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An American National Standard

Standard Practice for Establishing Shipbuilding Quality Requirements for Hull Structure, Outfitting, and Coatings[1]

This standard is issued under the fixed designation F2016; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice consists of three annexes: hull structure, outfitting, and coating. The subject of these annexes was selected for several reasons. Other commercial shipbuilding nations already have in place widely recognized standards of expectations in these areas. These constitute the most significant areas where workmanship is a critical factor in customer satisfaction. The cost associated with the labor involved in these three areas is a significant factor in construction man-hours and overall schedules.

1.2 The standard criteria provided in this practice are intended to apply to conventional, commercial ship construction. In many cases, specialized, nonconventional vessels using nonstandard materials or built-to-serve sole requirements may require unique acceptance criteria that are beyond those provided in this practice.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D4417 Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel

E337 Test Method for Measuring Humidity with a Psychrometer (the Measurement of Wet- and Dry-Bulb Temperatures)

2.2 *ISO Standards:*[3]

ISO 8502–3 Assessment of Dust on Steel Surfaces Prepared for Painting (Pressure-Sensitive Tape Method)

ISO 8502–6 Extraction of Soluble Contaminants for Analysis—The Bresle Method

2.3 *NACE Standards:*[4]

NACE No. 5 Surface Preparation and Cleaning of Steel and Other Hard Materials by High-and Ultrahigh-Pressure Water Jetting Prior to Re-coating (SSPC-SP 12)

NACE No. 7 Interim Guide and Visual Reference Photographs for Steel Cleaned by Water Jetting (SSPC-VIS 4(1))

2.4 *SSPC Standards:*[5]

SSPC-AB 1 Mineral and Slag Abrasives

SSPC-AB 2 Specification for Cleanliness of Recycled Ferrous Metallic Abrasives

SSPC-PA 2 Measurement of Dry Coating Thickness With Magnetic Gages

SSPC-SP 1 Solvent Cleaning

SSPC-SP 2 Hand Tool Cleaning

SSPC-SP 3 Power Tool Cleaning

SSPC-SP 7 Brush-Off Blast Cleaning

SSPC-SP 10 Near-White Blast Cleaning

SSPC-SP 11 Power Toll Cleaning to Bare Metal

SSPC-SP 12 Surface Preparation and Cleaning of Steel and Other Hard Materials by High-and Ultrahigh-Pressure Water Jetting Prior to Re-coating (NACE No. 5)

SSPC-VIS 1-89 Visual Standard for Abrasive Blast Cleaned Steel

SSPC-VIS 3 Visual Standard for Power- and Hand-Tool Cleaned Steel

SSPC-VIS 4(1) Interim Guide and Visual Reference Photographs for Steel Cleaned by Water Jetting (NACE No. 7)

2.5 *NSRP Documents:*[6]

National Shipbuilding Research Project 6–97–1 "American Shipbuilding Quality Standards," dated May 28, 1999

3. Summary of Practice

3.1 This practice provides workmanship criteria to be applied to commercial shipbuilding or ship repair, or both. The

[1] This practice is under the jurisdiction of ASTM Committee F25 on Ships and Marine Technologyand is the direct responsibility of Subcommittee F25.07 on General Requirements.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

[4] Available from NACE International (NACE), 1440 South Creek Dr., Houston, TX 77084-4906, http://www.nace.org.

[5] Available from Society for Protective Coatings (SSPC), 40 24th St., 6th Floor, Pittsburgh, PA 15222-4656, http://www.sspc.org.

[6] Available from The Librarian, Documentation Center, Marine Systems Division, University of Michigan Transportation Research Institute, 2901 Baxter Rd., Ann Arbor, MI 48109–2150.

criteria covers three primary phases of ship construction, that is, hull structure, outfitting, and coatings. Specific criteria to be selected from this standard should be as contractually agreed between the ship owner and shipbuilder.

4. Significance and Use

4.1 To achieve success in ship construction, it is necessary for the ship owner and the ship builder to agree on the level of quality in the final product. Classification rules, regulatory requirements, and ship specifications all help to define an acceptable level of construction quality; however, this guidance alone is not sufficient. It is up to the shipbuilder, therefore, to describe the level of workmanship sufficiently that will be reflected in the delivered ship, and for the ship owner to communicate his expectations effectively for the final product.

4.2 It is the intent of this document to contribute to these objectives in the following ways:

4.2.1 To describe a reasonable acceptable level of workmanship for commercial vessels built in the United States.

4.2.2 To provide a baseline from which individual shipyards can begin to develop their own product and process standards in accordance with generally accepted practice in the commercial marine industry.

4.2.3 To provide a foundation for negotiations between the shipbuilder and the ship owner in reaching a common expectation of construction quality.

4.3 The acceptance criteria herein are based on currently practiced levels of quality generally achieved by leading international commercial shipbuilders. These criteria are not intended to be a hard standard with which all U.S. shipyards must comply. Rather, they are intended to provide guidance and recommendations in the key areas that play a major role in customer satisfaction and cost-effective ship construction.

5. Keywords

5.1 coatings; hull structure; outfitting; quality; shipbuilding; workmanship

ANNEXES

(Mandatory Information)

A1. HULL STRUCTURE

I. HULL STRUCTURE			SHIPBUILDING QUALITY STANDARDS		
Division		Marking		UNIT: mm	
Section	Sub-section	Item	Standard Range	Tolerance Limits	Remarks
Cutting line and fitting line compared with correct ones	General members	Size and shape compared with correct ones.	± 2	± 3	
			± 1.5	± 2.5	Especially for the depth of floors and girders of double bottom.
		Corner angle compared with correct ones	± 1.5	± 2	
		Curvature	± 1	± 1.5	
		Location of member & mark for fitting compared with correct ones.	± 2	± 3	
		Block marking(Panel block) compared with correct ones.	± 2.5	± 3.5	
		Location of member for fitting compared with correct ones.	± 2.5	± 3.5	

FIG. A1.1 Hull Structure

I. HULL STRUCTURE			SHIPBUILDING QUALITY STANDARDS				
Division		Gas Cutting			UNIT: mm		
Section	Sub-section	Item	Standard Range	Tolerance Limits	Standard Range	Tolerance Limits	Remarks
Roughness	Free edge	Strength Shop member Field	100μ (2nd cl) 150μ (3rd cl)	200μ (3rd cl) 300μ (Out cl)	The class denoted in parentheses is in accordance with following definition. Less Than 50μ 1st class 50μ ~ 100μ 2nd class 100μ ~ 200μ 3rd class More than 200μ out of class - Special precautions are required in case where grinding or other treatments are requested. - For angle cutting the same as the case in field.		
		Other Shop Field	100μ (2nd cl) 500μ (Out cl)	200μ (3rd cl) 150μ (Out cl)			
	Weld groove	Strength Shop member Field	100μ (2nd cl) 400μ (Out cl)	200μ (3rd cl) 800μ (Out cl)			
		Other Shop Field	100μ (2nd cl) 800μ (Out cl)	1500μ (Out cl) 1500μ (Out cl)			

FIG. A1.2 Hull Structure

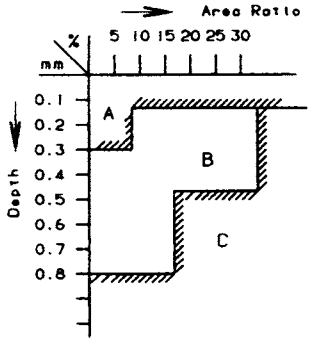
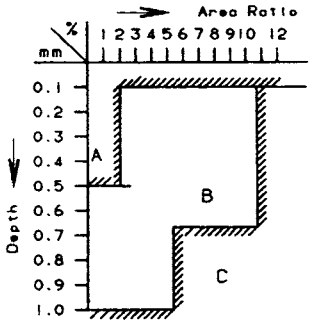
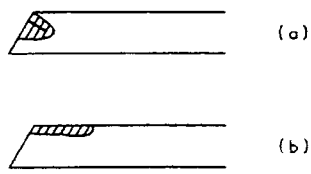
I. HULL STRUCTURE			SHIPBUILDING QUALITY STANDARDS
Division		Material	
Section	Sub-section	Item	Remarks
Surface flow	Pitting	Grade of pitting  	1. Grade A pitting is minor and no repair is necessary. Grade B pitting is moderate and is to be repaired as necessary. Grade C pitting is severe and requires repair. 2. Pitting that occurs on the boundary line between Grade A and Grade B can be considered minor and treated as Grade A pitting. 3. Repairs shall be made as follows: Depth of pitting :d Plate Thickness :t Where 0.07t>d Grind Smooth (Note:Regardless of plate thickness, at no time should pitting that is 3mm deep or greater be repaired by grinding only) Where 0.2t≥d0.07t Grind and Weld Note: The area ratio is the estimated percentage of the plate surface that is pitted to the point where the surface appearance is unsatisfactory.
	Flaking	Grade of surface flaking  	1. Grade A pitting is minor and no repair is necessary. Grade B pitting is moderate and is to be repaired as necessary. Grade C pitting is severe and requires repair. 2. Pitting that occurs on the boundary line between Grade A and Grade B can be considered minor and treated as Grade A pitting. 3. Repairs shall be made as follows: Depth of pitting :d Plate Thickness :t Where 0.07t>d Grind Smooth (Note:Regardless of plate thickness, at no time should pitting that is 3mm deep or greater be repaired by grinding only) Where 0.2t≥d0.07t Grind and Weld Note: The area ratio is the estimated percentage of the plate surface that is pitted to the point where the surface appearance is unsatisfactory.
Casting Steel	Details of Casting Steel	Applicable to cases where defects are over 20% of thickness, or over 25mm deep and 150mm long.	When the removal of a surface defect exposes other significant defects such as cavities, cracks or inclusions, the casting is to be checked using dye penetrant inspection, magnetic particle inspection or ultrasonic inspection and repaired accordingly, using an appropriate method of repair.
Delamination	Local delamination	 	Where delamination is minor it can be chipped or ground out and built-up with weld metal as shown in Figure (a). Where minor delamination occurs close to the plate surface grinding or chipping and weld metal build-up should be as shown in Figure (b). Repair of moderate delamination should be considered on a case by case basis.
	Severe delamination, requiring a local exchange of plate		Where delamination is fairly extensive, plating should be cropped out locally and replaced. The minimum width of plating to be cropped out is to be as follows: Highly Stressed Primary Longitudinal Strength Members: 1600mm Moderately Stressed Primary Longitudinal Strength Members: 800mm All Other Structural Members: 300mm Where severe delamination that affects the whole plate occurs, the whole plate must be replaced.

FIG. A1.3 Hull Structure

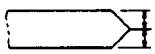
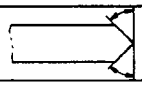
I. HULL STRUCTURE				SHIPBUILDING QUALITY STANDARDS	
Division		Gas Cutting		UNIT: mm	
Section	Sub-section	Item	Standard Range	Tolerance Limits	Remarks
Notches & Indentations Note: A notch is defined as a highly localized indent that is three times deeper than the tolerance limits for normal roughness.	Free edge	1)Upper edge of sheer strake. 2)Strength deck between 0.6l ◉ and free edge of opening of shell plate. 3)Main longl strength members.		Notch 0	Notches are to be welded up prior to grinding in areas where a smooth finish is required. Sufficient weld metal should be laid such that after grinding there are no residual voids or cracks between the weld metal and the parent metal.
		Longitudinal & Transverse Strength members		Indentation ≤1	Indentions greater than the stated tolerance limit are to be treated as notches.
		Others		Indentation ≤3	Indentions greater than the stated tolerance limit are to be treated as notches.
	Weld groove	Butt Weld: Shell plate & Upperdeck between 0.6l◉		Indentation ≤2	Indentions greater than the stated tolerance limit are to be treated as notches.
		Butt Weld: Others		Indentation ≤3	Indentions greater than the stated tolerance limit are to be treated as notches.
		Fillet Weld		Indentation ≤3	Indentions greater than the stated tolerance limit are to be treated as notches.
Dimension	Straightness of plate edge	Both side submerged arc welding	±0.4	±0.5	
		Manual welding; semi automatic welding	±1.0	±2.5	
	Depth of edge preparation		±1.5	±2.0	
	Angle of edge preparation		±2°	±4°	
	Length of taper	 (l compared with correct sizes)	±0.5d	±1.0d	
	Size of member	Structural members other than double bottom floors and girders.	±3.5	±5.0	
		Depth of double bottom floors and girders.	±2.5	±4.0	
		Breadth of face bar.	±2.0	-3.0 ~ +4.0	
	Edge preparation	Automatic welding	±2°	±4°	
		Semi-automatic & manual welding.	±2°	±4°	

FIG. A1.4 Hull Structure

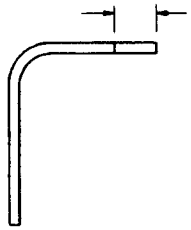
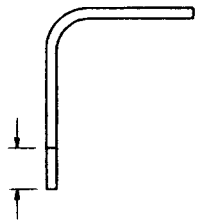
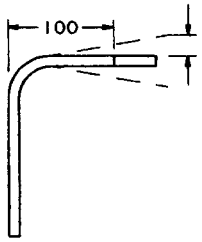
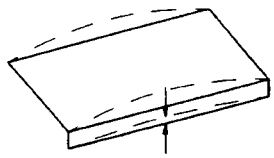
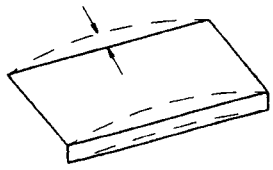
I. HULL STRUCTURE			SHIPBUILDING QUALITY STANDARDS		
Division		Fabrication			UNIT: mm
Section	Sub-section	Item	Standard Range	Tolerance Limits	Remarks
Flanged Longitudinal	Breadth of flange	 Compared with correct size	±3.0	±5.0	
	Depth of web	 Compared with correct size	±3.0	±5.0	Low and moderately stressed members.
			±2.0	±3.0	Highly stressed members.
	Angle between flange and web	 Compared with template per 100 mm in breadth of flange	±2.5	±4.5	
	Curvature or straightness in the plane of flange	 Per 10m in length	±10	±25	
	Curvature or straightness in the plane of web	 Per 10m in length	±10	±25	

FIG. A1.5 Hull Structure

I. HULL STRUCTURE			SHIPBUILDING QUALITY STANDARDS		
Division		Fabrication			UNIT: mm
Section	Sub-section	Item	Standard Range	Tolerance Limits	Remarks
Angle & Built up plate	Stringer angle	Angle Compared with template	±1.5	±2.0	
		Curvature 1000 Compared with template	±1.0	±1.5	Maximum permitted curvature per 100mm length of member.
	Frame & Long	Curvature compared with template or check line. Per 10m in length.	±2.0	±4.0	
		Deviation from. Inscribed curve Correct from inscribed.	±3.0	±5.0	
		Deviation in flange angle Compared with template	±1.5	±3.0	
		Deviation of face plate a	±1.5 per 100mm	±3.0 per 100mm	

FIG. A1.6 Hull Structure

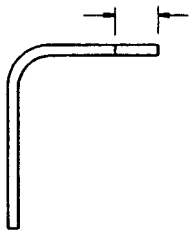
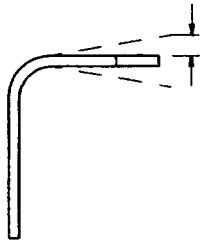
I. HULL STRUCTURE			SHIPBUILDING QUALITY STANDARDS		
Division		Fabrication		UNIT: mm	
Section	Sub-section	Item	Standard Range	Tolerance Limits	Remarks
Flanged Bracket	Breadth of flange	 Compared with correct size	±3.0	±5.0	
	Angle between flange and web	 Compared with template per 100 mm in breadth of flange	±3.0	±5.0	
Bending templates (plane or box shape).	Templates for box shapes	Actual line of plate edge, compared with template.	±2.0	±4.0	
		Actual curved surface, compared with template.	±2.0	±4.0	For dimensions greater than 1M, ±5.0.
	Section templates	Location of check line for leveling by sight, compared with template. (for transverse)	±1.5	±3.0	
		Location of check line for leveling by sight, compared with template. (for longitudinal)	±1.5	±3.0	
		Shape, compared with template.	±1.5	±3.0	
	Other templates	Shape, compared with template.	±1.5	±3.0	

FIG. A1.7 Hull Structure

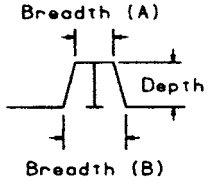
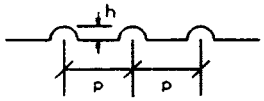
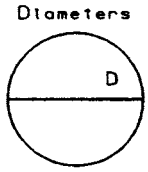
I. HULL STRUCTURE					SHIPBUILDING QUALITY STANDARDS
Division		Fabrication			UNIT: mm
Section	Sub-section	Item	Standard Range	Tolerance Limits	Remarks
Plate	Corrugated bulkhead	Depth of corrugation	±3.0	±6.0	
		Breadth of corrugation.  	A ±3.0	±6.0	
			B ±3.0	±6.0	
	Corrugated wall	 Pitch (p)	±6.0	±9.0	
			±2.0	±3.0	
		Depth (h)	±2.5	±5.0	
	Cylindrical structure (mast, post etc)	 	$\frac{\pm D}{200}$ But, Max. ±5.0	$\frac{\pm D}{150}$ But, Max. ±7.5	
	Curved shell late	In regard to the check line (for longitudinal)	±2.5	±5.0	
		(for transverse)	±2.5	±5.0	
		Gap between shell plate and section template	±2.5	±5.0	

FIG. A1.8 Hull Structure

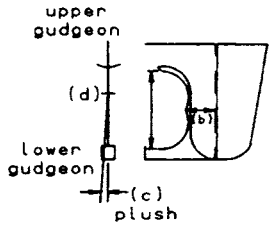
I. HULL STRUCTURE				SHIPBUILDING QUALITY STANDARDS		
Division			Sub-assembly	UNIT: mm		
Section	Sub-section		Item	Standard Range	Tolerance Limits	Remarks
Accuracy of Dimensions	Special Sub-assemblies	Block Sub-assembling including Stern frame	Distance between aft edge of boss and aft peak bulkhead (b)	±5	±10	
			Twist of Sub-assembly (c)	±5	±10	
			Deviation of rudder from shaft ℄ (d)	±4	±8	
		Rudder	Twist of Rudder plate over its length	±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	
			Others	The same as for flat plate block Sub-assembly		

FIG. A1.9 Hull Structure

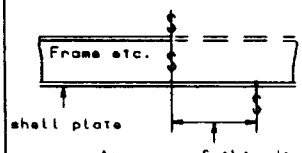
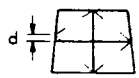
I. HULL STRUCTURE		SHIPBUILDING QUALITY STANDARDS		
Division		Sub-assembly		UNIT: mm
Section	Sub-section	Item	Standard Range	Tolerance Limits	Remarks
Accuracy of Dimensions	Flat plate Sub-assembly	Breadth of Sub-assembly	±4.0	±6.0	Cut, when too long
		Length of Sub-assembly	±4.0	±6.0	Cut, when too long
		Squareness of Sub-assembly	±4	±8	Measured difference of diagonal length of final marking lines. When the difference is over the limits, correct the final marking line.
		Distortion of Sub-assembly	±10	±20	Measured on the face of web or girder.
		Deviation of Interior members from shell plating	±5.0	±10.0	Excluding the case when interior members are connected by lapped joint. 
	Curved plate Sub-assembly	Breadth of Sub-assembly	±4.0	±8.0	Measured along the girth. Cut, when too long.
		Length of Sub-assembly	±4.0	±8.0	Cut, when too long.
		Distortion of Sub-assembly	±10	±20	Measured on face of web or girder. Correct the final marking line, when the distortion exceeds the limits.
		Squareness of Sub-assembly	±10	±15	Difference of base line to marking or difference of diagonal lengths along marking  d=l el=- e2=l adjust marking where practicable. 
		Deviation of interior members from shell plating	The same as for the flat plate Sub-assembly above.		
	Plate Block Sub-assembly	Breadth of each panel	The same as for the flat plate Sub-assembly above.		
		Length of each panel			
		Squareness of each panel			
		Distortion of each panel			
		Distortion of interior members from skin plating			

FIG. A1.10 Hull Structure

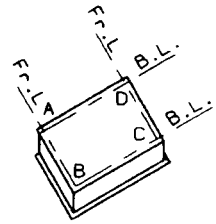
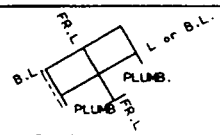
I. HULL STRUCTURE			SHIPBUILDING QUALITY STANDARDS		
Division		Sub-assembly			UNIT: mm
Section	Sub-section	Item	Standard Range	Tolerance Limits	Remarks
Accuracy of Dimensions	Plate Block Sub-assembly	Twist of Sub-assembly B.L. = baseline	±10	±20	Measured as follows:  The points A,B and C are established in the same plane. Measure the deviation of point D from that plane. May re-assemble partially when the deviation exceeds the limits.
		Deviation of upper/lower panel from ℄ or B.L.	±5	±10	 Accuracy of this dimension
		Deviation of upper/lower panel from ℄ or FR.L	±5	±10	
	Block Sub-assembly Including stern frame Plate Block Sub-assembly	Breadth of each panel			The same as for the flat plate Sub-assembly (previous page)
		Length of each panel			
		Distortion of each panel			
		Deviation of interior members from skin plating			
		Twist of Sub-assembly	±15	±25	The same as for the flat plate Sub-assembly (previous page)
		Deviation of upper/lower panel from ℄ or B.L.	±7	±15	Re-assemble partially when the deviation exceeds the limits
		Deviation of upper/lower panel from ℄ or FR.L	±7	±15	
		Distance between upper/lower gudgeon (a)	±5.0	±10.0	

FIG. A1.11 Hull Structure

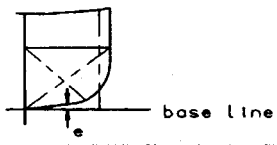
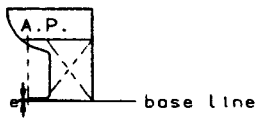
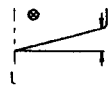
I. HULL STRUCTURE			SHIPBUILDING QUALITY STANDARDS		
Division		accuracy			UNIT: mm
Section	Sub-section	Item	Standard Range	Tolerance Limits	Remarks
Principal Dimensions	Length	Length between Perpendiculars	±50.0 Per 100M	Not defined	Applied to ships of 100 meters length and below. For the convenience of the measurement the point where the keel is connected to the curve of the stem may be substituted for the fore perpendicular in the measurement of the length.
		Length between aft edge of boss and main engine	±25.0	Not defined	
	Breadth	Molded breadth Amidships	±15.0	Not defined	Applied to ships of 15 meters breadth and above. Measured on the upper deck.
	Depth	Molded depth Amidships	±10.0	Not defined	Applied to ships of 10 meters depth and above.
Deformation of hull form	Flatness of Keel	Deformation for the whole length	±25.0	Not defined	Ups(-) and Downs(+) against the check line of keel sighting.
		Deformation for the distance between two adjacent bulkheads	±15.0	Not defined	Sighting by the transit or using slits.
	Forebody Alignment	Alignment of fore-body to baseline. 	±30.0	Not defined	Ups(-) and Downs(+) against the baseline of the keel at the foremost frame on the flat part of the keel.
		Alignment of aft-body to baseline. 	±20.0	Not defined	Ups(-) and Downs(+) against the baseline of the keel at the aft-perpendicular.
	Rise of Floor	Rise of floor amidships 	±15.0	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.

FIG. A1.12 Hull Structure

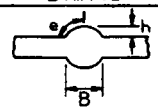
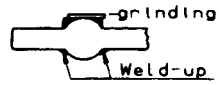
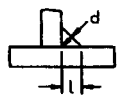
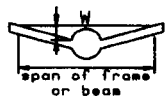
I. HULL STRUCTURE			SHIPBUILDING QUALITY STANDARDS	
Division		Welding		UNIT: mm
Section	Sub-section	Item	Tolerance Limits	Remarks
Shape of bead	Height of reinforcement Breadth of bead Flank angle		 h:not defined B:not defined e≤90°	 In case where e is over 90° it is to be repaired by grinding or welding to make e≤90°
	Under cut (butt weld)	Shell plate and face plate between 0.6l ●	over 90mm continuous d≤0.5 	Repair using fine electrode. (Avoid short beads for higher tensile steel)
		Other	d≤0.8	
	Under cut (fillet weld)			
	Leg length	Compared with Correct ones (l,d)	 l:Leg length d:Throat depth ≥0.9l ≥0.9d	When over tolerance limits, weld up. (Avoid short beads for higher tensile steels)
Distorsion of welding joint	Angular distorsion of welding joint	Shell plate between 0.6Lox	 W≤6	When over tolerance limits, repair by line heating or re-weld after cutting and re-fitting.
		Fore and Aft shell plating and Transverse strength member	W≤7	
		Others	W≤8	
Short bead	Tack welding bead Repairing of scar	.50HT .Cast steel TMCP type 50HT (ceq.>0.36%)	≥50	In case where short bead is unavoidable, preheat to ±25°C. If short bead is made inadvertently, remove the bead by grinding, and weld over length of visible crack.
		Grade E of mild steel	≥30	
		TMCP type 50HT (ceq.≤0.36%)	≥10	
	Repairing of welding bead	.50HT .Cast steel TMCP type 50HT (ceq.>0.36%)	≥50	
		Grade E of mild steel	≥30	
		TMCP type 50HT (ceq.≤0.36%)	≥30	

FIG. A1.13 Hull Structure

I. HULL STRUCTURE			SHIPBUILDING QUALITY STANDARDS	
Division		Welding		UNIT: mm
Section	Sub-section	Item	Tolerance Limits	Remarks
Arc strike	—	.50HT .Cast steel .Grade E of mild steel .TMCP type 50HT	not allowed	In case where arc-strike is made inadvertently, remove the hardened zone by grinding or weld over length of short bead on the arc-strike.
Pre-heating	Temperature required pre-heating	TMCP type 50HT (Ceq.≤0.36%)	T≤0°C	In case where Ceq. of each plate are different in joint, tolerance of higher Ceq. to be applied.
		.50HT Cast steel TMCP type 50HT (Ceq.>0.36%)	T≤5°C	
		Mild steel	T≤5°C	

FIG. A1.14 Hull Structure

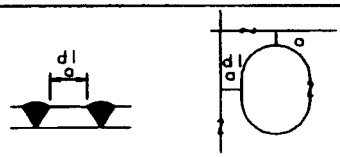
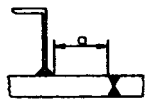
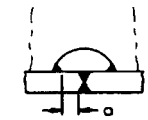
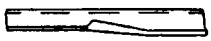
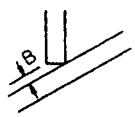
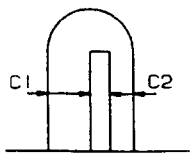
I. HULL STRUCTURE				SHIPBUILDING QUALITY STANDARDS
Division		Alignment and Finishing		UNIT: mm
Section	Sub-section	Item	Tolerance Limits	Remarks
Minimum distance of weld to adjacent weld	Butt weld to butt weld		a≥30	
	Butt weld to fillet weld	 Main structure	a≥10	Where beads are parallel.
		Other structure	a≥0	
		 Main structure	a≥5	
		Other structure	a≥0	
Gap between members	Gap between plate and stiffening member	Stiffening member located perpendicular to plate.  when C>3, any following treatment can taken. 1)  2)  3) 	C≤3	Gap between members is to be less than 3mm.
		Stiffening member located obliquely to plate. (without edge preparation) 	B≤3	
	Through piece and right plate	 C1 > C2	C1≤3	

FIG. A1.15 Hull Structure

I. HULL STRUCTURE

SHIPBUILDING QUALITY STANDARDS

Division: Alignment and Finishing — UNIT: mm

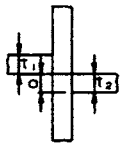
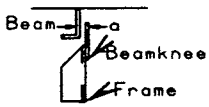
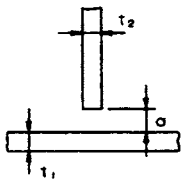
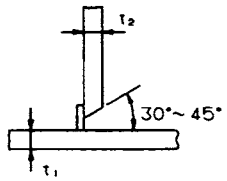
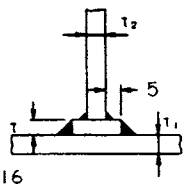
Section	Sub-section	Item	Standard Range	Tolerance Limits	Remarks
Fitting Accuracy	Alignment of fillet joint  a:Difference t:thickness t≥t2	Strength member		a≤1/3t2	1/3t2≤ a ≤1/2t2  a>1/2t2 re-fitting
		Others	a≤1/3t2	a≤1/2t2	a>1/2t2 re-fitting
	Differences between the beam and the frame	 a:Difference	a≤3	a≤5	The figure indicates the tolerance that the members can be welded by pulling without taking apart.
	Gap before welding	Fillet weld  	a≤2	a≤3	① 3<a≤5 Increased leg length Rule leg +(a-2) ② 5<a≤16 Welding with bevel preparation or Liner treatment Welding with bevel preparation  To make bevel edge of web to 30°~45°, attach the backing material, and after welding, remove it. Then weld the opposite side. Liner treatment Liner treatment  ③ a>16 Liner treatment or partial renew  Partial Renew

FIG. A1.16 Hull Structure

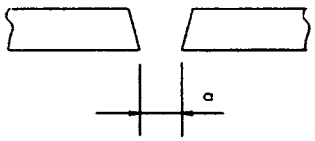
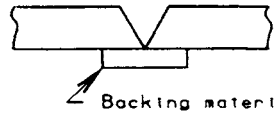
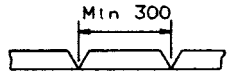
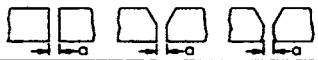
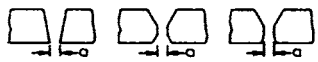
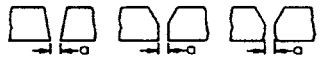
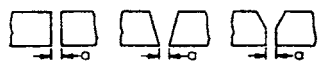
I. HULL STRUCTURE			SHIPBUILDING QUALITY STANDARDS		
Division		Fabrication			UNIT: mm
Section	Sub-section	Item	Standard Range	Tolerance Limits	Remarks
Fitting Accuracy	Gap before Welding	Butt weld (manual welding)  a: Gap	2≤a<3.5	a≤5	① 5<a≤16 After welding, remove backing material, chip and finish weld.  ② 16<a<25 Welding up with edge preparation or partial renew. ③ a>25 Partial renew. 
		Butt weld (automatic welding) 1. Two side submerged arc welding 	0≤a≤0.8	a≤5	Where predicted to burn through, weld sealing bead.
		2. Manual or CO_2 submerged arc welding 	0≤a≤3.5	a≤5	Where a is over 5mm, see manual welding.
		3. One side submerged arc welding with flux copper backing or flux backing 	0≤a≤1.0	a≤3	Where predicted to burn through, weld sealing bead.
		4. One side submerged arc welding with fiber backing 	0≤a≤4	a≤7	Where predicted to burn through, adjust by scattering of metal powder or weld sealing bead.

FIG. A1.17 Hull Structure

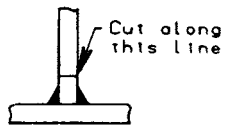
I. HULL STRUCTURE			SHIPBUILDING QUALITY STANDARDS		
Division		Alignment and Finishing		UNIT: mm	
Section	Sub-section	Scope of staging sockets and lifting lugs to be removed	Standard Range	Tolerance Limits	Remarks
Staging sockets	In tank	Not to be removed.			• Lifting lugs subjected to fatigue to be removed. ① Parts ruining appearance and passage to be removed flush to base plate. ② Others to be removed by gas cutting at the bond zone. 
	In engine room	Parts of ruining appearance and interfering with clear passage.			
	In hold	Under side of hold and hatch coaming.			
	exposed parts of shell upp DK etc..	To be removed.			
Lifting lugs	In tank	Not to be removed except disturbance of passage.			
	In engine room	Part of ruining appearance and passages.			
	In hold	To be removed except back of deck.			
	exposed parts of shell upp DK etc..	To be removed.			

FIG. A1.18 Hull Structure

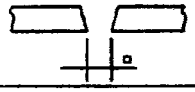
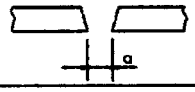
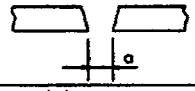
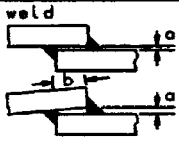
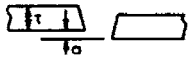
I. HULL STRUCTURE			SHIPBUILDING QUALITY STANDARDS		
Division		Fabrication		UNIT: mm	
Section	Sub-section	Item	Standard Range	Tolerance Limits	Remarks
Fitting Accuracy	Gap before Welding	5. CO_2 one side welding (with backing mat'l) 	2≤a≤8	a≤16	
		6. Electro gas welding 	9≤a≤16	a≤22	
		7. Simplified electric gas welding 	2≤a≤8	a≤10	
		Lap weld 	a≤2	a≤3	① 3<a≤5 ② a>5 Re-fitting
	Alignment of butt joint  a:Misalignment t:Thickness(thinner pl)	Strength member		a≤0.15t (max 3)	a>0.15t or a>3 Refitting
		Others		a≤0.2t (max 3)	a>0.2t or a>3 Refitting
Cleaning up traces of temporary attachments	Parts requiring good appearance	Outside surface of shell plates, Exposed deck, Exposed super-structure	Grind flush		See Annex A3 for surfaces that are to be painted
	Parts not requiring good appearance	Inside of tank Inside of ceiling Deck to be shield with deck com-position etc.	Grind only conspicuous parts finishing		See Annex A3 for surfaces that are to be painted
Surface defect	Scar	Depth (d) Length (e) — 10<e	d≤0.8		① d<0.07t(Max 3) Grinding or welding ② 0.07t≤d welding
		Depth (d) Length (e) — e≤10	d≤1.0		

FIG. A1.19 Hull Structure

I. HULL STRUCTURE			SHIPBUILDING QUALITY STANDARDS		
Division		Deformation		UNIT: mm	
Section	Sub-section	Item	Standard Range	Tolerance Limits	Remarks
Flatness of plate between frame	Shell plate	Parallel part side	4	6	
		Parallel part bottom	4	6	
		Fore and aft part	5	7	
	Double bottom tank top plate		4	6	
	Bulkhead	Longl Bulkhead Trans Bulkhead Swash Bulkhead	6	8	
	Strength deck	Parallel part (Between 0.6l⊗)	4	6	
		Fore and aft part	6	9	
		Covered part	7	9	
	Second deck	Exposed part	6	8	
		Covered part	7	9	
	Fore-castle deck Poop deck	Exposed part	4	6	
		Covered part	7	9	
	Super Structure deck	Exposed part	4	6	
		Covered part	7	9	
	Cross deck		5	7	
	House bulkhead	Outside bulkhead	4	6	
		Inside bulkhead	4	6	
		Covered part	7	9	
	Interior member	Web of girder, trans	5	7	
	Floor and girder of double bottom		6	8	

FIG. A1.20 Hull Structure

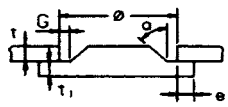
I. HULL STRUCTURE		SHIPBUILDING QUALITY STANDARDS			
Division		Alignment and Finishing			UNIT: mm
Section	Sub-section	Item	Standard Range	Tolerance Limits	Remarks
Treatment of temporary hull cuts	D<200	Strength member in skin plate		Ⓐ or Ⓑ	Open the hole to over 75ø mm Open the hole to over 200ø mm
		Others		Ⓑ, Ⓒ or Ⓓ	In case Ⓑ, open the hole to over 200ø mm
	D≥200	Strength member in skin plate		Ⓑ	Method of treatment Ⓐ: Spigot patch  α=30°~40° G=4%~6% t1=1/2t~t e=50% Ⓑ: Close by butt welding. Ⓒ: Close with lapping piece (Closing plate to be same thickness of base plate) Ⓓ: Where it is difficult from structual point of view to open the hole over 200mm, pre-heat and use a low hydrogen electrode. Inspect by radiographic or ultrasonic inspection.
		Others		Ⓑ or Ⓒ	
	Serration, Scallop Slot.			Ⓑ or Ⓒ	

FIG. A1.21 Hull Structure

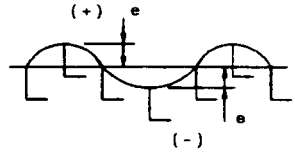
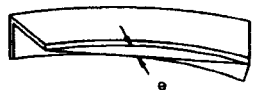
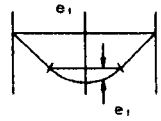
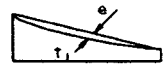
I. HULL STRUCTURE			SHIPBUILDING QUALITY STANDARDS		
Division		Deformation			UNIT: mm
Section	Sub-section	Item	Standard Range	Tolerance Limits	Remarks
Deviation of frame	Shell plate	Parallel part	±2e/1000	±3e/1000	
		Fore and aft part	±3e/1000	±4e/1000	
	Deck and top plate of double bottom		±3e/1000	±4e/1000	
	Bulkhead		±4e/1000	±5e/1000	
	Accommodation	Deck	±3e/1000	±4e/1000	
		Outside bulkhead	±2e/1000	±3e/1000	
	Others		±5e/1000	±6e/1000	
Miscellaneous	Distortion of deep girder and transverse (at the part of upper edge and flange)	Length of span	5	8	
	Distortion of longitudinal and transverse frame, beam and stiffener (at the part of flange).	e≤1000	5	8	
		1000<e	3 + 2e/1000 (max 10)	6 + 2e/1000 (max 13)	
	Distortion of H pillar between decks.		4	6	
	Distortion of cross tie.	Distortion of fore and aft direction. e_1 (cross tie only)	6	10	
		Distortion of fore and aft direction. e_1 (cross tie + trans web)	12	16	
	Distortion of tripping bkt and small stiffener with web plate.	Distortion at the part of free edge.		t_1	
	Distortion of face plate		a=2 + b/100	a=5 + b/100	

FIG. A1.22 Hull Structure

I. HULL STRUCTURE			SHIPBUILDING QUALITY STANDARDS		
Division		Miscellaneous		UNIT: mm	
Section	Sub-section	Item	Standard Range	Tolerance Limits	Remarks
Painting for welded joint at tightness test or construction inspection	Sub assembly and assembly welded joint		Paint after hull block inspection	Not defined	Shop primer can be applied.
	Erection welded joint		Paint after tightness test. Butts of Skin PLTS are coated wash primer before final construction inspection. Paint before tightness test, when tanks given special protective coating are hydraulically tested.	Butts of Skin PLTS are coated after final construction inspection and before leak test.	
Draft Mark	Compared to the template		±1.0	±2.0	
Freeboard Mark	Compared to the template		±0.5	±0.5	

FIG. A1.23 Hull Structure

I. HULL STRUCTURE			SHIPBUILDING QUALITY STANDARDS		
Division		Miscellaneous		UNIT:mm	
Section	Sub-section	Item	Standard Range	Tolerance Limits	Remarks
Hatch Coaming	Principal dimensions of hatch coaming	Length	±5	±10	
		Breadth	±5	±10	
		Difference of diagonal length	±10	±15	
	Deformation of horizontal stiffener	End coaming	±3	±5	
		Side coaming	±5	±8	
		Deformation per one meter (random)	±2	±3	
Opening of entrance	Opening of steel wall	Breadth and Height	±4	±7	
		Sill height	0~15	-10~+30	
		Deformation (per 1m)	±2	±3	
	Opening of deck (through type)	Breadth	±2	±3	
		Length	±3	±3	
	Opening of deck (not through type)	Breadth	-3~+2	-5~+3	
		Length	-3~+2	-5~+3	

FIG. A1.24 Hull Structure

A2. OUTFITTING

I. PIPING

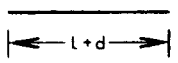
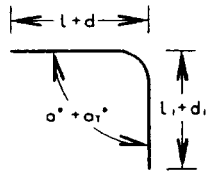
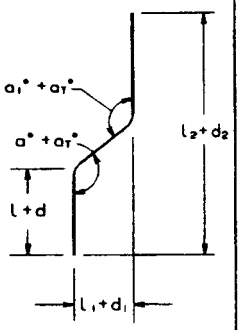
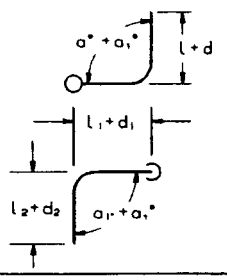
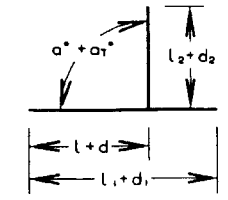
Division	A. PIPE FABRICATION			SHIPBUILDING QUALITY STANDARDS			
Section	1. STRAIGHT PIPE						
Sub-section	Item		Figure	Nominal Diameter (mm)	Standard Range (mm)	Tolerance Limits (mm)	Remarks
	Indicated length of pipe on drawing	l					
	Length tolerence	d			±6	Not Defined	
Section	2. BENT PIPE						
a. Single direction bending	Indicated lengths of pipe on drawing	l & l_1					
	Length tolerence	d			±6	Not Defined	
	Length tolerence	d_1			±5	Not Defined	
	Design bending angle	$a°$					
	Bend tolerance	$a_T°$			±1°	Not Defined	
b. Two direction bending	Indicated lengths of pipe on drawing	l, l_1, l_2					
	Length tolerence	d			±6	Not Defined	
	Length tolerence	d_1			±5	Not Defined	
	Length tolerence	d_2			±6	Not Defined	
	Design bending angles	$a°, a_1°$					
	Bend tolerance	$a_T°$			±2°	Not Defined	
c. Three direction bending	Indicated lengths of pipe on drawing	l, l_1, l_2					
	Length tolerence	d			±5	Not Defined	
	Length tolerence	d_1			±5	Not Defined	
	Length tolerence	d_2			±5	Not Defined	
	Design bending angles	$a°, a_1°$					
	Bend tolerance	$a_T°$			±1°	Not Defined	
Section	3. Branch pipe						
	Indicated lengths of pipe on drawing	l, l_1, l_2					
	Length tolerence	d			±5	Not Defined	
	Length tolerence	d_1			±5	Not Defined	
	Length tolerence	d_2			±5	Not Defined	
	Design angle	$a°$					
	Angle tolerance	$a_T°$			±1°	Not Defined	

FIG. A2.1 Piping

I. PIPING

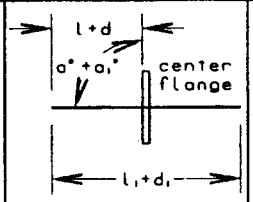
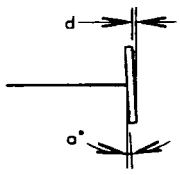
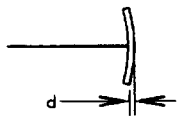
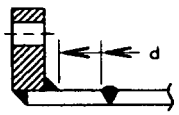
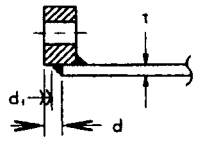
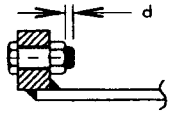
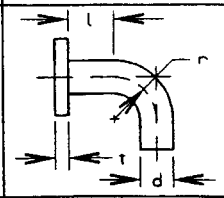
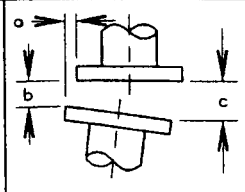
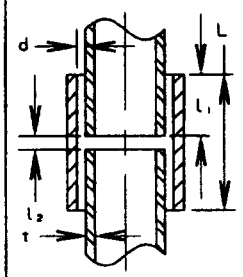
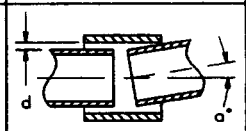
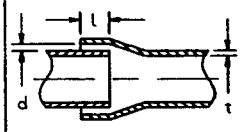
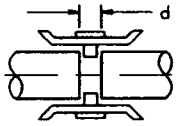
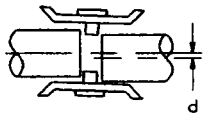
Division	A. PIPE FABRICATION			SHIPBUILDING QUALITY STANDARD			
Section	4. PENETRATION PIECE						
Sub-section	Item		Figure	Nominal Diameter (mm)	Standard Range (mm)	Tolerance Limits (mm)	Remarks
	Indicated lengths of pipe on drawing	l, l_1					
	Length tolerence	d			±4	Not Defined	
	Length tolerence	d_1			±4	Not Defined	
	Design penetration angle	a°					
	Angle tolerance	a_1°			±1°	Not Defined	
Section	5. FLANGES						
a. Angle of flange to pipe	Displacement of flange face	d					
	Angle deviation from normal	a°		< 150 ≥ 150	a°≤1° d°≤1.5°		
b. Distortion of flange face	Distortion dimension	d		<200 200-450 >500	≤0.5 ≤1.0 ≤1.5	<1.0 <2.0 <2.5	
c. Distance between fillet and butt welding bead	Distance between fillet and butt welding bead	d					
d. Attachment of flange to pipe	Pipe setback from face of flange	d			t+1.5	Not Defined	
	Toe of weld setback from face of flange	d_1					
e. Thread extension past nut	Length of thread protrusion	d				0-3 threads	
f. Distance between pipe and bending area	Distance between flange and bend	l			>t		
	Thickness of flange	t					
	Bend radius	r			≥2d		
	Pipe diameter	d					
g. Alignment of flanges	Amount of flange offset	a			a≤3 c-b≤3		
	Maximun distance between flange faces	c					
	Minimun distance between flange faces	b					

FIG. A2.2 Piping

I. PIPING

Division A. PIPE FABRICATION

Section 6. COUPLINGS

Sub-section	Item		Figure	Nominal Diameter (mm)	Standard Range (mm)	Tolerance Limits (mm)	Remarks
a. Coupling (sleeve)	Length of coupling Length of pipe inside coupling Distance beween pipes inside coupling Pipe thickness Distance between inside of coupling and outside of pipe	L l_1 l_2 t d			≥3t 1 ~ 3	not defined not defined	l_1 & a vary according to pipe diameter
b. Coupling misalignment	Distance between inside of coupling and outside of pipe Angle misalignment	d a°			≤2.0 <5°		
c. Coupling bell & socket	Distance between inside of coupling and outside of pipe Distance pipe inserted in socket Pipe thickness	d l t			≤0.2 ≥5t		
d. Dresser coupling distance between pipe ends	Distance between pipe ends	d			±10	not defined	
e. Dresser coupling pipe misalignment	Amount of misalignment	d			±3	±5	

Division B. PIPE BENDING

Section 1. ELLIPTICITY (out of roundness)

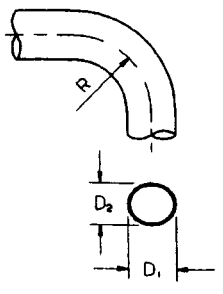
Sub-section	Item		Figure	Tolerance Limits (unit: %) Bending Radius	Cold Bending	Hot Bending	Remarks
a. Steel and non-ferrous pipe	Ellipticity= $\frac{(D_1-D_2)\times 100}{D}$ (%) Outside dia. of pipe before manufacturing Major dia. of bent pipe Minor dia. of bent pipe Nominal dia. Bending radius	 D D_1 D_2 A R		R≤2A 2A<R≤3A 3A<R≤4A 4A<R	- 10 10 10	10 8 8 5	Tolerance limits of cold bending includes that of high frequency induction heating bending Standard range not defined

FIG. A2.3 Piping

I. PIPING

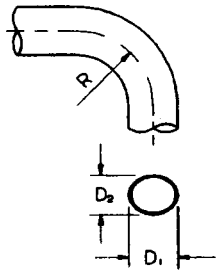
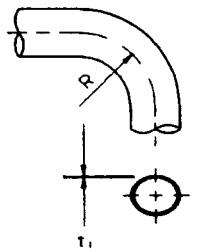
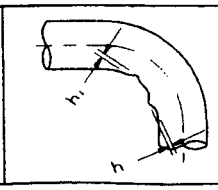
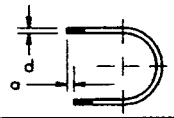
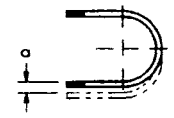
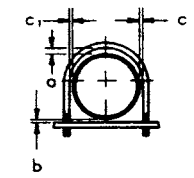
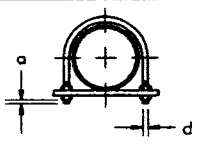
Division	B. PIPE BENDING			SHIPBUILDING QUALITY STANDARDS			
Section	1. ELLIPTICITY (out of roundness)			Tolerance Limits (unit: %)			
Sub-section	Item		Figure	Bending Radius	Cold Bending	Hot Bending	Remarks
b. Al-brass & CuNi pipe	Ellipticity= $\frac{(D_1-D_2)\times 100}{D}$ (%)			R≤2A	15		Tolerance limits of cold bending includes that of high frequency induction heating bending Standard range not defined
	Outside dia. of pipe before manufacturing	D		2A<R≤3A	10		
	Major dia. of bent pipe	D_1		3A<R≤4A	10		
	Minor dia. of bent pipe	D_2		4A<R	8		
	Nominal dia.	A					
	Bending radius	R					
Section	2. REDUCTION IN WALL THICKNESS						
a. Steel pipe	Reduction in wall thickness = $\frac{(t-t_1)\times 100}{t}$ (%)			R≤2A	-	20	Tolerance limits of cold bending includes that of high frequency induction heating bending Standard range not defined
	Original wall thickness	t		2A<R≤3A	25	10	
	Wall thickness after bending	t_1		3A<R≤4A	20	5	
	Nominal dia.	A		4A<R	15	5	
	Bending radius	R					
b. Copper pipe				R≤2A	-	20	Tolerance limits of cold bending includes that of high frequency induction heating bending Standard range not defined
				2A<R≤3A	30	15	
				3A<R≤4A	25	10	
				4A<R	20	10	
c. Al-brass & CuNi pipe				R≤2A	25		Tolerance limits of cold bending includes that of high frequency induction heating bending Standard range not defined
				2A<R≤3A	25		
				3A<R≤4A	20		
				4A<R	15		
Section	3. SWELL & WRINKLE DISTORTION						
a. All pipe materials	Amount of swell distortion	h			h or h_1 ≤ $\frac{1}{100}$A		Tolerance limits not defined
	Amount of wrinkle distortion	h_1					
	Nominal dia.	A					

FIG. A2.4 Piping

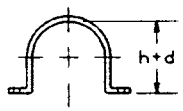
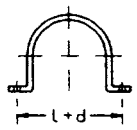
I. PIPING

Division C. PIPE HANGERS

Section 1. U-BOLT

Sub-section	Item		Figure	SHIPBUILDING QUALITY STANDARDS Standard Range	Tolerance Limits	Remarks
				unit: mm		
a. Height difference between ends of U-bolt	Diameter of u-bolt Difference between bolt ends	d a		≤d/2	not defined	
b. Pitch of U-bolt	Difference between required and actual location	a		±2	not defined	
c. Clearance between pipe & U-bolt or flat steel band	Clearance between top of pipe & hanger Clearance between bottom of pipe & hanger Clearance between side of pipe & hanger	a b c & c_1		≥1≤3	not defined	Applied to necessary part only
d. Thread extension from nut for U-bolt or flat steel band	Length of thread protusion beyond nut Diameter of bolt	a		0~5 threads	not defined	

Section 2. FLAT STEEL BAND

a. Hanger height	Required height of hanger Dimensional variation	h d		-2~0	not defined	
b. Pitch of bolt holes	Required pitch between bolt holes Dimensional variation	l d		±2	not defined	

Section 3. DISTANCE BETWEEN PIPE HANGERS

Pipe nominal diameter	Maximun hanger spacing	Pipe nominal diameter	Maximun hanger spacing
10	1.4 m	125	4.5 m
15	1.6 m	150	5.0 m
20	1.8 m	200	5.0 m
25	2.1 m	250	5.5 m
32	2.4 m	300	6.0 m
40	2.6 m	350	6.0 m
50	2.8 m	400	6.0 m
65	3.2 m	500	7.0 m
80	3.5 m	600	7.0 m
100	4.0 m	700	7.0 m

FIG. A2.5 Piping

I. PIPING

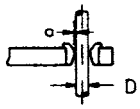
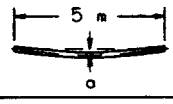
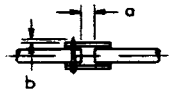
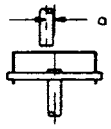
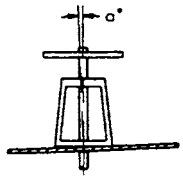
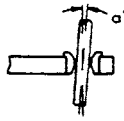
Division	E. REACH RODS			SHIPBUILDING QUALITY STANDARDS		
Section	1. MANUFACTURING OF REACH ROD					
Sub-section	Item		Figure	Standard Range	Tolerance Limits	Remarks
				unit: mm		
a. Clearance between reach rod and bearing	Diameter of reach rod	D		D≥25	not defined	
	Clearance between reach rod & bearing	a		0.5≤a≤1.5 D≥32 0.5≤a≤2.0	not defined	
b. Straightness of spindle (per 5 m)	Deflection of rod (per 5 m length)	a		≤10	not defined	
c. Clearance between reach rod and joint piece	Clearance between reach rod and joint piece	a		0.2≤a≤1.0	not defined	
Section	2. FITTING OF REACH ROD					
a. Spindle end spacing & free end spacing of taper pin	Spindle end spacing	a		≤10	not defined	
	Free end spacing of taper pin	b		5≤b≤8	not defined	
b. Straightness of reach rod (per 5 m)	Deflection of rod (per 5 m length)	a		≤10	not defined	
c. Misalignment between valve spindle and reach rod	Misalignment distance	a		≤10	not defined	
d. Fitting angle of deck stand	Angle deviation from vertical	a°		≤1°	not defined	
e. Deviation of reach rod from perpendicular to bearing	Angle deviation from normal	a°		≤1°	not defined	

FIG. A2.6 Piping

I. PIPING

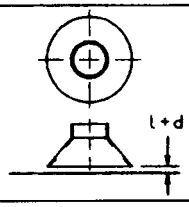
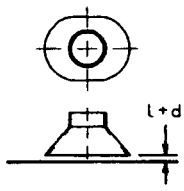
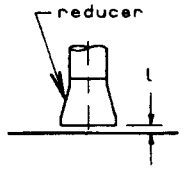
Division	F. BELLMOUTHS			SHIPBUILDING QUALITY STANDARDS			
Section	1. A-TYPE BELLMOUTH						
Sub-section	Item		Figure	Nominal Diameter (mm)	Standard Range (mm)	Tolerance Limits (mm)	Remarks
	Height of bellmouth above bottom of tank Height tolerances	l d		80 100 125 150 200	l=15 l=20 l=20 l=25 l=35		
Section	2. B-TYPE BELLMOUTH						
	Height of bellmouth above bottom of tank Height tolerances	l d		250 300 350 400 450 500 550	l=50 l=50 l=80 l=80 l=100 l=100 l=120		
Section	3. C-TYPE BELLMOUTH						
	Height of bellmouth above bottom of tank	l		40 50 65 80 100 125 150 200	l=15 l=15 l=20 l=25 l=35 l=40 l=45 l=65		

FIG. A2.7 Piping

I. HULL OUTFITTING

Division	I-A WATER TIGHT STEEL HATCH COVER	SHIPBUILDING QUALITY STANDARDS		
Section	I. HATCH COVER (SINGLE PULL TYPE)			
Sub-section	Item	Standard Range (mm)	Tolerance Limits (mm)	Remarks
1. Dimension of hatch cover	Length (1 hatch) δ_1 ①	±5	Not Defined	① and ② indicate acceptable tolerances for various support conditions shown below:
	Length (1 panel) δ_2	±3	Not Defined	
	Breath δ_3 ①	±3	Not Defined	①: condition where each cover is ranged without closely tightening
	Height of hatch cover δ_4	±3	Not Defined	
	Difference between diagonals (1 hatch) $\lvert L_1-L_2\rvert$ ①	≤5	Not Defined	②: condition where each cover is ranged and tightened
	Difference between diagonals (1 panel) $\lvert L_3-L_4\rvert$	≤4	Not Defined	l = designed dimension
				L_1 = actual dimension
2. Deflection of side end and top plate	Deflection of side plate in the vertical direction δ_6	±3	Not Defined	*Indicates clearance between under-surface of cover and surface table when putting on the surface table
	Deflection of end plate in the vertical direction δ_7	±3	Not Defined	
	Bend of side plate in the transverse direction δ_8	±3	Not Defined	
	Bend of end plate in the transverse direction δ_9	±3	Not Defined	
	Deformation of top plate δ_{10}	±4	Not Defined	
	*Flatness of undersurface of hatch cover (1 panel)	≤3	Not Defined	
3. Dimension of wheel after installing	Dimension of balancing wheel after installing δ_{11}	±2	±3	
	Height of balancing wheel δ_{12}	±2	±3	
	Dimension of wheel after installing δ_{13}	±2	±3	
	Height of wheel δ_{14}	±2	±3	
	Pitch of installed wheel δ_{15} ①	±2	±4	

FIG. A2.8 Hull Outfitting

I. HULL OUTFITTING

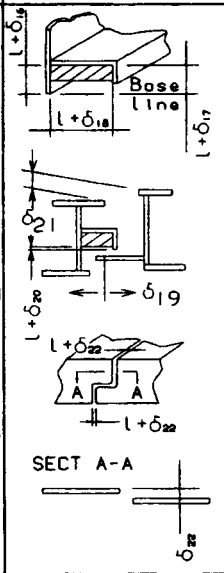
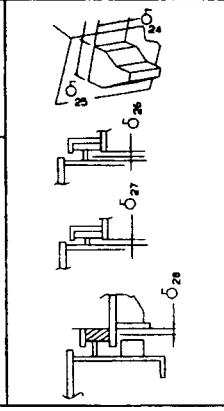
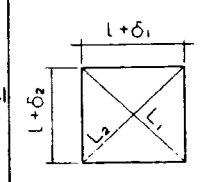
Division	I-A WATER TIGHT STEEL HATCH COVER			SHIPBUILDING QUALITY STANDARDS		
Section	1. HATCH COVER (SINGLE PULL TYPE)					
Sub-section	Item		Figure	Standard Range (mm)	Tolerance Limits (mm)	Remarks
4. Intermediate hinge and water tightness	Height from base line to packing gutter	δ_{16} δ_{17}		±1 ±1	±2 ±2	t=thickness of compression bar
	Breath of packing gutter	δ_{18}		±1	±2	Compressed depth of packing surrounding hatch cover to be in accordance with this item.
	Deviation between compression bar and packing	δ_{19} ②		±5	$\pm\frac{1}{2}$	
	Compressed depth of packing	δ_{20} ②		±3	*	* not defined
	Deviation between top plates	δ_{21} ②		≤2	≤4	
	Deviation between side plates	δ_{22} ②		≤2	≤4	
	Clearance between hatch covers	δ_{23} ②	SECT A-A	±3	-5-+10	
5. Installing position of snag for quick acting cleat	Longitudinal deviation	δ_{24}		±4	±6	
	Vertical deviation	δ_{25}		±4	±6	
6. Clearance between hatch cover and hatch coaming	Touchpiece type	δ_{26}		≤1	≤2	Refer to note
	Directly of touched type	δ_{27}		≤3	≤5	
	Rest pad type	δ_{28}		≤1	≤2	
	Note Every touchpiece of A or C type to be in touch with end and side girder of hatch cover or rest arm of hatch cover. For type B, end and side girder of hatch cover to be in touch with the coaming top plate at least one position in any 3 meters.					
Section	2. HATCH COVER (SINGLE PULL TYPE)					
1. Dimension of hatch coaming	*Length	δ_1		±5	±10	* to be in accordance with hull specification.
	*Breadth	δ_2		±5	±10	
	*Difference between diagonals	$\lvert L_1-L_2\rvert$		≤10	≤15	l=designed dimension L_1=actual dimension

FIG. A2.9 Hull Outfitting

I. HULL OUTFITTING

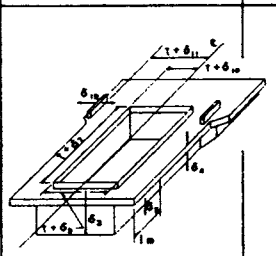
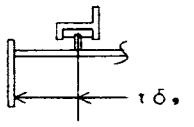
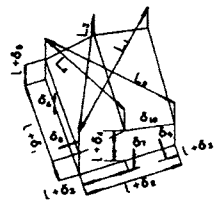
Division	I-A WATER TIGHT STEEL HATCH COVER			SHIPBUILDING QUALITY STANDARDS		
Section	2. HATCH COAMINGS (SINGLE PULL TYPE)					
Sub-section	Item		Figure	Standard Range (mm)	Tolerance Limits (mm)	Remarks
2. Deflection of horizontal stiffener (installing position of compression bar)	* End coaming	δ_3		±3	±5	* to be in accordance with hull specification.
	* Side coaming	δ_4		±5	±8	
	* Deflection in any one meter (at end and side coaming	δ_5		±2	±3	
3. Installing dimension of compression bar	Installing position	δ_6		±3	±5	t= thickness of compression bar
	Longitudinal deviation	δ_7		±3	±8	
	Transverse deviation	δ_8		≤3	±5	
	Deviation from center line of cover packing	δ_9		≤5	$\pm\frac{1}{2}$	
4. Installing dimension of guide rail and ramp	Installing position of guide rail	δ_{10}		±3	±3	
	Installing position of ramp	δ_{11}		±3	±3	
	Deviation of ramp from vertical line	δ_{12}		±3	±3	
Section	3. HATCH COAMINGS (SIDE ROLLING TYPE)					
1. Dimension of hatch cover	Length	δ_1 ①		±5	Not Defined	① and ② indicate acceptable tolerances for various support conditions shown below:
	Breadth (1 hatch)	δ_2 ①		±5	Not Defined	①: condition where each cover is ranged without closely tightening
	Breadth (1 panel)	δ_3		±4	Not Defined	②: condition where each cover is ranged and tightened
	Height of cover	$\delta_{4,5}$		±3	Not Defined	l= designed dimension
	Difference between diagonals (1 panel)	$\lvert L_1-L_2\rvert$ ①		≤5	Not Defined	L_1= actual dimension
	Difference between diagonals (1 panel)	$\lvert L_3-L_4\rvert$		≤4	Not Defined	
2. Deflection of side, end and top plate	Deflection of side plate in the vertical direction	δ_6		±3	Not Defined	* indicates clearance between under surface of hatch cover and suface table, when putting on the surface table.
	Deflection of end plate in the vertical direction	δ_7		±3	Not Defined	
	Bend of side plate in the transverse direction	δ_8		±3	Not Defined	
	Bend of end plate in the transverse direction	δ_9		±3	Not Defined	
	Deformation of top plate	δ_{10}		±4	Not Defined	
	*Flatness of lower surface of hatch cover (1 panel)			≤3	Not Defined	

FIG. A2.10 Hull Outfitting

I. HULL OUTFITTING

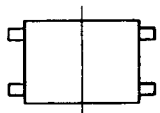
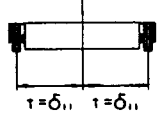
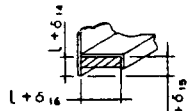
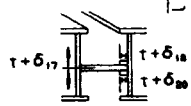
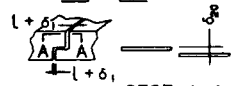
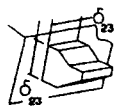
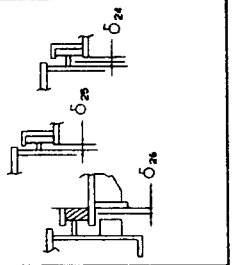
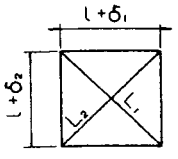
Division	I-A WATER TIGHT STEEL HATCH COVER			SHIPBUILDING QUALITY STANDARDS		
SECTION	3. HATCH COVER (SIDE ROLLING TYPE)					
Sub-section	Item		Figure	Standard Range (mm)	Tolerance Limits (mm)	Remarks
3. Installing dimension of wheel	Span (between center lines)	δ_{11}		±2	±3	
	Installing height	δ_{12}		±2	±3	
	Installing pitch	δ_{13}		±2	±3	
4. Intermediate hinge and watertight construction	Height from base line to packing gutter	δ_{14} ⊘ δ_{15}		±1 ±1	±2 ±2	t=thickness of compression bar
	Breath of packing gutter	δ_{16} ⊘		±1	±2	Compressed depth of packing, surrounding hatch cover to be in accordance with this item.
	Deviation between compression bar and packing	δ_{17} ⊘		≤5	$\pm\frac{1}{2}$	
	Compressed depth of parking	δ_{18} ⊘		≤3	*	* not defined
	Deviation between top plates	δ_{19} ⊘		±2	≤4	
	Deviation between end plates	δ_{20}		±3	≤4	
	Clearance between hatch covers	δ_{21}	SECT A-A	±3	-5~+10	
5. Installing position of snag for quick acting cleat	Longitudinal deviation	δ_{22}		±4	±6	
	Vertical deviation	δ_{23}		±4	±6	
6. Clearance between hatch cover and hatch coaming	Touch piece type	δ_{24}		≤1	≤2	Refer to note
	Directly touched type	δ_{25}		≤3	≤5	
	Rest pad type	δ_{26}		≤1	≤2	
	Note Evevy touchpiece of A or C type to be in touch with end and side girder of hatch cover or rest arm of hatch cover. For type B, end and side girder of hatch cover to be in touch with the coaming .. top plate at least one posistion in any 3 meters.					
SECTION	4. HATCH COAMING (SIDE ROLLING TYPE)					
1. Dimension of hatch coaming	*Length	δ_1		±5	±10	* to be in accordance with hull specification.
	*Breadth	δ_2		±5	±10	
	*Difference between diagonals	$\lvert L_1-L_2\rvert$		≤10	≤15	l=designed dimension L_1=actual dimension

FIG. A2.11 Hull Outfitting

I. HULL OUTFITTING

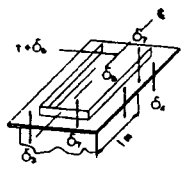
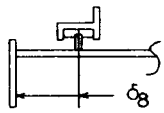
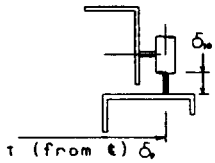
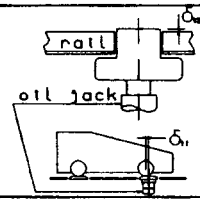
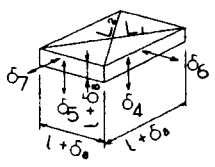
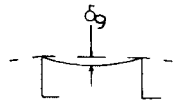
Division	I-A WATER TIGHT STEEL HATCH COVER			SHIPBUILDING QUALITY STANDARDS		
Section	4. HATCH COAMINGS (SIDE ROLLING TYPE)					
Sub-section	Item		Figure	Standard Range (mm)	Tolerance Limits (mm)	Remarks
2. Deflection of horizontal stiffener (at installing position of compression bar)	• End coaming	δ_3		±3	±5	• to be in accordance with hull specification.
	• Side coaming	δ_4		±5	±8	
	• Deflection in any one meter (at end and side coaming	δ_5		±2	±3	l= Design dimension
3. Installing dimension of compression bar	Installing position	δ_6		±3	±5	t=thickness of compression bar
	Longitudinal and transverse deviation	δ_7		±3	±5	
	Deviation from center line of cover packing	δ_8		±5	$\pm\frac{1}{2}$	
4. Installing dimension of rail	Installing position of rail	δ_9		±3	±5	
	Level of rail top	δ_{10}		±3	±5	
5. Position of opening hole of jack	Deviation between wheel center and jack center	δ_{11}		±3	±5	
	Deviation between rail and flap	δ_{12}		±1	±2	
Section	5. HATCH COVER (PONTOON TYPE FOR CONTAINER SHIP)					
1. Dimension of hatch cover	Length	δ_1		±5	•	① and ② indicate acceptable tolerances for various support conditions shown follows:
	Breadth	δ_2		±5	•	
	Height of cover	δ_3		±3	•	
	Difference between diagonals	$\lvert L_1-L_2\rvert$		≤5	•	① : condition putting together, nontight:
2. Deflection of side, end and top plate	Deflection of side plate in the direction of up and down	δ_4		±3	•	② : closed condition
	Deflection of end plate in the direction of up and down	δ_5		±3	•	l= Design dimension L_1= actual dimension to be measured by condition 2 at container mount on cover or pedestal.
	Bend of side plate in the direction of transverse	δ_6		±3	•	• not defined
	Bend of end plate in the direction of transverse	δ_7		±3	•	
	Deformation of top plate	δ_8		±4	•	
	Flatness of under surface of cover			≤3	•	

FIG. A2.12 Hull Outfitting

I. HULL OUTFITTING

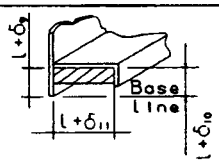
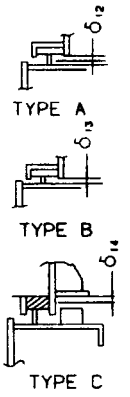
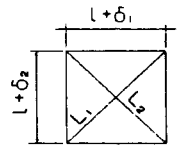
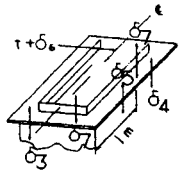
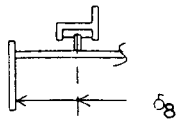
Division	I-A WATER TIGHT STEEL HATCH COVER			SHIPBUILDING QUALITY STANDARDS		
Section	5. HATCH COVER (PONTOON TYPE FOR CONTAINER SHIP)					
Sub-section	Item		Figure	Standard Range (mm)	Tolerance Limits (mm)	Remarks
3. Water tightness	Height from base line to packing gutter	δ_9 δ_{10}		±1 ±1	±2 ±2	
	Breath of packing gutter	δ_{11}		±1	±2	
4. Clearance between hatch cover and hatch coaming	Touch piece type	δ_{12}		≤1	≤2	Refer to note
	Directly touched type	δ_{13}		≤3	≤5	
	Rest pad type	δ_{14}		≤1	≤2	
	Note Evevy touchpiece of A or C type to be in touch with end and side girder of hatch cover or rest arm of hatch cover. For type B, end and side girder of hatch cover to be in touch with the coaming top plate at least one posisition in any 3 meters.					
Section	6. HATCH COAMING (PONTOON TYPE FOR CONTAINER SHIP)					
1. Dimension of hatch cover	•Length	δ_1		±5	±10	* to be in accordance with hull specification.
	•Breadth	δ_2		±5	±10	
	•Difference between diagonals	$\lvert L_1-L_2 \rvert$		≤5	≤15	
2. Deflection of horizontal stiffner (at installing position of compression bar)	•End coaming	δ_3		±3	±5	
	•Side coaming	δ_4		±5	±8	
	•Deflection in any one meter (at end and side coaming)	δ_5		±2	±3	
3. Installing dimension of compression bar	•Installing position	δ_6		±3	±5	t=thickness of compression bar
	•Longitudinal and transverse deviation	δ_7		±3	±5	
	•Deviation from center line of cover packing	δ_8		±5	$\pm\frac{1}{2}$	

FIG. A2.13 Hull Outfitting

I. HULL OUTFITTING

Division: I-A WATER TIGHT STEEL HATCH COVER

Section: 1. HATCH COVER (FOLDING TYPE)

Sub-section	Item		Figure	SHIPBUILDING QUALITY STANDARDS: Standard Range (mm)	Tolerance Limits (mm)	Remarks
1. Dimension of hatch cover	Length (1 hatch)	δ_1 ①		±5	Not Defined	① and ② indicate acceptable tolerances for various support conditions shown below:
	Length (1 panel)	δ_2		±3		
	Breath	δ_3 ①		±3		①: condition where each cover is ranged without closely tightening
	Height of hatch cover	δ_4		±3		
	Difference between diagonals (1 hatch)	$\lvert L_1-L_2\rvert$ ①		≤5		②: condition where each cover is ranged and tightened
	Difference between diagonals (1 panel)	$\lvert L_3-L_4\rvert$		≤4		
2. Deflection of side end and top plate	Deflection of side plate in the vertical direction	δ_5		±3		l= designed dimension
	Deflection of end plate in the vertical direction	δ_6		±3		L_1= actual dimension
	Bend of side plate in the transverse direction	δ_7		±3		*Indicates clearance between under-surface of cover and surface table when putting on the surface table
	Bend of end plate in the direction of transverse	δ_8		±3		
	Deformation of top plate	δ_9		±4		
	*Flatness of tranverse under surface of hatch cover (1 panel)			≤3		
3. Installing dimension of wheel	Span (between center lines)	δ_{10}		±2	±3	
	Installing height	δ_{11}		±2	±3	
	Installing pitch	δ_{12}		±2	±4	
4. Intermediate hinge and water thightness	Height from base line to packing gutter	δ_{13}		±1	±2	t=thickness of compression bar
		δ_{14}		±1	±2	
	Breath of packing gutter	δ_{15}		±1	±2	Compressed depth of packing surrounding hatch cover to be in accordance with this item.
	Deviation between compression bar and packing	δ_{16}		±5	$\pm\frac{1}{2}$	
	Compressed depth of packing	δ_{17} ②		±2	*	* not defined
	Deviation between top plates	δ_{18} ②		≤2	≤4	
	Deviation between side plates	δ_{19} ②		≤2	≤4	
	Clearance between hatch covers	δ_{20} ②	SECT A-A	±3	-5~+10	

FIG. A2.14 Hull Outfitting

I. HULL OUTFITTING

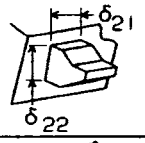
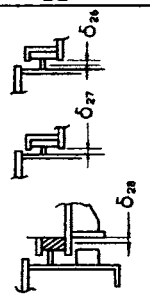
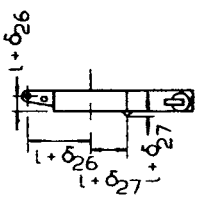
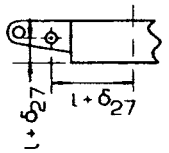
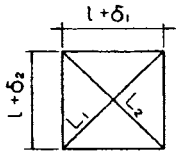
Division	I-A WATER TIGHT STEEL HATCH COVER			SHIPBUILDING QUALITY STANDARDS		
Section	1. HATCH COVER (FOLDING TYPE)					
Sub-section	Item		Figure	Standard Range (mm)	Tolerance Limits (mm)	Remarks
5. Installing position of snag for quick acting cleat	Longitudinal deviation	δ_{21}		±4	±6	
	Vertical deviation	δ_{22}		±4	±6	
6. Clearance between hatch cover and hatch coaming	Touchpiece type	δ_{23}		≤1	≤2	Refer to note
	Directly of touched type	δ_{24}		≤3	≤5	
	Rest pad type	δ_{25}		≤1	≤2	
	Note Evevy touchpiece of a A or C type to be in touch with end end and side girder of hatch cover or rest arm of hatch cover. For type B, end and side girder of hatch cover to be in touch with the coaming top plate at least one posisition in any 3 meters.					
7. Installing dimension of intermediate and main hinge	Deviation between main hinge and baseline of hatch cover (longitudinal and vertical direction)	δ_{26}		±2	±3	
	Deviation between main hinge and baseline of hatch cover (longitudinal and vertical direction)	δ_{27}		±2	±3	
8. Installing dimension of intermediate and main hinge	Deviation between eye plate for main cylinder and base line of hatch cover	δ_{28}		±2	±3	
Section	2. HATCH COVER (FOLDING TYPE)					
1. Dimension of hatch coaming	*Length	δ_1		±5	±10	* to be in accordance with hull specification.
	*Breadth	δ_2		±5	±10	
	*Difference between diagonals	$\lvert L_1-L_2\rvert$		≤10	≤15	l=designed dimension L_1=actual dimension

FIG. A2.15 Hull Outfitting

I. HULL OUTFITTING

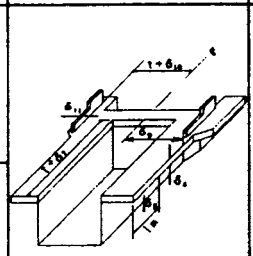
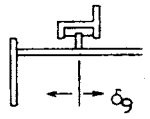
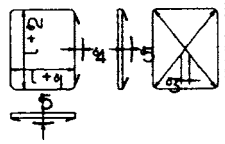
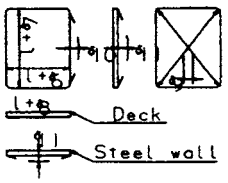
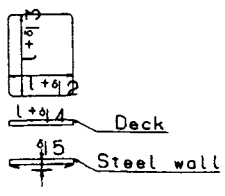
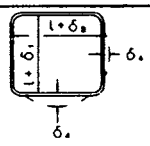
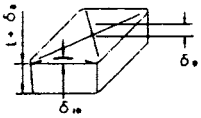
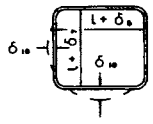
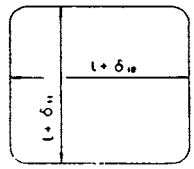
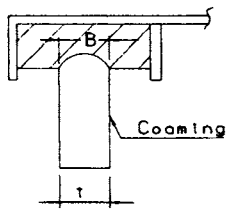
Division	I-A WATER TIGHT STEEL HATCH COVER			SHIPBUILDING QUALITY STANDARDS		
Section	2. HATCH COAMINGS (FOLDING TYPE)					
Sub-section	Item		Figure	Standard Range (mm)	Tolerance Limits (mm)	Remarks
2. Deflection of horizontal stiffener (installing position of compression bar)	• End coaming	δ_3		±3	±5	• to be in accordance with hull specification.
	• Side coaming	δ_4		±5	±8	
	• Deflection in any one meter (at end and side coaming	δ_5		±2	±3	l= designed dimension
3. Installing dimension of compression bar	Installing position	δ_6		±3	±5	t= thickness of compression bar
	Longitudinal deviation	δ_7		±3	±8	
	Transverse deviation	δ_8		±3	±5	
	Deviation from center line of cover packing	δ_9		±5	$\pm\frac{t}{2}$	
4. Installing dimension of guide rail	Installing position of rail	δ_{10}		±3	±5	
	Deviation of ramp from vertical line	δ_{11}		±3	±5	
Division	I-B ENTRANCE DOOR AND HATCH					
Section	1. WATER TIGHT STEEL DOOR					
1. Door	Breadth	δ_1		±2	±4	l= designed dimension
	Height	δ_2		±2	±4	δ_3 : distance between middle points of diagonals
	Distortion	δ_3		±2	±3	
	Straightness	δ_4		±1	±3	
	Warp	δ_5		±1	±3	
2. Door coaming	Breadth	δ_6		±2	±4	δ_9 : distance between middle points of diagonals
	Height	δ_7		±2	±4	
	Height of sill	δ_8		0~15	0~30	
	Distortion	δ_9		±2	±4	
	Straightness	δ_{10}		±1	±3	
	Warp	δ_{11}		±1	±3	
3. Part of cut steel wall	Breadth	δ_{12}		±4	±7	
	Height	δ_{13}		±4	±7	
	Height of sill	δ_{14}		0~15	-10~30	
	Defromation	δ_{15}		±2	±3	

FIG. A2.16 Hull Outfitting

I. HULL OUTFITTING

Division I-B ENTRANCE DOOR AND HATCH

Section 2. WATER TIGHT STEEL SMALL HATCH (SQUARE TYPE)

Sub-section	Item		Figure	SHIPBUILDING QUALITY STANDARDS Standard Range (mm)	Tolerance Limits (mm)	Remarks
1. Hatch cover	Breadth	δ_1		±3	±5	δ_3 : distance between middle points of diagonals
	Length	δ_2		±3	±5	
	Distortion	δ_3		±2	±3	
	Straightness	δ_4		±1	±3	
	Deformation (in any one meter)	δ_5		±1	±3	
2. Hatch coaming	Breadth	δ_6		±2	±5	δ_9 : distance between middle points of diagonals
	Length	δ_7		±2	±5	
	Height	δ_8		0 ~ 6	0 ~ 20	
	Distortion	δ_9		±2	±3	
	Straightness	δ_{10}		±1	±3	
3. Part of cut deck plate (penetration type)	Breadth	δ_{11}		±2	±3	
	Length	δ_{12}		±2	±3	
4. Part of cut deck plate (non-penetration type)	Breadth	δ_{11}		-3 ~ 2	-5 ~ 3	
	Length	δ_{12}		-3 ~ 2	-5 ~ 3	
5. Water tightness	Touch between gasket and coaming			$B \geq \frac{1}{2}$		To be applied for steel water tight door and water tight steel small hatch. (Water tight door) B:Breadth of chalk clung on the gasket after tightening test. The test is to be carried out with thrusting chips to the middle of the wedges. (Water tight small hatch) B:Breadth of chalk clung on the gasket after tightening test. The test is to be carried out with thrusting chips to the middle of the wedges.

Section 3. WATER TIGHT STEEL SMALL HATCH (ROUND TYPE) TO BE IN ACCORDANCE WITH THE WATER TIGHT SQUARE SMALL HATCH NOTE: REGUARDING A DIAMETER AS LENGTH OR BREATH

FIG. A2.17 Hull Outfitting

I. HULL OUTFITTING

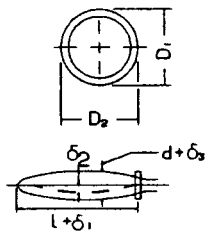
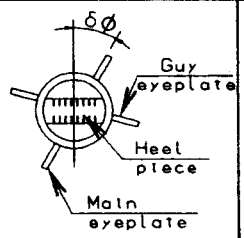
Division / Section / Sub-section	Item		Figure	Standard Range (mm)	Tolerance Limits (mm)	Remarks
Division I-C VENTILATOR AND SKYLIGHT				SHIPBUILDING QUALITY STANDARDS		
Section 1. ANOTHER WATER TIGHT STEEL HATCH						
1. Water tightness	• Contact between gasket and coaming			$B \geq \frac{1}{2}$		Ventilation hole with wall Wall louver Goose neck ventilator Mushroom ventilator
Section 1. SKYLIGHT						
1. Water tightness	Contact between gasket and coaming			$B \geq \frac{1}{2}$		
Division I-D CARGO LOADING APPARATUS						
Section 1. WELDING FABRICATED BOOM						
1. Derrick boom	Length	δ_1		±7	±10	d: designed dimension of derrick boom at measuring position D_1= max diameter D_1= min. diameter
	Bending	δ_2		±5	±10	
	Diameter	δ_3		$0-\frac{D}{100}$	$0-\frac{2D}{100}$	
	Permissible out of roundness of cylindrical shell at installing position of base assemblies	D_1-D_2		≤1	≤2	
2. Derrick boom and assemblies	Distortion between assemblies on base and assemblies on top	δ_ϕ		≤1	≤2	

FIG. A2.18 Hull Outfitting

I. HULL OUTFITTING

Division I-E CONTAINER LASHING DEVICES

Section 1. CONTAINER LASHING FITTING

SHIPBUILDING QUALITY STANDARDS

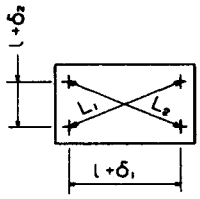
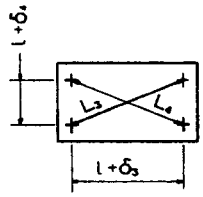
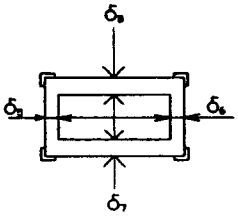
Sub-section	Item		Figure	Standard Range (mm)	Tolerance Limits (mm)	Remarks
1. 20' Container fitting	Length	δ_1		±3	±4	① and ② indicate acceptable tolerances for various support conditions shown follows:
	Breadth	δ_2 ②		±2	±3	
	Difference of height at cross section of diagonals	②		2	4	① : condition putting together, nontight;
	Difference between diagonals	② $\lvert L_1-L_2\rvert$		5	8	② : closed condition l= Specified dimension
2. 40' Container fitting	Length	δ_3		±3	±5	L_1= actual dimension to be measured by condition ② at container mount on cover or pedestal.
	Breadth	δ_4 ②		±2	±3	
	Difference of height at cross section of diagonals	②		2	4	
	Difference between diagonals	② $\lvert L_3-L_4\rvert$		5	8	
3. Clearance between cell guide and container	Length	$\delta_8+\delta_5$			±7	
	Breadth	$\delta_7+\delta_6$			±7	

FIG. A2.19 Hull Outfitting

I. HULL OUTFITTING

Division: I-F MOVABLE DECK, RAMP WAY, ETC.

Section I: HOISTABLE DECK (LIFTABLE DECK)

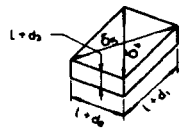
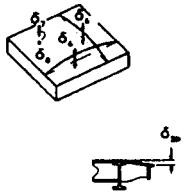
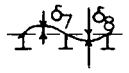
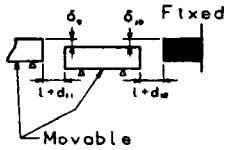
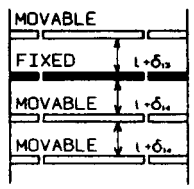
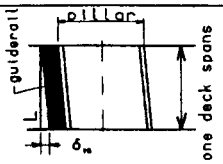
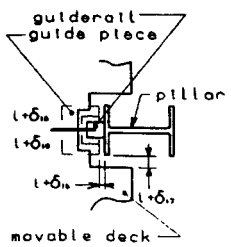
Sub-section	Item		Figure	SHIPBUILDING QUALITY STANDARDS: Standard Range (mm)	Tolerance Limits (mm)	Remarks
1. Dimension of deck	Length	δ_1		±5	±8	l = designed dimension
	Breadth	δ_2		±5	±8	
	Height	δ_3		±3	±5	δ_4, δ_5: actual dimension
	Difference between diagonals	$\delta_4 - \delta_5$		±8	±10	
2. Distortion of deck	Deflection of deck	δ_6		+5 -0	+10 -5	
	Distortion of deck	δ_7 δ_8		+5 -2	+10 -5	δ_7, δ_8: distortion of deck to be kept designed supporting condition.
	Deviation of deck end from deck level	δ_{20}			5	
3. Clearance between decks	Difference in level between movable decks	δ_9			10	l = designed dimension
	Difference in level between movable deck and fixed deck	δ_{10}			10	$\delta_9, \delta_{10}, \delta_{11}, \delta_{12}$: difference of level and clearance between decks to kept designed supporting and guided position.
	Clearance between movable decks	δ_{11}		±5	±8	
	Clearance between movable deck and fixed deck	δ_{12}			±10	
4. Height between decks	Height between fixed deck and movable deck	δ_{13}		+20 -0		l = designed dimension
	Height between movable decks	δ_{14}		+20 -0		*: Planned dimension means the clear height to be kept in the loading conditon.
5. Guiderail	Deviation of guiderail from vertical line	δ_{15}		5		δ_{15}: deviation from vertical line between one deck, spans.
6. Clearance between pillar and movable deck	Deviation of guiderail from vertical line	δ_{16}			+10	l = designed dimension
	do	δ_{17}			±10	
7. Clearance between guiderail and guide piece	Clearance between guiderail and guide piece	δ_{18}			+8 -0	
	do	δ_{19}			+8 -0	

FIG. A2.20 Hull Outfitting

I. HULL OUTFITTING

Division: I-F MOVABLE DECK, RAMP WAY, ETC.

Section 2: STERN RAMP (INCLUDING RAMP DOOR)

SHIPBUILDING QUALITY STANDARDS

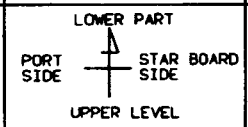
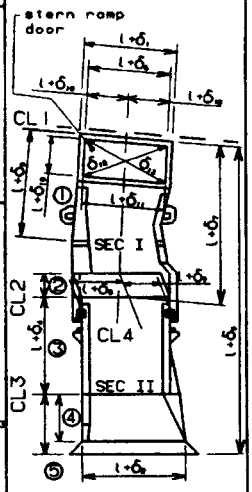
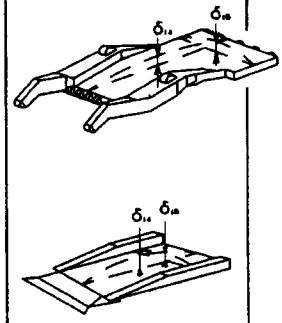
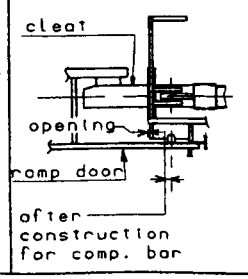
Sub-section	Item		Figure	Standard Range (mm)	Tolerance Limits (mm)	Remarks
1. Dimension of ramp	Breadth (lower part)	δ_1		±5	±8	ℓ=designed dimension
	Breadth (upper part)	δ_2		±5	±8	CL1 : center of main hinges
	Length (SEC I)	δ_3		±5	±8	CL2 : center of interchange
	Length (SEC II)	δ_4		±5	±8	CL3 : center of flap hinges
	Length (TOTAL)	δ_5		±10	±16	CL4 : means the perpenndicular to CL1.
2. Position of hinges	Distance between main hinges	δ_6			±5	$L+\delta_3$= ① +②
	Distance between the center of hinges	δ_7			±8	
	Distance between inter-hinge	δ_8 δ_9			±4 ±4	$L+\delta_3$= ③ + ④ + ⑤
3. Dimension of ramp door	Longitudinal distance between compression bars	δ_{10}			±5	δ_4, δ_5: to be measured after erection
	Transverse distance between compression bars	δ_{11}			±5	δ_{12}, δ_{13}: actual distance
	Difference between diagonal distances of compression bar	δ_{12}-δ_{13}			±8	
4. Distortion of ramp	Longitudinal distortion	δ_{14}			±5	δ_{14}, δ_{15}: Distortion of top plate on girders
	Transverse distortion	δ_{15}			±5	
5. Clearance eTc. in way of tightening part	Deviation of the position of compression bar from the centerline of packing	δ_{16}			±5	
	Clearance between the packing glove and the top plate of ramp door	δ_{17}			5	

FIG. A2.21 Hull Outfitting

I. HULL OUTFITTING

Division: I-F MOVABLE DECK, RAMP WAY, ETC.

Section 3: MIDSHIP RAMP (INCLUDING RAMP DOOR)

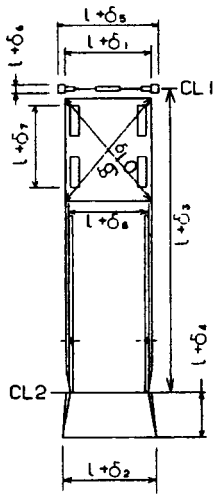
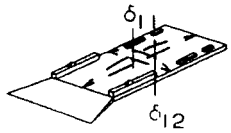
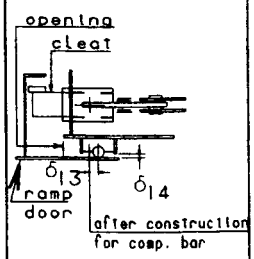
Sub-section	Item		Figure	SHIPBUILDING QUALITY STANDARDS: Standard Range (mm)	Tolerance Limits (mm)	Remarks
1. Dimension of ramp	Breadth (lower part)	δ_1		±5	±8	l=designed dimension
	Breadth (upper part)	δ_2		±5	±8	
	Length (ramp)	δ_3		±5	±8	CL1 : center of main hinges
	Length (flap)	δ_4		±5	±8	CL2 : center of flap hinges
2. Dimension and position of hinges	Distance between main hinges	δ_5			±5	
	Breadth of lifting eyes	δ_6			±2	
3. Dimension of ramp door	Longitudinal distance between compression bars	δ_7			±5	
	Transverse distance between compression bars	δ_8			±5	δ_9, δ_{10}: actual distance
	Difference between diagonal distances of compression bar	δ_9-δ_{10}			±8	
4. Distortion of ramp	Longitudinal distortion	δ_{11}			±5	δ_{11}, δ_{12}: Distortion of top plate on girders
	Transverse distortion	δ_{12}			±5	
5. Clearance etc. in way of tightening part	Deviation of the position of compression bar from the centerline of packing	δ_{13}			±5	
	Clearance between the packing glove and the top plate of ramp door	δ_{14}			5	

FIG. A2.22 Hull Outfitting

I. HULL OUTFITTING

Division: I-F MOVABLE DECK, RAMP WAY, ETC.

Section 4: BULKHEAD DOOR/COAMING

SHIPBUILDING QUALITY STANDARDS

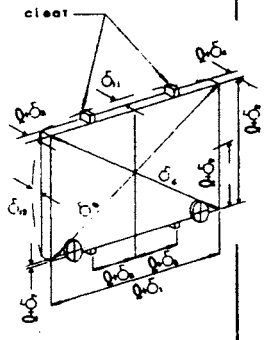
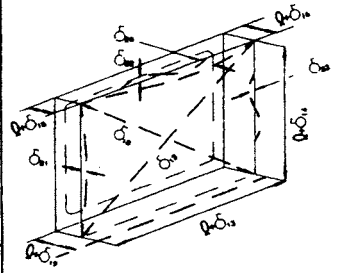
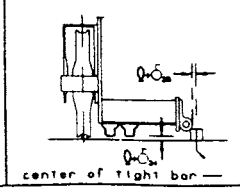
Sub-section	Item		Figure	Standard Range (mm)	Tolerance Limits (mm)	Remarks
1. Dimension of door	Breadth	δ_1			±5	l=designed dimension
	Height	δ_2			±5	
	Depth	δ_3			±3	
		δ_4			±3	δ_5, δ_6, δ_{11}, δ_{12}: actual dimension
	Difference between diagonal distances	$\delta_5-\delta_6$			±8	
2. Position of fittings	Height of the center line of wheel	δ_7			±3	
	Position of cleat	δ_8			±3	
	Position of stopping device	δ_9			±5	
3. Distortion of door	Distortion (transverse direction)	δ_{10}			±3	
	Distortion (vertical direction)	δ_{11}			±3	
4. Dimension of coaming	Breadth	δ_{12}			±5	l=designed dimension
	Height	δ_{13}			±5	δ_{17}, δ_{18} δ_{20}-δ_{23}: actual dimension
	Depth	δ_{14}			±3	
		δ_{15}			±3	
	Difference between diagonal distances	$\delta_{17}-\delta_{18}$			±8	
5. Position of rail	Distance from the bulkhead to the center of guiderail	δ_{19}			±3	
6. Distortion of coaming	Deflection (transverse direction)	δ_{20}			±3	
	Deflection (vertical direction)	δ_{21}			±3	
	Distortion (transverse direction)	δ_{22}			±3	
	Distortion (vertical direction)	δ_{23}			±3	
	Clearance between deck and back plate of door packing	δ_{24}			±3	l=designed dimension
	Gap between the corner of tight bar and packing end	δ_{25}			±3	

FIG. A2.23 Hull Outfitting

II. WOODWORK

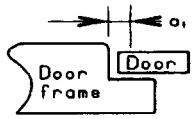
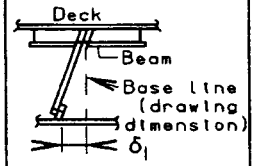
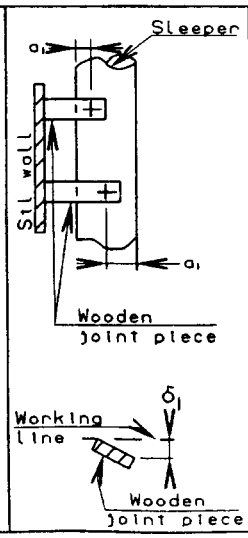
Division	II-A ACCOMMODATION SPACE			SHIPBUILDING QUALITY STANDARDS		
Section 1	DOOR AND DOOR FRAME					
Sub-section	Item		Figure	Standard Range (mm)	Tolerance Limits (mm)	Remarks
1. Clearance between door and door frame	Between wooden door and door frame	a_1		≤2	≤3	
	Between steel door and door frame	a_1		≤2	≤3	
Section 2	DIVISIONAL WALL					
1. Fitting of division wall	Deviation	δ_1		≤5	≤8	
Section 3	CEILING					
1. Ceiling clear height	Short of ceiling clear height (clear height)	δ		≤10		To be defined by planned dimension
Section 4	DETAIL OF DIVISIONAL PARTS					
1. Joint piece of woodwork	Relation between wooden parts and screw hole	a_1		≥2.5 D	≥1.5 D	D= dia. of bolt or dia. of screw
	Deviation from marking line	δ_1		≤2	≤5	

FIG. A2.24 Woodwork

II. WOODWORK

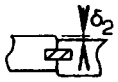
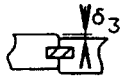
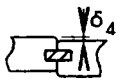
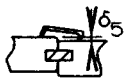
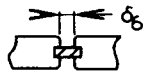
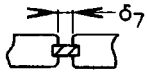
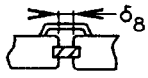
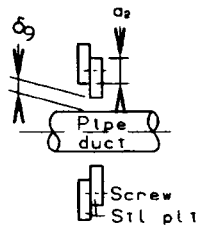
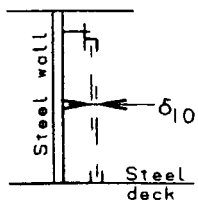
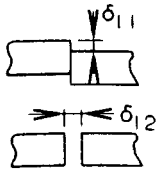
Division	II-A ACCOMMODATION	SHIPBUILDING QUALITY STANDARDS		
Section 4	DETAIL OF DIVISIONAL PARTS			
Sub-section	Item	Figure	Standard Range (mm)	Tolerance Limits (mm)	Remarks
2. Alignment of plywood joint	A joiner (plywood with the last coat of paint) δ_2		≤0.5	≤1	
	A joiner (To be veneered) δ_3		≤0.3	≤0.5	
	No joiner (To be veneered) δ_4			≤0.3	
	A joiner with joint pieces (To be veneered) δ_5		≤0.5	≤1	
3. Clearance of plywood joint	Plywood with the last coat of paint δ_6		≤0.3	≤1	
	Without joint pieces (To be veneered) δ_7		≤0.3	≤0.5	
	With joint pieces (To be veneered) δ_8		≤1	≤2	
4. Penetrations of wooden wall	Fireproof bulkhead (Clearance and lap length) δ_9 a_2	 (thickness more than 1.0 mm)	≤2	≤2.5 ≥25	
5. Steel panel	Deviation between upper and lower pieces δ_{10}		≤5	≤8	
	Alignment of joint δ_{11}		≤0.5	≤1	
	Gap of joint δ_{12}		≤0.5	≤1	

FIG. A2.25 Woodwork

II. WOODWORK

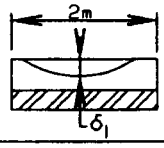
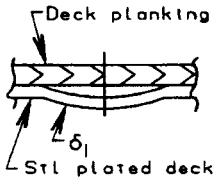
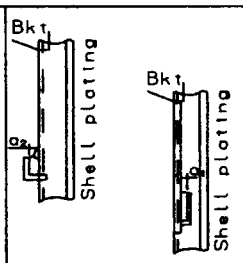
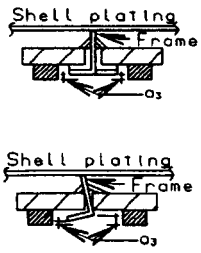
Division	II-A ACCOMMODATION			SHIPBUILDING QUALITY STANDARDS		
Section 5	DECK COVERING LEVEL					
Sub-section	Item		Figure	Standard Range (mm)	Tolerance Limits (mm)	Remarks
1. Deck composition	Flatness of deck composition	δ_1			≤5	Depth of δ_1 in two meters.
2. Deck covering	Flatness of deck covering		Ditto		≤5	Ditto
Division	II-B DECK COMPARTMENT					
Section 1	ON DECK					
1. Deck planking	Gap between deck planking and steel deck	δ_1		≤7	≤9	Distortion of steel deck is based on quality standard for hull. Deck planking is based on quality standard for bare steel parts.
Section 2	IN HOLD					
1. Clearance between sparring and cleat	Horizontal Longitudinal	a_1 a_2		≤6 ≤6	≤10 ≤10	
2. Location of cleat	Deviation of sparring from face	a_3		$10 \le a_3$ $a_3 \le 15$	$5 \le a_3$ $a_3 \le 20$	Fitting accuracy of cleat is defined as installed. In case where it is impossible to comply with the standard due to form of frames. Sparring is to be divided as appropriate.
Section 3	THE COLD STORAGE SPACES					
1. Door	Air tightness of door			—	Not defined	To be checked by chalk test. No measurable frost outside the cold storage spaces under refrigerating test. In case where it frosts, blow air from the outside and check with leakage of air with a candle or a joss stick in the cold storage space.

FIG. A2.26 Woodwork

IV. MACHINERY

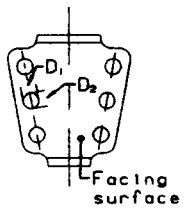
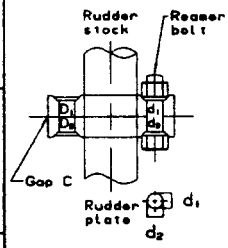
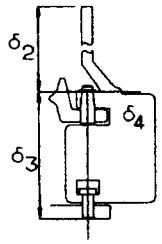
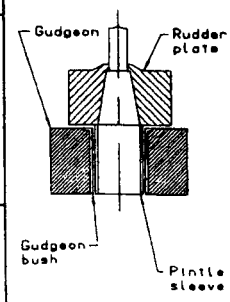
Division	IV-A RUDDER			SHIPBUILDING QUALITY STANDARDS		
Section	1. RUDDER PLATE AND RUDDER STOCK					
Sub-section	Item		Figure	Standard Range (mm)	Tolerance Limits (mm)	Remarks
1.Reamer	Dimension of reamer bolt hole Roundness Cylindrical	$\lvert D_1-D_2\rvert$ $\lvert D_2-D_3\rvert$			≤0.01 ≤0.02	D1:dia of bolt d1:dia of hole
	Dimension of reamer bolt hole Roundness Cylindrical	$\lvert d_1-d_2\rvert$ $\lvert d_3-d_4\rvert$			≤0.01 ≤0.02	
	Interference of reamer bolt	d-D		0.005 ~0.015	>0	
2. Join	Facing surface area between rudder plate and rudder stock			>60%	*	*not defined
	Deviation from the center line of rudder and rudder stock after connection	δ_1		≤0.3	≤0.5	Both longitudinal and transverse deviations are to comply with this standard
	Length of rudder plate and rudder stock after connection Length of rudder stock	δ_2		±3	*	
	Length of rudder plate	δ_3		±4	*	
	Total length	$\delta_2+\delta_3$		±5	*	
	Gap between rudder plate and rudder stock after connection	δ_4		<0.03	*	After tightening of reamer bolt
3. Sleeve of rudder stock	Interference for sleeve of rudder stock (S U S) (B C)	 d_3-d_4 d_3-d_4		 $\frac{(5\sim10)d_3}{10,000}$ $\frac{(10\sim20)d_3}{10,000}$	 * *	*not defined d_1:outside dia. of rudder stock d_1:outside dia. of sleeve
Section 2. Pintle and gudgeon bushing						
1. Pintle	Facing surface area between pintle and taper of rudder plate			>60%	*	*not defined
	Interference for pintle of rudder stock (S U S) (B C)	 d_1-d_2 d_1-d_2		 $\frac{(5\sim10)d_1}{10,000}$ $\frac{(10\sim20)d_1}{10,000}$	 * *	d_1:outside dia. of pintle d_2:inside dia. of sleeve
2. Gudgeon bushing	Interference of gudgeon bushing (BC, SUS) (Synthetic resin)	 d_4-d_3 d_4-d_3		 0~0.05	 * *	*not defined d_3:outside dia. of pintle d_4:inside dia. of sleeve

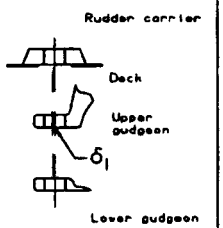
FIG. A2.27 Machinery

IV. MACHINERY

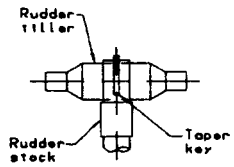
Division IV-A Rudder

SHIPBUILDING QUALITY STANDARDS

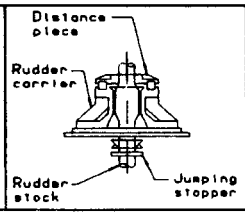
Section 3. Stern frame

Sub-section	Item		Figure	Standard Range (mm)	Tolerance Limits (mm)	Remarks
1. Gudgeon center line	Alignment of centerline for rudder carriers, upper & lower gudgeons after boring, or after cramming eccentric bushing	δ_1		≤0.3	≤0.5	Both longitudinal and transverse deviations are to comply to this standard

Section 4. Rudder tiller

1. Rudder stock and tiller	Interference of rudder stock and tiller Interference of taper key			 0.005 -0.015	>0 >0	
2. Rudder stock and tiller with taper	Facing surface area between rudder stock and tiller Fastening clearance of taper key			>60% 0.005 -0.015	* >0	*not defined

Section 5. Rudder carrier and stuffing box

1 Installation	Facing surface area of liner Gap between rudder carrier and liner			>50% <0.05	* *	not defined This standard is also aplied to that of stuffing box To be measured in the condition before tightening of up bolts

Division IV-B Steering engine

Section 1. Ram cylinder type

1 Reamer bolt	Interference	d-D		0.01	>0	d: dia. of bolt D: dia of hole
2 Installation of liner (Top liner Chock liner)	Clearance			<0.06	*	*not defined In the condition before tightening of bolts
3 Level and torsion of ram cylinder	Level and torsion			$\leq\frac{10}{100}$	Within 75% of clearance of ram cylinder	

FIG. A2.28 Machinery

IV. MACHINERY

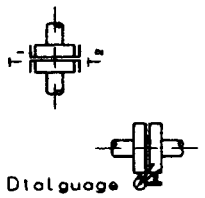
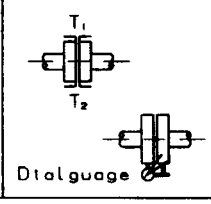
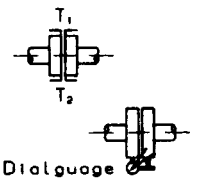
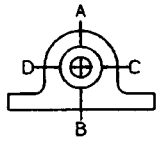
Division				SHIPBUILDING QUALITY STANDARDS		
Section 1. Ram cylinder type						
Sub-section	Item		Figure	Standard Range (mm)	Tolerance Limits (mm)	Remarks
4 Alignment coupling center of hydraulic pump after installation	Inclination of the surface Concentricity	$\lvert T_1-T_2\rvert$		≤0.07 ≤0.05	* *	In case of solid coupling To measure like this figure by means of dial guage, in case of solid coupling.
Section 2. Rotary vane type						
1 Taper area between rudder stock and boss on steering engine	Facing surface area			≥60%	*	*not defined
2 Interference mark on nut at the top of the rudder stock	Push up travel			0.6 ~1.0	*	Length of indentation is ccording to the maker standard *not defined
3 Alignment of coupling center of hydraulic pump after installation	Inclination of the surface Concentricity	$\lvert T_1-T_2\rvert$		≤0.07 ≤0.05	* *	In case of solid coupling to be measured by means of dial guage See left sketch
Division IV-C Deck machine						
Section 1. Installation of machine seat						
1 Clearance between seat and machine	A class B class C class			<0.06 <0.10 *	<0.10 <0.20 *	A class: deck crane and cargo gear B class: pump C class: miscellaneous winch and davit A B C class to be measured before tightening *not defined

FIG. A2.29 Machinery

IV. MACHINERY

Division IV-C Deck machine

Section 1. Installation of machine seat

Sub-section	Item		Figure	SHIPBUILDING QUALITY STANDARDS: Standard Range (mm)	Tolerance Limits (mm)	Remarks
2 Alignment of coupling center	Inclination of the surface Concentricity	$\lvert T_1-T_2 \rvert$		≤0.07 ≤0.05	* *	In case of solid coupling To be measured by means of dial gauge See sketch
3 Alignment of shaft center		$\frac{\lvert C-D \rvert}{2}$		≤0.05	*	A class *not defined

Division IV-D Deck crane

Section 1. Traveling type (include traveling type hopper)

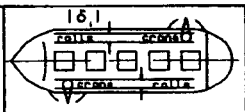
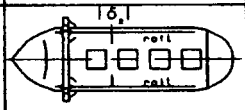
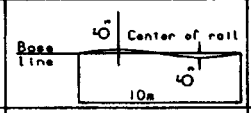
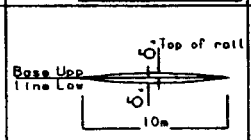
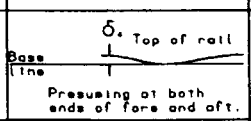
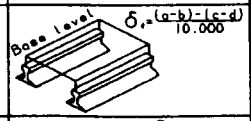
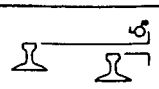
1 Laying rail	Distance between center of the rails (one side type)	$\lvert \delta_1 \rvert$		≤5	*	*not defined
	Distance between center of the rails (both side type)	$\lvert \delta_2 \rvert$		≤10	*	*not defined
	Horizontal line of rail (for optional 10m)	$\lvert \delta_3 \rvert$		≤5	*	Standard per meter
	Vertical line of rail (for optional 10m)	$\lvert \delta_4 \rvert$		≤5	*	Standard per meter
	Slope of rail (for optional 10m)	$\lvert \delta_5 \rvert$		$<\frac{1}{1000}$	*	Standard per meter
	Plane of rail (for optional 10m)	$\lvert \delta_6 \rvert$		$<\frac{1}{1000}$	*	
	Inclination of rail	$\lvert \delta_7 \rvert$		$<\frac{1}{200}$	*	
	Difference of height between port and stbd	$\lvert \delta_8 \rvert$		≤8	*	To be measured at each 5m

FIG. A2.30 Machinery

IV. MACHINERY

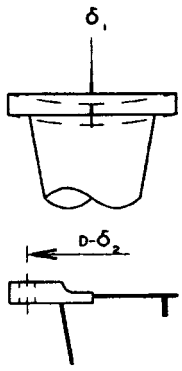
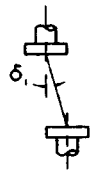
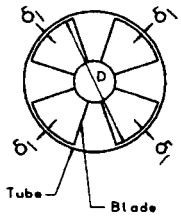
Division IV-D Deck crane / Section 2. Fixed type				SHIPBUILDING QUALITY STANDARDS		
Sub-section	Item		Figure	Standard Range (mm)	Tolerance Limits (mm)	Remarks
1 Installation of post	Plane of flange	$\lvert\delta_1\rvert$		≤0.4	•	
	Difference of bolt hole on flange	$\lvert\delta_2\rvert$		≤0.6	•	Difference for diameter •not defined
Division IV-E Side thruster / **Section 1. Side thruster**						
1 Center of coupling	Clearance between tube and blade	δ_1		50/1000	•	Universal coupling type •not defined
2 Deformation of tube	Clearance between tube and blade	δ_1		≥ D/600	•	•not defined

FIG. A2.31 Machinery

A3. COATINGS

A3.1 Contents A3.1

A3.2 Introduction

A3.2.1 This practice for coatings addresses those aspects of coating application inherent in achieving finished product quality that can be measured and warranted as meeting acceptable criteria. Because of the nature of coating systems, in which preparation and methodology directly affect finished quality, this practice contains information about processes and application practices, as well as, pass/fail criteria of the end product. It should be acknowledged that measuring finished coating attributes cannot determine that good application practices were followed and, therefore, cannot be used as a sole means of warranting the finished quality of the coating.

No.	Item	Prerequisites	Remarks
1	Type of Vessel	Commercial and Military	
2	Tank Coating Area	No Limitation	
3	Type of cargo	Products identified in the specification section.	Refer to ship's specification
4	Tank anodes	In accordance with ship's specifications in Water Ballast Tanks and Slop Retention Tank.	Refer to ship's specification. Refer to Fig. A3.9 (Explanations).
5	Outfitting	In the case of steel, painting is similar to the surrounding area. Paint shall not be applied to woodwork, polished fittings, gaskets, packing, anodes, non-ferrous material, or other non-corrosive metals and any other surface or fittings and equipment where paint could obstruct their proper function.	
6	Paint to be used	As specified by owner. Coatings shall be lead free, chromate free, asbestos free, cadmium free and comply with applicable Federal, State and local Regulations	Refer to ship's specification
7	Dry film thickness	Refer to ship's specification and manufacturer's recommendations.	Refer to Fig. A3.9 (Explanations).
8	Shop primer	After primary surface preparation, one (1) coat of inorganic zinc silicate type shop primer will be applied in accordance with the paint manufacturer's recommendation, for structural steel not coated with inorganic zinc silicate type shop primer builder shall blast to SSPC-SP 10 and apply first coat of specified system, subject to owner approval. Surface profile to comply with ship's specification.	
9	Holding coat	As determined by builder with consideration to paint manufacturer's recommendation.	
10	Painting Process	Block unit through completion.	Refer to Fig. A3.9 (Explanations).

FIG. A3.1 General

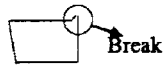
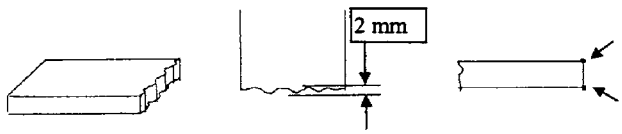
No.	Item	Process Standard	Judgment	Remarks
11	**Free edge In Immersion Service Areas To Be Coated**	(1) Break 90 degree edges 1 mm minimum. (2) In general, rolled angle edges, bulb flats, etc. (including flat bars) are to be left untreated. 	Visual	
12	**Spatter In Immersion Service Areas To Be Coated**	(1) For spatter observed before blasting: (a) Remove with a chipping hammer, scraper, etc. (b) For spatter not easily removable with a scraper, etc. Use grinder or disc. Note: It is the intent of this standard that all spatter is to be removed before surface prep. Any remaining or additional spatter observed after surface prep shall be removed in accordance with 1(a) and 1(b).	Visual	
13	**Undercut**	Undercut to a depth exceeding 1.6mm and a width smaller than the depth is to be repaired by grinding. If a sharp edge exists with a crest exceeding 3mm grind until irregularity is less than 3mm.	Visual	Refer to Fig. A3.10 (Explan.)
14	**Surface damage**	Surface damage, pitting, break-off marks to depths exceeding 1 mm are to be repaired by welding or grinding	Visual	Refer to Fig. A3.10 (Explan.)
15	**Manual welding bead**	Weld beads with surface irregularities exceeding 3 mm or with a sharp crest are to be ground until the irregularity is less than 3 mm.	Visual	
16	**Automatic welding bead**	In general, no specific treatment is required.	Visual	
17	**Overlap welding bead**	Overlapping weld beads that create sharp notches are to be repaired as per item No. 13, "Undercut".	Visual	
18	**Welding arc strike**	Same as Item No. 12, "Spatter", and Item No. 14, "Surface Damage."	Visual	
19	**Gas cut surface**	Gas cut surfaces are to be ground as follows. (a) Except where hull strength considerations require a smooth finish, notches shall be ground to less than 2mm. (b) Gas slag produced during cutting is to be treated according to Item 11, "Free Edge." Treatment to be accomplished before blasting. 	Visual	
20	**Lifting lugs**	Where a lifting lug is partially removed by cutting the pad-eye portion off per page 17 of the Hull volume, the remaining stub and surrounding area is to be treated according to item No. 11 "Free Edge", item No. 15 "Manual welding bead", and item No. 19 "Gas cut surface".	Visual	

FIG. A3.2 Presurface Preparation Standards

No.	Item	Process Standard	Judgment	Remarks
21	Moisture	To be removed until no visible moisture remains	Visual	Refer to Fig. A3.10 (Explan.)
22	Oil and grease contaminants	To be removed, by wiping with thinner, fresh water (preferably high pressure wash), wire brush or compressed air or as permitted by paint manufacturer.	Visual	
23	Dust and non-visual contaminants	Dust and contaminants are to be removed by compressed air, vacuum or high pressure water cleaning, as necessary.	Visual Clear Tape Test Method	
24	Chalk or slate pencil marks	To be removed with rag or brush in accordance with manufacturer's recommendation.	Visual	
25	Marking paint	To be removed by blasting, power tool or other. Marking paint for epoxy does not need to be removed if it is in accordance with paint manufacturer's recommendation	Visual	

FIG. A3.2 Presurface Preparation Standards *(continued)*

No.	Item	Process Standard	Judgment	Remarks
26	Solvent Cleaning	Refer to ship's specification	Visual Standards	Refer to Fig. A3.11 (Explanations)
27	Mechanical Cleaning	Refer to ship's specification	Visual Standards	
28	Abrasive Blast Cleaning And Surface Profile	Refer to ship's specification	Visual Standards	
29	Water Jetting	Refer to ship's specification	Visual Standards	
30	Abrasives	Refer to ship's specification	Written Standards	
31	Repairs to Shop Primed Surfaces	Refer to ship's specification	Visual Standards	

FIG. A3.3 Surface Preparation Standards

No.	Item	Process Standard	Judgment	Remarks
32	Stripe Coating Tanks	To achieve the specified DFT, stripe coats shall be applied to: edges of small holes, corners of other flame burned edges, free edges of structural members, and rough welding seams.	Visual	Refer to Fig. A3.12 (Explanations)
33	Overall coat	When more than one coat is specified, subsequent coats shall not be applied until preceding coat has sufficiently cured/dried in accordance with paint manufacturer's recommendation.	Wet gauge and Visual	

FIG. A3.4 Coating Standards

No.	Item	Process standard	Judgment	Remarks
34	**Sagging**	Sagging with a height of 2 mm or more is to be repaired in accordance with the paint manufacturer's recommendations.	Visual	Refer to Fig. A3.13 (Explanations)
35	**Spray dust**	Dry spray, over spray, and spray dust is to be removed before painting in accordance with the manufacturer's recommendations.	Visual	
36	**Foreign matter**	Foreign matter in the paint film shall be removed. Damaged film is to be repaired in accordance with the manufacturer's recommendations.	Visual	Refer to Fig. A3.13 (Explanations)
37	**Crater, pinholes and bubbles**	Defects are to be repaired in accordance with the manufacturer's recommendations.	Visual	
38	**Blushing**	Excepting the final coat film, visible blushing on the film surface is to be repaired in accordance with the manufacturer's recommendations.	Visual	
39	**Mechanical damage**	Touch up is to be equivalent to the original specification, unless otherwise noted in the Painting Plan.	Visual	
40	**Insufficient film thickness**	Areas with insufficient film thickness are to be repaired in accordance with the manufacturer's recommendations.	Visual/Dry Film Gage	Refer to Fig. A3.14 (Explanations)

FIG. A3.5 Coating Repair Standards

No.	Item	Process standard	Judgment	Remarks
41	**Film thickness measurement of tank plate**	Film thickness to be measured for every five square meters for flat panels or corrugated bulkheads. Film thickness is to be measured at two (2) points in each panel of plating bounded by transverse and longitudinal members. (Note: *this excludes panel breaker, or panel stiffeners*)	Micro tester or electro-magnetic film thickness gauge	Refer to Fig. A3.14 (Explanations)
42	**Film thickness measurement of tank longitudinal members**	Film thickness to be measured at two points between transverse members on each side of web and face plates (Note: *this excludes panel breakers and panel stiffeners*)	Micro tester or electro-magnetic film thickness gauge	
43	**Film thickness measurement of tank transverse members**	Film thickness to be measured at three points between longitudinal girders or bulkhead on each side of web and face plates.	Micro tester or electro-magnetic film thickness gauge	

FIG. A3.6 Film Thickness Measurement Standards

No.	Item	Process standard	Judgment	Remarks
44	**Temperature (During painting, and drying)**	Steel and air temperatures are to be in accordance with the paint manufacturer's recommendations.	Measure with a thermometer	
45	**Humidity (During painting, and initial drying)**	Paint shall not be applied during periods of rain, snow, fog or mist in the open air or when ambient relative humidity exceeds manufacturer recommendation.	Measure with a hygrometer. Measure with a surface thermometer	
46	**Ventilation (Immediately before blasting to paint)**	Air change rate to be two times per hour, or more as directed by the manufacturer's product data sheet.	Check ventilating requirement	Refer to Fig. A3.15 (Explanations)
47	**Ventilation (During paint drying)**	Air change rate to be five times per hour or more. Dehumidifying capacity to be according to ventilation requirements. If the external air humidity is above 85%, air change rate may be decreased to the capacity of the dehumidifier.	Check ventilating requirement	
48	**Erection of scaffolding**	Make sure that scaffolding does not interfere with painting, ventilation, illumination, blasting and inspection (builder shall attempt to maintain a 150 mm clearance wherever possible). If not possible (to maintain the 150 mm clearance), the Owner shall be informed of the particular area and review during the scaffolding inspection.	Visual	
49	**Removal of scaffolding**	Care must be taken not to damage the film.	Visual	
50	**Illumination**	Effective illumination to be provided to ensure proper inspection of the blast and coated surface is achieved.	Visual	

FIG. A3.7 Environmental Painting Standards

			Control		
No.	Item	Standard	Owner	Shipyard	Paint Manufacturer
51	Pre-Surface Preparation	Refer to Fig. A3.2	Δ	Δ	Δ
52	Surface Preparation	Refer to Fig. A3.3	Δ	Δ	Δ
53	Stripe Coating	Refer to Fig. A3.12 (Explanations)		Δ	Δ
54	Film Thickness	Refer to Figs. A3.9 and A3.14 (Explanations)		Δ	Δ
55	Final Inspection	Final confirmation of completion of painting	Δ	Δ	Δ
56	Temperature Humidity and Dew Point	Refer to Fig. A3.15 (Explanations)		Δ	Δ
57	Gas Concentration Of solvent	Refer to Fig. A3.15 (Explanations)		Δ	Δ
58	Ventilation	Refer to Fig. A3.15 (Explanations)		Δ	Δ

FIG. A3.8 Inspection Standards

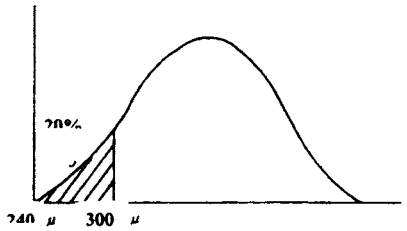
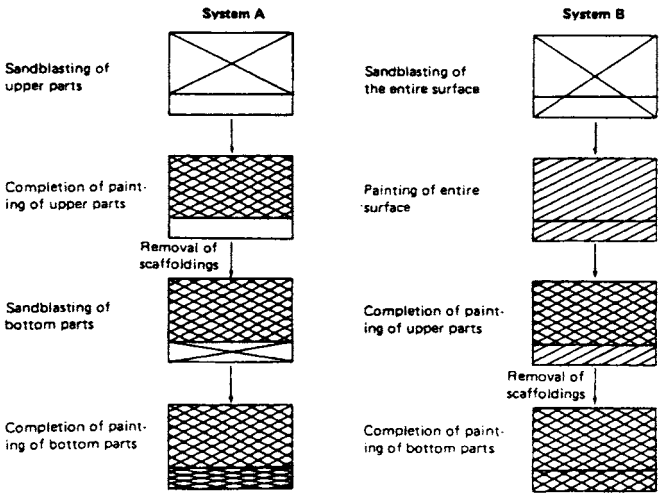
N0.	Item	Explanation
4	**Tank anodes**	(1) Anodes may be installed in ballast tanks which are often loaded with sea water. (2) Anodes are not to be installed when dissolution of zinc into the tank contents presents problems (as in the case of jet fuel, etc.).
7	**Dry film thickness for Ballast Tanks, Fore/Aft Peak Tanks, Wet Spaces and Water Tanks shown. See note for all other spaces.**	Measurements at 80% of total measuring points must verify a film thickness exceeding or equal to a specified value (e.g., 300 microns). For the remaining 20%, the measured film thickness must be equal to or over 80% (e.g., 240 micron) of the specified thickness. *(Note: All other tank spaces the 90-10 rule shall apply, All other surfaces to SSPC-PA 2)* 
10	**Tank painting process (Typical; guideline only, deviations are acceptable)**	(1) For tank coating, block painting, painting in a dry dock, afloat painting, or any combination is considered. However this standard is based on afloat painting only. (2) For abrasive blasting and painting in tank, the following two systems may be considered: 

FIG. A3.9 General (Explanations)

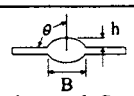
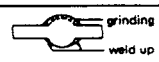
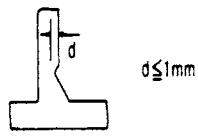
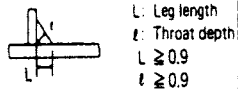
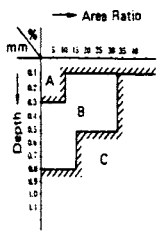
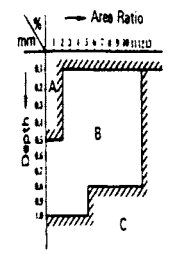
<table>
<tr><th>No.</th><th>Item</th><th colspan="5">Explanation</th></tr>
<tr><td rowspan="6">13</td><td rowspan="6">Undercut</td><td colspan="2">Division</td><td colspan="3">Welding</td></tr>
<tr><td>section</td><td>Sub-section</td><td>Item</td><td>Tolerance Limits</td><td>Remarks</td></tr>
<tr><td></td><td>hgt. of reinf. brth. of bead, flank of ang.</td><td></td><td> 
h: not defined
B: not defined
θ= 90°</td><td> 
In cases where θ is over 90°, repair by grinding or welding to make θ = 90°</td></tr>
<tr><td></td><td>under-cut (butt weld)</td><td>Skin plate and face plate between 0.6⊗</td><td>Over 90 mm continuous d = 1.6mm</td><td rowspan="2">  </td><td rowspan="3">To be repaired by welding electrode or other, (carefully avoid short bead for higher tensile steels).</td></tr>
<tr><td></td><td>under-cut fill</td><td>Others</td><td>d = 1.6mm</td></tr>
<tr><td></td><td>leg lgth.</td><td></td><td colspan="2"> 
d≦1mm</td></tr>
<tr><td></td><td></td><td>Compared with correct ones</td><td colspan="2"> 
L: Leg length
ℓ: Throat depth
L ≧0.9
ℓ ≧0.9</td><td>If over tolerance, fill weld to correct.</td></tr>
<tr><td rowspan="3">14</td><td rowspan="3">Surface damage</td><td colspan="2">Division</td><td colspan="3">Material</td></tr>
<tr><td>section</td><td>Sub-section</td><td>Item</td><td colspan="2">Remarks</td></tr>
<tr><td>surface flaw</td><td>Pit</td><td>Grade of pitting
  </td><td colspan="2">1. Grade A is considered slight and no repair is necessary. Grade B is medium and is to be repaired if necessary. Grade C requires some repair.
2. Pitting or flaking on boundaries of grade "A" and "B", grade "B" and "C", and grade "A" and "C" shall be classified as grade "A", grade "B" and grade "A" respectively.
3. Repair method of surface flaw: depth of defect = d , plate thickness = t (d=.07 t remove by grinding (but in no case d= 3 mm) .07 t= d= .2 t grinding followed by welding.</td></tr>
<tr><td></td><td>surface flaw</td><td>Flaking</td><td>Grade of surface flaking
  </td><td colspan="2">4. Grade A is considered slight and no repair is necessary. Grade B is medium and is to be repaired if necessary. Grade C needs some repair.
5. Pitting or flaking on boundaries of grade "A" and "B", grade "B" and "C", and grade "A" and "C" shall be classified as grade "A", grade "B" and grade "A" respectively.
6. Repair method of surface flaw depth of defects = d, plate thickness = t, d= .07 removed by grinding (but in no case d = 3 mm), .07 t = d = .2 t grinding followed by welding.</td></tr>
</table>

FIG. A3.10 Preparation Standards for Steel (Explanations)

21	**Moisture**	Rainwater inflow and moisture in the air may produce sweat on steel surface. After secondary surface preparation, moisture may cause turning or hinder adhesion. Appropriate measures must be taken to prevent rainwater from flowing in.
22	**Oil and grease contaminants**	In general, remove with a rag and thinner/cleaner. For heavy adhesion of grease and oil, first dissolve with a brush soaked in thinner/cleaner, then wipe off with a clean rag. Detect oil visually with a black light or water spray bottle (water break test).
23	**Dust and non-visual contaminants**	Check for dust with clear tape, clean cloth or pictorial standard in accordance with ISO 8502-3. Remove dust by compressed air or vacuum. Non-visual contaminants may be removed in accordance with SSPC-SP 12/NACE No. 5 as applicable to meet the ship's specification and manufacturer's recommendation. Check for soluble salts according to ISO 8502-6 when required by manufacturer or ship's specification.
24	**Chalk or slate pencil marks**	Remove with a rag or brush. When marks enter an anchor-pattern concavity and are difficult to remove, use a hard brush.

FIG. A3.10 *(continued)*

No.	Item	Explanation
26	**Solvent Cleaning**	Surface cleanliness is to be in accordance with SSPC-SP 1. Note: SSPC-SP 1 is required prior to all other surface preparation methods.
27 52	**Mechanical Cleaning**	SSPC-SP 3 is the minimum accepted method of repair for non-immersion service substrates. (SSPC-SP 2 may be substituted where SSPC-SP 3 is impractical). SSPC-SP 11 is the minimum accepted method for repair of immersion service substrates. To determine surface cleanliness, refer to the SSPC-VIS 3 photographic standard. To determine surface profile use ASTM D 4417 Method A or B.
28 52	**Abrasive Blast Cleaning and Surface Profile**	SSPC-SP 10 is the minimum accepted surface preparation for pre-construction primer and for immersion service substrates. SSPC-SP 7 may be used in place of SSPC-SP 3 when practical. For cleanliness refer to SSPC-VIS 1-89 photographic standard. To determine surface profile use ASTM D 4417 Method A or B.
29 52	**Water Jetting**	Where acceptable according to the ship's specification and manufacturer's recommendations, clean in conformance with SSPC-SP 12/NACE No. 5. Refer to SSPC-VIS 4(1)/NACE No. 7 photographic standard. To confirm pre-existing surface profile use ASTM D 4417.
30	**Abrasives**	Blast surface color tends to vary depending on the abrasive material used. As long as the same grade of cleanliness is used, a difference in color does not affect the film performance. Abrasives to be determined according to SSPC-AB 1. Recycled Abrasive Cleanliness to be determined according to SSPC-AB 2.
31	**Repairs to shop primed surfaces**	(1) In general shop primer in the cargo oil and slop retention tanks shall be removed in accordance with manufacturer's recommendation to a visual acceptance. (2) All other spaces intact shop primer may remain and over coated in accordance with manufacturer's recommendation. (3) In no way does the above supercede the ship's specification

FIG. A3.11 Surface Preparation Standards (Explanations)

No.	Item	Explanation
32	**Stripe coating in tanks.**	Where airless spraying is difficult and the film thickness can not be maintained, apply stripe coating with a brush before or after spraying. Stripe coating locations are as follows: (a) Inside and edges of holes ..... ① (b) Free edges ..... ② (c) Welding beads ..... ③ (d) Where painting is difficult ..... ④

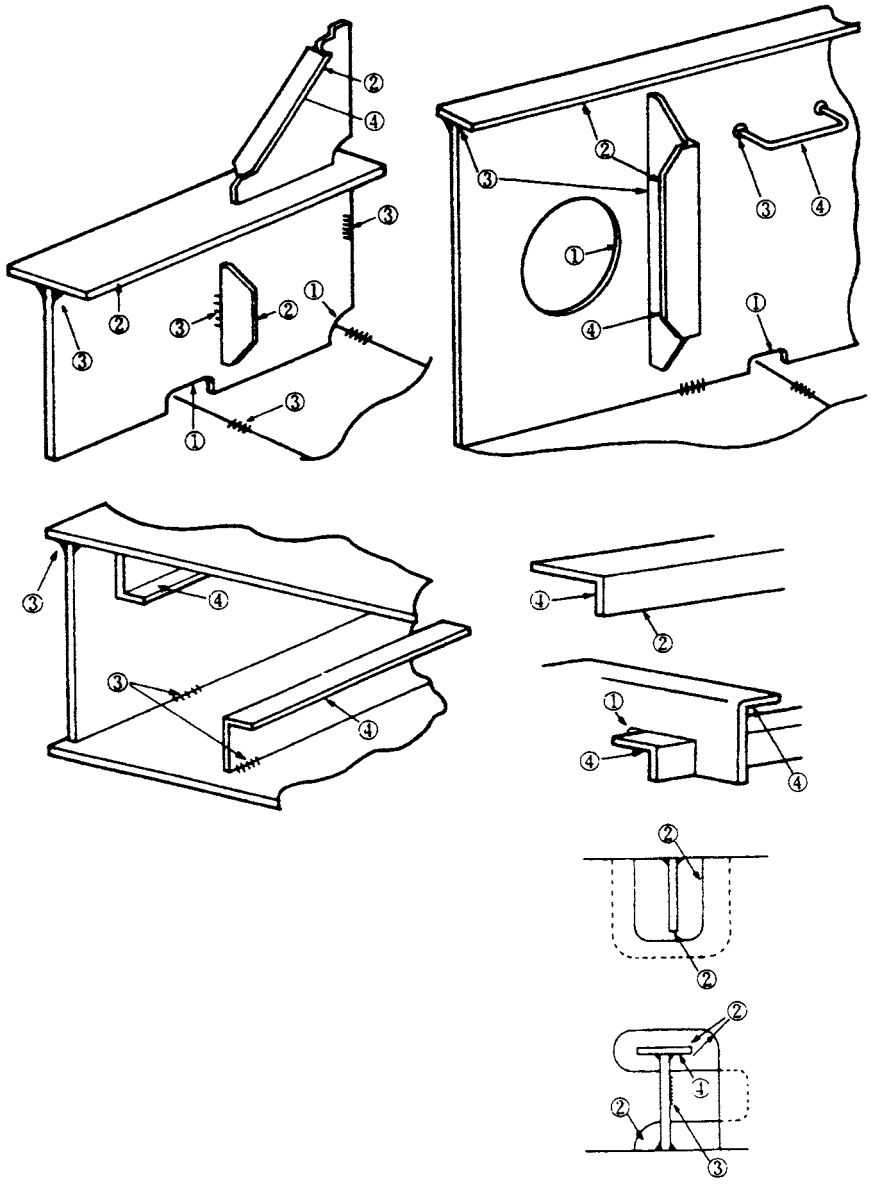


FIG. A3.12 Coating Standards (Explanations)

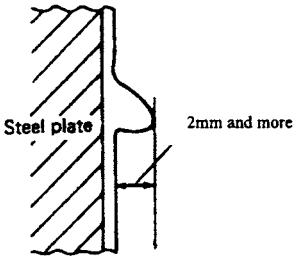
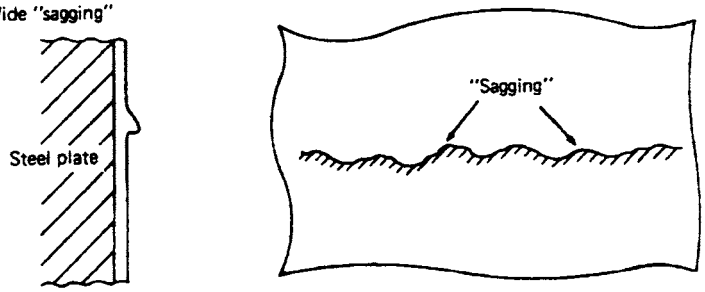
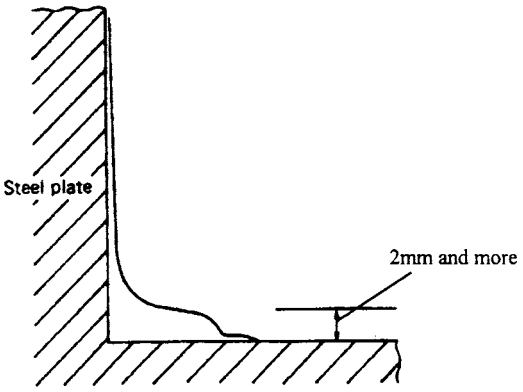
No.	Item	Explanation
34	"Sagging"	The "sagging" of the film needs repair due to the following causes: (1) Spray dust, dust, etc. tend to collect. (2) Sag having a large film thickness. Solvent tends to collect on high film thicknesses. If coating is applied over the "sagging" area, solvent evaporation becomes more difficult leading to possible cracks in the film. "Sagging" to be repaired is as follows: (a) Sagging with the height of 2mm and more.  (b) Wide "sagging"  (c) "Sagging" in the bottom corners 

FIG. A3.13 Coating Repair Standards (Explanations)

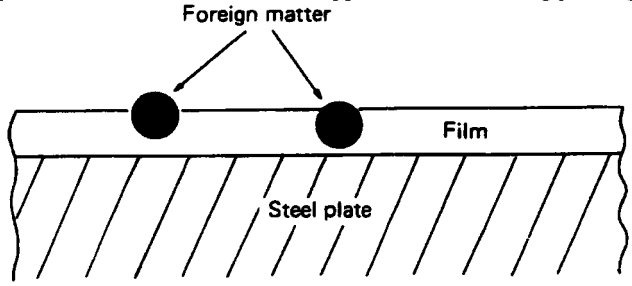
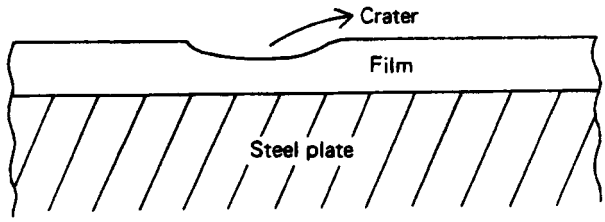
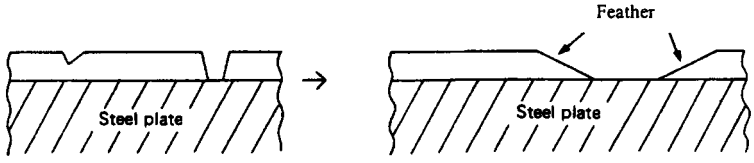
No.	Item	Explanation
36	**Foreign matter**	When abrasives are used in surface preparations (blasting), abrasives remaining may adhere to the substrate and be trapped in the film during painting.  Foreign material shall be removed by screen, sanding, etc. as directed by the paint manufacturer.
37	**Craters, pinholes, and bubbles**	(1) Pinholes tend to occur at the pit of manual welding bead. (2) Craters tend to occur when surface tension becomes uneven during the film drying process. A crater is a concave, and reduces film thickness.  (3) Bubbles occur when paint mixed with air is applied in the airless painting. Repairs to coating to be in accordance with manufacturer recommendations. Generally, surface will be feathered by sanding or screening and coating applied to achieve desired DFT.
38	**"Blushing"**	The film will "blush", due to humidity absorbed by the hardening agent. When humidity rises or dew is produced before curing, this may occur. Blushing is confined to the film surface and does not affect film performance. However, excessive blushing must be repaired because it hinders adhesion of overcoating.
39	**Mechanical damage**	The surface of the film shall be lightly abraded with sandpaper, screen, or as recommended by coating manufacturer and coating applied to the desired DFT. 

FIG. A3.13 *(continued)*

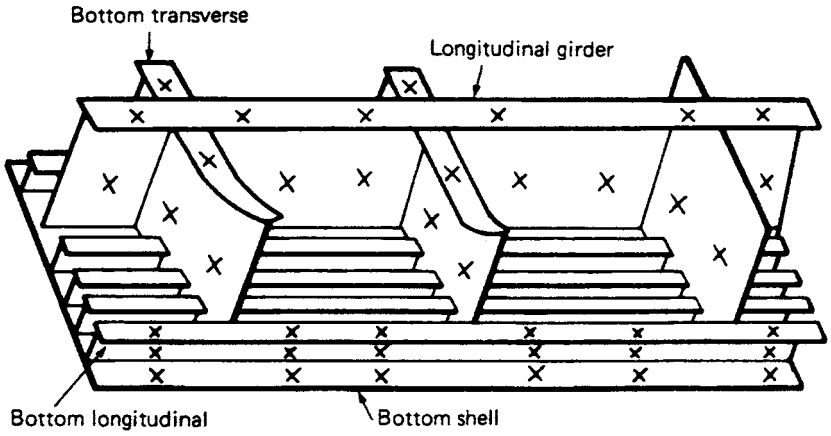
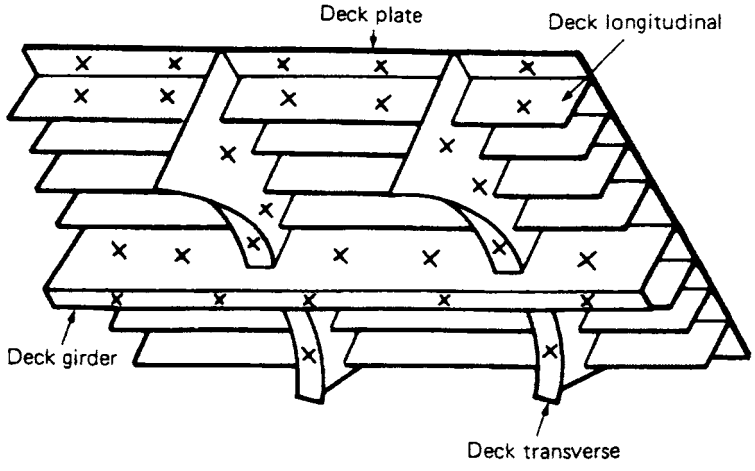
No.	Item	Explanation
40 41 42 43 44	**Film thickness measurement in tanks. For other areas see Note.**	(1) Measuring equipment to be adjusted once a day by using a reference plate with a thickness nearest to the film thickness to be measured. (2) The measured value of film thickness to be marked at a measuring point using a specified marking material. Film thickness measuring point (x mark) (a) Bottom part  (b) Deck part  NOTE: (For all other areas, measure every 93m^2 (1,000 ft^2) in accordance with SSPC-PA 2)

FIG. A3.14 Film Thickness Measurement Standards (Explanations)

No.	Item	Explanation
44	**Temperature (During painting and drying)**	(1) Lowest temperature (a) Temperature must be 3° C or more above the dew point. Theoretically the steel plate surface temperature is used. However the air temperature in tank is practically used herein. (b) Curing of epoxy resin slows down when the temperature drops below 10 ° C and 5 ° C is the lowest limit. It is preferable to keep the temperature above 10 ° C and in conformance with the paint manufacturer's recommendation. (2) Highest temperature The maximum temperature is affected by the type of paint used and the painting process. Consult the paint manufacturer for maximum allowable temperature for application and cure.
45	**Humidity (During painting, and initial drying)**	Relative humidity is to be below 85% . This value applies when the painted surface temperature is equal to or above the atmospheric temperature.
46 47	**Ventilation**	(1) The amount of ventilation required during painting and drying is greater than that required for blasting due to the following reasons: (a) The film begins hardening with evaporation of solvents in the film. (b) Solvent evaporation is greatly influenced by ventilation and temperature. (c) Retained solvents affect film performance. (2) Air change rate This standard is determined for correct film performance and this varies depending on tank capacity. These standards are different from OSHA 29 CFR 1915.35 and OSHA 29 CFR 1926.57. Consult "Industrial Ventilation, 20th Edition"[1] and OSHA Technical Manual Section III: Chapter 3 for guidance. (3) Air change rate for high humidity (85% RH or above). With high humidity, dew must be prevented after painting, from blasting stages up to the film hardening stages. Otherwise, the following may occur: (a) Turning of blasted surfaces (b) Film defects (Blushing, poor adhesion) As described above in (1) insufficient ventilation also deteriorates film performance. Consequently it is preferable to ventilate at least three times per hour even with high humidity for two days (this varies according to the type of paint) immediately after painting.

FIG. A3.15 Environmental Painting Standards (Explanations)

No.	Item	Explanation
46 47	**The safety and Health Standards for Painting**	(1) The safety and Health Standards for Painting (a) When gas concentration reaches 10% of the lower explosion limit (LEL), stop operations and evacuate workers. (b) When gas concentration exceeds 10% of the lower explosion limit (LEL), take appropriate measures such as adding fans and reducing the number of paint sprayers. Refer to OSHA 29 CFR 1915.35 and 29 CFR 1926.57 Consult "Industrial Ventilation, 20th Edition" [1] OSHA Technical Manual Section III: Chapter 3 for guidance.
45 46 47	**Instruments for measuring environmental conditions**	(1) For humidity and dew point: Sling psychrometer and psychrometric tables or battery operated psychrometer according to ASTM E 337 Standard. (2) Surface temperature Magnetic contact surface thermometer. (3) Anemometer Used to measure the ventilation volume and rate.
48 49	**Erection of scaffoldings**	(1) Scaffolding pieces Scaffolding pieces not to be removed are recommended to be of stainless steel. (2) The distance between painted surfaces and scaffolding is to be between 150 and 300 mm (to prevent unpainted portions). (3) Scaffold planks of expanded metal or similar open design to assist in abrasive removal and ventilation. (4) Height of scaffolding; 1,700 to 1,900 mm (to ensure easy and satisfactory work).
50	**Illumination**	Explosion-proof lighting is to be used during painting and drying.

FIG. A3.15 *(continued)*