طرح نگهداشت و افزایش تولید 27 مخزن

Specification For Pressure Vessels

نگهداشت و افزایش تولید میدان نفتی بینک

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IFC: Issued For Comment
IFA: Issued For Approval
AFD: Approved For Design
AFC: Approved For Construction
AFP: Approved For Purchase
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IFI: Issued For Information
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REVISION RECORD SHEET

PAGE	D00	D01	D02	D03	D04
1	X	X			
2	X	X			
3	X	X			
4	X	X			
5	X	X			
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12	X	X			
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38					
39					
40					
41					
42					
43					
44					
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46					
47					
48					
49					
50					
51					
52					
53					
54					
55					
56					
57					
58					
59					
60					
61					
62					
63					
64					
65					

PAGE	D00	D01	D02	D03	D04
66					
67					
68					
69					
70					
71					
72					
73					
74					
75					
76					
77					
78					
79					
80					
81					
82					
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84					
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107					
108					
109					
110					
111					
112					
113					
114					
115					
116					
117					
118					
119					
120					
121					
122					
123					
124					
125					
126					
127					
128					
129					
130					

CONTENTS

1.0 INTRODUCTION

Binak oilfield in Bushehr province, a part of the southern oilfields of Iran, is located 20 km northwest of Genaveh city.

With the aim of increasing production of oil from Binak oilfield, an EPC/EPD Project has been defined by NIOC/NISOC and awarded to Petro Iran Development Company (PEDCO). Also PEDCO (as General Contractor) has assigned the EPC-packages of the Project to "Hirgan Energy - Design and Inspection" JV.

GENERAL DEFINITION

The following terms shall be used in this document.

CLIENT: (D01)	National Iranian South Oilfields Company (NISOC)
PROJECT:	Binak Oilfield Development – General Facilities
GENERAL CONTRACTOR (GC):	Petro Iran Development Company (PEDCO)
EPC CONTRACTOR:	Joint Venture of : Hirgan Energy – Design & Inspection(D&I) Companies
VENDOR:	The firm or person who will fabricate the equipment or material.
EXECUTOR:	Executor is the party which carries out all or part of construction and/or commissioning for the project.
THIRD PARTY INSPECTOR (TPI):	The firm appointed by EPC CONTRACTOR and approved by GC & CLIENT (in writing) for the inspection of goods.
SHALL: (D01)	Is used where a provision is mandatory.
SHOULD:	Is used where a provision is advisory only.
WILL: (D01)	Is normally used in connection with the action by CLIENT rather than by an EPC/EPD CONTRACTOR, supplier or VENDOR.
MAY:	Is used where a provision is completely discretionary.

2.0 SCOPE

This specification outlines the general requirements for the designing, material supply, fabrication and test of Pressure Vessels and it is intended to supplement the Iranian Petroleum Standard IPS-G-ME-150, “General Standard for Towers, Reactors, Pressure Vessels and Internals” 2nd Revision, Jul.

D01 2019. However, Generally Pressure Vessels should meet requirements of ASME code “Unfired Pressure Vessel, Sec. VIII, Div.1 2019”

The following paragraphs specifying the modifications follow the IPS-G-ME-150 numbers and each paragraph denotes an addition, modification, substitution or deletion:

D01
- Sub. (Substitution):

The clause in IPS-G-ME-150(2) shall be deleted and replaced by the new clause in this specification.

D01
- Del. (Deletion):

The clause in IPS-G-ME-150(2) shall be deleted without any replacement.

- Add. (Addition):

The clause in this specification shall be added to IPS-G-ME-150(2) with a new number.

D01
- Mod. (Modification):

The clause in IPS-G-ME-150(2) shall be modified and / or a new description and/or condition shall be added to that clause.

3.0 NORMATIVE REFERENCES

D01 If not mentioned, Latest revision of standards should be used.

3.1 LOCAL CODES AND STANDARDS

• IPS-M-PI-150	Material and Equipment Standard for Flanges & Fittings
• IPS-E-TP-350	Engineering Standard for Linings
• IPS-E-CE-120	Engineering Standard Foundations
• IPS-E-CE-500	Engineering Standard for Loads
• IPS-E-TP-700	Engineering Standard for Thermal Insulation
• NIOEC-SP-41-03	NIOEC Specification for Pressure Vessels
• IPS-E-TP-740	Engineering Standard for General Standard for Packing and Packages
• IPS-E-TP-100	Engineering Standard for Paint
• IPS-E-GN-100	Engineering Standard for Units
• IPS-D-ME-010	Drawing Standard for Vertical Vessel Support Skirt Opening Details
• IPS-D-ME-002	Drawing Standard for Lifting Lug to Lift Vessels Up to 60 Tons
• IPS-D-ME-003	Drawing Standard for Lifting Lug to Lift Vessels Up to 200 Tons
• IPS-D-EL-413	Reference Drawing Grounding Installation Details Earthing Lug Category 400
• IPS-E-EL-100	Engineering Standard for Electrical System Design

D01

- IPS-G-GN-210 General Standard for Packing and Packages

3.2 INTERNATIONAL CODES AND STANDARDS (MODIFICATION ON IPS CLAUSE 2)

(Following standards shall be added to references list)

- ASME American Society of Mechanical Engineers
  - ASME Section II Material Specification
  - ASME Section VIII, Div. 1 Boiler And Pressure Vessel Code
  - ASME Section VIII, Div. 2 Pressure Vessels Alternative Rules
  - ASME Section V Non-Destructive Examination
  - ASME Section IX Welding and Brazing Qualifications
  - ASME SA-370 Standard Test Methods and Definitions for Mechanical Testing of Steel Products
  - B16.9 Steel Butt Welding Fittings
  - B16.11 Forged Steel Fittings, Socket Welding and Threaded
  - B16.20 Metallic Gaskets for Pipe Flanges: Ring-Joint, Spiral-Wound, and Jacketed
  - B16.21 Non- Metallic Gaskets For Pipe Flanges
  - B16.25 Butt Welding Ends
  - B 1.1 Unified Inch Screw Threads (UN and UNR Thread Form)
  - B 16.5 Pipe Flanges and Flanged Fittings
  - B 16.47 Flanges Larger Than DN600
  - B 18.2.2 Square and Hex Nuts
- ASTM American Society For Testing And Materials
  - ASTM A578 Standard Specification for Straight-Beam Ultrasonic Examination of Rolled Steel Plates for Special Applications
- ASCE American Society Of Civil Engineers
  - ASCE 7-10 American Society of Civil Engineers 7-10
- AWS American Welding Society
- EJMA Expansion Joint Manufacturers Association, Inc.
- ISO International Organization for Standardization
  - ISO 9001 Quality Management Systems - Requirements
- Welding Research Council (WRC)
  - 107 Local Stresses in Spherical & Cylindrical Shells Due to External Loading

- ➢ 297 — Local Stresses in Cylindrical Shells Due to External Loadings on Nozzles–Supplement to WRC Bulletin No. 107

- BS PD 5500, APP. G — British Standard; Specification for Unfired Fusion Welded Pressure Vessels (Recommendations for the Design of Local Loads, Thermal Gradients, etc.)
- NACE/ISO — National Association Of Corrosion Engineers
  - ➢ NACE MR0175/ISO 15156 — Petroleum and Natural Gas Industries Materials for Use in H2S-Containing Environments in Oil and Gas Production
  - ➢ RP0472 — Methods and Controls to Prevent In-Service Environmental Cracking of Carbon Steel Weldments in Corrosive Petroleum Refining Environments
  - ➢ NACE TM0177 — Standard Test Method – Laboratory Testing of Metals for Resistance to Sulfide Stress Cracking and Stress Corrosion Cracking in H2S Environments
- API — American Petroleum Institute
  - ➢ API 601 — Metallic Gaskets for Raised Face Pipe Flanges and Flanged Connections (Double Jacketed Corrugated and Spiral-Wound)
  - ➢ API Publ. 941 — Steel for Hydrogen Service at Elevated Temperatures and Pressures in Petroleum Refineries and Petrochemical Plants

3.3 THE PROJECT DOCUMENTS

- BK-00-HD-000-PR-DB-0002 — Process Basis of Design
- BK-00-HD-000-ME-DC-0001 — Mechanical Design Criteria
- BK-00-HD-000-ST-DC-0001 — Structural Design Criteria
- BK-00-HD-000-PI-SP-0006 — Specification For Painting
- BK-00-HD-000-PI-SP-0007 — Specification for Lining (Internal Protection of Equipment by Painting)
- BK-00-HD-000-PI-SP-0008 — Specification for Material Requirements in Sour service
- BK-00-HD-000-PI-SP-0011 — Specification For Welding of Plant Piping System
- BK-00-HD-000-ME-DW-0001 — Standard Detail Drawing For Pressure Vessels and Heat Exchangers
- BK-GNRAL-PEDCO-000-EL-DC-0001 — Electrical System Design Criteria
- BK-GNRAL-PEDCO-000-EL-DW-0002 — Typical Installation Details & Notes For Earthing and Lightning Protection System

- Piping and Instrumentation Diagrams

3.4 ENVIRONMENTAL DATA

Refer to "Process Basis of Design, Doc. No. BK-00-HD-000-PR-DB-0002".

3.5 ORDER OF PRECEDENCE

D01

In case of any conflict between the contents of this document or any discrepancy between this document and other project documents or reference standards, this issue must be reported to the CLIENT. The final decision in this situation will be made by CLIENT

4.0 UNITS (MODIFICATION ON IPS CLAUSE 4)

International System of Units (SI Units) shall be used for all documents. However, there are recognized exceptions for Pressure Unit (bar) and Nominal Pipe Size (inch).

5.0 DOCUMENTATION REQUIREMENTS (IPS CLAUSE 6)

5.1 ADDITION TO IPS CLAUSE 6.1

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6.1.6 The vendor shall perform a complete Calculation book, in accordance with the ASME VIII, Div. 1 and other design codes and send to purchaser for approval. Calculation report shall include checking strength of all parts of the vessel, whether under pressure or not. Comply with codes requirement, the vendor shall check and guarantee stability under all possible load conditions including wind, earthquake, concentrated loads, transport and lifting, etc. during operation.

5.2 MODIFICATION ON IPS CLAUSE 6.2

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6.2. j Commissioning & start-up and two-year normal operation spare parts shall be considered per attachment 11 of the project EPC tender dossier, as a minimum requirement.

6.0 MATERIAL (IPS CLAUSE 7.1)

6.1 MODIFICATION ON IPS CLAUSE 7.1.1

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7.1.1.1 All material used in the fabrication shall be new and have a minimum quality as specified in the requisition and shall be in accordance with ASME Sec.II Part D specifications and standard.

7.1.1.3 All components, including internals and non-pressure parts, shall be identified by appropriate ASME/ASTM designations.

6.2 MODIFICATION ON IPS CLAUSE 7.1.2

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7.1.2.1 Structural quality steel shall not be used for pressure retaining parts.

7.1.2.3 Pressure retaining materials for H2S services, shall observe clause 7.1.7 conditions.

6.3 ADDITION TO IPS CLAUSE 7.1.6

D01

Materials of construction for equipment operating in sour service shall comply with NACE MR0175/ISO 15156, ASME Section VIII division 1 part UCL, this requirement applies to the pressure containing material and to any corrosion resistant alloy applied by weld metal overlay.
All low alloy and carbon steel plate, welded pipe and fittings in sour service shall be subject to HIC testing in accordance with NACE TM0284 and shall meet the requirements of clause 6.7 below.
The test method Sulphide Stress Cracking (SSC) for metals resistance to H2S environments shall be Four-Point Bending Test and the relevant details of such test shall be in accordance with NACE TM0177 and ISO 15156-2 Appendix B.

D01

7.1.6.1 Plate

The steel shall be vacuum degassed, deoxidized, desulphurised and dephosphorised. Plate shall be supplied in the normalized condition and with material certifications. Repair of defects by welding is not permitted.
Ultrasonic tests shall be performed according to ASTM A 578 level B.
Plates of thickness 15 mm and greater shall have through-thickness tension tests per ASTM A770 to determine reduction of area. Minimum reduction of area shall not be less than 35%.

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7.1.6.2 Welded Pipe

Seamless pipe is preferred; however, welded pipe may be used and shall be manufactured from plate with full material certificates and shall be subject to agreement by the CLIENT.

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6.4 ADDITION TO IPS CLAUSE 7.1.7

D01

7.1.7.1 Plate

All pressure retaining carbon steel plate in contact with the process media shall be HIC-tested in accordance with this section. Plate shall be tested after a simulated PWHT to the same standard of PWHT as that to which it will be subjected in the final vessel.

D01

7.1.7.2 Manufacturing Process

The manufacturing/ rolling process shall be such that a homogeneous microstructure is obtained, i.e. the structure shall be free of any significant ferrite/ pearlite banding.
Calcium treatment shall be applied for inclusion shape control except that it need not be applied to plate with sulphur levels lower than 0.001%. The calcium content should not exceed 3 times the sulphur content.
Alternative methods of inclusion shape control may be proposed for approval.

D01

7.1.7.3 Chemical Composition

Chemical composition (product analysis) shall be restricted as follows unless the standard material specification is more stringent.

Element	Maximum wt.%
Carbon	0.22
Manganese	1.55
Sulphur	0.003
Phosphorus	0.015
Silicon	0.40
Aluminium	0.02-0.06% (Note 1)
Copper	0.30
Nickel	0.50
Chromium	0.30
Molybdenum	0.08
Vanadium	0.08 (Note 2)
Niobium	0.05 (Note 2)
Titanium	0.03 (Note 2)
Nitrogen	0.012
Boron	0.0005 (Note 2)
Element combinations	
%Cr + %Mo + %Ni + %Cu	0.8
%V + %Nb	0.10

Notes:

1. Al% ≥ 2 x Ni%
2. Boron, Titanium, Niobium and Vanadium shall not be intentionally added to the steel.

D01

7.1.7.4 Hardness

Maximum hardness of weld/ HAZ/ parent plate shall not exceed 248 HV10 measured by the Vickers method. Where existing Welding Procedure Qualification Records do not show adequate results from a hardness traverse of a macro section then this test shall be repeated using contract material.

D01

7.1.7.5 HIC Testing

HIC testing shall be carried out in accordance with NACE TM0284 using solution A. Test rate shall be per heat and from the thickest and thinnest plate from that heat. Also Seamless pipes and forgings need the HIC/SSC test. In addition SSC testing shall be carried out in accordance with NACE TM0177 at the same test rate.

The acceptance criteria shall be as follows based on the average of 3 sections from each specimen:

CLR (Crack Lengthy Ratio)	**15% max**
CSR (Crack Sensitivity Ratio)	**1.5% max**
CTR (Crack Thickness Ratio)	**5 % max**

D01

6.5 ADDITION TO IPS CLAUSE7.1.8 (MATERIAL CRITERIA FOR SOUR SERVICE)

In sour environment vendor shall provide the material certificates which include the items as mentioned in 7.1.6 & 7.1.7 of this document, and attach the required sour service laboratory reports.

7.0 DESIGN (IPS CLAUSE 7.2)

7.1 SUBSTITUTION TO ARTICLE 7.2.1

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7.2.1.4 Vendor is responsible for preparing all detailed designs and drawings. These documents shall be submitted to Purchaser for approval.

7.2 ADDITION TO IPS ARTICLE 7.2.2.1

7.2.2.1.4 Multi- compartment equipment (i.e. jacketed vessels, vessels with coil etc.) with different or equal operating pressures shall be designed each for the maximum possible pressure difference.

7.3 MODIFICATION ON IPS CLAUSE 7.2.2.1

D01

7.2.2.1.1 The design pressure of vessel shall be the greater of followings:

1) The specified design pressure on process data sheet
2) Equal to the maximum operating pressure plus 10 percent or plus 350 kPa, whichever is greater.

Hydrostatic head (equivalent pressure) shall be added to the design pressure shown on the data sheets for all required calculations.

Vessel parts subject to different internal pressure on both sides shall be designed to withstand the most severe combination of the pressure.

D01

7.2.2.1.3 ‘Maximum allowable working pressure (MAWP)’, ‘design pressure’ and ‘design pressure + liquid content static head’ shall be stamped on the name plates as per design code.

The design pressure and maximum allowable working pressure of a vessel shall not be limited by minor components such as flanges, nozzles, manholes, or reinforcing pads.

In addition to mentioned required items following phrases shall be stamped on the name plate:

- Lethal / Non-Lethal Service
- Sour / Non-Sour Service
- 'NACE MR-0175' Requirement

Also maximum allowable pressure for cold and new condition (MAP cold/new), at an un-corroded wall thickness of the vessel shall be determined and hydro-test pressure shall be based on (MAP cold/new). Stress during hydro test shall not exceed 90% of minimum yield strength of the material.

7.4 MODIFICATION ON IPS ARTICLE 7.2.2.2

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7.2.2.2.3 Maximum allowable design temperature and minimum design metal temperature shall be shown on the vessel's nameplate.

7.5 SUBSTITUTION TO IPS ARTICLE 7.2.2.2

D01

7.2.2.2.1 The maximum design temperature and the minimum design metal temperature (MDMT) shall be as per the project "Process Design Criteria, Doc. No. BK-00-HD-000-PR-DC-0001"

7.2.2.2.2 The maximum design temperature for vessels which will operate at temperature above 400°C shall be as per the project "Process Design Criteria, Doc. No. BK-00-HD-000-PR-DC-0001"

7.6 SUBSTITUTION ON IPS ARTICLE 7.2.2.3

D01

7.2.2.3.2 All equipment and relative structural support shall be designed to withstand:

a) Internal/External pressure

b) Dead load of the equipment including all internal and external attachments supported thereon and causing forces and bending moments

c) The weight of vessel content in operation, hydrotest and empty case

d) 150 Kg/m^2 Live load on platforms

e) Wind load for equipment exposed to the wind

f) Earthquake loads

g) Any cycling loading the number of cycle is to be stated on the data sheets

h) Forces resulting from thermal expansions and shutdown and startup loads

i) Local Loads

j) Transportation and Erection Loads

k) Relating Piping System Loads

D01

7.2.2.3.6 For vertical vessels, the maximum lateral deflection in the corroded condition at the top tangent line shall not exceed 1/200th of the vessel's height under any load.

7.7 ADDITION TO IPS ARTICLE 7.2.2.3

7.2.2.3.9 Local loading: For Nozzles directly connected to process piping, and also for anywhere imposed any local loads and/or moments, which will cause high local stresses in a part of pressure containing envelope, the subject components shall be investigated to WRC 107 and 297 or any other method for local stress calculation approved by owner. The piping load applied on vessel nozzles, which shall be used in WRC calculation, shall not be less than specified in "Appendix N".

D01

7.2.2.3.10 For large, thin vessels, supplier shall make a design check and, if necessary provide additional stiffening to prevent shell distortion during fabrication, heat treatment, hydro testing, shipment or erection.

7.2.2.3.11 Vessels with saddle supports shall be designed to prevent deformation under all load conditions. The design of saddles shall be in accordance with the revised L.P. Zick analysis as noted in ASME Pressure Vessel and Piping: Design and Analysis/A Decade of Progress, Volume Two, 1982.

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7.2.2.3.12 Loaded attachments to a vessel wall (e.g., clips, legs and support brackets), shall have reinforcement pads welded in between the attachment and the vessel wall.

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7.8 DELETED

D01

7.9 ADDITION TO IPS ARTICLE 7.2.2.12

7.2.2.12.1 For non-pressure parts the permissible design stresses shall be the least of the following values at design metal temperature:

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a) One third of minimum ultimate tensile strength.

b) Two thirds of minimum yield strength.

c) That stress producing a creep rate of 1% in 10,000 hours.

D01

7.2.2.12.2 The stresses determined from the ASME code shall also apply to the supporting skirt of the vessel.

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7.2.2.12.3 Allowable stress for anchor bolts (based on ASME SA 307 Grade B material) shall be as

follows:

- 240 MPa (tension)
- 120 MPa (shear)

D01 Bolt circle templates shall be supplied by VENDOR for all skirt-supported equipment. Allowable bearing stress for concrete foundations under equipment support base plates, shall not exceed 6.9 MPa. This value is based on a minimum compressive strength for concrete of 20.7 MPa.

D01 **7.2.2.12.4** Whenever two different allowable stress values are listed in ASME Section II, Part D for a material, the lower value shall be used.

7.10 MODIFICATION ON IPS ARTICLE 7.2.2.4

D01 **7.2.2.4.2** The minimum corrosion allowance for carbon steel shall be 1.6 mm for sweet service and 3.2 mm for sour service or shall be based on project “corrosion study & material selection report”, Doc. No. “BK-PPL-PEDCO-320-PI-RT-0001 “ whichever is the greater

7.11 ADDITION TO IPS ARTICLE 7.2.2.4

D01 **7.2.2.4.6** On fillet and seal welds on internal attachments, the full corrosion allowance shall be added to the thickness necessary for strength or tightness, measured across the throat (maximum 10 mm throat).

7.12 SUBSTITUTION ON IPS ARTICLE 7.2.2.5

D01 **7.2.2.5.10** Connections of DN 50 (2in) and smaller, shall made from clad material (e.g. fully S.S. 316L instead of S.S. 316L as a cladding part) if its mechanical properties can satisfy previous material missions.

7.13 MODIFICATION ON IPS ARTICLE 7.2.2.6

D01 **7.2.2.6.1** The minimum shell thickness for vessels shall be confirmed by purchaser.

D01 **7.2.2.6.2** ASME ellipsoidal or hemispherical heads with 2 to 1 ratio shall be provided for design pressures exceeding 700 kPa (ga). ASME flanged and torispherical heads are not acceptable.

7.14 ADDITION TO IPS ARTICLE 7.2.2.6

D01 **7.2.2.6.5** The inside diameter of shells and heads shall be matched as closely as possible at the weld seams. Generally, when a difference in thickness exist between shell and head plates, the inside diameter shall be maintained. The minimum allowable offset between shell and adjacent head sections shall not exceed the code limit.

D01

7.2.2.6.6 All ellipsoidal, semi-ellipsoidal and or torispherical heads shall have a straight cylindrical section whose length shall not be less than 0.015D+S (where D is the outside diameter of the vessel and S is the minimum thickness of head in mm) and shall not be less than 50 mm and not more than 100 mm (except when otherwise specified by the reference code). Deleted

7.15 MODIFICATION ON IPS ARTICLE 7.2.2.7

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D01

7.2.2.7.1 All nozzles < 1½", shall be reinforced by 2 stiffeners of minimum 30x4mm. The arrangement shall be 90° apart to each other.

7.2.2.7.3 Reinforcing pad welds, at the junction of nozzle to shell, shall be full penetration, unless written approval is obtained to deviate from this statement.

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7.2.2.7.8 Nozzle necks DN 25 shall be constructed of schedule 160 pipe, as a minimum. Nozzle necks DN 40 to DN 200 pipe size shall be a minimum of schedule 80 seamless pipe. Larger nozzle necks shall be a minimum 12.7 mm.

D01

7.2.2.7.13 Vessel flanges shall be forged, rolled or pressed. Flanges made of plate or welded together from several parts may be used only upon approval by purchaser and upon detailed indication of the manufacturing and testing methods to be adopted.

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7.2.2.7.14 Welding neck flanges shall be used where the pressure-temperature design conditions require an ASME class 300 or greater flange. Nozzles for pressure, temperature and level measurement shall be 300# as minimum.

D01

Deleted

7.2.2.7.16 All vessels shall be provided with at least two manholes in opposite direction for full reach and air recirculation (when vent nozzle is not used), unless otherwise specified in the project data sheets. The minimum size of manholes shall be 20 inch with davit and handle.

Manholes providing access for removal of equipment shall not be less than 600 mm (24”) in diameter.

Manhole and hand-hole covers shall be provided with handles. The following parts shall be provided they have to be designed according to the relevant standard drawings:

- Davits for manhole covers for not-insulated and heat-insulated vessels.
- Hinges for cold-insulated vessels.
- Handles above the opening inside the vessel.
- Safety rungs below the opening inside the vessel.

The inside edge of manholes shall be smooth. The inside flange and pipe edges shall be rounded with a minimum 3 mm radius.

D01 **7.2.2.7.21** Threaded connections, if specified, shall be 6000 class ASTM A 105 forged steel couplings.

7.16 ADDITION TO IPS ARTICLE 7.2.2.7

D01 **7.2.2.7.24** All nozzles, connections and manways shall be set flush with the inside of the shell/head where they are attached, unless otherwise specified on the Vessel Data Sheet.

7.2.2.7.25 The thickness of reinforcement pads shall not exceed the thickness of the vessel's wall.

7.17 MODIFICATION ON IPS ARTICLE 7.2.2.8

D01 **7.2.2.8.6** Vortex breakers shall be provided on liquid bottom outlet nozzles from vessels as follows:

D01 a) Pump suction connection.

b) Vessels where two phases may be present.

7.18 MODIFICATION ON IPS ARTICLE 7.2.2.9

D01 **7.2.2.9.2** Wind and seismic loads shall not be assumed to occur simultaneously. Vertical vessels shall normally be supported on skirts or lugs. Vessels may be supported on structural steel or steel pipe legs, when 1000 mm I. D. and smaller provided no anticipated vibration, or when specified by Licenser.

D01 **7.2.2.9.4** The minimum corrosion allowance for anchor bolts shall be considered as 1.6 mm. The stress induced by the anchorage system in skirt supporting vessel shall be checked as per Brownell and Young Method too.

7.19 ADDITION TO IPS ARTICLE 7.2.2.9.2

D01 **7.2.2.9.2.1** Skirts supporting columns or vertical cylindrical vessels shall be welded directly to bottom head without intermediate sleeve or ring by continuous full penetration welds. Welded joints in the skirt shall be double or single welded butt joints. Connections between skirts and vessel head shall be made with a smooth flat-faced weld. The width of weld shall be at least equal to the skirt thickness and its height shall be twice its width. Mid surface of the skirt shell shall be in the same line as mid surface of the vessel shell. For conical skirts the cone angle (half-apex) should not be taken more than 30 degrees.

D01 **7.2.2.9.2.2** For skirt supported alloy vessels, at least the top 450 mm of skirt material shall be the same material as the vessel.

D01 **7.2.2.9.2.3** Minimum skirt thickness shall be 6 mm or 1/3 of the lowest course shell thickness, which is greater one.

D01

7.2.2.9.10 At design stage platforms to be considered with following instruction:

a) For horizontal vessel, the area of platform should be vessel ID X TL to TL length

b) For vertical vessel, bellow each manhole a platform with 180 degree rotation and 1500 mm width to be considered.

c) For vertical vessel a square top platform with length of 1.1 XID (Vessel Inside Diameter) to be considered

d) Maximum distance between platforms in vertical vessels should be 8m. Unless a 90 degree rotated platform has been considered.

D01 **7.2.2.9.13** Vessels with saddle supports shall be designed to prevent deformation under all load conditions. The design of saddles shall be in accordance with the revised L.P. Zick analysis as noted in ASME Pressure Vessel and Piping, Design and Analysis/ A Decade of Progress, Volume 2, 1982.

7.20 MODIFICATION ON IPS ARTICLE 7.2.2.10

D01 **7.2.2.10.2** Non- metallic flat gaskets for flanged pipe joints shall be in accordance with ASME B16.21.

7.2.2.10.3 Spiral wound gaskets shall have a minimum thickness of 4.5 mm, unless otherwise specified on engineering data sheets. For raised face flanges, the spiral wound gasket shall have an internal compression ring and an external guide ring. The inner compression ring shall be the same material as the spirals.

D01 **7.2.2.10.4** Asbestos shall not be used as a gasket material.

7.2.2.10.5 For internal bolting minimum size of M10 shall be used Bolting for internals shall be secured (e.g. spring washers, lock nuts, etc.)

D01 7.2.2.10.6 Stud bolts shall be long enough to extend 12 mm beyond each nut. Stud bolts M48 and larger, shall be one bolts diameter longer, to allow for the use of the bolt tensionless. Thread protectors shall be fitted prior to shipment.

7.21 MODIFICATION ON IPS ARTICLE 7.2.2.11

D01 **7.2.2.11.1** Suggested location for earthing lug is about 150mm from bottom and following orientation:

- Vessels with skirt : On north/ south centerline
- Vessels on legs : On any two legs for vessels with three legs, on diametrically opposite legs for vessels with four legs.

- Vessels on brackets : On any diametrically opposite brackets.
- Vessels on saddles : On central web of each saddle, on the outside.

For all vessels with existing conductivity break between the support ends, one earthing boss shall be provided for each isolated part.

8.0 FABRICATION (IPS CLAUSE 7.3)

8.1 MODIFICATION ON IPS ARTICLE 7.3.1

D01

7.3.1.3 Anchor bolt holes of baseplate for vertical vessels shall be provided straddling the principal centerlines of the vessel.

7.3.1.5 Reinforcement pads thickness shall not exceed the shell/head thickness. Reinforcement pads also shall have 0.75 thickness of shell / head as a minimum. Vent holes shall be plugged with heavy grease after testing.

D01

7.3.1.11 Course having a diameter ≤2 meters shall have one longitudinal joint only. No longitudinal joints shall be allowed in the downcomer area or behind any other plate or obstruction which prevents proper inspection of the weld. Circumferential welded joints shall clear tray support ring welds by 25mm minimum and be located so as to allow inspection with all internal equipment in place. Vessel skirt shall not hide circumferential weld.

8.2 ADDITION TO IPS ARTICLE 7.3.1

D01

7.3.1.13 All vessel weld seams shall be located to clear all internal and external attachments to the extent practical. When getting covered by reinforcing pads or reinforcing rings is unavoidable the weld shall be ground flush and fully radiographed for a distance extending 150mm on each side of the length being covered. If reinforcing rings cover circumferential seams, the weld seams shall be ground flush and radiographically examined before the ring is attached. Gas leak test (see ASME VIII/I UG 99(g)) to be taken care of.

In horizontal vessels weld seams shall clear saddle supports and their wear plates.

D01

7.3.1.14 Junction of more than two weld seams Where meeting of more than two weld seams is unavoidable, then intermediate stress relief shall be applied.

8.3 MODIFICATION ON IPS ARTICLE 7.3.1.1

D01

7.3.1.1.1 Complete material certification, welding and testing plan shall be confirmed by purchaser too, before fabrication beginning.

7.3.1.1.2 Repairs of faulty materials (e.g. plates, forgings, etc.) shall not be permitted without the prior

authorization by the purchaser. Weld metal shall not be used to build up the edges of plates or nozzles that are too short or contain large cavities without approval of the purchaser.

8.4 MODIFICATION ON IPS ARTICLE 7.3.3

Deleted

7.3.3.8 Longitudinal and circumferential welds (shell and head of the vessel) shall be fabricated and joined by full penetration welding. In case of code requirements double butt welded shall be used. This sequence shall also apply to the skirt. Full penetration welding shall also be performed in the case of closing welds on vessels without manholes or wherever back welding cannot be carried out. The use of backing strips that are not removed after welding is not permitted. Internals connected to the shells but not subjected to pressure shall be fillet welded using the continuous welding technique.

8.5 ADDITION TO IPS ARTICLE 7.3.3

D01

7.3.3.11 Qualification for welding procedures and welders shall be in accordance with the requirements of ASME Code Section IX.

In Sour services, each Welding Specification (WPS), shall be qualified for the required hardness as per NACE MR0175/ISO 15156 commitments.

7.3.3.12 Where meeting of more than two weld seams is unavoidable, then intermediate stress relief shall be applied.

D01

7.3.3.13 Edges shall be visibly checked before welding to ensure that there are no cracks laminations or other serious defects. Immediately prior to welding the edges shall be properly cleaned and dried.

D01

7.3.3.14 for vessel wall thickness 12 mm and below, back-gouging may be performed by grinding only provided all relevant welds are 100% X-ray inspected.

8.6 MODIFICATION ON IPS ARTICLE 7.3.7

D01

7.3.7.1 Pressure vessels for lethal and sour service shall be post weld heat treated as per code.

8.7 ADDITION TO IPS ARTICLE 7.3.7

D01

7.3.7.3 Post weld heat treatment of welds between dissimilar materials shall conform to the requirements of the material having the more stringent requirement. The procedure for post weld heat treating welds between ferritic and austenitic steels shall be submitted for review by the purchaser.

D01

7.3.7.4 Internal bolting of ferritic materials for services in which stress cracking is possible should be heat treated. The bolting shall not exceed 225 BHN after such heat treatment.

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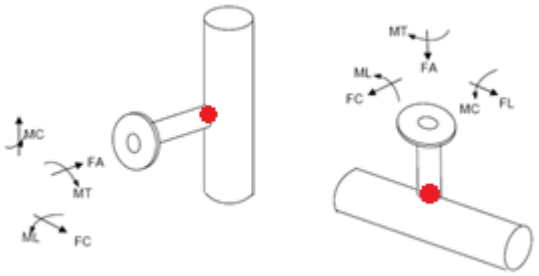
Appendix N (Addition)
Nozzle Load table (as Min.)

NOZZLE SIZE (In)	150LB & 300LB FLANGE RATING					
	FORCES KN			MOMENTS KN.m		
	FL	FA	FC	MC	MT	ML
2	2.80	2.80	2.10	0.28	0.42	0.36
3	4.20	4.20	3.15	0.63	0.95	0.82
4	5.60	5.60	4.20	1.12	1.68	1.46
6	8.40	8.40	6.30	2.52	3.78	3.28
8	11.20	11.20	8.40	4.48	6.72	5.82
10	14.00	14.00	10.50	7.00	10.50	9.10
12	16.80	16.80	12.60	10.08	15.12	13.10
14	19.60	19.60	14.70	13.72	20.58	17.84
16	22.40	22.40	16.80	17.92	26.88	23.30
18	25.20	25.20	18.90	22.68	34.02	29.48
20	28.00	28.00	21.00	28.00	42.00	36.40
22	30.80	30.80	23.10	33.88	50.82	44.04
24	33.60	33.60	25.20	40.32	60.48	52.42
26	36.40	36.40	27.30	47.32	70.98	61.52
28	39.20	39.20	29.40	54.88	82.32	71.34
30	42.00	42.00	31.50	63.00	94.50	81.90
32	44.80	44.80	33.60	71.68	107.52	93.18
34	47.60	47.60	35.70	80.92	121.38	105.20
36	50.40	50.40	37.80	90.72	136.08	117.94
38	53.20	53.20	39.90	101.08	151.62	131.40
40	56.00	56.00	42.00	112.00	168.00	145.60

Notes:

1. All forces and moments in the above table are positive and sign notation is as per WRC 107. The most stringent case caused by axial load 'FA' acting inward or outward shall be considered.



2. The supplier shall ensure that all process nozzles shall be suitable for the nozzle loads shown in the above table and provide the necessary local calculations in accordance with WRC bulletin 107 and ASME code.

3. All forces and moments act on the intersection of the nozzle (including hillside type) centerline with the mid-thickness plane of the shell or head plates.

4. Loading nomenclature:
   FORCES: FL= Longitudinal, FA= Axial, FC= Circumferential
   MOMENTS: ML= Longitudinal, MT= Torsional, MC=Circumferential
   (Reference: Technip Specification for “General Design Rules for Pressure & Atmospheric Equipment”)