	<b>TECHNICAL SPECIFICATION</b>		Nº: I-ET-3010.2E-1350-200-P4X-001
	CLIENT:	AGUP	SHEET: 1 OF 16
	JOB:	HIGH CAPACITY FPSO - GAS EXPORTATION ALL ELECTRIC	
	AREA:	ATAPU 2 AND SÉPIA 2	
SRGE	TITLE: <b>HULL PIPING PRACTICE</b>		INTERNAL ESUP

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<b>INDEX OF REVISIONS</b>
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0	ORIGINAL
A	GENERAL REVISION


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DATE	OCT/14/22	DEC/14/22							
DESIGN	ESUP	ESUP							
EXECUTION	CXDI	U4T1							
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THIS FORM IS PART OF PETROBRAS N-381 REV.J ANNEX A – FIGURE A.1.



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	<b>TECHNICAL SPECIFICATION</b>	Nº: I-ET-3010.2E-1350-200-P4X-001	REV. <b>A</b>
	AREA:	ATAPU 2 AND SÉPIA 2	
	SHEET:	3 OF 16	
TITLE:	<b>HULL PIPING PRACTICE</b>		INTERNAL
			ESUP

## 1. SCOPE

- 1.1 This Specification defines the minimum requirements and recommended practices for design, fabrication and assembly of pipe supporting of production and utility piping systems for HULL, TOPSIDE and modules of offshore projects.
- 1.2 In case of conflicting requirements between this technical specification and other references or requirements on project, the most stringent shall prevail and must be brought to BUYER attention. If necessary, the CONTRACTOR may revert to BUYER for clarification.

## 2. ABBREVIATIONS

In addition to general definitions set in reference \1\, the following abbreviations are used in this specification.

- 2.1. CS CLASSIFICATION SOCIETY
- 2.2. DNV DET NORSKE VERITAS

## 3. DEFINITIONS AND TERMS

For the purposes of this document, the following definitions and terms are applicable.

All definitions are found on \1\.

## 4. NORMATIVE REFERENCES

The following standards and documents include provisions, which, through reference in this text or not, constitute requirements of this technical specification. Latest issue of the references shall be used unless otherwise agreed. Other recognized standards may be used provided it can be shown that they meet or exceed the requirements of the standards referenced below.

### 4.1. CLASSIFICATION RULES

Refer to Project General Conditions and Data Specification for nominated Classification Society. Relevant Class Rules shall apply.

SELLER's responsibilities include documents submission to the certifying authority as described in the latest edition of their rules for equipment on offshore facilities.

### 4.2. CODES, STANDARDS AND REGULATIONS

In addition to rules and regulations set forth in reference \2\, the following codes and standards are applicable to piping supports.

ASME B31.3 - Process Piping

ASME B31.8 - Gas Transmission and Distribution Piping Systems



#### 4.3. REFERENCE DOCUMENTS

The following documents are cited or not within this technical specification and therefore constitute requirements for the piping supports.

Ref. #	Doc. No.	Doc. Title
\1\	I-ET-3010.00-1200-940-P4X-002	General Technical Terms
\2\	I-MD-3010.XX-1200-940-P4X-0XX	Descriptive Memorandum – General
\3\	I-ET-3010.2E-1200-200-P4X-001	Piping Specification for Hull
\4\	I-ET-3010.2E-1200-200-P4X-004	Requirements for Piping Support
\5\	I-ET-3010.2E-1200-200-P4X-005	Minimum Requirements for Piping Mechanical Design and Layout
\6\	I-ET-3010.2E-1200-200-P4X-006	Requirements for Piping Stress and Flexibility Analysis
\7\	I-ET-3010.00-1200-956-P4X-002	General Painting

#### 5. Double plates

For suction and discharge pipes in structural tanks, there shall be plates welded to the structure, aligned with the suction(s) and discharge(s) in each structural tank, to prevent wear of the main structure.

The area of the plate shall be sufficient to ensure that a jet from the end of the discharge / suction pipe at an angle of 45° to the flow will collide with the tanks plate and not with the unprotected structure, to guarantee that the entire area of contact with the jet will be properly protected against corrosion and abrasion. The area of the double plate shall be at least four times the projection area of the discharge or suction piping. The plate area will be limited to the distances between the reinforcements.

##### 5.1. GENERAL REQUIREMENTS

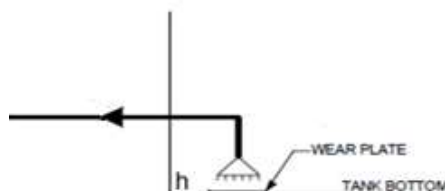
The thickness and material of the plate shall be the same as the structure in which the plate will be welded.

An anti-abrasion coating shall be applied at double plates of tanks. The anti-abrasion coating is an 100% solid reinforced with ceramic composite coating specially developed with high resistance to abrasion-corrosion, details according to reference \7\.

For double/wear plates for suction and discharge of submerge pumps located inside tanks, the dimensions and distance to the equipment shall be in accordance with vendor's recommendations.

### 5.2. DOUBLE PLATES FOR SUCTION PIPES IN TANKS

The height (H) shown in Figure 1, between the suction face of the pipe and wear plate face, unless it is defined in the P&ID or it is required by the classification society shall have the dimensions defined in Table 1:



*Figure 1: Double plate for suction pipes*

*Table 1: distance between pipe and double plate*

Pipeline Dn (in)	H (mm)
1" - 2 1/2"	15
3" - 6"	35
8" - 12"	80
14" - 18"	120
20" - 24"	170
26" - 30"	210
>= 32"	250

### 5.3. DOUBLE PLATES FOR DISCHARGE PIPES IN TANKS

The distance (H) shown in Figure 2, between the discharge face of the pipe and double plate face, unless it is defined in the P&ID or it is required by the classification society shall have the dimensions defined in Table 2.

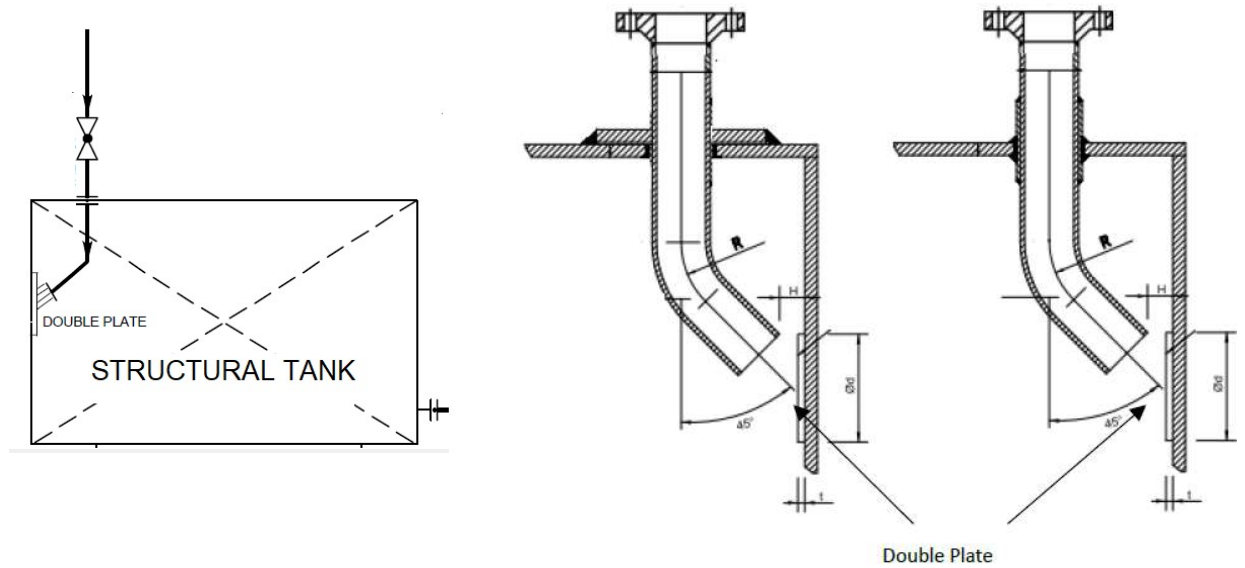


Figure 2: Double plate for discharge pipes

Table 2: distance between pipe and wear plate

Dn (in)	H (mm)
1" - 2 1/2"	50
3" - 6"	80
8" - 12"	120
14" - 18"	170
20" - 24"	220
26" - 30"	300
>= 32"	350

#### 5.4. DOUBLE PLATES FOR DROPLINES

The Loading and Transference systems droplines are vertical pipes fitted inside the cargo tanks from main deck up to a height of 500 mm from the bottom plating, as shown in Figure 3 and Figure 4.

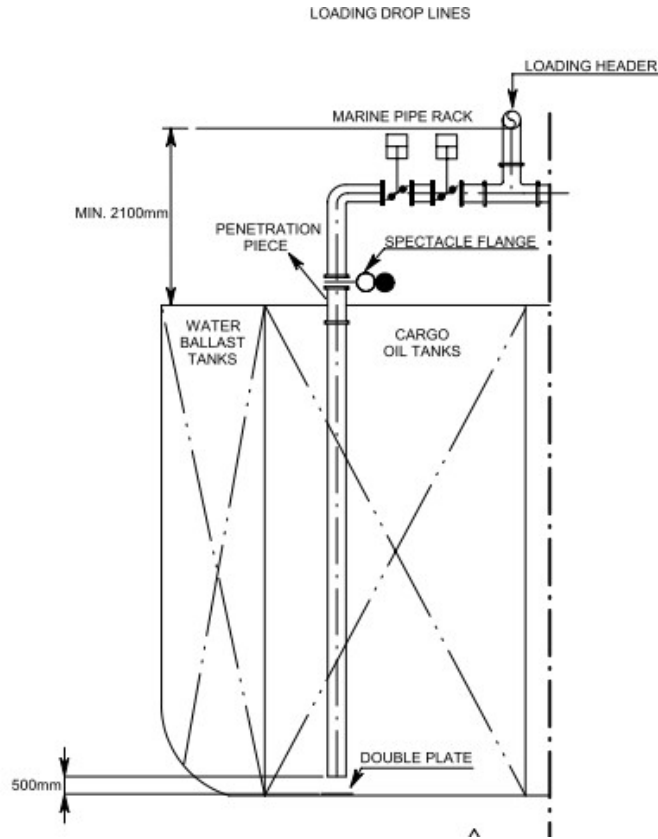


Figure 3: Double plate for droplines of the Loading System

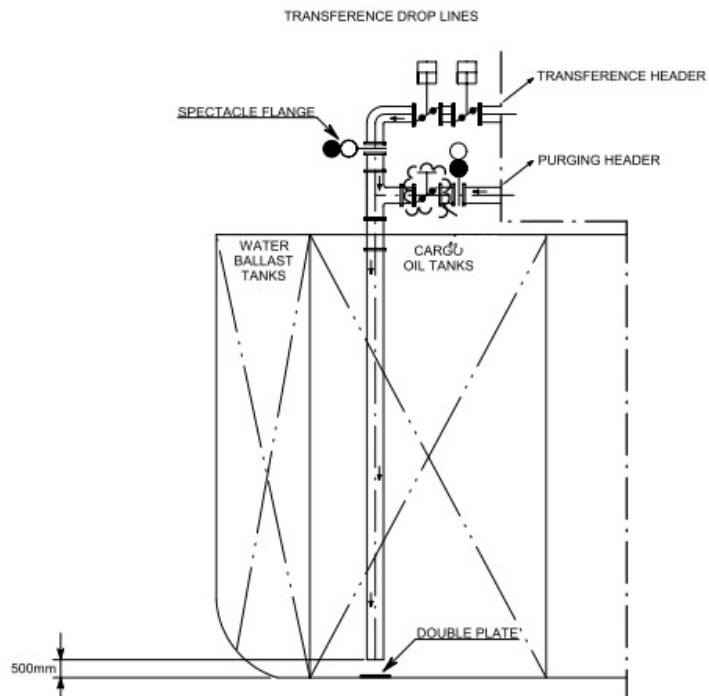
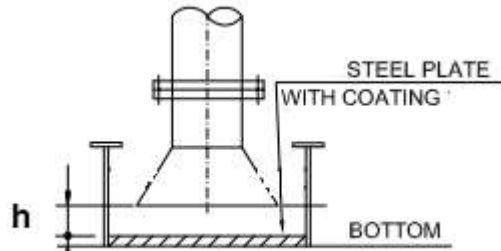


Figure 4: Double plate for droplines of the Transference System

### 5.5. DOUBLE PLATES FOR BELL MOUTHS



*Figure 5: bell mouth*

Bell mouths, Figure 5, shall have a double plate in alignment with its suction / discharge to prevent wear of the main structure, with the same requirements of 5.1. The distance from the bell mouth to the bottom of the tank shall be calculated according to the following formula.

$$h = 1,3 \cdot \frac{d^2}{4 \cdot D}$$

where,

d = pipe internal diameter (mm);

D = bell mouth internal diameter (mm), and;

h = distance from the bell mouth to the bottom of the tank (mm).

### 5.6. DISCHARGE LINES IN SLOP TANKS

For lines that discharge into Slop tanks (TQ-5336506P / S), the height of the double plate shall be 3 m above the bottom of the tank, as shown in Figure 6.

The discharge lines in slop tanks should preferably be fitted in bulkheads without reinforcements.



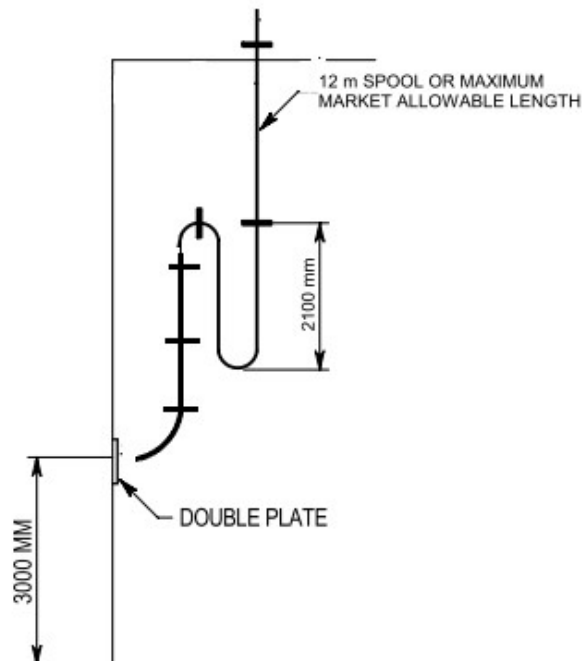


Figure 6: Double plate of the slop tanks discharge pipes

## 6. PENETRATION PIECES

### 6.1. GENERAL REQUIREMENTS

Here is presented some types of penetration pieces to be applied where de pipes passes through side/bottoms, watertight bulkhead or deck.

The types to be used are not limited to those described below. Other types that are not represented below, such as for penetrations pieces for fire integrity bulkhead, penetrations pieces for hydraulic piping, shall be developed during the detailing phase.

The dimensions referenced here for the components of the penetration pieces may change during the detailing phase or by recommendations of the classification society. Those changes shall be submitted to BUYER approval.

Where pipes pass through side/bottoms, bulkheads, decks or tanks tops the penetrations are to be made by methods, which will maintain the required tightness (watertight, firetight or smoketight) integrity and do not cause damage to the inside lining of these penetrations.

Penetration pieces shall be made of the same or compatible material of the plates in which it penetrates. Dissimilar connection between materials is not allowed, due to possibility of galvanic corrosion.

Two types of penetration pieces such as sleeve and middle flange type shall be generally applied on pipe which is passed through side shell, bottom, watertight bulkhead or deck. The

types of penetration pieces to be developed during detailing phase shall be submitted to OWNER approval.

The dimensions and materials used in the penetration parts also shall comply with Classification Society requirements.

Only weld neck type flanges shall be used.

## 6.2. MIDDLE FLANGE TYPE

This type shall be preferably used in carbon steel piping system.

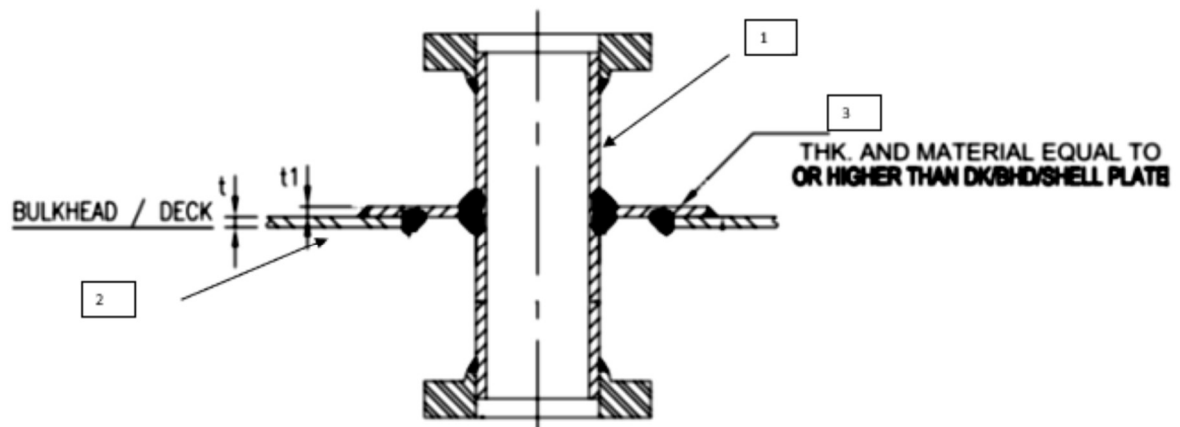


Figure 7: Middle flange type

### 1- Pipe

- Thickness: according to I-ET-3010.1Y-1200-200-P4X-002 – PIPING SPECIFICATION FOR HULL, if there is no requirement of the Classification Society.

- Material: same as pipeline material. If the pipeline is made of a nonmetallic material, the pipe shall follow the system's P&ID.

### 2- Bulkhead or deck

### 3- Middle flange

- Thickness ( $t_1$ ) and material: equal to or higher than deck's, bulkhead's shell plate.

Note 1: The area of the middle flange shall be calculated to compensate the strength of the structure, recomposing the area where the opening will be made and to guarantee that no

damage will be made to the pipes internal lining due to the welding on deck/bulkhead.

Note 2: The middle flange of coated lines shall be welded and adjusted before pipe coating.

The thickness of piping shall also comply with Classification Society requirements.

Note 3: If necessary, to guarantee the strength, structural brackets may be applied. These brackets shall be welded and adjusted on pipe (1) before pipe coating.

### 6.3. SLEEVE TYPE

The sleeve type chosen shall preferably be used in stainless steel, duplex piping system.

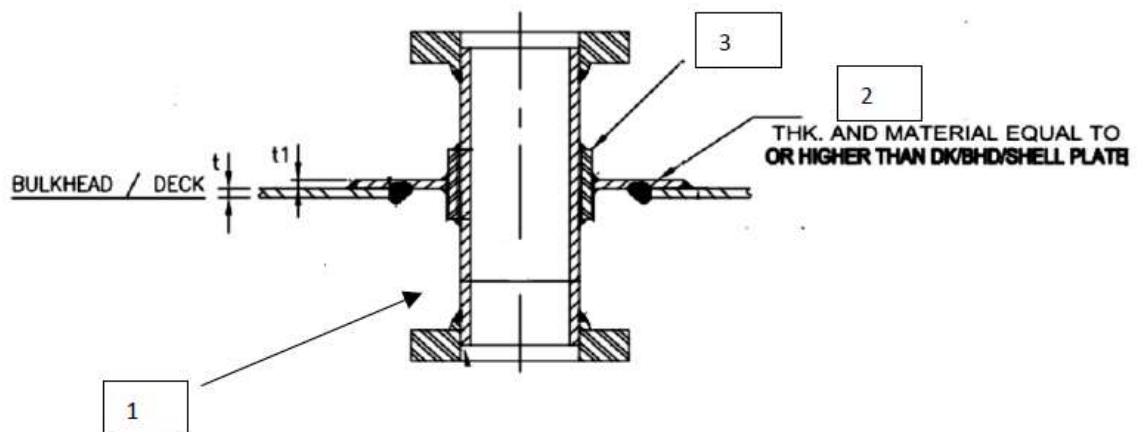


Figure 8: Sleeve type

#### 1- Pipe

- Thickness: shall be according to reference /3/, but shall also comply with requirements of the Classification Society.

- Material: Same as pipeline material.

#### 2- Middle flange

- Thickness (t1) and material: equal to or higher than deck's, bulkhead's shell plate.

#### 3- Sleeve

- Material: API 5L Gr B or the same of pipeline; to be defined

- Thickness: Shall be the same as the pipeline.

Note 1: Shall be calculated and replaced the removed area of the structure to install the middle flange, recomposing the area where the opening is made.

#### 6.4. ADDITIONAL REQUIREMENTS FOR SHIP SIDE AND SEA CHEST PENETRATION PIECES

Pipe connections fitted between shell and valves are to be at least extra strong, in accordance with Classification Society. Shall be used SPEC B18H, according to reference \3\.

#### 6.5. TUBING PENETRATION PIECES OF REMOCON SYSTEM

The penetration pieces for tubing shall be according to the following requirements.

- The penetration pieces shall be composed, whenever possible, of the grouping of the tubing arranged on a plate, as shown in **Erro! Fonte de referência não encontrada..**
- Plate- material: Same as Bulkhead or deck. Thickness shall be equal to or greater than the thickness of the deck or bulkhead.
- The distances "A", "B" and "D", shall be calculated according to the diameter of the tubing.
- Pipe 1, Material: API 5L GR B PSL 1, size according OD tubing, SCH 80.
- Pipe 2, Material ASTM A312 GR TP 316, size according OD tubing, SCH 40.

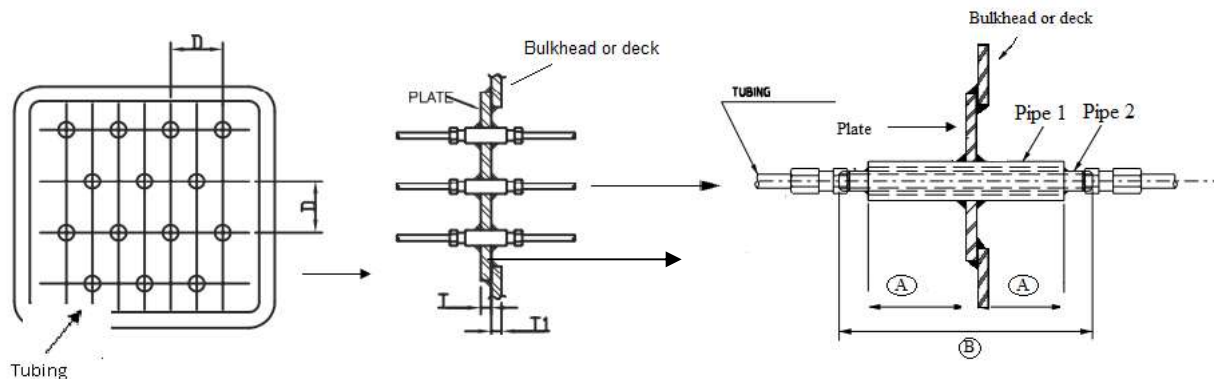


Figure 9 : Typical detail of tubing penetration

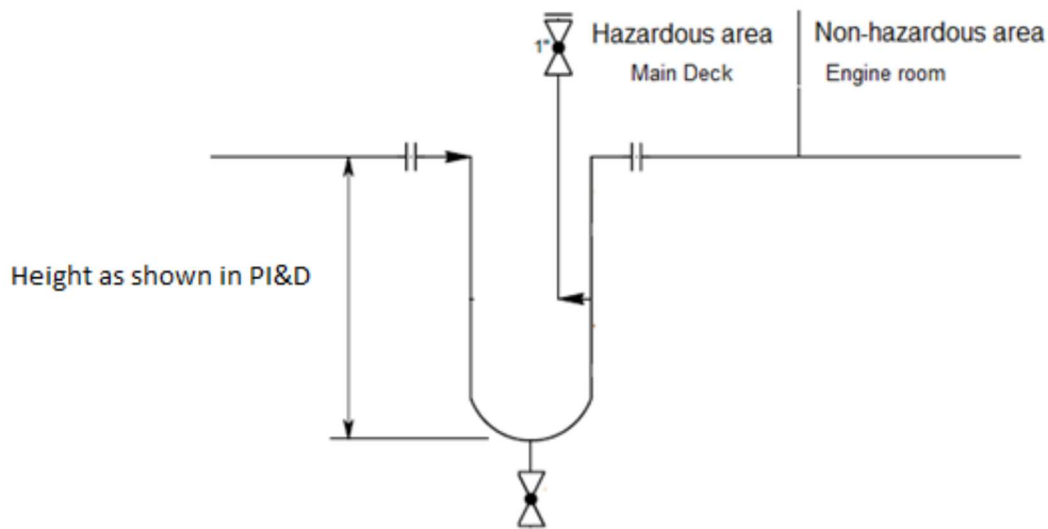
## 7. SIPHON

### 7.1. WATER SEALS

Any connections between hazardous and non-hazardous systems shall be designed to eliminate or control the risk of ingress of hazardous material from one system to the other due to incorrect operation or leaks. In the case of piping system connecting hazardous and non-hazardous areas the lines shall have a siphon to avoid gas back flow.

The siphon shall comply with the following requirements:

- Shall be installed with a purge valve and blind flange.
- Shall be installed at hazardous area as close as possible to non-hazardous area entrance, according to Figure 10. Example: main deck and engine room.
- Shall have a minimum height as indicated in the P&IDs. If not indicated in the P&ID, the height of the siphon shall be 750 mm.
- Shall have a block valve for filling operation.
- Valve type according to reference \3\.



*Figure 10: Typical siphon*

## 7.2. SLOP TANK DISCHARGE LINES

All discharge lines inside the slop tanks (TQ-5336506S/P) shall have one siphon with height according Figure 11. Height as shown in P&ID

The line above main deck shall have a block valve and blind flange to filling operation. And shall be fitted between spectacle blind and block valve, as shown in Figure 11.

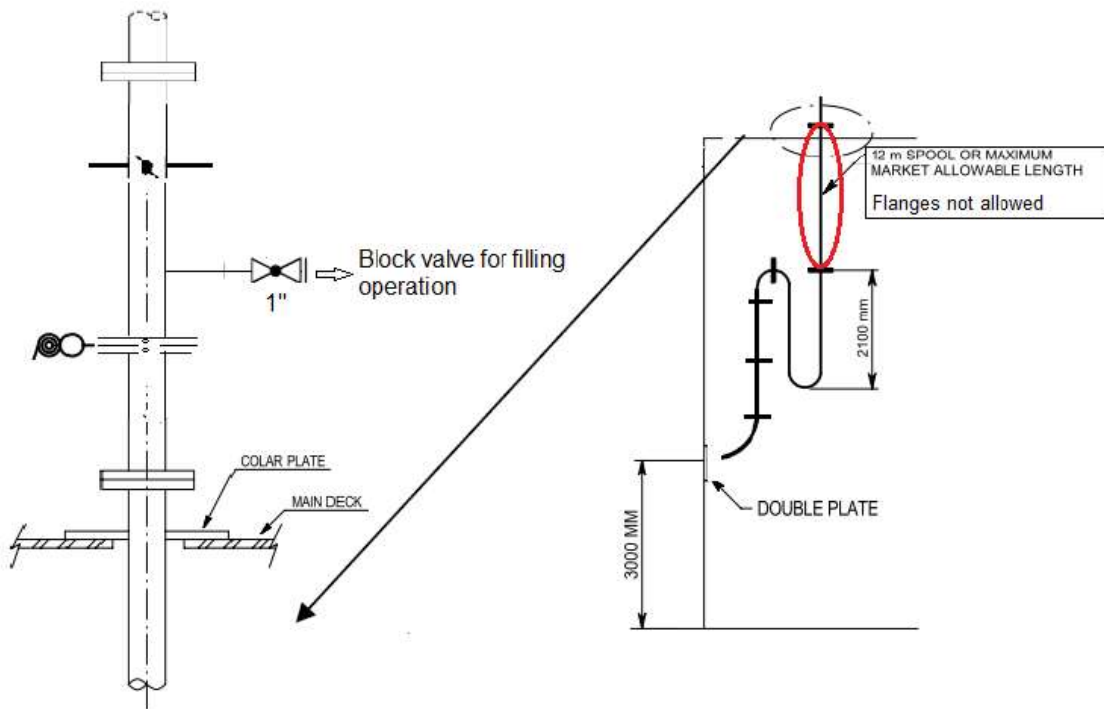


Figure 11: Slop discharge line

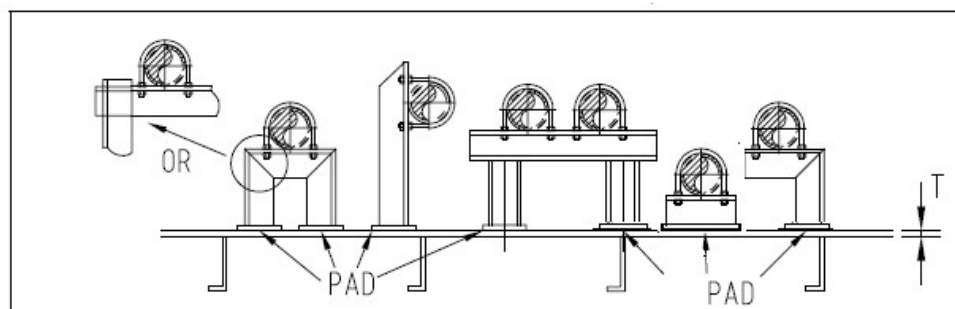
## 8. SUPPORTS

### 8.1. ANTI-FRICTION PADS

Besides the requirements of use of nonmetallic material on supports presented on reference \4\, the horizontal piping systems on main deck, ballast tanks, void spaces and cofferdams shall have anti-friction nonmetallic pads on rest supports to avoid piping wearing. The half round bar from nonmetallic material shall be griped or fastened to the support and shall comply with requirements presented on reference \4\.

### 8.2. PAD PLATE FOR SUPPORTS

Pad plate for supports shall be fitted in tanks, main deck, bulkheads.



Tank Wall constructed into hull, tank top, upper deck bulkhead

*Figure 12: Pad plate for supports*

**Notes:**

Main supports for heavy pipes to be fitted on the longitudinal member structure.

Pad dimensions shall be calculated on detailed design phase.

Pad plates shall be fully welded to avoid crevice corrosion.

**9. VENTS AND DRAINS**

The installation of vents at all high points and drains at all low points is mandatory for any piping, if those showed on the P&IDs are not sufficient/suitable for pressure test.

Drains and vents connections shall be according to Annex C of reference \3\. Drains and vents used for pressure pressure test shall be removed and replaced by blind flanges after test according to reference \3\.

**10. INERT GAS INJECTION NOZZLE**

The penetration pieces of the inert gas system of each cargo tank shall be fitted with the inert gas nozzles, supplied by vendor, and shall be assembled according to Figure 13 and Figure 14.

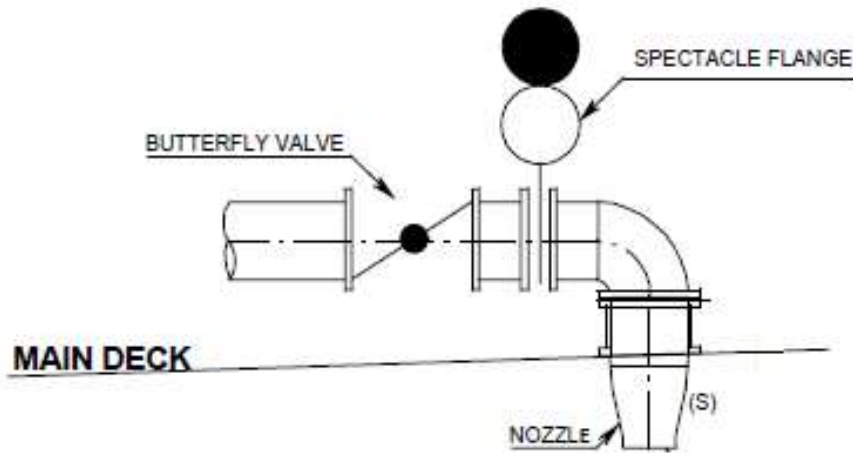


Figure 13: Typical detail inert gas nozzle

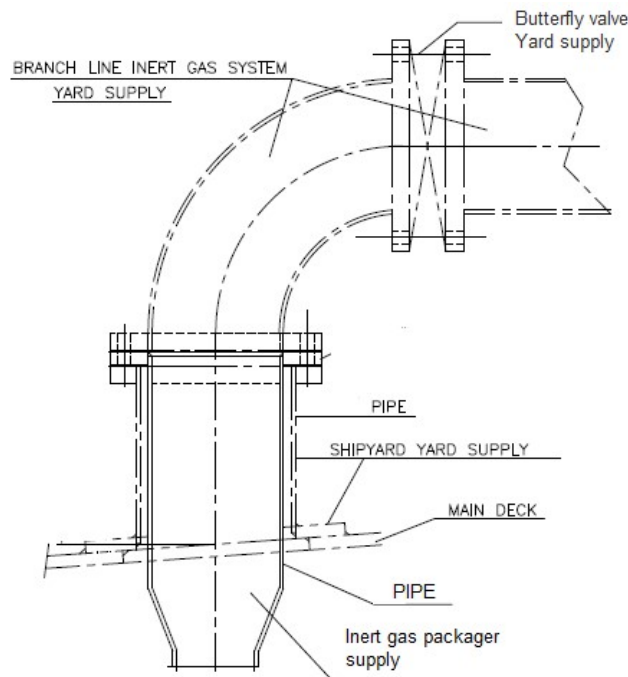


Figure 14: Inert gas nozzle

## 11. HULL SYSTEMS' EXPANSION LOOPS

The headers that shall have the expansion and piping movement flexibility performed by loops are indicated in Marine Systems and Safety P&IDs.

The expansion loop quantity and location to be spaced shall be defined in the detailed engineering design according to piping stress analysis.