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DSQS

DAEWOO SHIPBUILDING QUALITY STANDARD

2016

DSME DAEWOO SHIPBUILDING & MARINE ENGINEERING CO.,LTD.

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DSQS

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2016

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DSME DAEWOO SHIPBUILDING & MARINE ENGINEERING CO.,LTD.

PREFACE

The shipbuilding construction process involves assembling numerous hull block, machinery, equipment, other outfitted items and subsequent testing. The quality of a ship is determined by the accurate and controlled construction, assembly and installation of the various items to a defined acceptable standard.

Workmanship quality is very important, and the only way to attain the required quality and productivity improvements is to ensure the desired quality at each stage of production. This is achieved by each worker following the defined quality standard.

This quality standard consists of 4 parts as following;

Part Ⅰ. General procedure
Part Ⅱ. Hull part
Part Ⅲ. Outfitting & Machinery part
Part Ⅳ. Painting part

The standards stipulated in this quality standard are generally applied to shipbuilding at the shipyard. In case of conflict, however, the requirements of the contract, building specifications, approved drawings or agreed letters/memorandum shall prevail over this DSQS.

October, 2016

Quality Management Division

[DSME's Quality Philosophy]

As the world's leading shipyard, we willingly create the highest value and share deep trust with our customers.

DSME DAEWOO SHIPBUILDING & MARINE ENGINEERING CO.,LTD.

PART I. GENERAL PROCEDURE

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1. Mandatory Inspection and Test

(1) The inspection and test items listed herein are the fundamental inspection /witness points of the Client and the Classification Societies based on the Classification Society's rules.

(2) For those inspections and tests which are not listed, however, the Client's representative and the Classification surveyor can have a free access to inspect all works during process unless additional staging or work stop is required.

(3) In principle, inspection and test are to be carried out in accordance with the Builder's working schedule. For smooth construction of the vessel, the inspection parties shall not refuse to inspect the parts designated by the Builder even if some minor works remain which can be completed and subjected to inspection at later stage.

2. Request for Inspection/Test

(1) The Builder shall request the attendance of the Client's representative and the Classification surveyor for the relevant inspections/tests by means of e-QISS computerized system.

(2) The request of inspections/tests for owner/class is to be noticed as followings;

- For the inspection to be carried out from Tuesday to Saturday, the request will be given not later than 16:30 the day before.
- For the inspection to be carried out on Sunday, the request will be given not later than 16:30 on Friday.
- For the inspection to be carried out on Monday, the request will be given not later than 12:00 on Saturday.

(3) For some reason, if the daily inspection schedule is changed or delayed, the Builder shall notify the situation to the Client and the Classification office as soon as possible.

(4) In the event of urgent inspection, the Builder shall notify and discuss with the Client's representative and the Classification Society.

3. Inspection Cancellation, Postponement, Non-attendance

(1) For any reason, if the inspection schedule is cancelled or postponed, the concerned parties are to be informed as soon as possible.

(2) If either the Client's representative or Classification surveyor fails to attend the inspection, it is to be deemed to waive his right and he shall accept the results of inspection performed by attended surveyor and/or Builder's Q.M inspector.

(3) If either the Client's representative or Classification surveyor fails to attend the inspection applied on holidays, he(she) shall accept the results of inspection carried out by attending surveyor and/or Builder's Q.M inspector.

4. Inspection/Test Record

(1) The Builder shall submit the "Inspection and Test Record" forms containing the necessary information for the inspection items to the Client's representative and the Classification surveyor.

(2) After completion of inspections/tests, the Client's representative and/or the Classification surveyor shall make confirmation signature on the inspection /test record, with the comments if any, and return to Builder's Q.M inspector.

(3) Inspection results shall be clearly judged as follows;

(a) AA	: Accepted in the existing condition.
(b) AC	: Accepted with comments to be confirmed by Builder's QM.
(c) RC	: Required re-inspection for the comments to be confirmed by Client and/or Class.
(d) NA	: Not accepted, and subjected to re-inspection
(e) CXL	: Cancelled due to faults of the group requesting inspection.
(f) PP	: Cancelled due to inevitable reasons.

(4) The major inspection and test records including the on-board test results are to be submitted to the Client's representative and the Classification surveyor at the ship's delivery stage by means of CD.

5. Repair Work

(1) Repair work shall be basically carried out in accordance with builder's working practices and the rules of Classification Societies.

(2) When re-inspection is required, it will normally be included in the "Daily Inspection Schedule" and shall follow the procedure described in the preceding paragraphs.

6. Other Quality Standard

(1) In general, other quality standard except various quality standard described in this standard are applied to DSME's technical standards, and they are maintained in accordance with DSME's standard control system.

(2) For the technical field of DSME, the technical standards applied to the material, component, design, inspection are classified as follows.

(a) Regulation
Document defining a standard for a specific character, efficiency, dimension required on the producing product, part product, raw material and purchasing product and a term, abbreviations, symbol, units, system related to the technical fields.

(b) Procedure
Document defining the efficient and effective means, methods and sequence on the design, working, inspection, testing, purchasing and equipment of the engineering and manufacturing.

(c) Job instruction
Document describing a diagram, symbol and sentence after standardizing the job sequence, job method, standard time and job caution item for all of works performing in each working group.

※ REMARKS

(1) Marks of O, C and R in the list of inspection/test items mean as follows;

- **O** : Items to be witnessed by the Client's representative.
- **C** : Items to be witnessed by the Classification surveyor.
- **R** : Items to be required test records and/or Classification certificate, which are to be submitted to the Client's representative.

(2) Detail testing to be carried out separately for each system is to be specified in the procedure such as "On-board Test Procedure" and "Mooring/Sea Trial Procedure/Gas Trial Procedure".

(3) The inspections of the Regulatory body or Government body specified in the contract or specifications are to be scheduled separately.

PART Ⅱ. HULL PART

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1. CUTTING/FORMING PROCESS

1.1 Control of Steel Materials

(1) When steel materials are transferred to shot blasting/priming process from steel stock area, the designated steel materials should be correctly selected and supplied by comparing the identification numbers of the steel materials with the “Steel Material Input Order Sheet”.

(2) Input sequences of steel materials to the shot blasting/priming process are controlled by computerized system for correct trace of the materials.

(3) After blasting/priming, the necessary information such as project no., block no., grade, and applied cutting station no., are marked down on the primed steel materials to identify the material.

(4) At the cutting stage, the part numbers of each cut steel pieces are clearly marked according to the cutting drawing.

(5) Accuracy control of steel pieces should be maintained continuously throughout the cutting process to minimize welding gaps.

(6) Following items are to be checked in this process.

Stage	Check point	Remarks
Blasting /Priming	a. Thickness and grade of plates, bars and shaped angles, etc. b. Surface defects such as pitting or flaking	
Marking	a. Precision of mould line b. Drawing information c. Color marking for steel grade ① Manual marking - Mild steel : White - “E” and “EH” grade steel : Green - High tensile steel : Yellow - Low temp. steel (L to LHSA) : Red ② Auto-marking : Black	
Gas cutting	a. Condition of cutting surface - Slag removal - Notch b. Dimensions after cutting c. Primer touch-up condition	

1.2 Forming

(1) Mechanical Bending

The plate having cylindrical shapes is generally formed by a hydraulic press using the universal jigs with templet tables. Most templets are produced by a computerized system except for manual drawings of fore and stern parts.

(2) Hot Bending

The plate having compound curves is firstly formed by the mechanical bending and finally formed by hot bending with the line-heating or spot heating.

The applied temperature in hot bending is controlled by means of temperature sensitive chalk(Tempil-stick) according to following table.

Steel Type	Cooling Method	Standard Range (^{o}C)
▪ High tensile 50Kg/mm^2 grade	Water cooling Air cooling	≤ 650 ≤ 900
▪ TMCP type 50 HT (Ceq. > 0.38%)	Air cooling Water cooling (after air cooling)	≤ 900 Starting temperature of water cooling : ≤ 500
▪ TMCP type 50HT (Ceq. ≤ 0.38%) - AH to DH	Water cooling or air-cooling	≤ 1000
▪ TMCP type 50HT (Ceq. ≤ 0.38%) - EH Grade	Water cooling or air-cooling	≤ 900
▪ Low temp. steel - L to LHSA	Air cooling Water cooling (after air cooling)	≤ 900 Starting temperature of water cooling : ≤ 550
※ Ceq. is obtained from Mill certificates.		

(3) Major Check Points

a. Heating temperature
b. Accuracy of bending

2. ASSEMBLY PROCESS

2.1 Sub-assembly

(1) For good access to block assembly work, structures having some size such as floor, bulkhead, deck, side shell and large brackets, etc., are built up prior to block assembly.

(2) After completion of sub-assembly work, the sub-assembly is to be inspected by builder's inspector.
Then, necessary leakage tests on the fillet welds where water tightness is required should be carried out by means of fillet air test, vacuum test or other proper methods.

2.2 Assembly

(1) Block assembly is a process of assembly / welding together with sub-assembled block and independent material pieces on the platform or jig, and automatic or semi-automatic welding is applicable alternatively according to shape of welding parts such as flat plate, curved plate, etc..

(2) The complicated blocks such as fore or aft parts of hull should be assembled with great care to acquire the acceptable accuracy of dimensions.

(3) After completion of the assembly work, the block is inspected in the presence of Classification surveyor and Client's representative. Then, necessary leakage tests on the fillet weld parts where watertight is required should be carried out by means of fillet air test, vacuum test or other methods which are proved the tightness of welded part.

(4) The inspection of blocks by Client's representative and Classification Society's surveyor shall be waived and carried out by the Builder's staff under the supervision of Builder's QM and Classification Society in the process of block fabrication provide that the blocks are being fabricated in a workshop or by a production team that has been proven its ability to maintain acceptable quality level through self-quality control by periodical evaluations of Builder's QM and Classification Society.

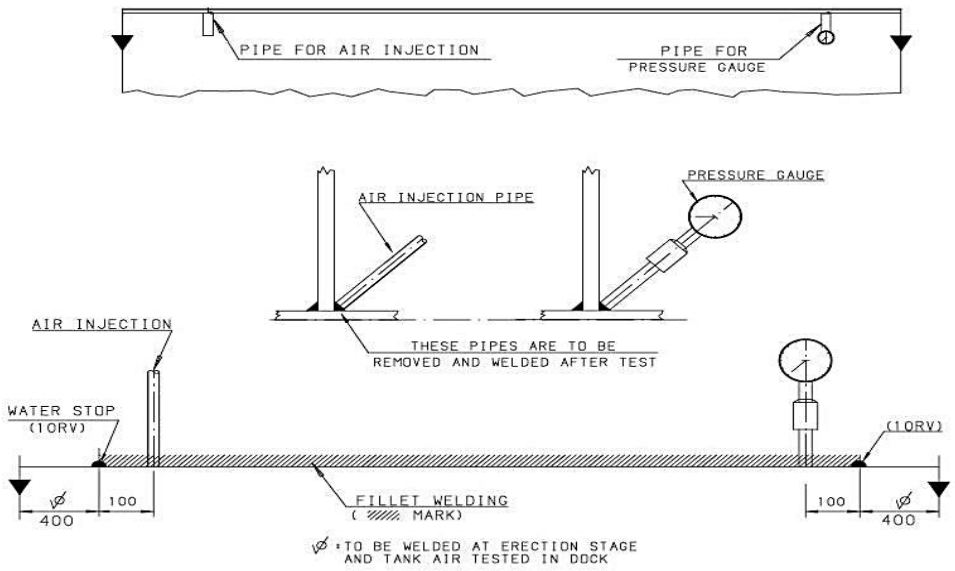
2.3 Major Check Points at Assembly Process

a. Shape of cutting surface
b. Accuracy of dimensions for a single part
c. Precision of 100 mark for fitting
d. Position alignment of parts to the principle line/right angle
e. Position of scallops or butt lines in way of bracket toe
f. Collars or carlings as per drawing
g. Position and size of lightening holes, drain holes, air holes, etc
h. Any damages caused by cutting
i. Amount, direction of cutting allowance
j. Removing unnecessary pieces
k. Lapped-length of lap joint
l. Radius in way of squared hole
m. Precision of center line, water line, buttock line and/or control line
n. Welding condition (refer to para. 4. "Welding process")
o. Basic dimension as final

2.4 Fillet Air Test

After completion of welding, compressed air is injected to the fillet/p.p weld joints through the plug piece, and inside air pressure should be checked with pressure gauge as shown on the following figure.

Leakage can be detected by spraying a soapy water solution on the weld joints.



3. ERECTION PROCESS

3.1 Pre-erection / Erection

(1) Pre-erection / Erection is a process of erection and welding the unit blocks at the dock side or in the building dock with regular checks of the hull dimensions.

(2) After completion of pre-erection/erection work, final inspection is carried out by Classification surveyor and Client's representative.
Then, necessary leakage tests on the fillet weld parts where watertight is required are carried out by means of fillet air test, vacuum test or other methods which are proved the tightness of welded part.

(3) Welded joints of deck plates, bottom and side shell plates are subjected to NDE(Non-Destructive Examination) with radiographic test or ultrasonic flaw detector, etc. in accordance with NDE plan which is approved by the Classification Society.

(4) At pre-erection/erection stage, followings are to be carefully checked.

Check Point	Remarks
a. Height and inclination of wooden block and its position b. Amount of cocking-down c. Center line and water line of each block d. Reference line and/or distance between adjacent frames in way of block joint e. Arrangement of temporary pieces such as strong-backs f. Alignment of structural members g. Any structural inconsistency h. Center line of stern boss / gudgeon at stern block i. welding condition (refer to para. 4. "Welding process") j. Other necessary items	Wooden blocks are to be arranged to bear local compression.

3.2 Tank Testing

(1) All structural tanks are to be tested by the air test or the hydrostatic test. The hydrostatic tests are to be carried out for the specified tanks to confirm the structural strength in accordance with the "Tank Testing Plan" which is approved by the Classification Society.

(2) The hydrostatic test need not be repeated for the succeeding sister vessels of the same series.

(3) Before tank testing, the penetration pieces/piping concerned to the tests are to be completed as far as possible.

(4) Check points during tank test are as follows.

kind of test	Check point	Remarks
Air test (Leakage test)	a. Internal pressure b. Leakage	
Hyd. test (Strength test)	a. Height of water head b. Leakage(except the complete parts at air test) c. Deformation of bulkhead.	- Attention to be paid to air pocket or air discharge route during filling water

3.3 Scaffolding Pieces and Lifting Lugs

3.3.1 Scaffolding Pieces

(1) Scaffolding pieces shall not be removed in the position where they do not interfere with the function of the ship. However, those in the following location are to be removed.

a. Exposed parts of ship where they are likely to spoil the appearance

b. Scaffolding pieces installed under 2.0m height above passage(Main passage and equipment operation area)

※ Details are referred to in the quality standards, para. 7.2 "Disposal of lifting lug and scaffolding piece".

3.3.2 Lifting lugs

(1) Lifting lugs shall not be removed in the position where they do not interfere with the function of the ship. However, those in the following location are to be removed.

a. Exposed parts of ship where they are likely to spoil the appearance

b. Passages where they may cause danger for ship’s crew

c. Other parts designated by design as high stress area

※ Details are referred to in the quality standards, para. 7.3 "Disposal of lifting lug and scaffolding piece ".

3.4 Temporary Access Opening

(1) When the temporary access openings are required on the shell plates, decks,

bulkheads and tank top of double bottom for passages of hull and outfitting work, and for ventilation, they are to be provided according to Builder's Practice.

(2) The shape of the openings and the method of closing are referred to in the quality standards, para. 8 - "Insert".

4. WELDING PROCESS

4.1 General

(1) Since welding is an important work directly related to hull strength, it should be carefully controlled according to the welding procedure with the specified welding parameters and the repair methods for welding gaps exceeding the tolerance limit should be thoroughly controlled.

(2) When a new welding procedure is necessarily applied, it shall be approved by the Classification Society.

4.2 Preparation before Welding

(1) All parts to be welded are fitted with sufficient care to their accuracy. Edge-preparation, angle of bevel, alignment of intercostals plates and fitting angles are controlled within the accuracy range specified in the quality standard.

(2) Welding parts shall be free from moisture, loose mill scale, excessive rust or harmful paint.

(3) Tack welding is carried out under the same preparation of welding.

4.3 Welding

(1) After confirming the above preparation, welding is carried out according to the "Welding Procedure Specification" to minimize deformation and residual stress.

(2) Electrodes, welding method, welding condition shall be in accordance with "Welding Procedure Specification" and requirements of the Classification Society.

(3) After completion of welding, if necessary, the weld lines are touched up with a zinc epoxy primer to prevent rusting.

4.4 Inspection on Weld Parts

Following inspections are carried out to verify the quality of weld parts.

(1) Visual inspection

(a) Visual inspection is carried out on all beads. Any defect parts found are marked on the block and properly corrected.

(b) The welding throat of fillet weld is to be checked by random sampling.

(2) Non-destructive examination

(a) Welded joints of strength deck plates, bottom and side shell plates are tested by the radiographic examination or ultrasonic flaw detector according to NDE plan which is approved by the Classification Society.

(b) Magnetic particle test or dye-penetration test is to be adopted for detecting the surface defect.

4.5 Major Check Points

a. Dimension and shape of edge preparation
b. Alignment of welding parts
c. Tab piece
d. Arrangement against deformation such as strong-back
e. Amount of pre-heating if specified
f. Fitness of electrode and consumable used
g. Welder's qualification
h. Gap before welding
i. Weld throat in fillet weld / Leg length in P.P, D.P, F.P weld
j. Uniformity of beads, intervals in intermittent welding
k. Surface defects on weld such as crack, undercut, crater, etc.
l. Slag, porosity inclusion
m. Soundness of turn-round weld on such part as bracket toe
n. Position of water-stop hole
o. Other necessary items

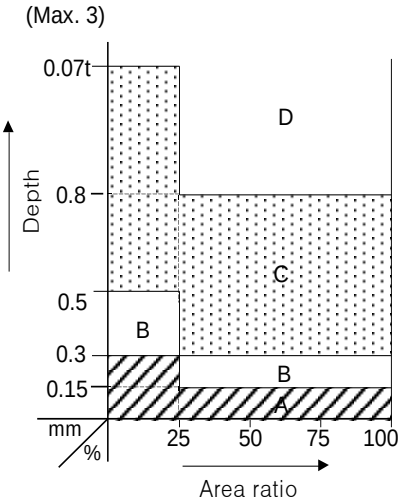
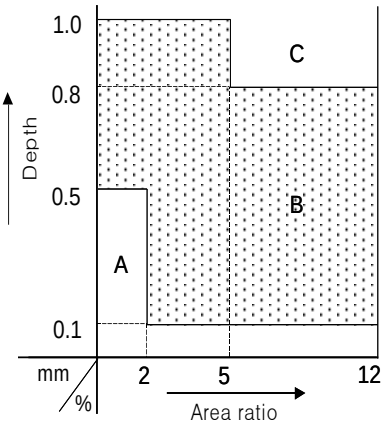
1. Hull structure part	C	O	R	Remarks
1.1 Fillet air test for sub assembly and unit assembly			O	•To be tested by QM
1.2 Sub assembly and unit assembly inspection			O	•To be inspected by QM •The blocks that comply with the condition of DSQS Part II, I, 2.2.(4) shall be excepted.
1.3 Block inspection for hull structure below main deck	O	O		
1.4 Block inspection for hull structure above main deck		O		
1.5 Erection inspection for pre-erected lines or tank space below main deck including accommodation	O	O		
1.6 Erection inspection for erection lines or tank space below main deck	O	O		
1.7 Erection inspection for erection lines or space above main deck		O		
1.8 Tank hydrostatic test according to "tank testing plan"	O	O		
1.9 Air leakage test or vacuum test for weld joint at tight boundary of tanks	O	O		
1.10 Non-destructive examination according to the Classification Society's rule	O		O	•NDE plan is made to show kinds and locations of NDE items with Classification Society's approval.
1.11 L x B x D measurement at ship center and midship	O	O	O	
1.12 Draft mark inspection	O	O		
1.13 Free-board mark inspection	O			•Check at the marked condition.
1.14 In-water survey mark(for the applied ship) inspection	O			•Check at the marked condition.
1.15 Bottom survey for launching	O	O		•Check the closing of sea chest, bottom plug, etc.
1.16 Inclining experiment and deadweight measurement	O	O	O	

Ⅲ. QUALITY STANDARDS	16

1. MATERIAL

1.1 Surface flaw

(Unit : mm)

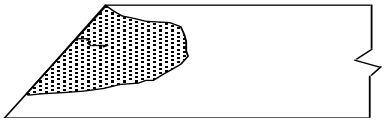
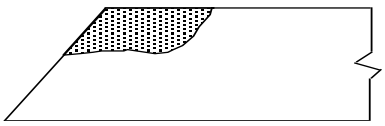
Detail	Correction / Remarks
Pitting Grade of pitting  Area Ratio(%) ; $\frac{\text{Area of pitting}}{\text{Total area of steel surface}} \times 100$	1. Grade A : Repair is not required. 2. Grade B : a) Outer surface of shell plates : To be repaired by painting with epoxy (When painting with epoxy can not be done, grinding is to be carried out) b) Others : Repair is not required. 3. Grade C : Repair is required. a) Outer surface of shell plates : To be repaired by grinding. b) Others : Painting with epoxy is to be carried out. 4. Grade D : Repair method shall be determined after discussion with owner and Classification Society. ※ Recommended repair method : Grinding followed by repair welding.
Flaking Grade of surface flaking  Area Ratio(%) ; $\frac{\text{Area of flaking}}{\text{Total area of steel surface}} \times 100$	1. Grade A : Repair is not required. 2. Grade B : To be repaired. 3. Grade C : To be repaired. ※ Repair method (d = depth of defects) a) $d \leq 0.07t$(max. 3mm) : Grinding. b) $0.07t < d \leq 0.2t$: Welding and grinding. (The welded area should be less than 2% of the total area of a plate)

1.2 Casting

(Unit : mm)

Detail	Correction / Remarks
Defect of cast steel In case where defect is over 20% of thickness, or over 25mm of depth and 150mm of length.	In case that cavity, crack and other injurious defect are found, after removal of the defects, it is to be checked by dye penetration inspection, magnetic particle inspection, or ultrasonic test and to be repaired by adequate method. * The extent of repair is to be agreed upon with the Classification surveyor.

1.3 Lamination

Local lamination  (A)  (B)	1. In case that the range of lamination is limited, it can be chipped out and built-up by welding as shown in (A). NDE is to be done after repair. 2. In case that the range of lamination is limited and near the plate surface, it is preferable to make the built-up welding as shown in (B). NDE is to be done after repair. ※ The extent of repairs is to be agreed upon with the Classification surveyor from case by case.

2. GAS CUTTING

2.1 Notch

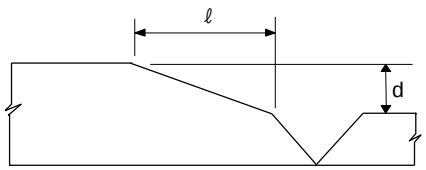
(Unit : mm)

Section	Detail	Tolerance Limit
Free edge	Primary Member	Indentation ≤ 1.0
	Others	Indentation ≤ 3.0
Weld groove	Primary Member	Indentation ≤ 2.0
	Others	Indentation ≤ 3.0
	For fillet welding	Indentation ≤ 3.0

- Notch is to be repaired by grinding or welding.
- Short bead is to be avoided.
- Notch on free edge of primary member is to be smoothly ground.

2.2 Dimension

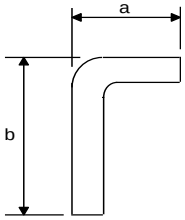
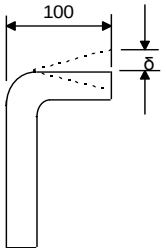
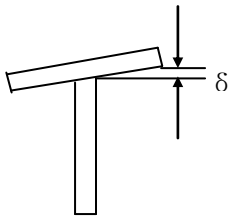
(Unit : mm)

Detail	Standard Range	Tolerance Limit
Length of taper 	ℓ = 3d ± 0.5d	ℓ = 3d ± 1.0d

3. FABRICATION

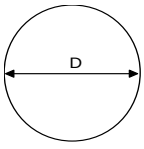
3.1 Flange, longitudinal & flanged bracket

(Unit : mm)

Detail	Standard Range	Tolerance Limit
Breadth of flange 	a : ±3.0 b : ±3.0	a : ±5.0 b : ±5.0
Angle between flange and web 	δ : ±3.0 per 100mm	δ : ±5.0 per 100mm
Angle deflection of built up 		

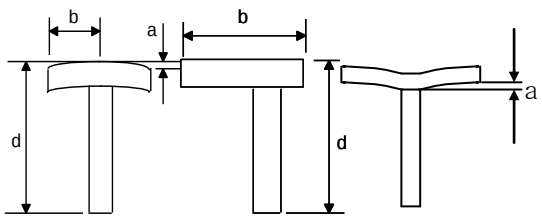
3.2 Plating

(Unit : mm)

For cylindrical structure (mast, post, etc.)	Diameter 	D: $\pm\frac{D}{200}$ But, max. ±5.0	D: $\pm\frac{D}{150}$ But, max. 7.5

3.3 Size of built-up section (girder, stiffener)

(Unit : mm)



$a = 3 + \frac{b}{100}$

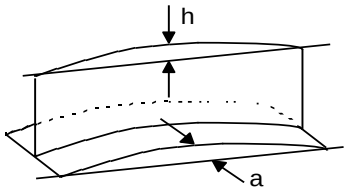
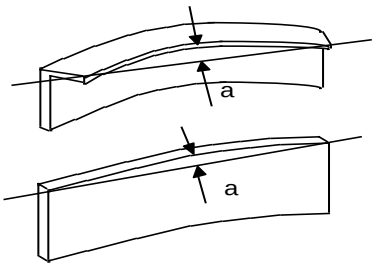
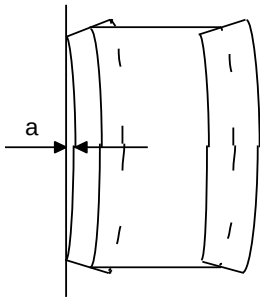
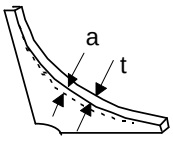
b = design breadth ±5

d = design depth ±5

a ≤3 + b/100 mm	a ≤5 + b/100 mm

3.4 Distortion of girder, stiffener, pillar, cross-tie, etc.

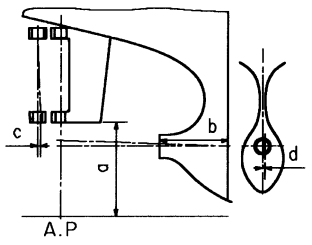
(Unit : mm)

Detail	Standard Range	Tolerance Limit
- Girder at flange and upper edge of web. - Cross-tie 	$h \leq 10$ / 10m $a \leq \frac{1.5\ell}{1000}$ (Max.10mm) (ℓ = length of span)	$h \leq 25$ / 10m $a \leq \frac{2.0\ell}{1000}$ (Max.25mm) (ℓ = length of span)
Stiffener (longitudinal, frame, Bulkhead) 	$\ell \leq 1000$, $a \leq 5$ $1000 < \ell < 3500$, $a \leq 3+2\ell/1000$ $\ell \geq 3500$, $a \leq 10$ (ℓ = length of span)	$\ell \leq 1000$, $a \leq 8$ $1000 < \ell < 3500$, $a \leq 6+2\ell/1000$ $\ell \geq 3500$, $a \leq 13$ (ℓ = length of span)
H-pillar (between decks) 	$a \leq 4$	$a \leq 6$
Tripping bracket and small stiffener  Distortion at the part of free edge	$a \leq \frac{t}{2}$	$a \leq t$

4. ASSEMBLY

4.1 Special sub-assembly

(Unit : mm)

Block ass'y with stern frame	Distance between aft edge of boss and aft peak bulkhead	b : ±5	b : ±10	 C : Twist of plane including center line
	Twist of assembly	c : 5	c : 10	
	Deviation of rudder from shaft center line	d : 4	d : 8	
Rudder	Twist of rudder plate	6	10	Correct or re-assemble partially
Main engine bed	Flatness of top plate of main engine bed	5	10	
	Breadth and length of top plate of main engine bed	±4	±6	

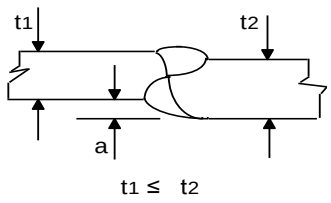
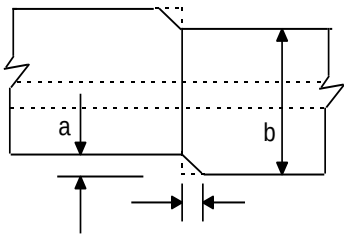
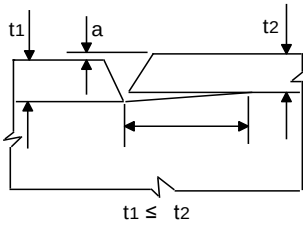
4.2 Temperature for line heating

Steel type	Cooling method	Standard range
● High tensile 50Kg/mm² grade	Water cooling	≤ 650 °C
	Air cooling	≤ 900 °C
● TMCP type 50 HT (Ceq. > 0.38%)	Air cooling,	≤ 900 °C
	Water cooling (after air cooling)	Starting water cooling ≤ 500 °C
● TMCP type 50 HT (Ceq. ≤ 0.38%) - AH to DH grade	Water cooling or air cooling	≤ 1000 °C
● TMCP type 50 HT (Ceq. ≤ 0.38%) - EH grade	Water cooling or air cooling	≤ 900 °C
※ Ceq. is obtained from Mill certificates.		

5. ALIGNMENT AND FINISHING

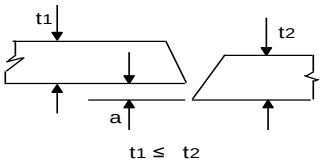
5.1 Fitting accuracy of longitudinal

(Unit : mm)

Detail	Tolerance Limit	Corrections
Web in T-, L- and flat bar longitudinal  	• Main primary member a ≤ 0.15 t1 (max. 3mm) • Secondary member a ≤ 0.2 t1 (max.3.0mm)	When a > 0.15t1(Primary member) and a > 0.2t1(Secondary member), or a > 3.0 additional welding smoothly or release and adjust the plate. The plate is to be released min. 30 x a.
Breadth of flange in T-longitudinal  	a ≤ 0.04b (max. 8mm)	When 0.04b < a ≤ 0.08b, grind corners to smooth taper over distance min. 30 x a. when a > 0.08b, release and adjust the plate. The plate is to be released min. 50 x a.
Flange (The height of web varies)  	• Main primary member a ≤ 0.2 t1 (max. 4mm) • Secondary member a ≤ 0.3 t1 (max. 4mm)	When a > 0.2t1(Primary member) and a > 0.3t1(Secondary member), additional welding smoothly or release and adjust the plate. The plate is to be released min. 20 x a.

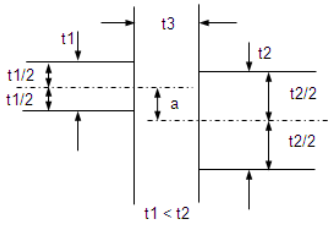
5.2 Misalignment of butt joint

(Unit : mm)

 	• Main primary member a ≤ 0.15 t1 (max. 4mm) • Secondary member a ≤ 0.2 t1 (max. 4mm)	When a > 0.15t1(Primary member)/ a > 0.2t1(Secondary member), or a > 4mm additional welding smoothly or release and adjust the plate.

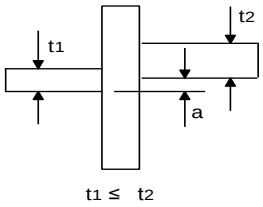
5.3 Fitting of corrugated bulkhead

(Unit : mm)

Detail	Tolerance Limit	Corrections
	Strength member and higher stress member $a \leq t1/3$ Others $a \leq t1/2$ Where t_3 is less than t_1, then t_3 should be substituted for t_1 in the standard.	Strength member and higher stress member: t1/3<a≤t1/2 – generally increase weld throat by 10% a>t1/2 – release and adjust over a minimum of 50a Other: a>t1/2 – release and adjust over a minimum of 30a

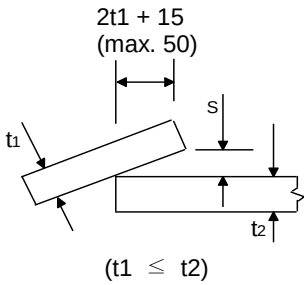
5.4 Fitting of cruciform joint

(Unit : mm)

	Longi. members within 0.6L and principal transverse supporting members $a \leq t1/3$	When $t1/3 < a \leq t1/2$, weld throat shall be increased by 10%. When $a > t1/2$, release over distance of Min. 50 x a, and adjust the members.
	Others $a \leq t1/2$	When $a > t1/2$, release over distance of Min. 30 x a, and adjust the members.

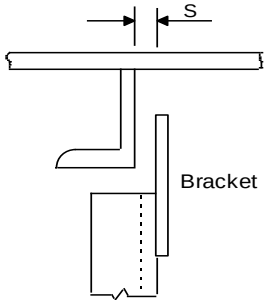
5.5 Gap for overlap joint

(Unit : mm)

	Weld throat(a) $a \leq 4$ $s \leq 2$ $a > 4$ $s \leq 3$	When $3 < s \leq 5$, the weld throat is to be increased as much as the increase of gap opening exceeding 3mm. When $s > 5$, release and adjust.

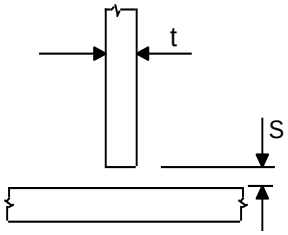
5.6 Gap for bracket

(Unit : mm)

Detail	Tolerance Limit	Corrections
	Weld throat(a) $a \leq 4$ $s \leq 2$ $a > 4$ $s \leq 5$	When $3 < s \leq 5$, the weld throat is to be increased as much as the increase of gap opening exceeding 3mm. When $s > 5$, release and adjust..

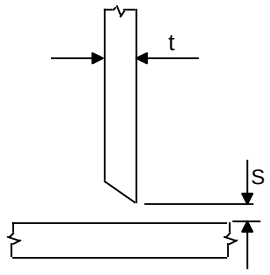
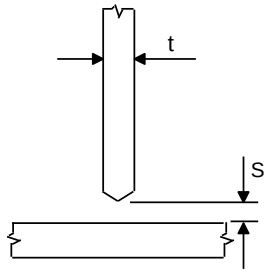
5.7 Gap for fillet joint

(Unit : mm)

Fillet 	Weld throat < 4, $s \leq 2$ Weld throat ≥ 4, $s \leq 3$	1. When $3 < s \leq 5$, the weld throat is to be increased as much as the increase of gap opening exceeding 3mm. 2. When $5 < s \leq 16$ (max. 1.5t), chamfer $30^{o} \sim 45^{o}$ and build up by welding with/without ceramic backing or flat bar. 3. When $16 < s$ or $s > 1.5t$, new plate is to be inserted min. 300mm wide or repair in accordance with the agreed procedure.

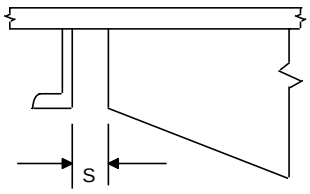
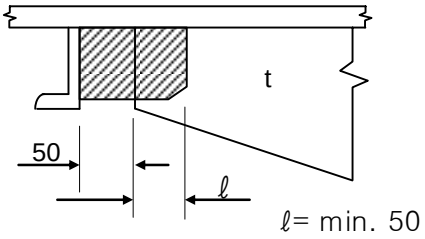
(5.7 Gap for fillet joint)

(Unit : mm)

Detail	Tolerance Limit	Corrections
Single V groove  Double bevel groove  	s ≤ 3 s ≤ 3	1. When 3 < s ≤ 16 (max. 1.5t), build up by welding with/without ceramic backing or flat bar. 2. After welding, remove flat bar/ ceramic backing and complete back side welding. 3. When 16 < s or s > 1.5t, new plate is to be inserted min. 300mm wide or repair in accordance with the agreed procedure.

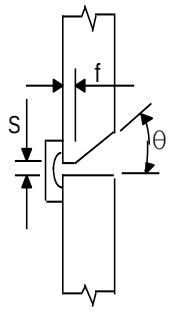
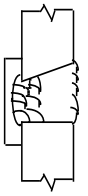
5.8 Gap for bracket, frame, beam, stiffener, etc.

(Unit : mm)

Detail	Tolerance Limit	Corrections
	$s \leq 3$	1. When $3 < s \leq 5$, the weld throat is to be increased as much as the increase of gap opening exceeding 3mm. 2. When $5 < s \leq 16$(Max. 1.5t), bevel $30^{o} \sim 45^{o}$ and build up by welding. 3. When $s > 16$(Max. 1.5t), fit the collar plate after cutting of nib up to 50mm gap. 

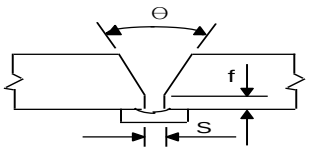
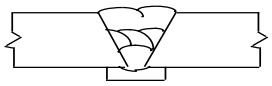
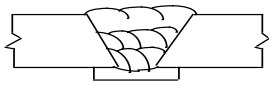
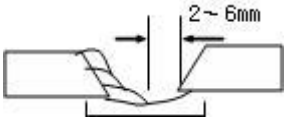
5.9 Gap for butt joint (for FCAW, GMAW)

(Unit : mm)

Detail	Standard Range	Corrections
Horizontal position 	$\Theta = 30 \sim 45^{o}$ f = 0 ~ 2 s = 3 ~ 8	1. When $8 < s \leq 25$ (Max. 1.5t)  2. When $s > 25$ or $s > 1.5t$, new plate is to be inserted with min. 300mm wide or repair in accordance with the agreed procedure.

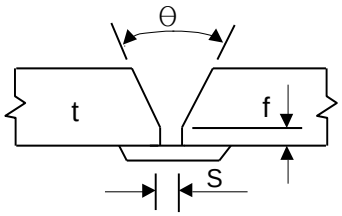
(5.9 Gap for butt joint (for FCAW, GMAW))

(Unit : mm)

Detail	Standard Range	Corrections
Flat / vertical position 	■ **For general** θ= 30~50° f = 0～2 s = 3~12	1. When 12＜s≤16  2. When 16＜s≤25 (Max. 1.5t)  3. When s＞25 or s＞1.5t, new plate is to be inserted with min. 300mm wide or repair in accordance with the agreed procedure.
	■ **For low temp. steel (L to LHSA)** θ= 35~65° f = 0～2 s = 2~6	1. When 6＜s≤12  2. When 12＜s≤16 (Max. 1.5t)  3. When s＞16 or s＞1.5t, new plate is to be inserted with min. 300mm wide or repair in accordance with the agreed procedure.

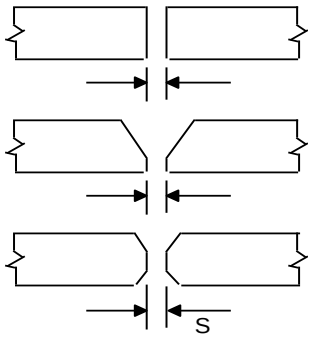
5.10 Gap for butt joint (for E.G.W)

(Unit : mm)

Detail	Standard Range
Vertical position 	t: **11≤t≤25** → **20~40°**; **25<t≤50** → **20~30°(25<t≤40)**, **18~25°(40<t≤50)** θ: **20~40°** / **20~30°(25<t≤40)**, **18~25°(40<t≤50)** f: **0~2** / **0~2** s: **6~14** / **6~14**

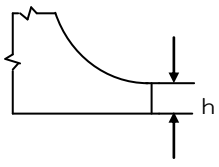
5.11 Gap for butt joint (for S.A.W)

(Unit : mm)

Detail	Standard Range	Corrections
Flat position 	s≤0.8	1. When 0.8<s≤ 5, : Sealing bead is to be done. 2. When s>5, : Re-fitting.

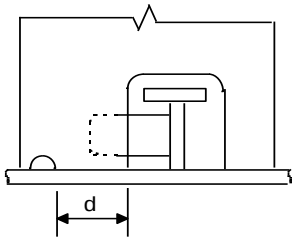
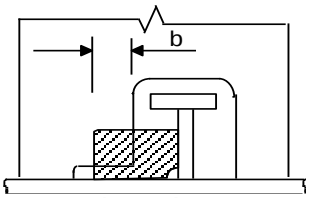
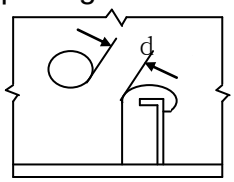
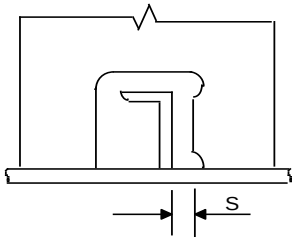
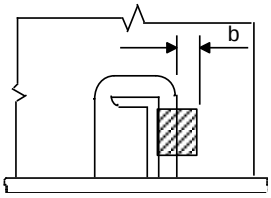
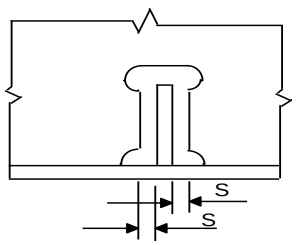
5.12 Height of bracket toe.

(Unit : mm)

Detail	Standard Range	Corrections
	**Designed** **h ±5**	

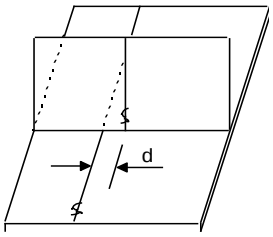
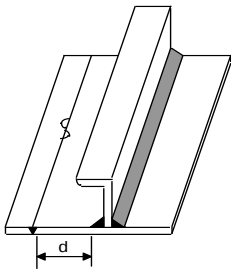
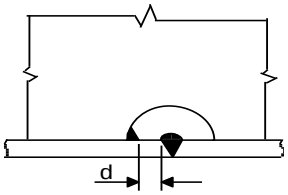
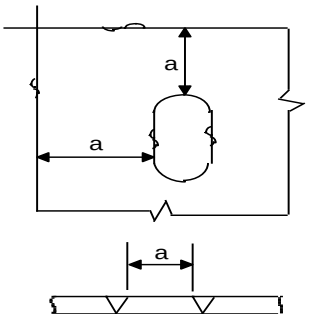
5.13 Slot holes

(Unit : mm)

Detail	Standard Range	Tolerance Limit	Corrections
Position of scallop 		d ≥ 75	When d < 75, web plate is to be cut between scallop and slot hole, And fit the collar plate as per following Fig.  b : min. 50
Distance between slot opening and hole. 			When d is not sufficient enough, correction shall be done in accordance with design practice.
Gap 	s ≤ 2	s ≤ 3	1. When 3 < s ≤ 5, weld throat to be increased as much as increase of gap opening exceeding 3mm. 2. When 5 < s ≤ 10, nib to be chamfered and built up by welding 3. When s > 10, cut off nib and fit the collar plate with the same height as the nib. (20 < b ≤ 50) 
	s ≤ 2	s ≤ 3	

5.14 Distance between welds

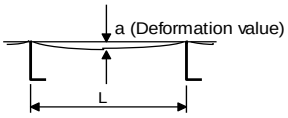
(Unit : mm)

Detail	Tolerance Limit	Corrections
A. Distance between two butt welds 	$d \geq 0$	
B. Distance between butt weld and fillet weld 	Primary structure $d \geq 10$ Secondary structure $d > 0$ Distance 'd' is only for access when fillet is welded first.	When butt is welded first, the weld is to be ground if fillet welds are on or closed to the welding seam.
C. Scallops over welding seams 	Primary structure $d \geq 5$ Secondary structure $d \geq 0$	Primary structure : If $d < 5$, enlarge scallop to obtain distance between welds.
D. Distance between two butt welds 	$a \geq 30$	

6. UNFAIRNESS

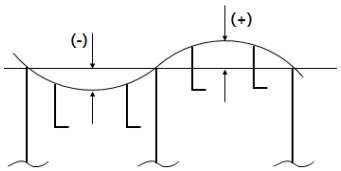
6.1 Deformation

(Unit : mm)

Detail		Standard Range	Tolerance Limit	Remarks
Shell plate	Parallel part (Side & bottom shell)	4	8	L is one stiffener, frame, or longi. space.  If L > 3 meter, the tolerance should be applied to the table of 6.2 "Deformation per basic length". In case thickness of interior plate is 8mm and less, the tolerance is to be added to 2mm.
	Fore and aft part	5		
Tank top plate		4		
Bulkhead	Longi. bulkhead Trans. bulkhead Swash bulkhead	6		
Strength deck	Parallel part (Between 0.6L)	4		
	Fore and aft part	6	9	
	Covered part	7	9	
Second deck	Bare part	6	8	
	Covered part	7	9	
	Liftable car deck Light car deck Vent truck wall	7	9	
Fore-castle deck Poop deck	Bare part	4	8	
	Covered part	6	9	
Superstructure deck	Bare part	4	6	
	Covered part	7	9	
House wall	Outside wall	4	6	
	Inside wall	6	8	
	Covered part	7	9	
Secondary member (web of girder, etc.)		5	7	
Floor and girder of double bottom		5	8	

6.2 Deformation per basic length

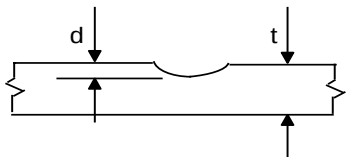
(Unit : mm)

Detail		Standard Range	Tolerance Limit	Remarks
Shell plate	Parallel part	±2L/1000	±3L/1000	Basic length L is one transverse space. (min. 3 meters) 
	Fore and aft part	±3L/1000	±4L/1000	
Deck, Tank top of double bottom		±3L/1000	±4L/1000	
Bulkheads		±4L/1000	±5L/1000	
Accommodation & Others		±5L/1000	±6L/1000	

7. SURFACE FINISH CONDITION

7.1 Surface defects on plate

(Unit : mm)

Detail	Tolerance Limit	Correction
 - Soft round - Sharp buckles and/or surface flaws in plate	d ≤ 0.07t (max. 3mm)	1. When d ≤ 0.07t(max. 3mm) defects are to be ground off. 2. When d > tolerance limit, defects are to be ground off but not deeper than 0.2t and welded smoothly. - Exposed area(weather exposed area, main access way of engine room and workroom) : remove the weld beads. - Others : remain the weld beads.

7.2 Disposal of Scaffolding piece

<table>
<tr><th>Location</th><th>Removal type</th><th>Corrections</th></tr>
<tr><td>Exposed area

- Exposed surface of shell, decks, living quarters

- Outer surface of super structure and funnel

- Top/Inside of deck store</td><td>

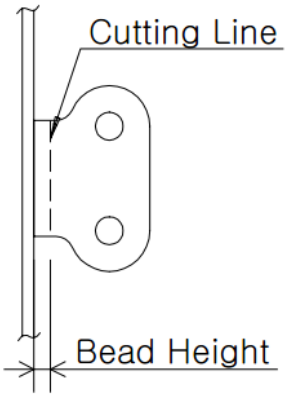
X

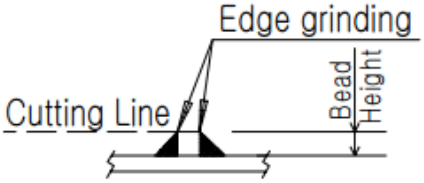
X

△</td><td rowspan="5">

<u>Type X :</u>
After removing piece, make it as shown para. 7.1."Surface defect on plate".

<u>Type △ :</u>
The piece shall be cut above the beads, and sharp edges shall be ground.
All around welding shall be done.

<u>Type ○ :</u>
The piece shall be remained as it is, but all around welding shall be done.</td></tr>
<tr><td>Inside of accommodation

- Behind ceiling and lining
• Lower than ceiling depth
• Higher than ceiling depth

- Without ceiling and lining

- Deck covering</td><td>

○
△

△

X</td></tr>
<tr><td>Inside of engine room (including Inside of engine casing and funnel), Steering gear room, Pump room, Fore body and other work shop.

- Deck without any covering

- Deck under grating floor

- Under up to 2.0 meter height above passage floor (Only main passage and equipment operation area)

- Other area</td><td>

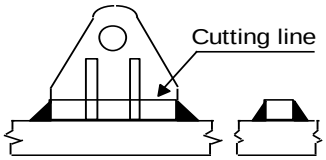
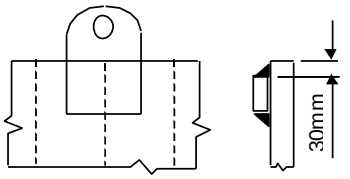
X

△

△

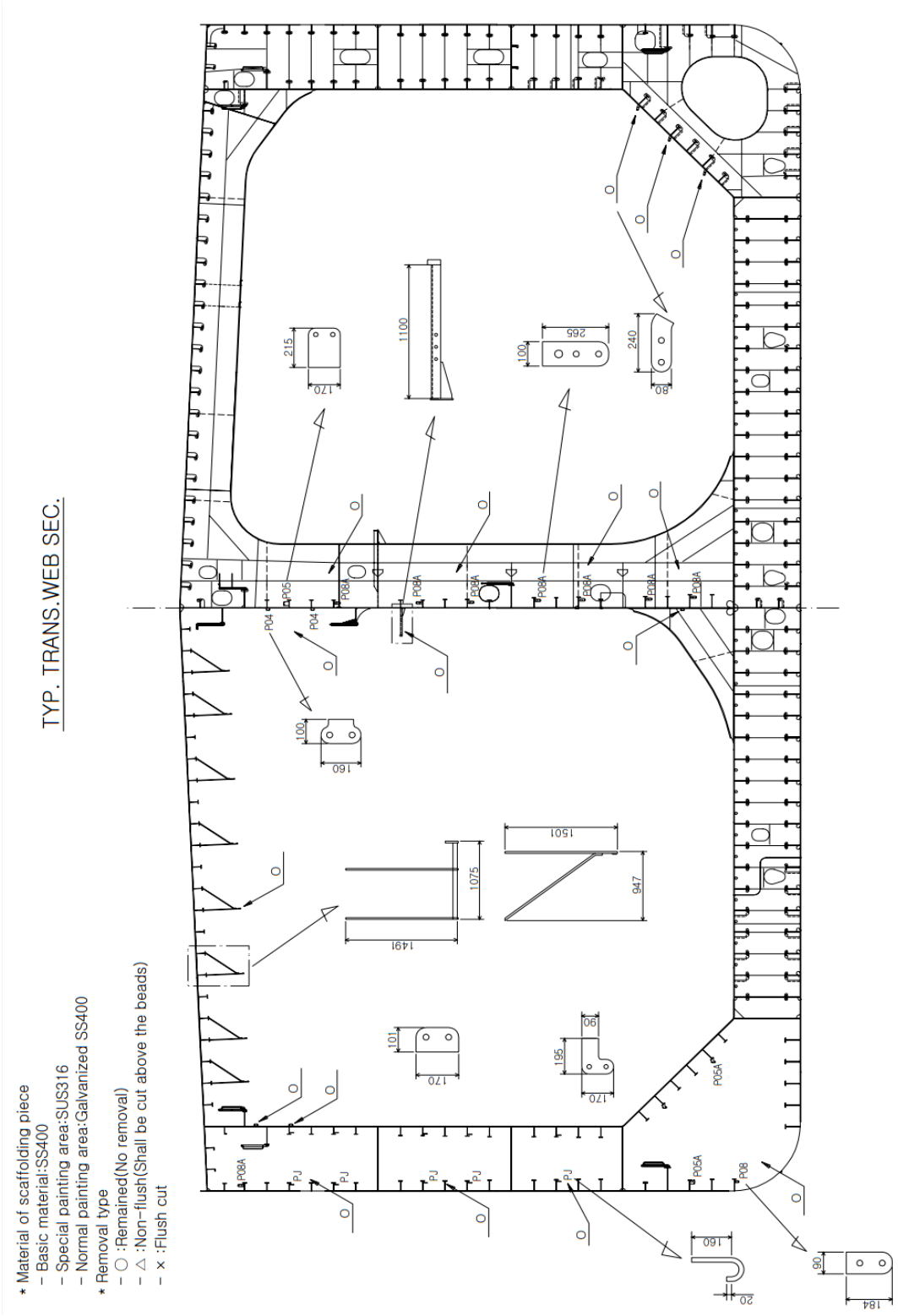
○</td></tr>
<tr><td>Inside of chain locker</td><td>X</td></tr>
<tr><td>Fresh water tank(SUS 316 material)
Cofferdams, Void space, Oil tanks and Others</td><td>○
○</td></tr>
<tr><td>In cargo tanks, ballast tanks and Specified area on attached DWG</td><td>Details are as following DWG.</td></tr>
</table>

7.3 Disposal of lifting lug

Location	Removal type	Corrections
Exposed area		Type **X** : After removing piece, make it as shown para. 7.1."Surface defect on plate".
- Exposed surface of shell, decks, living quarters	**X**	
- Outer surface of super structure and funnel	**X**	
- Top/Inside of deck store	△	
Inside of accommodation		Type △ : The piece shall be cut above the beads, and sharp edges shall be ground. All around welding shall be done. 
- Behind ceiling and lining • Lower than ceiling depth • Higher than ceiling depth	○ △	
- Without ceiling and lining	△	
- Deck covering	**X**	
Inside of engine room (including Inside of engine casing and funnel), Steering gear room, Pump room, Bosun store and other work shop.		Type □ : The extruded part of the "lapped type lug" is to be cut off and welded as below sketch, and sharp edges shall be ground. 
- Deck without any covering	**X**	
- Deck under grating floor	△ or □	
- Under up to 2.0 meter height above passage floor (Only main passage and equipment operation area)	△	
- Other area	○	
Access trunk and chain locker	**X**	Type ○ : The piece shall be remained as it is, but all around welding shall be done. (Ordinary lifting lug, Lashing eyes, Rib bracket and hand grips/steps)
Fresh water tank(SUS 316 material)	○	
Cofferdams, Void space and others	○	
In cargo tanks and ballast tanks	Details are as following DWG.	

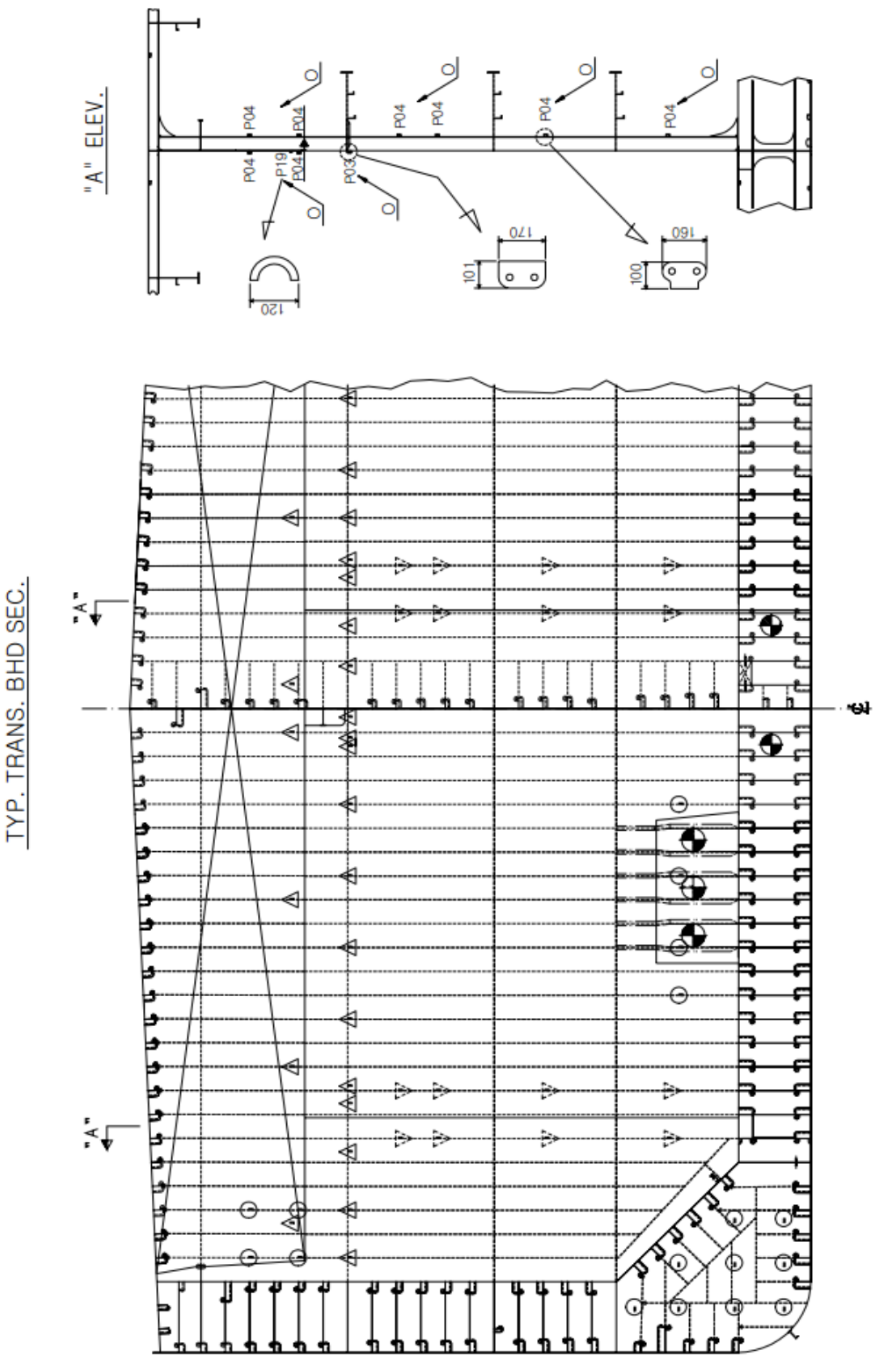
(7.2 Disposal of scaffolding piece)

COT (1)



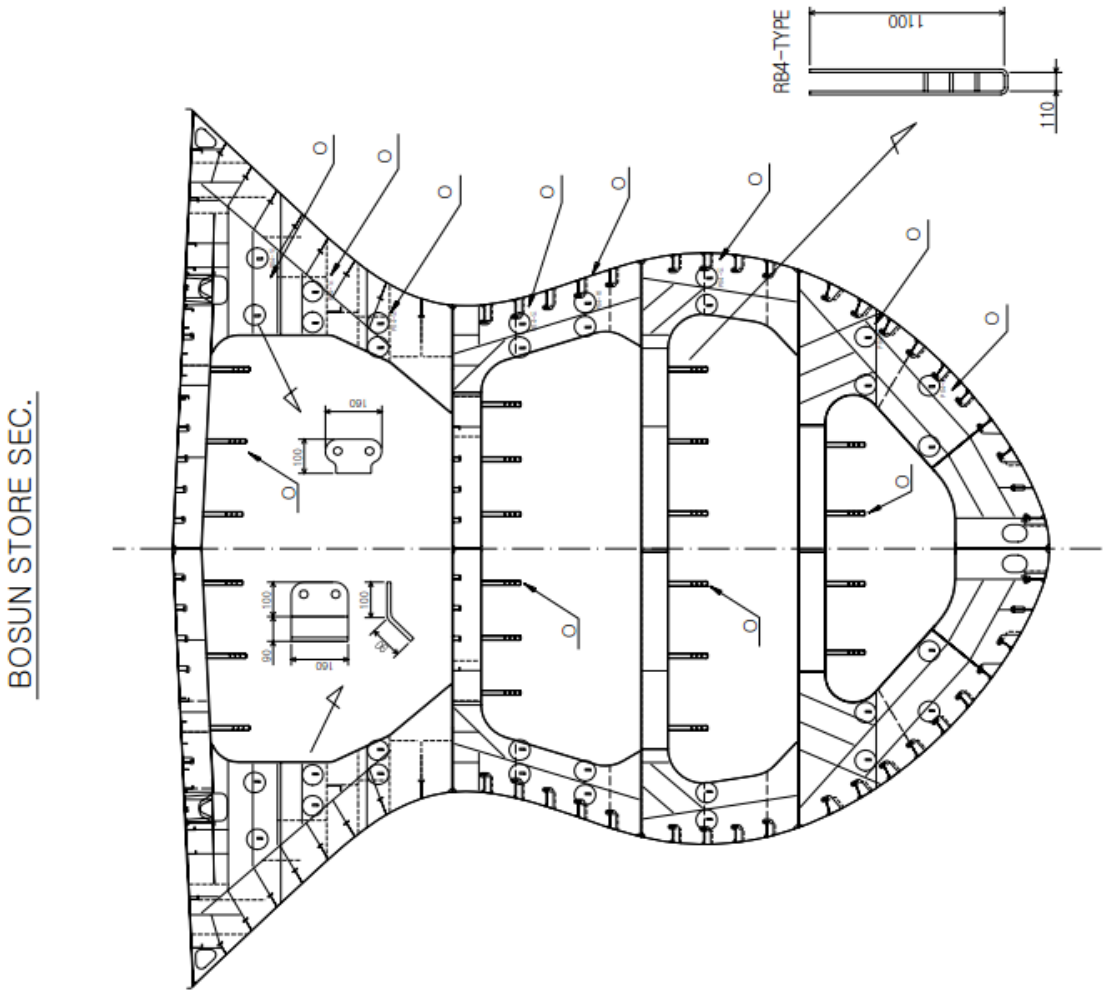
(7.2 Disposal of scaffolding piece)

COT (2)



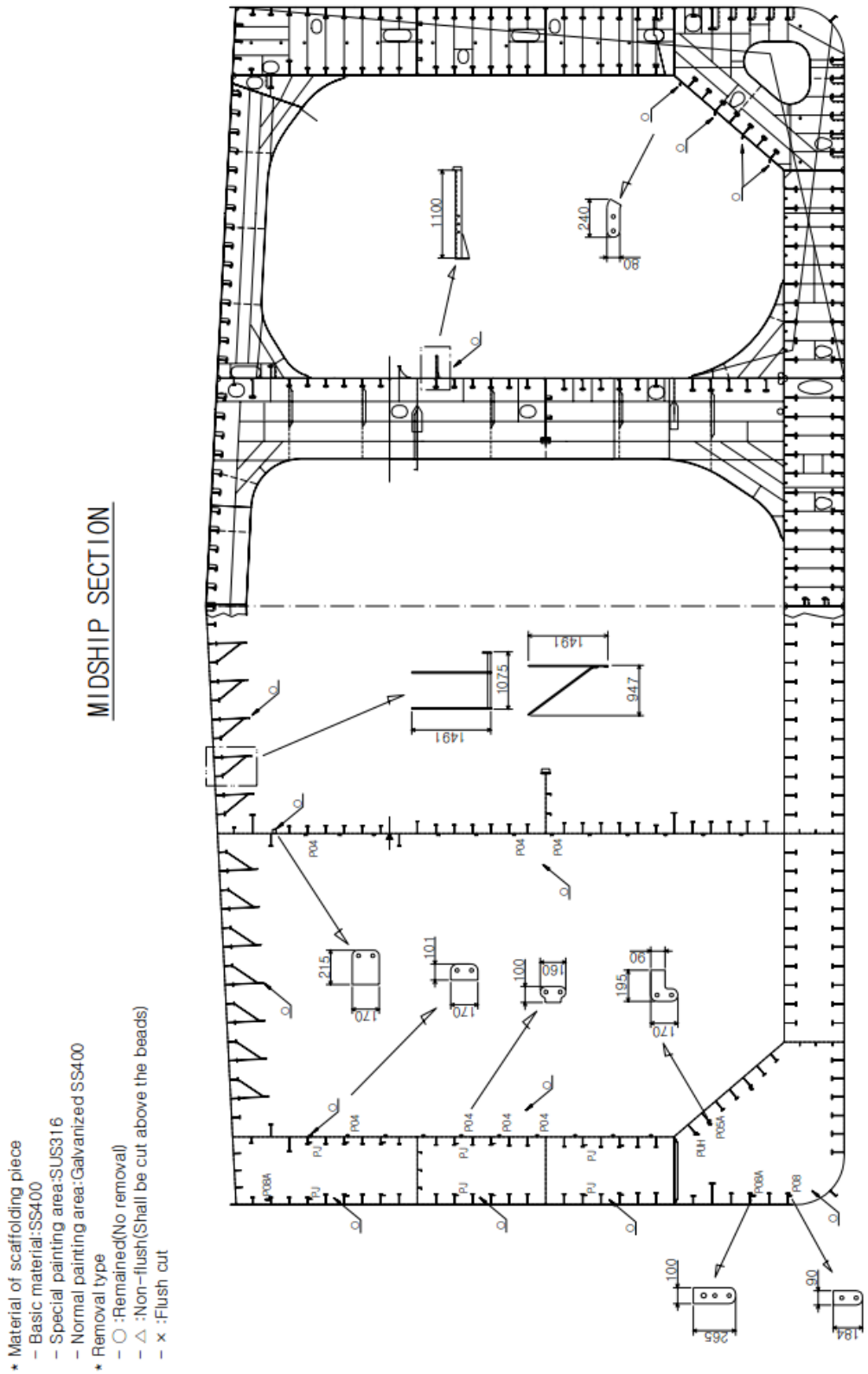
(7.2 Disposal of scaffolding piece)

COT (3)



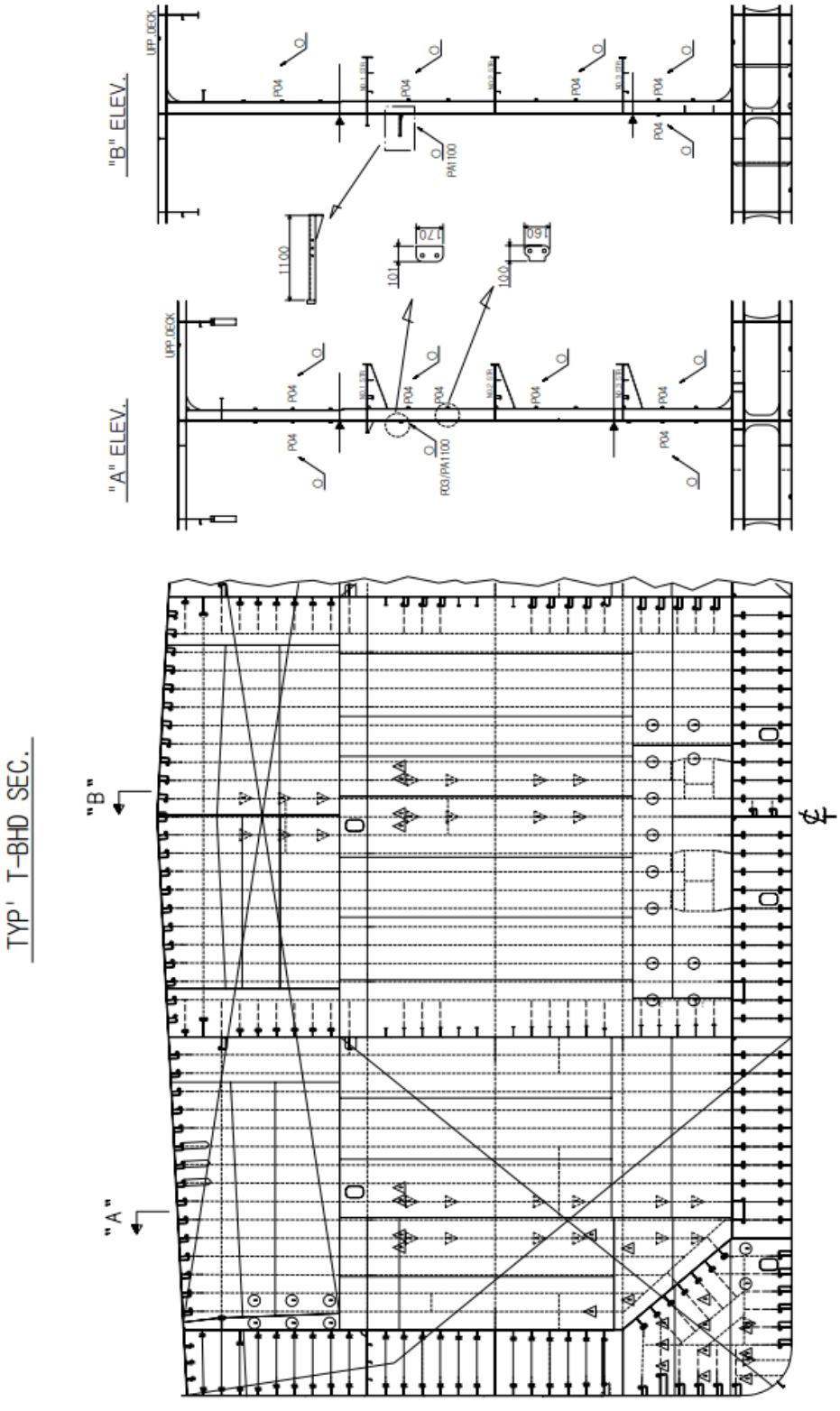
(7.2 Disposal of scaffolding piece)

VLCC (1)



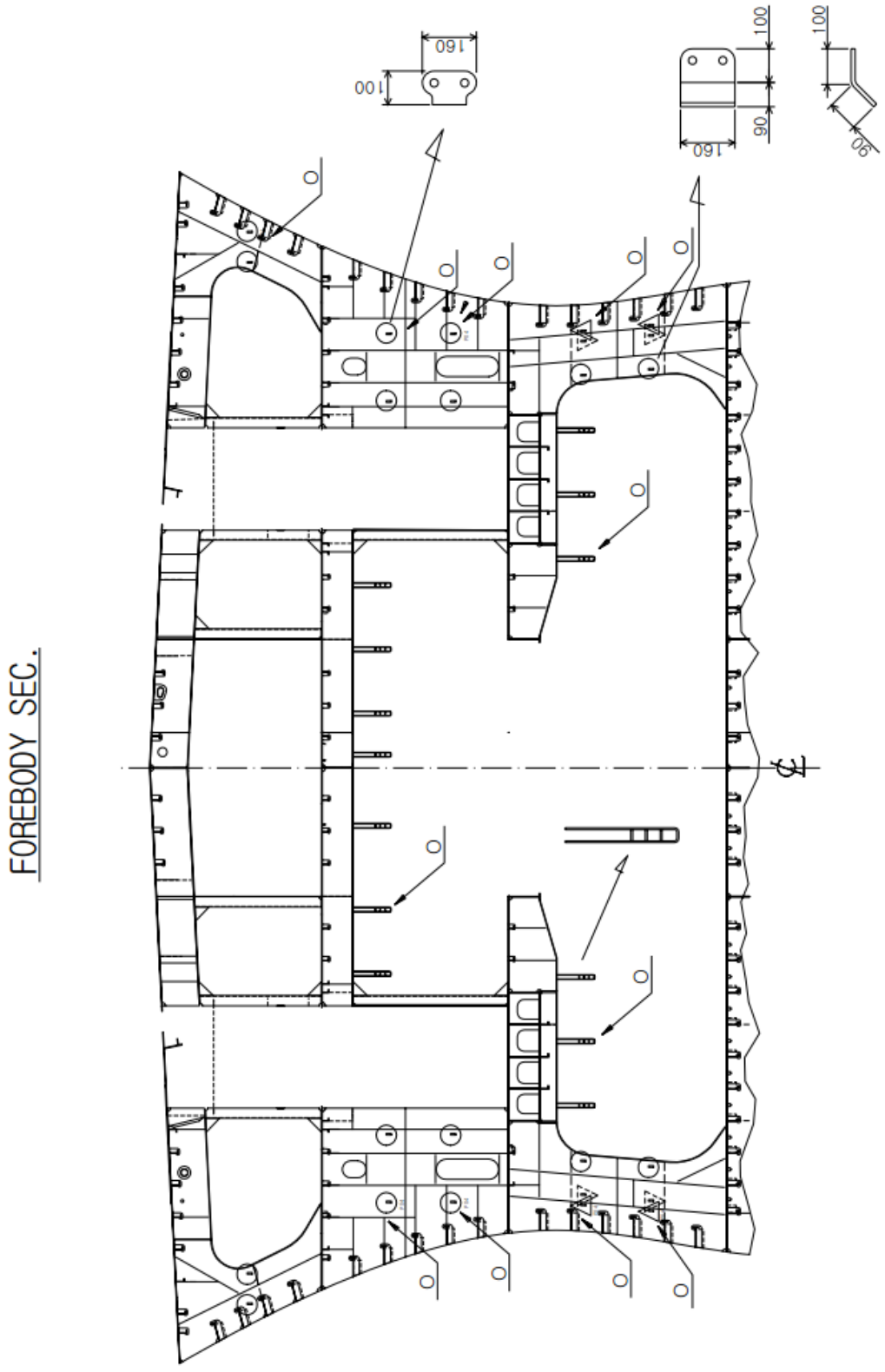
(7.2 Disposal of scaffolding piece)

VLCC (2)



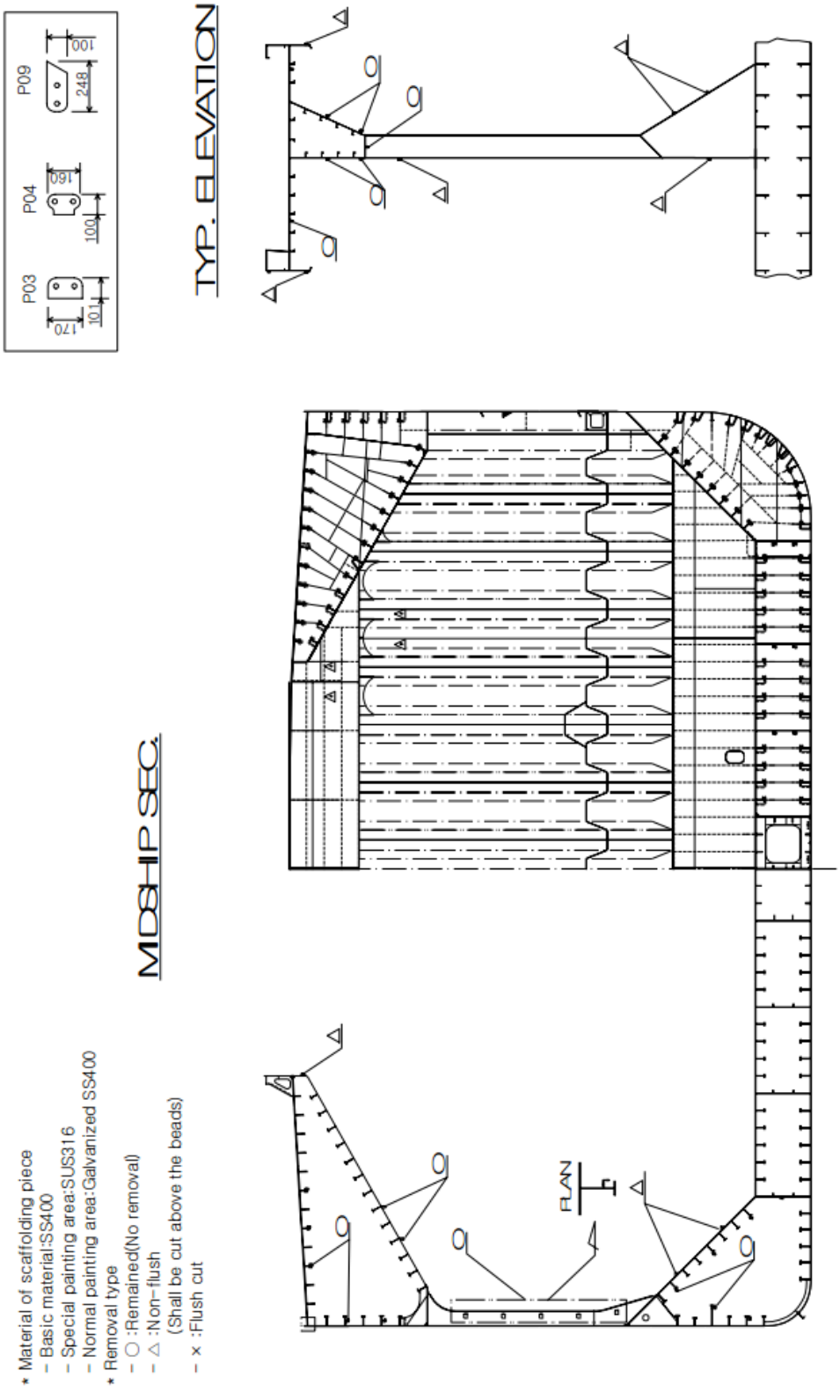
(7.2 Disposal of scaffolding piece)

VLCC (3)



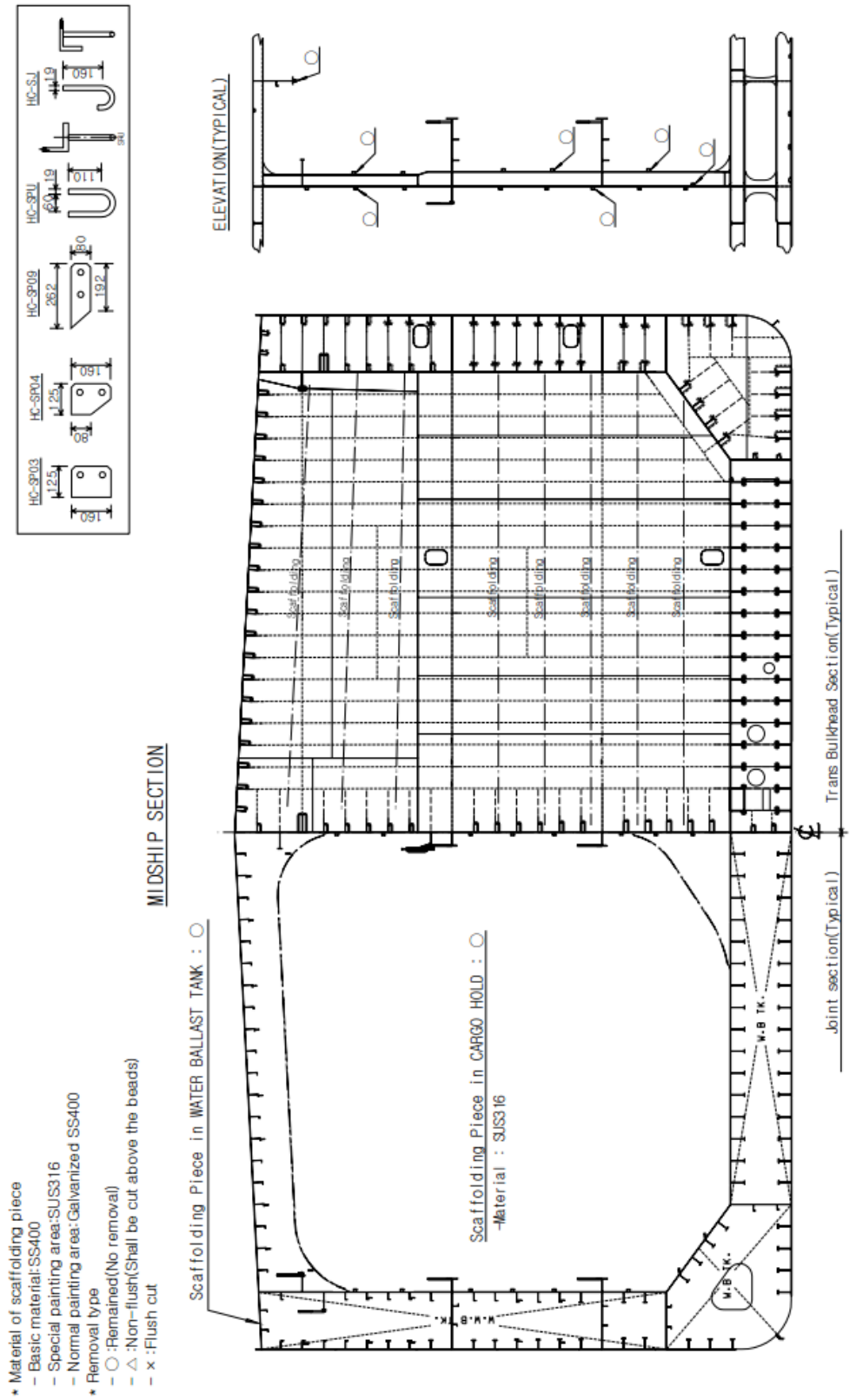
(7.2 Disposal of scaffolding piece)

BULK CARRIER



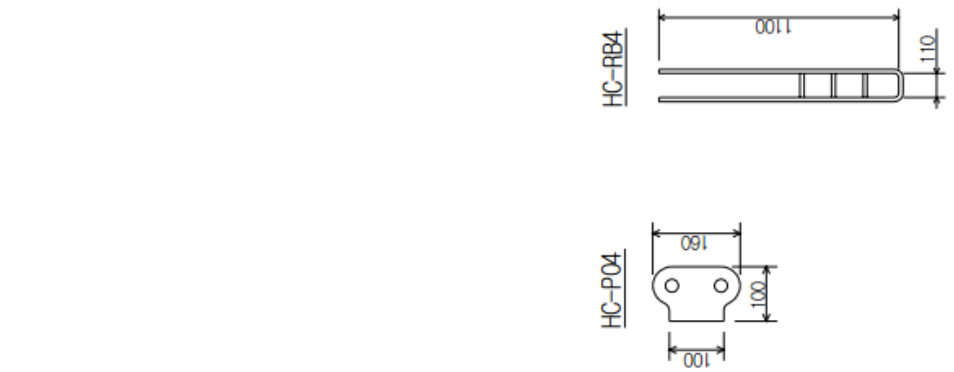
(7.2 Disposal of scaffolding piece)

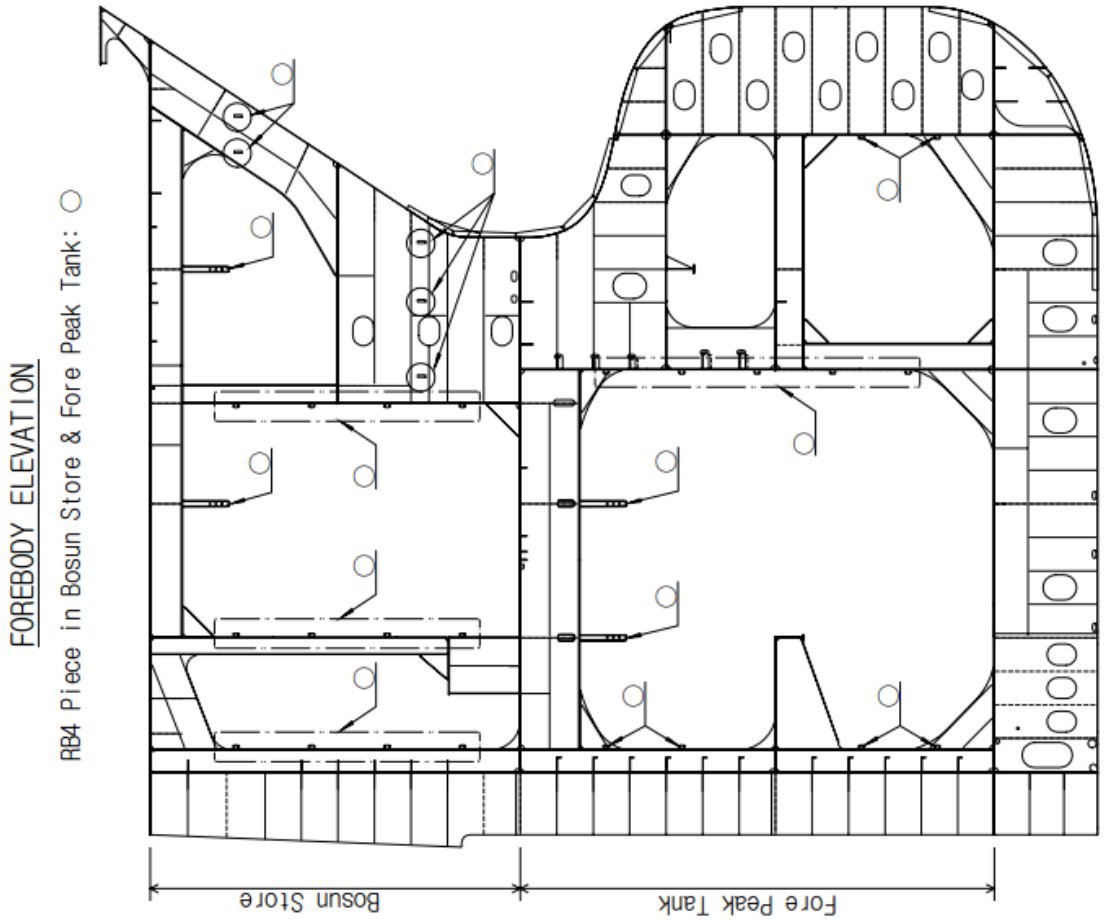
PRODUCT CARRIER (1)



(7.2 Disposal of scaffolding piece)

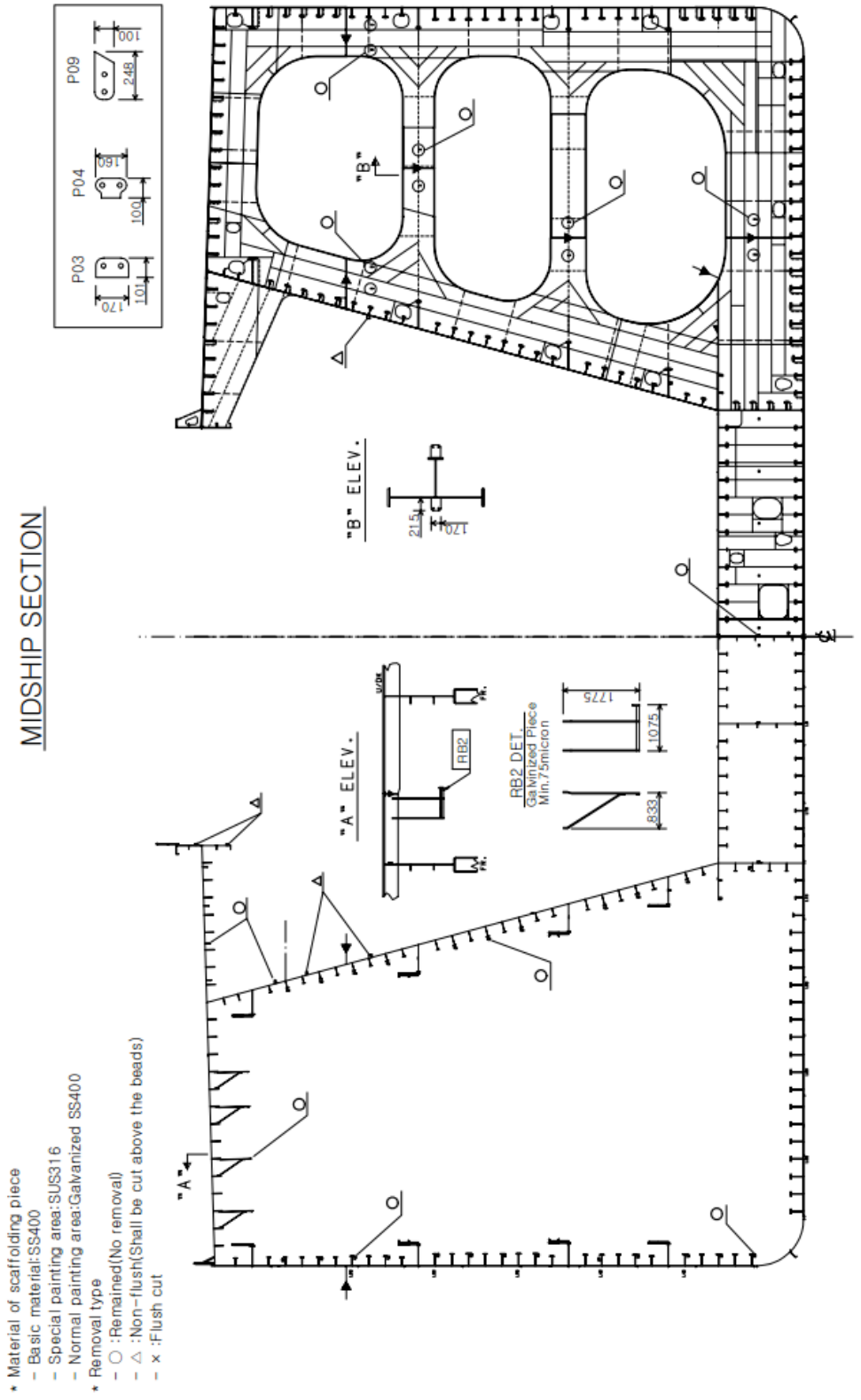
PRODUCT CARRIER (2)





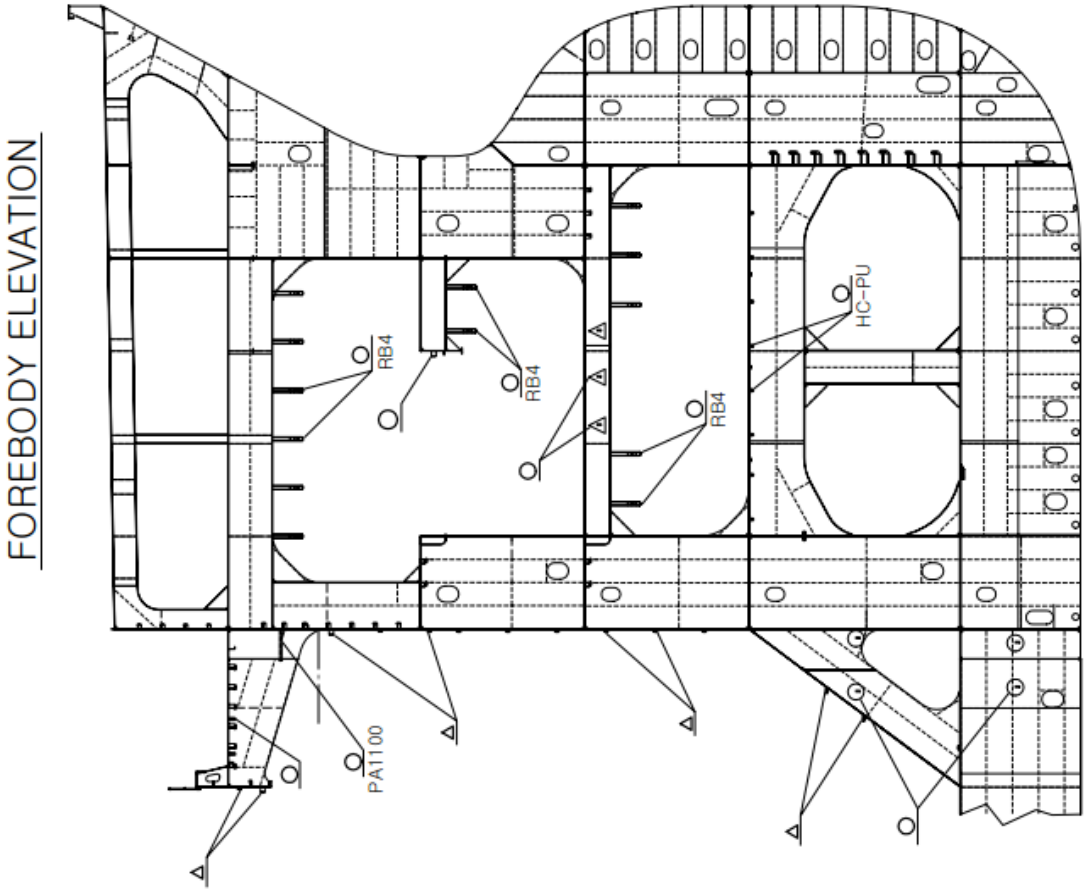
(7.2 Disposal of scaffolding piece)

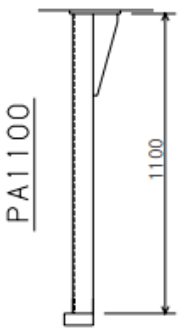
VLOC (1)

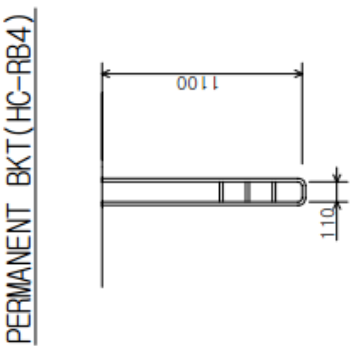


(7.2 Disposal of scaffolding piece)

VLOC (2)

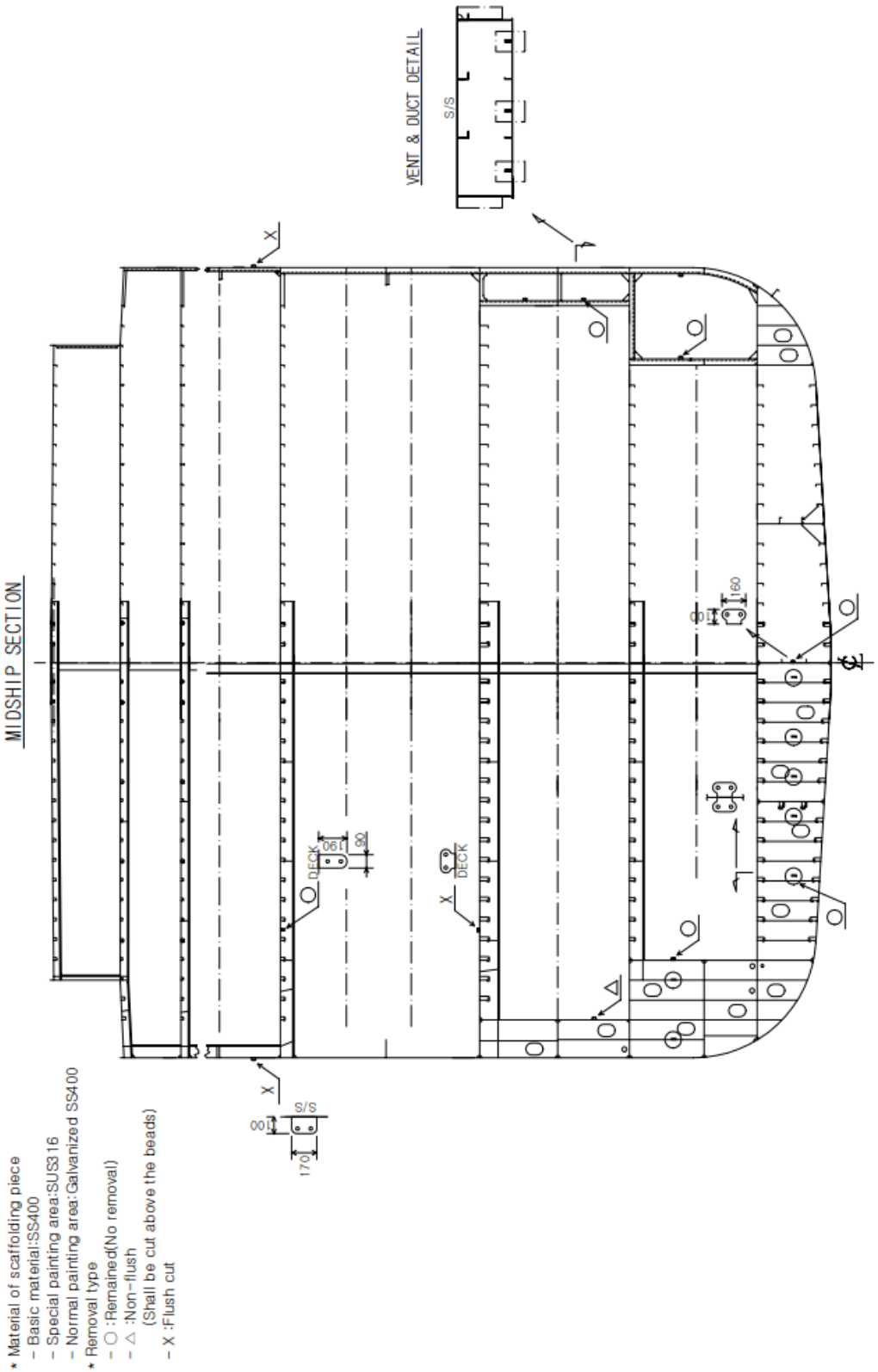






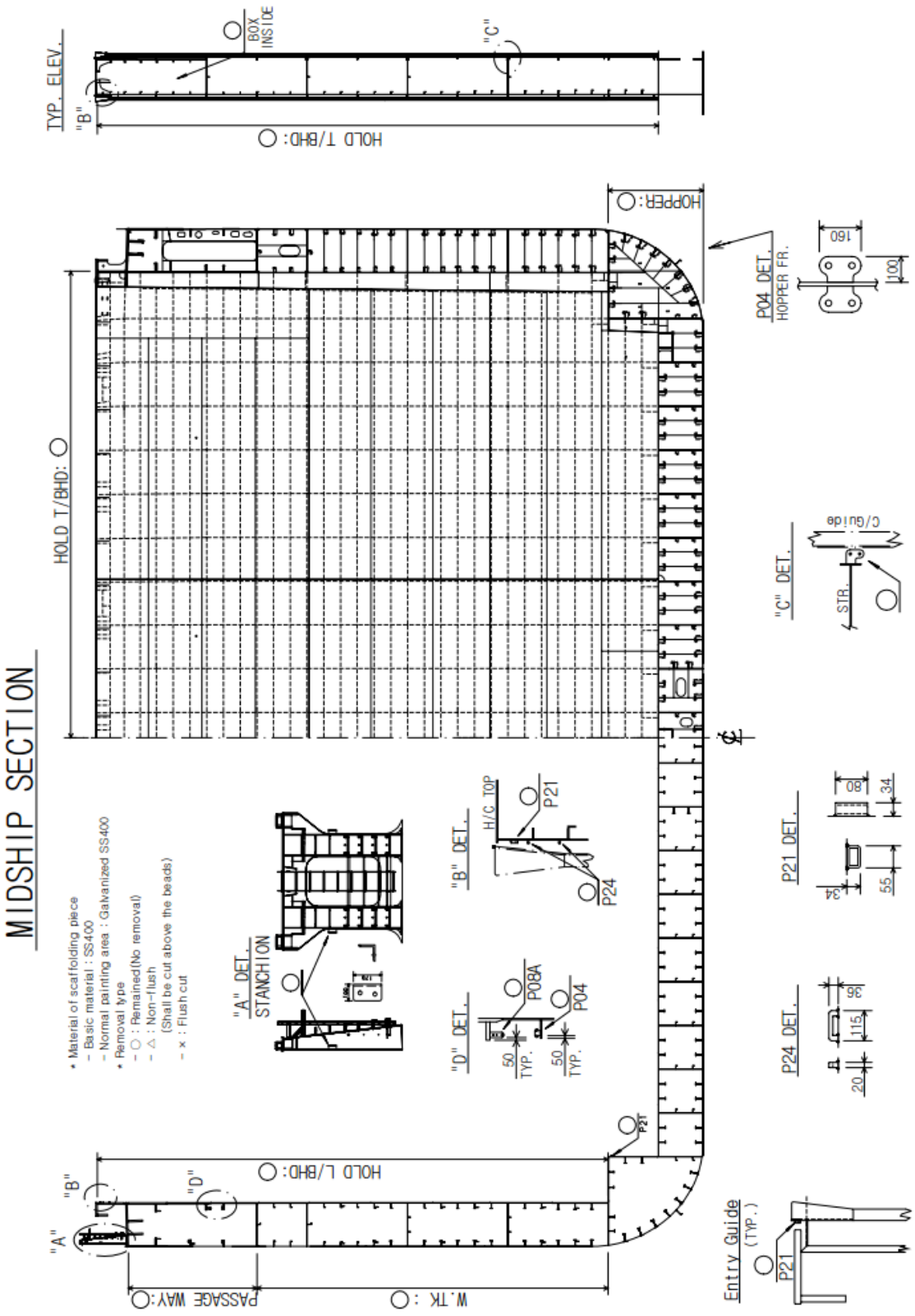
(7.2 Disposal of scaffolding piece)

RO-RO VESSEL



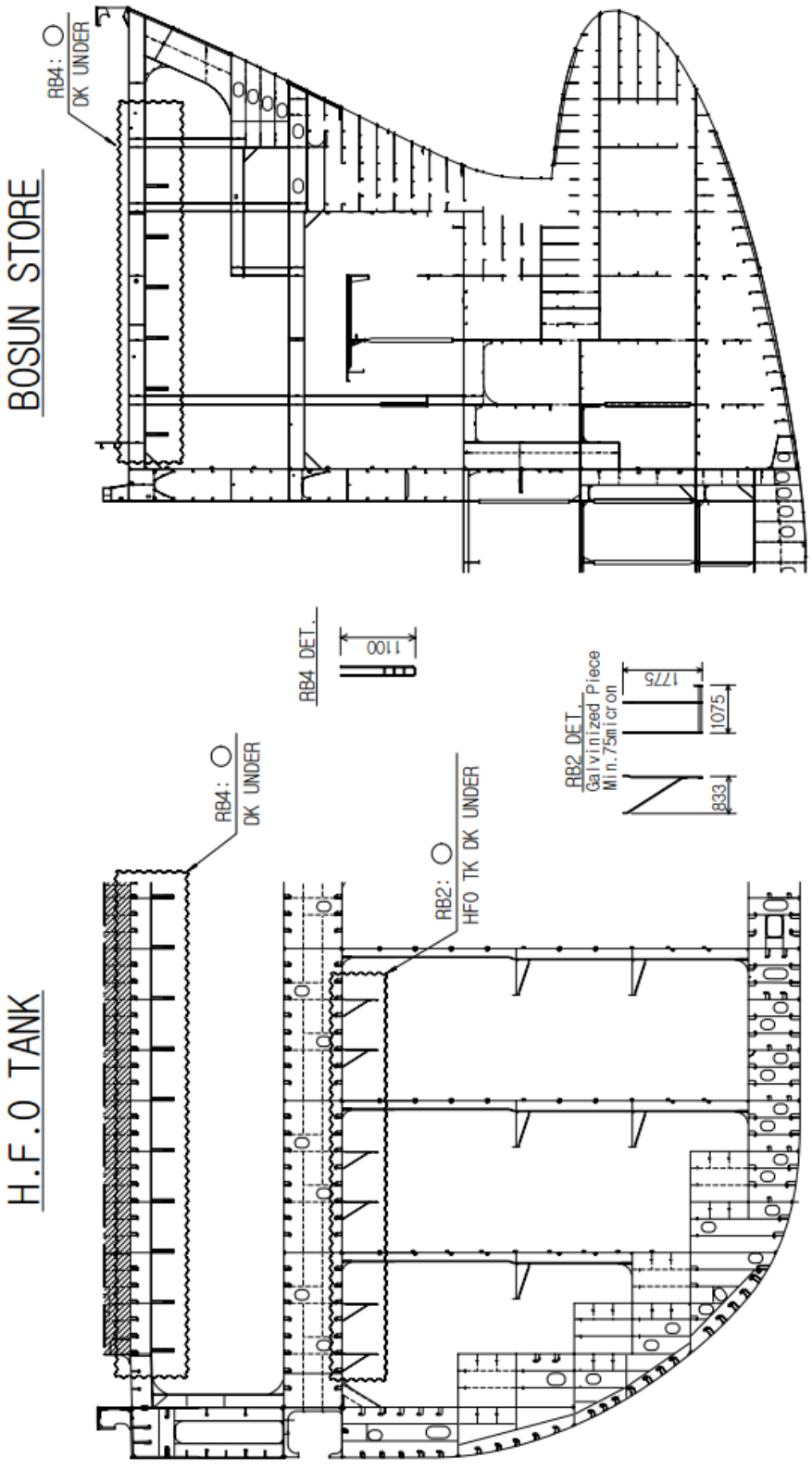
(7.2 Disposal of scaffolding piece)

CONTAINER SHIP (1)



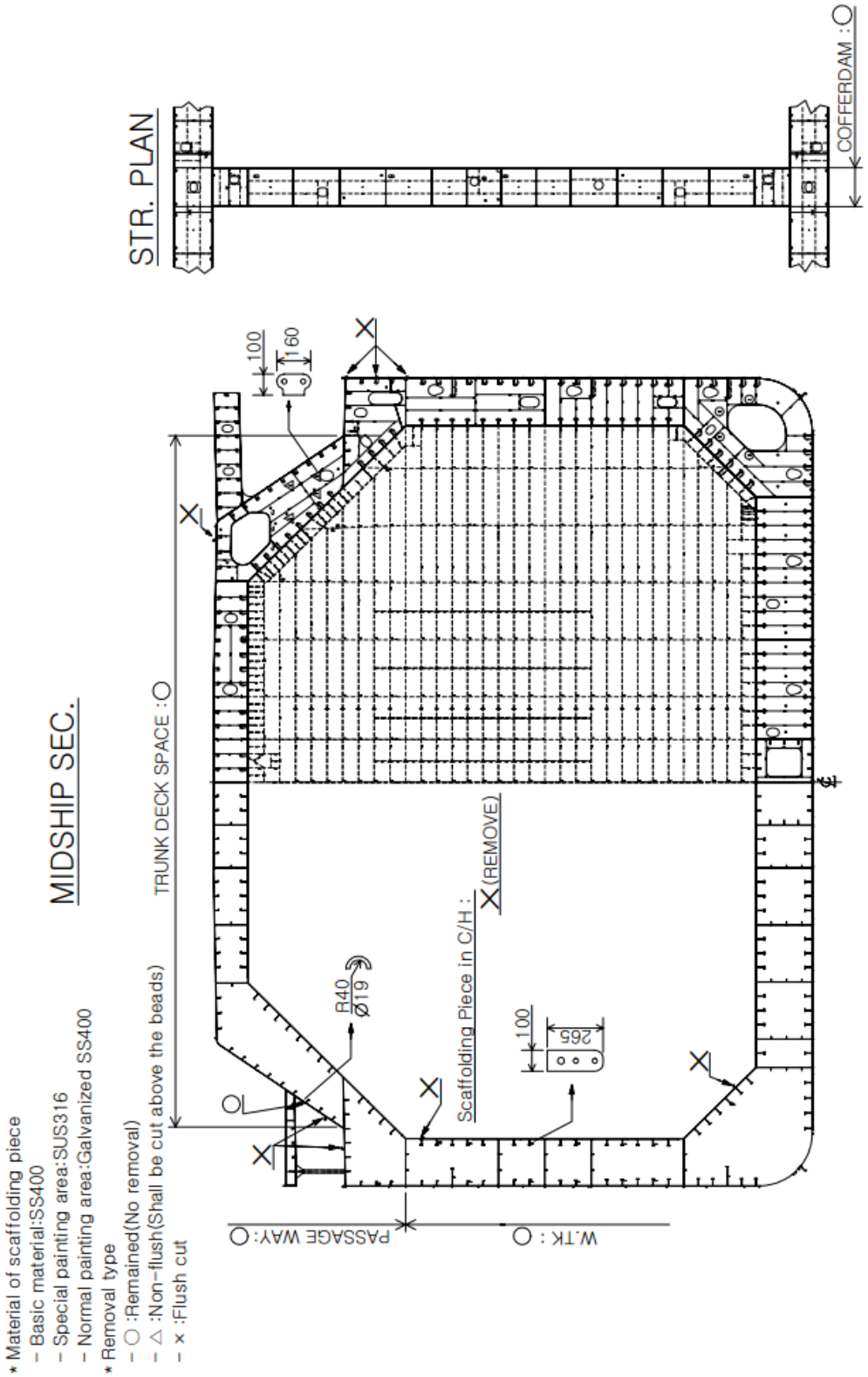
(7.2 Disposal of scaffolding piece)

CONTAINER SHIP (2)



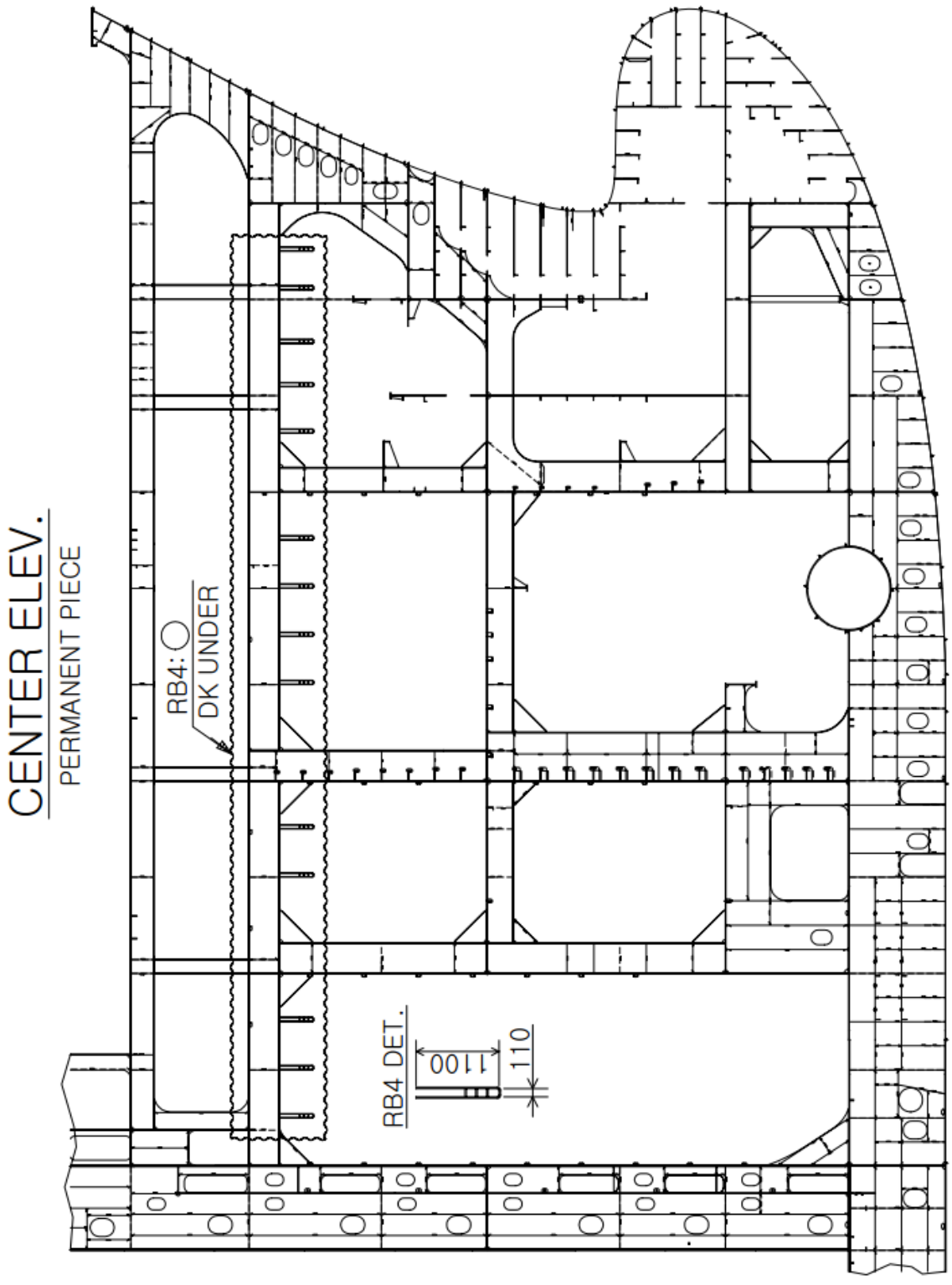
(7.2 Disposal of scaffolding piece)

LNG CARRIER (1)



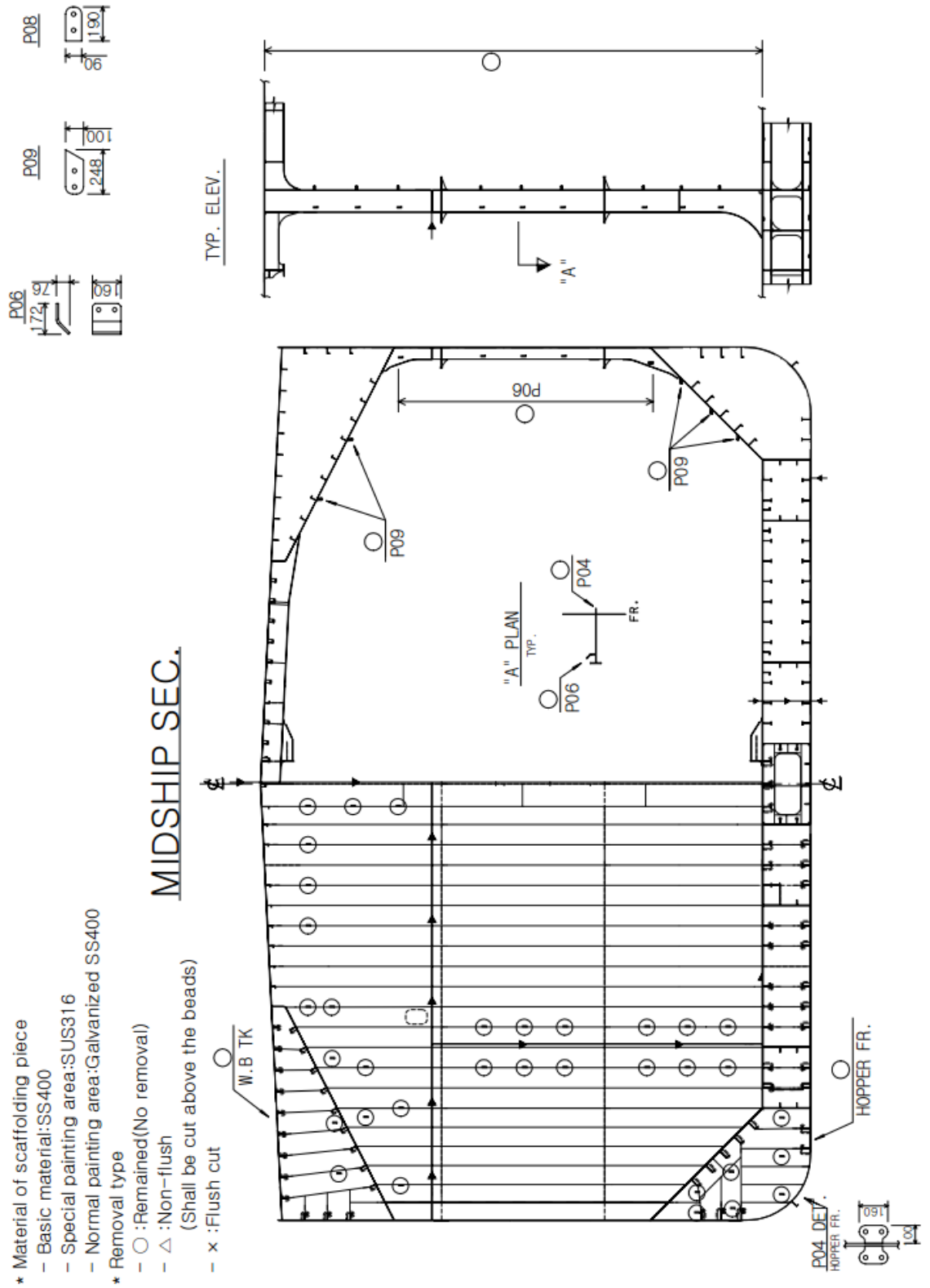
(7.2 Disposal of scaffolding piece)

LNG CARRIER (2)



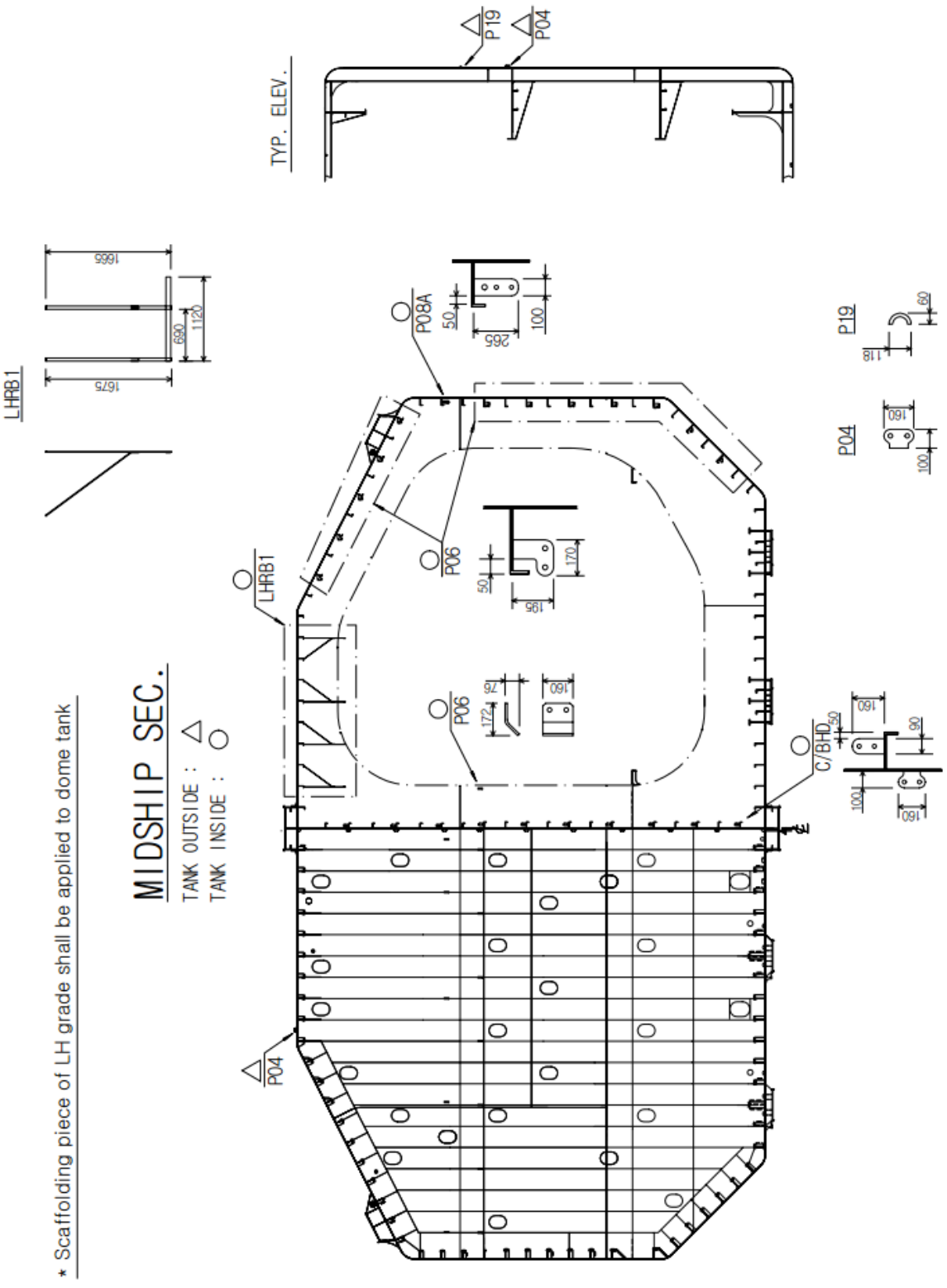
(7.2 Disposal of scaffolding piece)

LPG CARRIER (1)



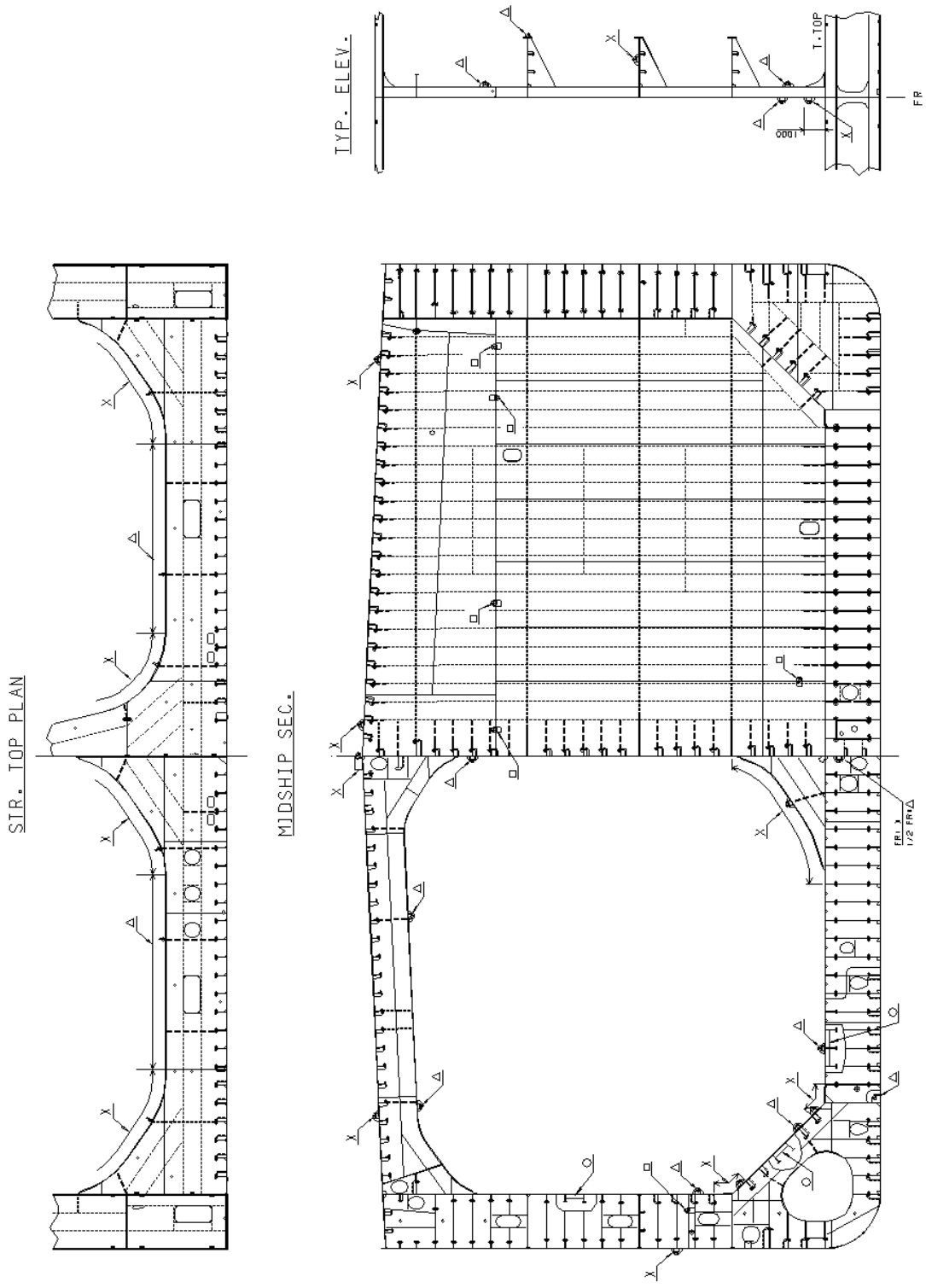
(7.2 Disposal of scaffolding piece)

LPG CARRIER (2)



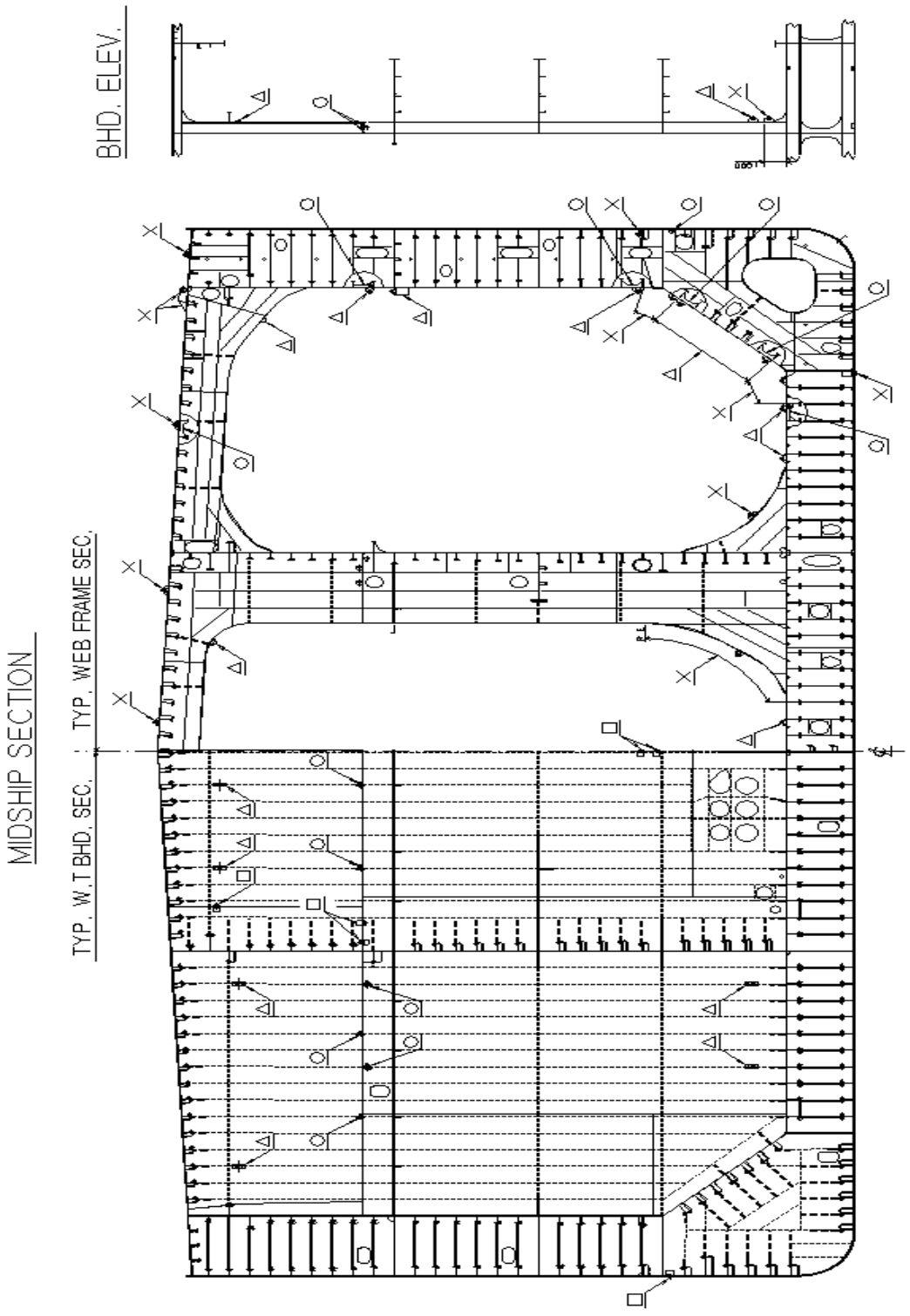
(7.3 Disposal of lifting lug)

OIL TANKER



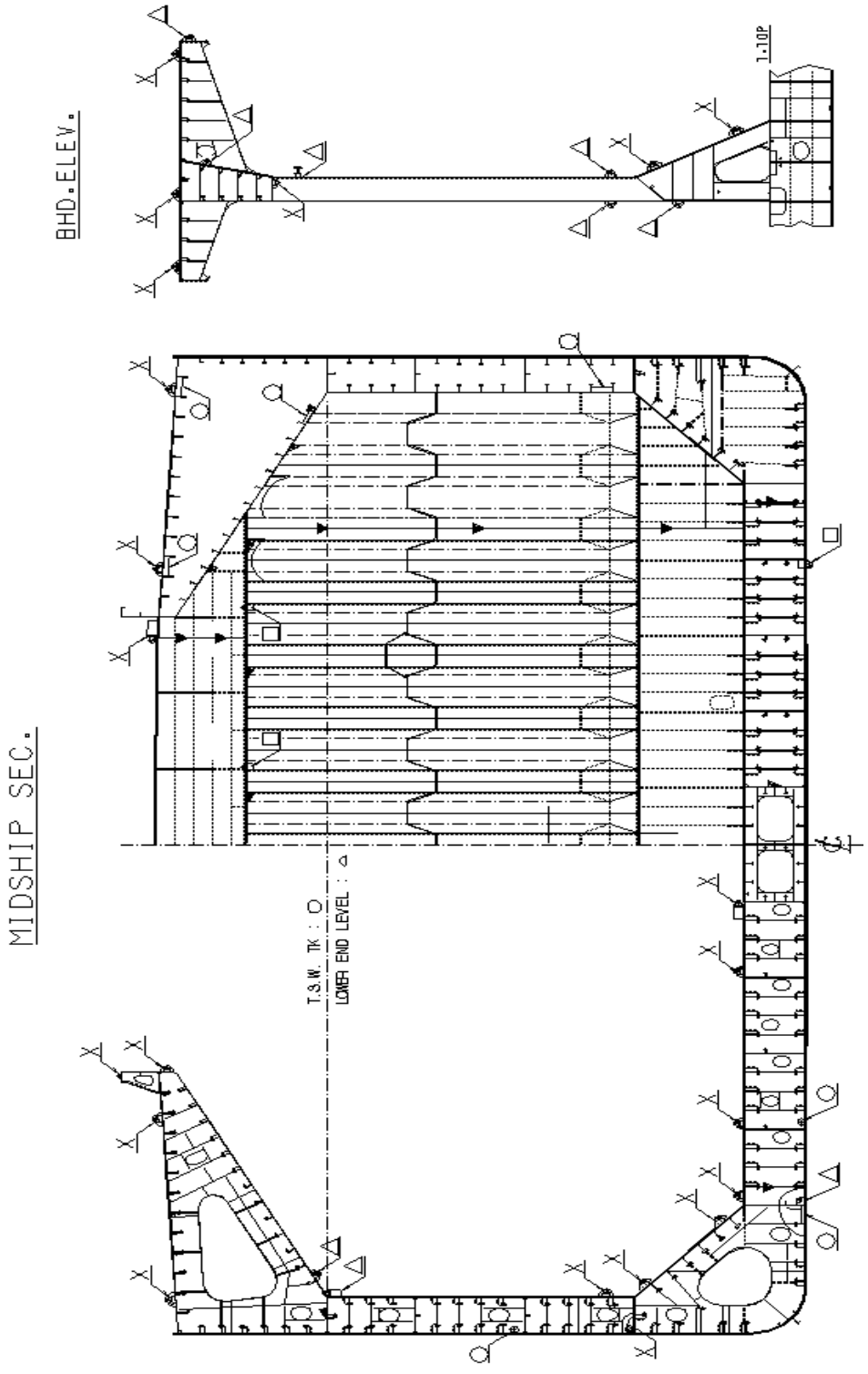
(7.3 Disposal of lifting lug)

VLCC



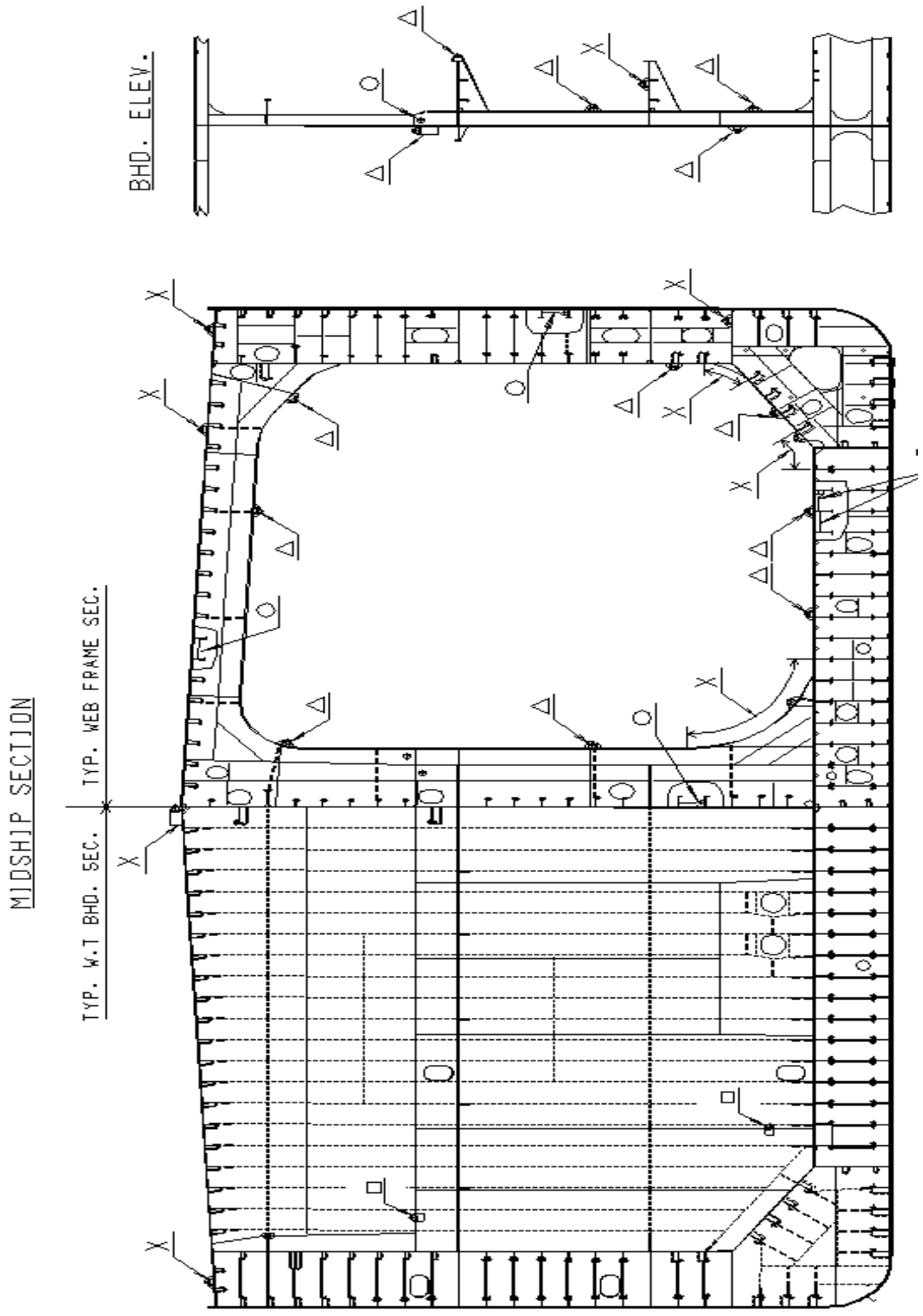
(7.3 Disposal of lifting lug)

BULK(LOG BULK) CARRIER



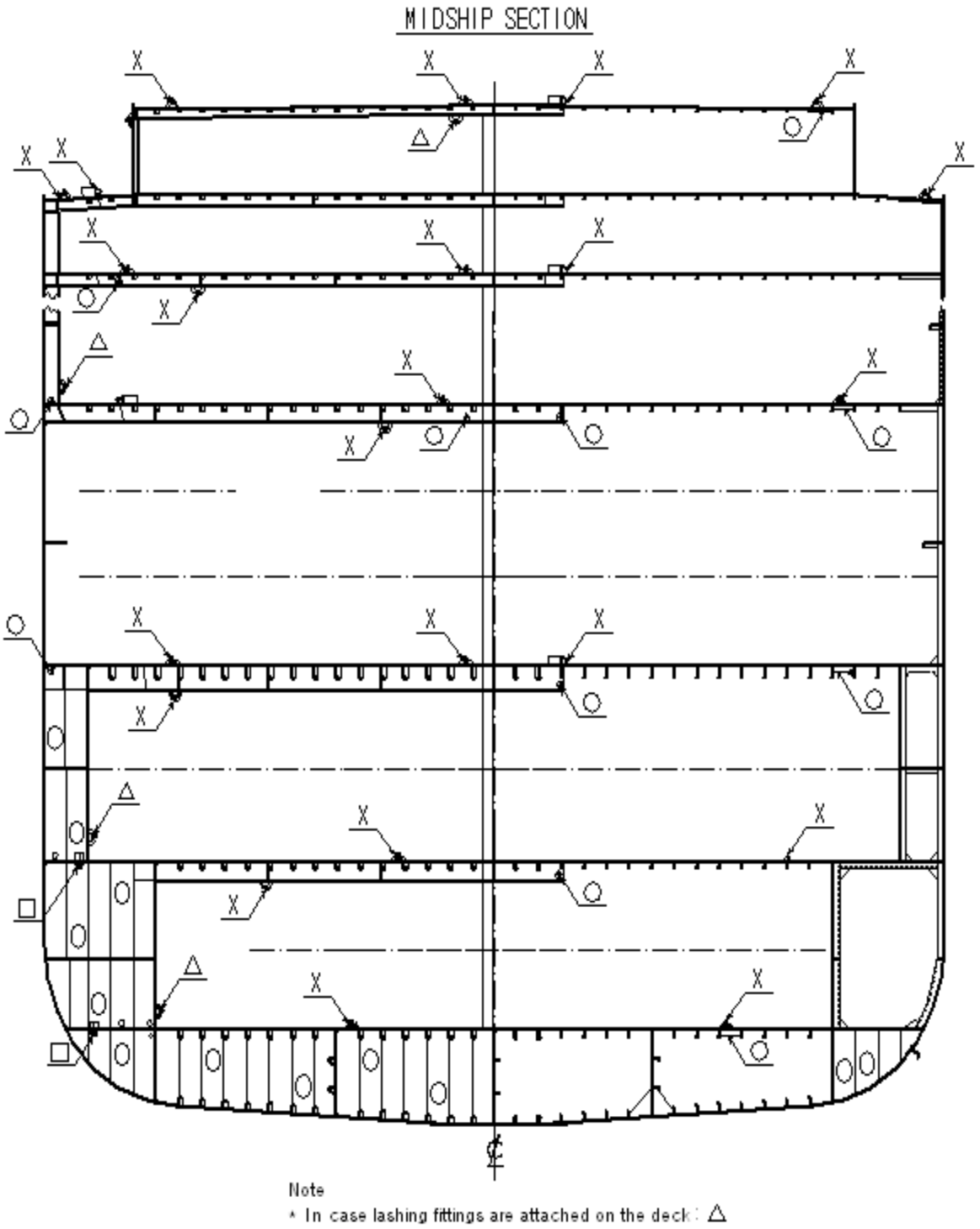
(7.3 Disposal of lifting lug)

PRODUCT CARRIER



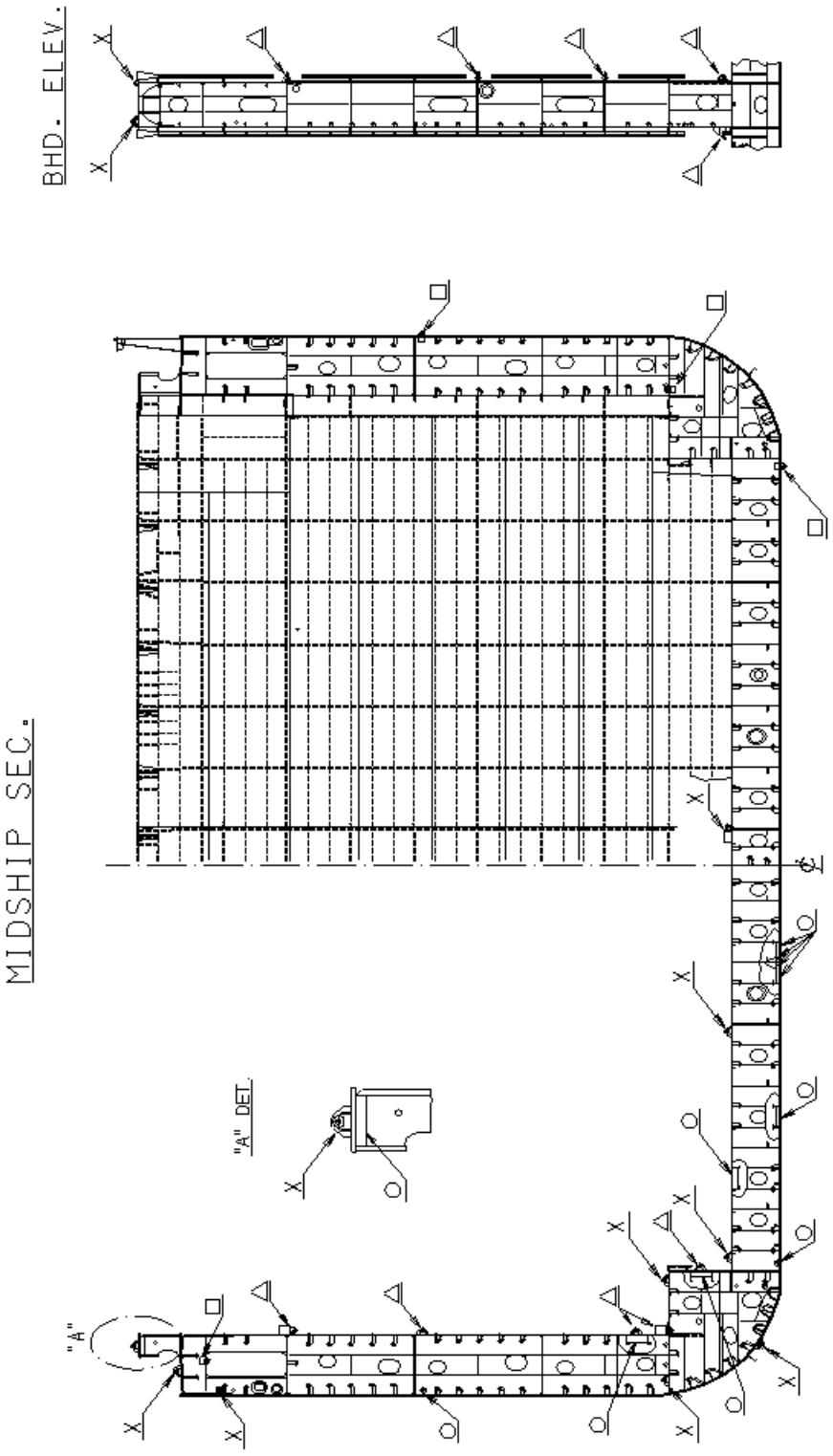
(7.3 Disposal of lifting lug)

RO-RO VESSEL



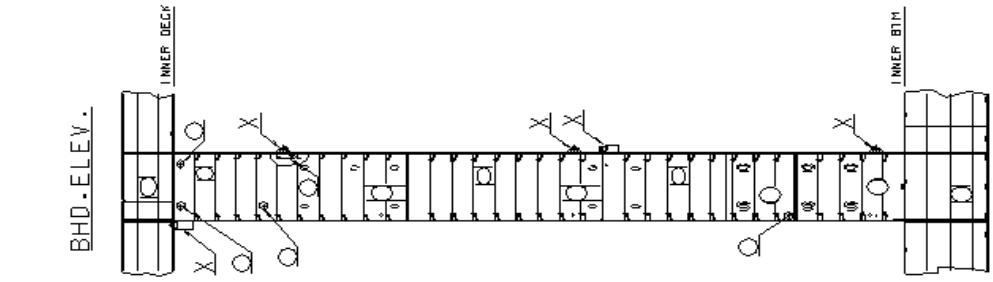
(7.3 Disposal of lifting lug)

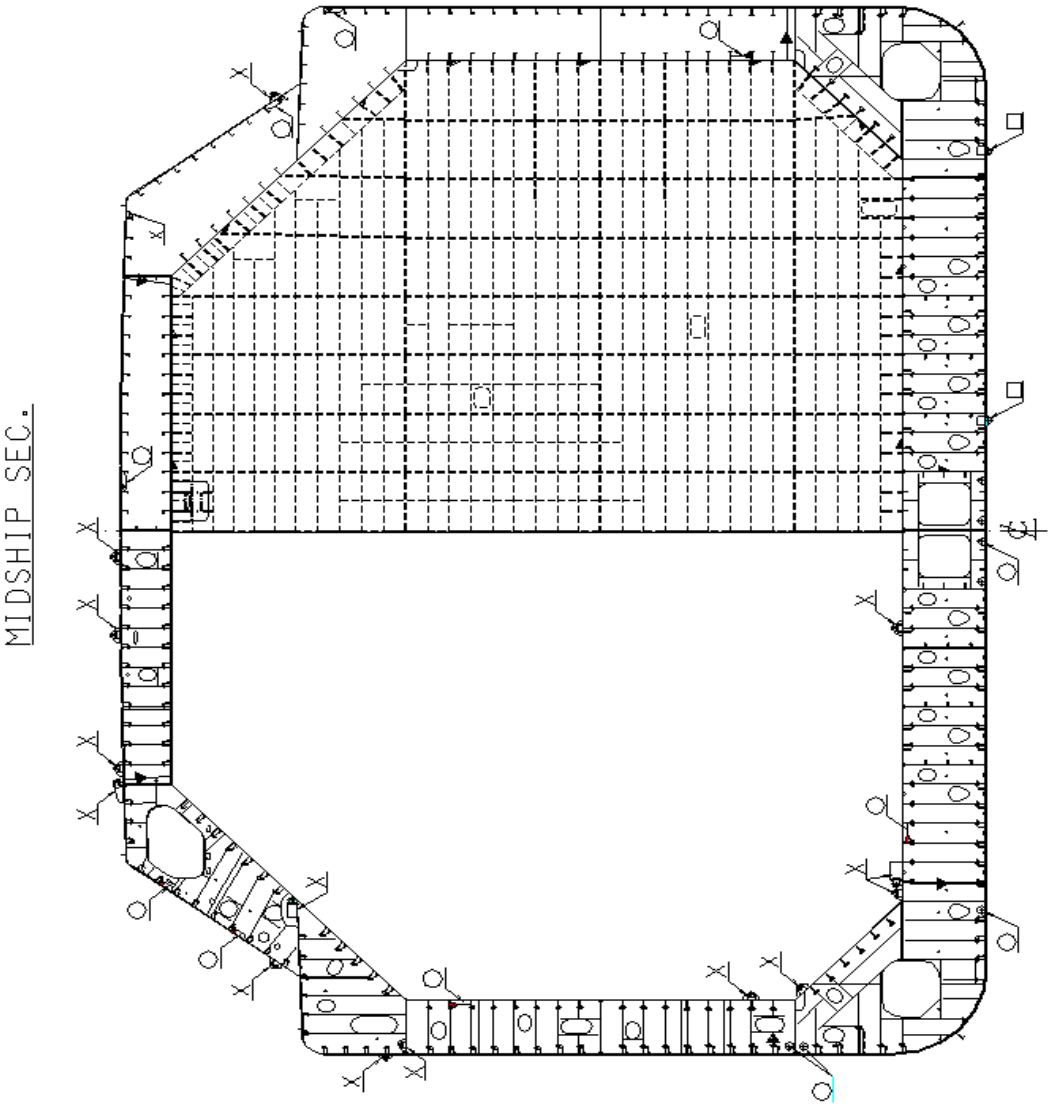
CONTAINER SHIP



(7.3 Disposal of lifting lug)

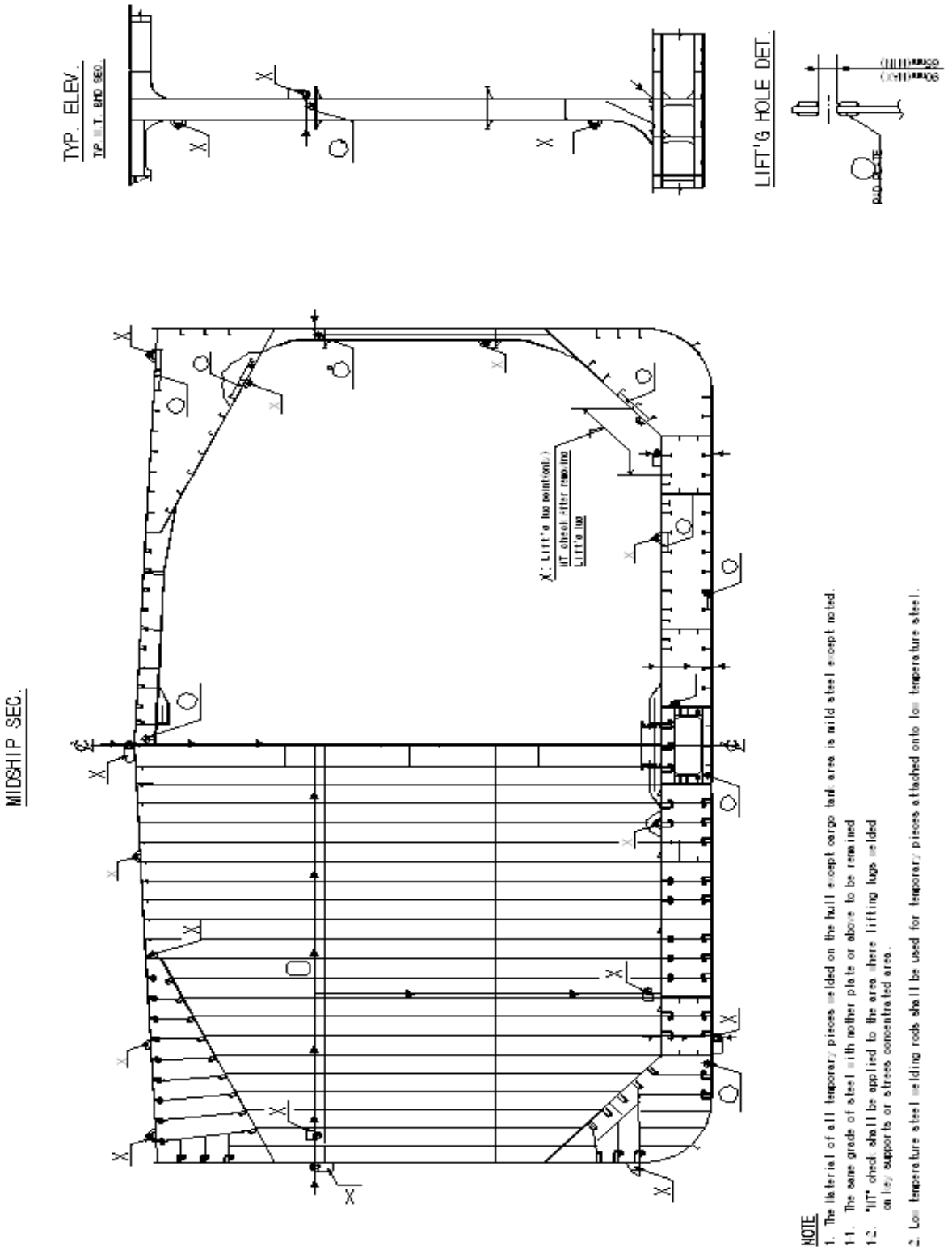
LNG CARRIER





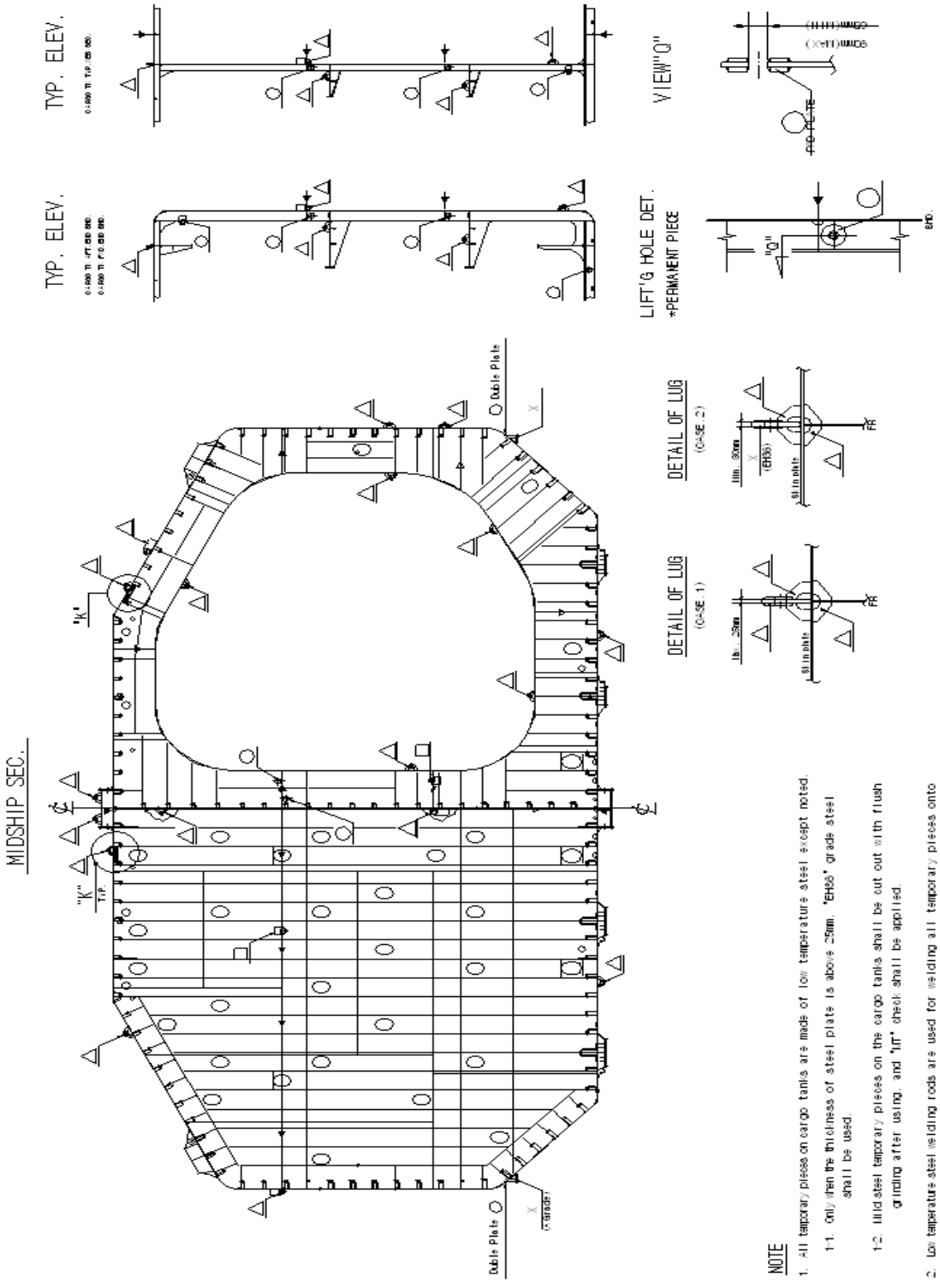
(7.3 Disposal of lifting lug)

LPG CARRIER (1)



(7.3 Disposal of lifting lug)

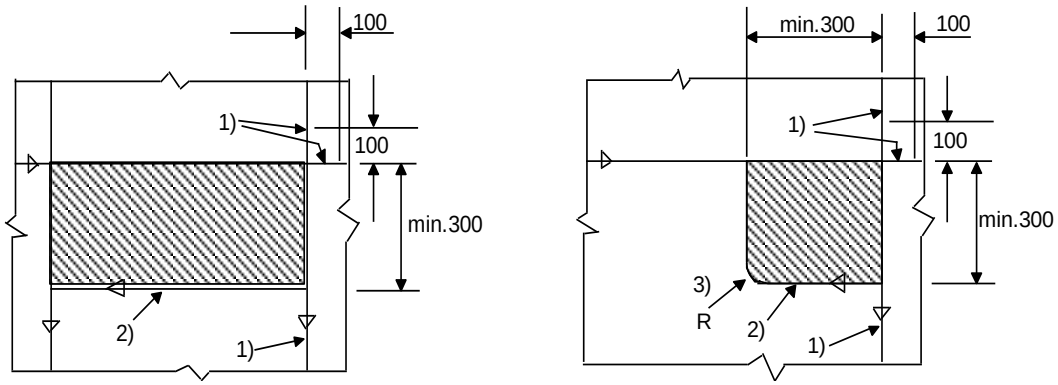
LPG CARRIER (2)



8. INSERT

8.1 Insert on the plate edge

(Unit : mm)

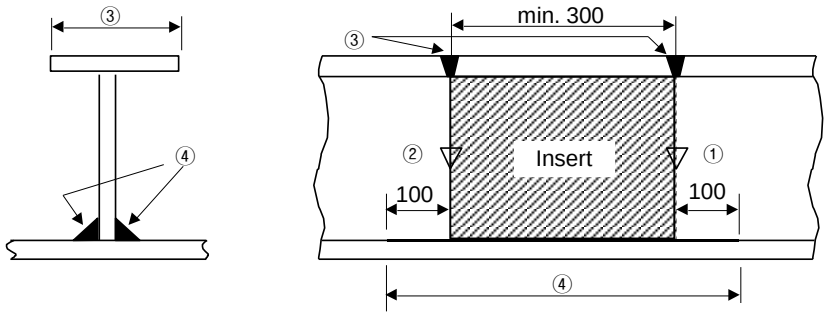


Note ;

1) Each end of the insert plate is to be released min. 100mm extended.
2) Joint towards the plate being joined is to be welded first.
3) R = 5 x plate thickness, min. 100mm.

8.2 Insert of built-up member

(Unit : mm)

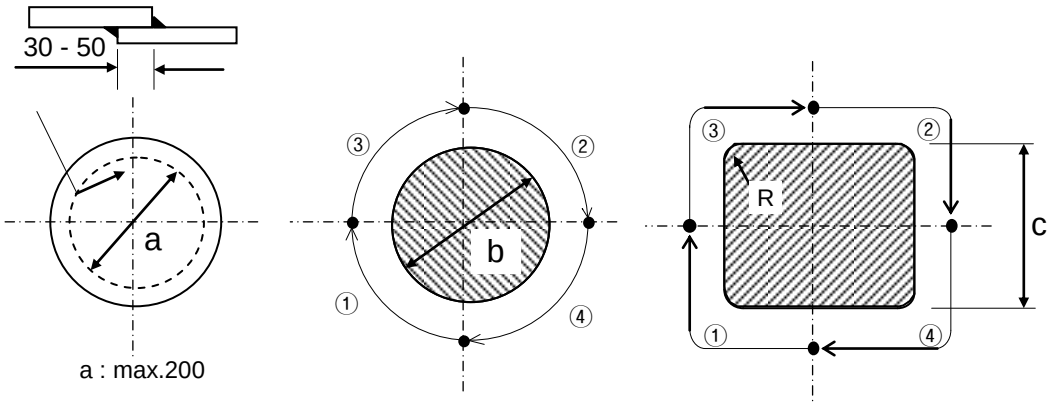


Weld sequence : ① → ② → ③ → ④

8.3 Insert of holes

※ Insert of holes is to be made according to type 1), 2) and 3).
After tack welding, welding sequence should be kept as follows;

(a) R = 5 x Plate Thickness (Min. 100mm)
(b) Weld Sequence : ① → ② → ③ → ④
(c) b, c : min. 300mm or ten times the plate thickness, whichever is the greater



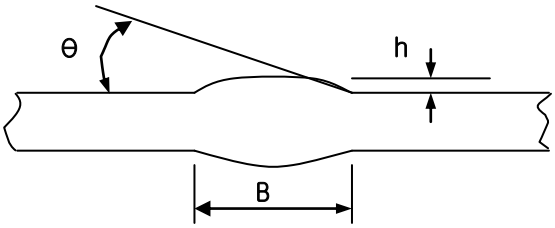
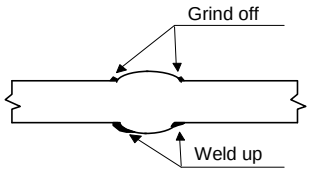
1) Lap type 2) Insert type 1 3) Insert type 2

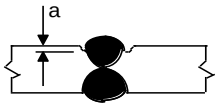
Detail	Method
Skin plate(shell), Deck, Longitudinal bulkhead, Transverse bulkhead and High stress area	Insert type
Others	Lap type
Holes up to 25mm diameter in W.T or area of stress concentration. (near toes of brackets, etc.)	To be closed by welding or welded by means of reinforcement.

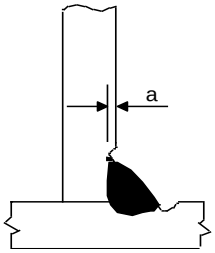
9. WELDING / WELD CONDITION

9.1 Shape of bead

(Unit : mm)

<table>
<tr><th>Detail</th><th>Tolerance Limit</th><th colspan="2">Corrections</th></tr>
<tr><td>Breadth of bead
flank angle.
 
</td><td>B: Not defined
$\Theta \leq 90^o$
h: max. 6mm</td><td colspan="2"> 

Where $\Theta > 90^o$, it is to be repaired by grinding or welding to make $\Theta \leq 90^o$.</td></tr>
<tr><td rowspan="3">Undercut in welding
 

 
</td><td>Butt weld
$a \leq 0.5$
(Length of less than 90 mm)</td><td>Main structures within 0.6L
(Skin plate, Longi. member and principal transverse supporting members)</td><td rowspan="3">When undercut exceeds the tolerance limits, it shall be ground smoothly(locally) or filled up by welding.

However, the filled up welding shall not be ground off.

(Short bead shall be avoided for high tensile steel)</td></tr>
<tr><td>Butt weld
$a \leq 0.8$</td><td>Others</td></tr>
<tr><td>Fillet weld
$A \leq 0.8$</td><td></td></tr>
<tr><td>Weaving width</td><td>SMAW
Diameter of electrode x 3.5

FCAW
max. 23 mm

Low temp. steel
max. 19 mm</td><td colspan="2"></td></tr>
</table>

9.2 Repair weld of surface defect

(Unit : mm)

Detail	Tolerance Limit		Remarks
	Base metal	Welded metal	
Cast steel	Weld length ℓ ≥50	Weld Length ℓ ≥50	• For casting steel, preheating necessary as per WPS. • Where short bead is necessary, preheating shall be done up to 100±25℃. • In case short bead is made erroneously, it shall be removed by grinding and rewelded. • For base metal which could be affected by risk of cold cracking, the short bead part to be ground off 2 to 4mm in depth and rewelded.
High tensile steel			
Mild steel	Weld length ℓ ≥10	Weld length ℓ ≥30	
Low temp. steel	Weld length ℓ ≥50	Weld Length ℓ ≥50	

9.3 Temperature required preheating

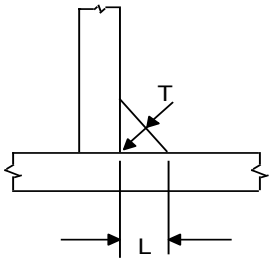
High tensile steel	Air temperature T≤0℃	
Low temp. steel		
Mild steel	T≤-5℃	

9.4 Repair of arc strike

• High tensile steel • Cast steel	Not permitted	If arc-strike is made erroneously, the hardened zone shall be removed by grinding.

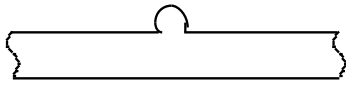
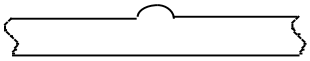
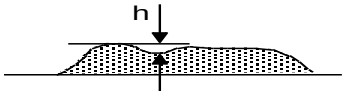
9.5 Shape of fillet welds

(Unit : mm)

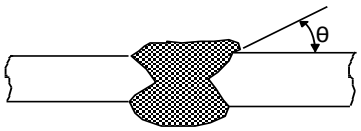
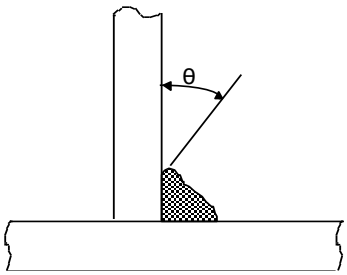
Detail	Tolerance Limit	Corrections
	L : Leg length T : Throat thick. L ≥ 0.9 x Design Figure * T ≥ 0.9 x Design Figure	In case the length is less than the tolerance limits, the weld is to be increased. * Undersize portion shall not exceed 10% of weld length in a span.

9.6 Weld surface

(Unit : mm)

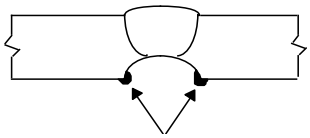
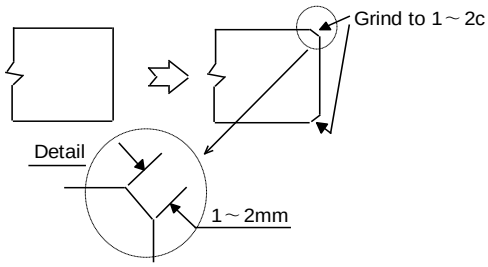
Detail	Corrections	Remarks
Spatter	1. Remove spatter observed before blasting with scraper or chipping hammer, etc.  2. For spatter observed after blasting; 1) Remove with a chipping hammer, scraper, etc. 2) For spatter not easily removable with a chipping hammer, scraper, etc., grinding the sharp angle of spatter to make it obtuse. 	In principle no grinding is applied on weld surface.
Irregularity of manual weld	When the surface irregularity exceeds 3mm, apply the grinding until the irregularity becomes less than 3mm.  h ≤ 3 mm	This standard is applied to fillet weld as well.

(9.6 Weld surface)

Detail	Corrections	Remarks
Over lap	In case θ is less than 90^o, it shall be repaired by suitable method to make $\theta > 90^o$.  	Short bead is avoided for high tensile steel.
Weld defect	The following defects are to be removed by suitable method. Example : 1) Crack 2) Clustered porosity 3) Short bead 4) Arc strike 5) Hydrogen porosity	Weld defect like crack is to be examined by NDE(MT) before repair welding.

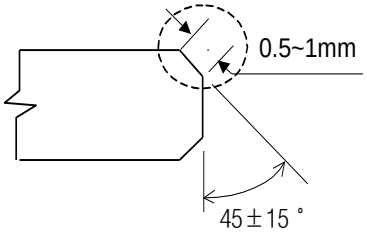
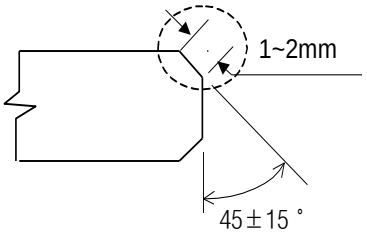
10. GRINDING

(Unit : mm)

Detail	Grinding Standard	Remarks
Cleanliness of the weld groove	1) As-cut surface or as-rolled surface is acceptable for all welding. 2) As-rusted surface is acceptable for manual welding but not acceptable for automatic welding. 3) As-gouged surface is acceptable for A to D grade and AH grade steel. Slag, crack, incomplete penetration and clustered porosity on the gouged surface are to be completely removed.  Gouged burrs are to be completely removed.	Thick rusted scale is to be removed by grinding or brushing
Gas cut edge of high stress members	The high stress members mean the openings of strength deck and the free edge of sheer strake.  When noted on the drawing, it is to be as per the drawing.	

10. GRINDING (Gas cut edge general)

(Unit : mm)

Area	Detail	Standard
A. Painting area	OPTION 1 In accordance with building specification.	Grind to 1C  Legend : "1C"
	OPTION 2 In accordance with building specification.	Grind to 2C  Legend : "2C"
B. Painting area (Non-exposed area and general)	• Machinery Space • Cargo Holds (B/C, Container, Ro-Ro, Drill ship)	No Grinding
C. Others (Incl. no painting area)	• Except above A and B	No Grinding

11. ACCURACY OF HULL FORM

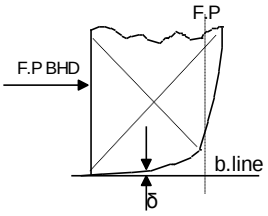
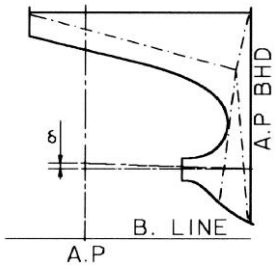
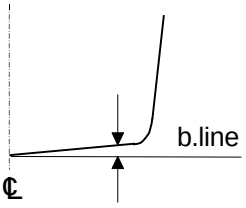
11.1 Principal dimension

(Unit : mm)

Detail		Standard Range	Tolerance Limit	Remarks
Length	Length between Perpendiculars	±50 per 100m	Not defined	Applied to ships of 100m length and above.
	Length between aft-perpendicular and forward bulkhead of engine room	±25	Not defined	Accuracy in accordance with the shaft length.
Breadth Moulded breadth (Amidships)		±15	Not defined	
Depth Moulded depth (Amidships)		±10	Not defined	Applied to ships of 10m depth and above.

11.2 Deformation of hull form

(Unit : mm)

Detail		Standard Range	Tolerance Limit	Remarks
Flatness of keel	Deformation for the whole length	±25	Not defined	Up(+) and down(-) against the check line of the keel sighting.
	Deformation for the distance between two adjacent bulkheads.	±15	Not defined	Sighting by the transit or laser. Local unfairness is referred to section 6. "Unfairness".
Cocking	Cocking of Fore-body 	±30	Not defined	Up(+) and down(-) against the check line of the keel at the fore most frame on the flat part of the keel.
	Cocking of Aft-body 	±20	Not defined	Up(+) and down(-) against the check line of the keel at the aft-perpendicular.
Rise of floor amidships 		±15	Not defined	The height of the lower turn of the bilge, compared with the planned height. Measured from the plane passing through the outer surface of the keel plate.

12. MISCELLANEOUS

12.1 Draft mark

(Unit : mm)

Detail	Standard Range	Tolerance Limit	Remarks
In regard to the templet	±1.0	±2.0	

12.2 Freeboard mark

(Unit : mm)

In regard to the templet	±0.5	±1.0	

12.3 Opening of entrance

(Unit : mm)

Opening of Steel door	Breadth and height	±4	±7	
	Sill height	0～15	-10～+30	
	Deformation	±2 /1000	±3 /1000	
Opening of Deck	Breadth	±2	±3	
	Length	±3	±5	

PART Ⅲ. OUTFITTING & MACHINERY PART

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1. PIPING PROCESS

1.1 Pipe Bending

(1) Pipe bending is to be carried out by the cold bending machine having bending radius of approximately 2～3 times the outside diameter of the pipe.

(2) Ellipticity, swells and rumples caused by bending of pipes shall not exceed the quality standards para. 3.2.

(3) In case the regular pipe bending, as mentioned above, can not be applied due to following reasons, the commercial bent pipe is to be used.

(a) When the capacity of existing bending machine is not enough to bend,
(b) When the non-standard bending radius is necessary to facilitate the piping arrangement.

(4) The commercial bent pipe should be of seam or seamless for general piping systems for those of nominal dia. 200mm below, and the fabricated pieces may be commonly used for those of nominal dia. 200mm and above, if there is no specific requirements from the Classification Society.

(5) In case the arrangement is difficult to use the commercial bent pipe, the miter welding pipe having a radius approximately equal to the nominal pipe diameter is to be applied. However, the miter welding method is to be applied only to low pressure and large size pipes, such as exhaust gas, sea water, exhaust steam piping, etc.

(6) Hot bending or High frequency bending may be applied in accordance with the requirements of the Classification Society as a special case.

(7) For adjustment of pipe alignment at pipe installation stage, hot process could be restrictively applied.

1.2 Finishing of Weld Parts after Pipe Fabrication

Weld beads on inside surface of fabricated pipes shall be finished to suit the intended purpose of the respective piping system in accordance with the following three grades.

<GRADE A>

(1) Weld beads of pipe insides shall be finished smoothly, and welding spatters and slag shall be removed.

(2) This grade applies to lubricating oil pipes, hydraulic oil pipes, fuel oil injection pipes after the 2nd filter for main diesel engine, turbine steam pipes and for synthetic rubber or plastic lined pipes.

<GRADE B>

(1) Welding spatters and slag shall be removed and welded beads shall be cleaned.

(2) This grade applies to power steam pipes, turbine exhaust pipes, cryogenic pipes, fuel oil service pipes, drinking water pipes, nozzle cooling pipes, feed water pipes, condensate water pipes, sea water cooling pipes, compressed air pipes, tank cleaning pipes and vent pipe for cargo tanks.

<GRADE C>

(1) Weld beads of pipe insides do not need to be finished.

(2) This grade applies to all other pipes which are not specified in GRADE A and GRADE B, and open ended lines like drains, overflows, vents and boiler escape pipes.

1.3 Flange Fitting in Shop

When the pipe is inserted into the flange for joining, inserting depth should be controlled so that the welding bead will not overpass the flange face. The flange face is usually not finished by grinding, but welding spatters and slag on its face shall be removed.

1.4 Pipe Joints

In general, pipe joints are grouped as follows by their use. Specially, cryogenic pipes subjected to the IGC Code for cargo and related systems shall be referred to in the following table.

Pipe Joints For Cryogenic Cargo System Pipes :

Kind of Joint	Application	Remarks
Butt welded joint	- Design temp. below -10℃	•Backing rings or gas purging shall be used on the 1st pass. •Backing rings shall be removed for design press. in excess of 10 bar and design temp. of -10℃ or lower.
Slip on welded joints with sleeves and related welding	- Open ended lines with external dia. of 50mm or less - Design temp. not lower than -55℃	•Piping connections, otherwise mentioned here shall be accepted by the administration/ Classification Society in each case.
Screwed coupling	- To be only used for accessory lines and instrumentation lines with external dia. of 25mm or less	
Welded neck flange	- For design temp. lower than -55℃	
Slip on flange	- Not to be used for design temp. lower than -10℃ N.D above 100mm.	
Socket welded joint	- Not to be used for design temp. lower than -10℃ N.D above 50mm.	
Bellows and expansion joints	- To be used to allow for expansion of piping	•If necessary, bellows shall be protected against icing
Slip joints	- Not to be used except within the cargo tanks	

1.4.1 Sleeve Joints and Butt Joints

(1) Generally, sleeve welded joints and butt welded joints are to be applied for permanent joints in spaces such as tanks, cargo holds, cofferdams, void spaces, ducts, store spaces, accommodation spaces, hatch side spaces, etc., unless other joints are specified in the building Specifications.

(2) Butt welded joints may be applied to the commercial bent pipe and T-piece.

1.4.2 Flange Joints and Union Joints

(1) Flange joints, union joints and other separable joints are to be applied in the engine room, pump room, steering gear room, other machinery spaces, and on exposed decks for facilitating to remove the pipes whenever required.

(2) Flanges or screwed union joints are to be used at the connection parts to all pipe fittings, machinery and equipment for maintenance or overhaul purposes.

1.4.3 Joints for Non-Ferrous Pipes

Pipe joints for non-ferrous pipes are to be applied similar to those for steel pipes. However for joining of plastic pipes, pipe joints are to be followed in accordance with the Classification Society's requirements unless otherwise specified in the Specifications.

1.4.4 Joint Gaskets

Universal heat and oil resisting non-asbestos joint sheets shall be used generally in all piping systems.

1.5 Adjusting Pipes

(1) Adjusting pipes are to be generally used for connections between pipe and equipment or pipes already fitted on the blocks. The flanges of the adjusting pipes may be welded on board.

(2) The flange angle of the adjusting pipe could be sloped in order to make parallel the connecting flange faces.

(3) For correction of alignment for pipe connection, the spot heating process could be applied. However, this method can not be applied to lubricating and hydraulic oil pipes.

1.6 Pipe Galvanizing

(1) The galvanizing shall be carried out after fabrication of pipes. However, if the welding is inevitably carried out the galvanized pieces during installation process such as in the cases mentioned below, the external surface of the welded parts shall be touched up with zinc rich epoxy primer :

(a) Socket welded joint or welded sleeve joint fabricated on board
(b) Middle flange of penetrating piece adjusted on board
(c) Anchoring piece welded on galvanized pipe after adjusted on board (except sea water handling system)
(d) Flange joint adjusted on board (except sea water handling system)

(2) Internal surface of the welded part of flange joints adjusted on board shall be touched up with zinc rich epoxy primer instead of zinc solution paint for better resistance against corrosion as far as practicable.

1.7 Pipe Pickling by Acid

(1) After fabrication of the steel pipes, acid cleaning shall be carried out before installation on board. For the steel pipes applying the polyethylene lining, blasting shall be carried out instead of acid cleaning before lining.

(2) Phosphate treatment after acid cleaning shall be processed for the steel pipes except for the pipes applying galvanizing or polyethylene lining.

(3) For proper prevention from rusting, following pipes shall be blown out with compressed air and dried before installation on board.

(a) Lub. oil pipes except drain pipes and air vent pipes.
(b) Fuel oil service pipes for main engine, aux. engine and aux. boiler.
(c) Hydraulic oil steel pipes.

(4) Exposed flanges of unfinished piping installed on board shall be protected by means of end caps (plugs or blanks), and precaution shall be taken to ensure the pipes remain sealed after cleaning.

1.8 Bolts for Pipe Flange Joint

(1) KS(JIS) Standard hexagonal head bolts and nuts of galvanized steel are to be generally used for pipe flange joints.

(2) The length of bolts protruding beyond the nuts after tightening is to be between zero and 1/2 Bolt diameter.

1.9 Pipe Supports

(1) In General, steel supports and U-type bolts are to be applied to pipe lines at suitable intervals. Pipe supports for non-ferrous are to be lined with copper, brass or lead plate, plastic or synthetic rubber.

(2) The length of the screw part of the U-type bolts protruding beyond the nuts after tightening is between zero and a half of the bolt diameter.

1.10 Hydrostatic / Leakage Test of Piping

(1) The piping systems are to be done hydrostatic / leakage test using suitable medium at the completion of installation to check the strength and/or leakage in the system.

(2) All piping joints may be primed and painted prior to hydrostatic or leakage testing.

1.11 Non-destructive Test for Welded Joint of Piping

The following non-destructive test shall be applied to welded joints designated by the Classification Society according to the rules and/or any other parts where mutually agreed upon.

(a) Radiographic Test (RT) (b) Ultrasonic Test (UT)
(c) Magnetic particle Test (MT) (d) Penetration Test (PT)

1.12 Air Conditioning and Refrigeration Plant Piping

After install of the refrigerant piping, the pressure and vacuum test to be carried out according to following conditions.

(1) Pressure Test

Division	Test Pressure (kg/㎠ · G)	Allowable Pressure Drop (kg/㎠ · G)	Test Duration (Hours)
High Pressure side	22	Less than 0.35	4
Low Pressure side	15		

The final pressure drop to be calculated as follows.

$$P_0 - P(T_0/T) \leq 0.35 \text{ (kg/㎠ · G)}$$

T_0 : The Initial Temperature T : The Final Temperature

P_0 : The Initial Pressure P : The Final Pressure

(2) Vacuum Test

Vacuum Pressure (mmHg)	Allowable Pressure Drop (mmHg)	Test Duration (Hours)
740	Less than 1	12

1.13 Piping Earthing

The following lines, which are connected with gasket flange joints, shall be electrically bonded to the hull structure with tooth washer, bonding wire or bonding plate.

(a) Cargo oil line
(b) Inert gas line
(c) Tank cleaning line
(d) Vapor emission control line
(e) Electric cable pipe line
(f) GRP(or GRE) line in dangerous area

And the detail earthing method shall be followed to the approved piping practice.

1.14 Flushing/Cleaning of Piping System

(1) The piping systems are to be flushed/cleaned after the completion of the piping system on board as the table below.

(2) For flushing by oil, the temporary filters and magnets are to be fitted in strainers.

(3) The flushing is to be completed when the filters have been maintained constantly with clean condition for over two(2) hours of flushing.

Piping	Applied system	Flushing/cleaning method
Lub. oil piping	M/E L.O	System oil
	M/E CYL. L.O	Compressed air
	Generator engine (D/G, T/G)	Compressed air
	L.O transfer, L.O purifier, S/T L.O	Compressed air
	L.O filling	Compressed air
Compressed air	Main engine starting air, Aux. diesel engine starting air and control air	Compressed air
Hyd. oil piping	Deck machinery	Flushing oil
	V.R.C system (main line)	Flushing oil
	V.R.C system (multi line)	Nitrogen
Steam piping	Steam supply line for steam driven machinery	Compressed air

2. PRE-OUTFITTING PROCESS

2.1 Outfitting Work during Block Assembly

Outfitting such as pipes, ducts, supports, electric cable trays, machinery seats, platforms, coaming, hand grips and steps, etc. are to be fitted during hull block assembling work or block assembly site as far as practicable.

2.2 Outfitting Work during Block Erection

In general, the installation of machinery, electrical equipment and outfitting, etc. are to be carried out at pre-erection stage of hull block and/or dock stage, which may be made in parallel with the hull construction works.

2.3 Unit Assembly

(1) Auxiliary machinery having similar function or closed locations are to be installed in a unified common skid as one unit. The unit consists of auxiliary machinery, electrical equipment, their seats, piping and steel outfitting, etc. All components necessary to the unit are assembled in the unit shop or sub-supplier shop.

(2) Each unit is to be installed at block stage or pre-erection stage. After installing the unit, the shaft centering of aux. machinery is to be checked and corrected by use of shim plate, if required.

2.4 Outfitting of Living Quarters Construction

(1) Outfitting such as mast, posts, piping, ducting, paneling, ceiling, flooring and cabling, etc. are to be done at the assembling site as far as practical.

(2) In connection with the outfitting works, hydraulic or water flooding test of piping may be carried out individually at each block, and then connection joint parts are to be checked on-board after the whole installation has been completed.

2.5 Galvanizing of Fittings

Galvanized surfaces must be practically smooth and free from conspicuous defects such as bare spots.

※ Note ; Damaged parts caused by gas cutting or welding are to be generally touched up by zinc rich solution paint.

3. MACHINERY OUTFITTING PROCESS

3.1 Shafting and Propeller

3.1.1 Shaft Centering and Stern Tube Boring

(1) Condition of shaft centering

a. Shaft centering is to be carried out after stern boss block is assembled and welded to the main engine bed plate block.
b. Shaft centering is to be carried out at pre-erection area or in the dock.

(2) Procedure of shaft centering and stern tube boring

Shaft centering is to be carried out before or after stern tube boring.

Case 1 Shaft centering before stern tube boring

a. After above-mentioned condition is completed, shaft centering is to be carried out.
b. Fix the center line level between stern boss and main engine. (see Fig. 1)
c. Measure the distance of the shaft length and the dimension of engine bed plate according to the Shafting Plan (drawing).
d. Bore the Aft & Fwd stern boss.

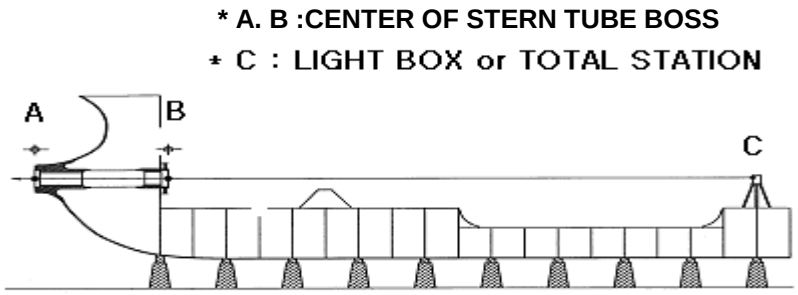


Fig 1-1. Shaft centering (Case 1)

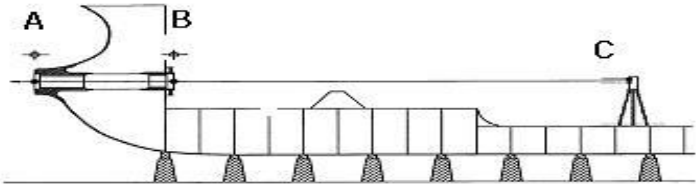


Fig 1-2. Shaft centering (Case 1)

Case 2 Shaft centering after stern tube boring

a. Fix the center line level between the stern boss and “D”. (see Fig. 2)
b. Bore the Aft & Fwd stern boss.

c. Shaft centering is to be carried out based on the machined surfaces of the stern boss after main engine bed plate block is assembled and welded to the stern boss block.
d. Fix the main engine center line level by extending the stern boss center line.
e. Measure the distance of the shaft length and the dimension of the engine bed plate according to the Shafting Plan (drawing).

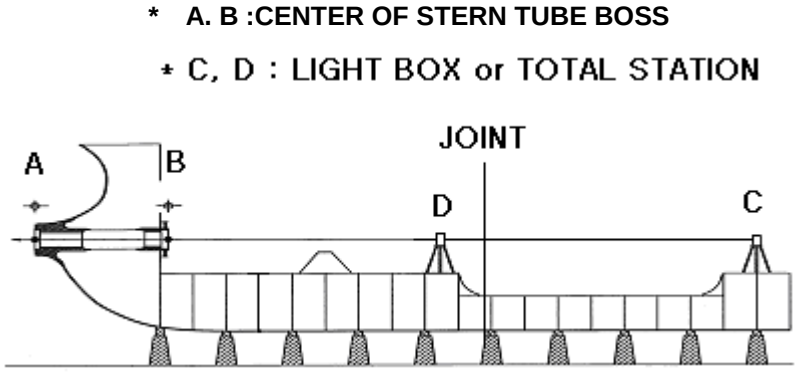


Fig 2. Shaft centering (Case 2)

3.1.2 Rudder Horn Boring at Pre-erection Stage

(1) Application condition

This case is to be applied when rudder horn boring is carried out at shop before block assembly.

(2) Procedure

a. After rudder horn block is erected and welded to steering gear deck block completely, rudder centering is carried out at dock stage.
b. Install the piano wire.
c. Measure the dimension and eccentricity of rudder horn gudgeon.
d. Bushes are to be machined in accordance with the eccentricity of the rudder horn gudgeon.
e. Fit the bushes by chilling with liquid nitrogen.
f. Bush fitting by chilling with liquid nitrogen is carried out at shop stage in case of full spade rudder.

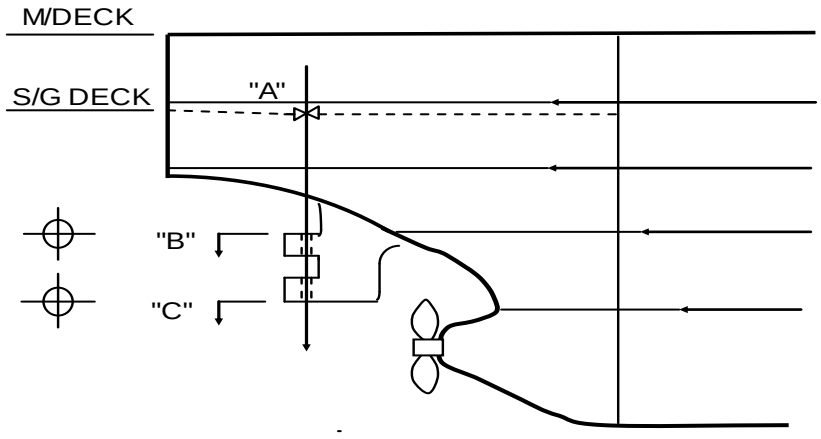


Fig 3. Rudder horn boring

3.1.3 Rudder Centering

(1) Condition of rudder centering

Rudder centering is to be carried out after rudder horn block, (A.P tank) E/R block and steering gear deck are assembled together and strength members of hull structure. However, the main deck block above the steering gear deck can be excluded in some cases.

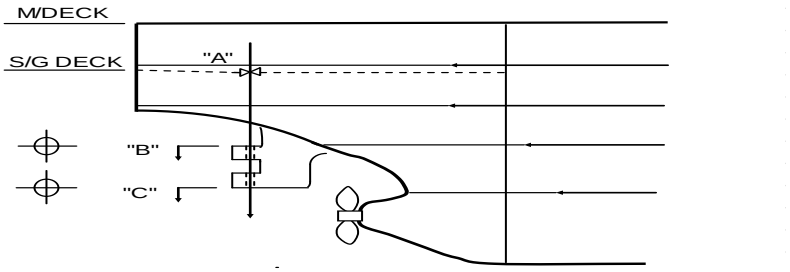


Fig 4. Condition of rudder centering

(2) Procedure of rudder centering

After above-mentioned condition is completed, rudder centering is to be carried out.

Case 1 Check with piano wire after shaft installation

a. The piano wire is to be installed at the end of propeller shaft center with jig "N", and between center of rudder horn.
b. Measure the deviation between the rudder center and the shaft center.
c. Measure the inside radius of rudder horns.

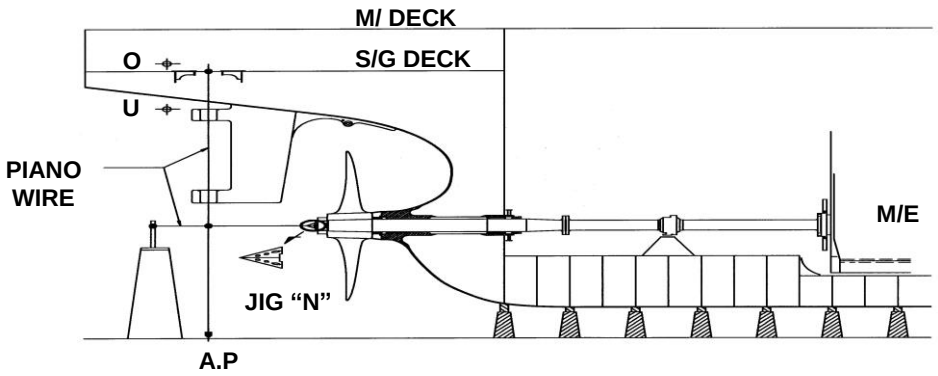


Fig 5-1. Rudder centering (Case 1)

Case 2 Check with Electronic Distance Measurement(E.D.M) equipment

a. Three targets (W1, W2, W3) is to be installed on the bottom plate of the vessel in order to figure out the base surface.
b. The deviation between shafting center and rudder center is to be measured using the E.D.M after confirming the base surface and then, measure the inside radius of rudder horns.

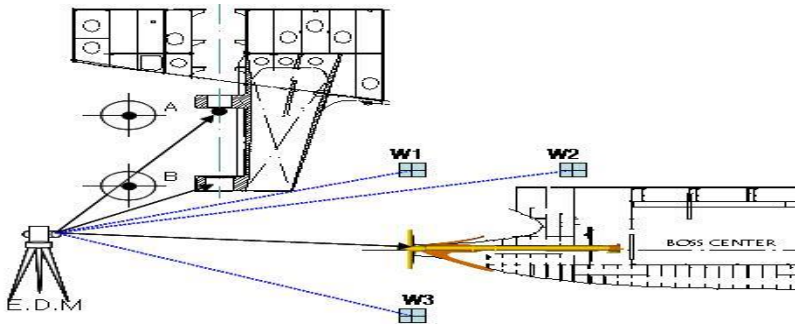


Fig 5-2. Rudder centering (Case 2)

Case 3 Check with the bottom base after shaft installation (Horizontal rotating laser beam)

a. Three targets (B1, B2, B3) is to be installed on the bottom plate of the vessel in order to figure out the base surface.
b. The deviation between shafting center and rudder center is to be measured using the vertical laser beam after confirming the base surface and using the horizontal rotating laser beam.
c. Measure the inside radius of rudder horns.

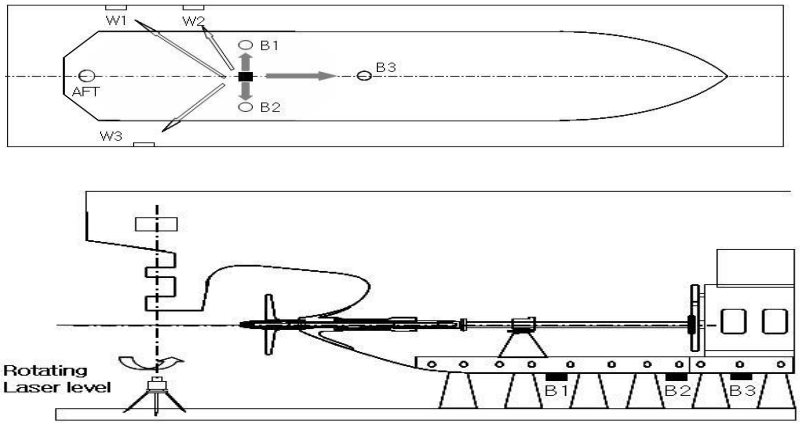


Fig 5-3. Rudder centering (Case 3)

Case 4 Check with laser measuring equipment after shaft installation

a. The optical alignment machine “M” is to be installed at the end of propeller shaft center.
b. The center line of the shaft to be extended on the optical nadir plummet machine “P”. Optical nadir plummet machine “P” is to be installed at the position “AP”.
c. The centering gauges are to be installed the steering gear deck, inside of upper/lower horns.
d. The deviation between shafting and rudder system can be measured through the target attached at the center of optical nadir plummet machine. (Y – axis)
e. Measure the inside radius of rudder horns.

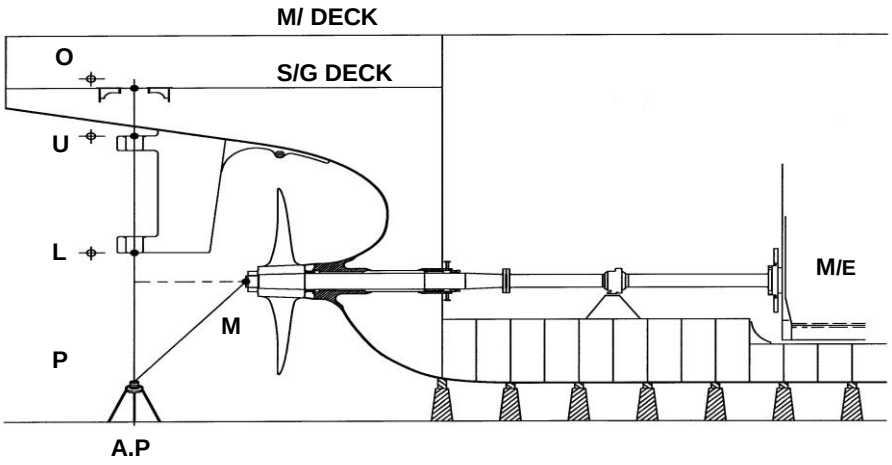


Fig 5-4. Rudder centering (Case 4)

Case 5 Check with piano wire before shaft installation

a. Install the piano wire at the shaft center line from forward stern bearing center to A.P line.
b. Install the piano wire from center of rudder born perpendicularly to the ground, and then measure the deviation from the shaft center line.
c. Measure the inside radius of rudder horns and stern bosses.

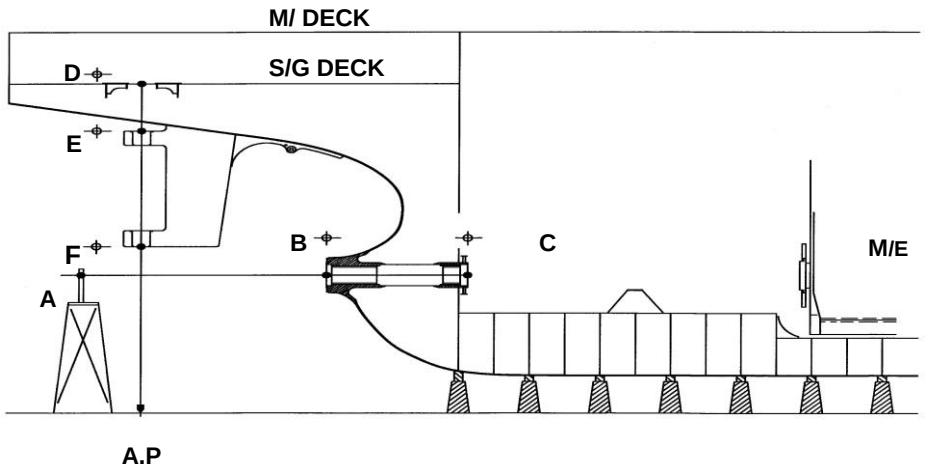


Fig 5-5. Rudder centering (Case 5)

Case 6 Check with laser measuring equipment before shaft installation.

a. The centering gauges are to be installed at the stern boss.
b. ser measuring equipment (Total Station) is to be installed at the position “M” and level adjusting and zero setting to be done.
c. The centering gauge and level-measuring machine are to be installed in line with rudder center.
d. The deviation between shafting and rudder system can be measured through the target attached at the center of level-measuring machine. (Y – axis)
e. Measure the inside radius of rudder horns and stern bosses.

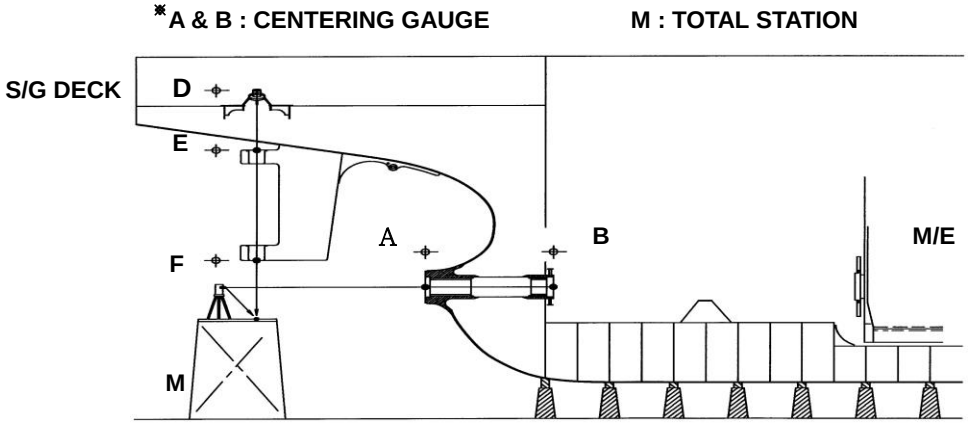


Fig 5-6. Rudder centering (Case 6)

Case 7 Check with piano wire & laser measuring equipment after shaft installation.

a. In some case, piano wire and laser measuring equipment (Total Station) can be used for measuring.

ex. 1) Shafting : Piano wire ------- Rudder : Total Station.

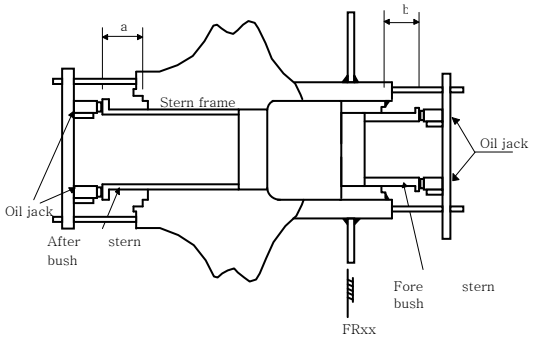
2) Shafting : Total Station ------- Rudder : Piano wire.

b. Then, measure the eccentric condition of the rudder horn.

3.1.4 Fitting of Stern Bush

Case 1. Press fitting

(1) The installation of stern bush is to be carried out by using hydraulic oil jack as below figures.



(2) Pressure and load of the hydraulic power are to be measured against inserting distance of the bush.

(3) The measurement is to be recorded from the last 100mm(b) drive for forward bush and from the last 200mm(a) drive for the aft-bush.

(4) Insertion load is decided according to the design calculation of shafting plan.

Case 2. Freeze fitting

In case of resin bush, the installation of stern bush is to be carried out by the maker recommendation.

Case 3. Epoxy resin fitting

The installation of stern bushes is to be carried out by pouring epoxy resin.
Before pouring the epoxy resin, the centering of stern bushes shall be confirmed.

3.1.5 Contact Conditions of Propeller Shaft and Propeller

(1) The contact condition is to be checked by contacting the propeller's boss and shaft with coating the blue or red paint on cone-part of the shaft.

(2) When the keyed propeller is provided, after fixing the key to propeller shaft, the contact condition of the cone-part is to be checked.
Acceptable contact ratio of the cone-part is at least 70% of matching surface.

3.1.6 Fitting of Propeller

The required push-up distance of propeller is obtained from the computation table to which the measured temperatures are applied.

3.1.7 Tightness Test of Oil Seal

(1) After installation of the seals at the fore and aft part of the stern bearing, the oil is to be filled in the stern tube and the head tank up to the level corresponding to the ship's full loaded condition, and then the oil level is to be maintained at least for 4 hours.

(2) The leakage of the oil seals is to be checked after detaching the bottom plugs of the seals.

3.1.8 Installation of Shaft

(1) The propeller shaft with propeller can be installed at pre-erection stage or in dock (including floating dock).

(2) The main engine and the intermediate shaft bearings are to be temporarily installed and then the shaft is to be fixed with the off-set value decided in the design stage.

(3) After adjusting the off-set, the shaft is to be connected with the coupling bolts.

(4) The shaft is to be installed in accordance with the calculation of shafting alignment.

3.2 Main Diesel Engine & Appurtenant Equipment

3.2.1 Tightening of Holding-Down Bolts

Hydraulic tightening of holding down bolts and end chock bolts is carried out as detailed in the foundation plan of main engine.

3.2.2 Installation of Main Engine

(1) In case Epoxy Resin is applied, the hardness is to be confirmed according to manufacturer's recommendation.

(2) The deflection of crankshaft is to be measured by turning the crankshaft according to manufacturer's recommended direction using turning gear.
The allowable limit of the deflection is to be applied in accordance with the engine manufacturer's recommendation.

3.2.3 Installation of Reduction Gear

(1) All the adjusting liners of the reduction gear are to be inserted or epoxy resin is to be poured according to the installation guidance by design plan.

(2) All the bolts of the reduction gear are to be fitted and tightened, and then the tooth contact condition is to be checked.

3.3 Boiler

(1) If the boiler unit is assembled at shop, the hydrostatic test is to be carried out at shop according to the rules of the Classification Society.
Any hydrostatic test for boilers shall not be performed on-board except the hydrostatic test is not carried out at shop for any reason.

(2) If necessary, soda boiling is to be carried out to remove oil, grease, paint or alkaline formation at shop.

3.4 Auxiliary Machinery

3.4.1 Diesel Generator

(1) Fitting condition of chock liners and tightening condition of holding down bolts are to be checked.
In case Epoxy Resin is applied, the hardness is to be confirmed according to manufacturer's recommendation.

(2) Crankshaft deflection is to be measured to confirm that it is within the allowable limit recommended by the engine manufacturer.

(3) Before filling the system oil, cleaning condition is to be confirmed, if there is any foreign matter in the crankcase. It is not to be necessary to remove the anti-rust stuff coated by the engine manufacturer.

3.4.2 Turbo Generator

(1) The alignment is to be adjusted in accordance with the manufacturer's recommendation.
In case of three-point supported turbo-generator set, only the gear tooth contact shall be checked.

(2) The fitting condition of chock liners and the tightening condition of holding down bolts shall be checked.

(3) After sea trial, the tooth contact condition of the reduction gear shall be examined by visual checking through peep holes.

3.4.3 Turbine Driven Cargo Oil Pumps & Ballast Pumps

(1) Fitting conditions of chock liners and tightening condition of holding down bolts are to be checked.

(2) The alignment of the coupling is to be confirmed by using a dummy or working intermediate shaft. The allowable alignment limits are as follows.

- For horizontal type
  : 0.5mm by rim reading and 0.25mm by face reading.
- For vertical Type
  : 1.00mm by rim reading and 0.5mm by face reading.

※ If there is the allowable limit recommended by the maker, it shall prevail.

3.4.4 Shaft Alignment of Turbine Driven and Motor Driven Auxiliaries

The allowable limit of the shaft alignment is referred to in the Quality Standards para. 2. Auxiliary Machinery.

3.4.5 Installation of Auxiliary Machinery

Installation condition of aux. machinery is to be checked as follows ;

(1) Grade "A" Auxiliary Machinery

The tightness of chock liners is to be checked by hammering after tightening the holding down bolts and the gap is to be checked by a feeler gauge of 4/100mm thickness. The feeler gauge should not be inserted more than 10mm.

- Grade "A" ; Generator set, plumber blocks, steering gear and aux. turbines.

(2) Grade "B" Auxiliary Machinery

The tightness of chock liners is to be checked by hammering after tightening the holding down bolts.

- Grade "B" ; Pumps, ref. machines, emergency diesel generator, and other rotating or reciprocating aux. machinery.

(3) Grade "C" Auxiliary Machinery

The tightness of chock liners is to be checked by hammering after tightening the holding down bolts.

If the auxiliaries and the seats are assembled in a unit at shop, such checking is to be performed at shop.

- Grade "C" ; Strainers, heaters, coolers, electric apparatus and other static aux. machinery, exh. gas boiler and portable tanks.

3.4.6 Installation of foundation bolts for Auxiliary Machinery

All foundation bolts of equipment shall be Installed In accordance with maker standard.
If there is no reference or any mention in the maker standard shall be installed in accordance with yard standard as below.

(1) Bolt head shall be installed under side of foundation.
If bolt head won't be installed under side of foundation, it can be installed upper side of foundation.

(2) In case of Double nut, it shall not be inserted the "washer".

(3) Nut shall be tightening by Double nut and it shall be Installed either 1 class+2 class or 2 class+2 class.

3.5 Overhauling

After completion of sea trial, main engine is to be overhauled for one cylinder unit and checked to confirm that major parts are in normal condition.

Following major parts are carefully investigated;

(1) Piston complete

(2) Cross-head pin and bearing

(3) Crank pin bearing

(4) Upper and lower shells of main bearing

4. ELECTRIC OUTFITTING PROCESS

4.1 General

(1) Cable runs are generally not to be laid on or covered with thermal insulation. (e.g. through refrigerated cargo holds), but may cross through such insulation.

(2) Cable runs are to be installed well clear of substantial heat sources such as boilers, heated oil tanks, steam, exhaust or other heated pipes, unless it is ensured that the insulation type and current ration is adapted to the actual temperatures at such spaces.

(3) In case intrinsically safe cables pass through a hole on the hull structure together with other kinds of cables, the intrinsically safe cables must be separated as per the rule requirement. (at least 50mm separated)

4.2 Cable bending

The internal radius of cable bends which are subject to movements by expansion is not less than that of rule requirement.
(Min. 6D, 15D in the case of High Voltage Cable.)

4.3 Spacing of fixing point.

- In case of vertical laid on, the fixing points shall be provided every 300mm distance.
- In case of horizontal laid on, the fixing points shall be provided 900mm distance

4.4 Earthing connection & conductors.

(1) General

a. All non-current carrying exposed metal parts of electrical machines or equipment should be earthed unless the machines or equipment are supplied at a voltage not exceeding 50V DC/AC or except where except where exempted by classification society.

b. Metal enclosures which are installed directly on the hull, or on steel constructions which are welded to the hull, are to be permanently earthed through metallic contact with structure by means of fixing devices, if a reliable contact is obtained.
Alternatively, They are to be connected to the hull by a separate conductor in accordance with below table.

(2) Earthing of metal covering of cables

a. Steel braided cable should be earthed effectively at the both ends except for the final branch circuits which are earthed at feeder side only.
b. Metal covering of electronic communication, instrumentation equipment and intrinsically safe circuits should be earthed at one end only. But intrinsically safe circuits are to be in accordance with the relevant certification if indicated.
c. The metal coverings of cables installed in dangerous zones or spaces are to be effectively earthed at least at both ends.
d. All armour of cables should be electrically continuous and should be earthed.

4.5 Cable pipes

(1) The sum of the cables total cross-section, based on the cables external diameter is not to exceed 40% of the pipe's internal cross-section.
This does not apply to a single cable in pipe.

(2) The expansion/compression possibility is to be at least ±10mm for every 10 meter section length from the fix point.

1. Hull outfitting part	In Shop			On-Board			Remarks
	C	O	R	C	O	R	
1.1 Mooring arrangement							
1) Anchor and chain							
- Drop and proof test	O		O				
- Identification of marking	O		O	O	O		
2) Chain compressor							
- Fabrication inspection	*O						•* In scope of Rule requirements.
3) Windlass							
- Running test(no load)	O	O	O				
- Anchoring test				O	O	O	•During sea trial.
4) Mooring winch							
- Running test(no load)		O	O		O		
1.2 Hatch cover and door							
1) Cargo hatch cover							
- Final inspection	O		O				
- Hose test (*1) (*2)				O	O		•Operation test is to be carried out at dock or quay stage.
- Operation test					O		
2) Watertight hatch and door							•*1) : Detail is referred to part Ⅲ, para.III.4
- Hose test (*1)				O	O		•*2) : Except for Non-tight Hatch Cover
3) Weather-tight hatch and door							
- Hose test (*1) or chalk test				O	O		•Position 1 only
1.3 Side scuttle and window							
- Hose test (*1) or chalk test				O	O		•Position 1 only
1.4 Cargo gear and lifting appliance							•* Register of lifting appliance/Cargo handling gear cert. ; Builder or Class. cert. shall be issued acc. to the contract spec.
1) Crane and davit							
- Fitting material test	*O		O				
- Operation and load test	*O	O	O	*O	O	O	•Operation test and/or load test is to be carried out under quay mooring condition of the vessel
2) Small davit							
- Operation test						O	•Less than 1.0 ton (S.W.L)

1. Hull outfitting part	In Shop			On-Board			Remarks
	C	O	R	C	O	R	
1.5 Life saving, fire fighting equipment and fire protection							•SOLAS item
1) Boat davit and winch							
- Operation and load test	O	O	O	O	O	O	
2) Life and rescue boat							
- Running test	O	O	O	O	O	O	
- Launching test				O	O	O	
3) Safety equipment							
- Confirmation inspection				O	O		
4) Fire fighting system							
- Confirmation inspection				O	O		
5) Fire damper							
- Operation test				O	O		
6) A-60 insulation and draft stop							
- Installation inspection				O	O		
1.6 Accommodation space							
● Galley and laundry equipment							
- Operation test					O		
1.7 Air conditioning system							
- Volume check in cabin				*O	O	O	•* If crew accom. cert. is required from Class. Society.
- Cooling or heating test					O	O	
1.8 Inert gas generating system							
- Safety device function test				O	O	O	
- Blower capacity test				O	O		•During sea trial.
- Shop test	O	O	O				
1.9 Accommodation ladder							•* In scope of rule requirement
- Proof load test	*O	O	O				•* Combining test with pilot ladder.
- Operation test				*O	O		

Ⅱ. CATEGORIES OF INSPECTION AND TEST ITEMS — 100

1. Hull outfitting part	In Shop			On-Board			Remarks
	C	O	R	C	O	R	
1.10 Oil discharge monitoring system							
- Function test				O	O		
- Flow meter calibration				O	O		•During sea trial.
1.11 Cargo turbine/pump and water ballast pump							
- Shaft alignment check				O	O	O	
- Safety device test				O	O	O	
- Capacity check					O		•Cargo pump only.
- Shop test	O	O	O				
1.12 Stripping pump							
- Operation test					O		
1.13 Crude oil washing system							
- Operation test				O	O		
1.14 Thruster							
- Shop test	O	O	O				
- Seal leak test					O		
- Blade gap check						O	
- Shaft alignment check				O	O	O	
- Operation test				O	O		•During sea trial.
1.15 GAS carrier							
1) Cargo pump, spray/stripping pump & emer'cy cargo pump							
- Manufacturing & performance test	O	O	O				
- Safety device test(alarm & trip)				O	O	O	
- Running test				O	O	O	•During gas trial.
- Rotation confirmation				O	O	O	•Cargo pump only
- Confirm condition of foot valve				O	O	O	•Emergency cargo pump only

1. Hull outfitting part	In Shop			On-Board			Remarks
	C	O	R	C	O	R	
2) Cargo compressor(L.D & H.D)							
- Manufacturing/performance test	O	O	O				
- Shaft alignment				O	O	O	
- Safety device test(alarm & trip)				O	O	O	
- Running test				O	O	O	•During gas trial.
3) Vaporizer & forcing vaporizer							
- Manufacturing insp.	O	O	O				
- Function test				O	O	O	•During gas trial.
4) Gas heaters(LD & HD)							
- Manufacturing insp.	O		O				
- Function test				O	O	O	•During gas trial.
5) Reliquefaction plant(If installed)							
- Manufacturing/performance test	O	O	O				
- Shaft alignment				O	O	O	
- Safety device test(alarm & trip)				O	O	O	
- Running test				O	O	O	•During gas trial.
6) Inert gas generator							
- Manufacturing inspection	O	O	O				
- Safety device test(alarm & trip)				O	O	O	
- Running test				O	O	O	•During gas trial.
7) Nitrogen generator							
- Manufacturing inspection	O	O	O				
- Safety device test(alarm & trip)				O	O	O	
- Running test				O	O	O	
8) Cargo safety valve for cargo tanks and insulation spaces							
- Vacuum test	O	O	O				
- Pressure test	O	O	O				

Ⅱ. CATEGORIES OF INSPECTION AND TEST ITEMS — 102

1. Hull outfitting part	In Shop			On-Board			Remarks
	C	O	R	C	O	R	
9) Vacuum pumps							
- Manufacturing/performance test	O		O				
- Shaft alignment						O	
- Safety device test(alarm & trip)				O	O	O	
- Running test				O	O	O	
10) Gas detection system							
- Function test(alarm & trip)				O	O	O	
11) Custody transfer system							
- Function test (pressure, temperature, level)	O	O	O	O	O	O	
12) Water detection system							
- Function test of water detector				O	O	O	
13) STL equipment							
- Manufacturing	O	O	O				
- Operation test				O	O		
- Dummy buoy test				O	O		
14) GCU equipment							
- Manufacturing insp.	O	O	O				
- Safety & Operation test				O	O		
15) Cold test				O	O	O	
16) Gas trial				O	O	O	
17) High pressure BOG compressor							
- Mechanical running test	O	O	O				
- Overhaul inspection	O	O	O				
- Safety device test				O	O	O	
- Operation test				O	O	O	
- Painting confirmation							
18) High pressure Pump & Vaporizer							
- Performance test	O	O	O	O	O	O	
- Safety device test				O	O	O	

1. Hull outfitting part	In Shop			On-Board			Remarks
	C	O	R	C	O	R	
1.16 Others							
1) Tank level gauge / Cargo monitoring system							
- Function test				O	O		
2) Draft gauge							
- Function test					O		
3) Loading computer							
- Function test				O	O		
4) Valve remote control system							
- Operation test	O	O	O		O		

2. Machinery part	In Shop			On-Board			Remarks
	C	O	R	C	O	R	
2.1 M/E shaft and propeller							
1) Intermediate/propeller shaft							
- Final inspection	O		O				
2) Coupling bolts/holes							
- Dimension check	O		O				
- Fitting inspection				O	O		
3) Propeller shaft with propeller							
- Contact inspection	O	O	O				
4) Stern boss/rudder horn casting							
- Final inspection	O		O				
5) Shaft center line sighting							
- Measurement inspection				O	O	O	
6) Stern tube bush							
- Fitting inspection				O	O	O	
- Clearance check						O	
7) Propeller							
- Final inspection	O	O	O				
- Fitting inspection				O	O	O	
8) Propeller shaft							
- Wear down check				O	O	O	
9) Stern tube seal							
- Leak test				O	O		
10) Shafting							
- Alignment check				O	O	O	
- Bearing reaction force check				O	O	O	
2.2 Rudder							
1) Stock							
- Final inspection	O		O				
- Fitting inspection				O	O	O	•Taper type
- Reamer bolt fitting				O	O	O	•Flange type
2) Stock & Rudder contact test	O	O	O				

2. Machinery part	In Shop			On-Board			Remarks
	C	O	R	C	O	R	
3) Tiller							
- Contact inspection	O	O	O				•Between stock and tiller.
- Fitting inspection				O	O	O	
4) Rudder horn bush							
- Fitting inspection	*O		O	O	O	O	•*In case of full spade rudder.
5) Rudder pintle							
- Final inspection	O		O				
- Contact test	O	O	O				
- Fitting inspection	O	O	O				
6) Rudder carrier/housing							
- Final inspection	*O		O				•* In scope of rule requirement
7) Rudder							
- Fabrication and air test	O	O					•Before covering plate
- VCI powder injection inspection		O					
(*VCI : Volatile Corrosion Inhibitor)							
- Alignment inspection	O	O					•Stock and pintle
- Swing test				O	O	O	
8) Rudder jumping stopper							
- Clearance check				O	O	O	
2.3 Main engine (Diesel/Turbine)							
1) Major components							
- Final inspection	O		O				
2) Shop test	O	O	O				
3) Chock fast/liner							
- Installation condition check				O	O		
4) Holding down bolts							
- Tightening inspection				O	O		•After sea trial
5) Crankshaft/shaft alignment							
- Deflection check	O		O	O	O	O	

2. Machinery part	In Shop			On-Board			Remarks
	C	O	R	C	O	R	
6) Safety device							
- Function test	O	O	O	O	O	O	
7) Mooring trial				O	O	O	
8) Overhaul inspection	O	O		O	O		
2.4 Reduction gear							
- Manufacturing insp.	O	O	O				
- Gear tooth contact	O	O	O	O	O	O	•For each wheel
- Safety device	O	O	O	O	O	O	and pinion.
- Running test	O	O	O	O	O	O	
2.5 Steering gear							
- Hydraulic pipe/actuator hyd. test	O		O				
- Safety valve setting	O		O	O	O	O	
- Running test(no load)	O	O	O				
- Alignment inspection				O	O	O	
- Operation test				O	O	O	•During sea trial.
2.6 Aux. Boiler							
- Hyd. test	O	O	O				
- Safety device test				O	O	O	
- Safety valve popping test				O	O	O	
2.7 Economizer							
- Hyd. test	O	O	O				
- Safety valve popping test				O	O	O	
2.8 Electric generator engine							
1) Diesel generator engine							
- Shop test	O	O	O				
- Overhaul inspection	O	O	O				
- Crankshaft deflection check				O	O	O	
- Safety device test	O	O	O	O	O	O	
- Con-rod bolt tightening confirmation							

2. Machinery part	In Shop			On-Board			Remarks
	C	O	R	C	O	R	
2) Turbine for turbo generator							
- Shop test	O	O	O				
- Safety device test	O	O	O	O	O	O	
- Overhaul inspection	O	O	O	O	O	O	
2.9 Em'cy generator engine							
- Shop test	O	O	O				
- Safety device test	O	O	O	O	O	O	
2.10 Air compressor and air reservoir							
1) Air compressor							
- Safety device test	O		O	O	O	O	
- Air charging test				O	O		
2) Air reservoir							
- Hyd. test	O	O	O				
- Safety valve popping test				O	O	O	
2.11 Heat exchanger							
- Hyd. test	O		O				
2.12 Air cond. and provision refrigerating plant							
- System vacuum test					O		
- Control device test					O	O	
- Running test					O		
2.13 Incinerator							
- Operation and safety device test	*O	O	O	O	O	O	•* Type approved certificates
2.14 Oily water separator							
- Operation test				O	O	O	
2.15 Oil purifier							
- Operation test					O	O	

2. Machinery part	In Shop			On-Board			Remarks
	C	O	R	C	O	R	
2.16 Overhead crane							
- Shop test	*O	O	O				•* Register of lifting appliance/Cargo handling gear cert. ; Builder or Class. cert. shall be issued acc. to the contract spec.
- Operation and load test				*O	O	O	
2.17 Sewage treatment plant							
- Operation test				O	O	O	
2.18 Bilge suction test				O	O		•E/R and cargo hold
2.19 Quick closing valve for oil tank							
- Operation test				O	O		
2.20 Power pack for hyd. oil system							
- Safety device test					O	O	
2.21 Elevator(personnel lift)							
- Operation and load test				*O	O	O	•* In scope of rule/ regulation require-ments
- Safety device test				*O	O	O	
2.22 Workshop machinery							
- Operation test					O		
2.23 Shipside valve							
- Operation test				O	O	O	•Only for power system
2.24 Marine growth prevent system							
- Function test					O		

3. Piping part	In Shop			On-Board			Remarks
	C	O	R	C	O	R	
3.1 Pipe pieces							
- Class Ⅰ,Ⅱ fabrication insp.	O	O					•In scope of rule requirements. •In-process inspection.
3.2 Steam line							
- Hydro test				O	O		
3.3 Compressed air line							
- Installation and hydro test				O	O		
3.4 Hydraulic oil line							
- Installation and hydro test				O	O		
3.5 Fuel oil line							
- Installation and hydro test				O	O		
3.6 Heating coil in tanks							
- Installation and hydro test				O	O		
3.7 Fire line							
- Installation and hydro test				O	O		
3.8 Bilge line							
- Installation and hydro test				*O	O		•* DNV only.
3.9 CO_2 fire extinguish line							
- Hydro test	O						•For manifold.
- Installation and leakage test				O	O		•For manifold.
3.10 Ballast line							
- Installation and leak test					O		
3.11 Cargo, stripping, crude oil washing line							
- Installation and hydro test				O	O		

3. Piping part	In Shop			On-Board			Remarks
	C	O	R	C	O	R	
3.12 Sanitary, scupper line							
- Flooding test				*O	O		•* Load line require-ment is to be confirmed.
3.13 L.O, D.O transfer line							
- Hydro or leak test				O	O		•Main deck only.
3.14 OX/AC line							
- Installation and leak test				O	O		
3.15 Boiler feed water line							
- Installation and hydro test				O	O		
3.16 L.O line for main engine							
- Flushing insp.					O		
3.17 Hydraulic oil line							
- Flushing insp.					O		•For deck machinery, hatch cover and Ro-Ro equipment.
3.18 Piping for GAS carrier							
1) Cargo liquid/stripping/spray sys.							
- Fit-up insp.			O			O	
- Pressure/ leakage test	O	O		O	O	O	•Leakage test is to be carried out at the shop or P.E stage.
- Cleaning insp.(camera test)				O	O	O	
2) Vapor gas system							
- Fit-up insp.			O			O	
- Pressure/leakage test	O	O		O	O	O	
- Cleaning insp.(camera test)				O	O	O	•Leakage test is to be carried out at the shop or P.E stage.

3. Piping part	In Shop			On-Board			Remarks
	C	O	R	C	O	R	
3) Venting system for cargo tank and vent heater							
- Fit-up insp.			O			O	
4) Fuel gas system							
- Fit-up insp.						O	
- Pressure/leakage test				O	O		
5) N_2 purge system							
- Fit-up insp.						O	
- Leakage test				O	O		
6) Main steam line							•For steam ship
- Fit-up insp.				O	O	O	
- Post weld heat treatment				O	O	O	
- Hyd. test				O	O		
- Blow-out test					O		
7) Cargo handling sys. (press. parts)							•For LPGC (No. 7~12 items)
- Fit-up insp.						O	
- Leakage test				O	O		
- Air blowing test						O	
8) Inert gas sys. (press. parts)							
- Fit-up insp.						O	
- Leakage test				O	O		
- Air blowing test						O	
9) Cargo hold drainage sys.							
- Fit-up insp.						O	
- Leakage test				O	O		
10) Cargo sea water cooling sys.							
- Fit-up insp.						O	
- Leakage test				O	O		
11) Nitrogen sys.							
- Fit-up insp.						O	
- Leakage test				O	O		
- Air blowing test						O	
12) Cargo steam sys.							
- Fit-up insp.						O	
- Hyd. test				O	O		

4. Electric part	In Shop			On-Board			Remarks
	C	O	R	C	O	R	
4.1 Main generator							
- Shop test	O	O	O				
- Insulation resistance test				O	O	O	
- Parallel operation test				O	O	O	
- Governor test				O	O	O	
- Full load test				O	O	O	
- Load characteristic test				O	O	O	
4.2 Main switchboard							
- Fabrication and shop test	O	O	O				
- Auto. control device test				O	O	O	
- Over current trip test				O	O	O	
- Reverse power trip test				O	O	O	
- Preferential trip test				O	O	O	
- Under voltage trip test				O	O	O	
- Frequency high/low test				O	O	O	
- Voltage high/low test				O	O	O	
- Black out test				O	O	O	
- Interlock device test				O	O	O	
- Power management system test				O	O	O	
4.3 Shaft generator							
- Shop test	O	O	O				
- Safety device test				O	O	O	
- M/E holding R.P.M check				O	O	O	
- Parallel operation test				O	O	O	
- Frequency converter device test				O	O	O	
4.4 Emergency generator							
- Shop test	O						
- Insulation resistance test			O	O	O	O	
- Governor test				O	O	O	
- Load & load characteristic test				O	O	O	
4.5 Emergency switch board							
- Fabrication & shop test	O	O	O				
- Over current trip test				O	O	O	
- Under voltage trip test				O	O	O	

4. Electric part	In Shop			On-Board			Remarks
	C	O	R	C	O	R	
4.6 Thruster							
- Safety device test				O	O	O	
- Pitch control test				O	O	O	
4.7 Battery & battery charging device							
- Operation test				O	O	O	
4.8 Motor and control gear							
1) Emergency stop of motor/fan							
- Operation test				O	O	O	
2) Sequential starting for maneuvering							
- Operation test				O	O	O	
3) Automatic change over for maneuvering							
- Operation test				O	O	O	
4) Blocking of heavy consumer starting							
- Operation test				O	O	O	
5) Steering gear alarm system							
- Operation test					O	O	
4.9 Insulation resistance for power circuit							• 10% random insp. of total items.
- Measurement test				O	O	O	
4.10 Lighting equipment							
1) Navigation and signal light							
- Function test				O	O		
2) Emergency light							
- Function test				O	O		
3) Day signal light							
- Function test				O	O		

4. Electric part	In Shop			On-Board			Remarks
	C	O	R	C	O	R	
4.11 Communication equipment and alarm system							
1) Auto. telephone - Function test						O	
2) Sound powered telephone - Function test				O	O		
3) Public address system - Function test				O	O		
4) Engine order telegraph - Function test				O	O	O	•During mooring trial
5) Rudder angle indicator - Function test				O	O	O	
6) Engineer/officer call system - Function test				O	O		
7) Communal aerial system - Function test						O	
8) Extension alarm - Function test				O	O		
9) Fire/general alarm - Function test				O	O		
10) CO_2 alarm - Function test				O	O		
4.12 Navigation and searching equipment							
1) Whistle - Function test				O	O		.
2) Magnetic compass - Function test					O		

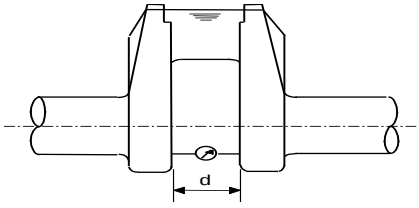
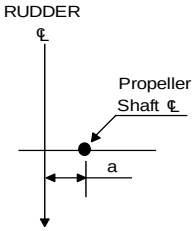
4. Electric part	In Shop			On-Board			Remarks
	C	O	R	C	O	R	
3) Gyro compass and autopilot							
- Function test					O		
4) Echo sounder							
- Function test					O		
5) Speed log							
- Function test					O		
6) Radar							
- Function test					O		
7) Positioning navigator							
- Function test					O		
4.13 Radio equipment							
1) Radio plant							
- Function test				*O	O		•* On behalf of government administration.
2) V.H.F telephone							•* On behalf of government administration.
- Function test				*O	O		
3) Satellite communication system							•* On behalf of government administration.
- Function test				*O	O		
4.14 Engine room alarm and monitoring system							
- Function test				O	O		
4.15 E.C.R & bridge console with alarm monitoring system							
- Function test	O	O	O				

5.Remote control/automation part	In Shop			On-Board			Remarks
	C	O	R	C	O	R	
5.1 Main propulsion plant and its essential auxiliaries							
- Function test				O	O	O	
5.2 Integrated automation system(I.A.S)							
- Function test				O	O	O	•If equipped.
5.3 Main propulsion system							
- Endurance test				O	O	O	•During sea trial.
5.4 E/R sys. automation system (E.O/U.M.S/ACCU/AUT)							
- Function test				O	O	O	•During sea trial.
5.5 Ship speed test							
- Progressive speed trial					O	O	•During sea trial.
5.6 Maneuvering test							•During sea trial.
1) Turning circle test					O	O	
2) Stopping inertia test					O	O	
3) Z maneuvering test					O	O	
4) Crash stop, ahead/astern test				O	O	O	
5) Bridge maneuvering test				O	O	O	
5.7 Dynamic positioning system.	O	O		O	O	O	

1. MAIN MACHINERY

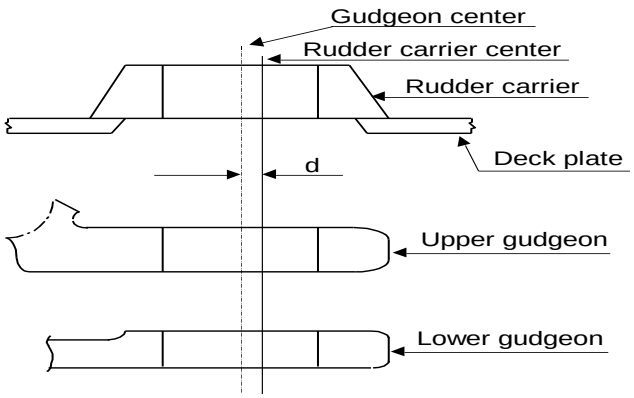
1.1 Main engine & shafting

(Unit : mm)

Item	Tolerance Limits	Remarks
1) Crankshaft deflection 		Note Maker's recommend-dation should be followed.
2) Centering (1) Diameter of piano wire : d (2) Tension of piano wire : T (3) Deviation of rudder center from shaft center line [Transverse direction(port – stb'd)] ● Deadweight : Over 100,000 tons ● Deadweight : Below 100,000 tons	d= 0.5~0.7mm T= 10~20kg a≤8 a≤6	 (Looking FWD)
3) Installation - Contact ratio of chock liner - Clearance between liner and base	≥70% ≤0.04	Clearance within 10mm depth can be allowed.

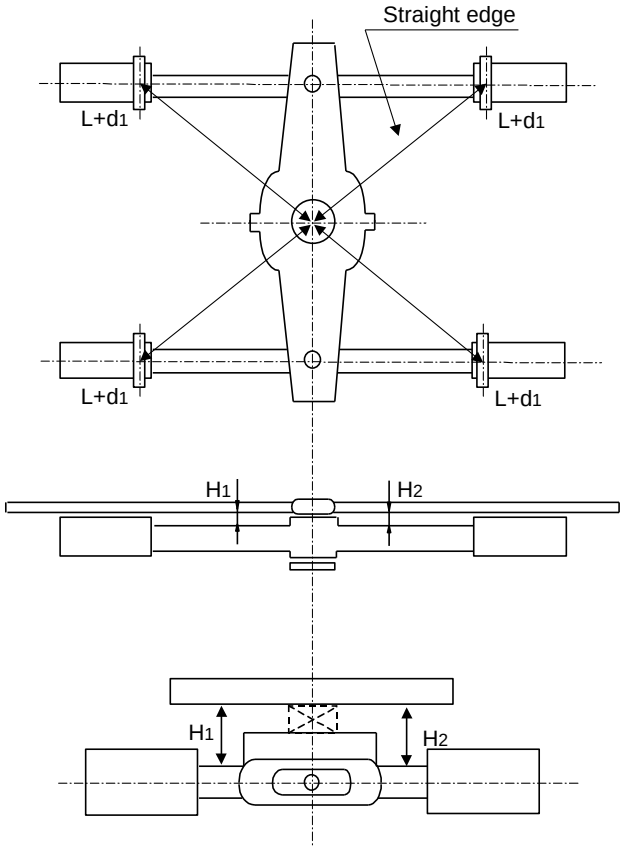
1.2 Rudder

(Unit : mm)

Item	Tolerance Limits	Remarks
Center of gudgeon (stern frame) Alignment (after bush fitting) 	d≤0.5	

1.3 Steering gear

(Unit : mm)

Item	Tolerance Limits	Remarks
1) Installation - Contact ratio of chock liner - Clearance between liner and base	≥70% ≤0.04	Clearance within 10mm depth can be allowed.
2) Alignment 	| d1 | ≤2 | H1-H2 | ≤0.15	

2. AUXILIARY MACHINERY

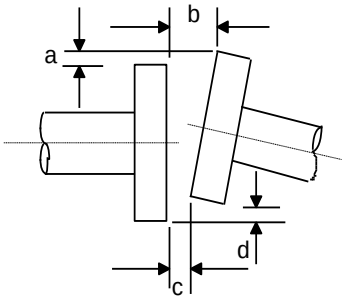
2.1 E/R aux. machinery

(Unit : mm)

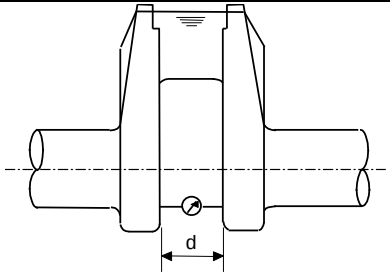
Item	Tolerance Limits	Remarks
Installation of aux. machinery shall be carried out in accordance with the following three grades. 1) Classification of machinery (1) Grade "A" : Diesel generator, Turbo generator, Plumber blocks. - Tightness of the chock liner shall be checked by hammering after tightening the holding down bolts and confirming that a feeler gauge of 4/100 mm thickness should not insert more than 10mm. (2) Grade "B" : Fresh water pump, Fresh water cooling pump, Bilge pump, Main engine sea water cooling p/p, Fire pump, Fuel oil transfer p/p, Ballast pump, Aux. boiler, Lub. oil pump, Bilge & general service pump, Emergency diesel generator, Air compressor, Cargo pump. - Tightness of holding down bolts shall be checked by hammering after installation completed (shop and onboard). (3) Grade "C" : Other machinery which are not listed on "grade A" and "grade B". - Tightness of holding down bolts shall be checked by hammering after installation completed (shop and onboard). 2) Installation (1) Clearance between liner and base		
Grade "A"	≤0.04	Grade B & C ; Machinery level can be adjusted with shim plate.
Grade "B"	-	
Grade "C"	-	

(2.1 E/R aux. machinery)

(Unit : mm)

Item			Tolerance Limits	Remarks
3) Alignment(solid type) Grade “B” only  Sag : $\frac{a - d}{2}$ Gap : b - c ※Where not defined from the maker.				
Below (inclusive)	37 Kw	Sag	≤0.05	Follow to maker’s recommendation.
		Gap	≤0.10	
Over	37 Kw	Sag	≤0.08	
		Gap	≤0.18	

2.2 Diesel generator

Crankshaft deflection	Cold condition	$\leq \frac{1}{10000}$ x stroke(mm)	Follow to maker’s recommendation.
	Hot condition	$\leq \frac{2}{10000}$ x stroke(mm)	
 			

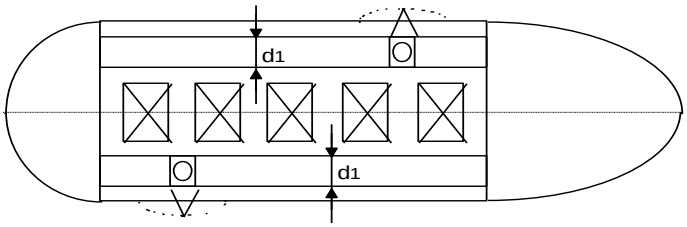
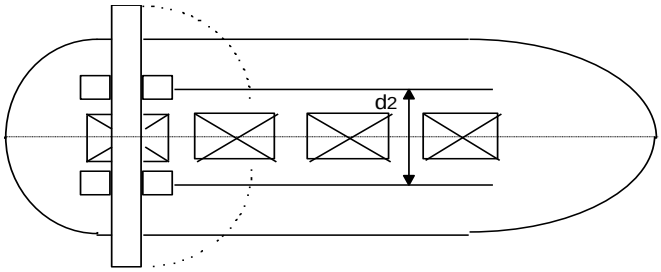
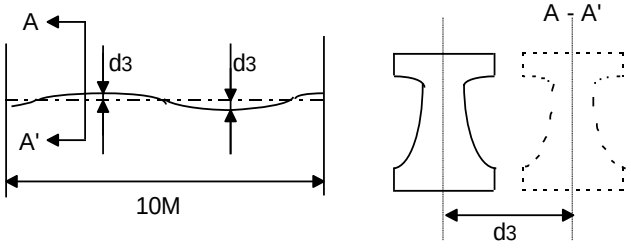
2.3 Deck machinery

(Unit : mm)

Item	Tolerance Limits	Remarks
Installation of aux. machinery shall be carried out in accordance with the following three grades. 1) Classification of machinery (1) Grade "A" : GAS Carrier Cargo pump - Tightness of chock liner shall be checked by hammering after tightening the holding down bolts and confirming that a feeler gauge of 4/100 mm thickness should not insert more than 10mm. (2) Grade "B" : Windlass Mooring winch Cargo winch - Tightness of holding down bolts shall be checked by hammering after installation completed. (3) Grade "C" : Other machinery which are not listed on "Grade A" and "Grade B". - Tightness of holding down bolts shall be checked by hammering after installation completed. 2) Installation Clearance between liner and base Grade "A" Grade "B" Grade "C"	 $\leq$0.04 - -	 Grade B & C ; Machinery level can be adjusted with shim plate.

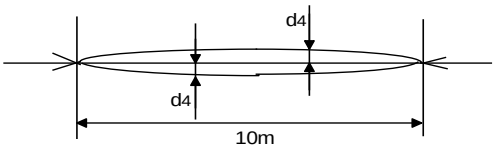
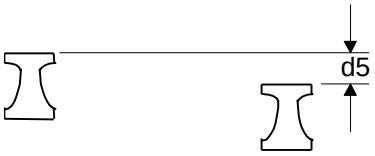
2.4 Travel type deck crane

(Unit : mm)

Item	Tolerance Limits	Remarks
(1) Distance between centers of rails (Common type) 	d1 ± 5 (per 10m)	
(2) Distance between centers of rails (Gantry type) 	d2 ± 10 (per 10m)	
(3) Straightness (longitudinal) of rail 	d3 ≤ 5 (per 10m)	

(2.4 Travel type deck crane)

(Unit : mm)

Item	Tolerance Limits	Remarks
(4) Straightness (level of rail top surface)  To be measured at each 5 meters.	d4 ≤ 5 (per 10m)	
(5) Difference of height between port and stb'd.  To be measured at each 5 meters.	d5 ≤ 8	

3. PIPING

3.1 Grade of pipe

The grade specified by each Classification society shall be divided as follows;

(1) LR

P(Kg/cm^2), T(^{o}C)

Service \ Grade	Class 1		Class 2		Class 3	
	P	T	P	T	P	T
Steam	P > 16.3 or T > 300		7.1 < P ≤ 16.3 or 170 < T ≤ 300		P ≤ 7.1	T ≤ 170
Flammable Liquids (See note)	P > 16.3 or T > 150		7.1 < P ≤ 16.3 or 60 < T ≤ 150		P ≤ 7.1	T ≤ 60
Other media, Cargo oil	P > 40.8 or T > 300		16.3 < P ≤ 40.8 or 200 < T ≤ 300		P ≤ 16.3	T ≤ 200

NOTE : Flammable liquids include ; Fuel oil, Lubricating oil, Thermal oil and hydraulic oil.

(3.1 Grade of pipe)

(2) ABS

P(kgf/㎠), T(℃)

Service	Class Ⅰ		Class Ⅱ		Class Ⅲ	
	P	T	P	T	P	T
Steam and Thermal Oil	P > 16.3 or T > 300		16.3≥ P > 7.1	300≥ T	P≤ 7.1	T≤ 170
			or			
			16.3≥ P	300≥ T > 170		
Fuel Oil	P > 16.3 or T > 150		16.3≥ P > 7.1	150≥ T	P≤ 7.1	T≤ 60
			or			
			16.3≥ P	150≥ T > 60		
Other Fluids, Except Cargo Oil and Open Ended Piping	P > 40.8 or T > 300		40.8≥ P > 16.3	300≥ T	P≤ 16.3	T≤ 200
			or			
			40.8≥ P	300≥ T > 200		

① CLASS Ⅰ
- Toxic or Corrosive Fluids
- Flammable Fluids Heated to above flash point
- Flammable Fluids having flash point below 60℃ other than cargo oil
- Liquefied gases

② CLASS Ⅲ
- Cargo Oil
- Open Ended Piping

(3) KR & NK

P(bar), T(℃)

Service \ Grade	Group 1		Group 2		Group 3	
	P	T	P	T	P	T
Steam	P>16 or T>300		7<P≤16	170<T≤300	P≤7	T≤170
Fuel oil	P>16 or T>150		7<P≤16	60<T≤150	P≤7	T≤ 60
Water, Lub. oil, Comp. air, Hyd. oil	P>40 or T>300 (only KR)		16<P≤40	200<T≤300 (only KR)	P≤16	T≤200 (only KR)
Primary Refrigerant (Ammonia)	All		-		-	
(R12, R22)	-		-		All	

(3.1 Grade of pipe)

(4) U.S.C.G

P(PSI), T(^{o}F)

Service	Class	P(PSI)		T(^{o}F)
Class B and C poisons (2)	Ⅰ	any	and	0 and above
	Ⅰ – L	any	and	below 0
	Ⅱ	See note (3)		
	Ⅱ – L	See note (3)		
Gases and vapors (2)	Ⅰ	above 150	or	above 650
	Ⅰ – L	above 150	and	below 0
	Ⅱ	150 and below	and	0 to 650
	Ⅱ – L	150 and below	and	below 0
Liquified flammable gases (2)	Ⅰ	above 150	and	0 and above
	Ⅰ – L	above 150	and	below 0
	Ⅱ	150 and below	and	0 and above
	Ⅱ – L	150 and below	and	below 0
Molten sulphur	Ⅰ	above 225	or	above 330
	Ⅱ	225 and below	and	330 and below
Cargo liquids Grades A through D (2)	Ⅰ	above 225	or	above 150
	Ⅰ – L	above 225	and	below 0
	Ⅱ	225 and below	and	0 to 150
	Ⅱ – L	225 and below	and	below 0
Cargo liquids Grade E	Ⅰ	above 225	or	above 400
	Ⅰ – L	above 225	and	below 0
	Ⅱ	225 and below	and	0 to 400
	Ⅱ – L	225 and below	and	below 0
Water	Ⅰ	above 225	or	above 350
	Ⅱ	225 and below	and	350 and below
Fuel(bunker, diesel, gasoline, etc.)	Ⅰ	above 150	or	above 150
	Ⅱ	150 and below	and	150 and below
Lubricating oil	Ⅰ	above 225	or	above 400
	Ⅱ	225 and below	and	400 and below
Asphalt	Ⅰ	above 225	or	above 400
	Ⅱ	225 and below	and	400 and below

(continued)

(3.1 Grade of pipe)

((4) U.S.C.G)

P(PSI), T(^{o}F)

Service	Class	P		T
Heat transfer oil	Ⅰ	above 225	or	above 400
	Ⅱ	225 and below	and	400 and below
Hydraulic fluid	Ⅰ	above 225	or	above 400
	Ⅱ	225 and below	and	400 and below

- Flammable or combustible dangerous cargo
  : Refer to specific requirements of C.F.R
- Other dangerous cargo
  : Refer to specific requirement of C.F.R

(1) Where doubt exists as to proper classification, refer to the commandant for resolution.

(2) For definitions, see 46 C.F.R part 30, 151 and 154.
Note that the category “B” and “C” position is not used in the rules applying to self-propelled vessels(46 C.F.R part 153).

(3) Not permitted except inside cargo tanks approved for class B and C position.

(5) D.N.V

P(bar), T(^{o}C)

Piping system for	Class Ⅰ *1)		Class Ⅱ *1)		Class Ⅲ *1)	
	P	T	P	T	P	T
Steam	>16	>300	≤16	≤300	≤ 7	≤170
Fuel oil	>16	>150	≤16	≤150	≤ 7	≤ 60
Other media *2), *3)	>40	>300	≤40	≤300	≤16	≤200

*1) For Class Ⅱ and Ⅲ piping, both specified conditions are to be met
For Class Ⅰ piping, one condition only is sufficient.

*2) Air, water, lubricating oil and hydraulic oil.

*3) Cargo oil and open ended pipes(drains, overflows, vents, boilers escape pipes, etc.) independently of the pressure and temperature, are pertaining to ClassⅢ.

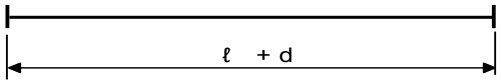
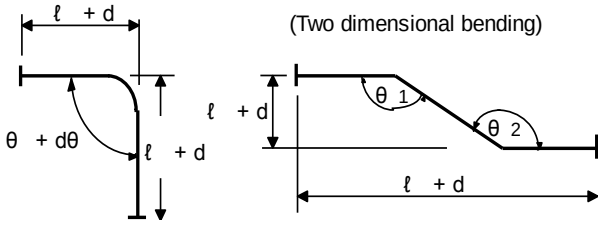
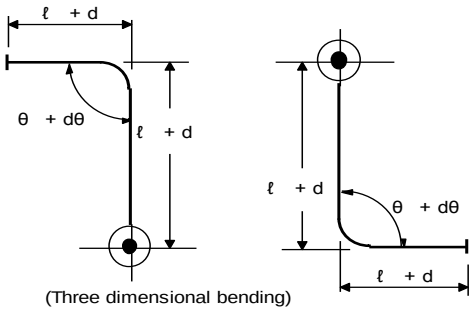
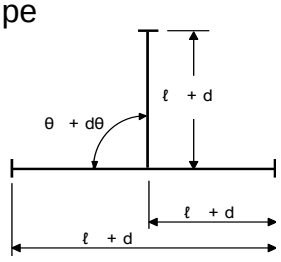
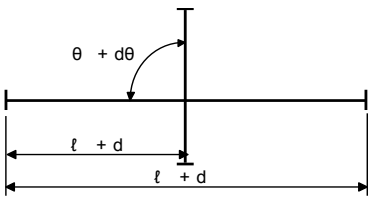
(3.1 Grade of pipe)

(6) G.L

Medium/type of pipeline	Design pressure : PR(bar) Design temperature : t(℃)		
	Class Ⅰ	Class Ⅱ	Class Ⅲ
Toxic and corrosic media Inflammable media with service temperature above the flash point Inflammable media with a flash point below 60℃ Liquefied gases(LG)	all	*1)	-
Steam, thermal oil	PR >16 or t >300	PR ≤ 16 and t ≤ 300	PR ≤ 7 and t ≤ 170
Air, gas Lubricating oil, Hydraulic oil Boiler feed water, condensate Sea water and fresh water for cooling Brine in refrigerating plant	PR >40 or t >300	PR ≤ 40 and t ≤ 300	PR ≤ 16 and t ≤ 200
Liquid fuels	PR >16 or t >150	PR ≤ 16 and t ≤ 150	PR ≤ 7 and t ≤ 60
Cargo pipelines for oil tankers	-	-	all
Open-ended pipelines(without shutoff), e.g. drains, venting pipes, overflow lines and boiler blow down lines	-	-	all
Refrigerants	-	all	-
Cargo and venting lines for gas and chemical tankers	all	-	-
*1) Classification in Pipe Class Ⅱ is possible if used for special safety arrangements and arranged for structural safety precautions.			

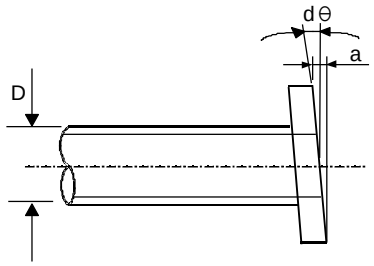
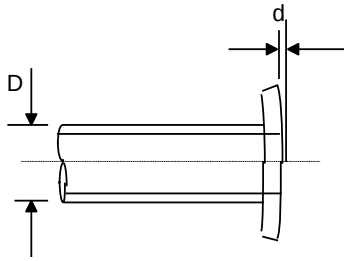
3.2 Pipe fabrication

(Unit : mm)

Item	Tolerance Limits	Remarks
1) Dimension (1) Straight pipe 	d = ± 2	
(2) Bent pipe 	d = ± 2 dΘ = ± 0.5° | Θ1-Θ2 | ≤ 2°	
	d = ± 2 dΘ = ± 0.5°	
(3) Branch pipe 	d = ± 2 dΘ = ± 0.5°	
(4) Penetration piece 	d = ± 2 dΘ = ± 0.5°	

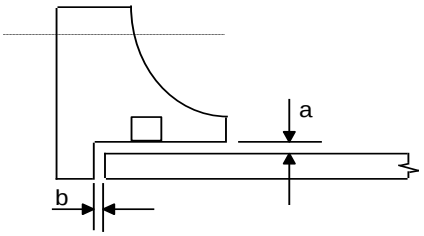
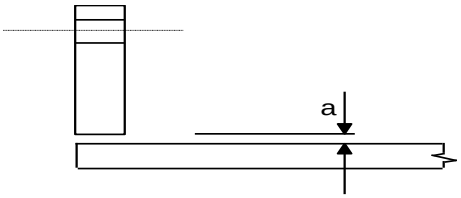
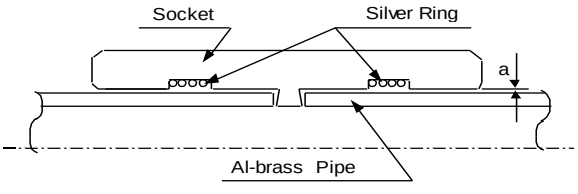
(3.2 Pipe fabrication)

(Unit : mm)

Item	Tolerance Limits	Remarks
2) Attachment of flange to pipe (1) Angle of flange to pipe  	dΘ ≤0.5° a : max. 1.0	In case of adjusting pipe, see PART III 1.5
(2) Distortion of flange face  	D < 200, d ≤ 0.5 200 ≤ D ≤ 450, d ≤ 1.0 D > 450, d ≤ 1.5	

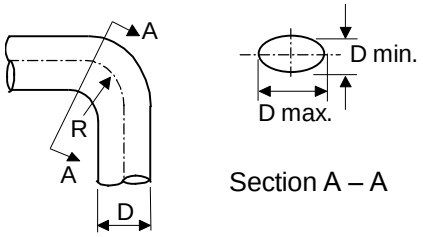
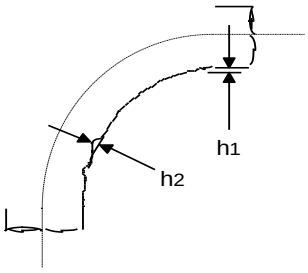
(3.2 Pipe fabrication)

(Unit : mm)

Item	Tolerance Limits	Remarks
(3) Welding joint for non-ferrous pipe ① Silver brazing of flange 	$0.05 \leq a \leq 0.13$ $b \leq 1.6$	For al-brass heating coil
② Brass brazing of flange 	$a \leq 0.3$	
③ Silver brazing of pipe 	$0.05 \leq a \leq 0.13$	For al-brass heating coil

(3.2 Pipe fabrication)

(Unit : mm)

Item	Tolerance Limits	Remarks
3) Pipe bending (1) Ellipticity(E)  Section A – A $* E = 2 \frac{Dmax.- Dmin.}{Dmax.+ Dmin.} x100(\%)$ Where : D = Outdia. Of pipe R = Bending radius (2)Thickness reduction ratio(T) $T = \frac{t - t1}{t} x\ 100(\%)$ t : Original pipe thickness t1 : Thickness after bending D : Outside dia. Of pipe (3)Rumples and swells  	*Class Ⅰ, Ⅱ pipe ; E≤ 7% Class Ⅲ pipe ; E≤10%	

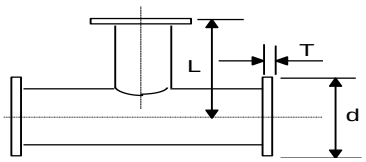
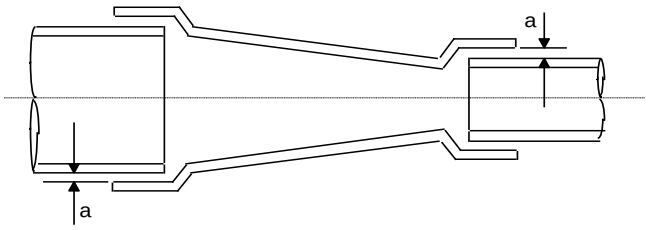
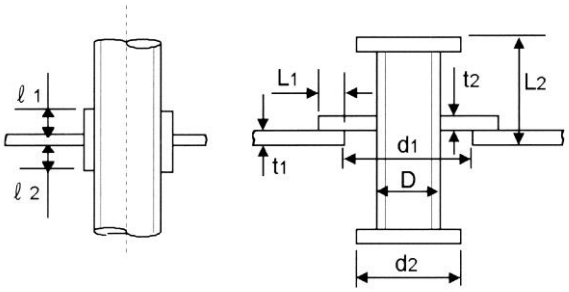
Curvature radius	T(%)	
	Steel	Copper
	H and C	H and C
2D＜R≤3D	25	30
3D＜R≤4D	20	25
R＞4D	16	20

H : Hot bending/High frequency bending
C : Cold bending

- Swell : $h1 \leq \frac{1}{100} x\ D$
- Rumple : $h2 \leq \frac{1}{100} x\ D$
- D : Outside dia. Of pipe
- h1 : Max. 2.0 mm for DNV Class Ⅰ and Ⅱ pipes.

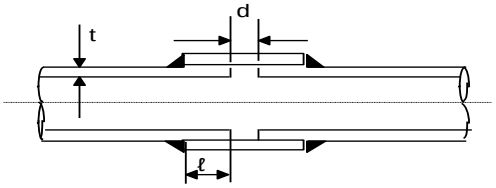
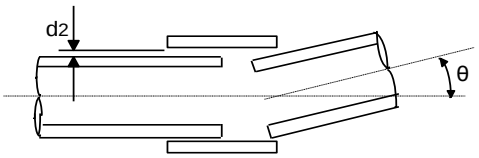
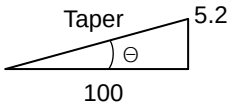
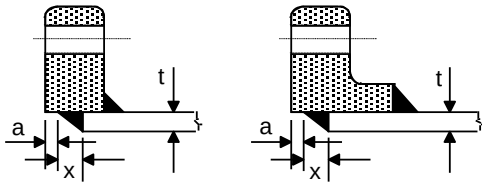
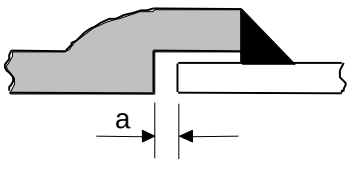
(3.2 Pipe fabrication)

(Unit : mm)

Item	Tolerance Limits	Remarks
4) Length of branch connection 	L ≥ 1/2d + T + 2H d : O.D of main pipe flange T : Thickness of main pipe flange H : Nut thickness	
5) Reducer < Copper pipe > 	0.1 ≤ a ≤ 0.3	
6) Penetration piece 	ℓ 1or ℓ 2 ≥ 15, d1 ≥ d2 +10 L2 ≥ 50 t2=12, t1 ≤ 12 t2=15, t1 ≤ 15 t2=20, t1 ≤ 20 t2=25, t1 ≤ 25 t2=30, t1 > 25 D=15A~300A L1 ≥ 40 D=350A~500A L1 ≥ 50 D=550A~ L1 ≥ 60	

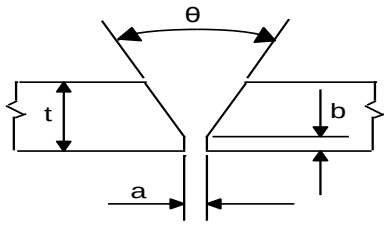
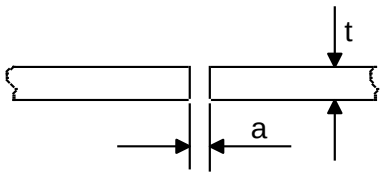
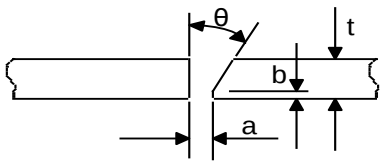
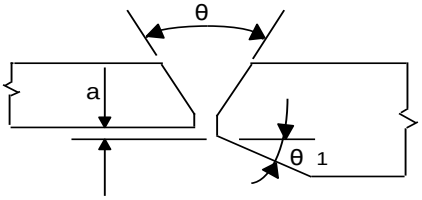
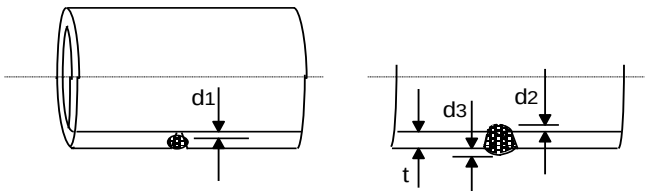
(3.2 Pipe fabrication)

(Unit : mm)

Item	Tolerance Limits	Remarks
7) Sleeve joint 	ℓ ≥ 15 d ≥ 2.0	
	d2 : max. 2.5 Θ < 3°	
8) Flange joint 	a ≤ max.1.5 X : To be carried out according to design practice	
9) Socket joint 	a ≤ 1.6	

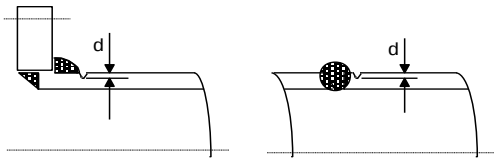
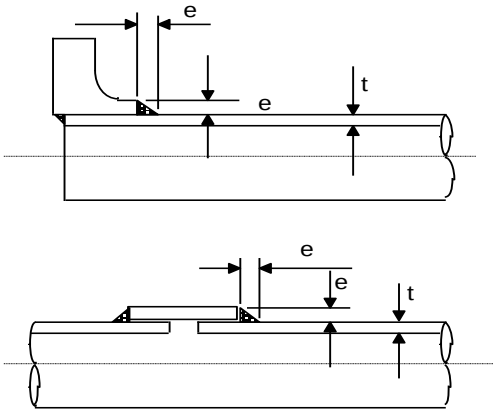
(3.2 Pipe fabrication)

(Unit : mm)

Item	Tolerance Limits	Remarks
10) Welding (1) Edge preparation  	2.8 ≤ t ≤ 26.0 a = 2.0~4.0 b = 1~2 Θ = 50~60°	Class Ⅰ, Ⅱ A welding procedure specification(WPS) should refer to details such as the thickness of base metal.
 	a = 0~2 t ≤ 4.2	
 	Θ = 50~60° a = 2~4 b = 0~2 t > 4.2	
 	Θ = 50~60° Θ 1 ≤ 30° a ≤ 1.6	
(2) Back bead  	1) t ≤ 6.4 d2, d3 ≤ 1.6 2) 6.4 < t ≤ 12.7 d2, d3 ≤ 3.2 3) 12.7 < t ≤ 25.4 d2, d3 ≤ 4.0 4) t > 25.4 d2, d3 ≤ 4.8 5) All thickness d1 ≤ 0.5	

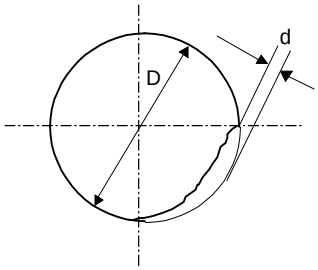
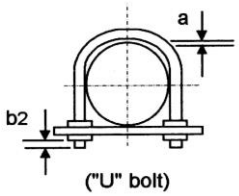
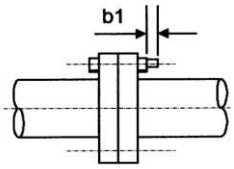
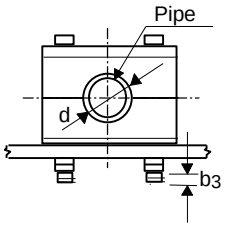
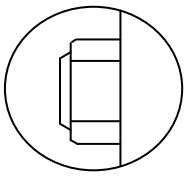
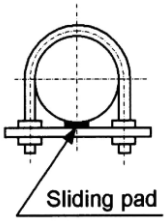
(3.2 Pipe fabrication)

(Unit : mm)

Item	Tolerance Limits	Remarks
(3) Undercut 	d ≤ 0.8 or 12.5% of the wall thickness which is smaller.	
(4) Leg length 	e : In accordance with design practice.	

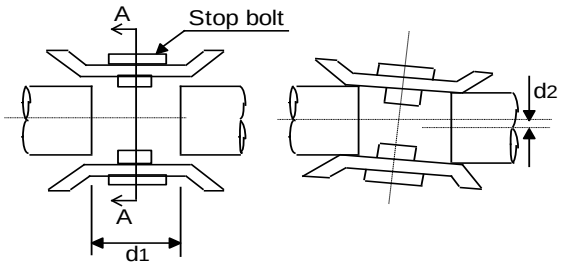
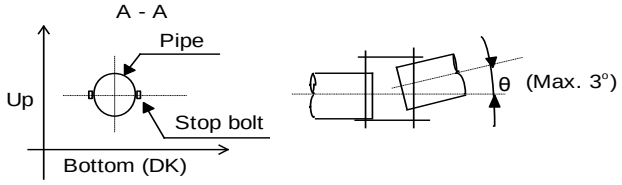
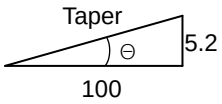
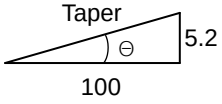
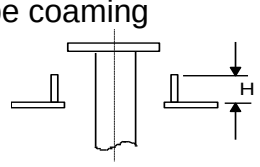
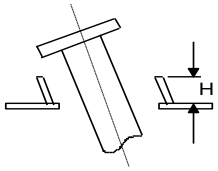
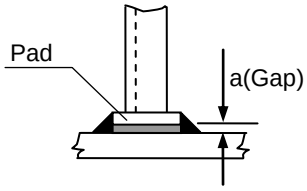
3.3 Pipe fitting

(Unit : mm)

Item	Tolerance Limits	Remarks
1) Pipe hole cutting 	d ≤ D/50	
2) Bolting  ("U" bolt)  (Flange bolt) Plastic clamp 	0.1 ≤ a ≤ 3.0 b1: 0~1/2D b2: 0~1/2D b3: 0~1/2D (D: Bolt diameter) d: Pipe O.D+1  b1,b2,b3 = “0”	Apply to the place where expansion is needed; Cargo oil/ballast pipe, heating coil in hull tank (length over 3m), inert gas pipe, etc. •Details of piping Installation shall be In accordance with piping practice.
3) Sliding pad 	Sliding pad in Weather Deck shall be applied to the longitudinal direction pipe of ND 125A and above	

(3.3 Pipe fitting)

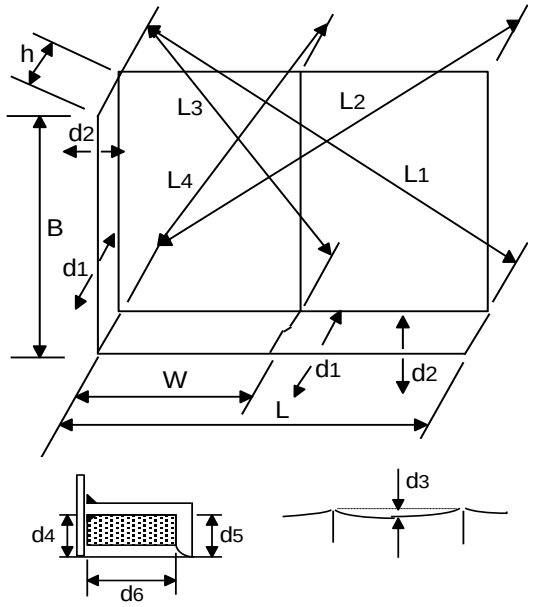
(Unit : mm)

Item	Tolerance Limits	Remarks
4) Dresser   	For short type d1 = 40±5 Θ ≤ 3° 1) 400A and above d2 ≤ 7 2) 350A and below d2 ≤ 5 For long type Θ ≤ 3° 1) 400A and above d1= 80±40 d2 ≤ 9 2) 350A and below d1= 70±30 d2 ≤ 7	 
5) E/R pipe coaming   	H = 75 for general	
6) Support pad gap welding  	a ≤ 3mm : 1 Pass welding 3 < a ≤ 5mm : Increase welding throat thickness 5 < a : Insert additional pad	

4. SHEET METAL OUTFITTING

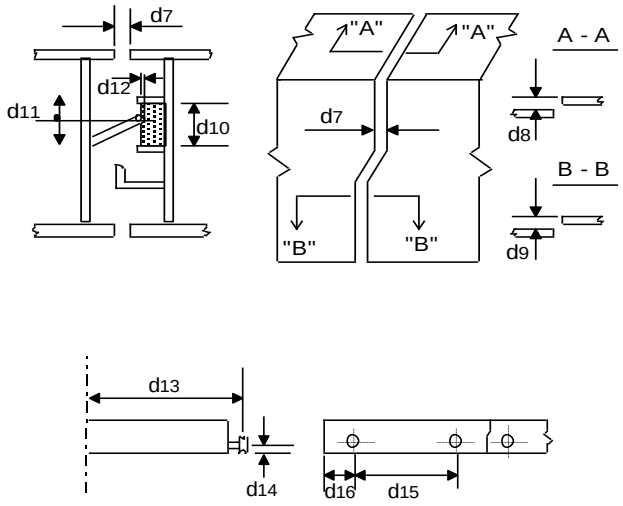
4.1 Side rolling type hatch cover

(Unit : mm)

Item		Tolerance Limits	Remarks
			
(1) Length (1 hatch)	L	$\pm(3+\frac{4L}{10000})$	
(2) Length (1 panel)	W	± 6	
(3) Breadth	B	$\pm(3+\frac{4L}{10000})$	
(4) Height of hatch cover	h	± 4	
(5) Diagonal difference(1 hatch)	| L1 – L2 |	≤ 10	
(6) Diagonal difference(1 panel)	| L3 – L4 |	≤ 5	
(7) Vertical deflection	d1	± 4	
(8) Transverse deflection	d2	± 5	
(9) Deformation of top plate	d3	≤ 6	
(10) Height of packing gutter	d4	± 2	
(11) Height of packing gutter	d5	± 2	
(12) Breadth of packing gutter	d6	± 2	

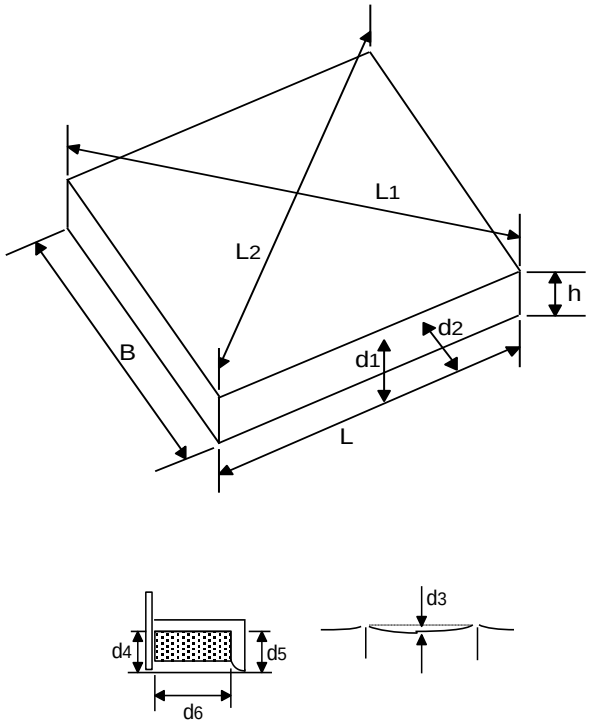
(4.1 Side rolling type hatch cover)

(Unit : mm)

Item		Tolerance Limits	Remarks
			
(1) Top plate clearance	d7	± 5	
(2) Top plate difference	| d8 |	≤ 5	
(3) Side & end plate difference	| d9 |	≤ 5	
(4) Width of packing groove	d10	± 2	
(5) Deviation of compression bar centering	d11	≤ 15	
(6) Compression of packing	d12	± 5	
(7) Span(between centering)	d13	± 3	
(8) Installing height	d14	± 3	
(9) Installing pitch	d15	± 4	
(10) Installing pitch	d16	± 3	

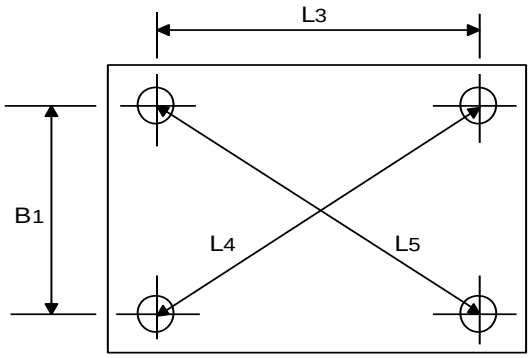
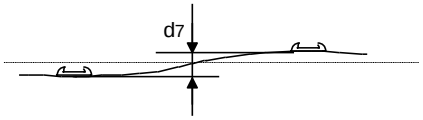
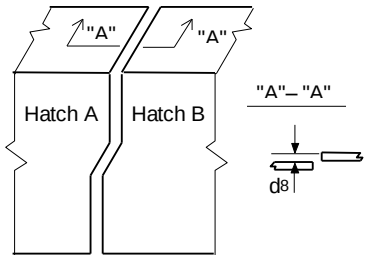
4.2 Pontoon type hatch cover

(Unit : mm)

Item		Tolerance Limits	Remarks
			
(1) Length(1 hatch)	L	$\pm(3+\frac{4L}{10000})$	
(2) Breadth	B	$\pm(3+\frac{4L}{10000})$	
(3) Height of hatch cover	h	± 4	
(4) Diagonal difference	| L1 - L2 |	≤ 12	
(5) Vertical difference	d1	± 4	
(6) Diagonal difference	d2	± 5	
(7) Deformation of top plate	d3	± 6	
(8) Height of packing gutter	d4	± 2	
(9) Height of packing gutter	d5	± 2	
(10) Breadth of packing gutter	d6	± 2	

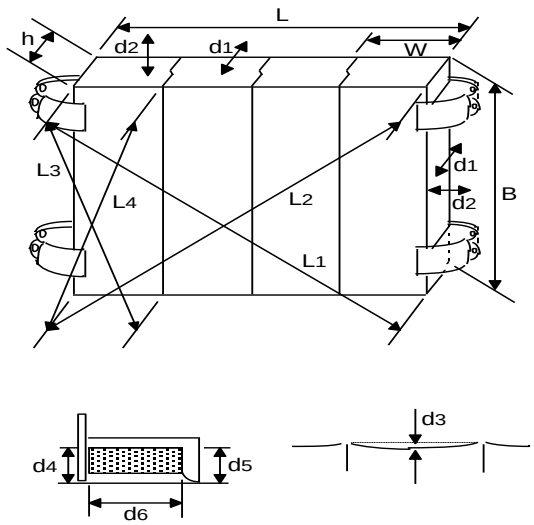
(4.2 Pontoon type hatch cover)

(Unit : mm)

Item		Tolerance Limits	Remarks
  			
(1) Container cone 1level(20ft)	d7	± 5	
(2) Container cone level(40ft)		± 5	
(3) Length(container cone 20ft)	L3	± 5	
(4) Length(container cone 40ft)		± 6	
(5) Breadth(container cone 20ft)	B1	± 2	
(6) Breadth(container cone 40ft)		± 2	
(7) Diagonal difference(20ft)	| L4 – L5 |	≤ 8	
(8) Diagonal difference(40ft)		≤ 10	
(9) Top plate difference	d8	≤ 10	

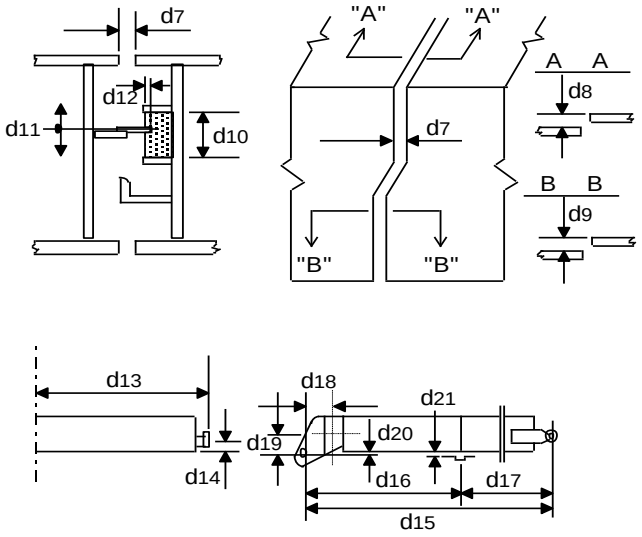
4.3 Folding type hatch cover

(Unit : mm)

Item		Tolerance Limits	Remarks
			
(1) Length(1 hatch)	L	$\pm(3+\frac{4L}{10000})$	
(2) Length(1 panel)	W	± 4	
(3) Breadth	B	$\pm(3+\frac{4L}{10000})$	
(4) Height of hatch cover	h	± 4	
(5) Diagonal difference(1 hatch)	| L1 - L2 |	≤ 10	
(6) Diagonal difference(1 panel)	| L3 - L4 |	≤ 5	
(7) Vertical deflection	d1	± 4	
(8) Transverse deflection	d2	± 5	
(9) Deformation of top plate	d3	± 6	
(10) Height of packing gutter	d4	± 2	
(11) Height of packing gutter	d5	± 2	
(12) Breadth of packing gutter	d6	± 2	

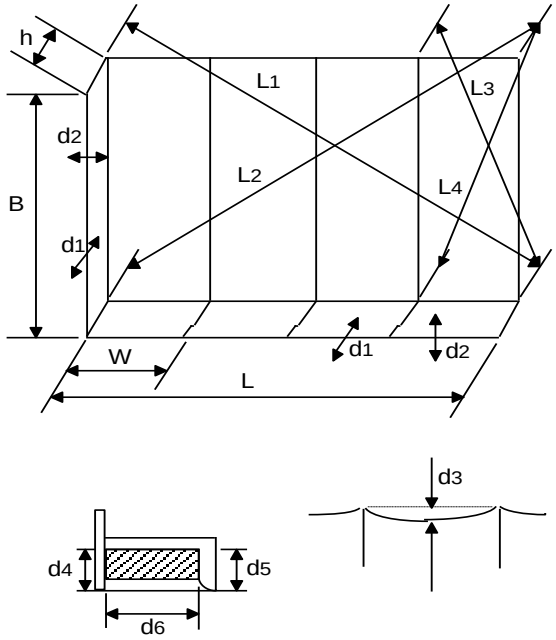
(4.3 Folding type hatch cover)

(Unit : mm)

Item		Tolerance Limits	Remarks
			
(1) Top plate clearance	d7	± 5	
(2) Top plate difference	| d8 |	≤ 4	
(3) Side & end plate difference	| d9 |	≤ 4	
(4) Width of packing groove	d10	± 2	
(5) Deviation of compression bar centering	d11	± 15	
(6) Compression of packing	d12	± 5	
(7) Span(between centering)	d13	± 3	
(8) Height of wheel	d14	± 3	
(9) Distance of wheel & main hinge	d15	± 2	
(10) Distance of main hinge & inter hinge	d16	± 2	
(11) Distance of wheel & inter hinge	d17	± 2	
(12) Gap of main hinge & cylinder pin	d18	± 2	
(13) Height of main hinge & cylinder pin	d19	± 2	
(14) Height of main hinge	d20	± 2	
(15) Height of inter hinge	d21	± 2	

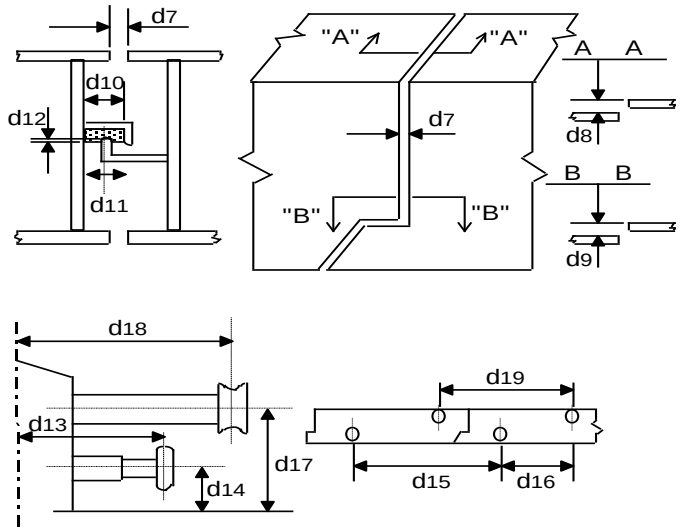
4.4 Single pull type hatch cover

(Unit : mm)

Item		Tolerance Limits	Remarks
			
(1) Length(1 hatch)	L	$\pm(3+\frac{4L}{10000})$	
(2) Length(1 panel)	W	± 5	
(3) Breadth	B	$\pm(3+\frac{4L}{10000})$	
(4) Height of hatch cover	h	± 4	
(5) Diagonal difference(1 hatch)	| L1 - L2 |	≤ 8	
(6) Diagonal difference(1 panel)	| L3 - L4 |	≤ 6	
(7) Vertical deflection	d1	± 4	
(8) Transverse deflection	d2	± 4	
(9) Deformation of top plate	d3	± 6	
(10) Height of packing gutter	d4	± 2	
(11) Height of packing gutter	d5	± 2	
(12) Breadth of packing gutter	d6	± 2	

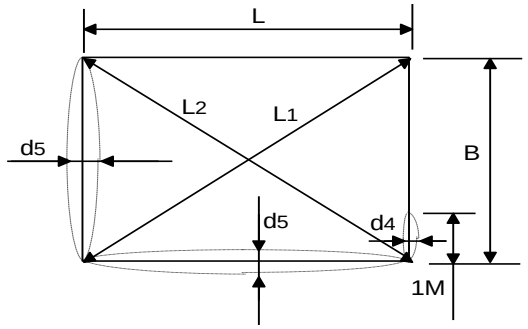
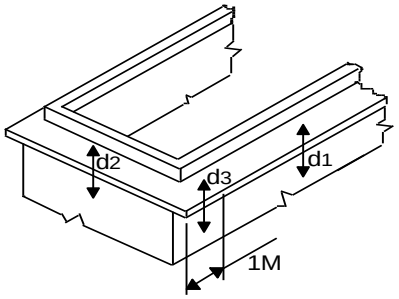
(4.4 Single pull type hatch cover)

(Unit : mm)

Item		Tolerance Limits	Remarks
			
(1) Top plate clearance	d7	± 5	
(2) Top plate difference	| d8 |	≤ 4	
(3) Side & end plate difference	| d9 |	≤ 4	
(4) Width of packing groove	d10	± 2	
(5) Deviation of compression bar centering	d11	± 15	
(6) Compression of packing	d12	± 5	
(7) Span(between centering)	d13	± 3	
(8) Installing height	d14	± 3	
(9) Installing pitch	d15	± 4	
(10) Installing pitch	d16	± 4	
(11) Balancing wheel height	d17	± 3	
(12) Balancing wheel distance	d18	± 4	
(13) Balancing wheel pitch	d19	± 4	

4.5 Hatch coaming

(Unit : mm)

Item		Tolerance Limits	Remarks
 			
(1) Length	L	± 10	
(2) Breadth	B	± 10	
(3) Diagonal	| L1-L2 |	≤ 15	
(4) Straightness of top plate(side coaming)	d1	± 5	
(5) Straightness of top plate(end coaming)	d2	± 5	
(6) Straightness of top plate(partially/m)	d3	± 3	
(7) Straightness of hatch coaming(partially/m)	d4	± 3	
(8) Straightness of hatch coaming(all length)	d5	$\pm(3+\frac{4L}{10000})$	

4.6 Hose Test Requirements

Class.	Press.(kg/cm^2)	Nozzle Inside Dia.	Nozzle Dist.	Remarks
DNV	2.53	Min. 12.5 ∅	Max. 1.5 m	
ABS, KR, NKK	2.1			
LR, BV etc.	2.04			

PART Ⅳ. PAINTING PART

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Ⅱ. CATEGORIES OF INSPECTION AND TEST ITEMS

1. Painting Part ——— **150**

1. PAINTING PROCESS

1.1 General

(1) Painting work will be carried out basically according to the Builder's standard of QISSP(Quality and Inspection Standard for Ships Painting) and the paint manufacturer's recommendation. Painting work is also proceeded according to the Builder's building schedule for smooth construction progress.

(2) All painting works are inspected in accordance with the painting specifications, drawings and QISSP.

1.2 Surface Preparation

Details of de-rusting standard and surface cleaning standard are to be referred to in QISSP chapter 1 "Quality & Insp. Standard for Surface Preparation".

1.3 Repair Priming at Assembly Shops

Burn damaged parts of shop primer by welding are to be mechanically cleaned to QISSP DPt 2～3(equivalent to ISO 8501-1 St 2～3) and immediately primed with Builder’s standard touch-up primer to prevent rusting before secondary surface preparation where exposed to weather.

1.4 Hull Block Painting

(1) After finishing the hull block construction works, coating is to be applied. If the surface cleaning work of the block is partially proceeded and not completed on the whole block for some reason, the coating could be applied to the cleaned surface only before it becomes rusting.

(2) Outfitting works on the hull block are to be carried out before or after painting works according to the construction schedule.

1.5 Correction of Trivial Defects

(1) Trivial defects or damages which are not detected at block inspection but found after surface preparation (sand blasting, etc.) are to be corrected by welding, chipping and/or grinding and then touch up with paint.

(2) Paint repair work shall be carried out in accordance with the Builder's practice and inspection standards.

1.6 Finishing of Free Edges of Steel and Welded Beads

Free edges of steel members cut by gas cutting and irregular welding beads in heavy corrosive area such as water ballast tanks and fresh water tanks are to be carefully treated in accordance with the Builder's practice.

1.7 Dry Film Thickness

Measuring method, points and instruments of dry film thickness are referred to in QISSP chapter 2.1.

1.8 Surface of Final Coat

Surface of final coat is referred to in QISSP chapter 2.2.

1.9 Inspection Items Subject to Attendance of Client's Representative

Inspection items of Client's representative are referred to in QISSP chapter 3.

Ⅱ. CATEGORIES OF INSPECTION AND TEST ITEMS	150

1. Painting part	In Shop			On-Board			Remarks
	C	O	R	C	O	R	
1.1 Painting - Refer to QISSP Chapter 3.0							

DAEWOO SHIPBUILDING QUALITY STANDARD

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