mm GAP)	1	-
9	16	PSL-008	1	-
10	16	PSL-007(GUID WITH 5mm GAP)	1	-
11	16	PSL-006	1	-
12	16	PSL-005(GUID WITH 5mm GAP)	1	-
13	16	PSL-004	1	-
14	16	PSL-003(GUID WITH 5mm GAP)	1	-
15	16	PSL-003(A)(GUID WITH 5mm GAP)	1	-
16	16	PSL-002(GUID WITH 5mm GAP)	1	-

TOTAL FABRICATION WEIGHT 6085.8

TOTAL WEIGHT UNLISTED ITEMS 57.7

TOTAL WEIGHT - THIS DRG 6143.5



CUT PIPE LENGTH

PIECE NUM	LENGTH (MM)	SIZE (INCH)
<A>	36226	16
	20000	16
<C>	5569	16



NOTES:-

1. ALL DIMENSIONS ARE IN mm. UNLESS OTHERWISE STATED.
2. ALL DIMENSIONS & ELEVATIONS TO BE VERIFIED AT SITE PRIOR TO CONSTRUCTION.
3. DETAIL OF CONNECTIONS TO EQUIPMENT TO BE FINALIZED AS PER SITE CONDITIONS.
4. 100% RADIOGRAPHY TO BE PERFORMED FOR WELDS.
5. SUPPORT DETAILS ARE ON HOLD AND WILL BE PROVIDED LATER

REFERENCE DRAWINGS	TECHNICAL INFORMATION
DESIGN PRESSURE	-
TEST PRESSURE	-
DESIGN TEMPERATURE	-
DESIGN CODE	-
PAINTING SPEC.	-
PIPING SPCE	-

CLIENT:	OIL & GAS DEVELOPMENT COMPANY LTD. <small>OSGDC HOUSE, TORONTO, FIRST FLOOR, 1000, BLUE AREA, JNN-041 WYNDOL, ISLAMABAD PAKISTAN FAX: +92 51 262033, P#0012 +9214528959</small>
CONSULTANT:	Zishan Engineers (Pvt.) Ltd. <small>An ISO 9001-2008 certified company 47F Block 6, PECHS, Kamek Park, Islamabad Tel: (9951) 34904941 & 343151146, Fax: (9951) 3490493 & 3491596 Email: contact@zishanengineers.com, Website: www.zishanengineers.com</small>
PROJECT :	KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE-II

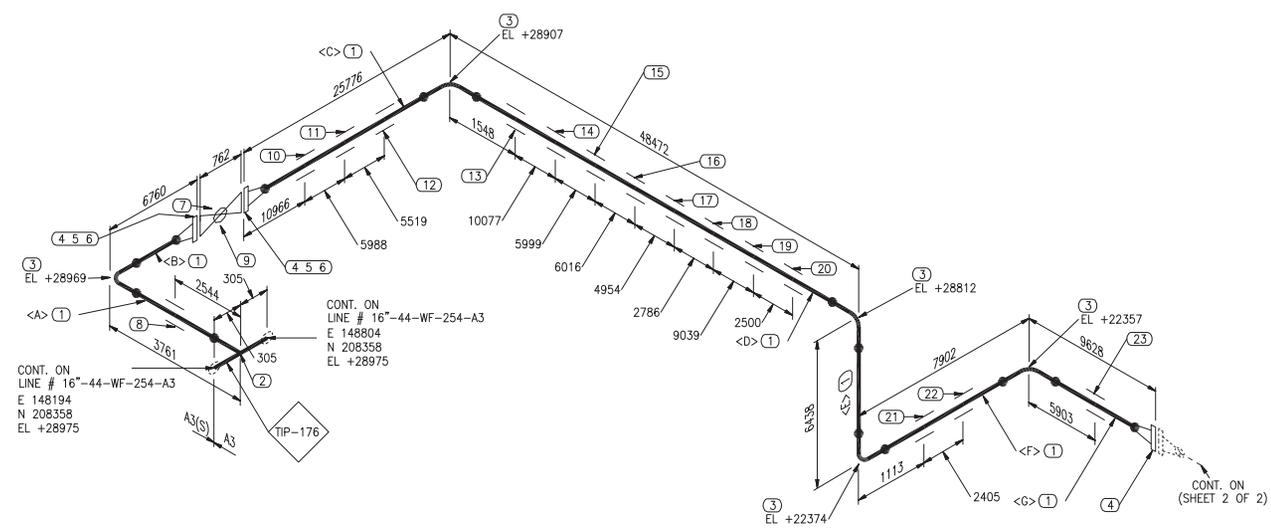
CO	ISSUED FOR CONSTRUCTION	27-09-2016	UMA	MAS
NO.	REVISION	DATE	BY	APR
LINE NO.	1033-16"-A3(S)-AG-100			
TITLE :	ISOMETRIC FOR AREA-400 (INCINERATOR PACKAGE)			REV. CO
DRAWING NO.	165-4-ISO-400-072			SHEET NO. 2 OF 2



FABRICATION MATERIALS

BILL OF MATERIAL

MARK	SIZE	DESCRIPTION	QTY	WEIGHT
PIPE				
1	16	PIPE, SCH.STD, SEAMLESS, BW, ASTM A-333 GR.6, ASME B36.10 (NACE COMPLIANT)	01956 MM	9495.2
FITTINGS				
2	16X16	TEE, STRAIGHT, SCH.STD, SEAMLESS, BW, ASTM A-420 GR.WPL6, ASME B16.9 / B16.25	1	113.4
3	16	ELBOW 90, LONG RADIUS, SCH.STD, SEAMLESS, BW, ASTM A-420 GR.WPL6, ASME B16.9 / B16.25 (NACE COMPLIANT)	5	471.8
FLANGES				
4	16	FLANGE, WELD NECK, 150 LB, SCH.STD, RF, ASTM A-350 GR.LF2, ASME B16.5 (NACE COMPLIANT)	3	172.9
GASKETS				
5	16	GASKET, SPIRAL WOUND, 150 LB, 1/8" THICK SPIRAL WOUND, CARBON STEEL RING 304 OR 316 STAINLESS STEEL WINDING, FLEXIBLE GRAPHITE, ASME B16.20 / B16.21 / B16.5 (NACE COMPLIANT)	2	2.0
BOLTS				
6	1X140	(16) STUD BOLTS WITH TWO HEXAGONAL NUTS & TWO WASHERS EACH, STUD BOLTS: ASTM A-320 GR.L7 (CADMIUM PLATED); NUTS: ASTM A-194 GR.7 (HEAVY HEXAGONAL, CADMIUM PLATED), ASME B18.2.1 / B18.2.2 / B16.5 (NACE COMPLIANT)	2	2.0
VALVES / IN-LINE ITEMS				
7	16	BALL VALVE (PIPING SPEC. NAME: VB-202), 150 LB, BOLTED BONNET, FLOATING TYPE (TRUNNION MOUNTED BALL OVER 4"), REGULAR PORT, FLANGE ENDS, RF, API 6D, ASME B16.34 / B16.10 (NACE COMPLIANT)	1	600.0
SUPPORTS				
8	16	ST-001(GUID WITH 5mm GAP)	1	--
9	16	ST-002	1	--
10	16	ST-004(GUID WITH 5mm GAP)	1	--
11	16	ST-005	1	--
12	16	ST-006(GUID WITH 5mm GAP)	1	--
13	16	ST-014(GUID WITH 5mm GAP)	1	--
14	16	ST-013(GUID WITH 5mm GAP)	1	--
15	16	ST-016	1	--
16	16	ST-018(GUID WITH 5mm GAP)	1	--
17	16	ST-020	1	--
18	16	ST-022(GUID WITH 5mm GAP)	1	--
19	16	ST-024	1	--
20	16	ST-026(GUID WITH 5mm GAP)	1	--
21	16	PSL-018(GUID WITH 5mm GAP)	1	--
22	16	PSL-015	1	--
23	16	PSL-012	1	--
TOTAL FABRICATION WEIGHT			10857.1	



PIECE NUM	LENGTH (MM)	SIZE (INCH)
<A>	2847	16
	6024	16
<C>	25040	16
<D>	47253	16
<E>	5218	16
<F>	6683	16
<G>	8891	16

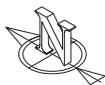
- NOTES:-**
1. ALL DIMENSIONS ARE IN mm. UNLESS OTHERWISE STATED.
 2. ALL DIMENSIONS & ELEVATIONS TO BE VERIFIED AT SITE PRIOR TO CONSTRUCTION.
 3. DETAIL OF CONNECTIONS TO EQUIPMENT TO BE FINALIZED AS PER SITE CONDITIONS.
 4. 100% RADIOGRAPHY TO BE PERFORMED FOR WELDS.
 5. SUPPORT DETAILS ARE ON HOLD AND WILL BE PROVIDED LATER

CO	ISSUED FOR CONSTRUCTION	27-09-2016	UMA	MAS
NO.	REVISION	DATE	BY	APR

165-4-MPL-40001	OVERALL PIPING PLAN LPG LOADING AREA-400	DESIGN PRESSURE	--
		TEST PRESSURE	--
		DESIGN TEMPERATURE	--
		DESIGN CODE	--
		PAINTING SPEC.	--
		PIPING SPC	--

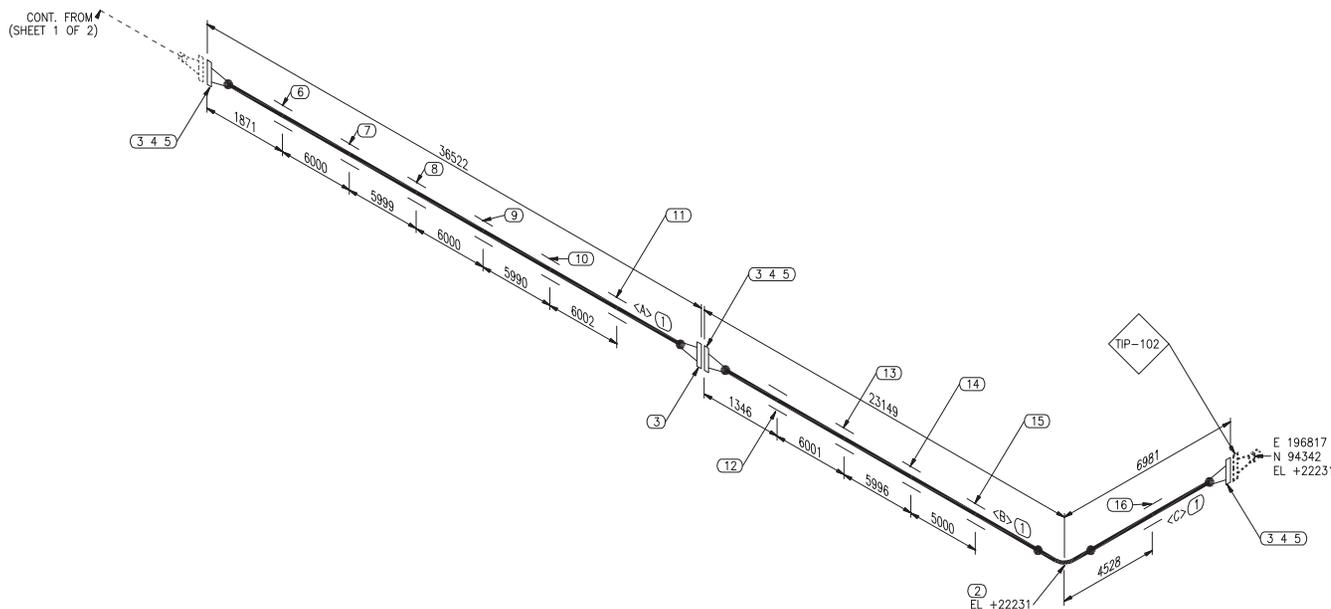
CLIENT: **OIL & GAS DEVELOPMENT COMPANY LTD.**
02225 HOUSE TOWER 1801 WEST PLOT 11/02 BLVD JAKKA, JAKKANA AVE/100 BALAKRISHNA PALLETT
 FAX: +91 91 2620233, PHONE: +91-40-269989

CONSULTANT: **Zishan Engineers (Pvt.) Ltd.**
An ISO 9001-2008 certified company
 4/F Block 6, PECHS, KaveriKallan
 The 16th/17/18th/19th/20th/21st/22nd/23rd/24th/25th/26th/27th/28th/29th/30th/31st/32nd/33rd/34th/35th/36th/37th/38th/39th/40th/41st/42nd/43rd/44th/45th/46th/47th/48th/49th/50th/51st/52nd/53rd/54th/55th/56th/57th/58th/59th/60th/61st/62nd/63rd/64th/65th/66th/67th/68th/69th/70th/71st/72nd/73rd/74th/75th/76th/77th/78th/79th/80th/81st/82nd/83rd/84th/85th/86th/87th/88th/89th/90th/91st/92nd/93rd/94th/95th/96th/97th/98th/99th/100th/101st/102nd/103rd/104th/105th/106th/107th/108th/109th/110th/111th/112th/113th/114th/115th/116th/117th/118th/119th/120th/121st/122nd/123rd/124th/125th/126th/127th/128th/129th/130th/131st/132nd/133rd/134th/135th/136th/137th/138th/139th/140th/141st/142nd/143rd/144th/145th/146th/147th/148th/149th/150th/151st/152nd/153rd/154th/155th/156th/157th/158th/159th/160th/161st/162nd/163rd/164th/165th/166th/167th/168th/169th/170th/171st/172nd/173rd/174th/175th/176th/177th/178th/179th/180th/181st/182nd/183rd/184th/185th/186th/187th/188th/189th/190th/191st/192nd/193rd/194th/195th/196th/197th/198th/199th/200th/201st/202nd/203rd/204th/205th/206th/207th/208th/209th/210th/211st/212nd/213th/214th/215th/216th/217th/218th/219th/220th/221st/222nd/223rd/224th/225th/226th/227th/228th/229th/230th/231st/232nd/233rd/234th/235th/236th/237th/238th/239th/240th/241st/242nd/243rd/244th/245th/246th/247th/248th/249th/250th/251st/252nd/253rd/254th/255th/256th/257th/258th/259th/260th/261st/262nd/263rd/264th/265th/266th/267th/268th/269th/270th/271st/272nd/273rd/274th/275th/276th/277th/278th/279th/280th/281st/282nd/283rd/284th/285th/286th/287th/288th/289th/290th/291st/292nd/293rd/294th/295th/296th/297th/298th/299th/300th/301st/302nd/303rd/304th/305th/306th/307th/308th/309th/310th/311st/312nd/313th/314th/315th/316th/317th/318th/319th/320th/321st/322nd/323rd/324th/325th/326th/327th/328th/329th/330th/331st/332nd/333rd/334th/335th/336th/337th/338th/339th/340th/341st/342nd/343rd/344th/345th/346th/347th/348th/349th/350th/351st/352nd/353rd/354th/355th/356th/357th/358th/359th/360th/361st/362nd/363rd/364th/365th/366th/367th/368th/369th/370th/371st/372nd/373rd/374th/375th/376th/377th/378th/379th/380th/381st/382nd/383rd/384th/385th/386th/387th/388th/389th/390th/391st/392nd/393rd/394th/395th/396th/397th/398th/399th/400th/401st/402nd/403rd/404th/405th/406th/407th/408th/409th/410th/411st/412nd/413th/414th/415th/416th/417th/418th/419th/420th/421st/422nd/423rd/424th/425th/426th/427th/428th/429th/430th/431st/432nd/433rd/434th/435th/436th/437th/438th/439th/440th/441st/442nd/443rd/444th/445th/446th/447th/448th/449th/450th/451st/452nd/453rd/454th/455th/456th/457th/458th/459th/460th/461st/462nd/463rd/464th/465th/466th/467th/468th/469th/470th/471st/472nd/473rd/474th/475th/476th/477th/478th/479th/480th/481st/482nd/483rd/484th/485th/486th/487th/488th/489th/490th/491st/492nd/493rd/494th/495th/496th/497th/498th/499th/500th/501st/502nd/503rd/504th/505th/506th/507th/508th/509th/510th/511st/512nd/513th/514th/515th/516th/517th/518th/519th/520th/521st/522nd/523rd/524th/525th/526th/527th/528th/529th/530th/531st/532nd/533rd/534th/535th/536th/537th/538th/539th/540th/541st/542nd/543rd/544th/545th/546th/547th/548th/549th/550th/551st/552nd/553rd/554th/555th/556th/557th/558th/559th/560th/561st/562nd/563rd/564th/565th/566th/567th/568th/569th/570th/571st/572nd/573rd/574th/575th/576th/577th/578th/579th/580th/581st/582nd/583rd/584th/585th/586th/587th/588th/589th/590th/591st/592nd/593rd/594th/595th/596th/597th/598th/599th/600th/601st/602nd/603rd/604th/605th/606th/607th/608th/609th/610th/611st/612nd/613th/614th/615th/616th/617th/618th/619th/620th/621st/622nd/623rd/624th/625th/626th/627th/628th/629th/630th/631st/632nd/633rd/634th/635th/636th/637th/638th/639th/640th/641st/642nd/643rd/644th/645th/646th/647th/648th/649th/650th/651st/652nd/653rd/654th/655th/656th/657th/658th/659th/660th/661st/662nd/663rd/664th/665th/666th/667th/668th/669th/670th/671st/672nd/673rd/674th/675th/676th/677th/678th/679th/680th/681st/682nd/683rd/684th/685th/686th/687th/688th/689th/690th/691st/692nd/693rd/694th/695th/696th/697th/698th/699th/700th/701st/702nd/703rd/704th/705th/706th/707th/708th/709th/710th/711st/712nd/713th/714th/715th/716th/717th/718th/719th/720th/721st/722nd/723rd/724th/725th/726th/727th/728th/729th/730th/731st/732nd/733rd/734th/735th/736th/737th/738th/739th/740th/741st/742nd/743rd/744th/745th/746th/747th/748th/749th/750th/751st/752nd/753rd/754th/755th/756th/757th/758th/759th/760th/761st/762nd/763rd/764th/765th/766th/767th/768th/769th/770th/771st/772nd/773rd/774th/775th/776th/777th/778th/779th/780th/781st/782nd/783rd/784th/785th/786th/787th/788th/789th/790th/791st/792nd/793rd/794th/795th/796th/797th/798th/799th/800th/801st/802nd/803rd/804th/805th/806th/807th/808th/809th/810th/811st/812nd/813th/814th/815th/816th/817th/818th/819th/820th/821st/822nd/823rd/824th/825th/826th/827th/828th/829th/830th/831st/832nd/833rd/834th/835th/836th/837th/838th/839th/840th/841st/842nd/843rd/844th/845th/846th/847th/848th/849th/850th/851st/852nd/853rd/854th/855th/856th/857th/858th/859th/860th/861st/862nd/863r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FABRICATION MATERIALS

		DESCRIPTION	QTY	WEIGHT
BILL OF MATERIAL				
MARK	SIZE			
<u>PIPE</u>				
1	16	PIPE, SCH.STD, SEAMLESS, BW, ASTM A-333 GR.6, ASME B36.10 (NACE COMPLIANT)	64925 MM	6046.5
<u>FITTINGS</u>				
2	16	ELBOW 90, LONG RADIUS, SCH.STD, SEAMLESS, BW, ASTM A-420 GR.WPL6, ASME B16.9 / B16.25 (NACE COMPLIANT)	1	94.4
<u>FLANGES</u>				
3	16	FLANGE, WELD NECK, 150 LB, SCH.STD, RF, ASTM A-350 GR.LF2, ASME B16.5 (NACE COMPLIANT)	4	230.5
<u>GASKETS</u>				
4	16	GASKET, SPIRAL WOUND, 150 LB, 1/8" THICK SPIRAL WOUND, CARBON STEEL RING 304- OR 316 STAINLESS STEEL WINDING, FLEXIBLE GRAPHITE, ASME B16.20 / B16.21 / B16.5 (NACE COMPLIANT)	3	3.0
<u>BOLTS</u>				
5	1X140	(16) STUD BOLTS WITH TWO HEXAGONAL NUTS & TWO WASHERS EACH, STUD BOLTS: ASTM A-320 GR.L7 (CADMIUM PLATED), NUTS: ASTM A-194 GR.7 (HEAVY HEXAGONAL, CADMIUM PLATED), ASME B18.2.1 / B18.2.2 / B16.5 (NACE COMPLIANT)	3	3.0
<u>SUPPORTS</u>				
6	16	PSL-011(GUID WITH 5mm GAP)	1	-
7	16	PSL-010	1	-
8	16	PSL-009(GUID WITH 5mm GAP)	1	-
9	16	PSL-008	1	-
10	16	PSL-007(GUID WITH 5mm GAP)	1	-
11	16	PSL-006	1	-
12	16	PSL-005(GUID WITH 5mm GAP)	1	-
13	16	PSL-004	1	-
14	16	PSL-003(GUID WITH 5mm GAP)	1	-
15	16	PSL-003(A)(GUID WITH 5mm GAP)	1	-
16	16	PSL-001(GUID WITH 5mm GAP)	1	-
TOTAL FABRICATION WEIGHT			6377.3	
TOTAL WEIGHT UNLISTED ITEMS			57.7	
TOTAL WEIGHT - THIS DRG			6435.0	



CUT PIPE LENGTH

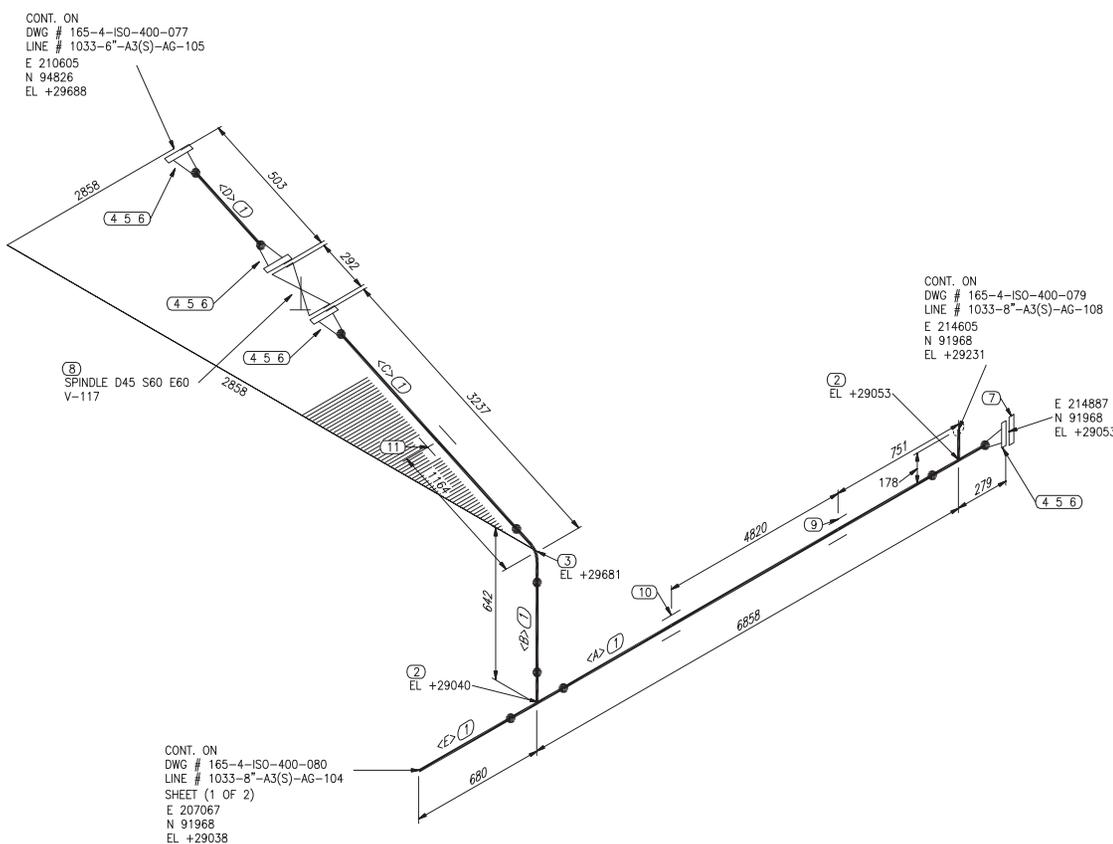
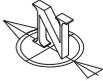
PIECE NUM	LENGTH (MM)	SIZE (INCH)
<A>	36268	16
	22413	16
<C>	6244	16



NOTES:-

1. ALL DIMENSIONS ARE IN mm. UNLESS OTHERWISE STATED.
2. ALL DIMENSIONS & ELEVATIONS TO BE VERIFIED AT SITE PRIOR TO CONSTRUCTION.
3. DETAIL OF CONNECTIONS TO EQUIPMENT TO BE FINALIZED AS PER SITE CONDITIONS.
4. 100% RADIOGRAPHY TO BE PERFORMED FOR WELDS.
5. SUPPORT DETAILS ARE ON HOLD AND WILL BE PROVIDED LATER

165-4-MPL-40001	OVERALL PIPING PLAN LPG LOADING AREA-400	DESIGN PRESSURE	-	CLIENT:	OIL & GAS DEVELOPMENT COMPANY LTD.	LINE NO.	1033-16"-A3(S)-AG-101		
		TEST PRESSURE	-			TITLE :	ISOMETRIC FOR AREA-400 (INCINERATOR PACKAGE)		
		DESIGN TEMPERATURE	-	CONSULTANT:	Zishan Engineers (Pvt.) Ltd.	DRAWING NO.	165-4-ISO-400-073		
		DESIGN CODE	-		An ISO 9001-2008 certified company	REV.	CO		
		PAINTING SPEC.	-		407 Block E, PECHS, Kazeri Park, Kharajpur, Bhubaneswar, Odisha - 751015, India. Phone: +91 674 2522222. Fax: +91 674 2522222. Email: zshans@zshans.com Website: www.zshans.com	SHEET NO.	2 OF 2		
		PIPING SPCE	-	PROJECT :	KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE-II				
REFERENCE DRAWINGS		TECHNICAL INFORMATION							



CONT. ON
 DWG # 165-4-ISO-400-077
 LINE # 1033-6"-A3(S)-AG-105
 E 210605
 N 94826
 EL +29688

CONT. ON
 DWG # 165-4-ISO-400-079
 LINE # 1033-8"-A3(S)-AG-108
 E 214605
 N 91968
 EL +29231

CONT. ON
 DWG # 165-4-ISO-400-080
 LINE # 1033-8"-A3(S)-AG-104
 SHEET (1 OF 2)
 E 207067
 N 91968
 EL +29038

FABRICATION MATERIALS

		BILL OF MATERIAL			
MARK	SIZE	DESCRIPTION	QTY	WEIGHT	
PIPE					
1	8	PIPE, SCH.40, SEAMLESS, BW, ASTM A-333 GR.6, ASME B36.10 (NACE COMPLIANT)	10293 MM	437.4	
FITTINGS					
2	8X8	TEE, STRAIGHT, SCH.40, SEAMLESS, BW, ASTM A-420 GR.WPL6, ASME B16.9 / B16.25 (NACE COMPLIANT)	2	54.7	
3	8	ELBOW 90, LONG RADIUS, SCH.40, SEAMLESS, BW, ASTM A-420 GR.WPL6, ASME B16.9 / B16.25 (NACE COMPLIANT)	1	20.4	
FLANGES					
4	8	FLANGE, WELD NECK, 150 LB, SCH.40, RF, ASTM A-350 GR.LF2, ASME B16.5 (NACE COMPLIANT)	4	70.8	
GASKETS					
5	8	GASKET, SPIRAL WOUND, 150 LB, 1/8" THICK SPIRAL WOUND, CARBON STEEL RING 304 OR 316 STAINLESS STEEL WINDING, FLEXIBLE GRAPHITE, ASME B16.20 / B16.21 / B16.5 (NACE COMPLIANT)	4	4.0	
BOLTS					
6	3/4X115	(8) STUD BOLTS WITH TWO HEXAGONAL NUTS & TWO WASHERS EACH, STUD BOLTS: ASTM A-320 GR.L7 (CADMIUM PLATED); NUTS: ASTM A-194 GR.7 (HEAVY HEXAGONAL, CADMIUM PLATED), ASME B18.2.1 / B18.2.2 / B16.5 (NACE COMPLIANT)	4	4.0	
VALVES / IN-LINE ITEMS					
7	8	FLANGE, BLIND, 150 LB, RF, ASTM A-350 GR.LF2, ASME B16.5 (NACE COMPLIANT)	1	20.5	
8	8	GATE VALVE (PIPING SPEC. NAME: VG-202), 150 LB, OS&Y, BOLTED BONNET, SOLID WEDGE, FLANGE ENDS, RF, API 600, API 6D, ASME B16.34 / B16.10	1	140.7	
SUPPORTS					
9	8	PS-019	1	-	
10	8	PS-018	1	-	
11	8	PS-021	1	-	
TOTAL FABRICATION WEIGHT				752.1	

CUT PIPE LENGTH

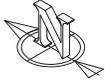
PIECE NUM	LENGTH (MM)	SIZE (INCH)
<A>	6502	8
	159	8
<C>	2830	8
<D>	300	8
<E>	502	8



- NOTES:-**
1. ALL DIMENSIONS ARE IN mm. UNLESS OTHERWISE STATED.
 2. ALL DIMENSIONS & ELEVATIONS TO BE VERIFIED AT SITE PRIOR TO CONSTRUCTION.
 3. DETAIL OF CONNECTIONS TO EQUIPMENT TO BE FINALIZED AS PER SITE CONDITIONS.
 4. 100% RADIOGRAPHY TO BE PERFORMED FOR WELDS.
 5. SUPPORT DETAILS ARE ON HOLD AND WILL BE PROVIDED LATER

165-4-MPL-40001	OVERALL PIPING PLAN LPG LOADING AREA-400	DESIGN PRESSURE	-	CLIENT: OIL & GAS DEVELOPMENT COMPANY LTD. <small>OSDC HOUSE, TORONTO, 1801 FLOOR, 1800, BLUE HAVEN, 43RD AVE, WILLOWDALE, ONTARIO M2H 1P7 CANADA FAX: +1 416 512 2620/2233, PHONE: +1 416 491 8889</small>	LINE NO.	1033-8"-A3(S)-AG-106		
		DESIGN TEMPERATURE	-		CONSULTANT:	 Zishan Engineers (Pvt.) Ltd. <small>An ISO 9001:2008 certified company 47F Block 6, PECHS, Kowloon, Kowloon Tel: (8542) 34242444 & 34212124, Fax: (8542) 3363333 & 34212124 Email: contact@zishanengineers.com Website: www.zishanengineers.com</small>		
	PIPING SPC	DESIGN CODE	-	PROJECT :	KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE-4I			
REFERENCE DRAWINGS		TECHNICAL INFORMATION		TITLE :	ISOMETRIC FOR AREA-400 (INCINERATOR PACKAGE)			REV. CO
				DRAWING NO.	165-4-ISO-400-074			SHEET NO. 1 OF 1

CO	ISSUED FOR CONSTRUCTION	27-09-2016	UMA	MAS
NO.	REVISION	DATE	BY	APR



FABRICATION MATERIALS

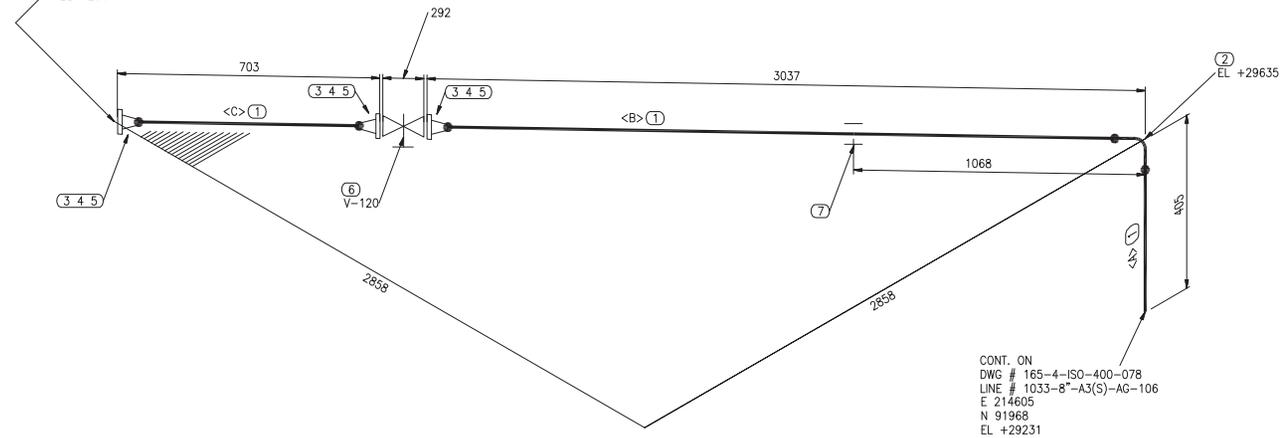
BILL OF MATERIAL				
MARK	SIZE	DESCRIPTION	QTY	WEIGHT
PIPE				
1	8	PIPE, SCH.40, SEAMLESS, BW, ASTM A-333 GR.6, ASME B36.10 (NACE COMPLIANT)	3230 MM	137.3
FITTINGS				
2	8	ELBOW 90, LONG RADIUS, SCH.40, SEAMLESS, BW, ASTM A-420 GR.WPL6, ASME B16.9 / B16.25 (NACE COMPLIANT)	1	20.4
FLANGES				
3	8	FLANGE, WELD NECK, 150 LB, SCH.40, RF, ASTM A-350 GR.LF2, ASME B16.5 (NACE COMPLIANT)	3	53.1
GASKETS				
4	8	GASKET, SPIRAL WOUND, 150 LB, 1/8" THICK SPIRAL WOUND, CARBON STEEL RING 304 OR 316 STAINLESS STEEL WINDING, FLEXIBLE GRAPHITE, ASME B16.20 / B16.21 / B16.5 (NACE COMPLIANT)	3	3.0
BOLTS				
5	3/4X115	(8) STUD BOLTS WITH TWO HEXAGONAL NUTS & TWO WASHERS EACH, STUD BOLTS: ASTM A-320 GR.L7 (CADMIUM PLATED), NUTS: ASTM A-194 GR.7 (HEAVY HEXAGONAL, CADMIUM PLATED), ASME B18.2.1 / B18.2.2 / B16.5 (NACE COMPLIANT)	3	3.0
VALVES / IN-LINE ITEMS				
6	8	GATE VALVE (PIPING SPEC. NAME: VG-202), 150 LB, OS&Y, BOLTED BONNET, SOLID WEDGE, FLANGE ENDS, RF, API 600, API 6D, ASME B16.34 / B16.10	1	140.7
SUPPORTS				
7	8	PS-020	1	-
TOTAL FABRICATION WEIGHT				357.3

CUT PIPE LENGTH

PIECE NUM	LENGTH (MM)	SIZE (INCH)
<A>	100	8
	2630	8
<C>	500	8



CONT. ON
 DWG # 165-4-ISO-400-081
 LINE # 1033-6"-A3(S)-AG-107
 E 211747
 N 94826
 EL +29641

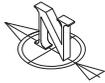


CONT. ON
 DWG # 165-4-ISO-400-078
 LINE # 1033-8"-A3(S)-AG-106
 E 214605
 N 91968
 EL +29231

- NOTES:-**
1. ALL DIMENSIONS ARE IN mm. UNLESS OTHERWISE STATED.
 2. ALL DIMENSIONS & ELEVATIONS TO BE VERIFIED AT SITE PRIOR TO CONSTRUCTION.
 3. DETAIL OF CONNECTIONS TO EQUIPMENT TO BE FINALIZED AS PER SITE CONDITIONS.
 4. 100% RADIOGRAPHY TO BE PERFORMED FOR WELDS.
 5. SUPPORT DETAILS ARE ON HOLD AND WILL BE PROVIDED LATER

165-4-MPL-40001	OVERALL PIPING PLAN LPG LOADING AREA-400	DESIGN PRESSURE	-	CLIENT: OIL & GAS DEVELOPMENT COMPANY LTD. <small>ONGC HOUSE, TONGRAL, 8th FLOOR, HOOR, BLUE AREA, BHIMAVARAM, VISAKHAPATNAM</small> FAX: +91 91 202033, PHONE: +91 91 4529859	LINE NO.	1033-8"-A3(S)-AG-108		
	REFERENCE DRAWINGS	TECHNICAL INFORMATION	DESIGN TEMPERATURE		-	TITLE :	ISOMETRIC FOR AREA-400 (INCINERATOR PACKAGE)	REV.
		TEST PRESSURE	-	CONSULTANT:				
		DESIGN CODE	-	 Zishan Engineers (Pvt.) Ltd. <small>An ISO 9001-2008 certified company</small> <small>4/F, Block 6, PECHS, KarambaKallan</small> <small>Tel: (91-7) 3426048-9, 3426101-2; Fax: (91-7) 3423333, 3423336</small> <small>Email: contact@zishanengineers.com Website: www.zishanengineers.com</small>	DRAWING NO.	165-4-ISO-400-075	SHEET NO.	1 OF 1
		PAINTING SPEC.	-	PROJECT :	KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE-II			
		PIPING SPCE	-					

CO	ISSUED FOR CONSTRUCTION	27-09-2016	UMA	MAS
NO.	REVISION	DATE	BY	APR



FABRICATION MATERIALS

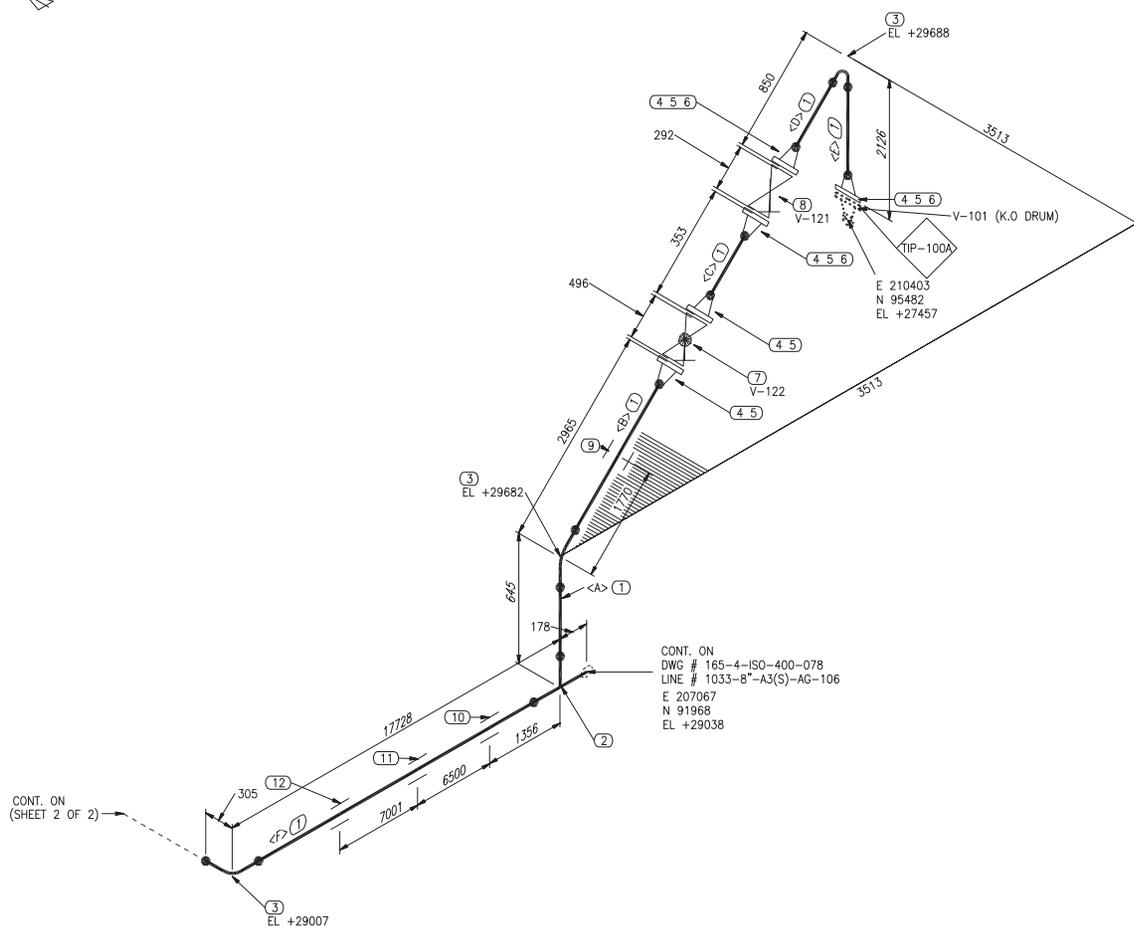
BILL OF MATERIAL

MARK	SIZE	DESCRIPTION	QTY	WEIGHT
PIPE				
1	8	PIPE, SCH.40, SEAMLESS, BW, ASTM A-333 GR.6, ASME B36.10 (NACE COMPLIANT)	22281 MM	946.8
FITTINGS				
2	8X8	TEE, STRAIGHT, SCH.40, SEAMLESS, BW, ASTM A-420 GR.WPL6, ASME B16.9 / B16.25 (NACE COMPLIANT)	1	27.4
3	8	ELBOW 90, LONG RADIUS, SCH.40, SEAMLESS, BW, ASTM A-420 GR.WPL6, ASME B16.9 / B16.25 (NACE COMPLIANT)	3	61.2
FLANGES				
4	8	FLANGE, WELD NECK, 150 LB, SCH.40, RF, ASTM A-350 GR.LF2, ASME B16.5 (NACE COMPLIANT)	5	88.5
GASKETS				
5	8	GASKET, SPIRAL WOUND, 150 LB, 1/8" THICK SPIRAL WOUND, CARBON STEEL RING 304 OR 316 STAINLESS STEEL WINDING, FLEXIBLE GRAPHITE, ASME B16.20 / B16.21 / B16.5 (NACE COMPLIANT)	5	5.0
BOLTS				
6	3/4X115	(8) STUD BOLTS WITH TWO HEXAGONAL NUTS & TWO WASHERS EACH, STUD BOLTS: ASTM A-320 GR.L7 (CADMIUM PLATED), NUTS: ASTM A-194 GR.7 (HEAVY HEXAGONAL, CADMIUM PLATED), ASME B18.2.1 / B18.2.2 / B16.5 (NACE COMPLIANT)	3	3.0
VALVES / IN-LINE ITEMS				
7	8	GLOBE VALVE (PIPING SPEC. NAME: VGL-202), 150 LB, OS&Y, BOLTED BONNET, FLANGE ENDS, RF, BS 1873, ASME B16.34 / B16.10 (NACE COMPLIANT)	1	420.0
8	8	GATE VALVE (PIPING SPEC. NAME: VG-202), 150 LB, OS&Y, BOLTED BONNET, SOLID WEDGE, FLANGE ENDS, RF, API 600, API 6D, ASME B16.34 / B16.10	1	140.7
SUPPORTS				
9	8	PS-021	1	-
10	8	PS-017	1	-
11	8	PS-016	1	-
12	8	PS-001	1	-

TOTAL FABRICATION WEIGHT 1692.2
 TOTAL WEIGHT UNLISTED ITEMS 17.7
 TOTAL WEIGHT - THIS DRG 1709.9

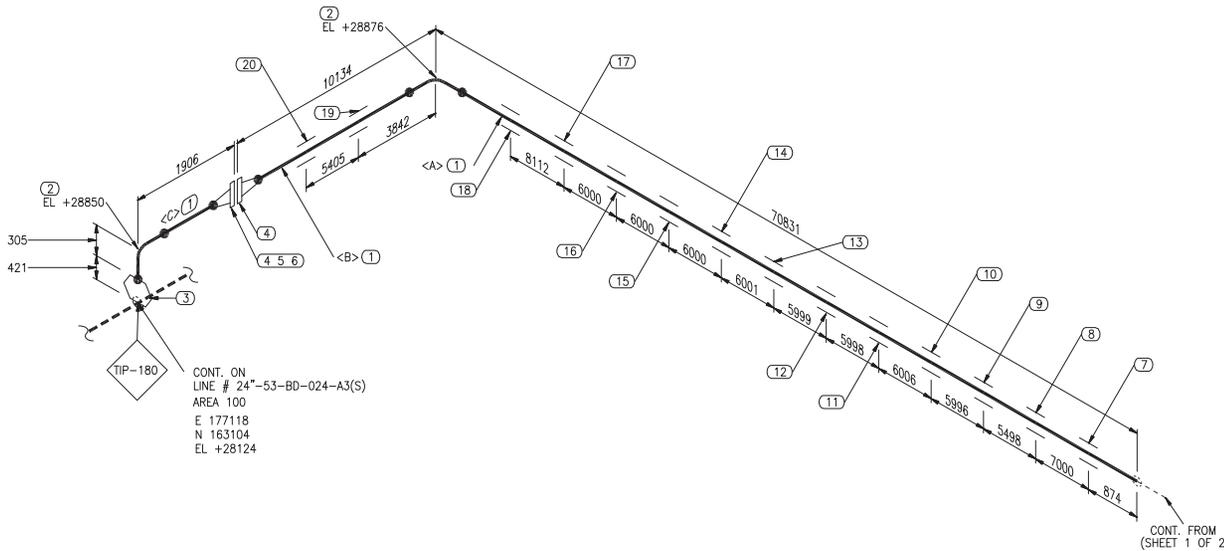
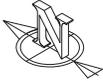
CUT PIPE LENGTH

PIECE NUM	LENGTH (MM)	SIZE (INCH)
<A>	162	8
	2559	8
<C>	150	8
<D>	444	8
<E>	1720	8
<F>	17246	8



- NOTES:-**
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 2. ALL DIMENSIONS & ELEVATIONS TO BE VERIFIED AT SITE PRIOR TO CONSTRUCTION.
 3. DETAIL OF CONNECTIONS TO EQUIPMENT TO BE FINALIZED AS PER SITE CONDITIONS.
 4. 100% RADIOGRAPHY TO BE PERFORMED FOR WELDS.
 5. SUPPORT DETAILS ARE ON HOLD AND WILL BE PROVIDED LATER

165-4-MPL-40001	OVERALL PIPING PLAN LPG LOADING AREA-400	DESIGN PRESSURE	-	CLIENT:	OIL & GAS DEVELOPMENT COMPANY LTD.	LINE NO.	1033-8"-A3(S)-AG-104
		TEST PRESSURE	-	CONSULTANT:	Zishan Engineers (Pvt.) Ltd. An ISO 9001-2008 certified company	TITLE :	ISOMETRIC FOR AREA-400 (INCINERATOR PACKAGE)
		DESIGN TEMPERATURE	-		4/F Block B, PECHS, KarambaKuluan 14, 15/01/2013 14:00:00:00 & 14/01/2014:00:00:00, File: 165-4-ISO-400-078.dwg, 165-4-ISO-400-078.dwg E-Mail: contact@zishanengineers.com Website: www.zishanengineers.com	REV.	CO
		DESIGN CODE	-	PROJECT :	KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE-4I	DRAWING NO.	165-4-ISO-400-076
		PAINTING SPEC.	-			SHEET NO.	1 OF 2
		PIPING SPEC	-				
REFERENCE DRAWINGS		TECHNICAL INFORMATION					



CONT. ON
LINE # 24"-53-BD-024-A3(S)
AREA 100
E 177118
N 163104
EL +28124

FABRICATION MATERIALS

BILL OF MATERIAL

MARK	SIZE	DESCRIPTION	QTY	WEIGHT
<u>PIPE</u>				
1	8	PIPE, SCH.40, SEAMLESS, BW, ASTM A-333 GR.6, ASME B36.10 (NACE COMPLIANT)	81753 MM	3473.7
<u>FITTINGS</u>				
2	8	ELBOW 90, LONG RADIUS, SCH.40, SEAMLESS, BW, ASTM A-420 GR.WPL6, ASME B16.9 / B16.25 (NACE COMPLIANT)	2	40.8
3	8	WELDOLET, SCH.40, BW, ASTM A-350 GR.LF2, MSS-SP-97 (NACE COMPLIANT)	1	127.0
<u>FLANGES</u>				
4	8	FLANGE, WELD NECK, 150 LB, SCH.40, RF, ASTM A-350 GR.LF2, ASME B16.5 (NACE COMPLIANT)	2	35.4
<u>GASKETS</u>				
5	8	GASKET, SPIRAL WOUND, 150 LB, 1/8" THICK SPIRAL WOUND, CARBON STEEL RING 304 OR 316 STAINLESS STEEL WINDING, FLEXIBLE GRAPHITE, ASME B16.20 / B16.21 / B16.5 (NACE COMPLIANT)	1	1.0
<u>BOLTS</u>				
6	3/4X108	(8) STUD BOLTS WITH TWO HEXAGONAL NUTS & TWO WASHERS EACH, STUD BOLTS: ASTM A-320 GR.L7 (CADMIUM PLATED), NUTS: ASTM A-194 GR.7 (HEAVY HEXAGONAL, CADMIUM PLATED), ASME B18.2.1 / B18.2.2 / B16.5 (NACE COMPLIANT)	1	1.0
<u>SUPPORTS</u>				
7	8	PS-002(A)	1	-
8	8	PS-002	1	-
9	8	PS-003	1	-
10	8	PS-004	1	-
11	8	PS-005	1	-
12	8	PS-006	1	-
13	8	PS-007	1	-
14	8	PS-008	1	-
15	8	PS-009	1	-
16	8	PS-010	1	-
17	8	PS-011	1	-
18	8	PS-012	1	-
19	8	PS-013	1	-
20	8	PS-014	1	-

TOTAL FABRICATION WEIGHT 3678.8

CUT PIPE LENGTH

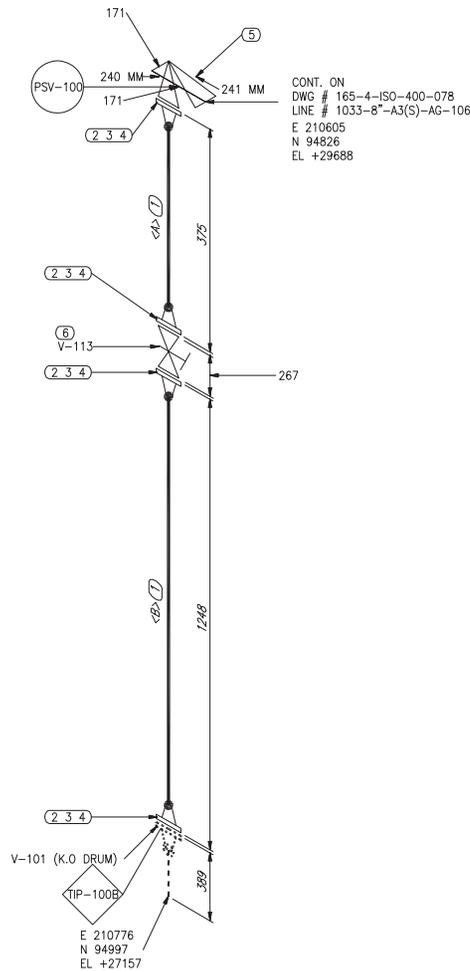
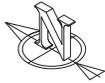
PIECE NUM	LENGTH (MM)	SIZE (INCH)
<A>	70526	8
	9728	8
<C>	1499	8



NOTES:-

1. ALL DIMENSIONS ARE IN mm. UNLESS OTHERWISE STATED.
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3. DETAIL OF CONNECTIONS TO EQUIPMENT TO BE FINALIZED AS PER SITE CONDITIONS.
4. 100% RADIOGRAPHY TO BE PERFORMED FOR WELDS.
5. SUPPORT DETAILS ARE ON HOLD AND WILL BE PROVIDED LATER

165-4-MPL-40001	OVERALL PIPING PLAN LPG LOADING AREA-400	DESIGN PRESSURE	-	CLIENT:	OIL & GAS DEVELOPMENT COMPANY LTD. <small>OSD&G HOUSE, TONGKAL, 19001 FLOOR 19/001, BLUSU AREA, JHR TANJUNGPURA, BANGALAMPUR</small>	LINE NO.	1033-8"-A3(S)-AG-104		
		TEST PRESSURE	-	CONSULTANT:	Zishan Engineers (Pvt.) Ltd. <small>An ISO 9001-2008 certified company 47F Block 6, PECHS, Karamakuram 14, 15/01/1, 34/01/04/06 & 34/01/04/04, Palu, 16/01/1, 34/01/04 & 34/01/06 E-MAIL: contact@zishanengineers.com Website: www.zishanengineers.com</small>	TITLE :	ISOMETRIC FOR AREA-400 (INCINERATOR PACKAGE)		
		DESIGN TEMPERATURE	-	PROJECT :	KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE-4I	DRAWING NO.	165-4-ISO-400-076		
		DESIGN CODE	-			REV.	CO		
		PAINTING SPEC.	-			SHEET NO.	2 OF 2		
		PIPING SPC	-						
REFERENCE DRAWINGS		TECHNICAL INFORMATION							



FABRICATION MATERIALS

BILL OF MATERIAL

MARK	SIZE	DESCRIPTION	QTY	WEIGHT
PIPE				
1	6	PIPE, SCH.80, SEAMLESS, BW, ASTM A-333 GR.6, ASME B36.10 (NACE COMPLIANT)	1267 MM	35.8
FLANGES				
2	6	FLANGE, WELD NECK, 150 LB, SCH.80, RF, ASTM A-350 GR.LF2, ASME B16.5 (NACE COMPLIANT)	4	43.6
GASKETS				
3	6	GASKET, SPIRAL WOUND, 150 LB, 1/8" THICK SPIRAL WOUND, CARBON STEEL RING 304 OR 316 STAINLESS STEEL WINDING, FLEXIBLE GRAPHITE, ASME B16.20 B16.21 / B16.5 (NACE COMPLIANT)	4	4.0
BOLTS				
4	3/4X105	(8) STUD BOLTS WITH TWO HEXAGONAL NUTS & TWO WASHERS EACH, STUD BOLTS: ASTM A-320 GR.L7 (CADMIUM PLATED), NUTS: ASTM A-194 GR.7 (HEAVY HEXAGONAL, CADMIUM PLATED), ASME B18.2.1 / B18.2.2 / B16.5 (NACE COMPLIANT)	4	4.0
VALVES / IN-LINE ITEMS				
5	8X6	RELIEF VALVE, 150 LB, FLANGE ENDS (NACE COMPLIANT)	1	111.2
6	6	GATE VALVE (PIPING SPEC. NAME: VG-202), 150 LB, OS&Y, BOLTED BONNET, SOLID WEDGE, FLANGE ENDS, RF, API 600, API 6D, ASME B16.34 / B16.10	1	79.4
			TOTAL FABRICATION WEIGHT	277.8
			TOTAL WEIGHT UNLISTED ITEMS	19.4
			TOTAL WEIGHT - THIS DRG	297.2

CUT PIPE LENGTH

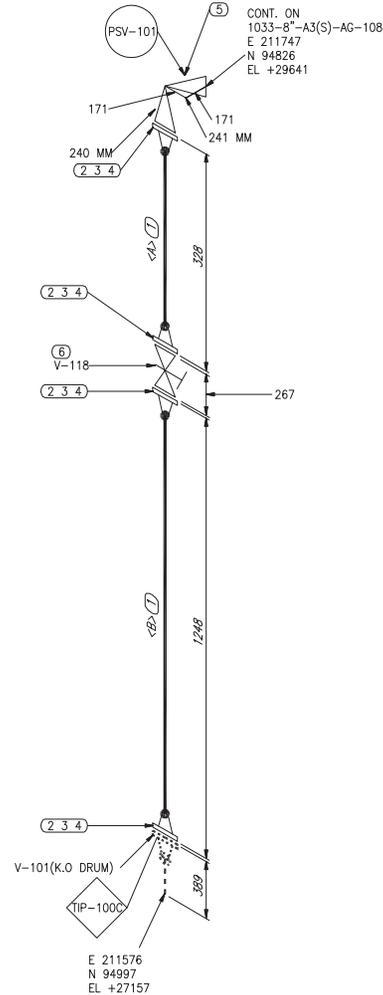
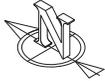
PIECE NUM	LENGTH (MM)	SIZE (INCH)
<A>	197	6
	1070	6



NOTES:-

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4. 100% RADIOGRAPHY TO BE PERFORMED FOR WELDS.
5. SUPPORT DETAILS ARE ON HOLD AND WILL BE PROVIDED LATER

165-4-MPL-40001	OVERALL PIPING PLAN LPG LOADING AREA-400	DESIGN PRESSURE	-	CLIENT:	OIL & GAS DEVELOPMENT COMPANY LTD. <small>OSDC HOUSE, TORONTO, 1801 FLOOR, 1800, BLUE HILLS, 4360 HWY 10 WEST, BURNHAMTHORPE, ONTARIO, CANADA</small>	LINE NO.	1033-6"-A3(S)-AG-105		
		TEST PRESSURE	-	CONSULTANT:	Zishan Engineers (Pvt.) Ltd. <small>An ISO 9001-2008 certified company 47F Block 6, PECHS, Kowloon, Hong Kong 14-15/F, 340-340A & 340-340B, FAN SHEK STREET, HONG KONG EMAIL: contact@zishanengineers.com Website: www.zishanengineers.com</small>	TITLE :	ISOMETRIC FOR AREA-400 (INCINERATOR PACKAGE)		REV. CO
		DESIGN TEMPERATURE	-	PROJECT :	KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE-II	DRAWING NO.	165-4-ISO-400-077		SHEET NO. 1 OF 1
		DESIGN CODE	-						
		PAINTING SPEC.	-						
		PIPING SPCE	-						
REFERENCE DRAWINGS		TECHNICAL INFORMATION							



FABRICATION MATERIALS

BILL OF MATERIAL				
MARK	SIZE	DESCRIPTION	QTY	WEIGHT
PIPE				
1	6	PIPE, SCH.80, SEAMLESS, BW, ASTM A-333 GR.6, ASME B36.10 (NACE COMPLIANT)	1220 MM	34.5
FLANGES				
2	6	FLANGE, WELD NECK, 150 LB, SCH.80, RF, ASTM A-350 GR.LF2, ASME B16.5 (NACE COMPLIANT)	4	43.6
GASKETS				
3	6	GASKET, SPIRAL WOUND, 150 LB, 1/8" THICK SPIRAL WOUND, CARBON STEEL RING 304 OR 316 STAINLESS STEEL WINDING, FLEXIBLE GRAPHITE, ASME B16.20 / B16.21 / B16.5 (NACE COMPLIANT)	4	4.0
BOLTS				
4	3/4X105	(8) STUD BOLTS WITH TWO HEXAGONAL NUTS & TWO WASHERS EACH, STUD BOLTS: ASTM A-320 GR.L7 (CADMIUM PLATED), NUTS: ASTM A-194 GR.7 (HEAVY HEXAGONAL, CADMIUM PLATED), ASME B18.2.1 / B18.2.2 / B16.5 (NACE COMPLIANT)	4	4.0
VALVES / IN-LINE ITEMS				
5	8X6	RELIEF VALVE, 150 LB, FLANGE ENDS (NACE COMPLIANT)	1	111.2
6	6	GATE VALVE (PIPING SPEC. NAME: VG-202), 150 LB, OS&Y, BOLTED BONNET, SOLID WEDGE, FLANGE ENDS, RF, API 600, API 6D, ASME B16.34 / B16.10	1	79.4
			TOTAL FABRICATION WEIGHT	276.5
			TOTAL WEIGHT UNLISTED ITEMS	19.4
			TOTAL WEIGHT - THIS DRG	295.9

CUT PIPE LENGTH

PIECE NUM	LENGTH (MM)	SIZE (INCH)
<A>	150	6
	1070	6



NOTES:-

1. ALL DIMENSIONS ARE IN mm. UNLESS OTHERWISE STATED.
2. ALL DIMENSIONS & ELEVATIONS TO BE VERIFIED AT SITE PRIOR TO CONSTRUCTION.
3. DETAIL OF CONNECTIONS TO EQUIPMENT TO BE FINALIZED AS PER SITE CONDITIONS.
4. 100% RADIOGRAPHY TO BE PERFORMED FOR WELDS.
5. SUPPORT DETAILS ARE ON HOLD AND WILL BE PROVIDED LATER

CO	ISSUED FOR CONSTRUCTION	27-09-2016	UMA	MAS
NO.	REVISION	DATE	BY	APR

DESIGN PRESSURE	-
TEST PRESSURE	-
DESIGN TEMPERATURE	-
DESIGN CODE	-
PAINTING SPEC.	-
165-4-MPL-40001	OVERALL PIPING PLAN LPG LOADING AREA-400
PIPING SPEC	-

CLIENT: **OIL & GAS DEVELOPMENT COMPANY LTD.**
ONEIS HOUSE 103RD AVE 18037 FLOOR 1000 BLUE AREA, JMWENVALEVICISSAWHARDPARKWAY
 FAX: +602 51 202033, PHONE: +602 4259859

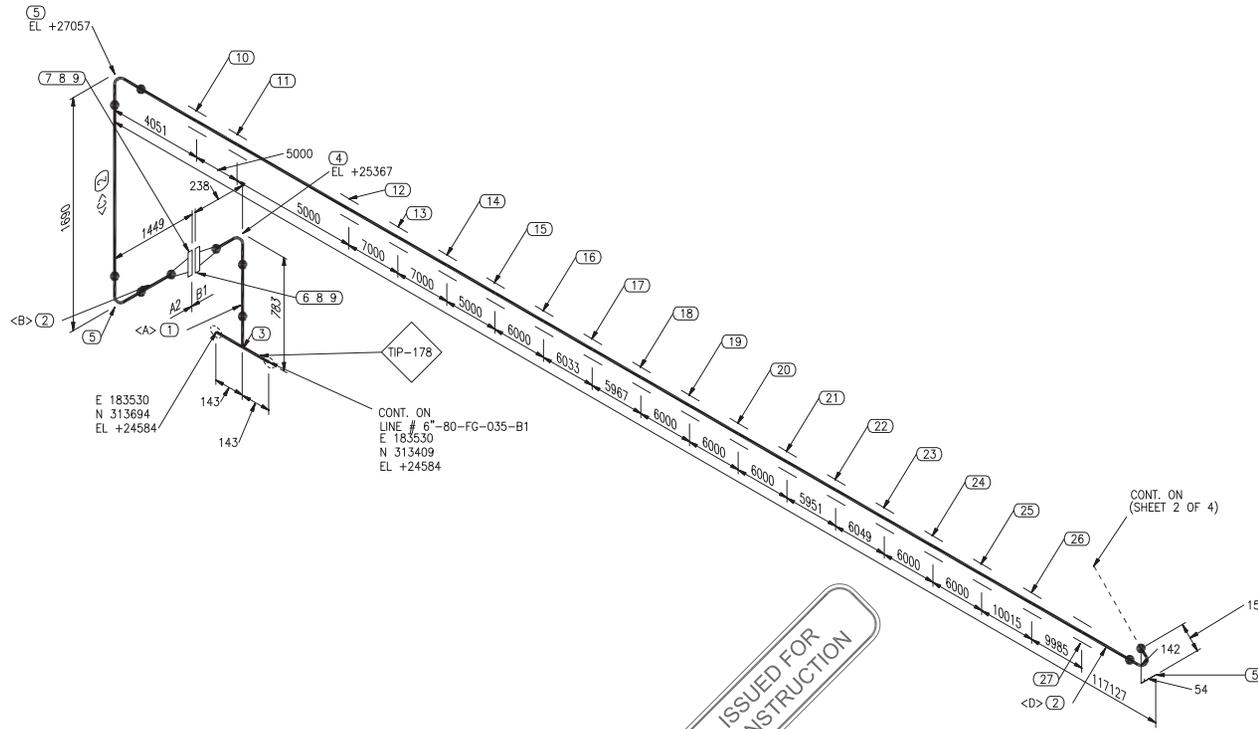
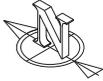
CONSULTANT: **Zishan Engineers (Pvt.) Ltd.**
An ISO 9001-2008 certified company
 47F Block E, F&C, Kallang, Singapore
 Tel: (65) 3 3402448, 3 3433101 ext. Fax: (65) 3 3402443, 3 3402445
 Email: zsoe@zishanengineers.com Website: www.zishanengineers.com

PROJECT: **KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE-II**

LINE NO.	1033-6"-A3(S)-AG-107		
TITLE :	ISOMETRIC FOR AREA-400 (INCINERATOR PACKAGE)	REV.	CO
DRAWING NO.	165-4-ISO-400-078	SHEET NO.	1 OF 1

REFERENCE DRAWINGS

TECHNICAL INFORMATION



FABRICATION MATERIALS

BILL OF MATERIAL

MARK	SIZE	DESCRIPTION	QTY	WEIGHT
<u>PIPE</u>				
1	4	PIPE, SCH.40, SEAMLESS, BW, ASTM A-106 GR.B OR API 5L GR.B, ASME B36.10	500 MM	8.1
2	4	PIPE, SCH.40, SEAMLESS, BW, ASTM A-106 GR.B OR API 5L GR.B, ASME B36.10	19419 MM	1917.9
<u>FITTINGS</u>				
3	6X4	TEE, REDUCING, SCH.40, SEAMLESS, BW, ASTM A-234 GR.WPB, ASME B16.9 / B16.25	1	12.6
4	4	ELBOW 90, LONG RADIUS, SCH.40, SEAMLESS, BW, ASTM A-234 GR.WPB, ASME B16.9 / B16.25	1	4.0
5	4	ELBOW 90, LONG RADIUS, SCH.40, SEAMLESS, BW, ASTM A-234 GR.WPB, ASME B16.9 / B16.25	3	11.9
<u>FLANGES</u>				
6	4	FLANGE, WELD NECK, 300 LB, SCH.40, RF, ASTM A-105, ASME B16.5	1	11.4
7	4	FLANGE, WELD NECK, 150 LB, SCH.40, RF, ASTM A-105, ASME B16.5	1	6.8
<u>GASKETS</u>				
8	4	GASKET, 300 LB, 1/8" THICK FLEXIBLE GRAPHITE WITH 304 OR 316 STAINLESS STEEL CORRUGATED INSERT, ASME B16.20 / B16.21 / B16.5	1	1.0
<u>BOLTS</u>				
9	3/4X114	(8) STUD BOLTS WITH TWO HEXAGONAL NUTS & TWO WASHERS EACH, STUD BOLTS: ASTM A-193 GR.B7 (CADIUM PLATED), NUTS: ASTM A-194 GR.2H (HEAVY HEXAGONAL, CADIUM PLATED), ASME B18.2.1 / B18.2.2 / B16.5	1	1.0
<u>SUPPORTS</u>				
10	4	PR-001 (GUIDE WITH 3mm GAP)	1	-
11	4	PR-002 (GUIDE WITH 3mm GAP)	1	-
12	4	PR-003 (GUIDE WITH 3mm GAP)	1	-
13	4	PR-004 (GUIDE WITH 3mm GAP)	1	-
14	4	PR-005 (GUIDE WITH 3mm GAP)	1	-
15	4	PR-006 (GUIDE WITH 3mm GAP)	1	-
16	4	PR-007 (GUIDE WITH 3mm GAP)	1	-
17	4	PR-008 (GUIDE WITH 3mm GAP)	1	-
18	4	PR-009 (GUIDE WITH 3mm GAP)	1	-
19	4	PR-010 (GUIDE WITH 3mm GAP)	1	-
20	4	PR-011 (GUIDE WITH 3mm GAP)	1	-
21	4	PR-012 (GUIDE WITH 3mm GAP)	1	-
22	4	PR-013 (GUIDE WITH 3mm GAP)	1	-
23	4	PR-014 (GUIDE WITH 3mm GAP)	1	-
24	4	PR-015 (GUIDE WITH 3mm GAP)	1	-
25	4	PR-016 (GUIDE WITH 3mm GAP)	1	-
26	4	PR-017 (GUIDE WITH 3mm GAP)	1	-
27	4	PR-018 (GUIDE WITH 3mm GAP)	1	-
TOTAL FABRICATION WEIGHT			1974.4	

CUT PIPE LENGTH

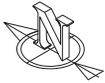
PIECE NUM	LENGTH (MM)	SIZE (INCH)
<A>	500	4
	1211	4
<C>	1386	4
<D>	116822	4

NOTES:-

1. ALL DIMENSIONS ARE IN mm. UNLESS OTHERWISE STATED.
2. ALL DIMENSIONS & ELEVATIONS TO BE VERIFIED AT SITE PRIOR TO CONSTRUCTION.
3. DETAIL OF CONNECTIONS TO EQUIPMENT TO BE FINALIZED AS PER SITE CONDITIONS.
4. 100% RADIOGRAPHY TO BE PERFORMED FOR WELDS.
5. SUPPORT DETAILS ARE ON HOLD AND WILL BE PROVIDED LATER

		DESIGN PRESSURE	-	CLIENT:	OIL & GAS DEVELOPMENT COMPANY LTD.		
		TEST PRESSURE	-	CONSULTANT:	Zishan Engineers (Pvt.) Ltd.		
		DESIGN TEMPERATURE	-	An ISO 9001:2008 certified company 47F Block 6, PECHS, Kaseri Park, K... Tel: (91) 9440404040 & 9440101040. Fax: (91) 9440404040 & 9440101040 Email: zshans@zshansengineers.com Website: www.zshansengineers.com			
		DESIGN CODE	-	PROJECT :	KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE-II		
165-4-MPL-40001	OVERALL PIPING PLAN LPG LOADING AREA-400	PAINTING SPEC.	-	LINE NO. 1033-4"-A2-FG-400			
		PIPING SPCE	-	TITLE : ISOMETRIC FOR AREA-400 (INCINERATOR PACKAGE) REV. CO			
REFERENCE DRAWINGS		TECHNICAL INFORMATION				DRAWING NO. 165-4-ISO-400-079	SHEET NO. 1 OF 4

CO	ISSUED FOR CONSTRUCTION	27-09-2016	UMA	MAS
NO.	REVISION	DATE	BY	APR



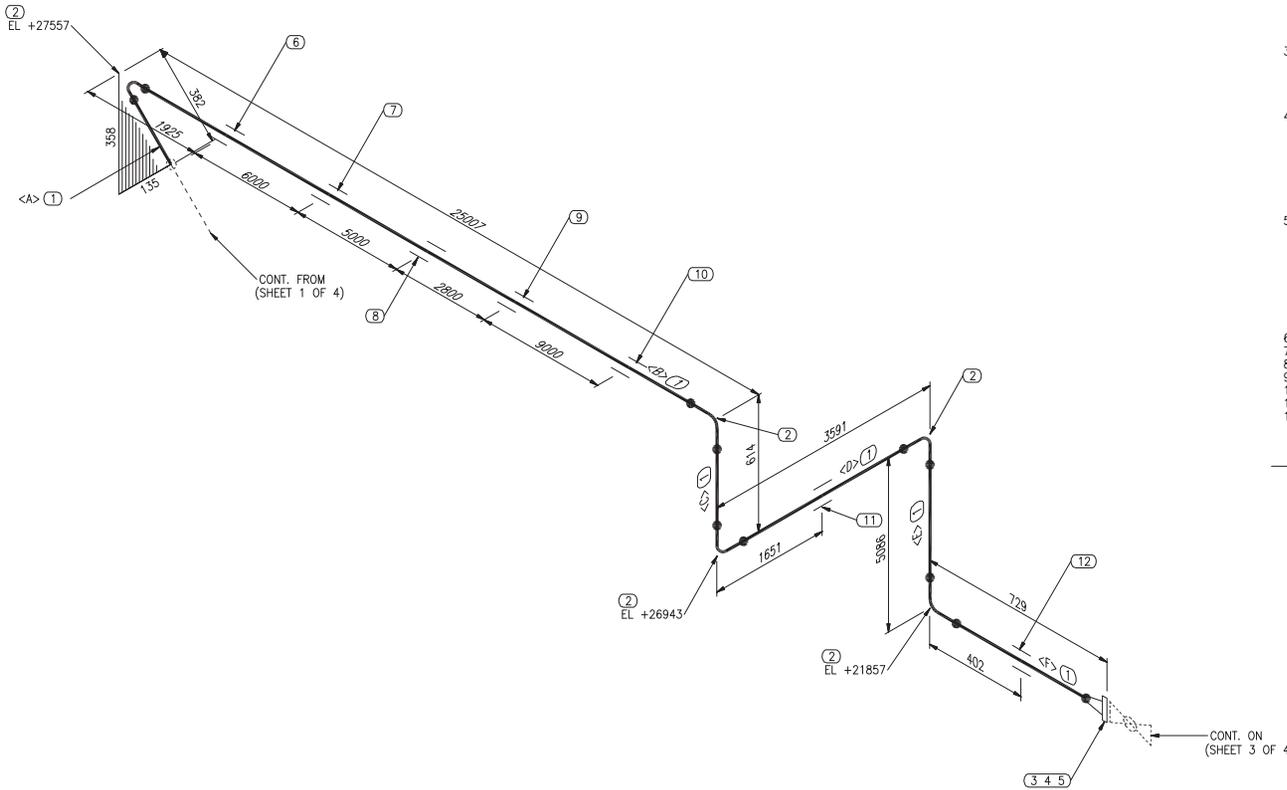
FABRICATION MATERIALS

BILL OF MATERIAL

MARK	SIZE	DESCRIPTION	QTY	WEIGHT
PIPE				
1	4	PIPE, SCH.40, SEAMLESS, BW, ASTM A-106 GR.B OR API 5L GR.B, ASME B36.10	33810 MM	543.0
FITTINGS				
2	4	ELBOW 90, LONG RADIUS, SCH.40, SEAMLESS, BW, ASTM A-234 GR.WPB, ASME B16.9 / B16.25	5	19.8
FLANGES				
3	4	FLANGE, WELD NECK, 150 LB, SCH.40, RF, ASTM A-105, ASME B16.5	1	6.8
GASKETS				
4	4	GASKET, CORRUGATED FLEXIBLE GRAPHITE, 150 LB, 1/8" THICK FLEXIBLE GRAPHITE WITH 304 OR 316 STAINLESS STEEL CORRUGATED INSERT, ASME B16.20 / B16.21 / B16.5	1	1.0
BOLTS				
5	5/8X95	(8) STUD BOLTS WITH TWO HEXAGONAL NUTS & TWO WASHERS EACH; STUD BOLTS: ASTM A-193 GR.B7 (CADMIUM PLATED), NUTS: ASTM A-194 GR.2H (HEAVY HEXAGONAL CADMIUM PLATED), ASME B18.2.1 / B18.2.2 / B16.5	1	1.0
SUPPORTS				
6	4	PR-019 (GUIDE WITH 3mm GAP)	1	-
7	4	PR-020 (GUIDE WITH 3mm GAP)	1	-
8	4	PR-021	1	-
9	4	PR-022 (GUIDE WITH 3mm GAP)	1	-
10	4	PR-023 (GUIDE WITH 3mm GAP)	1	-
11	4	ST-028 (GUIDE WITH 3mm GAP)	1	-
12	4	PSL-017 (GUIDE WITH 3mm GAP)	1	-
TOTAL FABRICATION WEIGHT			571.5	

CUT PIPE LENGTH

PIECE NUM	LENGTH (MM)	SIZE (INCH)
<A>	230	4
	24702	4
<C>	310	4
<D>	3287	4
<E>	4781	4
<F>	500	4

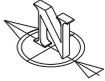


NOTES:-

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2. ALL DIMENSIONS & ELEVATIONS TO BE VERIFIED AT SITE PRIOR TO CONSTRUCTION.
3. DETAIL OF CONNECTIONS TO EQUIPMENT TO BE FINALIZED AS PER SITE CONDITIONS.
4. 100% RADIOGRAPHY TO BE PERFORMED FOR WELDS.
5. SUPPORT DETAILS ARE ON HOLD AND WILL BE PROVIDED LATER

165-4-MPL-40001	OVERALL PIPING PLAN LPG LOADING AREA-400	DESIGN PRESSURE	-	CLIENT:	OIL & GAS DEVELOPMENT COMPANY LTD. <small>OSD&G HOUSE, TONGKAL, 18007 FLOOY, 17000 BLUJE ARSA, JEMERAN AVENUE, BELAKANG PRAKARTAN T: +62 51 2620203, F: +62 51 2620989</small>	LINE NO.	1033-4"-A2-FG-400		
		TEST PRESSURE	-	CONSULTANT:	Zishan Engineers (Pvt.) Ltd. <small>An ISO 9001-2008 certified company 4/F Block E, PECHS, Karet Kraksaan T: +62 21 3430004-6, F: +62 21 3430003, 3430004 E: info@zishanengineers.com, Website: www.zishanengineers.com</small>	TITLE :	ISOMETRIC FOR AREA-400 (INCINERATOR PACKAGE)		
		DESIGN TEMPERATURE	-	PROJECT :	KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE-II	DRAWING NO.	165-4-ISO-400-079		
		DESIGN CODE	-			REV.	CO		
		PAINTING SPEC.	-			SHEET NO.	2 OF 4		
		PIPING SPCE	-						
REFERENCE DRAWINGS		TECHNICAL INFORMATION							

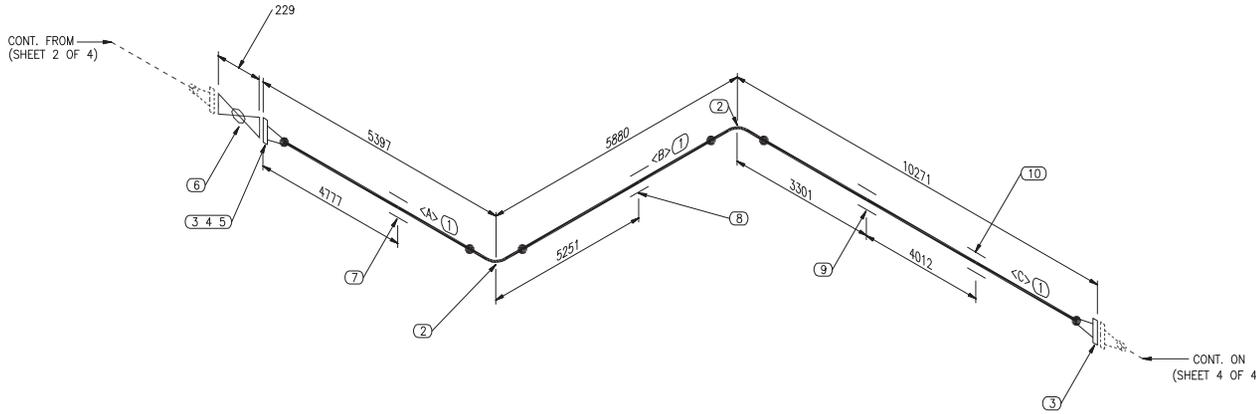
CO	ISSUED FOR CONSTRUCTION	27-09-2016	UMA	MAS
NO.	REVISION	DATE	BY	APR



FABRICATION MATERIALS

BILL OF MATERIAL

MARK	SIZE	DESCRIPTION	QTY	WEIGHT
PIPE				
1	4	PIPE, SCH.40, SEAMLESS, BW, ASTM A-106 GR.B OR API 5L GR.B, ASME B36.10	20786 MM	333.9
FITTINGS				
2	4	ELBOW 90, LONG RADIUS, SCH.40, SEAMLESS, BW, ASTM A-234 GR.WPB, ASME B16.9 / B16.25	2	7.9
FLANGES				
3	4	FLANGE, WELD NECK, 150 LB, SCH.40, RF, ASTM A-105, ASME B16.5	2	13.6
GASKETS				
4	4	GASKET, CORRUGATED FLEXIBLE GRAPHITE, 150 LB, 1/8" THICK FLEXIBLE GRAPHITE WITH 304 OR 316 STAINLESS STEEL CORRUGATED INSERT, ASME B16.20 / B16.21 / B16.5	1	1.0
BOLTS				
5	5/8X95	(8) STUD BOLTS WITH TWO HEXAGONAL NUTS & TWO WASHERS EACH, STUD BOLTS: ASTM A-193 GR.B7 (CADMIUM PLATED), NUTS: ASTM A-194 GR.2H (HEAVY HEXAGONAL CADMIUM PLATED), ASME B18.2.1 / B18.2.2 / B16.5	1	1.0
VALVES / IN-LINE ITEMS				
6	4	BALL VALVE (PIPING SPEC. NAME: VB-202), 150 LB, BOLTED BONNET, FLOATING TYPE (TRUNNION MOUNTED BALL OVER 4"), REGULAR PORT, FLANGE ENDS, RF, API 6D, ASME B16.34 / B16.10	1	51.3
SUPPORTS				
7	4	PSL-016 (GUIDE WITH 3mm GAP)	1	-
8	4	PSL-014 (GUIDE WITH 3mm GAP)	1	-
9	4	PSL-013 (GUIDE WITH 3mm GAP)	1	-
10	4	PSL-012	1	-
TOTAL FABRICATION WEIGHT			408.6	



CUT PIPE LENGTH

PIECE NUM	LENGTH (MM)	SIZE (INCH)
<A>	5168	4
	5575	4
<C>	10043	4



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4. 100% RADIOGRAPHY TO BE PERFORMED FOR WELDS.
5. SUPPORT DETAILS ARE ON HOLD AND WILL BE PROVIDED LATER

CO	ISSUED FOR CONSTRUCTION	27-09-2016	UMA	MAS
NO.	REVISION	DATE	BY	APR
LINE NO.	1033-4"-A2-FG-400			
TITLE :	ISOMETRIC FOR AREA-400 (INCINERATOR PACKAGE)			REV. CO
DRAWING NO.	165-4-ISO-400-079			SHEET NO. 3 OF 4

DESIGN PRESSURE	-
TEST PRESSURE	-
DESIGN TEMPERATURE	-
DESIGN CODE	-
PAINTING SPEC.	-
PIPING SPEC	-
165-4-MPL-40001	OVERALL PIPING PLAN LPG LOADING AREA-400
REFERENCE DRAWINGS	TECHNICAL INFORMATION

CLIENT: **OIL & GAS DEVELOPMENT COMPANY LTD.**
OODOL HOUSE TOWER 8/F, FIRST FLOOR FRUGI, BLUE AREA, 8/HH4 AVENUE ISLAMABAD PAKISTAN
 PAK+1-42 91 262023, PHONE: +92-343-98900

CONSULTANT: **Zishan Engineers (Pvt.) Ltd.**
An ISO 9001-2008 certified company
 47F, B-Block, F-7/2, Islamabad
 T: (92-31) 34390454-8, 34391915-4, Fax: (92-31) 3433340 & 34510156
 E: zsh@zsh.com.pk | info@zsh.com.pk | www.zsh.com.pk

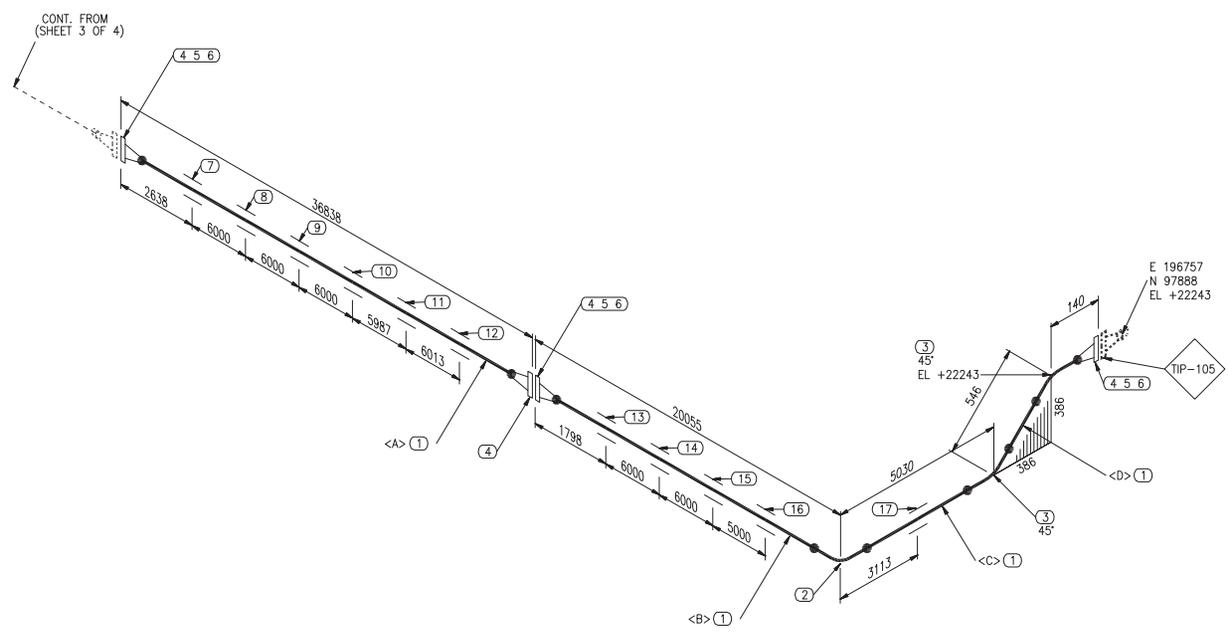
PROJECT : **KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE-II**



FABRICATION MATERIALS

BILL OF MATERIAL

MARK	SIZE	DESCRIPTION	QTY	WEIGHT
PIPE				
1	4	PIPE, SCH.40, SEAMLESS, BW, ASTM A-106 GR.B OR API 5L GR.B, ASME B36.10	61744 MM	991.7
FITTINGS				
2	4	ELBOW 90, LONG RADIUS, SCH.40, SEAMLESS, BW, ASTM A-234 GR.WPB, ASME B16.9 / B16.25	1	4.0
3	4	ELBOW 45, LONG RADIUS, SCH.40, SEAMLESS, BW, ASTM A-234 GR.WPB, ASME B16.9 / B16.25	2	3.9
FLANGES				
4	4	FLANGE, WELD NECK, 150 LB, SCH.40, RF, ASTM A-105, ASME B16.5	4	27.2
GASKETS				
5	4	GASKET, CORRUGATED FLEXIBLE GRAPHITE, 150 LB, 1/8" THICK FLEXIBLE GRAPHITE WITH 304 OR 316 STAINLESS STEEL CORRUGATED INSERT, ASME B16.20 / B16.21 / B16.5	3	3.0
BOLTS				
6	5/8X95	(8) STUD BOLTS WITH TWO HEXAGONAL NUTS & TWO WASHERS EACH, STUD BOLTS: ASTM A-193 GR.B7 (CADMIUM PLATED); NUTS: ASTM A-194 GR.2H (HEAVY HEXAGONAL, CADMIUM PLATED), ASME B18.2.1 / B18.2.2 / B16.5	3	3.0
SUPPORTS				
7	4	PSL-011 (GUIDE WITH 3mm GAP)	1	-
8	4	PSL-010	1	-
9	4	PSL-009 (GUIDE WITH 3mm GAP)	1	-
10	4	PSL-008	1	-
11	4	PSL-007 (GUIDE WITH 3mm GAP)	1	-
12	4	PSL-006	1	-
13	4	PSL-005 (GUIDE WITH 3mm GAP)	1	-
14	4	PSL-004	1	-
15	4	PSL-003 (GUIDE WITH 3mm GAP)	1	-
16	4	PSL-003(A) (GUIDE WITH 3mm GAP)	1	-
17	4	PSL-002 (GUIDE WITH 3mm GAP)	1	-
TOTAL FABRICATION WEIGHT			1032.7	
TOTAL WEIGHT UNLISTED ITEMS			6.8	
TOTAL WEIGHT - THIS DRG			1039.5	



CUT PIPE LENGTH

PIECE NUM	LENGTH (MM)	SIZE (INCH)
<A>	36685	4
	19826	4
<C>	4814	4
<D>	419	4



- NOTES:-**
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 4. 100% RADIOGRAPHY TO BE PERFORMED FOR WELDS.
 5. SUPPORT DETAILS ARE ON HOLD AND WILL BE PROVIDED LATER

REFERENCE DRAWINGS	TECHNICAL INFORMATION
165-4-MPL-40001	OVERALL PIPING PLAN LPG LOADING AREA-400
	DESIGN PRESSURE
	TEST PRESSURE
	DESIGN TEMPERATURE
	DESIGN CODE
	PAINTING SPEC.
	PIPING SPCE

CLIENT: **OIL & GAS DEVELOPMENT COMPANY LTD.**
OGDC HOUSE TORONTO ROAD P.O. BOX 1000, ELDT, ARBA, JHMM, AVESIDE ISLAMABAD PAKISTAN
 FAX: +92 31 2620253, PHONE: +92 31 2620859

CONSULTANT: **Zishan Engineers (Pvt.) Ltd.**
An ISO 9001-2008 certified company
 47F Block 6, F-6/2, Giza, Karachi
 Tel: (92) 21 3420496 & 3413111-44, Fax: (92) 21 3420493 & 3420156
 Email: zeshan@zeshan.com Website: www.zeshanengineers.com

PROJECT: **KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE-II**

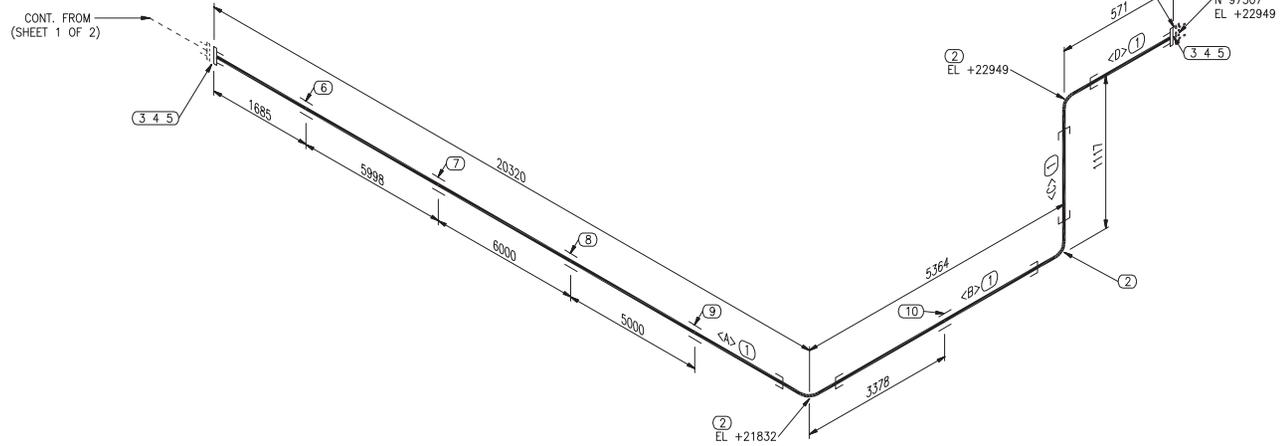
CO	ISSUED FOR CONSTRUCTION	27-09-2016	UMA	MAS
NO.	REVISION	DATE	BY	APR
LINE NO. 1033-4"-A2-FG-400				
TITLE: ISOMETRIC FOR AREA-400 (INCINERATOR PACKAGE)				REV. CO
DRAWING NO. 165-4-ISO-400-079				SHEET NO. 4 OF 4



FABRICATION MATERIALS

BILL OF MATERIAL

MARK	SIZE	DESCRIPTION	QTY	WEIGHT
PIPE				
1	2	PIPE, SCH.80, THRD ASTM A-106 GR.B,SMLS GALVANIZED ASME 36.10 TBE	27083 MM	202.4
FITTINGS				
2	2	90 ELL, THRD, CLASS 3000#, GALVANIZED ASTM A 105, ASME B16.11	3	7.5
FLANGES				
3	2	FLG, RF THRD CLASS 150# GALVANIZED ASTM A 105, ASME B-16.5	2	4.6
GASKETS				
4	2	GASKET CLASS 150, 1/8"Thk, SPIRAL WOUND CS RING 304 SS OR 316 SS WINDING, FLEXIBLE GRAPHITE ASME B16.20	2	2.0
BOLTS				
5	5/8X85	(4) STUD BOLTS & NUTS ASTM A193 Gr.B7 / A194 Gr.2H, CADMIUM PLATED	2	2.0
SUPPORTS				
6	2	PSL-005 (GUIDE WITH 3mm GAP)	1	-
7	2	PSL-004	1	-
8	2	PSL-003 (GUIDE WITH 3mm GAP)	1	-
9	2	PSL-003 (A)(GUIDE WITH 3mm GAP)	1	-
10	2	PSL-002 (GUIDE WITH 3mm GAP)	1	-
TOTAL FABRICATION WEIGHT			218.3	
TOTAL WEIGHT UNLISTED ITEMS			2.3	
TOTAL WEIGHT - THIS DRG			220.6	



CUT PIPE LENGTH

PIECE NUM	LENGTH (MM)	SIZE (INCH)
<A>	20267	2
	5273	2
<C>	1025	2
<D>	518	2

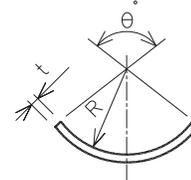
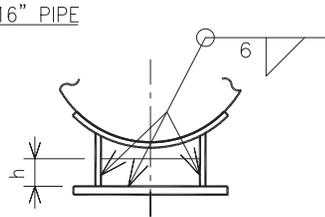
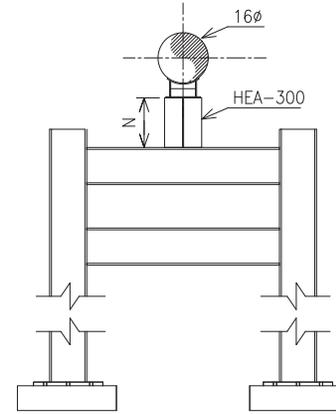
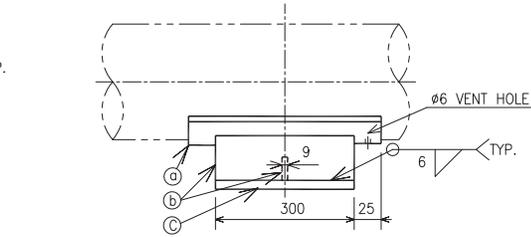
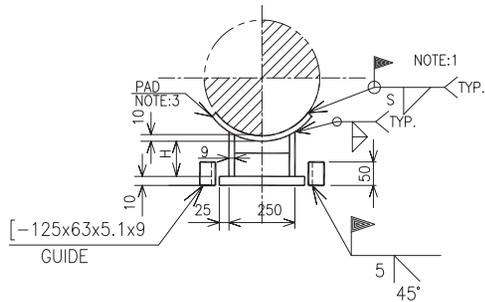


NOTES:-

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5. SUPPORT DETAILS ARE ON HOLD AND WILL BE PROVIDED LATER

CO	ISSUED FOR CONSTRUCTION	27-09-2016	UMA	MAS
NO.	REVISION	DATE	BY	APR
LINE NO.	1033-2"-A4-IA-300			
TITLE :	ISOMETRIC FOR AREA-400 (INCINERATOR PACKAGE)			REV. CO
DRAWING NO.	165-4-ISO-400-081			SHEET NO. 2 OF 2

DESIGN PRESSURE	-	CLIENT:	OIL & GAS DEVELOPMENT COMPANY LTD.
TEST PRESSURE	-	CONSULTANT:	Zishan Engineers (Pvt.) Ltd.
DESIGN TEMPERATURE	-		An ISO 9001-2008 certified company
DESIGN CODE	-		47F Block 6, PECHS, Kuantan, Pahang
PAINTING SPEC.	-		Tel: (607) 3440000-6, 3433310-40, Fax: (607) 3440000-5, 3440000-6
165-4-MPL-40001	OVERALL PIPING PLAN LPG LOADING AREA-400		Email: zconco@zishanengineers.com Website: www.zishanengineers.com
REFERENCE DRAWINGS	TECHNICAL INFORMATION	PROJECT :	KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE-II



MATERIAL

MATERIAL OF RUN PIPE MEMBER MARK	CARBON STEEL	LOW TEMP. CARBON STEEL	STAINLESS STEEL
Ⓐ	A	C	K
Ⓑ	SAME MATERIAL AS RUN PIPE	SAME MATERIAL AS RUN PIPE	SAME MATERIAL AS RUN PIPE
Ⓒ	A283 Gr.C	A516 Gr.65	A283 Gr.C
Ⓓ	A283 Gr.C	A283 Gr.C	A283 Gr.C

NOTES:

- "S" SHALL BE AS FOLLOWS.
 $t < 6 \quad S = t$
 $t \geq 6 \quad S = 6$
- PAD CAN BE MADE BY CUTTING PIPE MATERIAL INSTEAD OF PLATE MATERIAL. BUT THICKNESS OF PADS(mm) SHALL BE MINIMUM THE SAME THICKNESS AS RUN PIPE AND 10mm MAXIMUM.
- HEIGHT "H" SHALL BE 400mm MAXIMUM
- SLOPE OF THE PIPE VARIES WITH RESPECT TO WP.EL PROVIDED IN TABLE "A"
- FOR PIPE TO RACK ELEVATIONS (LESS THAN 100mm) WHERE SHOE IS NOT APPLICABLE, KR/XJ TO MAINTAIN THE PIPE SLOPE WITH THE HELP OF SHIM PLATES.
- "N" IS HEA-300 SHALL BE 400mm FOR HEIGHT "H" REFER TABLE "B".

MATERIAL:

PLATE : ASTM A283 Gr.C
 CHANNEL : ASTM A36

TABLE "A"

So#	SUPPORT No.	WP.EL(M)	H	LINE No.	NPS MARK	RUN PIPE SIZE	R	t
15.	ST-026	28.619	099	1033-16"-A3(S)-AG-101	16"	16"	203	NOTE : 2
16.	ST-024	28.624	104	1033-16"-A3(S)-AG-101				
17.	ST-022	28.642	122	1033-16"-A3(S)-AG-101				
18.	ST-020	28.647	127	1033-16"-A3(S)-AG-101				
19.	ST-018	28.657	137	1033-16"-A3(S)-AG-101				
20.	ST-016	28.669	149	1033-16"-A3(S)-AG-101				
21.	ST-014	28.682	162	1033-16"-A3(S)-AG-101				
22.	ST-013	28.702	182	1033-16"-A3(S)-AG-101				
23.	ST-006	28.708	188	1033-16"-A3(S)-AG-101				
22.	ST-027	28.629	109	1033-16"-A3(S)-AG-100				
24.	ST-025	28.634	114	1033-16"-A3(S)-AG-100				
25.	ST-023	28.652	132	1033-16"-A3(S)-AG-100				
26.	ST-021	28.657	137	1033-16"-A3(S)-AG-100				
27.	ST-019	28.667	147	1033-16"-A3(S)-AG-100				
28.	ST-017	28.679	159	1033-16"-A3(S)-AG-100				
29.	ST-015	28.691	171	1033-16"-A3(S)-AG-100				
30.	ST-012	28.707	187	1033-16"-A3(S)-AG-100				

TABLE "B"

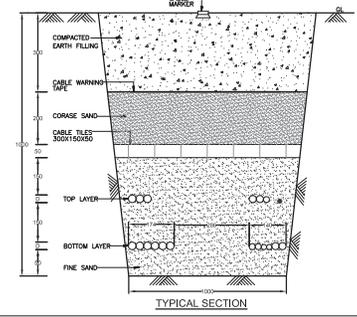
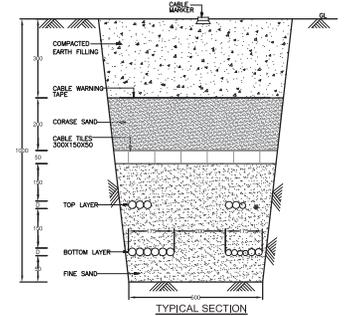
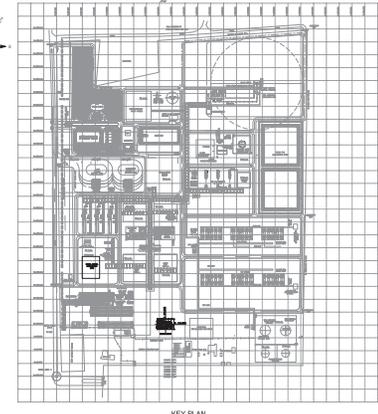
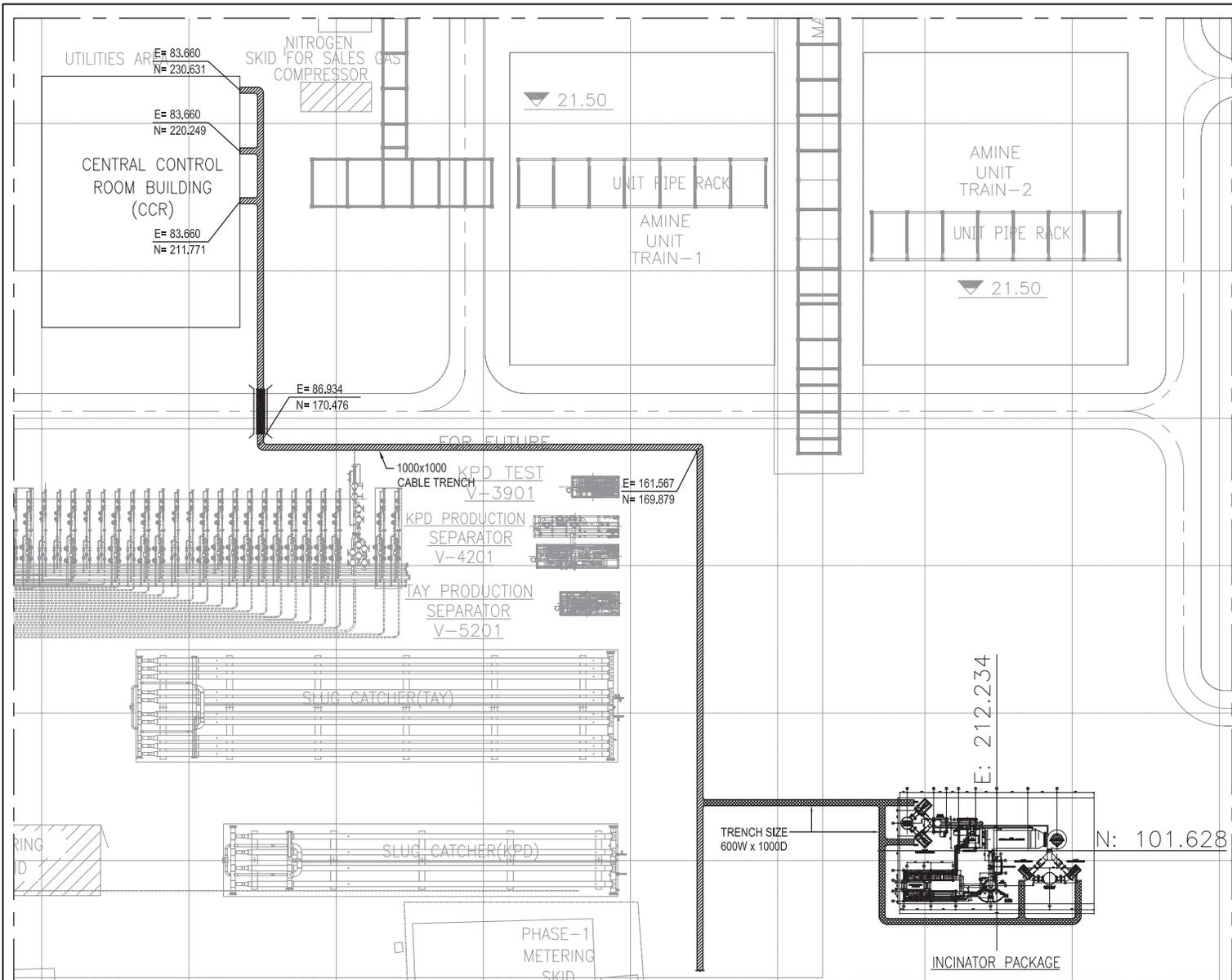
So#	SUPPORT No.	WP.EL(M)	N	H	LINE No.	NPS MARK	RUN PIPE SIZE	R	t
01.	ST-001	28.767	400	347	1033-16"-A3(S)-AG-101	16"	16"	203	NOTE : 2
02.	ST-002	28.754		334	1033-16"-A3(S)-AG-101				
03.	ST-003	28.744		324	1033-16"-A3(S)-AG-101				
04.	ST-004	28.732		312	1033-16"-A3(S)-AG-101				
05.	ST-005	28.720		300	1033-16"-A3(S)-AG-101				
06.	ST-011	28.718		298	1033-16"-A3(S)-AG-100				
07.	ST-010	28.729		309	1033-16"-A3(S)-AG-100				
08.	ST-009	28.741		321	1033-16"-A3(S)-AG-100				
09.	ST-008	28.753		333	1033-16"-A3(S)-AG-100				
10.	ST-007	28.76		345	1033-16"-A3(S)-AG-100				

So#	SUPPORT No.	WP.BOP.EL(M)	H	LINE No.	NPS MARK	RUN PIPE SIZE	R	t
01.	PSL-001	22.028	208	1033-16"-A3(S)-AG-101	16"	16"	203	NOTE : 2
02.	PSL-002	22.031	208	1033-16"-A3(S)-AG-100				
03.	PSL-003(A)	22.035	215	1033-16"-A3(S)-AG-101				
		22.043	210	1033-16"-A3(S)-AG-100				
04.	PSL-003	22.042	222	1033-16"-A3(S)-AG-101				
		22.055	218	1033-16"-A3(S)-AG-100				
05.	PSL-004	22.052	232	1033-16"-A3(S)-AG-101				
		22.066	227	1033-16"-A3(S)-AG-100				
06.	PSL-005	22.061	241	1033-16"-A3(S)-AG-101				
		22.078	236	1033-16"-A3(S)-AG-100				
07.	PSL-006	22.072	252	1033-16"-A3(S)-AG-101				
		22.090	246	1033-16"-A3(S)-AG-100				
08.	PSL-007	22.084	264	1033-16"-A3(S)-AG-101				
		22.102	258	1033-16"-A3(S)-AG-100				
09.	PSL-008	22.096	276	1033-16"-A3(S)-AG-101				
		22.114	270	1033-16"-A3(S)-AG-100				
10.	PSL-009	22.108	288	1033-16"-A3(S)-AG-101				
		22.126	282	1033-16"-A3(S)-AG-100				
11.	PSL-010	22.120	300	1033-16"-A3(S)-AG-101				
		22.137	294	1033-16"-A3(S)-AG-100				
12.	PSL-011	22.132	312	1033-16"-A3(S)-AG-101				
		22.147	306	1033-16"-A3(S)-AG-100				
13.	PSL-012	22.143	323	1033-16"-A3(S)-AG-101				
		22.155	317	1033-16"-A3(S)-AG-100				
14.	PSL-013	22.153	333	1033-16"-A3(S)-AG-101				
		22.155	325	1033-16"-A3(S)-AG-100				
15.	PSL-015	22.164	344	1033-16"-A3(S)-AG-101				
		22.155	341	1033-16"-A3(S)-AG-100				
16.	PSL-018	22.170	350	1033-16"-A3(S)-AG-101				

ISSUED FOR CONSTRUCTION

C1	27-09-2016	ISSUED FOR CONSTRUCTION	MU	MBS	MAS
CD	01-08-2016	ISSUED FOR CONSTRUCTION	MU	MBS	MAS
REC	DATE	DESCRIPTION OF REVISION	DRAWN	CHECKED	APPR.
<p>CURRENT:</p> OIL & GAS DEVELOPMENT COMPANY LTD. <small>02003, MOJIBE TOWER, FIRST FLOOR, BLUE AREA, JINNAH AVENUE, ISLAMABAD, PAKISTAN FAX: +92 01 28333333, PHONE: +92 01 28333333</small>					
<p>CONSULTANT:</p> Zishan Engineers (Pvt.) Ltd. <small>An ISO 9001-2008 certified company 4/F Block B, F-20/2, Phase-2, Islamabad Fax: +92 01 28333333 & 28333333, Fax: +92 01 28333333 & 28333333 E-Mail: contact@zishanengineers.com Website: www.zishanengineers.com</small>			<p>DWG. NO. 165-4-SKT-041</p> <p>REV. C1</p>		
<p>PROJECT : KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE-II</p>			<p>JOB NO. 165-4</p>		
<p>TITLE : PIPE ANCHOR DETAIL (PIPE SHOE) FOR INCINERATOR SKID ON SLIPPER & RACK</p>			SIZE	SCALE	SHEET
			A3	N.T.S	1 OF 1

ELECTRICAL & INSTRUMENTATION
DRAWINGS

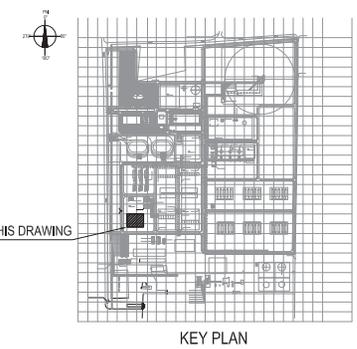
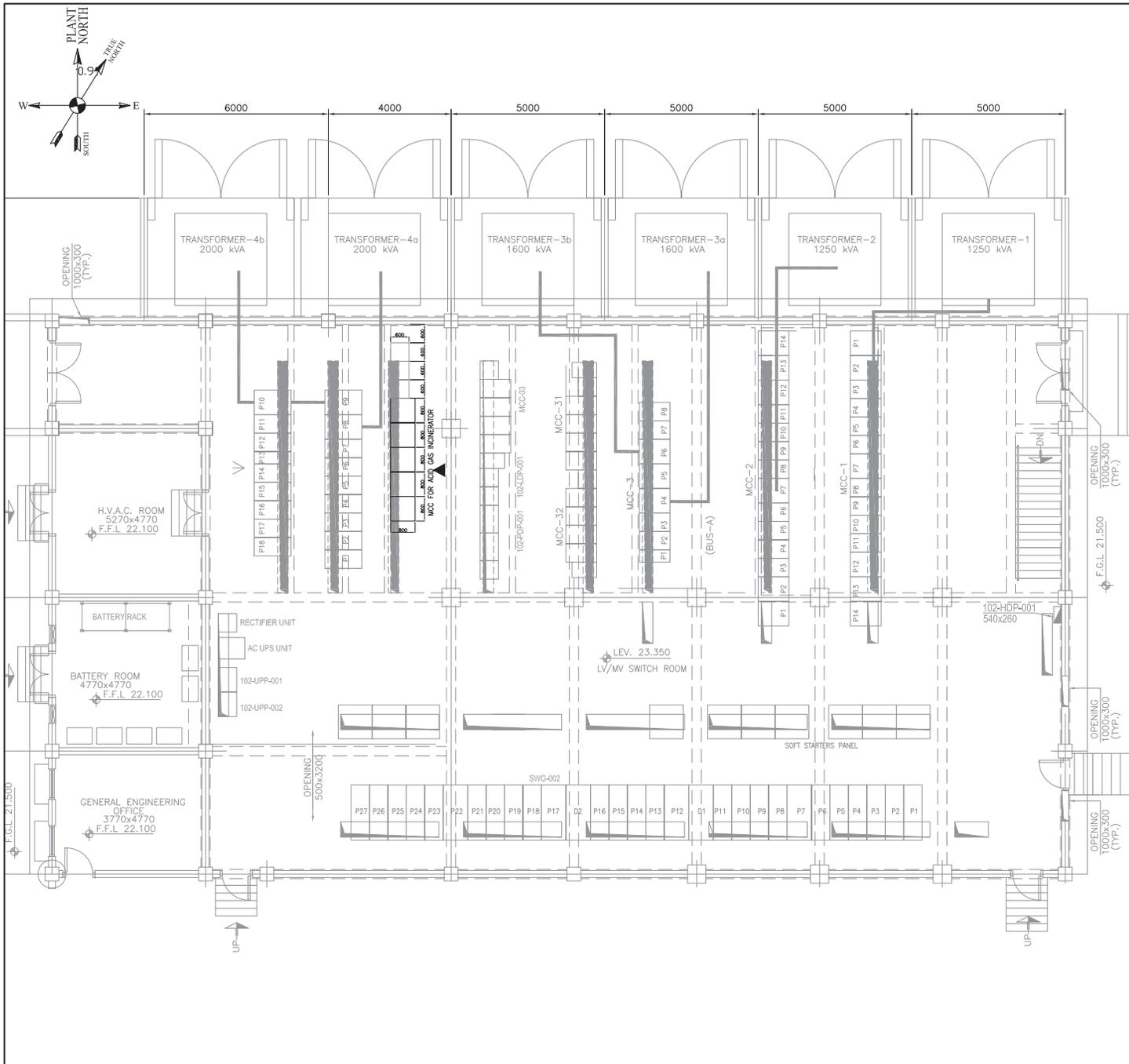


- NOTES:**
1. ALL COORDINATES AND ELEVATIONS ARE IN METERS.
 2. ALL DIMENSIONS ARE IN MILLIMETERS.
 3. INSTRUMENT CABLE TRENCH WILL RUN ABOVE THE ELECTRICAL CABLE TRENCH IN CASE OF INTERSECTION.
 4. FIRE WATER NETWORK WILL RUN BELOW THE ELECTRICAL CABLE TRENCH AT 1500.
 5. CABLE TRAYS ARE NOT SHOWN IN THE LAYOUT AND WILL BE SHOWN IN SEPARATE DOCUMENT.
 6. MANUAL EXCAVATION OF EXISTING TRENCH THEN BACK FILLING AND ARRANGEMENT OF BRICKS IS IN CONTRACTOR'S SCOPE, COMPLETE IN ALL RESPECT.

- LEGEND:**
- EXISTING LV ELECTRICAL CABLE TRENCH
 - NEW LV ELECTRICAL CABLE TRENCH

ISSUED FOR TENDER

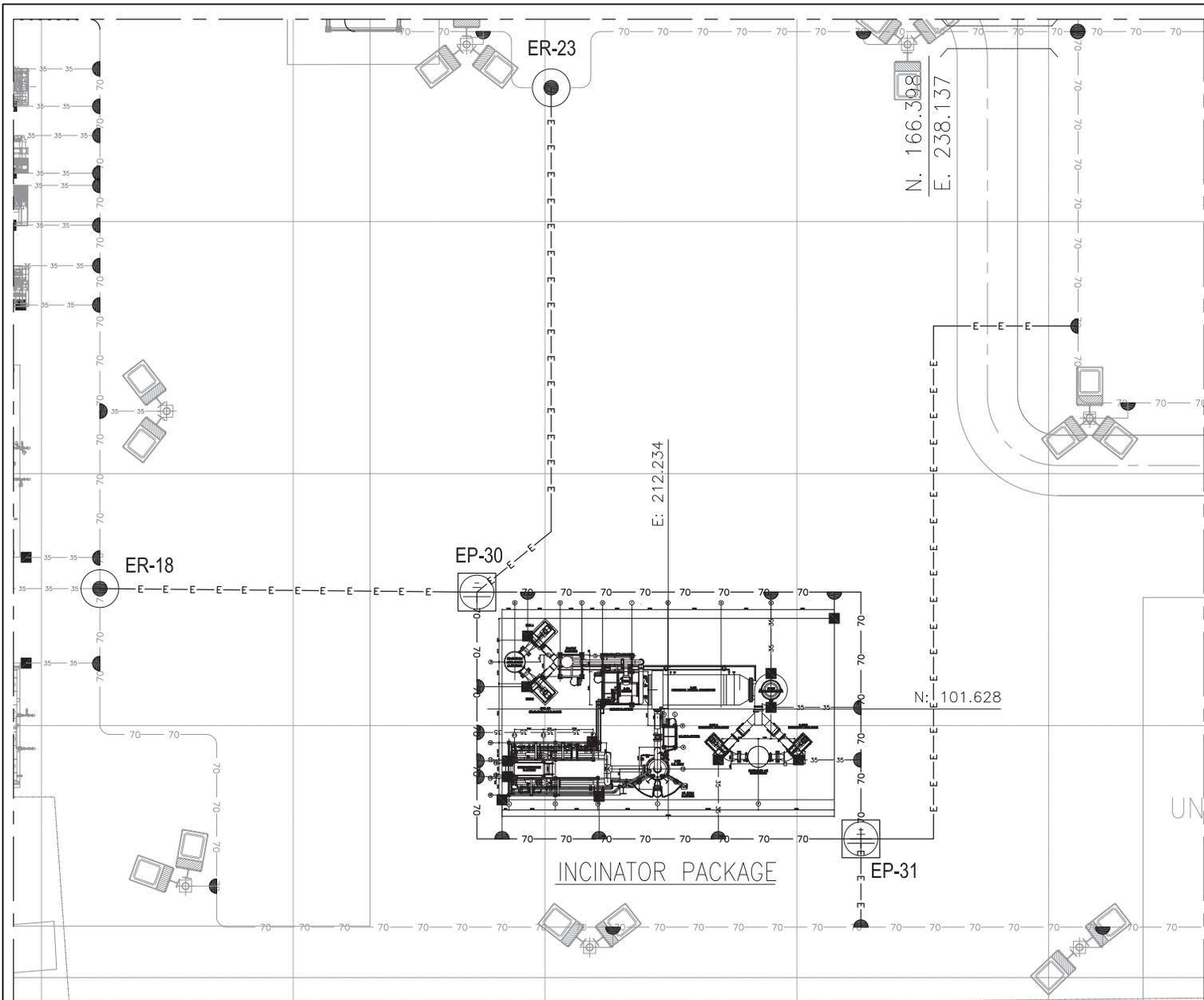
0	20-02-2017	ISSUED FOR TENDER	MSR	MP	NAK
REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHECKED	APPR.
<p>CLIENT: OIL & GAS DEVELOPMENT COMPANY LTD. <small>00551 HILUSE TOWER, FIRST FLOOR, BLUE AREA, JERBAK ANDRUE BLANRANG PANGKALAN FAX: +62 31 2623033. PHONE: +62 31 2623069</small></p>					
<p>CONSULTANT: Zishan Engineers (Pvt.) Ltd. <small>An ISO 9001-2008 certified company #18, 2008, E, PONDOK PONDOK Tel: (62-21) 3433365-68 & 34310151-54. Fax: (62-21) 3433331 & 34510156 E-Mail: info@zishanengineers.com Website: www.zishanengineers.com</small></p>					
<p>PROJECT : KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE-1I</p>			<p>DWG. NO. 165-4-ELL-028</p>		
<p>TITLE : CABLE TRENCH LAYOUT FOR ACID GAS INCINATOR PACKAGE</p>			<p>REV. 0</p>		
<p>JOB NO. 165-4</p>			<p>SIZE SCALE SHEET</p>		
			<p>A1 1:300 1 OF 1</p>		



ISSUED FOR TENDER

- NOTES**
1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE SPECIFIED.
 2. THE LOCATION OF THE PANELS INDICATIVE. SAME IS SUBJECT TO VARIATION OWING TO SITE CONDITIONS. ANY ON SITE CHANGES REQUIRED AS PER SITE CONDITIONS SHALL BE IMPLEMENTED ONLY AFTER DUE APPROVAL FROM OGDCL/ZEL SITE ENGINEER.

REV.	DATE	ISSUED FOR TENDER	MSR	MF	MAX
		DESCRIPTION OF REVISION	DRAWN	CHECKED	APPR.
CLIENT: OIL & GAS DEVELOPMENT COMPANY LTD. OGDCL HOUSE TOWER-4, FIRST FLOOR FLOOR, BLUE AREA, JIRRAH AVENUE ISLAMABAD PAKISTAN FAX: +92-01-36203333, PHONE: +92-01-36203000					
CONSULTANT: Zishan Engineers (Pvt.) Ltd. An ISO 9001-2008 certified company 47/F Block 6, PECHS, Karachi/Pakistan Tel: (92-21) 3433045-48 & 3437151-54 Fax: (92-21) 3433040 & 34310156 E-Mail: contact@zishanengineers.com Website: www.zishanengineers.com			DWG. NO. 165-4-ELL-029 REV. 0		
PROJECT : KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE-II			JOB NO. 165-4		
TITLE : ACID GAS INCINERATOR PACKAGE MCC PLACEMENT LAYOUT			SIZE	SCALE	SHEET
			A3	1:125	1 OF 1



SYMBOL	DESCRIPTION
	EARTH BUS BAR - EB
	240 Sq. mm PVC INSULATED COPPER CONDUCTOR
	70 Sq. mm PVC INSULATED COPPER CONDUCTOR
	35 Sq. mm PVC INSULATED COPPER CONDUCTOR
	AN LONG EARTH ROD WITH EARTH PIT.
	AN LONG EARTH ROD WITHOUT PIT.
	CADWELD CONNECTION FOR UNDER GROUND CABLES.
	EQUIPMENT EARTH BOLTED CONNECTION

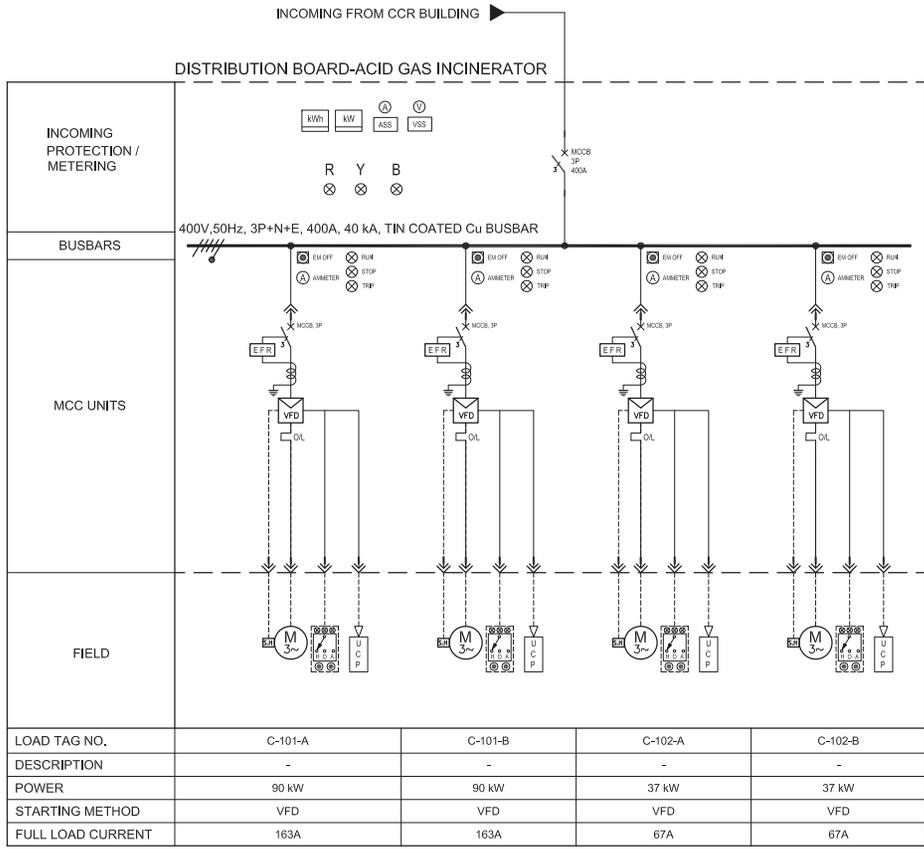
- NOTES:**
1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
 2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH TYPICAL GROUNDING INSTALLATION DETAIL DRAWINGS REFER TO DRAWING NO. 164-030.
 3. THE ROUTE OF THE MAIN EARTH GRID & EARTHING ROOSTERS IS INDICATIVE AND CAN BE ADJUSTED AS PER ACTUAL SITE CONDITION. THIS DRAWING IS MEANT TO SHOW THE MAIN GROUNDING NETWORK ONLY.
 4. THE MAIN EARTH GRID & BRANCH CONNECTIONS TO BE INSTALLED IN THE AVAILABLE CABLEWAYS, TRAY, CONDUIT, PIPE SLEEVES ETC.
 5. WHERE CABLES CROSS PIPES, MINIMUM CLEARANCE OF 100 MM SHALL BE MAINT.
 6. DIRECT BURIED GROUNDING CABLE SHALL BE INSTALLED A MINIMUM OF 300 MM BELOW FINISHED GRADE.
 7. EQUIPMENT & STRUCTURE EARTHING CONNECTIONS ARE TO BE PAINTED WITH ANTI CORROSIVE RESISTANT PAINT IMMEDIATELY AFTER INSTALLATION & TESTING.
 8. ALL GROUNDING CONNECTIONS SHALL BE CLEANED THOROUGHLY SHALL BE THROUGH PROPER LUGS, THIMBLS, ALL METALWORK IN OR ELEVATED STRUCTURE, WHICH IS NOT CONTINUOUS SHALL BE SEPARATELY GROUNDING.
 9. ALL GROUNDING CABLES AT EQUIPMENT OR GROUND BUSBAR END SHALL BE CARRIED OUT USING A CRIMPED TYPE CABLE LUGS WITH PROTECTIVE SLEEVES.
 10. CABLE TRAY SHALL BE BONDED TO THE MAIN GROUND GRID OR GROUNDING STEEL STRUCTURE AT EACH END AND FOR EQUIPOTENTIAL CONTINUITY (WHERE REQUIRED).
 11. OVER HANGING MULTIPLE GROUNDING POINTS SHALL BE PROVIDED WITH EARTHING BUSBAR HAVING REDUNDANT CONNECTION OF 70 SQ. MM CABLE WITH THE MAIN GRID.
 12. FOR EQUIPOTENTIAL BONDING OF STEEL STRUCTURE MIN. 6 SQ. MM SHALL BE UTILIZED.
 13. WHEN GROUNDING STORAGE TANKS THE MINIMUM NUMBER OF GROUND CONNECTIONS SHALL BE AS FOLLOWS:
 - TANKS OVER 30m DIA - 3 CONNECTIONS
 - TANKS OVER 30m DIA - 1 CONNECTIONS
 14. ALL UNDERGROUND BRANCH CONNECTIONS SHALL BE MADE THROUGH CADWELD JOINTS.
 15. ALL ABOVE GROUND BRANCH CONNECTIONS SHALL BE MADE THROUGH CRIMPED CONNECTOR.
 16. GROUND CONNECTIONS ON EQUIPMENT END TO BE BOLTED TYPE.
 17. EARTH BARS TO BE USED WITH IN PIT AREA / BUILDINGS ETC. ARE NOT SHOWN HERE AND TO BE TREATED AS ON HOLD.
 18. THE EARTH RESISTANCE VALUE FOR THE COMPLETE NETWORK SHALL NOT EXCEED 1 OHM. ANY ADDITIONAL GROUND RODS REQUIRED TO ACHIEVE THE VALUE SHALL BE SHOWN IN CONTRACTOR'S SCHEM.
 19. THE SIZES SHOWN IN THE TABLE REPRESENT MINIMUM SIZES, CONTRACTOR MAY USE LARGER SIZE DUE TO CONSIDERATION OF AVAILABLE QUANTITIES.

MINIMUM GROUNDING CABLES SHALL BE AS PER THE FOLLOWING TABLE UNLESS OTHERWISE NOTED.

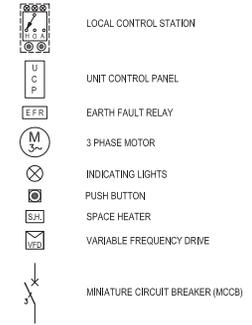
MINIMUM GROUNDING CABLE DIAMETER SEE NOTE-20	APPLICATION
240 Sq. mm PVC INSULATED	- MAIN GROUND GRID AROUND COR & MCC - TRANSFORMER BODY GROUNDING - LV/MCC SWGR GROUNDING
70 Sq. mm PVC INSULATED	- MV PANEL GROUNDING - MAIN PROCESS AREA GROUND GRID - STORAGE TANKS - FLARE STACK - SCADA ANTENNA AND TOWER - ANY OTHER GROUNDING RELATED TO LIGHTNING PROTECTION - FENCE GROUNDING
35 Sq. mm PVC INSULATED	- ALL MV/LV MOTORS - PROCESS SHEDS / EQUIPMENT - LIGHTING POLES - FIELD MOUNTED DISTRIBUTION PANELS - ELECTRICAL PANELS - STEEL STRUCTURES
16 Sq. mm PVC INSULATED	- IBS - ICS
6 Sq. mm PVC INSULATED	- EQUIPOTENTIAL BONDING JUMPERS

ISSUED FOR TENDER

0	20/02/2017	ISSUED FOR TENDER	MSR	MF	NAK						
REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHECKED	APPR.						
CLIENT: OIL & GAS DEVELOPMENT COMPANY LTD. <small>MODEL HOUSE TOWER, FIRST FLOOR, 10/15, RUE ALLEE, AREA 18, MANAMA, KINGDOM OF BAHRAIN FAX: +965 21 262303, PHONE: +965 14202868</small>											
CONSULTANT: Zishan Engineers (Pvt.) Ltd. <small>An ISO 9001:2008 certified company 4th Floor, P.O. Box 1000, Manama, Bahrain Tel: (965-21) 2438245-46 & 24310151-54, Fax: (965-21) 2432331 & 24310156 E-Mail: zishan@zishanengineers.com Website: www.zishanengineers.com</small>											
PROJECT : KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE-4I			DWG. NO. 165-4-ELL-030 REV. 0								
TITLE : EARTHING LAYOUT FOR INCINATOR PACKAGE			JOB NO. 165-4 <table border="1"> <tr> <td>SIZE</td> <td>SCALE</td> <td>SHEET</td> </tr> <tr> <td>A1</td> <td>1:300</td> <td>1 OF 1</td> </tr> </table>			SIZE	SCALE	SHEET	A1	1:300	1 OF 1
SIZE	SCALE	SHEET									
A1	1:300	1 OF 1									



LEGENDS:-

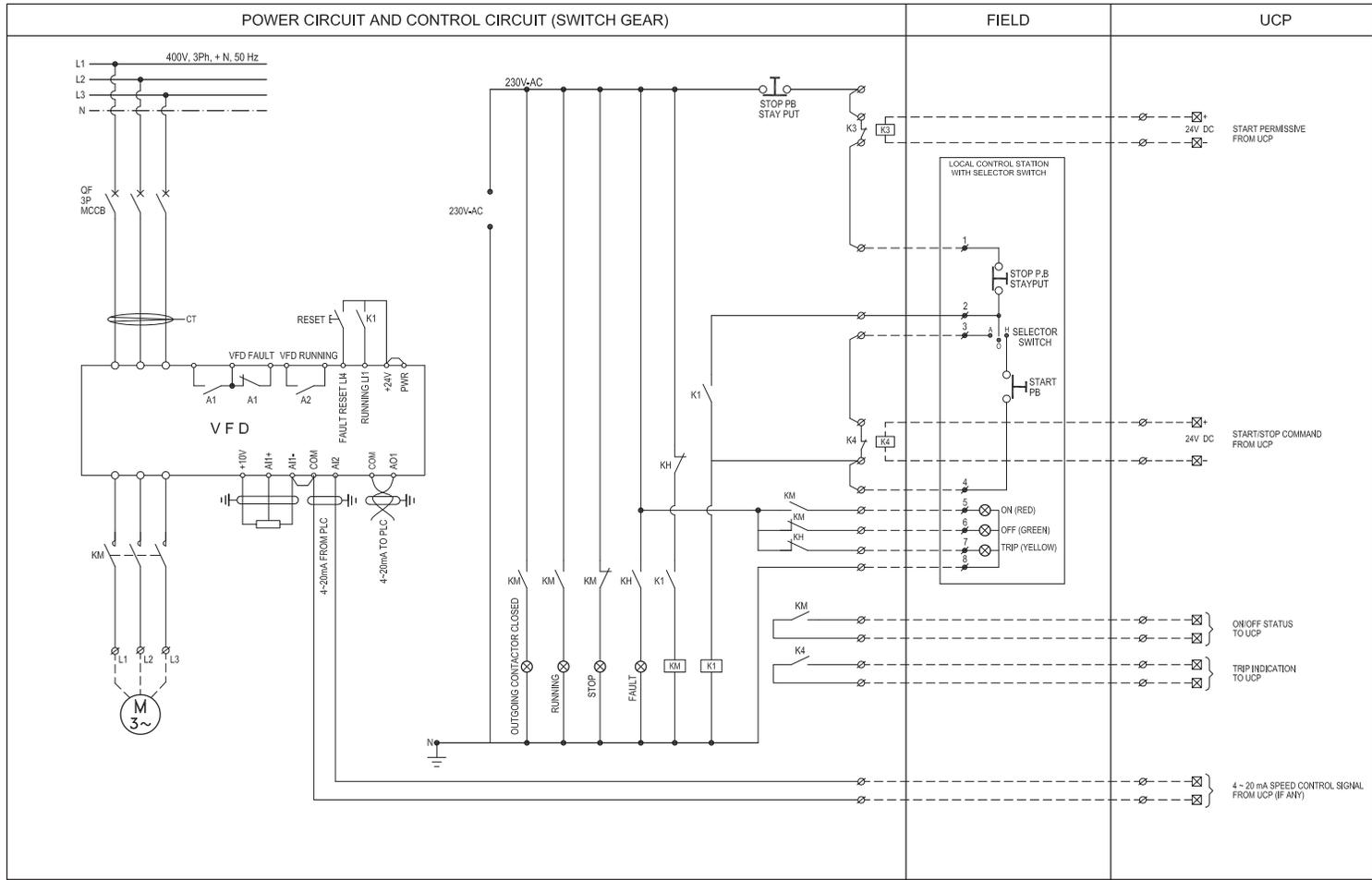


NOTES:

1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH DATA SHEET
2. THE ELECTRICAL EQUIPMENT SHOWN ARE THE MINIMUM DESIGN REQUIREMENT. THE SUPPLIER SHALL FURNISH ADDITIONAL REQUIREMENTS AS PER IEC AND OTHER RELEVANT STANDARDS CONSIDERING SYSTEM REQUIREMENT.
3. SUPPLIER SHALL CONSIDER MOTOR RATING FOR VERIFYING STARTER SIZE, BREAKER RATING AND OTHER ELECTRICAL COMPONENTS, AS PER RELEVANT IEC COORDINATION TABLES. (TYPE 2).
4. THE MCC ENCLOSURE RATING SHALL BE IP42, FLOOR MOUNTED FREE STANDING, POWDER COATED SHEET STEEL.
5. THE MCC SHALL BE FRONT OPERATED.
6. THE UNDER VOLTAGE / OVERVOLTAGE (27 & 59) & EARTH FAULT PROTECTION (50N/51N) TO BE CONFIGURED IN THE SST (LSIG) UNIT OF THE INCOMING BREAKER LV MCCB
7. THE POWER & CONTROL CABLES SHALL ENTER FROM BOTTOM OF MCC.
8. THE DOOR LOCKING SYSTEM SHALL BE STAINLESS STEEL.
9. NA - NOT APPLICABLE.
10. TBA - TO BE ADVISED.
11. ON ACTIVATION OF REMOTE SHUTDOWN SWITCH, MOTOR IN THIS MCC WILL BE SHUTDOWN. TO ACHIEVE THIS INTERPOSING RELAYS SHALL BE PROVIDED IN THE MCC BY SWITCHGEAR VENDOR.
12. THE CONTROL VOLTAGE SHALL BE 230V AC THROUGH CONTROL POWER TRANSFORMER (CPT) EACH STARTER ARRANGEMENT SHOULD BE PROVIDED WITH DEDICATED CPT UNIT.
13. VENDOR SHALL ALSO PROVIDE ADEQUATE NUMBER OF TERMINALS FOR INTERNAL WIRING.

ISSUED FOR TENDER

REV.	0	20-02-2017	ISSUED FOR TENDER	MSR	MF2	NHC
			DESCRIPTION OF REVISION	DRAWN	CHECKED	APPROV.
<p>CLIENT: OIL & GAS DEVELOPMENT COMPANY LTD. <small>ODOL HOUSE TOWER 4, FIRST FLOOR PRIDE, BLUE AREA, JINNAH AVENUE ISLAMABAD PAKISTAN FAX: +92 01 34530448 & 34510151-54 Fax: +92 011 34530420 & 34510155 E-Mail: contacts@oildgdev.com Website: www.oildgdev.com</small></p>						
<p>CONSULTANT: Zishan Engineers (Pvt.) Ltd. <small>An ISO 9001:2008 certified company 47F Block B, F-7/35, Islamabad Tel: +92 011 34530448 & 34510151-54 Fax: +92 011 34530420 & 34510155 E-Mail: contacts@zishanengineers.com Website: www.zishanengineers.com</small></p>						
<p>PROJECT : KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE-II</p>				<p>JOB NO. 165-4</p>		
<p>TITLE : SINGLE LINE DIAGRAM</p>				<p>SIDE SCALE SHEET A1 N.T.S. 1 OF 1</p>		



- NOTES:**
1. THIS DRAWING SHALL NOT BE CONSTRUED AS DEPICTION OF ALL PHYSICAL COMPONENTS REQUIRED IN THE MCC PERTAINING TO REQUIRED MOTOR CONTROLS. RATHER, THIS DRAWING PRESENTS THE DESIGN INTENT OF MOTOR CONTROL CIRCUITS. VENDOR SHALL REMAIN RESPONSIBLE TO FURNISH ALL COMPONENTS, ACCESSORIES, AUXILIARIES REQUIRED FOR FULFILLING THE STATED DESIGN INTENT VENDOR.
 2. THE SCHEMATICS MENTIONED IN THESE DRAWINGS ARE PRELIMINARY. VENDOR SHALL FURNISH THE FINAL CONTROL SCHEMATIC WIRING DRAWINGS, AFTER AWARD AND BEFORE START OF FABRICATION, FOR APPROVAL.
 3. THESE DRAWINGS SHALL BE READ IN CONJUNCTION WITH RELEVANT SINGLE LINE DIAGRAMS AND SWITCHGEAR DATASHEETS.
 4. MOTOR PROTECTION RELAY SHALL HAVE OVER LOAD, EARTH FAULT, UNDER VOLTAGE, PHASE CURRENT UNBALANCE AND MOTOR STALLED PROTECTION.
 5. THIS SCHEMATIC IS MEANT FOR
C-101A
C-101B
C-102A
C-102B

LEGEND / ABBREVIATIONS	
	MCCB BREAKER
	CONTACTOR
	PUSH BUTTON PAD LOCKABLE STAY PUT TYPE
	SELECTOR SWITCH, LOCAL-OFF-REMOTE
	AUXILIARY RELAY
	CONTACTOR COIL
	CONTACT, NO / NC
	TERMINAL MARSHALLING PANEL (PLC)
	TERMINAL SWITCHBOARD
	TERMINAL LOCAL CONTROL STATION
	INDICATION LAMPS
	MOTOR PROTECTION RELAY
	CURRENT TRANSFORMER

ISSUED FOR TENDER

REV.	DATE	DESCRIPTION OF REVISION	USER	MPZ	MAN
1	2020-07-17	ISSUED FOR TENDER			
			DRAWN	CHECKED	APPR.

CLIENT: **OIL & GAS DEVELOPMENT COMPANY LTD.**
102/24, HOUSE, 10TH FLOOR, BANGALORE, KARNATAKA, INDIA. 91, PONDY AVENUE, BELGAUM-591024
TEL: +91 98453 34343, FAX: +91 98453 34343, WWW: WWW.OILGASDEV.COM

CONSULTANT: **Zishan Engineers (Pvt.) Ltd.**
An ISO 9001:2008 certified company
477 Block 6, PECHS, Karachi-Pakistan
TEL: 993 271 34300/046, FAX: 993 271 34301/046, WWW: WWW.ZISHANENGINEERS.COM

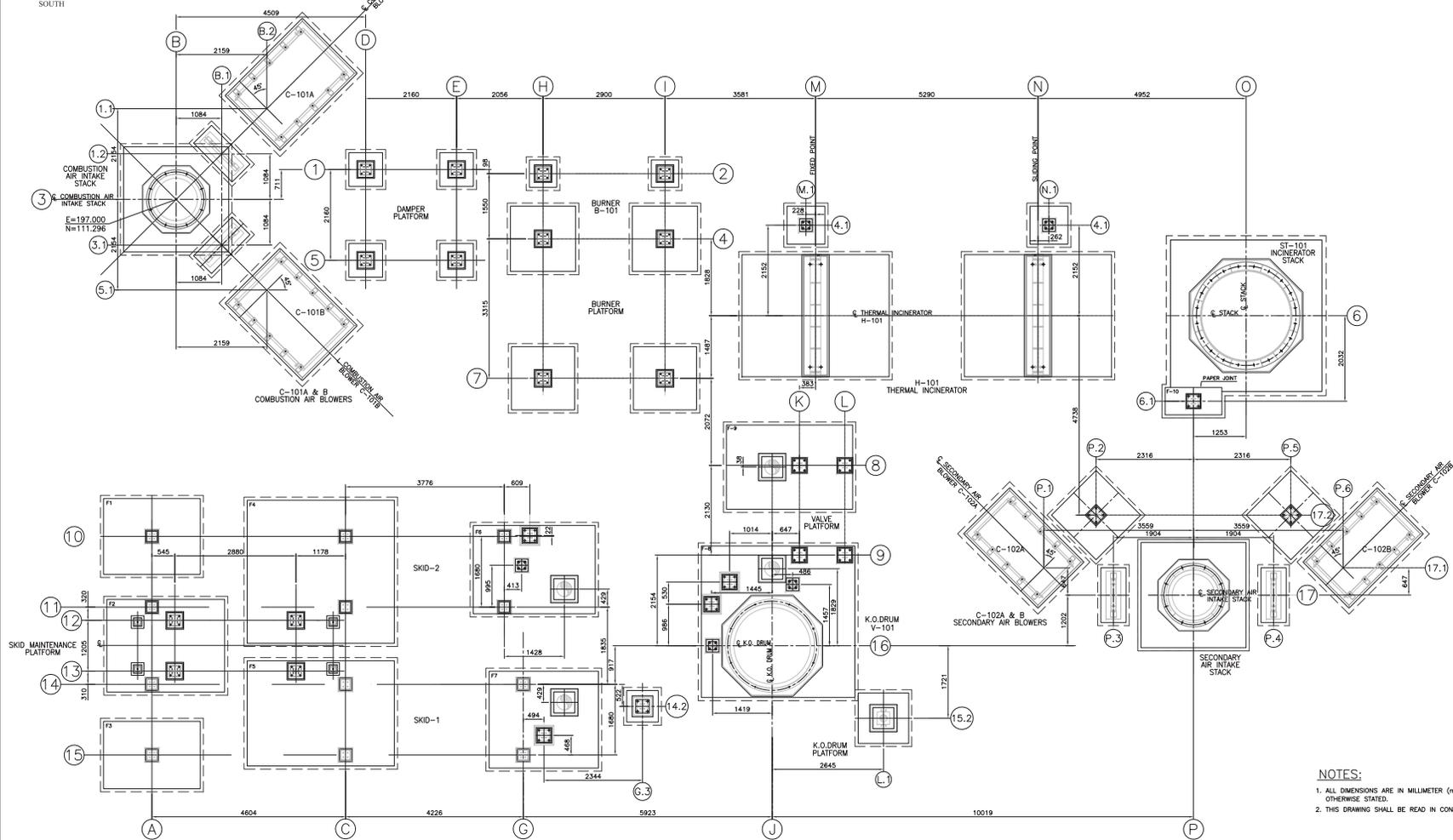
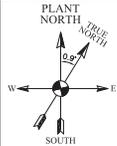
DWG. NO. **165-4-SCE-014**
 REV. **0**

PROJECT : **KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE-II**
 TITLE : **MOTOR CONTROL SCHEMATICS**

JOB NO. **165-4**
 SHEET **1 OF 1**

CIVIL DRAWINGS

(FOR INFORMATION / REFERENCE)



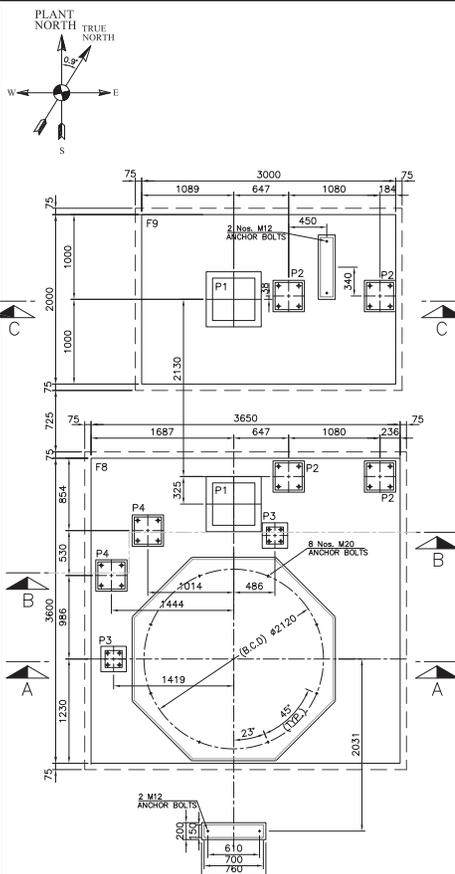
ISSUED FOR CONSTRUCTION

- NOTES:**
- ALL DIMENSIONS ARE IN MILLIMETER (mm), LEVELS AND COORDINATES ARE IN METER (m) UNLESS OTHERWISE STATED.
 - THIS DRAWING SHALL BE READ IN CONJUNCTION WITH DWG. NO. 165-4-CSTD-001 TO 004.

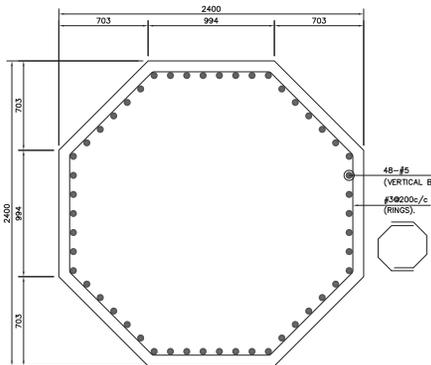
OVER ALL FOUNDATION LAYOUT PLAN FOR ACID GAS INCINERATOR SYSTEM

REFERENCE DRAWINGS	
DESCRIPTION	DWG. NO.
GENERAL PLOT PLAN	165-4-GPP-001
MECHANICAL PIPING LAYOUT FOR INCINERATOR SKID	165-4-MPL-002
FOUNDATION LAYOUT & LOADS	165-4-FWL-0001 (1 TO 14) (REV. 02)

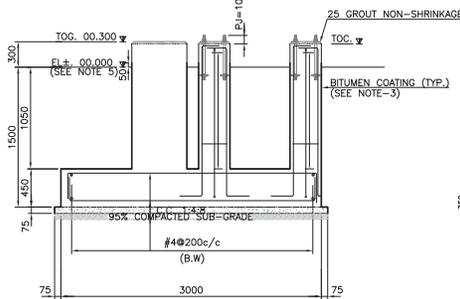
CD	22/06/2016	ISSUED FOR CONSTRUCTION	MSL	MSH	SMX
REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHECKED	APPR.
CLIENT: OIL & GAS DEVELOPMENT COMPANY LTD. <small>OGDC HOUSE TOWER NO. FIRST FLOOR F-6/3, BLUE AREA, BHARNAH AVENUE ISLAMABAD PAKISTAN FAX: +92 51 2622000, PPHONE: +92 51 2422000</small>					
CONSULTANT: Zishan Engineers (Pvt.) Ltd. <small>An ISO 9001:2008 certified company 2/F, Block 4, PECCS, Model Town Tel: (92-21) 3430245-46 & 3431051-54 Fax: (92-21) 3432340 & 3431051 E-Mail: contact@zishanengineers.com Website: www.zishanengineers.com</small>			DWG. NO. 165-4-C-364 REV. C0		
PROJECT : KPD-TAY ACID GAS INCINERATOR SYSTEM			JOB NO. 165-4		
TITLE : OVER ALL FOUNDATION LAYOUT PLAN FOR ACID GAS INCINERATOR SYSTEM			SIZE	SCALE	SHEET
			A1	1:50	1 OF 1



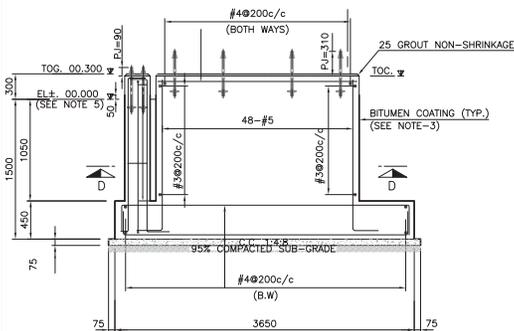
FOUNDATION PLAN
(SCALE 1 : 30)



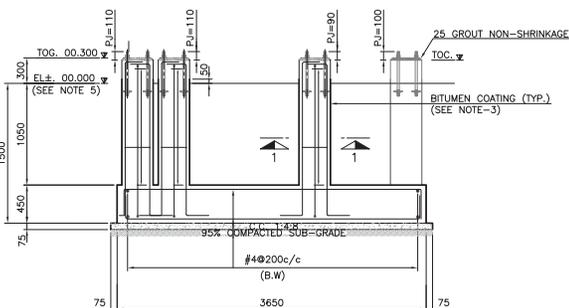
SECTION D-D
(SCALE 1 : 20)



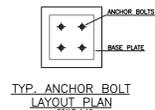
SECTION C-C
(SCALE 1 : 30)



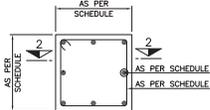
SECTION A-A
(SCALE 1 : 30)



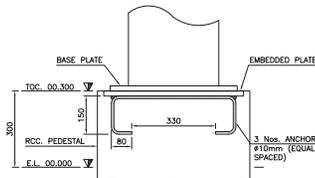
SECTION B-B
(SCALE 1 : 30)



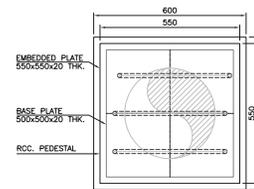
TYP. ANCHOR BOLT LAYOUT PLAN
(SCALE 1 : 10)



SECTION 1-1
(SCALE = 1 : 10)

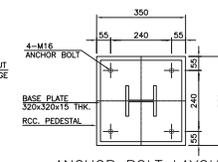


SECTION 2-2
(SCALE 1:10
(FOR P1))

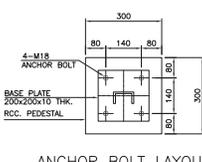


BASE PLATE PLAN-P1
(SCALE: 1:10)

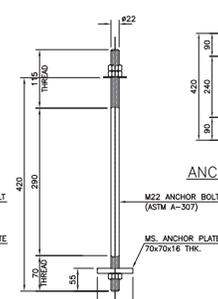
SECTION 2-2
(SCALE = 1 : 10
(FOR P2, P3 & P4))



ANCHOR BOLT LAYOUT PLAN-P2
(SCALE: 1:10)



ANCHOR BOLT LAYOUT PLAN-P3
(SCALE: 1:10)



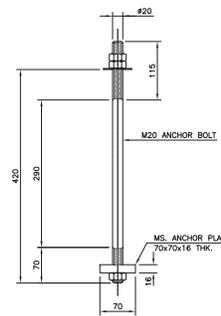
ANCHOR BOLT LAYOUT PLAN-P4
(SCALE = 1 : 10)

TYP. DETAIL FOR ANCHOR BOLT (M12)
(SCALE= 1:5)

TYP. DETAIL FOR ANCHOR BOLT (M16)
(SCALE= 1:5)

TYP. DETAIL FOR ANCHOR BOLT (M18)
(SCALE= 1:5)

TYP. DETAIL FOR ANCHOR BOLT (M22)
(SCALE= 1:5)



TYP. DETAIL FOR ANCHOR BOLT (M20)
(SCALE= 1:5)

ISSUED FOR CONSTRUCTION

LEGENDS:-

FGL FINISHED GROUND LEVEL.
TOG. TOP OF GROUT.
TOC. TOP OF CONCRETE.
TYP. TYPICAL.
THICK. THICK.
EL. ELEVATION.

SCHEDULE OF R.C.C. FOOTINGS

MARKS	FOOTING SIZE		DEPTH (E)	FOOTING REINFORCEMENT				REMARKS.
	1:2:4 C.C. (A x B)	1:4:8 C.C. (C x D)		BOTTOM REINFORCEMENT SHORT WAY	LONG WAY	TOP REINFORCEMENT SHORT WAY	LONG WAY	
F8	3650x3600	3850x3750	450	#4@200c/c	#4@200c/c	#4@200c/c	#4@200c/c	SEE PLAN
F9	3000x2000	3150x2150	450	#4@200c/c	#4@200c/c	#4@200c/c	#4@200c/c	SEE PLAN

SCHEDULE OF PEDESTAL

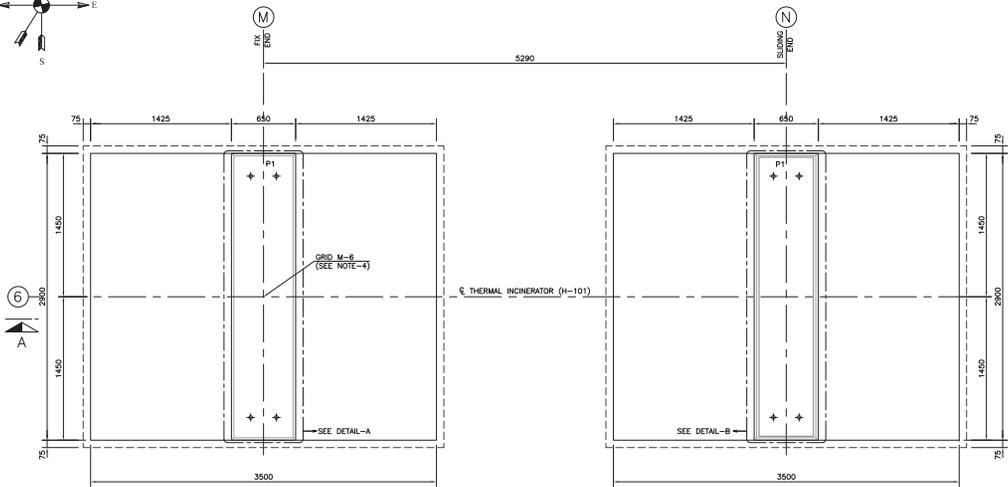
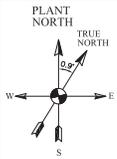
MARK	ABOVE PLINTH	VERTICAL BAR	RINGS
P1	600x600	12-#6	#3@200c/c
P2	350x350	6-#5	#3@200c/c
P3	300x300	6-#5	#3@200c/c
P4	420x420	8-#5	#3@200c/c

- NOTES:
- ALL DIMENSIONS ARE IN MILLIMETER (mm). LEVELS AND COORDINATES ARE IN METER (m) UNLESS OTHERWISE STATED.
 - THIS DRAWING SHALL BE READ IN CONJUNCTION WITH DWG. NO. 165-4-CST0-001 TO 004.
 - ALL CONCRETE SURFACE EXPOSED TO EARTH TO BE COATED WITH 1200 MICRON THK. 10/20 GRADE BITUMEN AFTER 01 COAT OF PRIMER OR ANY APPROVED EQUIVALENT FROM APPROVED VENDOR / SUPPLIER.
 - ORIENTATION OF THE EQUIPMENT AND STARTING ANGLE OF EQUIPMENT W.R.T PLANT NORTH TO BE CONFIRMED FROM RELEVANT VENDOR DRAWING / PIPING GAUGS.
 - E.L. ± 0.000 IS FINISHED GROUND LEVEL.
 - ANCHOR BOLTS TO BE PROVIDED BY CIVIL CONTRACTOR.

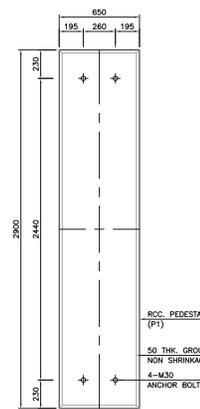
CO. 2024-0018	ISSUED FOR CONSTRUCTION	MSL	MSH	SARA
REV. DATE	DESCRIPTION OF REVISION	DRAWN	CHECKED	APPRO.
CLIENT: OIL & GAS DEVELOPMENT COMPANY LTD. 02002, HOSEI TOWER, BEST FLOOR REG. BLUE AREA, JERBA AVENUE, EL ANBARAD PARK AREA P.O. BOX 211, 202203, PHOENIX 162-01-4028897				
CONSULTANT: Zishan Engineers (Pvt.) Ltd. An ISO 9001:2008 certified company 47/F Block B, PECHS, Karama Plaza Tel: (92-21) 3420044-6, 3420191-4, Fax: (92-21) 3420430 & 3420195 E-Mail: contact@zishanengineers.com Website: www.zishanengineers.com				

DWG. NO. 165-4-C-365
REV. C0
JOB NO. 165-4
PROJECT : KP-D TAY INTEGRATED DEVELOPMENT PROJECT PHASE-II
TITLE : FOUNDATION PLAN & DETAILS FOR K.O. DRUM (V-101) AND VALVE PLATFORM
SIZE SCALE SHEET A1 AS SHOWN 1 OF 1

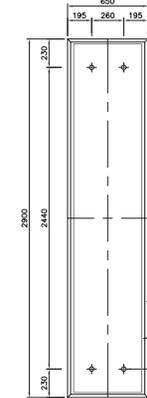
REFERENCE DRAWINGS	
DESCRIPTION	DWG. NO.
GENERAL PLOT PLAN	165-4-OPP-001
K.O. DRUM GENERAL ARRANGEMENT (V-101)	1033.06-DWG-00111 (1 TO 4)



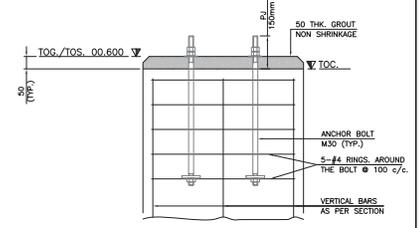
FOUNDATION LAYOUT PLAN
(SCALE = 1 : 20)



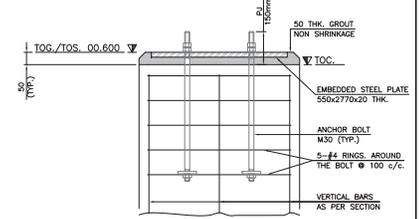
DETAIL-A (FIX END)
(SCALE = 1 : 20)



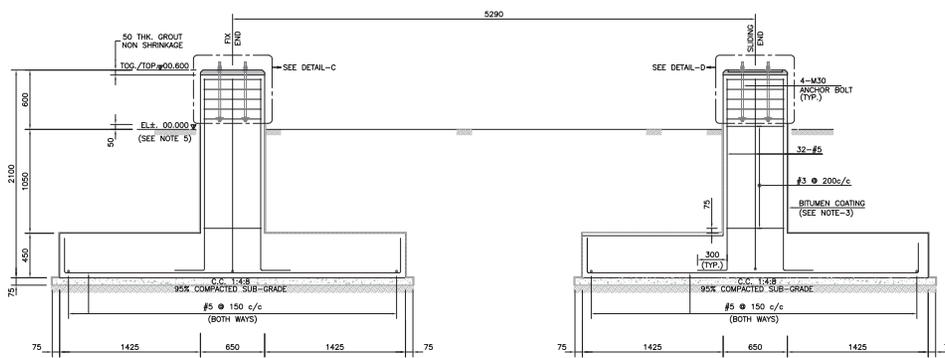
DETAIL-B (SLIDING END)
(SCALE = 1 : 20)



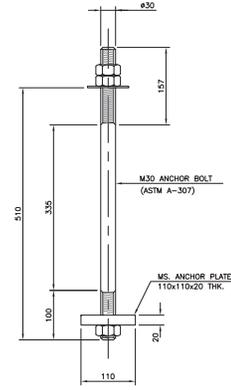
DETAIL-C (FIX END)
(SCALE = 1 : 10)



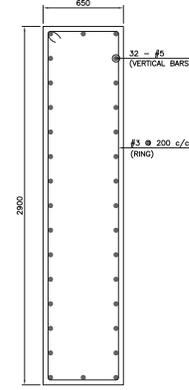
DETAIL-D (SLIDING END)
(SCALE = 1 : 10)



SECTION A-A
(SCALE = 1 : 20)



TYP. DETAIL FOR ANCHOR BOLT (M30)
(SCALE = 1:5)



TYP. CROSS SECTION OF RCC PEDESTAL (P1)
(SCALE = 1 : 20)

- LEGENDS:-**
- FINL. FINISHED GROUND LEVEL.
 - TOG. TOP OF GROUT.
 - TOS. TOP OF STEEL.
 - TOC. TOP OF CONCRETE.
 - TYP. TYPICAL.
 - THK. THICK. / THICKNESS.
 - EL. ELEVATION.

ISSUED FOR CONSTRUCTION

- NOTES:**
1. ALL DIMENSIONS ARE IN MILLIMETER (mm), LEVELS AND COORDINATES ARE IN METER (m) UNLESS OTHERWISE STATED.
 2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH DWG. NO. 165-4-CST0-001 TO 004.
 3. ALL CONCRETE SURFACE EXPOSED TO EARTH TO BE COATED WITH 1200 MICRON THK. 10/20 GRADE BITUMEN AFTER OI COAT OF PRIMER OR ANY APPROVED EQUIVALENT FROM APPROVED VENDOR / SUPPLIER.
 4. ORIENTATION OF THE EQUIPMENT W.R.T PLANT NORTH TO BE CONFIRMED FROM RELEVANT VENDOR DRAWING / PIPING GAIS.
 5. EL. 0.000 IS FINISHED GROUND LEVEL.
 6. ANCHOR BOLTS TO BE PROVIDED BY CIVIL CONTRACTOR.

NO.	REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHECKED	APPR.
01	22-08-2016		ISSUED FOR CONSTRUCTION			

CLIENT:
OIL & GAS DEVELOPMENT COMPANY LTD.
OOGL HOUSE TOWER 6/F, FIRST FLOOR FUSO, BLUE AREA, BINAH AVENUE, ILMUKABANG PAKISTAN
FAX: +92 051 2623303, PH: +92 051 2623309

CONSULTANT:

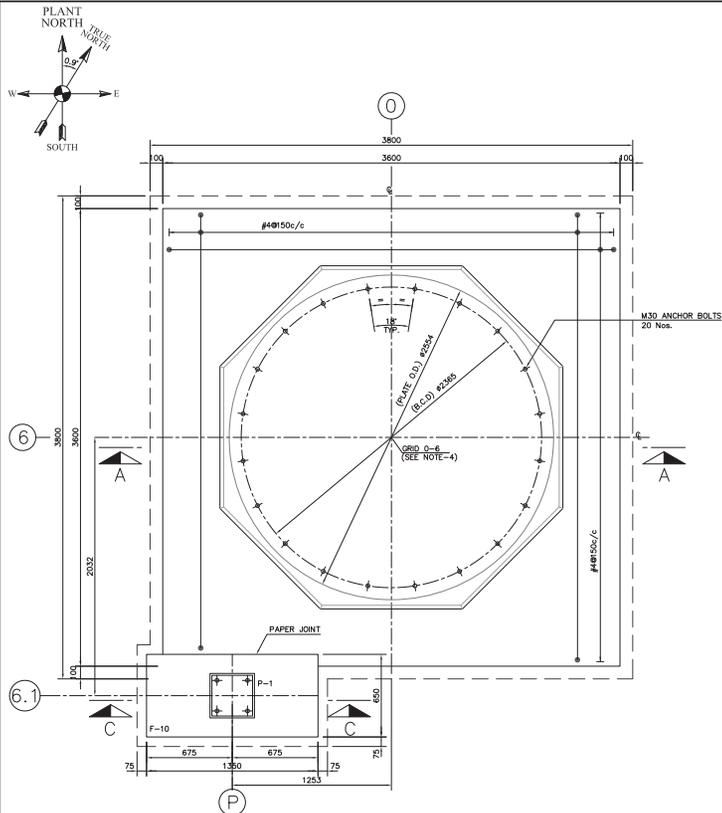
Zishan Engineers (Pvt.) Ltd.
An ISO 9001:2008 certified company
4/F, B-14, PESCO ROAD, PAKISTAN
Tel: (92-21) 3430245-46 & 3431071-54 Fax: (92-21) 3430340 & 3431070
E-Mail: contact@zishanengineers.com Website: www.zishanengineers.com

DWG. NO.
165-4-C-366

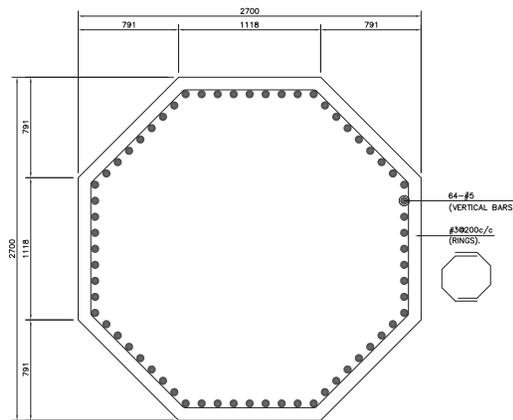
REV. C0

PROJECT : KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE-II	JOB NO. 165-4
TITLE : FOUNDATION PLAN & DETAILS FOR THERMAL INCINERATOR (H-101)	SIZE SCALE SHEET A1 AS SHOWN 1 OF 1

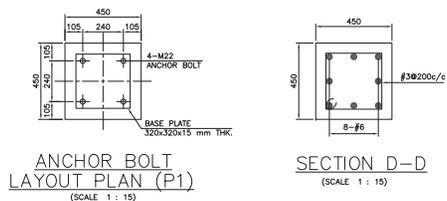
REFERENCE DRAWINGS	
DESCRIPTION	DWG. NO.
GENERAL PLOT PLAN	165-4-GPP-001
FOUNDATION LAYOUT & LOADS	1003-164-IRW-00001 2 OF 14 REVISED



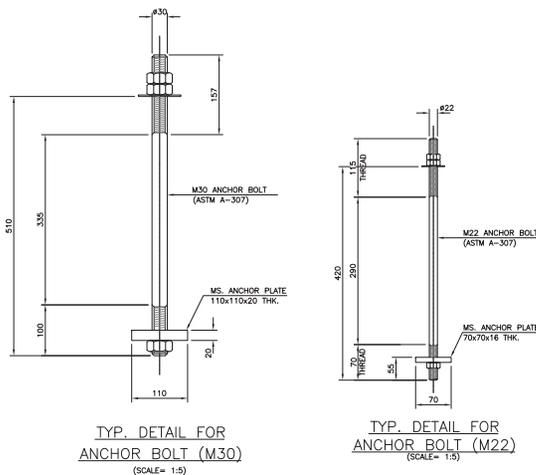
FOUNDATION PLAN
(SCALE 1 : 20)



SECTION B-B
(SCALE 1 : 20)

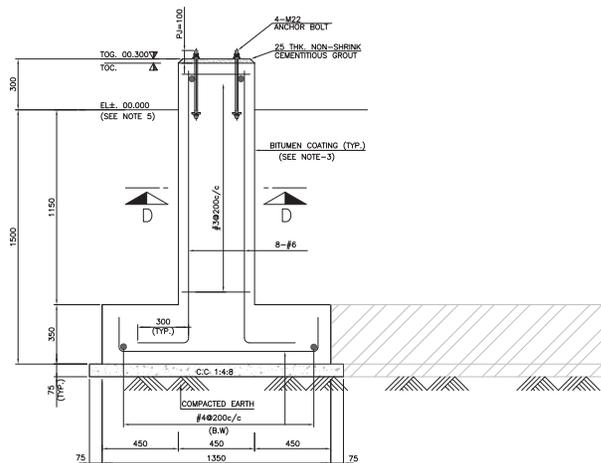


ANCHOR BOLT
LAYOUT PLAN (P1)
(SCALE 1 : 15)

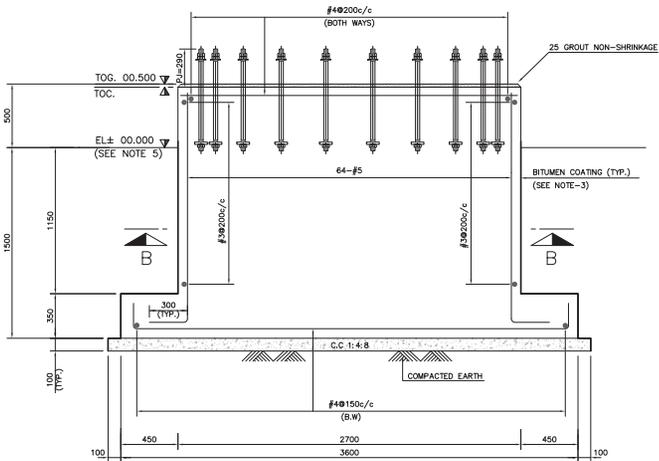


TYP. DETAIL FOR
ANCHOR BOLT (M30)
(SCALE= 1:5)

TYP. DETAIL FOR
ANCHOR BOLT (M22)
(SCALE= 1:5)



SECTION C-C
(SCALE 1 : 15)



SECTION A-A
(SCALE 1 : 20)

**ISSUED FOR
CONSTRUCTION**

LEGENDS:-

- FGL FINISHED GROUND LEVEL.
- TOG TOP OF GROUT.
- TOC TOP OF CONCRETE.
- TYP. TYPICAL.
- THK THICK.
- EL. ELEVATION

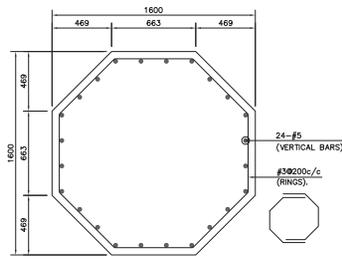
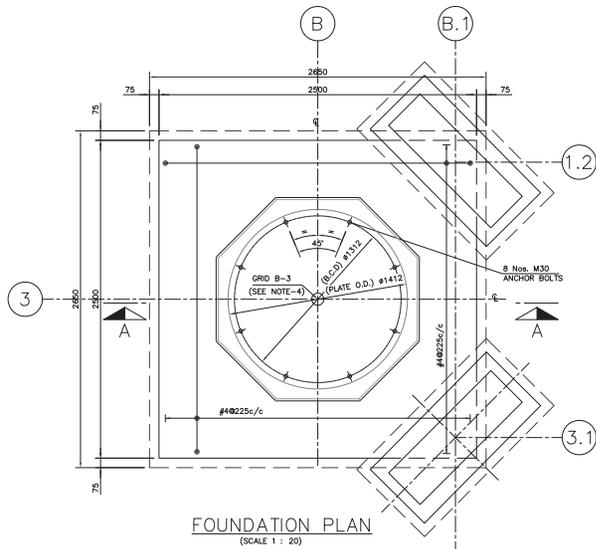
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETER (mm). LEVELS AND COORDINATES ARE IN METER (m) UNLESS OTHERWISE STATED.
2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH DWG. NO. 165-4-CST0-001 TO 004.
3. ALL CONCRETE SURFACE EXPOSED TO EARTH TO BE COATED WITH 1200 MICRON THK. 15/20 GRADE BITUMEN AFTER COAT OF PRIMER OR ANY APPROVED EQUIVALENT FROM APPROVED VENDOR / SUPPLIER.
4. ORIENTATION OF THE EQUIPMENT AND STARTING ANGLE OF EQUIPMENT W.R.T PLANT NORTH TO BE CONFIRMED FROM RELEVANT VENDOR DRAWING / PIPING GADS.
5. EL ± 0.000 IS FINISHED GROUND LEVEL.
6. ANCHOR BOLTS TO BE PROVIDED BY CIVIL CONTRACTOR.

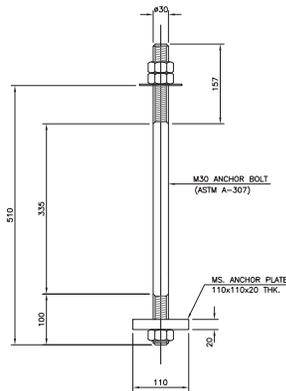
REFERENCE DRAWINGS	
DESCRIPTION	DWG. NO.
GENERAL PLOT PLAN	165-4-0PP-001
FOUNDATION LAYOUT & LOADS	1033-24-DWG-00001 (10 TO 14), REV/02

CS	ISSUED FOR CONSTRUCTION	MIL	MSH	SAMA	
REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHECKED	APPRD.

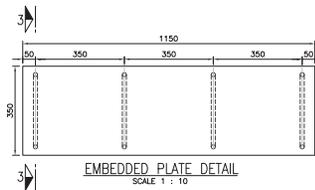
CLIENT:	OIL & GAS DEVELOPMENT COMPANY LTD. OGDC, HOUSE TOWER-1, WEST GROUND FLOOR, BLUE AREA, JERBAH AVENUE, ISLAMABAD PAKISTAN FAK: +92 31 35203148, E: 34301951@ogdc.gov.pk, 34301951@ogdc.gov.pk	DWG. NO. 165-4-C-367
CONSULTANT:	Zishan Engineers (Pvt.) Ltd. An ISO 9001-2008 certified company 4/F Block B, PESCO, Karachi Pakistan Tel: (92-21) 34303448, E: 34301951@ogdc.gov.pk, 34301951@ogdc.gov.pk E-Mail: contact@zishanengineers.com Website: www.zishanengineers.com	REV. C0
PROJECT :	KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE-II	JOB NO. 165-4
TITLE :	FOUNDATION PLAN & DETAILS FOR INCINERATOR STACK (ST-101)	SIZE SCALE SHEET A1 AS SHOWN 1 OF 1



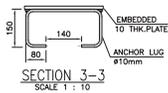
SECTION B-B
(SCALE 1 : 20)



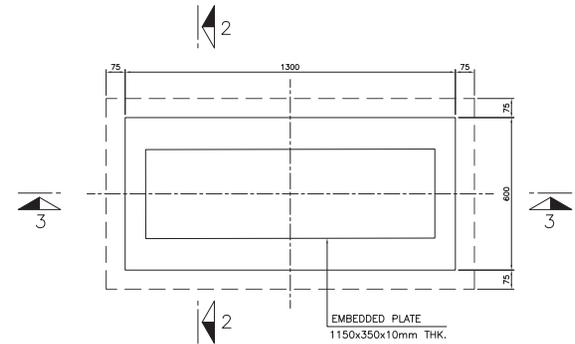
TYP. DETAIL FOR
ANCHOR BOLT (M30)
(SCALE= 1:5)



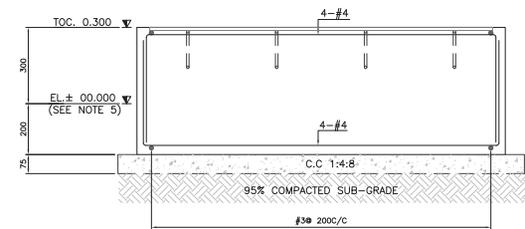
EMBEDDED PLATE DETAIL
(SCALE 1 : 10)



SECTION 3-3
(SCALE 1 : 10)



FOUNDATION PLAN OF
SUPPORT B1/1.2.3.1
(SCALE = 1 : 10)



SECTION 3-3
(SCALE = 1 : 10)

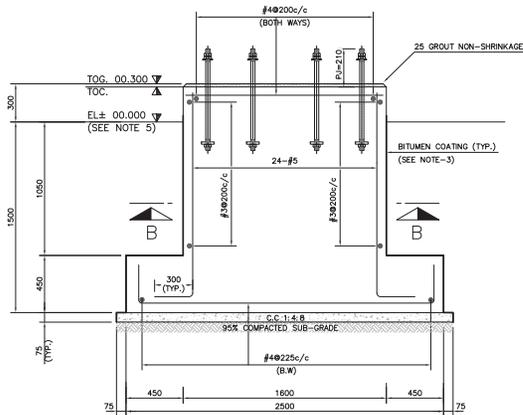
**ISSUED FOR
CONSTRUCTION**

LEGENDS:-

- FGL FINISHED GROUND LEVEL
- TOG. TOP OF GROUT.
- TOC. TOP OF CONCRETE.
- TYP. TYPICAL.
- THK. THICK.
- EL. ELEVATION.

NOTES:

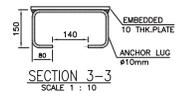
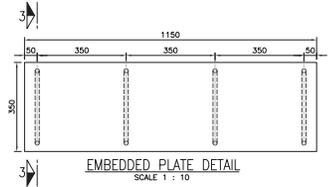
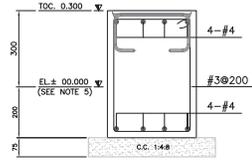
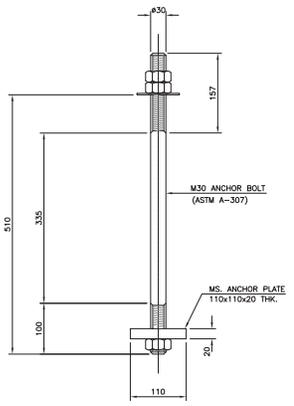
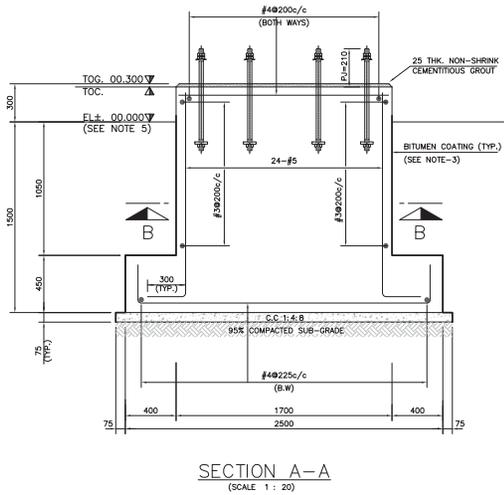
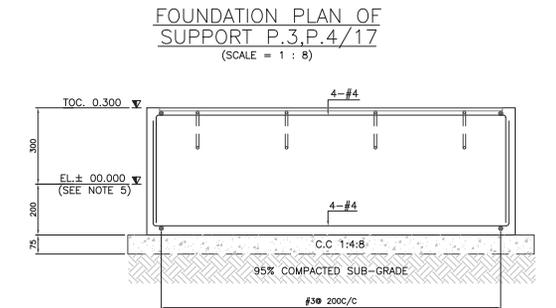
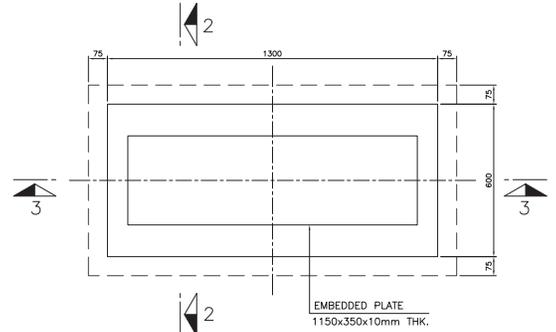
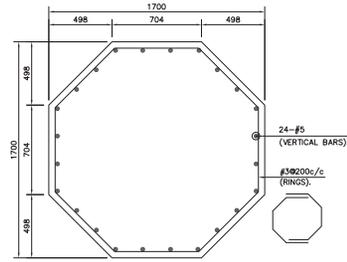
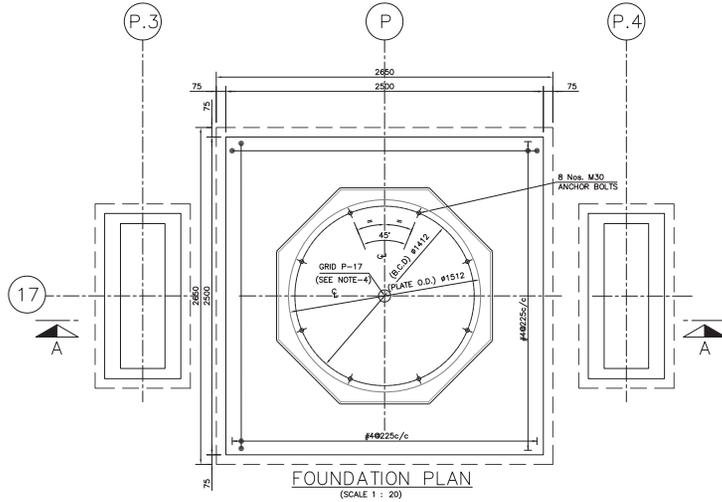
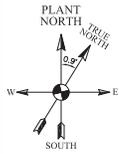
1. ALL DIMENSIONS ARE IN MILLIMETER (mm). LEVELS AND COORDINATES ARE IN METER (m) UNLESS OTHERWISE STATED.
2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH DWG. NO. 165-4-CSTD-001 TO 004.
3. ALL CONCRETE SURFACE EXPOSED TO EARTH TO BE COATED WITH 1200 MICRON THK. 10/20 GRADE BITUMEN AFTER O COAT OF PRIMER OR ANY APPROVED EQUIVALENT FROM APPROVED VENDOR / SUPPLIER.
4. ORIENTATION OF THE EQUIPMENT AND STARTING ANGLE OF EQUIPMENT W.R.T PLANT NORTH TO BE CONFIRMED FROM RELEVANT VENDOR DRAWING / PIPING GAUGS.
5. EL ± 0.000 IS FINISHED GROUND LEVEL.
6. ANCHOR BOLTS TO BE PROVIDED BY CIVIL CONTRACTOR.



SECTION A-A
(SCALE 1 : 20)

REFERENCE DRAWINGS		DWG. NO.
DESCRIPTION		
GENERAL PLOT PLAN		165-4-OPP-001
INLET STACK FOR COMBUSTION AIR BLOWERS C-101 A/B		1033-05-DWG-00021 (1 TO 2)

NO.	DATE	ISSUED FOR CONSTRUCTION	MSL	MESH	SAMA
01	23-08-2016	ISSUED FOR CONSTRUCTION			
REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHECKED	APPR.
CLIENT: OIL & GAS DEVELOPMENT COMPANY LTD. 00000, HUBER TOWER, FIRST FLOOR, HUBER BLUE AREA, JIBRAJI AVENUE, EL-AMARAD, FAYOUMI FAX: +91 21 2623315, PH: +91 21 2623315					
CONSULTANT: Zishan Engineers (Pvt.) Ltd. An ISO 9001-2008 certified company 4/F Block E, PFDYS, Knowledge Park Tel: (82-21) 3430344-6, 3430701-54, Fax: (82-21) 3432450 & 3431016 E-Mail: con@zishanengineers.com Website: www.zishanengineers.com			DWG. NO. 165-4-C-368 REV. C0		
PROJECT: KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE-II			JOB NO. 165-4		
TITLE: FOUNDATION PLAN & DETAILS FOR COMBUSTION AIR INTAKE STACK FOR COMBUSTION AIR BLOWERS			SIZE A1	SCALE AS SHOWN	SHEET 1 OF 1



ISSUED FOR CONSTRUCTION

LEGENDS:-

- FGL FINISHED GROUND LEVEL
- TOG TOP OF GROUT
- TOC TOP OF CONCRETE
- TYP. TYPICAL
- THK. THICK
- EL. ELEVATION

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETER (mm). LEVELS AND COORDINATES ARE IN METER (m) UNLESS OTHERWISE STATED.
2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH DWG. NO. 165-4-CSTD-001 TO 004.
3. ALL CONCRETE SURFACE EXPOSED TO EARTH TO BE COATED WITH 1200 MICRON THK. 10/20 GRADE BITUMEN AFTER COAT OF PRIMER OR ANY APPROVED EQUIVALENT FROM APPROVED VENDOR / SUPPLIER.
4. ORIENTATION OF THE EQUIPMENT AND STARTING ANGLE OF EQUIPMENT W.R.T PLANT NORTH TO BE CONFIRMED FROM RELEVANT VENDOR DRAWING / PIPING GAUGS.
5. EL ± 0.000 IS FINISHED GROUND LEVEL.
6. ANCHOR BOLTS TO BE PROVIDED BY CIVIL CONTRACTOR.

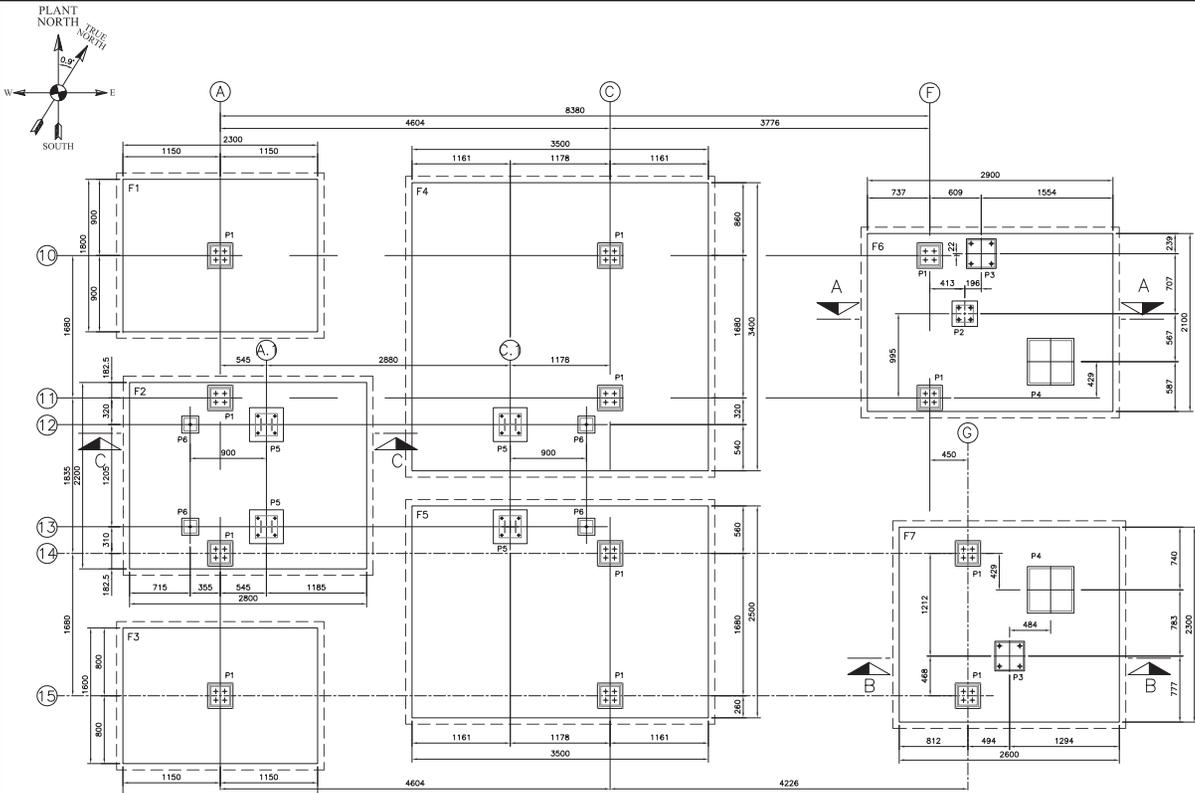
CS	23-08-2018	ISSUED FOR CONSTRUCTION	MSL	MESH	SAMA
REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHECKED	APPR.

CLIENT: OIL & GAS DEVELOPMENT COMPANY LTD.
0000L HOUSE TOWER, FIRST FLOOR REGD. BLUE AREA, JUBILEE AVENUE, ELANABAD, PUNE
 PAK-142 21 202303, PH:020-2705154, FAX:020-2705155

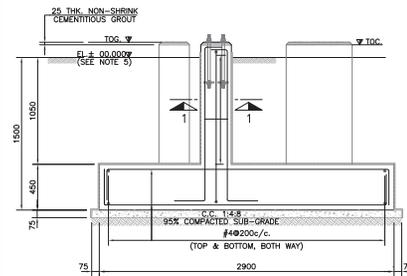
CONSULTANT: Zishan Engineers (Pvt.) Ltd.
An ISO 9001-2008 certified company
 4/F Block E, PWD, Kharadi, Pune
 Tel: (02-21) 34300448, 4342070554, Fax: (02-21) 34324510 & 34310166
 E-Mail: conrod@zishanengineers.com Website: www.zishanengineers.com

DWG. NO.	165-4-C-369
REV. C0	
JOB NO.	165-4
PROJECT :	KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE-II
TITLE :	FOUNDATION PLAN & DETAILS FOR SECONDARY AIR INTAKE STACK FOR SECONDARY AIR BLOWERS C-101 A/B
SIZE	A1
SCALE	AS SHOWN
SHEET	1 OF 1

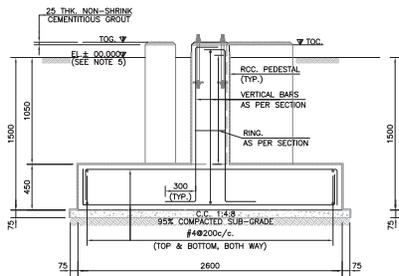
REFERENCE DRAWINGS	
DESCRIPTION	DWG. NO.
GENERAL PLOT PLAN	165-4-OPP-001
INLET STACK FOR SECONDARY AIR BLOWERS C-101 A/B	1033-04-DWG-00020 (12 TO 14)



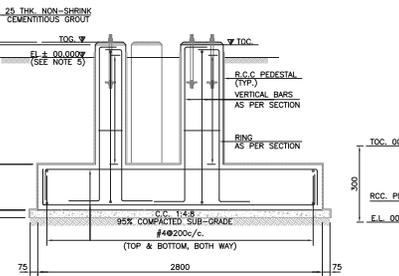
FOUNDATION LAYOUT PLAN
(SCALE = 1 : 30)



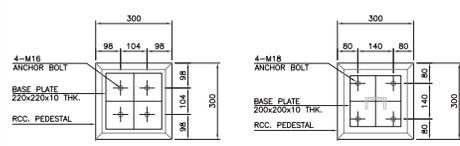
SECTION A-A
(SCALE = 1 : 25)



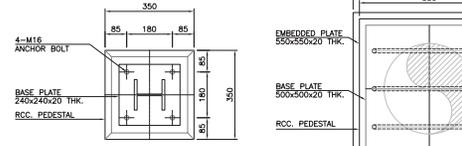
SECTION B-B
(SCALE = 1 : 25)



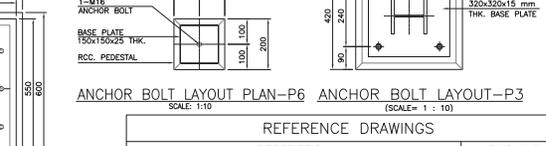
SECTION C-C
(SCALE = 1 : 25)



ANCHOR BOLT LAYOUT PLAN-P1
SCALE: 1:10



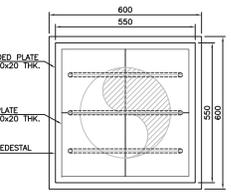
ANCHOR BOLT LAYOUT PLAN-P2
SCALE: 1:10



ANCHOR BOLT LAYOUT PLAN-P6
SCALE: 1:10



ANCHOR BOLT LAYOUT PLAN-P3
SCALE: 1:10



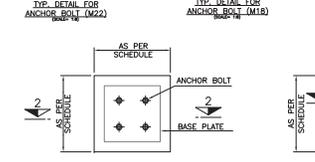
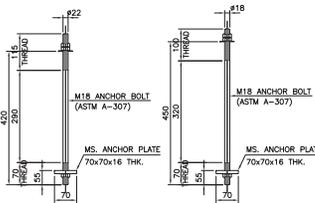
BASE PLATE LAYOUT PLAN-P4
SCALE: 1:10

SCHEDULE OF R.C.C. FOOTINGS

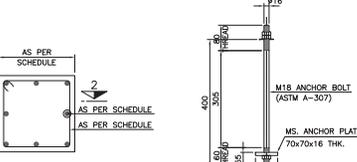
MARKS	FOOTING SIZE			FOOTING REINFORCEMENT				REMARKS.
	1:2:4 C.C. (A x B)		DEPTH (E)	BOTTOM REINFORCEMENT		TOP REINFORCEMENT		
	SHORT WAY	LONG WAY		SHORT WAY	LONG WAY	SHORT WAY	LONG WAY	
F1	2300x1800	2450x1950	450	#4@200/c	#4@200/c	-	-	SEE PLAN
F2	2800x2200	2950x2350	450	#4@200/c	#4@200/c	#4@200/c	#4@200/c	SEE PLAN
F3	2300x1600	2450x1750	450	#4@200/c	#4@200/c	-	-	SEE PLAN
F4	3500x3400	3650x3550	450	#4@200/c	#4@200/c	#4@200/c	#4@200/c	SEE PLAN
F5	3500x2500	3650x2650	450	#4@200/c	#4@200/c	#4@200/c	#4@200/c	SEE PLAN
F6	2900x2100	3050x2250	450	#4@200/c	#4@200/c	#4@200/c	#4@200/c	SEE PLAN
F7	2600x2300	2750x2450	450	#4@200/c	#4@200/c	#4@200/c	#4@200/c	SEE PLAN

SCHEDULE OF PEDESTAL

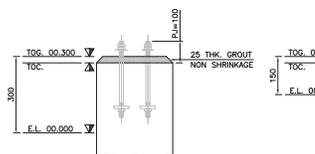
MARK	ABOVE PLINTH	VERTICAL BAR	RINGS
P1	300x300	4-#5	#3@200/c
P2	300x300	4-#5	#3@200/c
P3	420x420	8-#5	#3@200/c
P4	600x600	12-#5	#3@200/c
P5	350x350	4-#5	#3@200/c
P6	200x200	4-#5	#3@200/c



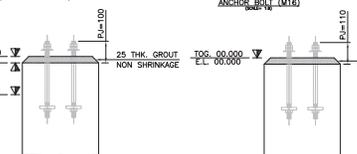
TYP. ANCHOR BOLT LAYOUT PLAN
SCALE: 1:10



SECTION 1-1
(SCALE = 1 : 10)



SECTION 2-2
(SCALE = 1 : 10)
(FOR P2, P3, & P5)



SECTION 2-2
(SCALE = 1 : 10)
(FOR P1)



SECTION 2-2
(SCALE = 1 : 10)
(FOR P6)

LEGENDS:-

- FGL FINISHED GROUND LEVEL.
- TOG TOP OF GROUT.
- TOC TOP OF CONCRETE.
- TYP. TYPICAL.
- THK. THICK.
- EL. ELEVATION.

NOTES:

- ALL DIMENSIONS ARE IN MILLIMETER (mm), LEVELS AND COORDINATES ARE IN METER (m) UNLESS OTHERWISE STATED.
- THIS DRAWING SHALL BE READ IN CONJUNCTION WITH DWG. NO. 165-4-CSTO-001 TO 004.
- ALL CONCRETE SURFACE EXPOSED TO EARTH TO BE COATED WITH 1200 MICRON THK. 10/20 GRADE BITUMEN AFTER COAT OF PRIMER OR ANY APPROVED EQUIVALENT FROM APPROVED VENDOR / SUPPLIER.
- ORIENTATION OF THE EQUIPMENT AND STARTING ANGLE OF EQUIPMENT W.R.T PLANT NORTH TO BE CONFIRMED FROM RELEVANT VENDOR DRAWING / PIPING GAUGS.
- FL ± 0.000 IS FINAL GROUND LEVEL.
- ANCHOR BOLTS TO BE PROVIDED BY CIVIL CONTRACTOR.

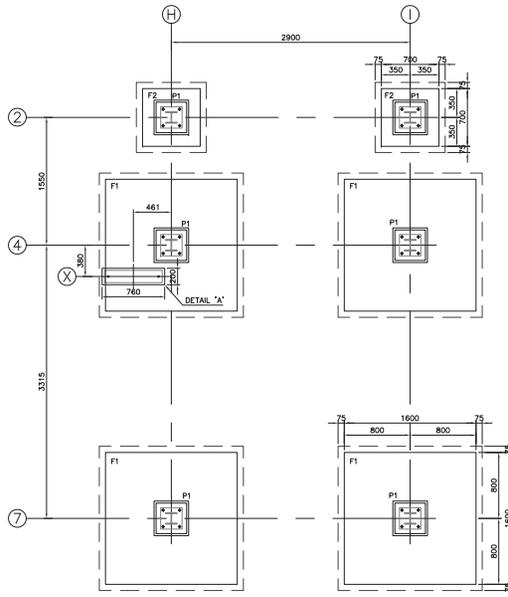
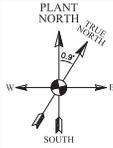


REFERENCE DRAWINGS		DWG. NO.
DESCRIPTION		
GENERAL PLOT PLAN		165-4-GPP-001
FOUNDATION LAYOUT & LOADS		1033-34-FND-00001 (1 OF 14)

NO.	DATE	ISSUED FOR CONSTRUCTION	MSL	MESH	SAMA
REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHECKED	APPR.

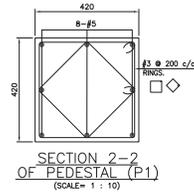
CLIENT: **OIL & GAS DEVELOPMENT COMPANY LTD.**
 CONSULTANT: **Zishan Engineers (Pvt.) Ltd.**
 An ISO 9001-2008 certified company
 DWG. NO. 165-4-C-370

PROJECT :	JOB NO.		
KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE-II	165-4		
TITLE :	SIZE	SCALE	SHEET
FOUNDATION PLAN & DETAILS FOR SKID 1, SKID 2 & SKID MAINTENANCE PLATFORM	A1	AS SHOWN	1 OF 1

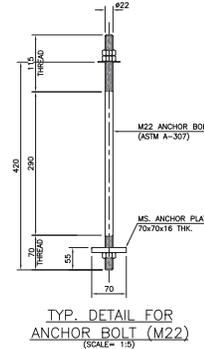


FOUNDATION LAYOUT PLAN FOR BURNER PLATFORM (SCALE = 1 : 30)

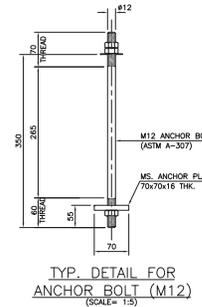
SCHEDULE OF R.C.C. FOOTINGS								
MARKS	FOOTING SIZE			FOOTING REINFORCEMENT				REMARKS.
	1:2:4 C.C. (A x B)	1:4:8 C.C. (C x D)	DEPTH (E)	BOTTOM REINFORCEMENT		TOP REINFORCEMENT		
				SHORT WAY	LONG WAY	SHORT WAY	LONG WAY	
F1	1600x1600	1750x1750	300	#4@200c/c	#4@200c/c	-	-	-
F2	700x700	850x850	300	#4@175c/c	#4@175c/c	-	-	-



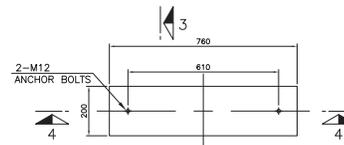
SECTION 2-2 OF PEDESTAL (P1) (SCALE = 1 : 10)



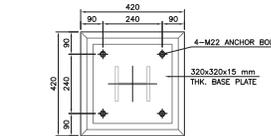
TYP. DETAIL FOR ANCHOR BOLT (M22) (SCALE = 1:5)



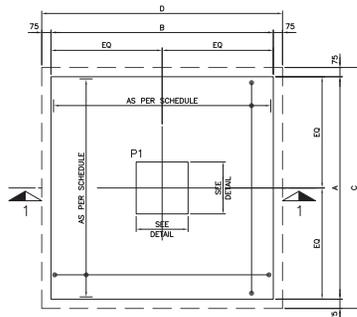
TYP. DETAIL FOR ANCHOR BOLT (M12) (SCALE = 1:5)



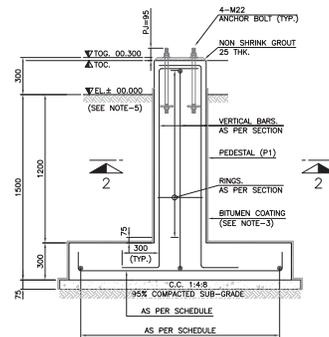
DETAIL 'A' (SCALE = 1 : 10)



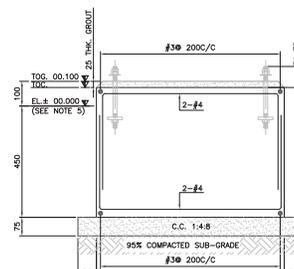
ANCHOR BOLT LAYOUT PLAN (SCALE = 1 : 10)



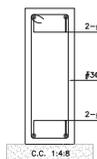
TYP. DETAIL OF R.C.C. FOOTING & COLUMN (SCALE = 1:20)



SECTION 1-1 (SCALE = 1:20)



SECTION 4-4 (SCALE = 1 : 10)



SECTION 3-3 (SCALE = 1 : 10)

ISSUED FOR CONSTRUCTION

LEGENDS:-

- FGL FINISHED GROUND LEVEL.
- T.O.G. TOP OF GROUT.
- T.O.C. TOP OF CONCRETE.
- TYP. TYPICAL.
- THK. THICK.
- EL. ELEVATION.

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETER (mm), LEVELS AND COORDINATES ARE IN METER (m) UNLESS OTHERWISE STATED.
2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH DWG. NO. 165-4-CST0-001 TO 004.
3. ALL CONCRETE SURFACE EXPOSED TO EARTH TO BE COATED WITH 1200 MICRON THK. 10/20 GRADE BITUMEN AFTER A COAT OF PRIMER OR ANY APPROVED EQUIVALENT FROM APPROVED VENDOR / SUPPLIER.
4. ORIENTATION OF THE PLATFORM W.R.T PLANT NORTH TO BE CONFIRMED FROM RELEVANT VENDOR DRAWING / PIPING GAES.
5. EL. ± 0.000 IS FINISHED GROUND LEVEL.
6. ANCHOR BOLTS TO BE PROVIDED BY CIVIL CONTRACTOR.

REFERENCE DRAWINGS	
DESCRIPTION	DWG. NO.
GENERAL PLOT PLAN	165-4-GPP-001
FOUNDATION LAYOUT & LOADS	1003-1-14-1111-03001 8 OF 14 REV. 02

REV.	DATE	ISSUED FOR CONSTRUCTION	MSL	MSH	SMV
		DESCRIPTION OF REVISION	DRAWN	CHECKED	APPR.
	22/08/2016				

CLIENT: **OIL & GAS DEVELOPMENT COMPANY LTD.**
OGDCL HOUSE TOWER #8, FIRST FLOOR FUGRO, BLUE AREA, JINNAH AVENUE ISLAMABAD PAKISTAN
 FAX: +92 91 2823033, PHONE: +92 91 2823059

CONSULTANT: **Zishan Engineers (Pvt.) Ltd.**
An ISO 9001-2008 certified company
 4/7F Block #, PESCO, Islamabad Pakistan
 Tel: (92-21) 3428245-49, 34210151-54 Fax: (92-21) 3423343& 34210159
 E-Mail: contact@zishanengineers.com Website: www.zishanengineers.com

PROJECT : **KPD-TAY ACID GAS INCINERATOR SYSTEM**

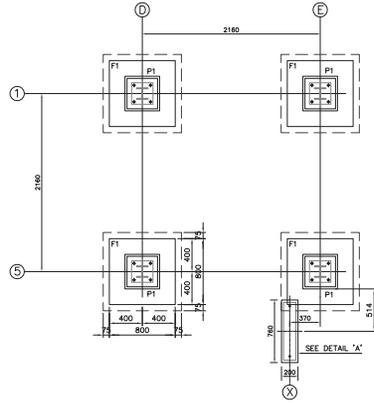
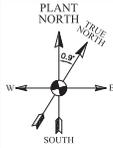
TITLE : **FOUNDATION PLAN & DETAILS FOR BURNER PLATFORM**

DWG. NO. **165-4-C-372**

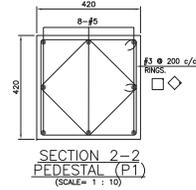
REV. **C0**

JOB NO. **165-4**

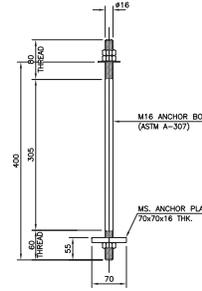
SIZE **A1** SCALE **AS SHOWN** SHEET **1 OF 1**



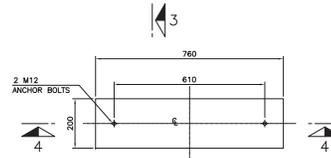
FOUNDATION LAYOUT PLAN FOR DAMPER PLATFORM
(SCALE = 1 : 30)



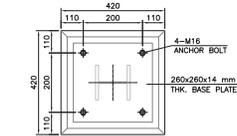
SECTION 2-2 PEDESTAL (P1)
(SCALE = 1 : 10)



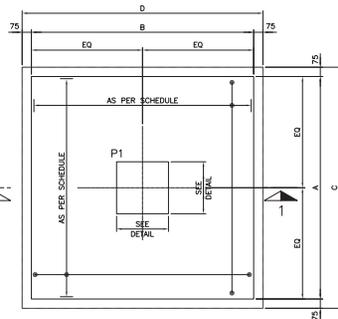
TYP. DETAIL FOR ANCHOR BOLT (M16)
(SCALE = 1 : 5)



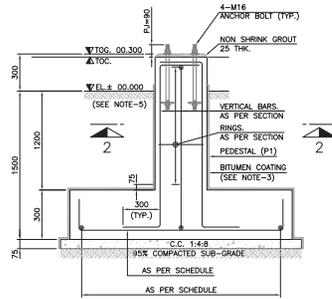
DETAIL 'A'
(SCALE = 1 : 10)



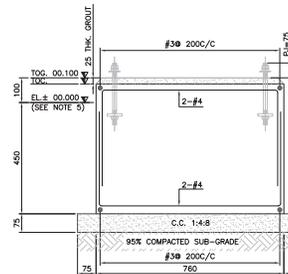
ANCHOR BOLT LAYOUT PLAN
(SCALE = 1 : 10)



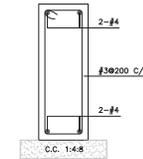
TYP. DETAIL OF R.C.C. FOOTING & COLUMN
(SCALE = 1:20)



SECTION 1-1
(SCALE = 1:20)



SECTION 4-4
(SCALE = 1 : 10)



SECTION 3-3
(SCALE = 1 : 10)

SCHEDULE OF R.C.C. FOOTINGS

MARKS	FOOTING SIZE			FOOTING REINFORCEMENT				REMARKS.
	1:2:4 C.C. (A x B)	1:4:8 C.C. (C x D)	DEPTH (E)	BOTTOM REINFORCEMENT		TOP REINFORCEMENT		
				SHORT WAY	LONG WAY	SHORT WAY	LONG WAY	
F1	800x800	950x950	300	#4@200c/c	#4@200c/c	-	-	-

ISSUED FOR CONSTRUCTION

LEGENDS:-

- FIGL FINISHED GROUND LEVEL.
- TOG TOP OF GROUT.
- TOC TOP OF CONCRETE.
- TYP. TYPICAL.
- THK. THICK.
- EL. ELEVATION.

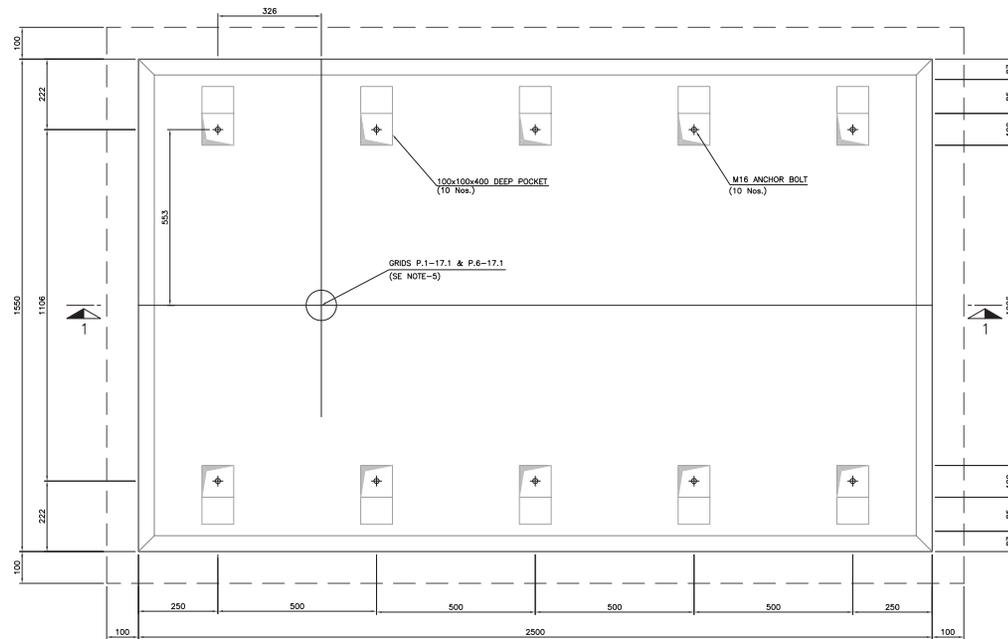
NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETER (mm). LEVELS AND COORDINATES ARE IN METER (m) UNLESS OTHERWISE STATED.
2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH DWG. NO. 165-4-CSTO-001 TO 004.
3. ALL CONCRETE SURFACE EXPOSED TO EARTH TO BE COATED WITH 1200 MICRON THK. 10/20 GRADE BITUMEN AFTER A COAT OF PRIMER OR ANY APPROVED EQUIVALENT FROM APPROVED VENDOR / SUPPLIER. VENDOR DRAWING / PILING CASES.
4. ORIENTATION OF THE PLATFORM W.R.T PLANT NORTH TO BE CONFIRMED FROM RELEVANT VENDOR DRAWING / PILING CASES.
5. EL ± 0.000 IS FINISHED GROUND LEVEL.
6. ANCHOR BOLTS TO BE PROVIDED BY CIVIL CONTRACTOR.

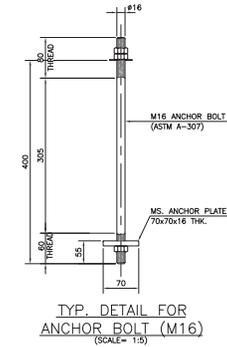
REFERENCE DRAWINGS

DESCRIPTION	DWG. NO.
GENERAL PLOT PLAN	165-4-OPP-001
FOUNDATION LAYOUT & LOADS	10033-04-DWG-00001 (6 OF 14) REV/02

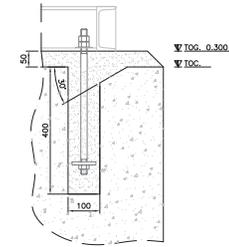
CD	22-08-2018	ISSUED FOR CONSTRUCTION	MSL	MSH	SMZ
REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHECKED	APPR.
CLIENT: OIL & GAS DEVELOPMENT COMPANY LTD. 00021 HOUSE TOWER/1st FLOOR/PRJG. BLUE AREA, JINNAH AVENUE ISLAMABAD PAKISTAN PAC-1#0-01#02001#PHONE-9504000900					
CONSULTANT: Zishan Engineers (Pvt.) Ltd. An ISO 9001:2008 certified company 47/F Block 6, PECHS, Karachi-Pakistan Tel: 021-2713430/4416 & 0301551-54 Fax: 021-7134334/3 & 34370155 E-Mail: contact@zishanengineers.com Website: www.zishanengineers.com		DWG. NO. 165-4-C-373 REV. C0			
PROJECT : KPD-TAY ACID GAS INCINERATOR SYSTEM		JOB NO. 165-4			
TITLE : FOUNDATION PLAN & DETAILS FOR DAMPER PLATFORM		SIZE: A1	SCALE: AS SHOWN	SHEET 1 OF 1	



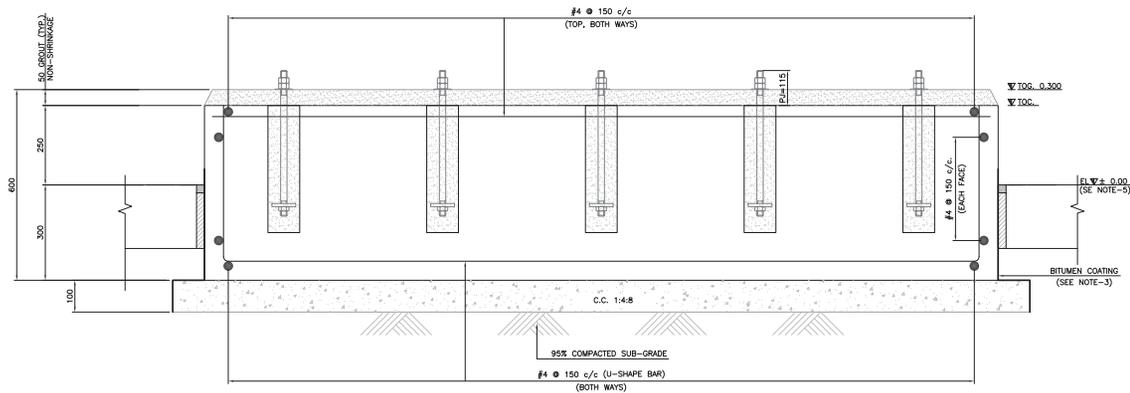
FOUNDATION LAYOUT PLAN FOR SECONDARY AIR BLOWERS (C-102 A/B)
(SCALE = 1 : 8)



TYP. DETAIL FOR ANCHOR BOLT (M16)
(SCALE = 1:10)



POCKET DETAIL
(SCALE = 1 : 8)



SECTION 1-1
(SCALE = 1 : 8)

ISSUED FOR CONSTRUCTION

LEGENDS:-

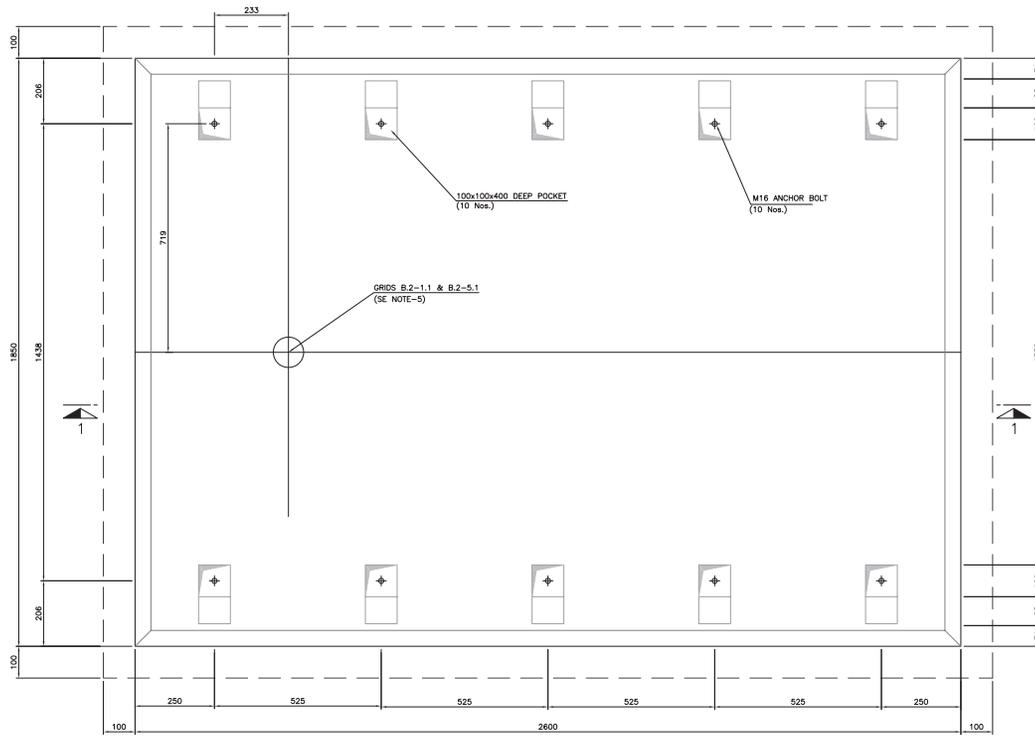
- FGL FINISHED GROUND LEVEL.
- TOG TOP OF GROUT.
- TOC TOP OF CONCRETE.
- TYP. TYPICAL.
- THK THICK.
- EL. ELEVATION.

NOTES:

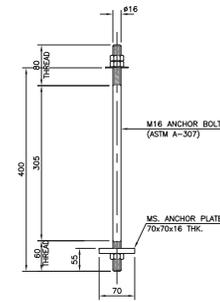
1. ALL DIMENSIONS ARE IN MILLIMETER (mm). LEVELS AND COORDINATES ARE IN METER (m) UNLESS OTHERWISE STATED.
2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH DWG. NO. 165-4-CST0-001 TO 004.
3. ALL CONCRETE SURFACE EXPOSED TO EARTH TO BE COATED WITH 1200 MICRON THK. 10/20 GRADE BITUMEN AFTER 01 COAT OF PRIMER OR ANY APPROVED EQUIVALENT FROM APPROVED VENDOR / SUPPLIER.
4. ORIENTATION OF THE EQUIPMENT W.R.T PLANT NORTH TO BE CONFIRMED FROM RELEVANT VENDOR DRAWING / PIPING GAUGS.
5. EL. ± 0.000 IS FINISHED GROUND LEVEL.
6. ANCHOR BOLTS TO BE PROVIDED BY CIVIL CONTRACTOR.

CO. 23-08-2016	ISSUED FOR CONSTRUCTION	MSL	MSH	SAMA
REV. DATE	DESCRIPTION OF REVISION	DRAWN	CHECKED	APPRO.
<p>CLIENT: OIL & GAS DEVELOPMENT COMPANY LTD. <small>OTDC, HOUSE TOWER, FIRST FLOOR FSG, BLUE AREA, JFRAH AVENUE, ELMAARAD, PAKISTAN FAX: +92 31 3623033, PHONE: +92 31 3623033</small></p>				
<p>CONSULTANT: Zishan Engineers (Pvt.) Ltd. <small>An ISO 9001-2008 certified company 4/F Block B, PECHS, Khasmeh Pakistan Tel: (92-21) 3432040-43, 3432101-04, Fax: (92-21) 3432340 & 34310156 E-Mail: contact@zishanengineers.com Website: www.zishanengineers.com</small></p>		<p>DWG. NO. 165-4-C-376 REV. C0</p>		
<p>PROJECT : KP-D-TAY INTEGRATED DEVELOPMENT PROJECT PHASE-II</p>		<p>JOB NO. 165-4</p>		
<p>TITLE : FOUNDATION PLAN & DETAILS FOR SECONDARY AIR BLOWERS (C-102 A/B)</p>		SIZE	SCALE	SHEET
		A1	AS SHOWN	1 OF 1

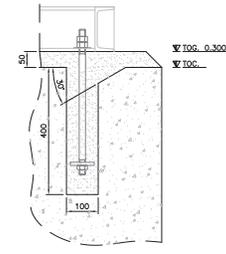
REFERENCE DRAWINGS	
DESCRIPTION	DWG. NO.
GENERAL PLOT PLAN	165-4-GPP-001
FOUNDATION LAYOUT & LOADS	1033-04-DWG-00220 (12 OF 14), REV-02



FOUNDATION LAYOUT PLAN
FOR COMBUSTION AIR BLOWERS (C-101A/B)
(SCALE = 1 : 8)

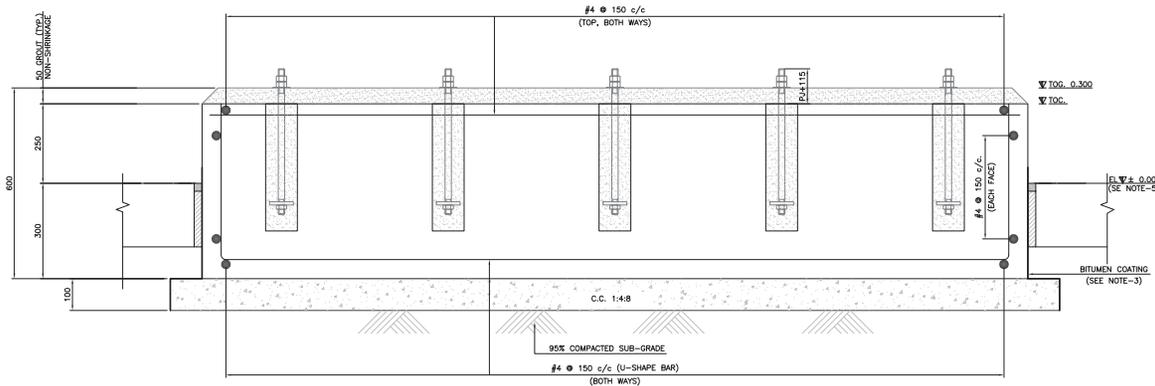


TYP. DETAIL FOR
ANCHOR BOLT (M16)
(SCALE = 1:5)



POCKET DETAIL
(SCALE = 1 : 8)

ISSUED FOR
CONSTRUCTION



SECTION 1-1
(SCALE = 1 : 8)

LEGENDS:-

- FGL FINISHED GROUND LEVEL.
- TOG TOP OF GROUT.
- TOC TOP OF CONCRETE.
- TYP. TYPICAL.
- THK. THICK.
- EL. ELEVATION.

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETER (MM), LEVELS AND COORDINATES ARE IN METER (M) UNLESS OTHERWISE STATED.
2. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH DWG. NO. 165-4-CSTD-001 TO 004.
3. ALL CONCRETE SURFACE EXPOSED TO EARTH TO BE COATED WITH 1200 MICRON THK. 15/20 GRADE BITUMEN AFTER OI COAT OF PRIMER OR ANY APPROVED EQUIVALENT FROM APPROVED VENDOR / SUPPLIER.
4. ORIENTATION OF THE EQUIPMENT W.R.T PLANT NORTH TO BE CONFIRMED FROM RELEVANT VENDOR DRAWING / PIPING AIDS.
5. EL±0.00 IS FINISHED GROUND LEVEL.
6. ANCHOR BOLTS TO BE PROVIDED BY CIVIL CONTRACTOR.

CS	ISSUED FOR CONSTRUCTION	MSL	MSH	SAMA
REV.	DATE	DESCRIPTION OF REVISION	DRAWN	CHECKED
CLIENT:				
OIL & GAS DEVELOPMENT COMPANY LTD. <small>OOZUL HOUSE THUNDERBOLT WEST FLOOR REGD. BLUE AREA- JHUPH AVENUE DELHANSAD PAKISTAN PAK: +92 31 3232653. PHONE: +92 31 4212959</small>				
CONSULTANT:				
Zishan Engineers (Pvt.) Ltd. <small>An ISO 9001-2008 certified company 4/F Block 6, FESCO, Karachi Pakistan Tel: (92-21) 34303454, 34307554; Fax: (92-21) 3433439, 34319156 E-Mail: contact@zishanengineers.com Website: www.zishanengineers.com</small>				
			DWG. NO. 165-4-C-377	
			REV. C0	

REFERENCE DRAWINGS	
DESCRIPTION	DWG. NO.
GENERAL PLOT PLAN	165-4-0PP-001
FOUNDATION LAYOUT & LOADS	1033-04-DWG-00220 (11 OF 14), REV-02

PROJECT :	KPD-TAY INTEGRATED DEVELOPMENT PROJECT PHASE-II
TITLE :	FOUNDATION PLAN & DETAILS FOR COMBUSTION AIR BLOWERS (C-101 A/B)
JOB NO. 165-4	
SIZE SCALE SHEET A1 AS SHOWN 1 OF 1	

