China Shipbuilding Quality Standard (CSQS 2005)

——for reference only, translated & edited by leigei

FOREWORD

This Standard is the revised edition, based on the *CHINA SHIPBUILDING QUALITY STANDARD (CSQS)* (1998 edition), issued by China State Shipbuilding Corporation(CSSC). Compared to the CSQC 1998 edition, major changes as following:

a) **enhance the quality control on producing progress;**
b) **adjust the drawings for classification society approved, so as to the inspection items;**
c) **revise some inspection items of contents and inspection time;**
d) **advance the requirements of shipbuilding precision control for hull architecting, outfitting and coating;**
e) **add new rules/items such as structure grinding, heating of low temperature steel, fixing of container, etc.**

The Standard will replace the *CHINA SHIPBUILDING QUALITY STANDARD (CSQS)* (1998 edition) since issued.
Since this Standard's contents in the first chapter of part three covering the Shipbuilding Precision Standard (CB/T 3136-1995) and Shipbuilding Precision Standard for Small & Middle Size Ship (CB/T 3195-1995), this Standard will replace the standards CB/T 3136-1995 and CB/T 3195-1995 when issued.

This Standard sponsored by China State Shipbuilding Corporation and China Shipbuilding Industry Corporation.
This Standard administrated by China Shipbuilding Technology Research and Economy Development Institute

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This Standard first time was published on June, 1993, and was revised on October, 1998.
The Standard CB/T 3136 was issued on July, 1983 first, edited again on December, 1995.
First time, the Standard CB/T 3195 was published on May, 1984, revised on June, 1995.

中国造船质量标准

China Shipbuilding Quality Standard

1. Range

With the purpose of ensuring proper performance, strength and safe operation of ship designed and constructed, the Standard specifies, the requirements on ship quality control through production process, on the scope and items of plan submission, inspection and testing and on the detailed construction accuracies. It provides a guideline of quality criteria for coordination among ship-owners, classification societies, designers and shipbuilders.

Special technical requirements concerning special types of ship are not incorporated in this Standard.

The Standard applies mainly to the conventional sea-going steel ships of 3000 tonne deadweight and above.

2. Contents

The Standard is composed of three parts.

The first part deals with the quality control through production and covers processes such as steel material and processing, fixing and assembling, welding, tightness test; pipe processing, fixing, tightness test and flushing; painting, hull outfitting, machinery installation, electric installation, equipment and test of automatic control and remote-control, remote-measuring systems, mooring test and sea trial, and final completion and delivery of ship.

The second part lists the names of drawings and documents that shall be submitted for review and approval by the classification society and shipowner, and the inspections and testings that shall be carried out.

The third part specifies the accuracy standards for ship building, which includes hull construction, outfitting, machinery installation, electric installation and painting. The shipbuilding precision of hull construction, outfitting and coating to be followed the requirements of production quality control procedures and approved drawings/inspection items by classification society

PART 1

Quality Control Through Production

1 STEEL MATERIAL AND PROCESSING

1.1 Steel material

1.1.1 Upon arrival in the yard, all marine steel material to be checked against quality certificates. Visual inspection to be done to confirm their quality.

1.1.2 All steel materials to be stowed in pile according to sizes and brand, and kept flat.

1.1.3 All steel materials shall be served out against material allocation sheet according to the production plan.

1.1.4 Visual inspection to be done to the steel materials before processing.

1.1.5 Key points of quality control:

a) size, brand, heat number, batch number;

b) minus tolerance in thickness for plates and sections;

c) surface qualities;

d) any defects in large forgings and castings.

1.2 Steel processing

1.2.1 Marking and cutting

1.2.1.1 Necessary pre-treatment such as leveling, straightening and de-rusting to be done to the plates and section before cutting.

1.2.1.2 Material property, heat number, batch number and thickness to be noted down for primary members according to the requirement.

1.2.1.3 Key points of quality control for marking:

a) size deviation;

b) angular deviation;

c) markings such as processing symbols, codes and marks.

d) Transfer marks of material and batch number.

1.2.1.4 Key points for quality control for cutting:

a) cutting accuracy;

b) dimensional size;

c) lamination;

d) period checking the precision of digital cutting machines.

1.2.2 Forming

1.2.2.1 Bending

Forming by cold or hot bending of steel plates and sections to be performed according to the specified requirements for materials of different properties and grades.

1.2.2.2 Key points of quality control for forming:

a) heating temperature;

b) bending radius of cold bending;

c) accuracy of forming.

1.2.3 Grinding of structures

1.2.3.1 Grinding free edges of ship structures, to be grouped into normal parts and coating parts, requirements of coating parts to be higher than normal parts.

1.2.3.2 Key points of quality control for structures grinding:

a) top shell plates, corner structure of cargo hatches, oil tanks and water tanks;

b) second time de-rust of narrow structure;

c) grinding of free edges.

2 FIXING AND ASSEMBLING

2.1 Fixing and assembling of parts and members

2.1.1 The accuracy requirements of block assembling to be met for the fixing and assembling of parts and members. Shop primer to be applied after welding.

2.1.2 Key points of quality control:

a) geometrical dimensions of parts and members;

b) installation locations;

c) deformation.

2.2 Block assembling

2.2.1 Block assembling to be generally carried out on the platform, jig or flat production line.

2.2.2 Pre-outfitting of parts and members to be done according to the design drawing.

2.2.3 The accuracy that meets the requirements of general assembling is to be applied for block assembling.

2.2.4 Coating to be carried out after blocks inspection completed.

2.2.5 Key points of quality control:

a) jig accuracy;

b) marking accuracy;

c) installation accuracy of internal structure joints inside the block;

d) accuracy of block configuration and its dimensional size;

e) accuracy of block edges;

f) correctness of assembling reference lines;

g) levelness of face plate and location deviation of main engine bed

h) installation locations of key components, such as shaft boss, stern tube, rudder horn, etc;

i)visual quality of blocks;

j)pre-fitting of pipes, ect. for blocks.

2.3 Erection on slipway(dry dock)

2.3.1 Carry out marking on the slipway(dry dock) with corresponding symbols and marks.

2.3.2 Place the reference block in position, and then proceed with successive blocks according to the slipway(dry dock) assembling schedule.

2.3.3 Carry out erection on slipway(dry dock).

2.3.4 During construction process, all temporary opening in the primary members and their closing-up are to comply with the requirements set out in the technical documents.

2.3.5 Remove temporary welding pieces and lifting eye pieces according to usual practice.

2.3.6 Key points of quality control:

a) accuracy of marking on the slipway(dry dock);

b) correctness of location of the reference block;

c) frame spacing at block junctions;

d) alignment accuracy of structural members;

e) deflection of the centerline of keel;

f) alignment accuracy of shaft centerline;

g) marking accuracy of loadline and draft marks;

h) principal dimensions of hull.

i) removing the temporary welding pieces and lifting eye pieces.

3 WELDING

3.1 Preparation before welding

3.1.1 Welding materials, preparation of weld joints and assembling accuracy are to be complied with relevant requirements set out in quality control documents.

3.1.2 The welding zone to be free of rust, scales, grease, moisture or other dirts.

3.1.3 The environmental condition of the welding area to be kept in good order.

3.1.4 Tack welding to be carried out according to specified technological procedures.

3.1.5 Wherever new material or new welding technologies are adopted, test reports and welding procedures to be submitted to the classification society for approval.

3.2 Welding process

All welding shall be carried out according to the methods and conditions as required by the technology procedures. Proper measures for minimizing welding deformation are to be taken.

3.3 Welding inspection

3.3.1 Inspection of welding to be carried out throughout the whole process of welding including inspections before, during and after welding as well as the inspection of finished weldments.

3.3.2 All welds are to be visually first.

3.3.3 Quality inspection of welded seams to be carried out according to the specified requirements. Either X-ray detection, ultrasonic detection or other inspection methods approved by the classification society.

3.3.4 Welded joints on the strength deck, shell plate and interior strength members in the mid-length region to be inspected in accordance with the non-destructive inspection plan approved by the classification society.

3.3.5 Welds not conforming to the requirements of quality standards to be rectified and repaired as required, and to be inspected again.

3.4 Key points of quality control for welding

a) qualification of welders;

b) welding materials;

c) groove sizes and seam clearance;

d) cleanness of welding region;

e) welding codes;

f) welding procedures;

g) preheating and heat-retaining;

h) welding deformation;

i) sizes of welded seams;

j) integrity of all-around welds;

k) surface and inner defects in welding seam.

4 TIGHTNESS TEST

4.1 Tightness test is to be conducted after main hull and the structure to be tested are completed, all accessories affecting the tightness are fixed and non-destructive testing are properly completed.

4.2 All welding seams having concern with tightness test are to be free of scales, slugs, paints(excluding primers) or any grease.

4.3 Tightness test of the hull structure may be performed with either hose test, hydraulic test, air test or other equivalent methods depending upon the hull strength and tightness requirement.

4.4 Tightness test may be performed on blocks.

4.5 The location and requirements for tightness test are to be in compliance with the requirements of the classification society.

4.6 Key points of quality control for tightness test:

a) cleaning of welding seams;

b) test pressure;

c) test procedure;

d) test duration;

e) inspection for deformation and leakage.

5 FABRICATION, FIXING, TIGHTNESS TESTING AND FLUSHING OF PIPES

5.1 Fabrication of pipes

5.1.1 Material of pipes

5.1.1.1 Upon arrival in the yard, visual inspection is to be conducted to the pipes against technical documents. The pipes are to be properly stowed separately according to their material quality, heat number, batch number, grade and size.

5.1.1.2 Key points of quality control for pipe material:

a) certificates of qualification;

b) size and visual appearance;

c) separate stowing.

5.1.2 Blanking of pipes

5.1.2.1 Before blanking, check is to be made to the pipe size, grade, material quality, heat number and batch number. After blanking and temporary sealing, the pipe sections are to be

properly numbered and stowed in accordance with technical document.

5.1.2.2 Key points of quality control for blanking of pipes:

a) size and visual appearance;

b) blanking length and serial number;

c) stowing and maintenance.

5.1.3 Bending of pipes

5.1.3.1 Either cold bending or hot bending may be used for pipe bending. In case of cold bending, the bending radius of the curvature of the pipe is to be in general not less than three times the outside diameter of the pipe. For special pipes such as tank heating pipe and pipes to be fixed in confined space, the radius of curvature is to be in general not less than two times the outside diameter of the pipe. When pre-fabricated bend is adopted, the diameter radius of the curvature is to be not less than the outside diameter of the pipe.

5.1.3.2 Key points of quality control for pipe bending:

a) Circularity of the pipe bend;

b) Height of bending corrugation of the pipe bend;

c) Mechanical damage or defect;

d) Bend angle, rotating angle and length of pipe segment after bending.

5.1.4 Fixing of pipes

5.1.4.1 The material, size and type of pipe fittings are to be in compliance with the requirements of the technical documents. The mating clearance or groove of the pipe with its connectors, of the branches with main pipe and between connection butts of pipes are to be in conformity with the relevant technical requirements.

5.1.4.2 Key points of quality control for fixing of pipes:

a) marks of pipe;

b) correct use of connector;

c) mating clearance and groove;

d) assembling dimensions;

e) position welding.

5.1.5 Welding of pipes

5.1.5.1 The welder shall hold proper qualification certificate for conducting welding. Measures are to be taken to avoid deformation of the welding for large diameter pipe. Welding is to be carried out in accordance with the requirements of welding procedures.

5.1.5.2 Key points of quality control for welding of pipes:

a) cleaning of welding parts;

b) welding material;

c) welding deformation;

d) welding quality.

5.1.6 Pipe cleaning and strength testing

5.1.6.1 The pipes are to maintain smooth surface after machining and welding, and are subject to hydraulic test in accordance with the requirements of technical documents.

5.1.6.2 Key points of quality control:

a) no welding slag, spray, sharp cut not burr on the surface;

b) strength and tightness test;

5.1.7 Surface treatment of pipes

5.1.7.1 After machining, pipe surface to be treated in accordance with the requirements of the technical documents. Pipes with different surface treatment shall be segregated and stowed separately.

5.1.7.2 Key points of quality control for surface treatment of pipes:

a) Internal cleaning of lub, hydraulic pipes and protection of pipes;

b) quality of galvanizing and painting;

c) stowing of pipes after surface treatment and seal blocking of pipe ends.

5.2 Fixing of pipes and fittings

5.2.1 Handling of pipes

5.2.1.1 Pipes to be installed are to be counted and served out in accordance with the technical documents.

5.2.1.2 Key points of quality control:

a) protection of non-ferrous and specially treated pipes;

b) prevention of impact or squeezing;

c) prevention of sand or dirt from entering the pipe;

d) flanges protection of pipes.

5.2.2 Fixing of pipes

5.2.2.1 Pipes, in general, are to be fixed in stages of unit assembling, block assembling, overall assembling and fixing on board.

5.2.2.2 Key points of quality control for fixing of pipes:

a) fixing sequence and accuracy of coordinate dimensions;

b) cleaning of pipe end mating surface and removal of foreign matters inside the pipe;

c) size and material quality of pipe connection bolts;

d) sealing material for pipe connection;

e) connecting accuracy of pipe to pipe and equipment.

5.2.3 Fixing of pipe fittings and supports

5.2.3.1 The fixing of pipe fitting and supports is to be in compliance with the requirements of classification society.

5.2.3.2 Key points of quality control:

a) type, size, position and flow direction of pipe fittings;

b) visual quality of fittings

c) connecting accuracy of pipe to the equipment;

d) supporting type and spacing of supports;

e) welding of support;

f) gasket between non-ferrous pipe and support.

5.3 Tightness testing of piping system

5.3.1 Tightness test to the piping system is to be carried out in accordance with the technical documents.

5.3.2 Key points of quality control:

a) requirements of tightness test.

b) completeness and accuracy of pipe fixing;

c) testing medium;

d) testing method;

5.4 Flushing of pipes

5.4.1 Flushing of the piping systems is to be carried out in accordance with the requirements of the technical documents.

5.4.2 Key points of quality control:

a) flushing medium;

b) flushing method;

c) cleanness.

6 PAINTING

6.1 Pre-treatment of steel surface

6.1.1 Surface pre-treatment of steels is to be done in general by means of shot-blasting, abrasive blasting and chemical cleaning. Shop primer is to be coated after derusting.

6.1.2 Key points of quality control:

a) cleanness and roughness of steels surface treatment;

b) film thickness

6.2 Shop primer touch-up

Any damaged shop primer is to be duly touched up during processing, assembling and welding.

6.3 Secondary derusting and surface cleaning

Key points of quality control for secondary derusting and surface cleaning:

a) selections of paints;

b) cleanness;

c) steel surface's splatter, dirts.

6.4 Painting work

6.4.1 Pre-painting

Pre-painting is to be done for the spots and areas that can not be easily accessed or difficult to reach the required film thickness by spraying.

6.4.2 Painting

Painting may be done by means of either airless spraying or roller application, etc.

6.4.3 Key points of quality control:

a) environmental conditions affecting painting operation;

b) appearance of coat;

c) wet film thickness or dry film thickness;

d) film thickness allocation.

7 HULL OUTFITTING

7.1 Pre-outfitting of ship equipment

Pre-outfitting is to be carried out as extensive as practically possible depending upon the conditions of construction.

7.2 Approval of ship equipment

All ship equipment such as mooring equipment, ladders, hatchcovers, closing appliances for windows and doors, air-conditioning system, fire-fighting system are to have the marine product certificates issued by the classification society, product qualification and test reports.

7.3 Installation of ship equipment

All ship equipment are to be completely and correctly installed.

7.4 Key points of equality control for ship equipment

7.4.1 Key points of quality control for steering equipment:

a) machining accuracy of all fitting faces;

b) machining accuracy and mating gaps for rudder stock, rudder plate, tiller, rudder carrier, rudder pintle and liner;

c) location deviations of various centerlines of rudder system;

d) correct zero position of rudder blade;

e) installation precision of the steering gear.

7.4.2 Key points of quality control for anchoring equipment:

a) installation precision of the windlass;

b) smooth engagement of anchor chains with chain wheel;

c) braking ability of chain stopper;

d) precision of installation between anchor chain tube and anchor setting cave or lip;

e) mating of anchor to anchor lips.

7.4.3 Key points of quality control of mooring equipment:

a) precision of installation;

b) ease of operation.

7.4.4 Key points of quality control for lifeboat(rescue boat) davits:

a) strength of boat davits;

b) no part of boat extruding overboard;

c) clear observation of boat-lowering and hoisting from the boat

handing station;

d) distance between boat and side shell when lowering, stability of boat lowering and reliability of braking;

e) simultaneous de-hooking when the boat is afloat;

f) correct installation of boat winches and accessories;

g) reliability of launching free-fall lifeboat and its callback device.

7.4.5 Key points of quality control for accommodation ladder:

a) strength of ladder;

b) easy and reliable lowering, hoisting and turning over.

7.4.6 Key points of quality control for cargo gear:

a) fabrication accuracy of derricks and derrick post;

b) levelness and flatness of derrick post flanges and crane seat;

c) precision of cargo winch installation;

d) braking reliability;

e) loading test of cargo gear.

7.4.7 Key points of quality control for cargo hold hatchcovers and hatch coamings:

a) accuracy of sizes and shapes; installation accuracy of water-tight rubber seals and their channels;

b) precision of position limiting;

c) fitness between securing wedges and wedge seats;

d) flatness of face plates on hatch coaming; difference between diagonals of hatch;

e) location of battens on hatch coaming;

f) water-tightness of hatchcovers;

g) easy handling.

7.4.8 Key points of quality control for container locking device:

a) precision of installation container seat;

b) precision of installation container guiding track.

7.4.9 Key points of quality control for steel weather-tight closing appliances:

a) visual quality after welding;

b) tightness.

7.4.10 Key points of quality control for air-conditioning system:

a) installation integrity and correctness of equipment, ducts and fittings;

b) smoothness and tightness of ducts;

c) running test to prove normal operation;

d) effect of air-conditioning.

7.4.11 Key points of quality control for fire-fighting system:

a) installation integrity and correctness of equipment, pipings and fittings;

b) tightness of pipings;

c) correct function and effectiveness of CO_2 or foam system;

d) correct function of fire-detection and alarm system;

e) releasing interlocking function.

7.4.12 Key points of quality control for bow/stern thruster:

a) location deviation of centerline of shaft coupling;

b) clearance between thruster tube and blades.

8 MACHINERY INSTALLATION

8.1 Shafting and propeller

8.1.1 Machining and assembling of shafting

8.1.1.1 The materials of intermediate shaft, tail shaft, connection bolt, bearings are to be in compliance with the requirements of the classification society and with the qualification certificate.

8.1.1.2 The cone end of the tail shaft is to be machined against the templet.

8.1.1.3 For key-fixing propeller, the grind-fitting of the key with shaft and propeller keyways is to be carried out at the same time of the grind-fitting of the propeller boss and shaft.

8.1.1.4 After machining, the reamed bolt hole of the connection flange is to be matched with the reamed bolt by cold or hydraulic pressing for interface checking.

8.1.1.5 The intermediate shaft is to be assembled by grind-fitting to the intermediate bearing.

8.1.1.6 The propeller is to be assembled by grind-fitting to the propeller shaft. The mating position of the propeller and shaft is to be marked

8.1.1.7 Key points of quality control:

a) tolerance of templet for tail shaft cone part machining and amount of deformation;

b) accuracy of reamed hole of connection flange and centering deviation of flange;

c) contact point and clearance of grind-fitting bearing bush;

d) contact point and fixing tightness of grind-fitting key with shaft and propeller keyways;

e) contact point and fixing tightness and assembling temperature of grind-fitting boss of keyless propeller with shaft;

f) pre-fitting in workshop of keyless propeller.

8.1.2 Centering and position fixing of shafting

8.1.2.1 The centering of the shafting is to be done in general by using the way of optical sight or running a line. The optical instrument used is to be accurate and in good condition and such centering is to be carried out at the time without direct

sunshine.

8.1.2.2 Before conducting shafting centering, all hull construction behind engine room fore bulkhead and below main deck or continuous strength deck are to be completed. The stern tube is to be centered, fixed and welded to completion based on ship's centerline duly surveyed and qualified.

8.1.2.3 During the process of shafting centering, any work that may cause severe vibration and lifting operation of heavy piece are to be forbidden.

8.1.2.4 After centering, check the vertical distance of the shafting center to the face plate of the foundation of main engine and to the face plate of bedding support of intermediate bearing, the deviation at fore and aft, and the machining tolerance of the stern boss are to be checked.

8.1.2.5 Reference position for boring is to be defined.

8.1.2.6 Key points of quality control for shaft centering:

a) deviation of center of boss at fore and aft ends;

b) deviation of shafting centerline from the rudder stock centerline;

c) tightness test

8.1.3 Boring of stern tube and machining of stern bush

8.1.3.1 The deviation of the center of the boring bar from the shafting

center is to be kept within the specified range.

8.1.3.2 After completing boring of stern tube, the deviation of its centerline from the fore and aft reference center points is to be rechecked.

8.1.3.3 The external circle of the stern bush is to be machined in accordance with the actual size of the stern tube after boring.

8.1.3.4 Final position of resin pouring stern tube.

8.1.3.5 Key points of quality control:

a) flexibility of boring bar;

b) roundness, cylindricity and coaxiality of fore and aft stern bearing holes;

c) perpendicularity of end face of stern tube to the centerline;

d) fixing interference of stern tube with stern bush;

e) position mark of stern bush;

f) surface roughness of stern bush;

g) precision of the position of resin pouring stern tube.

8.1.4 Shafting installation on slipway(dry dock)

8.1.4.1 The stern tube is to be normally assembled and mounted with hydraulic pressing. Before pressing-in, the dimensions of mating parts of stern tube and bush are to be checked under the same temperature. During the pressing-in process, the pressing-in force is to be in compliance with the requirements

of technical document.

8.1.4.2 Key points of quality control for stern bushes push in:

a) accuracy of positioning of stern bush into the boss;

b) temperature of stern tube and stern bush;

c) pressing-in force;

d) variation of bearing internal diameter after pressing-in and surface quality.

8.1.4.3 Before assembling the tail shaft, the completeness of stern sealing device and correct assembling of the temperature sensors and conductor are to be checked.

8.1.4.4 Key points of quality control for propeller shaft push in:

a) tightness of lub oil pipeline and sensor cable pipeline inside stern tube;

b) clearance of both fore and aft stern bushes.

8.1.4.5 The propeller is to be mounted by hydraulic pressing. After propeller mounting, the initial data of subsidence of the tail shaft sealing device is to be measured and marked.

8.1.4.6 Key points of quality control for propeller assembly:

a) temperature of tail shaft and propeller;

b) initial pressing force, pressing-in amount and pressure;

c) assembling tightness of propeller cap;

d) gravity oil filling test for tail shaft sealing device.

8.1.5 Alignment and installation of shafting

8.1.5.1 Shafting alignment is to be carried out with main engine, shafting and accessories all located, with in general other large machines and equipment in engine room all properly positioned, and after the ship is launched.

8.1.5.2 The assembling dimensions of the shafting are to be adjusted from aft end forward according to the results of shafting alignment calculation, and the position of intermediate shaft and main engine are to be decided.

8.1.5.3 The grounded liners and reamer bolts are to be assembled and tightly fastened.

8.1.5.4 Loading test of shaft system to be carried out accordance with the shafting alignment calculation after shaft system assembled.

8.1.5.5 Key points of quality control for shaft system:

a) deflection and offset of flange of each shaft;

b) contact point of grind-fitting liner;

c) surface roughness and mating accuracy of reamer bolt;

d) loading test of bearings(intermediate shaft bearing and stern shaft fwd bearing);

e) deflection of main engine crankshaft.

8.2 Main engine and accessories

8.2.1 Requirements before main engine positioning

8.2.1.1 Positions of bolt holes in the main engine foundation along the longitudinal direction are to be decided and machined.

8.2.1.2 The welding liners on face plate of main engine foundation are located and welded.

8.2.1.3 Main engine is to be assembled in accordance with the technical specification. Crank web deflection is to be measured.

8.2.2 Positioning of main engine

8.2.2.1 The main engine is to be positioned with reference to the shafting centerline

8.2.2.2 The required thickness of adjustable liner is to be measured and machined to the required value. In general, the liner can be made of steel or cast iron. Epoxy-cast plastic liner may be used according to the specific procedure defined by maker.

8.2.2.3 Bolt holes are to be machined and corresponding reamer bolts are to be prepared. Or tensile bolts are to be used.

8.2.2.4 The main engine foundation bolts are to be fastened.

8.2.2.5 Key points of quality control for main engine positioning:

a) contact point of grind-fitting liner, clearance between contact surface;

b) accuracy of dimensions, surface roughness, circularity and

cylindricality of reamer bolts;

c) tightening moment or tensile force for fastening of the foundation bolts;

d) crank web deflection of main engine;

e) alignment accuracy, deflection and offset of flange of output end.

8.2.3 Installation of accessories

8.2.3.1 The fixing of lateral bracing and the installation of thrust block at output end of the main engine are to be carried out in accordance with the design drawings.

8.2.3.2 Key points of quality control:

a) welding deformation;

b) contact point, clearance and taper of grind-fitting liner.

8.3 Auxiliary machinery

8.3.1 Category of auxiliary machinery and basic requirements on installation

8.3.1.1 For the first class auxiliary machinery such as diesel generating set and steam turbine set etc, the alignment is to be done to the required standards. Before tightening the fastening bolts, the clearance between the contact surfaces it to be measured with feeler gauge.

8.3.1.2 For the second class auxiliary machinery such as fresh water

pump etc, the fixing of the pump frame to the engine seating and the tightness of connection bolts during installation are to be checked.

8.3.1.3 For the third class auxiliary machinery such as filter and heat exchanger etc, the tightness of fastening bolt during installation is to be checked. For the complete packaged equipment, the installation quality may be checked in the workshop.

8.3.2 Installation of diesel generating set

8.3.2.1 The crank web deflection of diesel engine is to be measured at cold condition and shall be in compliance with the recommended standard of the technical specification.

8.3.2.2 In case the diesel engine and generator are installed separately, their alignment is to be checked to confirm that they meet the required standard of the technical specification.

8.3.2.3 The crank case is to be kept clean from foreign matters.

8.3.3 Installation of steam turbine set

8.3.3.1 Generally, the centering rechecking of the steam turbine set is to be carried out after the launching of the ship.

8.3.3.2 If the steam turbine and the driven machine are installed separately, their shaft centers shall be precisely aligned.

8.3.3.3 Special tools are to be used in installing the steam turbine set. After the installation, the closeness of the liner, fixing of the fastening bolt, engagement of gears and fixing accuracy of piping connection are to be checked.

8.3.4 Key points of quality control for auxiliary machinery assembly:

a) clearance between close contact liners;

b) tightness of bolt connection;

c) axial clearance;

d) easy rotating by hand turning.

8.4 Boiler

8.4.1 Before installing the boiler, the integrity of the boiler and its accessories are to be checked against certificate of the classification society and shop test report.

8.4.2 After fastening, the foundation bolts are to be checked to ensure their robustness and reliability. The bolts are to be fitted with locking devices.

8.4.3 The compensating connection pipe, etc. used for the exhaust pipe are to meet the technical requirements of the bellow. Either rigid or elastic support is to be reasonably arranged.

8.4.4 Key points of quality control for boiler assembly:

a) clearance between liner and bolt;

b) tension of support, bracing and pulling ring;

c) pre-tension of compensating connection pipe.

9 ELECTRIC INSTALLATION

9.1 Electric fittings

9.1.1 Electric fittings consist of cable supporters, cable penetrations and equipment supporters, etc. in general, standard fittings are to be used. The cable penetrations are to meet the watertight and fire-proof requirements for the places of application.

9.1.2 Key points of quality control for electric fittings:

a) selection of cable penetrations;

b) span of cable supporter;

c) welding;

d) painting.

9.2 Cable laying

9.2.1 Cables are to be laid at distance away from heat source. Heat insulation measures are to be taken where necessary.

9.2.2 Cables for emergency switchboard are normally not to be laid through the engine room where they have no concern with.

9.2.3 Cables having no concern with explosion-proof rooms such as battery room, paint room, etc. are not to pass through such

spaces. If passing, necessary protection methods to be taken.

9.2.4 Cables for two sets of steering gears are to be laid separately as far apart as possible.

9.2.5 Cables of intrinsic-safe circuits are to be laid separately from other cables

9.2.6 Cables laying abroad oil tanker are to be compliance with the special requirements for oil tanker and dangerous cargos.

9.2.7 Cables for refrigerated spaces are to be laid uncovered.

9.2.8 The material of cable fittings are to be selected according to the locations of their application.

9.2.9 Cable tray on supporting bracket may have 1 to 2 layers, and power cables, signal cables and intrinsic-safe cables on the tray are to be fastened in bundles separately.

9.2.10 The total sectional area of cables in the cable duct is not exceed 40% of inner sectional area of the duct. Single cable inside cable duct can be widen allowance.

9.2.11 Cables through the cable trunk/penetration, the rate of total external sectional area of cables and the inner sectional area of the cable trunk, are to meet the requirements of cable trunk's instruction.

9.2.12 Cables passing through packing or cast inorganic packing are to meet the watertight and fire-proof requirements for

approval certificate issued by the classification society.

9.2.13 Cable protection sheath is to meet the requirements of environment.

9.2.14 Laying the single core cable or high voltage cable, to meet the requirements of classification society and maker's technical specification.

9.2.15 Key points of quality control for cable laying:

a) cable allocation;

b) cable protection;

c) cable penetration and sealing.

9.3 Installation and earthing of electric equipment

9.3.1 The enclosure protection grade for the electric equipment is to meet the requirements for the places of their installation. For equipment installed in dangerous zones and spaces, the explosion protection type of the equipment is to meet the requirements for that location.

9.3.2 In general neither pipe flange nor valve piece is to be arranged above the electric equipment.

9.3.3 Electric equipment is to be installed even and upright at proper height for convenient operation and maintenance.

9.3.4 All electric equipment are to be earthed with special earthing conductors or through the base of the equipment installation.

Effective contact is to be ensured. The sectional area of the earthing conductor is to meet the relevant requirements of the classification society. For different character electric equipment's earthing(working type earthing and protection type earthing), to be conducted separately.

9.3.5 Key points of quality control:

a) installation location and degree of protection;

b) installation accuracy;

c) equipment earthing.

9.4 Connection and earthing of metal coverings of cables

9.4.1 The enclosure protective property of the equipment is not to be impaired when the cable is laid into the electric equipment.

9.4.2 Clear and durable marks are to be provided according to the design drawings at the core ends in connecting the cables.

9.4.3 Special tools are to be used for cold-pressing and connecting of wire terminals.

9.4.4 In case the cables of both the intrinsic-safe and non intrinsic-safe circuits are connected into one equipment, their cores are to be kept apart.

9.4.5 Metal sheath of the cable are to be effectively earthed at both ends. In safe region, cable of final branch circuit may be earthed at the source end only.

9.4.6 Cables of the intrinsic-safe system and of the signal and instrumentation system may be grounded at one end according to the equipments of their technical specification.

9.4.7 Earthing cable to be with the color of yellow-green alternately.

9.4.8 Handling and connecting the single core cable or high voltage cable, to meet the requirements of classification society and maker's technical specification.

9.4.9 For cables connecting and earthing, key points of quality control:

a) treatment of cable connecting terminal;

b) grounding of cable metal covering;

c) correctness of cable lead-in and connection.

10 AUTOMATIC CONTROL AND REMOVE CONTROL, TELEMETRY EQUIPMENT AND THEIR TESTING

10.1 Sensors test

10.1.1 Temperature sensors may be tested by means of either heating method or analogue method. Pressure sensors may be adjusted and tested while the system is in operation or tested with test pump. Liquid level sensors and signal

transducers are to be tested by analogue method.

10.1.2 For sensors test, key points of quality control:

a) setting value;

b) setting position mark;

c) locking of adjusting screw.

10.2 Main engine automatic control and remote control

10.2.1 For main engine's automatic/remote control test: the function tests such as remote operation, emergency stop, control position change-over, shut down, overriding, safe speed reducing etc. are to be carried out according to the requirements of the relevant technical specifications.

10.2.2 For main engine automatic and remote control adjustment, key points of quality control:

a) test procedure;

b) test records.

10.3 Main generator, main switchboards automatic and remote control

10.3.1 For main generator and main switchboards, automatic function test such as safe stop, heavy load paralleling, light load relief, and load sharing, etc. are to be carried out for the electric power station.

10.3.2 Key points of quality control:

a) test procedure;

b) setting value;

c) automatic control procedure;

d) test records.

10.4 Important pumps auto-control and remote-control test

10.4.1 Automatic change-over of standby pump.

10.4.2 Sequential starting on main source failure.

10.4.3 Key points of quality control:

a) test procedure;

b) automatic control procedure.

10.5 Monitoring and alarming

10.5.1 The monitoring and alarming functions are to be grouped under different systems or types of monitoring parameters, and such groups are to be tested in turn.

10.5.2 Key points of quality control:

a) test procedure;

b) adjustment of sensors;

c) correctness of alarming.

10.6 Test of unattended engine room

10.6.1 During the unattended engine room test, the relating automatic systems such as main engine remote control, auto-power station, engine room automatic running pumps, fire detecting system, remote level detection, etc. are to be at

automatic condition.

10.6.2 System adjustment, elimination of defects and miss alarm when the ship is running at designed speed.

10.6.3 Key points of quality control:

a) test procedure;

b) regulating and marking;

c) test records.

11 MOORING TEST AND SEA TRIAL

The mooring test and sea trial are to be carried out in accordance with the mooring test program and sea trial program respectively approved by both the classification society and ship owner.

11.1 Mooring test and sea trial for hull part

11.1.1 Key points of quality control for inclining test and light-ship measurement:

a) test environment and conditions;

b) over-weight and under-weight;

c) draft, initial heeling and trimming;

d) moving weight and distance;

e) readout accuracy;

f) ballast conditions

11.1.2 Tests for the deck machinery system includes the tests for anchoring equipment, mooring equipment, tug equipment, boats and davits, bow/stern thrusters, cargo handling equipment, accommodation ladder equipment and water-tight hatchcovers.

Key points of quality control:

a) working condition and function of equipment;

b) accuracy of testing data;

c) operation reliability.

11.1.3 The sea trial on ship operational performance includes the measuring of speed of the ship and measuring of inertial stopping distance, turning circle and course stability of the prototype ship.

Key points of quality control:

a) environment conditions such as wind direction, wind speed, sea states and water depth of the trial zone;

b) ballast condition of the ship;

c) propulsion engine output and revolution;

d) rudder angle and ship's course;

e) test and trial procedure and means of data logging.

11.2 Mooring test and sea trial for machinery part

11.2.1 For the tests such as main engine remote control, generator

auto-starting test of power black out during sailing, procedure starting pumps after power recovered, power black out test during ship stop and emergency switchboard supplying power inspection, engine room black out alarm test, etc.

Key points of quality control:

a) test procedure;

b) regulating and marking;

c) test records.

11.2.2 Key points of quality control for the testing of diesel generating sets:

a) functioning of safety and protection systems;

b) deviation of explosion pressure and exhaust temperature of each cylinder;

c) sensitivity and stability of governor;

d) crank web deflection.

11.2.3 The tests of main propulsion system includes those of the safeguard system, monitoring and controlling system, engine starting and reversing, minimum steady speed, remote astern manoeuvring, emergency manoeuvring, operation of turbocharger, and measuring of shaft vibration (for prototype ship only), etc.

Key points of quality control:

a) tightness of fastening;

b) monitoring and protection system for alarming, interlocking and shutdown;

c) remote control and reversing manoeuvring system;

d) temperature and lubrication of intermediate shaft bearing;

e) temperature, lubrication and sealing of stern bearings;

f) ventilation of engine room;

g) explosion pressure of cylinder, exhaust temperature and output power of main engine;

h) working parameters of various systems;

i) crank web deflection.

11.2.4 Key points of quality control for function test of boiler system:

a) automatic monitoring and controlling system for boiler ignition, combustion and water level;

b) opening and closing of safety valve;

c) stability of accumulated pressure.

11.2.5 Key points of quality control for function tests of the fire alarming system, bilge system, ballast system and fuel oil system:

a) functioning of equipment of each system;

b) working parameters.

11.2.6 The tests of special systems for the oil tanker includes those of cargo pumping system, stripping pumping, remote monitoring of cargo tank level, remote control of valve, inert gas system, tank washing system, portable hydraulic ventilator, oil water discharge monitoring system, ect. Key points of quality control:

a) working correctness of automatic control, remote control and remote monitoring system;

b) oily water discharging;

c) fire protection and explosion prevention.

11.3 Mooring test and sea trial for electric part

11.3.1 Key points of quality control for the testing of main switchboards and generator sets:

a) regulation of voltage characteristics of the generator;

b) regulation of load characteristics of the diesel engine;

c) test procedure;

d) setting of protection devices.

11.3.2 Key points of quality control for the testing of emergency switchboard and generator set:

a) setting of protection devices;

b) setting of automatic starting device;

c) regulation of voltage and frequent characteristics of generator

set.

11.3.3 Key points of quality control for the testing of electric motors and controllers:

a) overload protection of electric motor;

b) working conditions.

11.3.4 Key points of quality control for the testing of communication and navigation equipment:

a) check of power supply;

b) functioning of the equipment.

11.3.5 Key points of quality control for the testing of transformers and lighting equipment:

a) insulation of circuit;

b) arrangement of lighting fixtures.

12 COMPLETION AND DELIVERY

12.1 Delivery of cabin equipment, spares and supplies

Following items are to be delivered: cabin facilities, fire-fighting equipment, life-saving appliance, radio communication and navigational aids, spares and other supplies.

12.2 Inspection of markings and operation instructions

Inspection is to be done in accordance with the relevant rules

and conventions on the correct fixing and assignment of loadline markings, deadweight markings, fire-fighting indications and fire-fighting plan, dangerous area plans(for cargo oil tanker and chemical tanker). Inspection is also to be done to confirm that life-saving arrangement plans and operation instructions are displayed correctly at all required locations.

12.3 As-built drawings and ship delivery documents

12.3.1 As-built drawings and documents specified in the ship-building contract.

12.3.2 Records of important testings and inspections made during construction and trial.

12.4 Certificates to be handed over

12.4.1 Class certificates and statutory inspection certificates specified in the shipbuilding contract.

12.4.2 Equipment certificates, navigation certificates and corresponding quality certificates specified in the shipbuilding contract.

12.4.3 Ship delivery and acceptance document.

PART 2

PLANS FOR APPROVAL AND INSPECTIONS AND TESTS FOR ACCEPTANCE

1 PLANS FOR APPROVAL

1.1 General

1.1.1 The plans and documents listed in this standard are the major items that shall be submitted to the classification society and ship owner for review and approval, and are subject to proper adjustment as the case may require for ships of different types, designed for different navigation zones or areas and flying different flags.

1.1.2 For ensuring that the ship design and construction could be completed in time, the ship owner shall review and return the plans and documents duly approved according to the time schedule and requirements set forth in the shipbuilding contract.

1.2 Plans and documents to be submitted for review and approval

The plans and documents to be submitted for review and approval are divided into categories according to their professions: general, hull construction and painting, hull outfitting, machinery installation, electric installation, see table

2-1-1 through table 2-1-4. In the following tables, the items marked with symbol "∨" are the items that are to be reviewed and approved, that with the symbol "Δ" means the items for reference, and that with the symbol "-" means the items don't need for reviewed or approved.

Table 2-1-1 General, hull construction and painting

No.	Items	For classification society	For ship owner
1	**Technical specifications (including hull, machinery and electric parts)**	Δ	-
2	General arrangement		∨
3	Lines plan and offsets table		Δ
4	Hydrostatic curves		-
5	Loading condition and stability calculation	∨	∨
6	Damage stability calculation		
7	Freeboard calculation		
8	Tonnage calculation	-	Δ
9	Speed and power estimation		
10	Propeller calculation	∨	-
11	Longitudinal strength calculation		
12	Painting and coating specifications	-	∨
13	Capacity plan for tanks and holds	Δ	Δ
14	Tank sounding table	-	

Table 2-1-1(continued)

No.	Items	For classification society	For ship owner
15	Propeller plan		∨
16	Fire zone division plan		
17	Inclining test report	∨	Δ
18	Lightship weight measurement report		
19	**Arrangement plan of marks of loadline, draft and bulbous bow**		∨
20	Fire control plan		
21	Midship section		
22	Main structure plan		
23	Shell expansion		
24	Longitudinal and transverse bulkhead		
25	Bow structure		
26	Stern structure		
27	Cargo space structure	∨	∨
28	Engine room structure		
29	Superstructure		
30	Stem plan		
31	Stern frame plan		
32	Crane post and foundation structure		
33	Tightness test diagram of the ship		

Table 2-1-1 (end)

No.	Items	For classification society	For ship owner
34	Mooring test program	∨	∨
35	Sea trial program		
36	Funnel structure		
37	Bulwark structure		
38	Hatch coaming structure		
39	Main deck store room structure		
40	Rudder horn structure		
41	**Dangerous zones division plan (for tanker, chemical tanker)**		Δ

Table 2-1-2 Hull outfitting

No.	Items	For classification society	For ship owner
1	**Inventory of hull outfittings, spares and accessories**	–	∨
2	Equipment number calculation	Δ	–
3	Arrangement of anchoring equipment	∨	∨
4	Outfitting and marks of anchor chains		
5	Arrangement of mooring equipment	Δ	
6	Arrangement of steering equipment	∨	

Table 2-1-2 (continued)

No.	Items	For classification society	For ship owner
7	Arrangement of cargo gear		
8	Arrangement of metal doors, windows	∨	
9	Arrangement of manholes and covers of the ship		
10	Arrangement of hatchcovers	Δ	
11	Hatchcovers structure		
12	Arrangement of rails and ladders of the ship		
13	Arrangement of natural ventilation	∨	
14	Arrangement of mechanical ventilation		
15	**Arrangement of life-saving appliances on board the ship**		
16	**Arrangement of fire-fighting appliances on board the ship**		
17	Arrangement of cabins	Δ	∨
18	Arrangement of refrigerating provision cabins	–	
19	Arrangement of refrigerating cabins insulation	Δ	
20	Arrangement of deck dressing		
21	Arrangement of insulation of the ship		
22	Arrangement of radar mast and fore mast	∨	
23	Arrangement of magnetic compass		
24	Arrangement of cathodic protection		
25	Bilge and ballast piping system		

Table 2-1-2 (end)

No.	Items	For classification society	For ship owner
26	Fire-fighting piping system	∨	∨
27	**Air sounding and filling piping system (including coaming)**		
28	Drainage system diagram		
29	Potable water system diagram	Δ	
30	Water supply system diagram		
31	General arrangement of engine room	∨	
32	Air conditioning system and schematic diagram		
33	Arrangement of air conditioning ducts		
34	**Arrangement of equipment in air conditioning room**	–	
35	Arrangement of navigation/signal lights on mast	∨	

Table 2-1-3 Machinery installation

No.	items	For classification society	For ship owner
1	List of machinery equipment	Δ	Δ
2	Estimation (calculation) of machinery equipment		–
3	Calculation of lateral vibration of shafting	∨	
4	Calculation of longitudinal vibration of shafting		
5	Calculation of shafting alignment		
6	Calculation of torsional vibration of shafting		

Table 2-1-3 (continued)

No.	items	For classification society	For ship owner
7	Calculation of propeller and shaft connection		
8	Calculation of deck foam for oil tanker	∨	–
9	Calculation of shafting strength		
10	Calculation of oil tank heating pipeline		
11	Calculation of fire water system	Δ	
12	**Engine room arrangement (including workshop, store, and funnel)**		
13	**Emergency fire pump room arrangement and piping system**		
14	**Installation drawing of main engine and reduction gearbox**		
15	Arrangement of emergency generator room		
16	**Piping arrangement of emergency generator room**		
17	**Hydraulic (pneumatic) system and arrangement of deck machinery**		
18	Sea chest arrangement and construction	∨	∨
19	**Shafting arrangement (including intermediate and thrust shafts)**		
20	Tail shaft and stern tube assembly		
21	Layout of propeller shaft and intermediate shaft		
22	Fuel oil system		
23	Lubricating oil system		
24	Stern tube lubricating oil system		
25	Sea water cooling system		

Table 2-1-3 (continued)

No.	items	For classification society	For ship owner
26	Fresh water cooling system	∨	∨
27	Compressed air system		
28	Control air system		
29	Engine room steam system		
30	Feed water system		
31	Condensate water system		
32	Engine room supply water system	Δ	
33	Engine room bilge, ballast and fire water system	∨	
34	**Engine room venting, sounding and filling piping system**		
35	Engine room ventilation ducts arrangement		
36	Exhaust piping system		
37	**Steam piping for room heating and miscellaneous usage**		
38	Engine room fresh water generating system	Δ	
39	**CO2 fire extinguishing system and CO2 store room arrangement**	∨	
40	**Calculation and operation instruction of CO2 fire extinguishing system**		
41	Sewage treatment system	–	
42	**Remote control device of quick closing valve (including parts)**	∨	
43	Board side opening arrangement and structure		
44	Provision refrigerator room arrangement	–	

Table 2-1-3 (end)

No.	items	For classification society	For ship owner
45	Provision refrigeration system	—	√
46	Cargo pump room arrangement	√	
47	Cargo oil control room arrangement		
48	**Arrangement of deck foam fire extinguishing system**		
49	**Arrangement of hydraulic pump station for cargo oil and ballast control systems**		
50	Cargo oil and ballast water piping system		
51	Control system for cargo oil and ballast water		
52	Inert gas venting pipeline for cargo tank		
53	Cargo tank heating pipeline		
54	Deck steam and condensate pipeline		
55	**Draft, oil level sounding and oil temperature measuring pipeline**		
56	**Tank washing machine arrangement and tank washing pipeline**		
57	Inert gas system		
58	Deck foam fire extinguishing system		
59	Oil and water discharge monitoring pipeline		
60	**Operation manual for oil and water discharge monitoring pipeline**		
61	**Operation manual for cargo oil tank washing operation**		
62	**Operation manual for cargo oil tank stripping operation**		
63	**Arrangement of ventilation ducts for cargo pump room**		

Table 2-1-4 Electrical installation

No.	items	For classification society	For ship owner
1	List of major electric equipment	Δ	Δ
2	**List of spare parts and fittings for electric installations (including supplies)**	—	∨
3	**Calculation of alternating current short circuit current**	∨	Δ
4	Electric load calculation		∨
5	Calculation of capacities for storage batteries		Δ
6	Calculation of voltage decrease		
7	Electric power system diagram		∨
8	Normal lighting system	Δ	
9	Emergency lighting system	∨	
10	Navigation light and signal light system		
11	Radio communication system		
12	Interior communication system		
13	Navigational aid system		
14	**Arrangement of fire alarm and general alarm system**		
15	Single-line diagram of main switchboard		
16	Single-line diagram of emergency switchboard		
17	Electric equipment arrangement		
18	Lighting equipment arrangement	Δ	

Table 2-1-4 (end)

No.	items	For classification society	For ship owner
19	Interior communication system arrangement	∨	∨
20	Navigation aid equipment arrangement		
21	Wheelhouse arrangement		
22	Antenna arrangement	Δ	
23	Main cable layout diagram	∨	Δ
24	Engine room monitoring and alarm system		∨
25	Arrangement of engine control room		
26	**Arrangement of electric equipment for special cabins**	Δ	
27	Audio and visual signaling device arrangement	∨	

2 INSPECTIONS AND TESTS FOR ACCEPTANCE

2.1 General

2.1.1 The inspections and tests listed in this standard are those to be examined and surveyed by the classification society and the ship owner for acceptance, and are subject to proper adjustment as the case may require for ships of different types, designed for different navigation zones and areas and flying different flags.

2.1.2 Generally, the builder shall, according to the construction schedule, notify the supervisor of ship owner and the surveyor of classification society to attend the inspection and test in the

following procedures:

a) A “Test Notice” shall be forwarded to the supervisor and surveyor one day before the inspection and test. In special case, this “Test Notice” may be sent to the supervisor and surveyor at the commencing of work of the test day.

b) The builder shall notify the supervisor and surveyor of any temporary postponement of the scheduled inspection and test as early as possible.

c) The inspection and test for painting may be proceeded in different procedures.

2.1.3 The supervisor and surveyor shall sign their names to the “Test Notice” after surveyed the test together with their opinion of accepting or not accepting the result of survey so as to let the builder to proceed with the work accordingly.

2.2 Items of inspections and tests

The following inspection and tests are grouped under five parts according to their professions as hull construction and painting, outfitting, machinery installation, electric installation and automatic and remote control, see table 2-2-1 through table 2-2-5. The items marked with symbol “V” are the tests to be done for acceptance, the items marked with symbol “—” are the tests not need for attendance.

Table 2-2-1 inspections and tests for hull construction and painting

No.	Items	Content	Stage	Surveyor	Supervisor	Remarks
1	Hull steel plates and sections	Material quality report and visual appearance	Before processing			
2	Major castings and forgings (stem, stern frame, shaft brackets and rudder horn, etc.)	Material quality report and visual appearance	Before and after processing		–	With certificate from classification society
3	Hull welding material	Material quality report and visual appearance	Before processing	V		
4	Block assembling	Structural integrity and visual quality of seam	After completion		V	–
	Main hull & Superstructure					

Table 2-2-1 (continued)

5	Slipway assembling	Main hull blocks	**Structural integrity and visual quality of seam**	After completion	∨	∨	–
			Non-destructive inspection				
		Superstructure	**Structural integrity and visual quality of seam**				
6	Loadline markings and draft marks		Check for size	After marking			
			Check for installation accuracy	After fixing			
7	Measuring of principal dimensions after completion of hull construction		Overall length, moulded breadth, moulded depth and deflection of keel centerline	Before launching			
8	Funnel marks and ship name marks		Check for size and installation accuracy	After completion	–		

Table 2-2-1 (end)

9	Shipside marks	**Check for size and installation accuracy**	After completion	–	√	–
10	Bottom plug	**Installation correctness and integrity**				
11	Tightness test for hull	**As per tightness test plan**	During testing			
12	Deadweight measuring and inclining test	Measuring of lightship weight, center of gravity and deadweight				
13	Secondary derusting and painting	Derusting	After derusting	–		
		Finish coating	**Before delivery (or launching)**			

Table 2-2-2 inspections and tests for hull outfitting

No.	Items	Content	Stage	Surveyor	Supervisor	Remarks
1	Rudder stock Rudder shaft	Material quality report	Before fabrication	∨	–	With certificate from classification society
		Fabrication inspection	After fabrication		∨	
2	Rudder pintle, tiller and rudder bearing, etc.	Material quality report	Before fabrication		–	
		Fabrication inspection	After fabrication			
3	Ruder plate	Material quality report	Before fabrication		∨	
		Integrity of internal structure	Before sealing up			
		Main dimensions and visual quality of seam	After welding			
		Tightness test	During test			

Table 2-2-2 (continued)

No.	Items	Content	Stage	Surveyor	Supervisor	Remarks
4	Installation of rudder equipment	**Assembly of rudder bearing**	After installation	√	√	–
		Installation of rudder pintle				
		Assembling of rudder stock, plate and pintle. Alignment	During assembly			
		Installation clearance of rudder bearing	After installation			
		Check for rudder plate zero position				
		Check for gap of rudder post stopper	Before launching			
5	Steering gear	Installation correctness	After completion			**With certificate from classification society**
6	Rudder system	System integrity				–
		Performance test	During mooring test and sea trial			
		Automatic and emergency steering function test				

Table 2-2-2 (continued)

No.	Items	Content	Stage	Surveyor	Supervisor	Remarks
7	Anchors, chains and accessories	**Material quality report of anchors, chains, shackles and swivels**	Before installation	V	–	With certificate from classification society
		Visual quality				
		Stamp marks				
8	windlass	Installation correctness	After installation		V	
9	**Chain stopper, quick releasing device**	Installation correctness				–
10	Anchor system	Running test	During mooring test and sea trial			
		Dropping and lifting test				
11	Mooring equipment	**Installation correctness and integrity**	After completion	–		
12	Mooring winch	Installation integrity	After installation			With certificate from classification society
		Running test	During mooring test			
		Intension test				

Table 2-2-2 (continued)

No.	Items	Content	Stage	Surveyor	Supervisor	Remarks
13	Lift-saving appliance	**Lifeboat, boat winch, davit and cable**	**Before installation**		–	With certificate from classification society
		Load test of davit	Mooring test		V	
		Lifeboat hooking and dehooking test				
		Lifeboat afloating test				
		Check for boat spares and accessories				
		Check for correct amount and storage of other life-saving appliance and fittings	After installation	V	–	
14	Accommodation ladder and winch	Load test	Mooring test		V	
		Function test				
15	Pilot ladder	**Installation correctness and integrity**				
		Function test				

Table 2-2-2 (continued)

No.	Items	Content	Stage	Surveyor	Supervisor	Remarks
16	Mast and derrick post	Material quality report	Before fabrication		–	With certificate from classification society
		Structure integrity	After fabrication			
		Visual quality of seam			V	
		Non-destructive inspection of seams		V		
17	Derrick boom	Material quality report	Before fabrication		–	
		Welding seam quality	After completion			
		Non-destructive inspection of seams				
18	Cargo gear/crane	**Check for system integrity**			V	
		Cargo winch running test				
		Function test	Mooring test			

Table 2-2-2 (continued)

No.	Items	Content	Stage	Surveyor	Supervisor	Remarks
19	Cargo hold hatchcovers	Material quality report	Before fabrication		–	With certificate from classification society
		Installation integrity and welding quality	After completion	V	V	
		Tightness test				
		Function test				
20	**Water-tight doors, port-holes and weather-tight closing devices (including sea chest)**	Installation integrity				
		Tightness test				
21	Container fasteners	Installation correctness				
22	Container cell guides	Material quality report	Before fabrication		–	
		Installation integrity and welding quality	After completion		V	
		Function test				

Table 2-2-2 (end)

No.	Items	Content	Stage	Surveyor	Supervisor	Remarks
23	**Fire-fighting equipment**	Integrity and correctness	After installation	V	V	With certificate from classification society
24	**Fire-proof materials for cabins**	**Fire-proof material and fire-proof structure integrity**	After completion			
25	Cabins facilities	**Integrity and visual quality**		–		–
		Running test for laundry machine and galley equipment				
26	Lift	**Load test and running test**		V		With certificate from classification society
		Safety performance test				

Table 2-2-3 inspections and tests for machinery

No.	Items	Content	Stage	Surveyor	Supervisor	Remarks
1	Shafting	Centering and position fixing	Before boring	√	√	**Same time checking the centerline of rudder stock**
		Boring	After boring			
		Installation and tightness test of lubrication oil pipe of stern tube	After installation			
		Press-fitting of stern tube fore and aft bearings	During pressing			
		Measuring of clearance between propeller shaft and bearing	After assembling			
		Installation of propeller	During installation			
		Centering of shafting and mounting of intermediate bearing	After completion			
		Material quality of connection bolt and mating dimension of reamer bolt with bolt bole of shafting				**With non-destructive examination report**
		Installation and tightness test of stern shaft sealing device	After installation			**With certificate form classification society**

Table 2-2-3 (continued)

No.	Items	Content	Stage	Surveyor	Supervisor	Remarks
2	Propeller shaft	**Material quality report (including heat treatment and non-destructive examination)**	Before machining		—	**With certificate form classification society**
		Check for dimensions after machining	**Before taking off from lathe**		∨	
		Check for mating of propeller with shaft	After assembling			
3	Intermediate shaft	**Material quality report (including heat treatment and non-destructive examination)**	Before machining	∨	—	
		Check for dimensions after machining	**Before taking off from lathe**		∨	
4	Stern tube	Material quality report	Before machining		—	
		Tightness test after welding	After welding		∨	
5	Stern tube bearing	Material quality report	Before machining		—	
		Check for dimensions after machining	After machining		∨	

Table 2-2-3 (continued)

No.	Items	Content	Stage	Surveyor	Supervisor	Remarks
6	Position fixing and installation of main engine	Positioning of main engine	After positioning			**With certificate form classification society**
		Grind-fitting of liner	After machining			
		Tightness of holding-down bolt	During installation			
		Measuring of crank web deflection	**Before engine stating**			
		Installation of coupling (fasten its bolts)	During installation			
7	Running test of main engine	**Test of main engine alarm and safety devices**	During mooring test and sea trial	√	√	–
		Check for working condition of pumps and piping systems attached to main engine				
		Maneuvering test of main engine				
		Running test of main engine				
		Measuring of crank web deflection	After main engine running test			
		Piston lifting for inspection and measuring				

Table 2-2-3 (continued)

No.	Items	Content	Stage	Surveyor	Supervisor	Remarks
8	Diesel generating sets	Integrity of installation	After completion			**With certificate form classification society**
		Measuring crank web deflection	Before and after starting			
		Running test				
		Parallel running test	**During mooring test**			
9	Emergency generating set	Integrity of installation	After installation	V	V	
		Function test	**During mooring test and sea trial**			
10	Air compressor	**Test of safety valve and safety devices**	During mooring test			
		Function test (including air charging test)				
11	Air reservoir	**Completeness of accessories and tightness test**	After completion			
		Inspection of safety valve	During test			

Table 2-2-3 (continued)

No.	Items	Content	Stage	Surveyor	Supervisor	Remarks
12	**Auxiliary boiler and exhaust gas economizer**	Tightness test of system	**During mooring test**	√	√	**With certificate form classification society**
		Running test	During mooring test and sea trial			
		Test of safety valves (including accumulation test)				
13	Incinerator	Function test	During mooring test			
14	**Electric pumps (pumps for main engine, auxiliary machinery, boiler and shafting, etc.)**	Effectiveness test		–		
15	Oil separator	Effectiveness test	During mooring test			
16	**Bilge oily water separator**			√		
17	Sewage treatment plant					
18	Fresh water generator		During sea trial	–		–

Table 2-2-3 (continued)

No.	Items	Content	Stage	Surveyor	Supervisor	Remarks
19	Engine room hoisting crane	Safety device test and loading capacity test	**During mooring test**	∨		**With certificate form classification society**
20	Workshop equipment	Operation test		–		–
21	Pressure vessel	Effectiveness test				**With certificate form classification society**
22	Engine room ventilator					
		Remote control		∨		
23	Room ventilator	Effectiveness test		–		–
24	Lateral thruster		During mooring test and sea trial	∨		**With certificate form classification society**
25	Board side valve	Correctness of mounting	After mounting			
		Tightness test				

Table 2-2-3 (continued)

No.	Items	Content	Stage	Surveyor	Supervisor	Remarks
26	Compressed air and control air pipeline	Hydraulic test	Before fixing			
		Tightness test	After fixing			
		Test of safety valve and reducing valve	During mooring test			
		Effectiveness test				
27	Fuel oil pipeline	Hydraulic test	Before fixing			
		Tightness test	After fixing	√	√	–
		Effectiveness test				
28	Lubrication oil pipeline	Hydraulic test	Before fixing			
		Tightness test	After fixing			
		Flushing with oil		–		
		Effectiveness test	**During mooring test**	√		

Table 2-2-3 (continued)

No.	Items	Content	Stage	Surveyor	Supervisor	Remarks
29	**Sea water and fresh water cooling pipelines**	Tightness test (except cooler)	After fixing	√	√	–
		Effectiveness test	**During mooring test**	–		
30	Boiler feed water, steam and condensate pipeline	Hydraulic test	Before fixing	√		
		Tightness test	After fixing			
		Effectiveness test	**During mooring test**	–		
31	Steam heating pipeline	Hydraulic test	Before fixing	√		
		Tightness test	After fixing			
		Smooth steam flowing test	**During mooring test**			
32	**Water supply pipeline for whole ship (including engine room)**	Tightness test	After fixing	–		
		Smooth flowing test	**During mooring test**			
33	**Deck scupper and sanitary discharge pipeline**	Free flowing test				

Table 2-2-3 (continued)

No.	Items	Content	Stage	Surveyor	Supervisor	Remarks
34	Water fire extinguishing pipeline	Hydraulic test	Before fixing	√	√	–
		Tightness test	After fixing			
		Effectiveness test				
35	CO_2 fire extinguishing pipeline and foam fire extinguishing system	Hydraulic test	Before fixing			
		Tightness test	After fixing			
		Alarm function test	**During mooring test**			
		Effectiveness (simulated) test				
36	Emergency fire alarm test	Effectiveness test				
37	Ballast water pipeline	Tightness test	After fixing			
		Effectiveness test	**During mooring test**			

Table 2-2-3 (continued)

No.	Items	Content	Stage	Surveyor	Supervisor	Remarks
38	Bilge water pipeline	Tightness test	After fixing	V	V	–
		Effectiveness test	**During mooring test**			
		Effectiveness test for emergency suction				
39	Refrigerating pipeline	Air tightness test	After fixing	–		
		Vacuum test of refrigerating pipeline	**During mooring test**			
		Test of refrigeration and temperature keeping				
40	Air conditioning pipeline	Effectiveness test				
41	Air horn	Effectiveness test		V		**With certificate form classification society**
42	Air, sounding and filling pipeline	Free flowing test				–

Table 2-2-3 (continued)

No.	Items	Content	Stage	Surveyor	Supervisor	Remarks
43	Hydraulic system	Hydraulic test	Before fixing	√	√	–
		Tightness test	After fixing			
		Flushing with oil	**Before mooring test**	–		
		Effectiveness test of power pump station	During mooring test	√		
44	Cargo oil pump	Running test	**During mooring test and sea trial**			**With certificate form classification society**
45	Special ballast pump	Running and effectiveness test				
46	Stripping pump		**During mooring test**			
		Effectiveness test of remote control system				
47	**Condenser and air ejector for cargo pump**	**Effectiveness test with steam turbine driven cargo pump**	**During mooring test and sea trial**			
		Vacuum system test				

Table 2-2-3 (continued)

No.	Items	Content	Stage	Surveyor	Supervisor	Remarks
48	Valve remote control system of cargo tank	Tightness test	After fixing			**With certificate form classification society**
		Remote control test	**During mooring test**			
49	**Cargo oil system and segregated ballast pipeline**	Tightness test	After fixing			—
		Simulation test	**During mooring test or sea trial**			
50	Inert gas explosion proof system and pipeline	Tightness test	After fixing			**With certificate form classification society**
		Running test	**During mooring test**	√	√	
		Test of alarm and safety devices				
		Function(simulation) test of system and measuring of CO2 content	**During mooring test or sea trial**			
51	**Liquid level remote gauging and draft measuring system**	Effectiveness test				
52	**Crude oil tank washing machine and tank washing system**	System tightness test	After fixing			
		Function test of sea water tank washing	During sea trial			

Table 2-2-3 (end)

No.	Items	Content	Stage	Surveyor	Supervisor	Remarks
53	**Heater for tank washing sea water**	Function test	During sea trial			**With certificate form classification society**
54	**Oil sludge discharge monitoring system**	Function test (simulated)		√		
55	**Oil/water interface detector**	Function test	**During mooring test**		√	
56	Cargo oil steam heating system	Tightness test	After fixing			–
		Smooth steam flowing test	**During mooring test**	–		
57	Deck foam unit	Function test (simulated)		√		**With certificate form classification society**
Note: items No.44 – No.57 for tanker specially						

Table 2-2-4 inspections and tests for electric installation

No.	Items	Content	Stage	Surveyor	Supervisor	Remarks
1	Cable laying	**Completeness of cable laying in various zones**	After laying / after mounting	√	√	**With certificate form classification society**
2	**Cable penetrations on fire-proof / water-tight bulkheads and/or decks**	**Check to construction of cable penetrations**				
3	Main switchboard and emergency switchboard	Correctness of installation	**During mooring test**			
		Measuring of insulation resistance				
		Testing of protective devices				
		Function test				
4	Diesel generating sets	Alarm device test				
		Measuring of insulation resistance				
		Loading characteristics test				
		Parallel operation test				
		Automatic operation test				

Table 2-2-4 (continued)

No.	Items	Content	Stage	Surveyor	Supervisor	Remarks
5	Emergency generating set	Alarm device test	During mooring test	∨	∨	With certificate form classification society
		Measuring of insulation resistance				
		Loading characteristics test				
		Automatic power supply test	During mooring test or sea trial			If over 100 kw, to be with certificate form classification society
6	Shaft generator	Load test or effectiveness test				
7	Charging-discharging panel, storage batteries	Effectiveness test	During mooring test			
8	Electric motors and their controllers for auxiliary machines	Measuring of insulation resistance		–		–
		Effectiveness test				
9	Emergency cut out of ventilation and oil supply for engine room	Effectiveness test		∨		
10	Normal lighting	Measuring of insulation resistance				
		Effectiveness test				

Table 2-2-4 (continued)

No.	Items	Content	Stage	Surveyor	Supervisor	Remarks
11	Emergency lighting	**Measuring of insulation resistance**	**During mooring test**			–
		Effectiveness test				
12	**Alarm system (including fire alarm, CO2 release alarm, general alarm bell, cold store locked-in alarm, ect.)**	Effectiveness test or simulation test		√		**With certificate form classification society**
13	Navigation lights, signaling lights	Effectiveness test			√	–
		Alarm test				
14	**Electric galley appliances**	Function test		–		
15	**Electric main engine order telegraph**	Effectiveness test		√		
16	**Signaling systems such as: paging system, sound powered telephone system, fog whistle, etc.**					

Table 2-2-4 (continued)

No.	Items	Content	Stage	Surveyor	Supervisor	Remarks
17	**Automatic telephone system,**	Effectiveness test	**During mooring test**			—
18	Echo sounder		**During mooring test and sea trial**			**With certificate form classification society**
19	Speed log					
20	Gyro compass					
		Error correction	During sea trial	V	V	
21	**GPS satellite navigation system**	Effectiveness test				
22	**Radar, collision avoidance radar**		**During mooring test and sea trial**			
23	**Radio weather facsimile**		During sea trial			
24	GMDSS radio system	**Check for quality of antenna mounting and insulation of antenna**	**During mooring test**			
			During sea trial			
25	Broadcasting station	Effectiveness test	**During mooring test**	—		—

Table 2-2-4 (end)

No.	Items	Content	Stage	Surveyor	Supervisor	Remarks
26	Antenna duplexer	Effectiveness test	**During mooring test and sea trial**	–	√	**With certificate form classification society**
27	**VDR navigation recorder**	Check for installation		√		
28	AIS auto-identifying	and interface				

Table 2-2-5 inspections and tests for automatic control remote control

No.	Items	Content	Stage	Surveyor	Supervisor	Remarks
1	**Main engine remote control test**	Effectiveness test	**During mooring test and sea trial**	√	√	–
2	**Automatic monitoring and alarm devices**		**During mooring test**			
3	**Automatic operation of unattended machinery space**		During sea trial			

PART 3

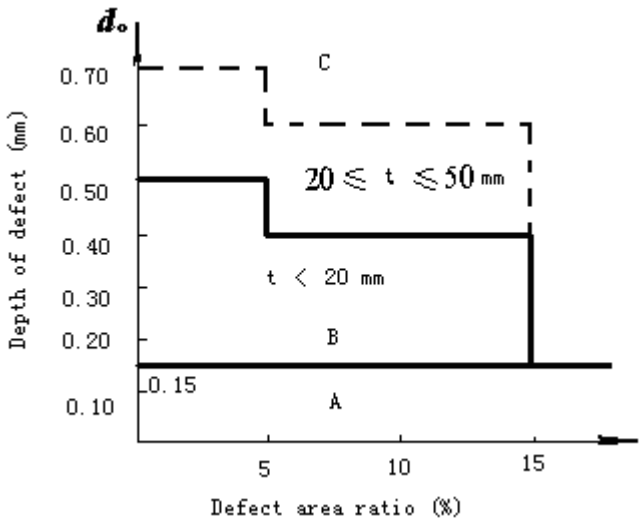
CONSTRUCTION ACCURACY

1 HULL CONSTRUCTION

1.1 Steel materials

1.1.1 Surface defects of steel plates are to be kept within the limits as defined in table 3-1-1.

Table 3-1-1

Items		Requirement
Pits, Flaking, Scars, Scratches and air bubbles	 ***d*。 -- defect area depth, unit in (mm)** ***t* - steel plate thickness, unit in (mm)**	**1) Zone A is in excellent order, with very slight surface defects less than 0.15 mm and no repairing is needed** **2) Zone B is in good order, with a certain amount of permissible surface defects, and no repairing is needed. Area enclosed by full lines denotes plate with thickness less than 20 mm and area enclosed by dotted lines (including straight line) denotes plates with thickness from 20 to 50 mm** **3) Zone C is in disorder, and repairing is needed, i.e. there are certain amount of impermissible surface defects that shall be repaired according to the requirement** **4) Repairing methods for surface defects:** **For d_o <0.07t, and $d_o \leq 3$ mm, by grinding;** **For 0.07t ≤d_o≤0.2t, by built-up welding and followed by grinding;** **In case the defect depth exceeds 20% plate thickness and defect area exceeds 2% plate area, this part of plate is to be replaced as required.**

1.1.2 The negative thickness tolerance for steel plates of hull structure is to be in compliance with the requirement as defined in table 3-1-2.

Table 3-1-2

Items	Requirement
Negative thickness tolerance for steel plates of hull structure	0.3 mm as max.

1.1.3 Lamination of steel plate is to be treated according to table 3-1-3.

Table 3-1-3

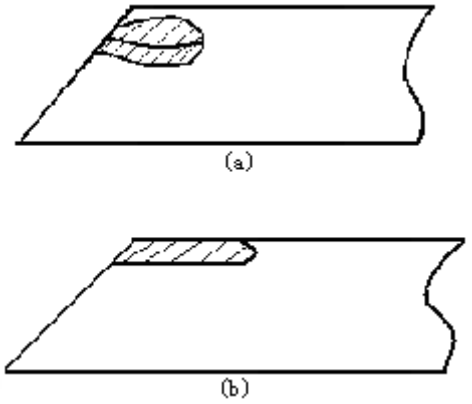
Items		Requirement
Local lamination		**1) In case the lamination defect area < 2% plate area, and defect depth < 20% plate thickness, chipped out and built-up by welding as shown in fig.(a).** **2) In case the range of lamination is fairly small and near the plate surface and defect area < 2% plate area, it is preferable to do the built-up welding as shown in fig.(b).** **3) In case the built-up welding length exceeds 20% the edge length of the steel plate, non-destructive inspection to be done to check the quality**

Table 3-1-3 （end）

Items		Requirement
Severe lamination		**1) In case the lamination defect area > 2% plate area, and defect depth > 20% plate thickness, it is recommended to change part of the plate.** **2) Minimum breadth or length of the part of standard size plate to be replaced are:** **For shell plate or strength deck plate:** **Within 0.6 L amidship: 1600 mm, L for ship length;** **Outside 0.6 L amidship: 800 mm** **For other members: 300 mm or 10 times plate thickness, which ever greater.** **In individual cases, the above values may be reduced to 50 mm + 4t, where t is plate thickness in mm.** **3) The whole plate must be replaced in case the lamination defect area > 5% plate area, and defect depth > 20% plate thickness**

1.1.4 Defects of casting steel surface are to be treated according to table 3-1-4.

Table 3-1-4

Items	Requirement
In case the depth of defect is over 20% plate thickness or the defect is over 25 mm in depth and 150 mm in length	Repairing and building up by appropriate method after non-destructive inspection. After repaired, non-destructive inspection again.
Air bubbles, flaws and other hazardous defects	

1.2 Marking

1.2.1 Position deviation of the marking is to be kept within the limits as defined in table 3-1-5.

Table 3-1-5

Items	Standard range	Allowable limits	Remarks
Centerline, theoretical line, alignment line, check line and installation position line	≤2.0	≤3.0	–

1.2.2 Deviation of marking dimensions of parts and members shall be kept within the limits as defined in table 3-1-6.

Table 3-1-6 **mm**

Items		Standard range	Allowable limits	Remarks
Length		±2.0	±3.0	–
Breadth		±1.5	±2.5	
Difference between diagonals		±2.0	±3.0	For rectangular plate
Curved configuration		±1.5	±2.5	–
Straightness	$l_{。} \leq 3$ m	≤1.0	≤1.2	**For straight edges of part or member, $l_{。}$ for marking line length**
	4m < $l_{。} \leq 8$m	≤1.2	≤1.5	
	$l_{。} > 8$ m	≤2.0	≤2.5	
Angle		±1.5	±2.0	For very meter
Cut out, opening		±1.5	±2.0	–

1.2.3 Deviation of marking dimensions of block structure is to be kept within the limits as defined in table3-1-7.

Table 3-1-7 mm

Items	Standard range	Allowable limits	Remarks
Deviation of marking line of panel block, compared with designed dimensions	±2.5	±3.5	–
Deviation of marking line of member on block, compared with designed position			

1.3 Cutting

1.3.1 Gas cutting

1.3.1.1 Surface roughness of gas cutting is to be kept within the limits as defined in table 3-1-8.

Table 3-1-8 **mm**

Items			Standard range	Allowable limits	Remarks
Free edges of members	**Important members**	Automatic cutting	0.10	0.20	**1) For steel sections, tolerance of mechanical cutting is the same as those for manual cutting** 2) **Burrs on free edge shall be removed**
		Semiautomatic/manual cutting	0.15	0.30	
	Others	Automatic cutting	0.10	0.20	
		Semiautomatic/manual cutting	0.50	1.00	
Welding seams' connecting edges	**Important members**	Automatic cutting	0.10	0.20	
		Semiautomatic/manual cutting	0.40	0.80	
	Others	Automatic cutting	0.10	0.20	
		Semiautomatic/manual cutting	0.80	1.50	

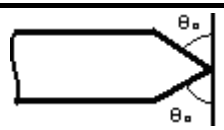
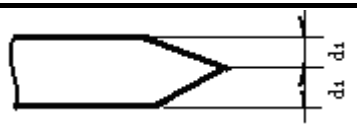
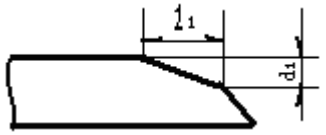
1.3.1.2 Notches of gas cutting ("Notch" is defined as groove 3 times of the surface roughness) are to be kept within the limits as defined in table 3-1-9.

Table 3-1-9 **mm**

Items			Standard range	Allowable limits	Remarks
Free edges of member	**Upper edge of sheer strake, strength deck, and free edge of opening on shell plate within 0.6L amidship; extremely important longitudinals and cantilever beam**		–	No notch	**1) "L" is ship length;** **2) Extremely important longitudinals for: longitudinal structure fitted on shell plate;** **3) Extremely important longitudinals and transverses: strength structures within 0.6 L, longitudinal/transverse girder, beam, bracket, edge of hatch coaming, bracket in after peak tank, edge of main engine foundation and thruster bearing foundation,etc. high stress structure;** **4) Repairing method:** **a) Finishing by grinding** **b) Bead welding may be applied where required, but short bead is to be carefully avoided**
	Important longitudinals and transverses			<1.0	
	Others			<3.0	
Weld edge	Butt weld	**Shell plate and strength deck within area of 0.6L amidship**		<2.0	Notch is to be repaired by grinding or built-up welding
		Other		<3.0	
	Fillet weld			<3.0	

1.3.1.3 Deviation of gas cutting dimension is to be kept within the limits as defined in table 3-1-10.

Table 3-1-10 **mm**

Items			**Standard range**	**Allowable limits**	**Remarks**
Straightness of plate edge	Automatic welding seam		0.4	≤0.5	–
	Semi-automatic and manual welding seam		≤1.5	2.5	
Dimension of groove	**Angle of groove, Θ_0**		±2°	±4°	
	Depth of groove, d_1		±1.5	±2.0	
	Length of taper, l_1		±0.5d_1	±1.0d_1	**As per classification society requirement, l_1 could be taken as $3d_1$, $4d_1$, or $5d_1$**
Size of member	Primary members		±2.5	±4.0	**For example: for members with high accuracy demand such as floors and girders, etc. in double bottom**
	Secondary members		±3.5	±5.0	–
	Breadth of face bar		±2.0	**+4.0 -3.0**	

1.3.2 Shearing

Deviation of shearing dimension is to be kept within the limits as defined in table 3-1-11.

Table 3-1-11 **mm**

Items	Standard range	Allowable limits	Remarks
Length of member	±3.0	±4.0	–
Breadth of member	±2.0	±3.0	
Breadth of face bar, height of ribbed plate	±2.0	±3.0	
Straightness of the edge	≤1.0	≤1.5	
Curved edge	≤1.5	≤2.0	

1.3.3 Planed and milled edges

Deviation of planed and milled edges is to be kept within the limits as defined in table 3-1-12.

Table 3-1-12 **mm**

Items	Standard range	Allowable limits	Remarks
Straightness of the edge	≤0.5	≤1.0	per 10 m in length
Angle of groove	±2º	±4º	—

1.4 Grinding

1.4.1 Deviation of grinding is to be kept within the limits as defined in table 3-1-13.

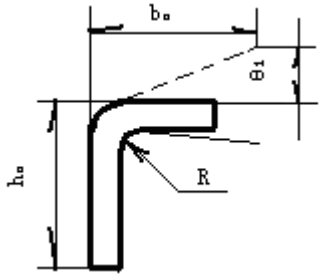
Table 3-1-13 **mm**

Items		Standard range	Allowable limits	Remarks
Free edge grinding radius $R_{。}$	Others	$R_{。}$ = 1 – 1.5	—	—
	Special coating parts	$R_{。} \geqslant 2$		

1.5 Forming

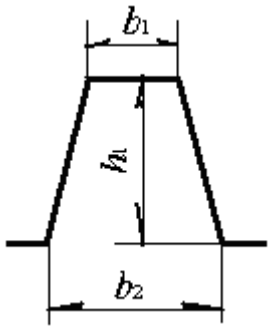
1.5.1 Deviation of flanging is to be kept within the limits as defined in table 3-1-14.

Table 3-1-14 **mm**

Items			Standard range	Allowable limits	Remarks
Breadth of flange, b_0		 R – radius of flange	±3.0	±5.0	–
Depth of web, h_0	**Primary members**		±2.0	±3.0	
	Secondary members		±3.0	±5.0	
Angle of flange, θ_1			±2.5	±4.5	per b_0 = 100
Straightness in the plane of flange			≤10	≤25	per 10 m
Straightness in the plane of web					

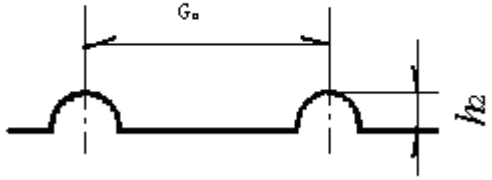
1.5.2 Deviation of channeled is to be kept within the limits as defined in table 3-1-15.

Table 3-1-15 **mm**

Items		Standard range	Allowable limits	Remarks
Depth of channel, h_1		±3.0	±6.0	—
Breadth of channel, b_1, b_2				
Straightness of channel		≤10	≤25	per 10 m

1.5.3 Deviation of corrugated plate is to be kept within the limits as defined in table 3-1-16.

Table 3-1-16 **mm**

Items			Standard range	Allowable limits	Remarks
Depth of corrugation, h_2			±2.5	±5.0	—
Pitch of corrugation, G_0	Connected		±2.0	±3.0	
	Not connected		±6.0	±9.0	

1.5.4 Bending deviation of angles and built-up profiles is to be kept within the limits as defined in table 3-1-17.

Table 3-1-17 **mm**

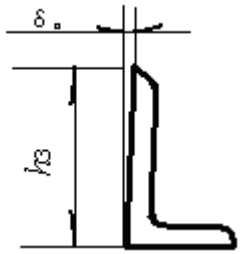
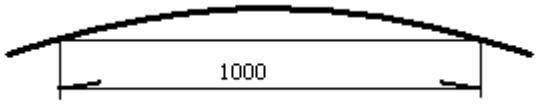
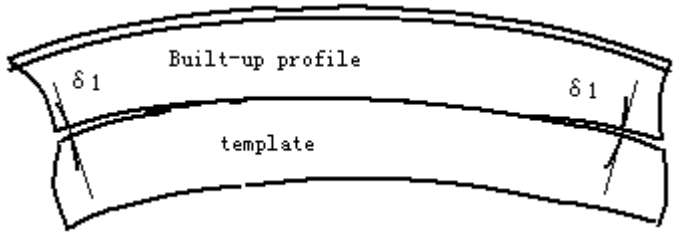
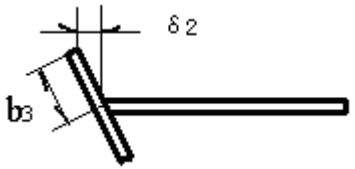
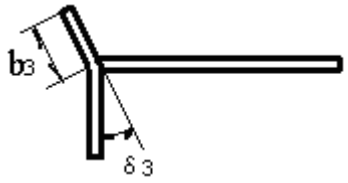
Items		Standard range	Allowable limits	Remarks
Angles	Angle, δ。  Height of angle bar, h_3	±1.5	±2.0	per h_3=100
	 Curvature	±1.0	±1.5	per 1 m in length, compared with template

Table 3-1-17 (end) **mm**

Items		Standard range	Allowable limits	Remarks
Built-up profiles	Deviation of curvature compared with template or check line, δ_1 	±2.0	±4.0	per 10 m in length, compared with template
	Inclination of face plate, δ_2 	±1.5	±3.0	per $b_3 = 100$
	Bending angle of face plate, δ_3 half-breadth of face plate, b_3 	≤3+b3/100	≤5+b3/100	—

1.5.5 Bending deviation of shell plates is to be kept within the limits as defined in table 3-1-18.

Table 3-1-18 **mm**

Items		Standard range	Allowable limits	Remarks
Plate with single curvature	Gap between curved plate and template	≤2.5	≤5.0	**Within each frame spacing**
	Straightness of check line on triangular template			
Plate with double curvature	**Deviation between drawn line and reference line on template**	±2.0	±3.0	
	Gap between plate and box template in breadthwise direction	≤4.0	≤5.0	
	Gap between plate and box template in lengthwise direction	≤3.0		

1.5.6 Heating is to be proceeded according to the requirement as defined in table 3-1-19.

Table 3-1-19 **mm**

Items			Standard range	Allowable limits	Remarks
Maximum heating temperature on surface	**High tensile steel *(TMPC)*** $C_{eq} > 0.38\%$	**Water cooling immediately after heating**	**Under 650°C**	650°C	Calculation equation for carbon equivalent: $C_{eq} = C + Mn/6 + (Cr+Mo+V)/5 + (Ni+Cu)/15$
		Air cooling immediately after heating	**Under 900°C**	900°C	
		Air cooling and subsequently water cooling after heating	**Air cooling under 900°C, water cooling started when temperature below 500°C**	**900°C (air-cooled)** **500°C (water-cooled)**	
	High tensile steel *(TMPC)* $C_{eq} \leq 0.38\%$ **AH~DH**	**Water or air cooling immediately after heating**	**Under 1000°C**	1000°C	
	High tensile steel *(TMPC)* $C_{eq} \leq 0.38\%$ **EH**	**Water or air cooling immediately after heating**	**Under 900°C**	900°C	
	Low temperature steel *(TMPC)*	**Air cooling and subsequently water cooling after heating**	**Air cooling under 900°C, water cooling started when temperature below 550°C**	**900°C (air-cooled)** **550°C (water-cooled)**	

1.6 Fixing and assembling

1.6.1 Fixing and assembling of various welding joints

1.6.1.1 Position deviation of fillet welding joints is to be kept within the limits as defined in table 3-1-20

Table 3-1-20 **mm**

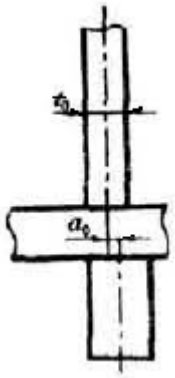
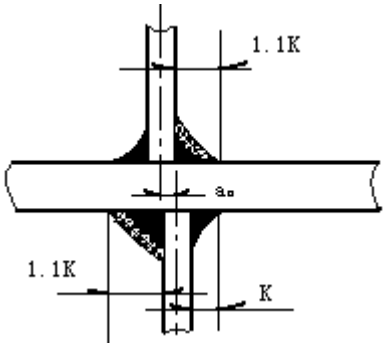
Items			Standard range	Allowable limits	Remarks
Alignment of cross joint		**Primary structure (longitudinal-Stressed members)**	≤ t。/4	≤ t。/3	1) when $t_0/3 < a_。 \leqslant t_0/2$, leg length is to be increased as shown in the figure  2) when $a_。 \geqslant t_0/2$, joint shall be re-fixed (disassembling distance to be bigger than 50 $a_。$).
	$a_。$ is misalignment $t_。$ is thickness of thinner plate	**Others (stressed members)**	≤ t。/3	≤ t。/2	**When deviation is over above data, joint shall be re-fixed (disassembling distance to be bigger than 30 $a_。$)**

Table 3-1-20(continued) **mm**

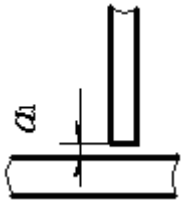
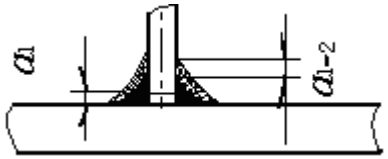
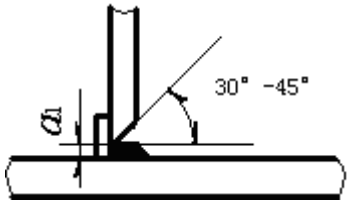
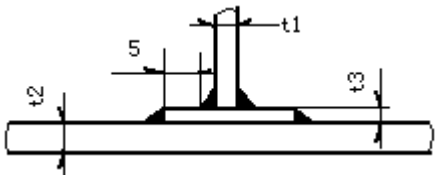
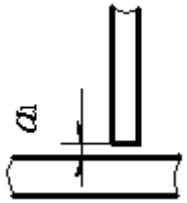
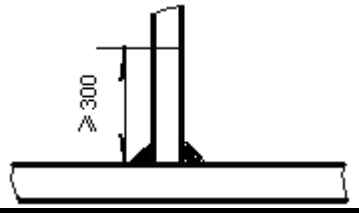
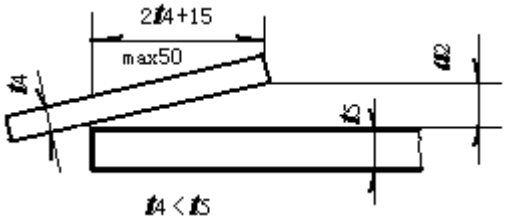
Items		Standard range	Allowable limits	Remarks
Gap before fillet welding	 a_1 is gap between two plate t_1, t_2 for thickness of two fillet plate	≤2.0	≤3.0	Treatment for exceeding allowable limits: 1) when 3< a_1 ≤ 5, leg length shall be increased by (a_1-2)  2) when 5< a_1 ≤ 16, a) add liner or do built-up welding. If liner is removed, back-up welding must be adopted  b) add pad plate and do welding. The pad thickness t_3 shall be $t_1 \le t_3 \le t_2$ 

Table 3-1-20(end) **mm**

Items		Standard range	Allowable limits	Remarks
Gap before fillet welding	 a_1 is gap between two plate	≤2.0	≤3.0	3) when a_1 >16, renew the plate, with cutting height ≥300 mm 

1.6.1.2 Deviation of lapping gap is to be kept within the limits as defined in table 3-1-21

Table 3-1-21 **mm**

Items		Standard range	Allowable limits	Remarks
a_2 is gap between two plate t_4 is thickness of thinner plate t_5 is thickness of thicker plate		≤2.0	≤3.0	**Treatment for exceeding allowable limit:** 1) when 3< a_2 ≤ 5, leg length is to be increased by (a_2-3) 2) when a_2 >5, re-fixing is required

1.6.1.3 Deviation of butt welding joints is to be kept within the limits as defined in table 3-1-22

Table 3-1-22 **mm**

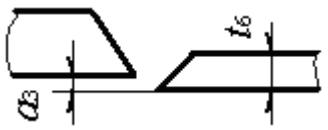
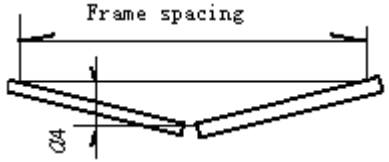
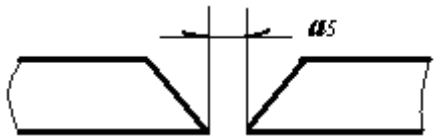
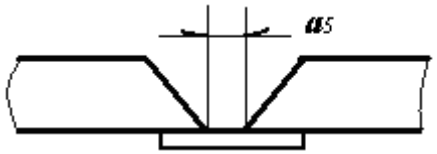
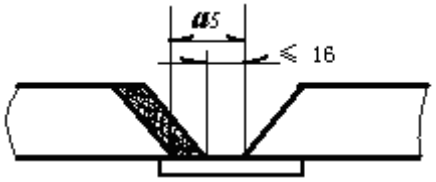
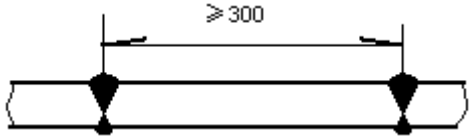
Items			Standard range	Allowable limits	Remarks
Misalignment	 a_3 is misalignment t_6 is thickness of thinner plate	**Primary members**	$\leq 0.1t_6$ and ≤ 3	$\leq 0.15t_6$ and ≤ 3	**Those exceeding allowable limit are to be re-fixed**
		Secondary members	$\leq 0.15t_6$ and ≤ 3	$\leq 0.2t_6$ and ≤ 3	
Flatness	 a_4 is flatness of plate		≤ 2.0	≤ 3.0	**Those exceeding allowable limit are to be flattened by adding technological plates**

Table 3-1-22 (end) **mm**

Items			Standard range	Allowable limits	Remarks
Gap between roots by manual welding, CO2 welding	 a_5 is gap between roots	**Manual welding, CO2 welding**	0~3.5	≤5.0	**Treatment for exceeding allowable limit:** 2) when 16< a_5 ≤ 25, a) Add backing material and weld the front b) Remove backing material and finish back weld 
		CO2 one side welding (with backing material)	2≤ a_5 ≤ 8	a_5 ≤ 16	3) when 5< a_5 ≤ 16, a) Add backing material. Weld main seam only after one slope of the front is in correct form dimension b) Remove backing material and finish back weld  4) when a_5 >25, renew the plate partially and refit 

1.6.1.4 Deviation between welds is to be in accordance with the limits as defined in table 3-1-23

Table 3-1-23 **mm**

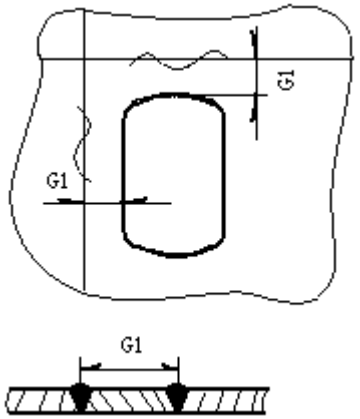
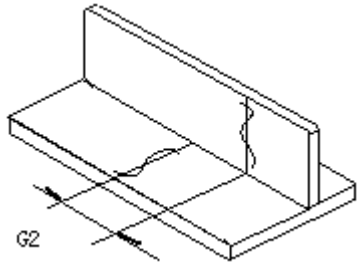
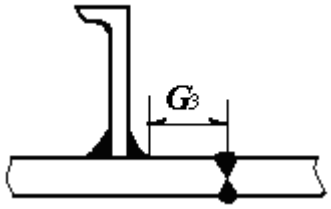
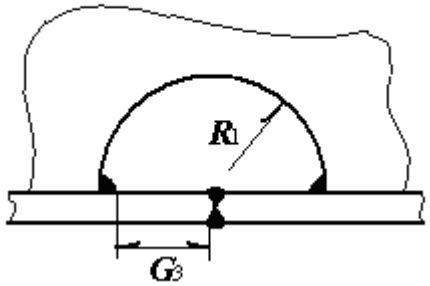
Items			Standard range	Allowable limits	Remarks
Gap between butt welding,	 ***G1*** is distance between two welding seams on the same plane	**For butt weld to open**	–	≥30	In case the details of construction are not defined in the approved plans, they shall be decided by mould lofting or in shop drawings, they are to be decided within the limits as given in the sketch shown left
		For butt weld on bilge shell plate	≥300	≥150	
	 ***G2*** is distance between two welding seams on the cross planes		–	≥0	

Table 3-1-23 (end) **mm**

Items			Standard range	Allowable limits	Remarks
Between butt weld and fillet weld		**Primary members**	–	≥10	–
		Secondary members		≥0	
		**Primary members**		≥5	
	G_3 is distance between two welding seams of butt weld & fillet weld R_1 is diameter of open hole, $R_1 \geq 30$	**Secondary members**		≥0	

1.6.2 Sub-assembling

1.6.2.1 Accuracy of installation dimensions for flat and curved sub-assemblies is to be in compliance with the requirements as defined in table 3-1-24

Table 3-1-24 **mm**

Items		**Standard range**	**Allowable limits**	**Remarks**
Breadth of sub-assembly	Flat	±4	±6	–
	Curved		±8	
Length of sub-assembly	Flat		±6	
	Curved		±8	
Squareness of sub-assembly	Flat	≤4	≤8	**Deviation of diagonals of final marking**
	Curved	≤10	≤15	
Distortion of sub-assembly			≤20	**Measured on face plates of beam or girder**

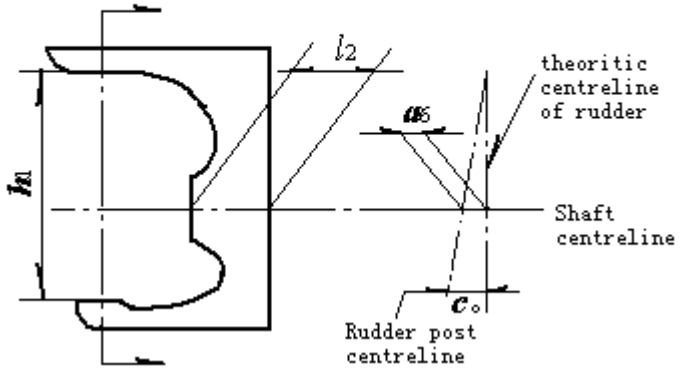
1.6.2.2 Accuracy of installation dimensions of block assemblies is to be in compliance with the requirements as defined in table 3-1-25

Table 3-1-25 **mm**

Items		**Standard range**	**Allowable limits**	**Remarks**
Centerlines of upper and lower planes	Flat block	≤5	≤10	–
	Curved block	≤7	≤15	
Frame lines of upper and lower planes	Flat block	≤5	≤15	
	Curved block	≤7	≤15	
Twist of assembly (for large rigid block assembly)	Flat block	≤10	≤20	**Method of measuring: take three points of the main plane to form a plane and measure the deviation of another point against this plane.**
	Curved block	≤15	≤25	
Height of members at same level		±4	±6	–
Height of member at two different levels		±5	±10	
Others		**Same as for plane and curved sub-assemblies in table 3-1-24**		

1.6.2.3 Accuracy of installation dimensions of block assemblies of stern frame is to be in compliance with the requirements as defined in table 3-1-26

Table 3-1-26 **mm**

Items		Standard range	Allowable limits	Remarks
Distance between upper and lower carrier h_1		±5	±10	–
Distance between aft edge of boss and aft peak bulkhead l_2				
Inclination of sub-assembly, c_o		≤5	≤10	
Deviation of rudder post centerline from shaft centerline, a_6		≤4	≤8	
Others		**Same as for those table 3-1-25**		

1.6.2.4 Accuracy of installation dimensions of block assemblies including main engine foundation is to be in compliance with the requirements as defined in table 3-1-27

Table 3-1-27 **mm**

Items	Standard range	Allowable limits	Remarks
Flatness of face plate of main engine foundation	≤5	≤10	–
Length and breadth of face plate of main engine foundation	±4	±6	
Deviation between M/E foundation longitudinal girder and block centerline	±2	±4	
Others	**Same as for plane and curved sub-assemblies in table 3-1-25**		

1.6.3 Assembling on slipway

Assembling deviation on the slipway is to be kept within the limits as defined in table 3-1-28

Table 3-1-28 **mm**

Items		Standard range	Allowable limits	Remarks
Centerlines	**Double bottom sub-assembly and slipway**	≤3.0	≤5.0	–
	Deck, platform, transverse bulkhead and double bottom	≤5.0	≤8.0	
	Fore/aft terminal points and slipway	<0.1% h_5	<0.15% h_5	h_5 **is height of fore/aft terminal points**
	Superstructure and deck	≤4.0	≤8.0	–
	Centerlines of upper rudder carrier and slipway			
	Center of stern shaft hole and centerline of slipway	≤5.0		
Levelness	**Levelness at four corners of bottom platform and deck**	≤8.0	≤12.0	
	Levelness of bulkhead (port/starboard, fore/aft)	≤4.0	≤6.0	
	Levelness of side sub-assembly (fore/aft)	≤5.0	≤10.0	
	Levelness at four corners of superstructure	≤10.0	≤15.0	

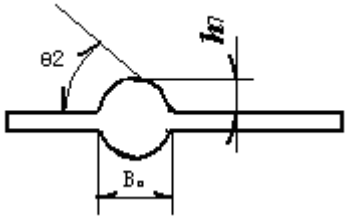
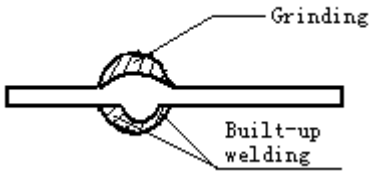
Table 3-1-28 (end) **mm**

Items		Standard range	Allowable limits	Remarks
Height of positioning	Bulkhead	±3.0	±6.0	–
	Side sub-assembly	±5.0	±8.0	
	Superstructure	≤10.0	≤15.0	
Frame spacing at sub-assembly joint		±10.0	±20.0	
Perpendicularity of bulkhead		**≤0.1% h_6 and <10.0**	**≤0.12% h_6 and <12.0**	**h_6 is height of bulkhead**

1.7 Welding

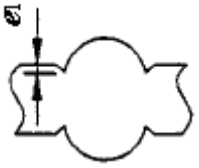
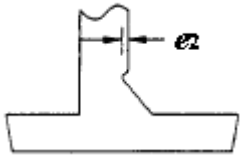
1.7.1 Deviation of welding dimensions is to be kept within the limits as defined in table 3-1-29

Table 3-1-29 **mm**

Items		Standard range	Allowable limits	Remarks
Height of bead, h_7	 B0 is breadth of head	≤0.2B。	≤6.0	Methods of repairing: 
Flank angle, θ_2		≤60°	<90°	

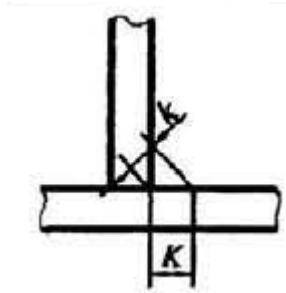
1.7.2 The requirements for weld under-cuts are defined in table 3-1-30

Table 3-1-30 **mm**

Items		Standard range	Allowable limits	Remarks
 e_1 is the under cut of butt weld	Primary members	–	≤0.5	**1) e_1 / e_2 is between 0.5 ~ 0.8, the sharp cutting edge is to be repaired even if angle of under cut is larger than 90°** **2) The sharp configuration of fillet weld is to be repaired**
	Secondary members		≤0.8	
 e_2 is the under cut of fillet weld				

1.7.3 Deviation of fillet welding dimensions is to be kept within the limits as defined in table 3-1-31

Table 3-1-31 **mm**

Items	Standard range	Allowable limits	Remarks
Specified dimension of welding, *K* **Actual dimension of welding, K_a** **Specified throat depth, *k*** **Actual throat depth, k_a** 	–	$K_a \geq 0.9K$ $k_a \geq 0.9k$	**In case it is not within allowable limits, weld-up over it with fine electrodes is required, avoid short bead.**

1.7.4 The requirements for short bead, tack welding and repairing bead are defined in table 3-1-32

Table 3-1-32 mm

Items		Standard range	Allowable limits	Remarks
Tack welding bead repairing of scar	H.T. steel, Cast steel TMCP type H.T. steel (Ceq＞0.36%) Low temp steel (Ceq＞0.36%)	–	≥50	**In case bead length is less than allowable limits, preheating at 100°c±25°c is necessary.** **When short bead is made erroneously, remove the bead by grinding, and weld over tolerable head length after confirmed crack.** **Tolerance of carbon content Ceq is to see table 3-1-19**
	Grade E of mild steel		≥30	
	TMCP type H.T. steel (Ceq≦0.36%) Low temp steel (Ceq≦0.36%)		≥10	
Repairing of welding bead	H.T. steel, Cast steel TMCP type H.T. steel (Ceq＞0.36%) Low temp steel (Ceq＞0.36%)		≥50	
	Grade E of mild steel		≥30	
	TMCP type H.T. steel (Ceq≦0.36%) Low temp steel (Ceq≦0.36%)			

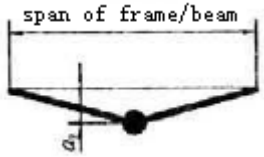
1.7.5 Arc-strike is to be in compliance with the requirements as defined in table 3-1-33

Table 3-1-33 **mm**

Items		Standard range	Allowable limits	Remarks
Arc strike	**H.T. steel Cast steel Grade E of mild steel TMCP type H.T. steel Low temp steel**		**Not allowed**	**In case arc-strike was made, do repairing as below: a) Weld over a short bead over 50mm on the arc-strike b) Remove the hardened zone by grinding**
Temperature required pre-heating	TMCP type H.T. steel (Ceq≦0.36%) Low temp steel (Ceq≦0.36%)	–	**≤ 0 °c**	**In case where Ceq of each plate are different in joint, tolerance of higher Ceq to be applied. Tolerance of carbon content Ceq is to see table 3-1-19**
	Cast steel H.T. steel(Ceq>0.36%) TMCP type H.T. steel (Ceq>0.36%) Low temp steel (Ceq>0.36%)		**≤ 5 °c**	
	Mild steel		**≤ - 5 °c**	**–**

1.7.6 Welding joint distortion is to be kept within the limits as defined in table 3-1-34

Table 3-1-34 **mm**

Items		Standard range	Allowable limits	Remarks
Shell plate between 0.6 L amidship	 a_7 is distortion of shell plate in frame span	–	≤6	**L is the length of ship.** **In case it exceeds allowable limits, it is to be repaired by line heating or to be re-welded after cutting and re-fitting.**
Shell plate at fore and aft ends			≤7	
Others			≤8	

1.8 Fairness and finishing

1.8.1 Fairness

1.8.1.1 Local fairness is to be compliance with the requirements as defined in table 3-1-35

Table 3-1-35 **mm**

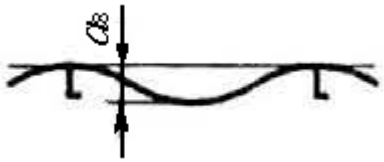
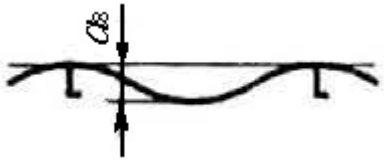
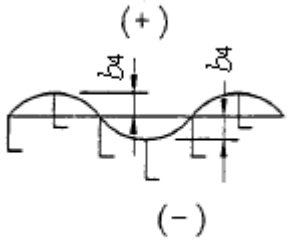
Items		Standard range	Allowable limits	Remarks
Shell plate	**Parallel midbody (side plate, bottom plate)**	≤4	≤6	 For every frame spacing, a_8 is fairness
	Fore and aft curved parts	≤5	≤7	
Double bottom	**Tank top plate**	≤4	≤6	
Bulkhead		≤6	≤8	
Upper deck	**Parallel midbody (including longitudinal and transverse structure)**	≤4	≤6	
	Fore and aft curved parts	≤6	≤8	
	Non-exposed part	≤7	≤9	

Table 3-1-35 (end) **mm**

Items		Standard range	Allowable limits	Remarks
Second deck	**Exposed part**	≤6	≤8	 For every frame spacing, a_8 is fairness
	Non-exposed part	≤7	≤9	
Superstructure deck	**Exposed part**	≤4	≤6	
	Non-exposed part	≤7	≤9	
House walls	**Exposed part**	≤4	≤6	
	Both sides of non-exposed part	≤7	≤9	

1.8.1.2 Overall fairness is to be compliance with the requirements as defined in table 3-1-36

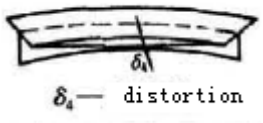
Table 3-1-36 **mm**

<table>
<tr><th colspan="2">Items</th><th>Standard range</th><th>Allowable limits</th><th>Remarks</th></tr>
<tr><td rowspan="2">Shell plate</td><td>Parallel midbody</td><td>± l_3/1000</td><td>± 3l_3/1000</td><td rowspan="6"> 

l_3 is measuring length, meter(m) as a unit
b_4 is overall fairness
Measuring method:
Minimum measuring length l_3=3m but about 5m for bulkhead and outside wall</td></tr>
<tr><td>Fore and aft parts</td><td rowspan="2">± 3l_3/1000</td><td rowspan="2">± 4l_3/1000</td></tr>
<tr><td colspan="2">Deck, platform and tank top plate</td></tr>
<tr><td colspan="2">Bulkhead</td><td>± 4l_3/1000</td><td>± 5l_3/1000</td></tr>
<tr><td rowspan="2">Superstructure</td><td>Deck</td><td>± 3l_3/1000</td><td>± 4l_3/1000</td></tr>
<tr><td>Outside wall</td><td>± 2l_3/1000</td><td>± 3l_3/1000</td></tr>
<tr><td colspan="2">Others</td><td>± 5l_3/1000</td><td>± 6l_3/1000</td></tr>
</table>

1.8.1.3 Straightness of inner supporting members is to be defined in table 3-1-37

Table 3-1-37 **mm**

Items		Standard range	Allowable limits	Remarks
Main members, such as strength beam, web frame, floor and deep deck girder (with length of 1 span) 		≤ 5	≤ 8	–
Others members, such as longitudinal, frame, beam and stiffener, with length l_4  δ_4 – distortion, l_4 – length of member	$l_4 \geq 1000$	≤ 10	≤ 13	
	$l_4 < 1000$	≤ 5	≤ 8	
"H" type pillar between decks 		≤ 4	≤ 6	
Others		≤ 6	≤ 10	

1.8.2 Finishing

1.8.2.1 Staging sockets and lifting eye pieces are to be finished according to the requirements as defined in table 3-1-38

Table 3-1-38 **mm**

Items		Requirments	Remarks
Staging sockets	In water and oil tanks	May be retained totally	1) After cutting off those lifting eye pieces affecting appearance and passage, the surface is to be finished as flush as the base plate 2) Such pieces may be removed by gas cutting at other places, root may be retained, but for parts especially important to strength, built-up welding is to be made to smooth and flushing after cutting
	In engine room	Only those affecting appearance and passage is to be removed	
	In cargo hold	Only those of lower level and on hatch coaming is to be moved	
	On exposed part of shell and upper deck, etc.	To be removed totally	
Lifting eye pieces	In water and oil tanks	May be retained provided not effecting passage	
	In cargo hold	10 mm of root may be retained on back side of deck plate	
	On exposed part of shell and upper deck, etc.	To be removed totally	Except fixed eye pieces

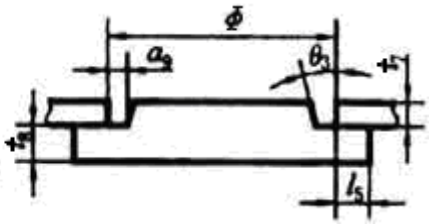
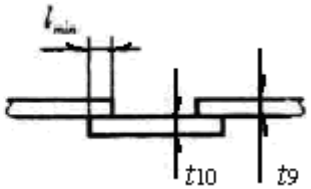
1.8.2.2 Temporary pieces are to be finished according to the requirements as defined in table 3-1-39

Table 3-1-39 **mm**

Items	Requirments	Remarks
Where good appearance is required	**Outside surface of shell plate, deck and superstructure are to be chipped flush and smooth. Under-cut of temporary pieces may have a depth of 0.5 mm. Above this limit, the cut is to be welded over and grinded flush.**	**Temporary pieces are not to be fixed or to be kept as less as possible on sheer strakes and on corner plate of strength deck with under-cuts welded over and grinded flush completely**
Where good appearance is not required	**Temporary piece inside holds and similar places are to be chipped off if they are at particularly conspicuous places. Under-cut may have a depth of 0.5~1.0mm and a length not more than 30mm. Over these limits they may be welded over and finished, but may be not chipped off and grinded.**	**–**

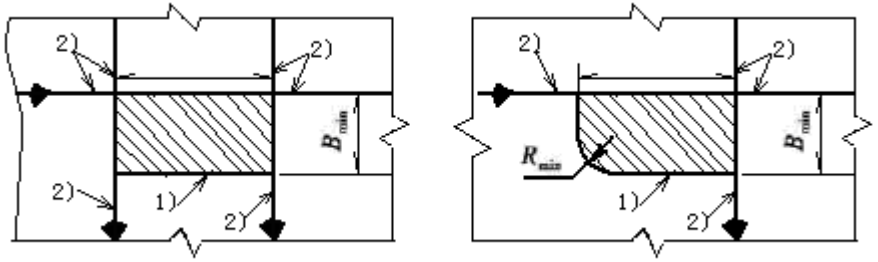
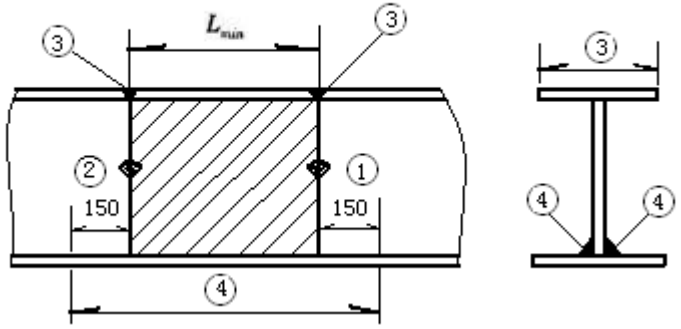
1.8.2.3 Holes made erroneously are to be treated according to the requirements as defined in table 3-1-40

Table 3-1-40 **mm**

<table>
<tr><th colspan="2">Items</th><th>Allowable limits</th><th>Method of treatment</th></tr>
<tr><td rowspan="2">Φ < 200</td><td>Main strength members on shell plate or upper deck</td><td>Cut an opening over 75 in diameter, then treat by method A.
Cut an opening over 200 in diameter, then treat by method B.</td><td rowspan="4">Method A: Spigot patch
$l_5 = 50$; $4 \leqslant a_9 \leqslant 6$;
$0.5 \leqslant t_8 \leqslant t_7$; $30° \leqslant \theta_3 \leqslant 40°$
 
Φ – diameter of round plate.
l_5 – length of connecting flange on spigot patch
Θ_3 – angle of groove
a_9 – gap between welding seams
t_7 , t_8 – thickness of plates
Method B: Repair and weld by insert plate(butt weld)
Method C: Built up and repair by lap welding (to same thickness as base plate)
$t_9 = t_{10}$; $l_{min} = 50$;
l_{min} — min. length of connecting plate
t_9, t_{10} — thickness of lapping piece
 
Method D: If is difficult from structural point of view to cut an opening over 200 in diameter, it may be processed by low hydrogen electrode after preheating and followed by radiographic examination or ultrasonic inspection.</td></tr>
<tr><td>Others</td><td>Cut an opening over 200 in diameter, then treat by method B, C or D.</td></tr>
<tr><td rowspan="2">$\Phi \geqslant 200$</td><td>Main strength members on shell plate or upper deck</td><td>Treat by method B.</td></tr>
<tr><td>Others</td><td rowspan="2">Treat by method B or C.</td></tr>
<tr><td colspan="2">Triangular opening, scallop, rectangular opening</td></tr>
</table>

1.8.2.4 Repairing by insert piece is to be done according to the requirements as defined in table 3-1-41

Table 3-1-41 **mm**

Items		Allowable limits	Method of treatment
Repairing by insert piece	**Minimum length of insert piece, L_{min}**	**300**	1) Seam with insert piece is to be welded first 2) Original seam is to be welded over at least for 150 at one end 
	Minimum breadth of insert piece, B_{min}		
	Minimum roughness of insert piece, R_{min}	**5 times plate thickness, but≥100**	
Repairing welding by insert piece for composite unit	**Minimum length of insert piece, L_{min}**	**300**	Welding procedure: ①→②→③→④ 

1.9 Principal dimensions and deformation

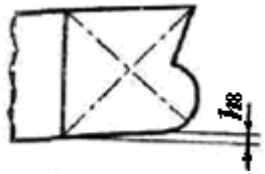
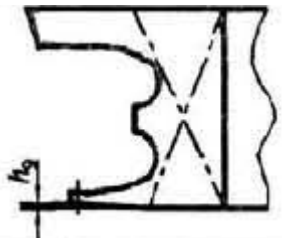
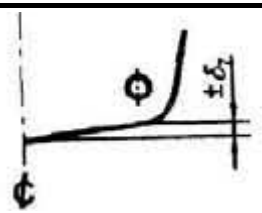
1.9.1 Deviation of principal dimensions is to be kept within the limits as defined in table 3-1-42

Table 3-1-42 **mm**

Items	Standard range	Allowable limits	Remarks
Overall length or length between perpendiculars, *L*	$\pm L/1000$	–	–
Moulded breadth, *B*	$\pm B/1000$		
Moulded depth, *D*	$\pm D/1000$		

1.9.2 Deformation of hull form is to be kept within the limits as defined in table 3-1-43

Table 3-1-43 mm

Items			Standard range	Allowable limits	Remarks
Deflection of keel centerline	Deflection δ_5 Within whole length between fore and aft peak tanks		± 25	± 35	–
	Deflection δ_6 Distance between adjacent transverse bulkheads		± 15	± 20	
Warping-up	Cocking-up of bow, h_8		± 30	± 40	
	Warping-up of stern, h_9		± 20	± 30	
	Transversely warping-up or sagging-down, δ_7		± 15 (per 10m of breadth)	± 25 (per 10m of breadth)	

1.10 Draught and freeboard marks

1.10.1 Deviation of draught mark is to be kept within the limits as defined in table 3-1-44

Table 3-1-44 **mm**

Items	Standard range	Allowable limits	Remarks
Deviation in regard to the straight ruler	± 1.0	± 2.0	–

1.10.2 Deviation of freeboard mark is to be kept within the limits as defined in table 3-1-45

Table 3-1-45 **mm**

Items	Standard range	Allowable limits	Remarks
Deviation in regard to the template	± 1.0	± 1.0	–

2 HULL OUTFITTING

2.1 Rudder

2.1.1 The rudder plate and rudder stock are to be manufactured in accordance with the requirements as defined in table 3-2-1

Table 3-2-1 **mm**

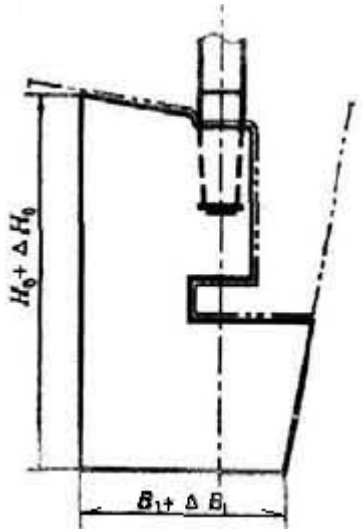
Items			Standard range	Allowable limits	Remarks
Rudder plate  H_0 – *rudder plate height,* B_1– *rudder plate width*	**Deviation of rudder plate height, ΔH_0**	$H_0 \leq 8$ m	± 4	± 6	–
		$H_0 > 8$ m	± 0.5 H_0/1000	± H_0/1000	
	Deviation of rudder plate width, ΔB_1	$B_1 \leq 8$ m	± 4	± 6	
		$B_1 > 8$ m	± 0.5 B_1/1000	± B_1/1000	

Table 3-2-1 (continued) mm

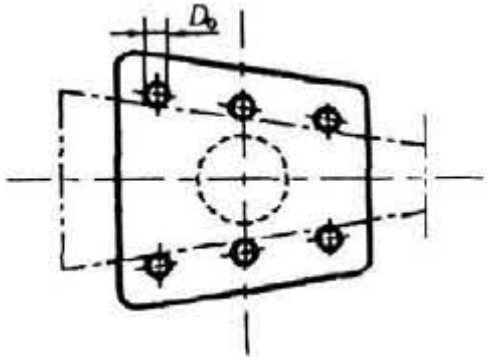
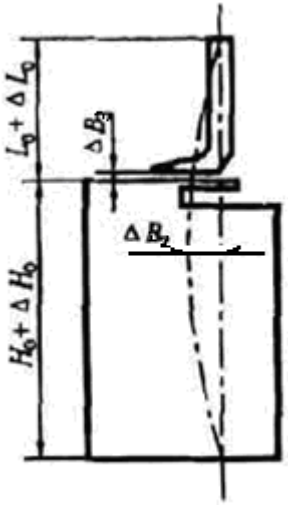
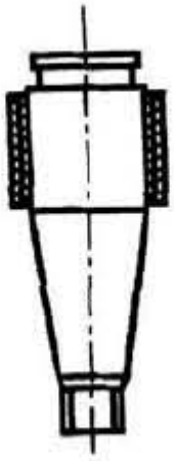
Items		Standard range	Allowable limits	Remarks
Reamer bolt hole and reamer bolt 	Roundness of bolt hole	≤ 0.01		–
	Cylindricity of bolt hole	≤ 0.02		
	Roundness of bolt	≤ 0.01		
	Cylindricity of bolt	≤ 0.02		
	Oversize of bolt, ($d_2 - D_0$)	0.005 ~ 0.015	> 0	d_2 –bolt diameter D_0–hole diameter
Connection of rudder plate and rudder stock 	Deviation of rudder stock length, ΔL_0	± 3	–	–
	Deviation of total length, $\Delta H_0 + \Delta L_0$	± 5		
	Offset of centerlines of rudder plate and rudder stock after installation, ΔB_2	≤ 0.30	≤ 0.50	
	Clearance between stock and rudder plate flange after installation, ΔB_3	≤ 0.03	≤ 0.05	The allowable inserting depth of 0.05 feeler shall not exceed 15
L_0 –length of rudder stock, H_0–height of rudder plate	Contact area of flange	> 70%	–	–

Table 3-2-1 (end) mm

Items		Standard range	Allowable limits	Remarks
Pintle 	**Contact area between taper part and rudder plate**	**> 70%**	**> 60%**	**–**
	Oversize of pintle when fitted with stainless steel sleeve, d_3-d_4	**[(5~10) d_3]/10000**		**d_3 is outside diameter of pintle,** **d_4 is inside diameter of sleeve,**
	Oversize of pintle when fitted with bronze sleeve, d_3-d_4	**[(10~20) d_3]/10000**		

2.1.2 The rudder is to be installed according to the requirements as defined in table 3-2-2

Table 3-2-2 **mm**

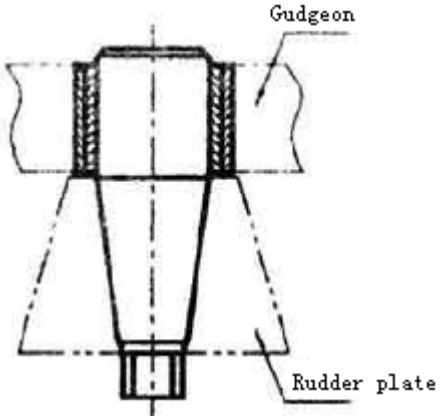
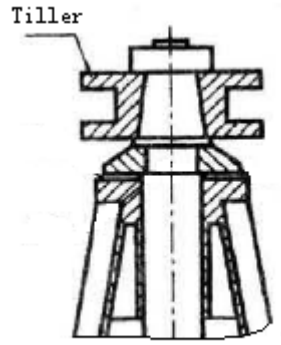
Items		Standard range	Allowable limits	Remarks
Gudgeon 	**Oversize when fitted with stainless steel bush, (d_5-d_6)**	**0 ~ 0.05**		d_5 is outside diameter of bush, d_6 is inside diameter of gudgeon. **Oversize with other material's bush, to be following production's instruction**
	Oversize when fitted with bronze bush, (d_5-d_6)			
	Oversize when fitted with lignum-vitae bush, (d_5-d_6)			
	Oversize when fitted with phenol resin bush, (d_5-d_6)	**0.30 ~ 0.50**	**0.50 ~ 0.70**	
Tiller 	**Oversize with cylinder part of rudder stock**	**> 0**		–
	Oversize with key	**0.005 ~ 0.015**	**> 0**	
	Contact area with rudder stock taper	> 70%		

Table 3-2-2 (continued) mm

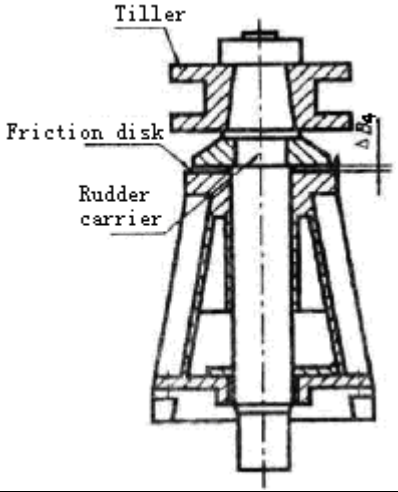
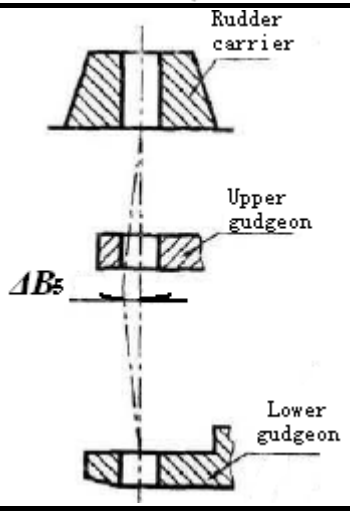
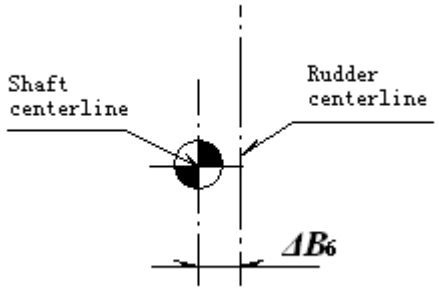
Items		Standard range	Allowable limits	Remarks
Rudder carrier 	**Contact area between rudder Carrier and friction disk**	> 50%		–
	Clearance between rudder Carrier and friction disk, ΔB_4	**≤ 0.05**		
Centerline of rudder system 	**Deviation of centerline for rudder carrier, upper/lower gudgeons after boring (in both fore and aft direction and athwartship direction), ΔB_5**	**≤ 0.3**	**≤ 0.5**	

Table 3-2-2 (end) **mm**

Items		Standard range	Allowable limits	Remarks
Shaft centerline against Rudder centerline 	**Offset of rudder centerline and shaft centerline, ΔB_6**	**≤ 4**	**≤ 8**	**–**

2.2 Mast, deck crane post and derrick boom

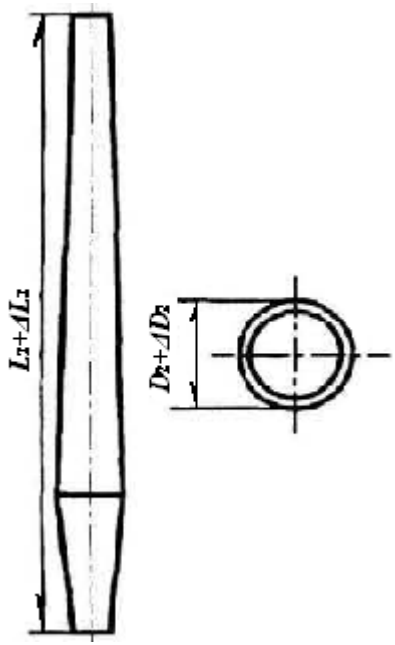
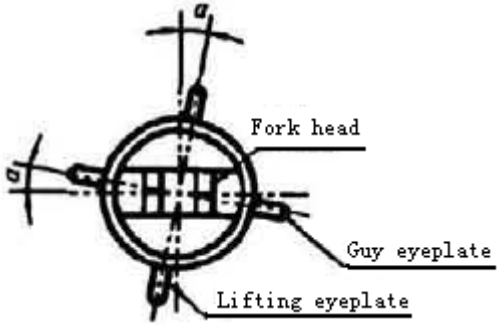
2.2.1 Mast and deck crane post are to be manufactured in accordance with the requirements as defined in table 3-2-3

Table 3-2-3 **mm**

Items	Standard range	Allowable limits	Remarks
Deviation of diameter	**$\pm D_1/200$ But max. ± 5.0**	**$\pm D_1/150$ But max. ± 7.5**	**D_1 is diameter of post**
Straightness	**$\leq L_1/1000$ and ≤10**	**$\leq 1.5L_1/1000$ and ≤15**	**L_1 is total length of deck carne post or mast**

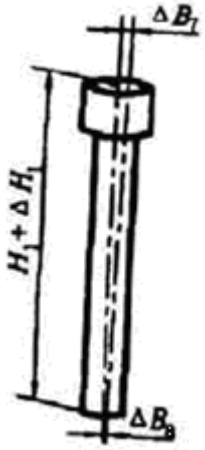
2.2.2 Derrick boom is to be manufactured in accordance with the requirements as defined in table 3-2-4

Table 3-2-4 **mm**

Items		Standard range	Allowable limits	Remarks
Derrick boom  **L_2 is length of crane post** **D_2 is diameter of crane post**	**Deviation of length, ΔL_2**	±7	±10	–
	Linearity	**≤ 5**	**≤ 10**	
	Deviation of diameter, ΔD_2	**± D_2/100**	**± 2D_2/100**	
Appendage  	**Roundness at the installing place of fork head of boom**	**≤ 1**	**≤ 2**	
	Deviation angle between fork head of boom and eyeplate, *a*	**≤ 1°**	**≤ 2°**	

2.2.3 Mast and deck crane post are to be installed according to the requirements as defined in table 3-2-5

Table 3-2-5 **mm**

Items		Standard range	Allowable limits	Remarks
 **H_1 is height of mast or crane post after installation**	**Deviation of centerline position of mast and crane post, ΔB_7**	**≤ 3**	**≤ 5**	–
	Verticality, ΔB_8	**≤ 1.0H_1/1000**	**≤ 2.0H_1/1000**	
	Deviation of height, ΔH_1	±10		

2.3 Cargo hold hatchcover

2.3.1 The manufacturing of hatchcover is to be according to the requirements as defined in table 3-2-6

Table 3-2-6 **mm**

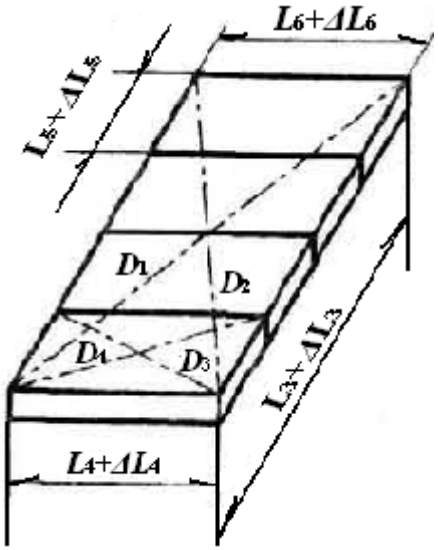
Items				Standard range	Allowable limits	Remarks
Deviation of dimensions of whole hatchcover and single cover part  **L_3 – longitudinal length of whole hatchcover,** **L_4 – transverse breadth of whole hatchcover,** **L_5 – longitudinal length of single panel,** **L_6 – transverse breadth of single panel,** **ΔL_3, ΔL_4, ΔL_5, ΔL_6 – Deviation of each length/breadth**	**L_3 or L_5 or L_6**	>1000~2000	**ΔL_3 or ΔL_5 or ΔL_6**	±3	±4	–
		>2000~4000		±4	±5	
		>4000~8000		±5	±6	
		>8000~12000		±6	±7	
		>12000~16000		±7	±8	
		>16000~20000		±8	±9	
		>20000~24000		±9	±10	
		>24000~28000				
		>28000				

Table 3-2-6 (continued) mm

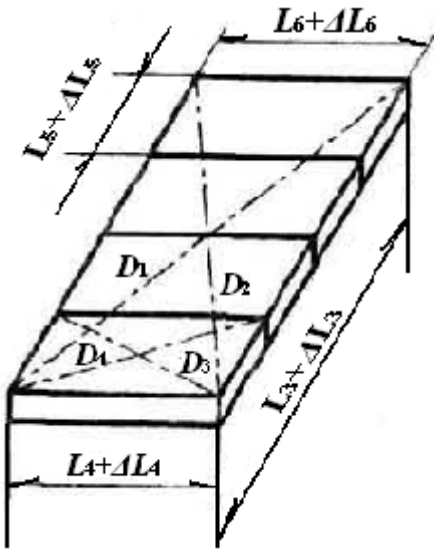
Items				Standard range	Allowable limits	Remarks
Deviation of dimensions of whole hatchcover and single cover part  **D_3, D_4 – diagonal length of whole hatchcover,** **D_5, D_6 – diagonal length of single panel,**	L_4	>1000~2000	ΔL_4	±3	±4	–
		>2000~4000		±5	±6	
		>4000~8000		±7	±8	
		>8000~12000		±9	±10	
		>12000~16000		±11	±12	
		>16000~20000		±13	±14	
		>20000~24000		±15	±16	
		>24000~28000		±16	±17	
		>28000				

Table 3-2-6 (continued) **mm**

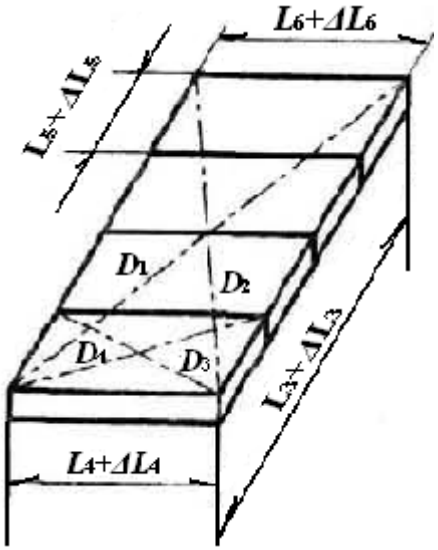
Items				Standard range	Allowable limits	Remarks
Deviation of dimensions of whole hatchcover and single cover part  **D_3, D_4 – diagonal length of whole hatchcover,** **D_5, D_6 – diagonal length of single panel,**	**L_3 or L_4 or L_5 or L_6**	>1000~2000	**Diagonal length (D_3 - D_4) or (D_5 - D_6)**	±6	±8	**L_3, L_4 or L_5, L_6, Whichever smaller**
		>2000~4000		±7	±9	
		>4000~8000		±8	±10	
		>8000~12000		±10	±12	
		>12000~16000		±11	±13	
		>16000~20000		±12	±14	
		>20000~24000		±13	±15	
		>24000~28000		±14	±16	
		>28000				

Table 3-2-6 (continued) **mm**

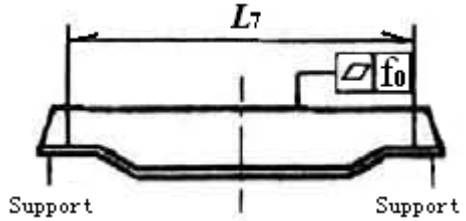
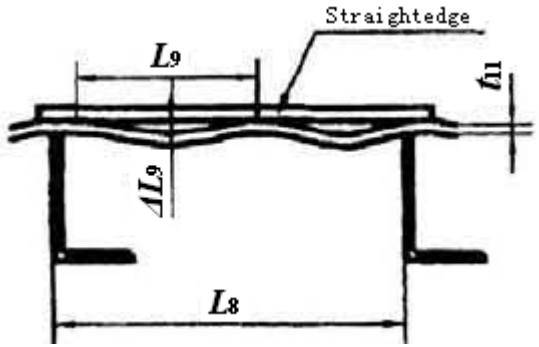
Items				Standard range	Allowable limits	Remarks
Planeness of single cover panel (i.e. deformation of the region formed by girders within the panel)  **L_7 – Max. length of the girders of the panel** **f_0 – Planeness of cover panel**	L_7	≤5000	f_0	≤3	≤5	**The measuring shall be done at the supported condition as that on board the ship**
		>5000~15000		≤6	≤8	
		>15000~25000		≤10	≤12	
Local deformation of top plate  **L_8 – distance between stiffeners** **L_9 –measuring distance between two contact points on top plate**	L_9 (t_{11}=7~9)	≤400	ΔL_9	≤3	≤4	**In case the measuring distance L_9 between two contact points is larger than the distance L_8 between the stiffeners, the L_8 value shall be adopted**
		>400~600		≤4	≤5	
		>600~800		≤5	≤6	
		>800~1000		≤6	≤7	
		>1000~1200		≤7	≤8	

Table 3-2-6 (continued) **mm**

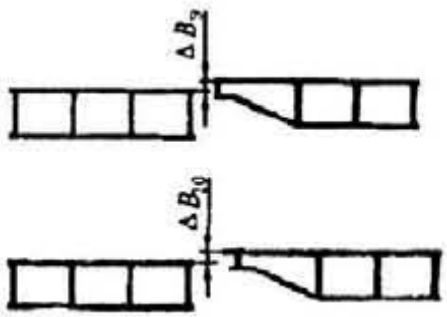
Items				Standard range	Allowable limits	Remarks
See above **ΔL_9 – deviation of concave on top plate during measuring L_9** **t_{11} – thickness of top plate**	**L_9 (t_{11}=10~12)**	≤400	**ΔL_9**	≤3	≤3	See above
		>400~600		≤3	≤4	
		>600~800		≤4	≤5	
		>800~1000		≤5	≤6	
		>1000~1200		≤6	≤7	
Elevations of adjacent top plates  **ΔB_9 – elevation of top plates at place supported by girder** **ΔB_{10} – elevation of top plates at place without girder supporting**	**Conventional hatchcover**		**ΔB_9**	≤6	≤7	–
			ΔB_{10}	≤3	≤4	
	Hatchcover for carrying evenly-loaded containers and hatchcover for tweendeck of reefer with wooden gratings		**ΔB_9**	≤4	≤5	
			ΔB_{10}	≤4	≤5	
	Hatchcover for tweendeck in cargo hold		**ΔB_9**	≤1	≤2	
			ΔB_{10}	≤1	≤2	

Table 3-2-6 (continued) **mm**

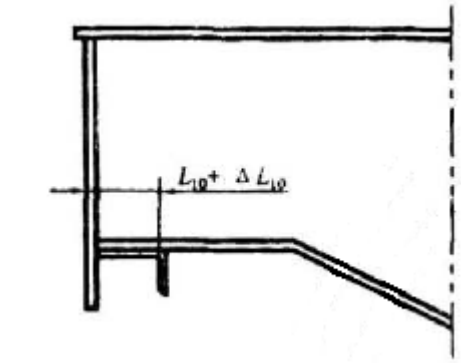
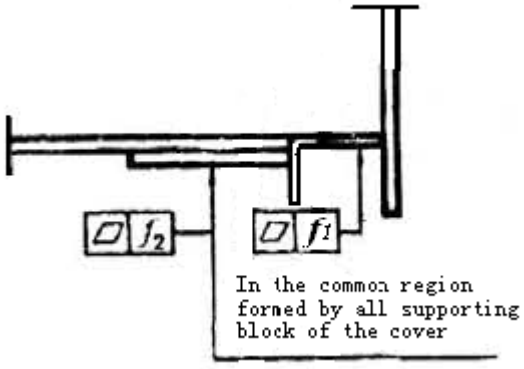
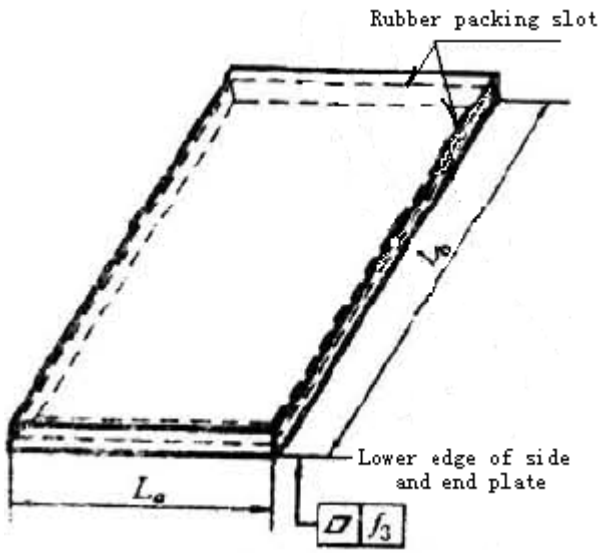
Items				Standard range	Allowable limits	Remarks
Size deviation of rubber packing slot at periphery  	ΔL_{10}			±0.5	±1.0	**For local measuring, the deviation of levelness shall be kept within 2 mm at measuring length within 1 meter**
	Open type structure, L_a **or** L_b	≤4000	f_1	≤2	≤3	
			f_2			
		>4000~8000	f_1	≤3	≤4	
			f_2	≤2	≤3	
		>8000~28000	f_1	≤5	≤6	
			f_2	≤4	≤5	

Table 3-2-6 (end) **mm**

Items				Standard range	Allowable limits	Remarks
See above  **L_{10} – Breadth of rubber packing slot** **ΔL_{10} – Deviation of L_{10}** **L_a – Length of rubber packing slot at side** **L_b – Length of rubber packing slot at end** **f_1 , f_2 , f_3 – Levelness of rubber packing slot at different length**	**Close type structure, L_a or L_b**	≤4000	f_3	≤2	≤3	See above
		>4000~8000		≤4	≤5	
		>8000~28000		≤6	≤6	

2.3.2 The manufacturing of hatchcover coaming is to be according to the requirements as defined in table 3-2-7

Table 3-2-7 **mm**

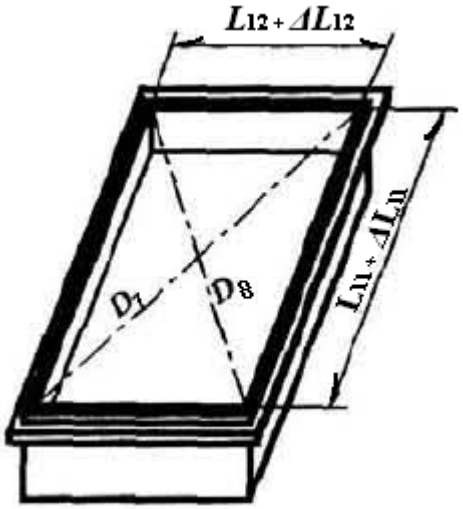
Items				**Standard range**	**Allowable limits**	**Remarks**
Deviation of dimensions of hatch coaming opening 	**Length L_{11} Or Breadth L_{12}**	>1000~2000	**ΔL_{11} or ΔL_{12}**	±3	±4	–
		>2000~4000		±5	±6	
		>4000~8000		±7	±8	
		>8000~12000		±9	±10	
		>12000~16000		±11	±12	
		>16000~20000		±13	±14	
		>20000~24000		±15	±16	
		>24000~28000		±16	±17	
		>28000		±17	±18	

Table 3-2-7 (continued) **mm**

Items				Standard range	Allowable limits	Remarks
See above L_{11} – length of hatch coaming along ship L_{12} – Breadth of hatch coaming transverse the ship $\Delta L_{11}, \Delta L_{12}$ – Deviation of L_{11} *and* L_{12} D_7, D_8 – Diagonal length of hatch coaming	Length L_{11} Or Breadth L_{12}	>1000~2000	Diagonal length of hatch coaming $(D_7 - D_8)$	±8	±10	–
		>2000~4000		±11	±13	
		>4000~8000		±14	±16	
		>8000~12000		±17	±19	
		>12000~16000		±20	±22	
		>16000~20000		±22	±24	
		>20000~24000		±24	±26	
		>24000~28000		±26	±28	
		>28000				

Table 3-2-7 (continued) **mm**

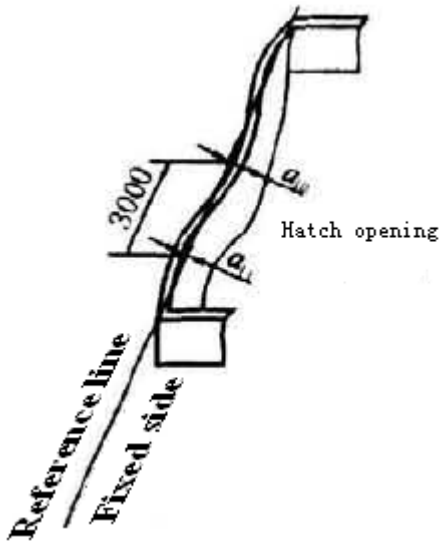
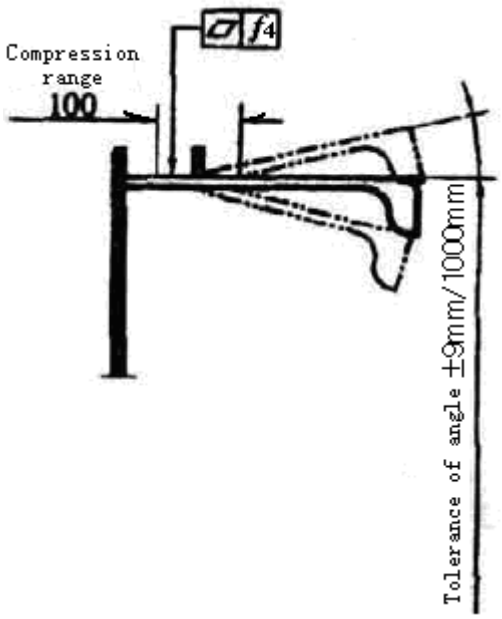
Items		Standard range	Allowable limits	Remarks
Straightness of side coaming  a_{10}, a_{11} – deviation between hatch coaming side plate and reference line of every 3 m in length	$\lvert a_{11} - a_{10} \rvert$	≤4	≤5	–

Table 3-2-7 (end) **mm**

Items				Standard range	Allowable limits	Remarks
Levelness of face plate of coaming  **L_c – length of compression bar** **f_4 – levelness of hatch coaming plates horizontally fitted**	**Compression bar to be fixed late (adjustable)**	≤3000	f_4	≤2	≤3	**For local measuring: The deviation of levelness shall be kept within 2 mm for every 1 meter length**
		>3000~13000		≤3	≤4	
		>13000~28000		≤4	≤5	
	Compression bar to be fixed before hand welded L_c	≤7000		≤2		
		≤28000		≤2	≤3	
	Without compression bar (sliding rubber)	≤14000				
		≤28000		≤3	≤4	

2.3.3 The installation of sealing rubber is to to be according to the requirements as defined in table 3-2-8

Table 3-2-8 **mm**

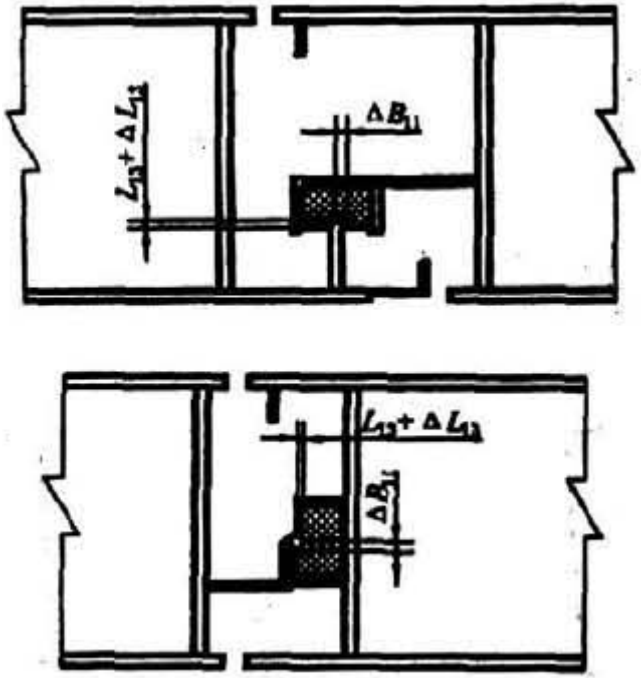
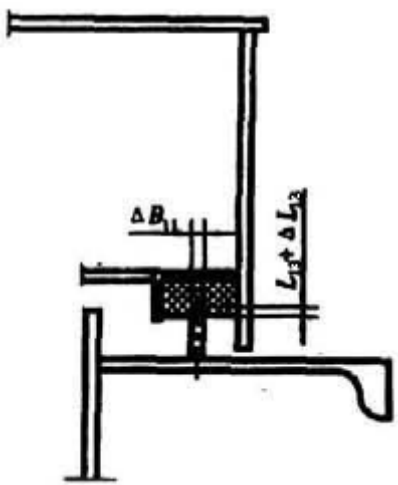
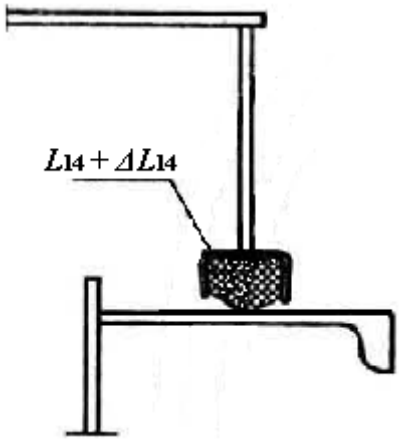
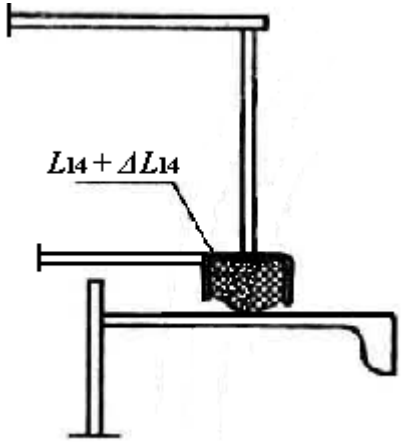
Items				Standard range	Allowable limits	Remarks
Deviation of compression of rubber and center of compression bar  **ΔB_{11} – center deviation of rubber as against compression bar** **L_{13} – compression rubber** **ΔL_{13} – deviation of rectangular foamed core rubber's compression**	**Rectangular rubber with foamed core**	Size 32×71 **L_{13} = 8**	**ΔB_{11}**	≤6	≤7	**The normal rubber compression is one-fourth of rubber thickness**
			ΔB_{13}	±1	±2	
		Size 40×71 **L_{13} = 10**	**ΔB_{11}**	≤6	≤7	
			ΔB_{13}	±2	±3	
		Size 50×93 **L_{13} = 10**	**ΔB_{11}**	≤8	≤9	
			ΔB_{13}	±3	±4	
		Size 50×120 **L_{13} = 13**	**ΔB_{11}**	≤11	≤12	
			ΔB_{13}	±3	±4	

Table 3-2-8 (end) **mm**

Items				Standard range	Allowable limits	Remarks
See above    **L_{14} – compression of sliding rubber** **ΔL_{14} – deviation of L_{14}**	**Sliding rubber**	**Hollow 67×72 L_{14} = 12**	ΔL_{14}	±6	±8	–
		Hollow 60×98 L_{14} = 12	ΔL_{14}	±5	±7	
		Solid 57×72 L_{14} = 7	ΔL_{14}	±2	±3	

2.4 Container fixing devices

2.4.1 The installation of container sockets is to be in accordance with the requirements as defined in table 3-2-9

Table 3-2-9 **mm**

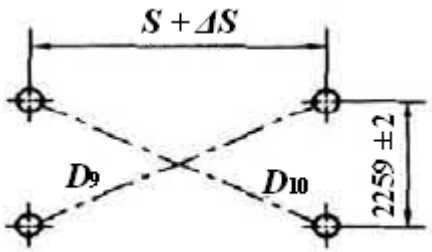
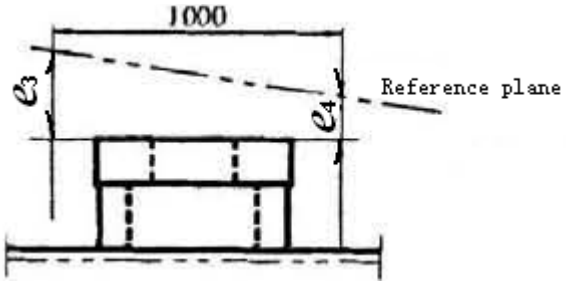
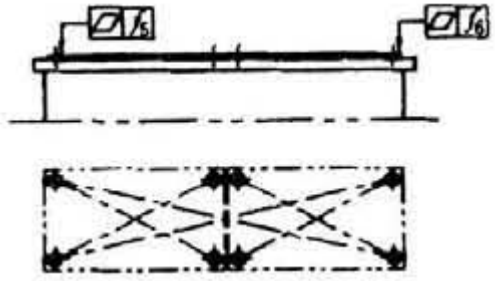
Items			Standard range	Allowable limits	Remarks
Deviation of the installation of container sockets  ***S*** – distance of two container sockets center points along the container ***ΔS*** – deviation of ***S*** ***D*9, *D*10** – diagonal distance of two container sockets center points	**53ft (S=15947)** **49ft (S=14729)** **48ft (S=14427)**	***ΔS***	±4.0	±5.0	Also the maker's technical instruction of container sockets to be followed
	45ft (S=13513) **43ft (S=12900)** **40ft (S=11985)**	**(*D*9 - *D*10)**	±6.0	±8.0	
	30ft (S=8918)	***ΔS***	±3.0	±4.0	
	24½ft (S=7225)	**(*D*9 - *D*10)**	±5.0	±8.0	

Table 3-2-9 (end) **mm**

Items			Standard range	Allowable limits	Remarks
See above	**20ft (S=5853)**	ΔS	±2.0	±3.0	See above
	10ft (S=2787)	$(D_9 - D_{10})$	±4.0	±6.0	
Allowance angular deviation of top surface of container socket  e_3, e_4 – distance of top surface of container socket against reference plane for 1 meter in length		$(e_3 - e_4)/1000$	–	≤5/100	
Planeness of common region formed by container sockets  f_5, f_6 – planeness of container sockets	Common region formed by 4 sockets of a single container	f_5	≤3	≤4	
	Common region formed by 8 sockets of two containers	f_6	≤6	≤7	

2.4.2 The installation of container side guiding frame is to be in accordance with the requirements as defined in table 3-2-10

Table 3-2-10 **mm**

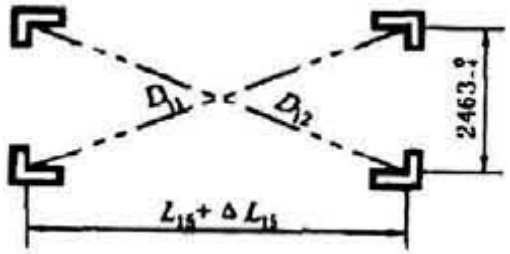
Items			**Standard range**	**Allowable limits**	**Remarks**
Deviation of the installation of container side guiding frame  L_{15} – distance of two container side guiding frames inside along the container ΔL_{15} – deviation of L_{15} D_{11}, D_{12} – diagonal distance of two container side guiding frames inside	**53ft (L_{15}=16192)** **49ft (L_{15}=14975)** **48ft (L_{15}=14670)**	ΔL_{15}	**0** **-6**	**0** **-10**	–
	45ft (L_{15}=13745) **43ft (L_{15}=13140)** **40ft (L_{15}=12230)**	**(D_{11} - D_{12})**	±8	±10	
	30ft (L_{15}=9165)	ΔL_{15}	**0** **-5**	**0** **-8**	
	24½ft (L_{15}=7470)	**(D_{11} - D_{12})**	±6	±8	

Table 3-2-10 (end) **mm**

Items			Standard range	Allowable limits	Remarks
See above	**20ft (L_{15}=6095) 10ft (L_{15}=3030)**	**ΔL_{15}**	**0 -4**	**0 -6**	–
		(D_{11} - D_{12})	±4	±6	
A single container side guiding frame's verticality			≤3	≤4	

2.5 Weathertight closing devices

2.5.1 The manufacture and installation of weathertight door is to be in accordance with the requirements as defined in table 3-2-11

Table 3-2-11 **mm**

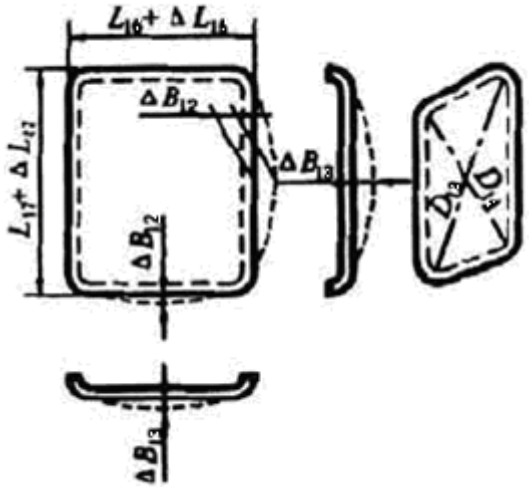
Items		Standard range	Allowable limits	Remarks
Door plate  L_{16} – breadth of door plate L_{17} – height of door plate D_{13}, D_{14} – diagonal distance of door plate	Deviation of breadth, ΔL_{16}	±2	±4	–
	Deviation of height, ΔL_{17}			
	Difference between lengths of diagonals, $(D_{13} - D_{14})$			
	Degree of distortion	≤2	≤3	Degree of distortion: distance between middle points of two diagonals
	Straightness, ΔB_{12}	≤1		–
	Planeness, ΔB_{13}			

Table 3-2-11 (continued) **mm**

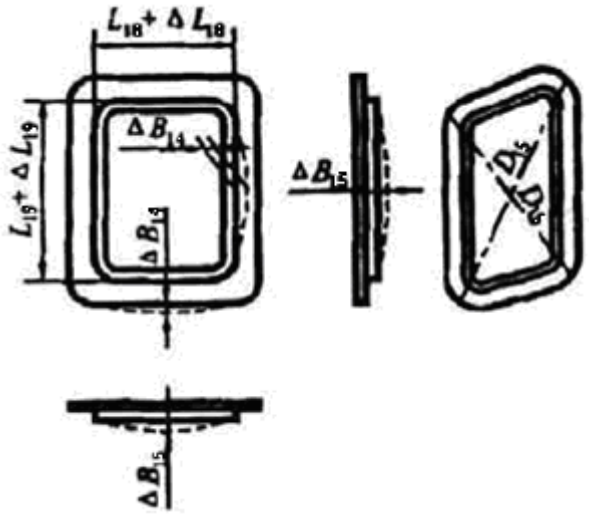
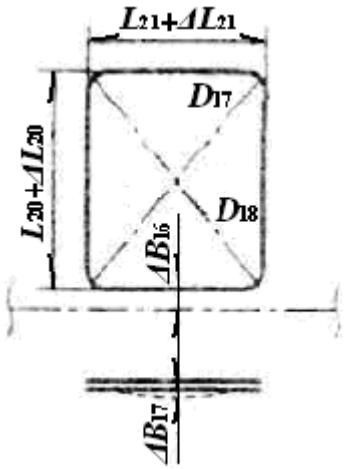
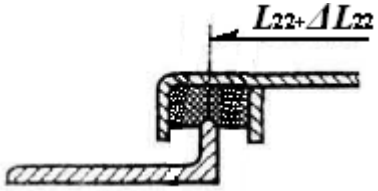
Items		Standard range	Allowable limits	Remarks
Door frame  L_{18} – breadth of door frame L_{19} – height of door frame D_{15}, D_{16} – diagonal distance of door frame	Deviation of breadth, ΔL_{18}	±2	±4	–
	Deviation of height, ΔL_{19}			
	Difference between lengths of diagonals, $(D_{15} - D_{16})$			
	Degree of distortion	≤2	≤4	Degree of distortion: distance between middle points of two diagonals
	Straightness, ΔB_{14}	≤1	≤3	–
	Planeness, ΔB_{15}			

Table 3-2-11 (end) **mm**

Items		Standard range	Allowable limits	Remarks
Wall opening  L_{20} – height of wall opening; L_{21} – breadth of wall opening D_{17}, D_{18} – diagonal distance of wall opening	Deviation of height, ΔL_{20}	±4	±6	–
	Deviation of breadth, ΔL_{21}			
	Difference between lengths of diagonals, $(D_{17} - D_{18})$	±2	±4	
	Deviation of sill height (lowest point), ΔB_{16}	**+5** **0**	**+30** **-10**	
	Planeness of wall at opening, ΔB_{17}	≤2	≤3	
Installation of door  L_{22} – distance between sealing pad centerline and door centerline	Deviation of sill height	**+15** **0**	**+30** **-0**	
	Verticality of door centre	$\leq 2L_{22}/1000$		
	Deviation of distance of seal pad centre to door centre, ΔL_{22}	±2		

2.5.2 The manufacture and installation of fire-proof door is to be in accordance with the requirements as defined in table 3-2-12

Table 3-2-12 **mm**

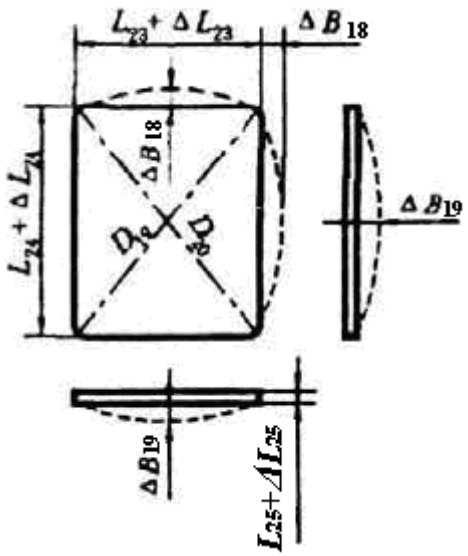
Items		**Standard range**	**Allowable limits**	**Remarks**
Door  L_{23} – breadth of door plate L_{24} – height of door plate L_{25} – thickness of door plate D_{19}, D_{20} – diagonal distance of door plate	Deviation of breadth, ΔL_{23}	±1.0		–
	Deviation of height, ΔL_{24}			
	Deviation of thickness, ΔL_{25}			
	Difference between lengths of diagonals,(D_{19} - D_{20})	±2.0	±4.0	
	Degree of distortion	≤2.0		Degree of distortion: distance between middle points of two diagonals
	Straightness, ΔB_{18}	<1.0		–
	Planeness, ΔB_{19}	≤1.0	≤2.5	

Table 3-2-12 (continued) **mm**

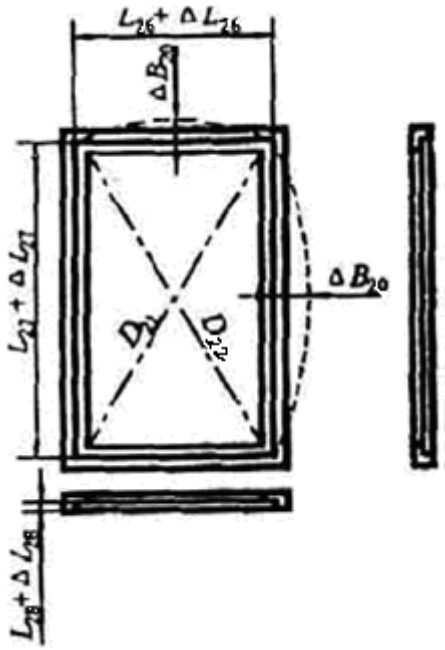
Items		Standard range	Allowable limits	Remarks
Door frame  L_{26} – breadth of door frame L_{27} – height of door frame L_{28} – depth of door frame D_{21}, D_{22} – diagonal distance of door frame	Deviation of breadth, ΔL_{20}	±1.0		–
	Deviation of height, ΔL_{27}			
	Deviation of depth, ΔL_{28}	±2.0		
	Difference between lengths of diagonals, $(D_{21} - D_{22})$	±2.0	±4.0	
	Degree of distortion	≤2.0		Degree of distortion: distance between middle points of two diagonals
	Straightness, ΔB_{20}	≤1.0		–

Table 3-2-12 (continued) **mm**

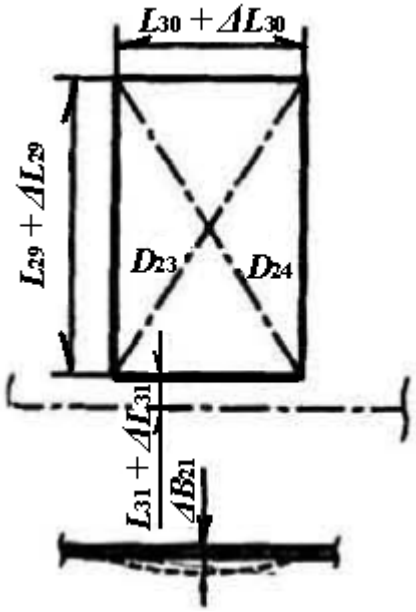
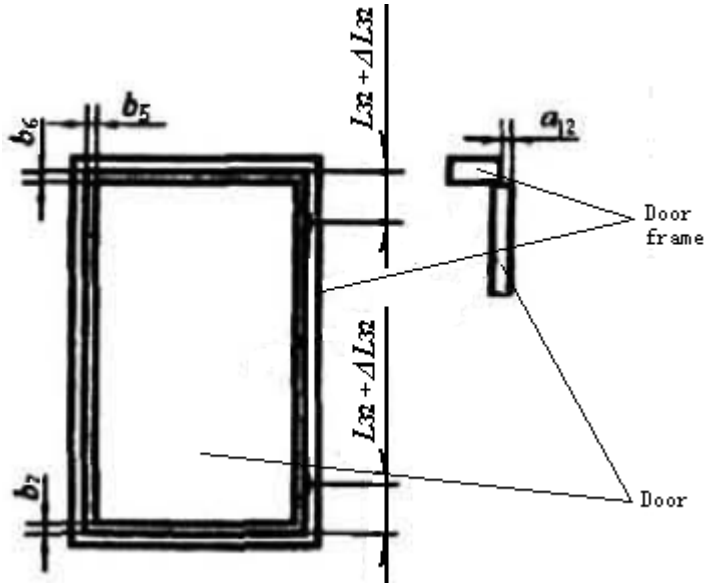
Items		Standard range	Allowable limits	Remarks
Wall opening  L_{29} – height of wall opening L_{30} – breadth of wall opening L_{31} – sill height D_{23}, D_{24} – diagonal distance of wall opening	Deviation of height, ΔL_{29}	±2.0		–
	Deviation of breadth, ΔL_{30}			
	Difference between lengths of diagonals, $(D_{23} - D_{24})$	±2.0	±4.0	
	Deviation of sill height (lowest point), ΔL_{31}	**+10 0**	–	
	Deformation of wall at cut, ΔB_{21}	≤1.5	≤2.0	

Table 3-2-12 (end) **mm**

Items			Standard range	Allowable limits	Remarks
Installation of door  L_{32} – distance between door top/bottom frame(inside) and hinge central position	Clearance between door frame and door	b_5	3.6	–	–
		b_6	3.0		
		b_7	5.0		
	Deviation of planeness of door frame and door, a_{12}		≤1.0		
	Deviation of hinge position, ΔL_{32}		±5.0	–	

2.5.3 The manufacture and installation of weathertight small hatchcover is to be in accordance with the

requirements as defined in table 3-2-13

Table 3-2-13 **mm**

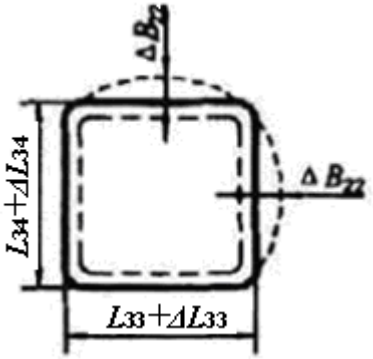
Items		Standard range	Allowable limits	Remarks
Hatchcover   L_{33} – breadth of hatchcover L_{34} – length of hatchcover D_{25}, D_{26} – diagonal distance of hatchcover	Deviation of breadth, ΔL_{33}	±3.0	±5.0	–
	Deviation of length, ΔL_{34}			
	Difference between lengths of diagonals, $(D_{25} - D_{26})$	±2.0	±4.0	
	Degree of distortion	≤2.0	≤3.0	Degree of distortion: distance between middle points of two diagonals
	Straightness, ΔB_{22}	≤1.0	≤2.0	–
	Planeness ΔB_{23}		≤3.0	

Table 3-2-13 (continued) **mm**

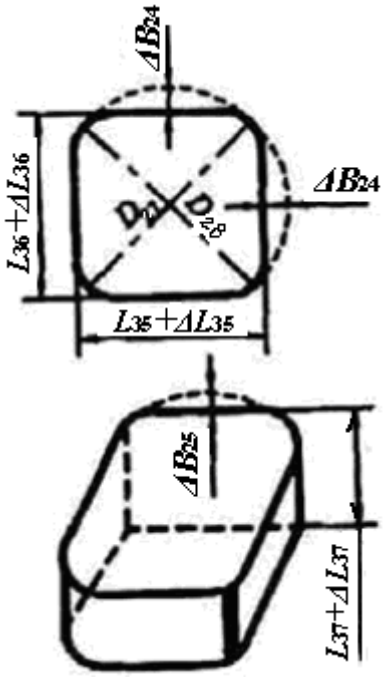
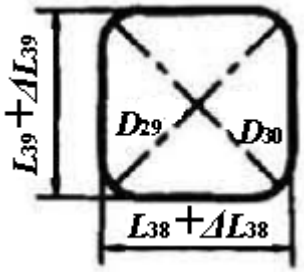
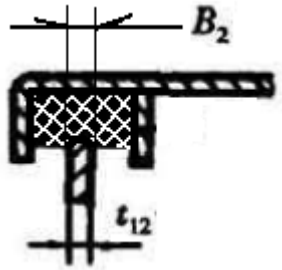
Items		Standard range	Allowable limits	Remarks
Hatch coaming  L_{35} – length of hatch coaming L_{36} – breadth of hatch coaming L_{37} – height of hatch coaming D_{27}, D_{28} – diagonal distance of hatch coaming	Deviation of length, ΔL_{35}	±2.0	±3.0	–
	Deviation of breadth, ΔL_{36}			
	Difference between lengths of diagonals, $(D_{27} - D_{28})$		±4.0	
	Deviation of height (lowest point), ΔL_{37}	**+6** **0**	**+20** **0**	
	Degree of distortion	≤2.0	≤3.0	**Degree of distortion:** distance between middle points of two diagonals
	Straightness, ΔB_{24}	≤1.0		–
	Planeness ΔB_{25}		≤2.0	

Table 3-2-13 (end) **mm**

<table>
<tr><th colspan="3">Items</th><th>Standard range</th><th>Allowable limits</th><th>Remarks</th></tr>
<tr><td rowspan="4">Deck plate opening
 

L₃₈ – breadth of deck plate opening
L₃₉ – length of deck plate opening
D₂₉, D₃₀ – diagonal distance of deck plate opening</td><td rowspan="2">Deviation of breadth,
ΔL₃₈</td><td>Penetration type</td><td>±2.0</td><td>±3.0</td><td rowspan="5">–</td></tr>
<tr><td>Non-penetration type</td><td>+2.0
-3.0</td><td>+3.0
-5.0</td></tr>
<tr><td rowspan="2">Deviation of length,
ΔL₃₉</td><td>Penetration type</td><td>±2.0</td><td>±3.0</td></tr>
<tr><td>Non-penetration type</td><td>+2.0
-3.0</td><td>+3.0
-5.0</td></tr>
<tr><td colspan="2">Difference between lengths of diagonals, (D₂₉ – D₃₀)</td><td>±2.0</td><td>±4.0</td></tr>
<tr><td>Watertight structure
 

t₁₂ – thickness of hatch coaming sealing plate
B₂ – breadth of touching mark</td><td colspan="2">Touch between sealing pad and coaming plate</td><td colspan="2">B₂ ≥ t₁₂ / 2</td></tr>
</table>

2.5.4 The manufacture and installation of circular weathertight hatchcover is to be in accordance with the

requirements as defined in table 3-2-14

Table 3-2-14 **mm**

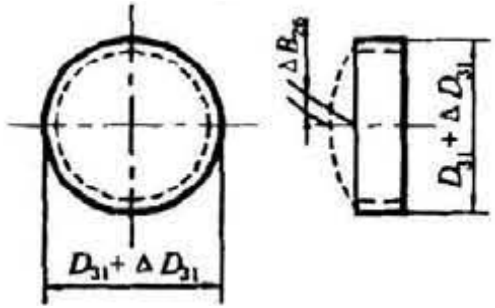
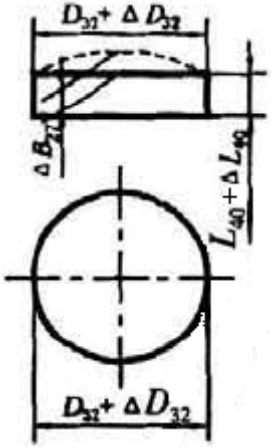
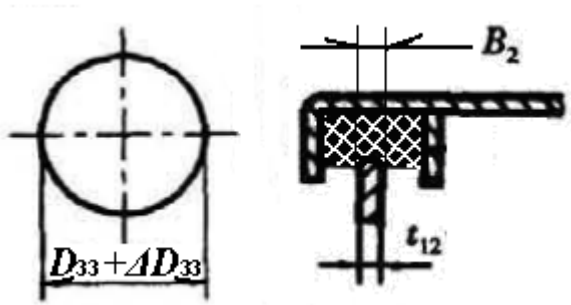
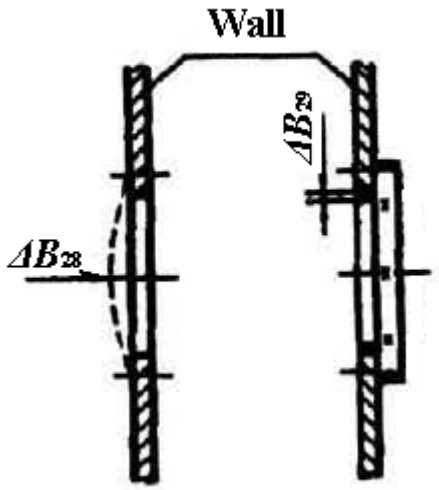
Items		Standard range	Allowable limits	Remarks
Cover  D_{31} – diameter of cover	Deviation of diameter, ΔD_{31}	±3.0	±5.0	–
	Roundness	≤2.0	≤3.0	
	Planeness, ΔB_{26}	≤1.0		
Hatch coaming  D_{32} – diameter of hatch coaming L_{40} – height of hatch coaming	Deviation of diameter, ΔD_{32}	±2.0	±3.0	
	Deviation of height, ΔL_{37}	**+6 0**	**+20 0**	
	Roundness	≤2.0	≤3.0	
	Planeness, ΔB_{27}	≤1.0	≤2.0	

Table 3-2-14 (end) **mm**

Items		Standard range	Allowable limits	Remarks
Cut in deck plate and water tightness  D_{33} – diameter of opening on deck plate; t_{12} – thickness of hatch coaming sealing plate B_2 – breadth of touching mark	Deviation of diameter, ΔD_{33}	±2.0	±3.0	–
	Touch between sealing pad and coaming plate	$B_2 \geq t_{12}/2$		

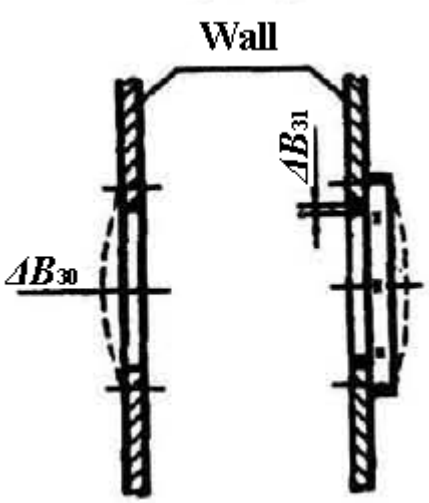
2.5.5 The installation of rectangular window is to be in accordance with the requirements as defined in table 3-2-15

Table 3-2-15 **mm**

Items		Standard range	Allowable limits	Remarks
Rectangular window 	Planeness of wall at cut, ΔB_{28}	≤2.0	≤3.0	–
	Clearance between window frame and cut, ΔB_{29}	≤1.0	≤2.0	

2.5.6 The installation of side scuttle is to be in accordance with the requirements as defined in table 3-2-16

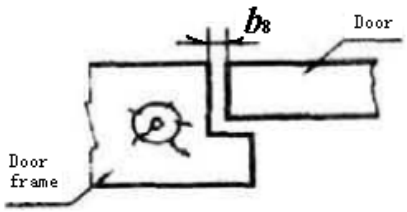
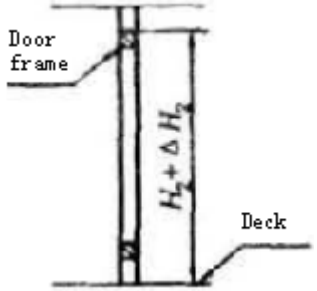
Table 3-2-16 **mm**

Items		Standard range	Allowable limits	Remarks
Side scuttle 	Planeness of wall at cut, ΔB_{30}	≤1.0	≤1.5	–
	Clearance between window frame and cut, ΔB_{31}	≤1.0	≤2.0	

2.6 Cabin outfitting

2.6.1 The installation of door and door frame is to be in accordance with the requirements of table 3-2-17

Table 3-2-17 **mm**

Items		Standard range	Allowable limits	Remarks
	Verticality of door frame, a_{13}	≤2.0	≤4.0	–
Clearance between wooden door and door frame, b_8 	Clearance at lock side		≤3.0	
	Clearance at hinge side			
	Upper crack		≤4.0	
	Lower crack	≤4.0	≤6.0	
H_2 – height of door frame 	Deviation of installed height of door frame ΔH_2	-3~10	-5~12	

2.6.2 The installation of lining and ceiling is to be in accordance with the requirements of table 3-2-18

Table 3-2-18 **mm**

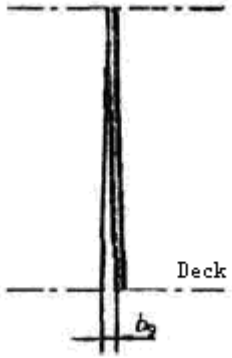
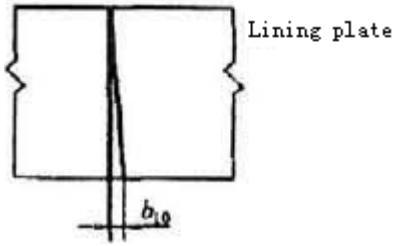
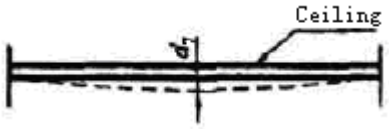
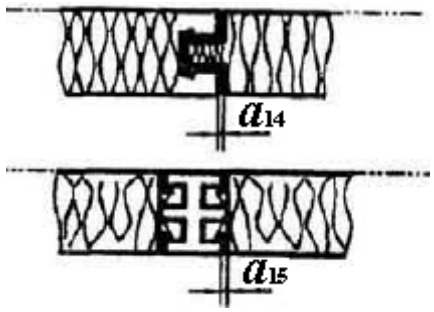
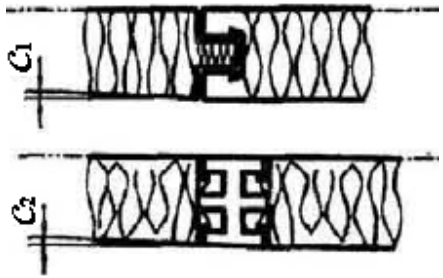
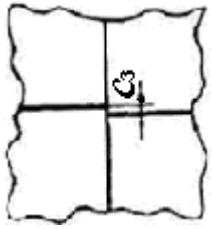
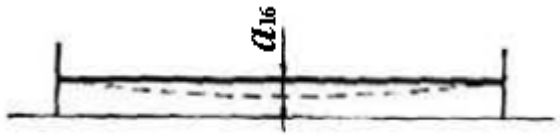
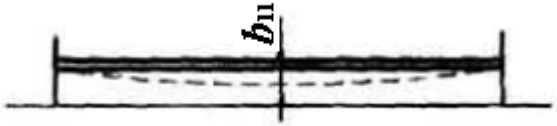
Items		Standard range	Allowable limits	Remarks
	Verticality of lining, b_9	≤3.0	≤5.0	–
	Verticality of seam of lining plate, b_{10}	≤1.0	≤3.0	
	Sagging of ceiling plate, d_7	≤3.0	≤5.0	

Table 3-2-18 (end) mm

Items		Standard range	Allowable limits	Remarks
Clearance between lining plates 	Without strip, a_{14}	≤0.5	≤0.8	—
	With strip, a_{15}	≤0.3	≤0.5	
Deviation of lining plates 	Without strip, c_1	≤0.5	≤0.8	
	With strip, c_2			
	Misalignment of ceiling plates, c_3	≤2.0	≤2.5	
Deviation of clear height of ceiling		-10	—	

2.6.3 The application of deck covering is to be in accordance with the requirements of table 3-2-19

Table 3-2-19 **mm**

Items		Standard range	Allowable limits	Remarks
	Planeness of deck covering, a_{16}	≤2.5	≤3.0	Per meter
	Planeness of plastic deck, b_{11}			

3 MACHINERY INSTALLATION

3.1 Diesel main engine

Installation of diesel main engine and manufacture of fastening accessories are to be in accordance with the requirements as defined in table 3–3–1

Table 3-3-1 **mm**

Items			Standard range	Allowable limits	Remarks
Foundation	Deviation of web plate of main engine foundation (longitudinal girder) from ship centerline		± 4	± 6	–
	Planeness of face plate of main engine foundation		≤5	≤10	Local, dispersed and small amount deviation from the limit is allowed
	Height deviation of face plate from ship baseline		≤3	≤5	–
	Outward taper of face plate		1:100	1:50	
Liner (including various liner of bearing seat)	Contact clearance of fixed liner before welding		≤0.10	–	Allowable inserting depth of 0.10 feeler to be not more than 10
	Support liners	Contact ratio	≥70%	≥60%	To be evenly colored
		Blue oil points (25 × 25)	≥3 points	–	
		Clearance	≤0.05		Allowable inserting depth of 0.05 feeler to be not more than 10

Table 3-3-1(continued) **mm**

Items					Standard range	Allowable limits	Remarks
Liner (including various liner of bearing seat)	Tapered wedge		Contact ratio		≥70%	≥60%	–
			Blue oil points (25 × 25)		≥3 points	–	
			Clearance		≤0.05		Allowable inserting depth of 0.05 feeler to be not more than 10
	Taper of contact surface between tapered liners				≤1:100	≤1:50	–
	Liner thickness		Cast iron		≥25	–	Liners in one group are not to be more than 2 pieces
			Steel		≥15		
			Epoxy resin		–		As per manufacturer's specification
Installation	Fit of reamer bolt with hole	Hole diameter *D*	18 ~ 50	Clearance	0.005	0.010	–
				Interference		0.005	

Table 3-3-1(end) **mm**

Items					Standard range	Allowable limits	Remarks
Installation	Fit of reamer bolt with hole	Hole diameter *D*	> 50 ~ 120	Clearance	0.010	0.015	–
				Interference	0	0.005	
	Clearance between bolt head and foundation and clearance between nut and liner bottom plate after fastening				< 0.05	–	
	Connection of output shaft flange of main engine with fore flange of intermediate shaft			Offset	≤ 0.10		D_{34} – outside diameter of measured flange; Or take the reasonable alignment calculation value of ±0.05
				Deflection	$\pm D_{34} \times 10^{-4}$		
	Crank web deflection				Follow maker's standard		In accordance with technical specification of manufacture
	Web deflection when moment balancer are fixed at fore and after ends or heavy fly-wheel is fixed at aft end				**<0.15×S_4/1000**		S_4 – stroke of piston; d_8 – diameter of main journal; Or as per specification of main engine
	Distance from the measured position to the centerline of crank pin				–	(S_4+ d_8)/2	

3.2 Shafting

Installation of shafting and boring of stern tube frame and shaft bracket are to be in accordance with the requirements as defined in table 3-3-2

Table 3-3-2 **mm**

Items				Standard range	Allowable limits	Remarks
Centering of shaft	Shafting centerline	Long shaft (>15m)	Portside or starboard	± 7	–	–
			Above or below	± 10		
		Short shaft (≤15m)	Portside or starboard	± 3		
			Above or below	± 7		
	Deviation of shafting centerline from rudder centerline	Deadweight exceeding 100,000 tonne		≤5	≤8	
		Deadweight not exceeding 100,000 tonne		≤4	≤6	
	Hole of stern tube frame and holes of shaft brackets	Deviation of bored center from calculated center		<0.10	–	
		Surface roughness *Ra* of bored circle		0.0063	0.0125	

Table 3-3-2(continued) **mm**

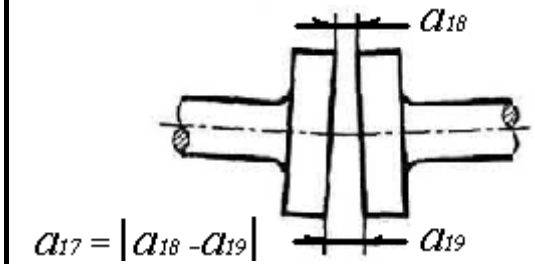
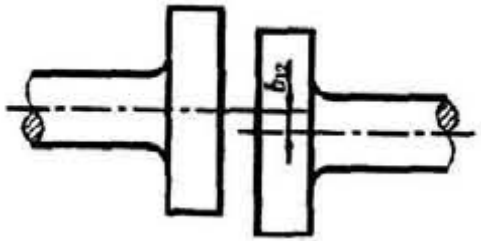
<table>
<tr><th colspan="5">Items</th><th>Standard range</th><th>Allowable limits</th><th>Remarks</th></tr>
<tr><td rowspan="7">Centering of shaft</td><td rowspan="7">Requirements of circularity and cylindricality of boring</td><td rowspan="7">Bore</td><td>≤120</td><td>≤0.015</td><td rowspan="9">–</td><td rowspan="8">–</td></tr>
<tr><td>> 120 ~ 180</td><td>≤0.020</td></tr>
<tr><td>> 180 ~ 260</td><td>≤0.025</td></tr>
<tr><td>> 260 ~ 360</td><td>≤0.030</td></tr>
<tr><td>> 360 ~ 500</td><td>≤0.035</td></tr>
<tr><td>> 500 ~ 700</td><td>≤0.040</td></tr>
<tr><td>> 700 ~ 900</td><td>≤0.050</td></tr>
<tr><td rowspan="2">Installation</td><td colspan="4">Deviation of actual load on bearing from calculated value</td><td>± 20%</td></tr>
<tr><td>Alignment of shafting</td><td> 
</td><td>Deflection a_{17}</td><td>≤0.10×D_{35}/1000</td><td>1) D_{35} is shaft flange diameter;</td></tr>
</table>

Table 3-3-2(end) **mm**

<table>
<tr><th colspan="5">Items</th><th>Standard range</th><th>Allowable limits</th><th>Remarks</th></tr>
<tr><td rowspan="4">Installation</td><td>Alignment of shafting</td><td colspan="2">  </td><td>Offset b_{12}</td><td>≤0.10</td><td rowspan="2">–</td><td>2) Or in accordance with shafting alignment calculation (with holding down bolts tightened, general take the reasonable alignment calculation value of ±0.05)</td></tr>
<tr><td colspan="4">Displacement between tail shaft anti-corrosion sealing liner and rubber ring seat</td><td>± 3</td><td>As per specification of tail shaft sealing device</td></tr>
<tr><td rowspan="3">Matching of propeller with cone part of tail shaft</td><td colspan="3">Contact ratio</td><td>≥75%</td><td>>70%</td><td rowspan="3">–</td></tr>
<tr><td rowspan="2">Blue oil points (25 × 25)</td><td>Key connection</td><td>≥3 points</td><td rowspan="2">–</td></tr>
<tr><td>Keyless connection</td><td>≥3 points</td></tr>
</table>

3.3 Auxiliary machinery

3.3.1 The auxiliary machinery as per their complexity and importance to be divided into first class, second class and third class, the contents of each class is shown as following:

a) First class: diesel generator set, steam turbine generator set, steam turbine auxiliary machinery;

b) Second class: fresh water pump, fresh water cooling pump, bilge pump, main engine sea water cooling pump, fire pump, fuel oil transfer pump, ballast water pump, bilge and general service pump, emergency diesel generator set, air compressor, cargo oil pump, oil separator, hydraulic pump;

c) Third class: Auxiliary machinery other than those of first class and second class.

3.3.2 Installation of auxiliary machinery and fasteners are to be in accordance with the requirements as defined in table 3-3-3

Table 3-3-3 **mm**

Items			Standard range	Allowable limits	Remarks
Installation	Levelness of bed frame face plate		≤2	≤5	–
	Clearance between liner and foundation	First class	≤0.05	–	Allowable inserting depth of 0.05 feeler to be not more than 10
		Second class	≤0.08	≤0.12	–
		Third class	–		

Table 3-3-3(continued) **mm**

Items				Standard range	Allowable limits	Remarks
Installation	Contact area between liners		First class	≥60%	≥50%	–
			Second class	≥50%	≥40%	
			Third class	–		
	Outward taper of liner face			1:100	1:50	Epoxy resin liner as per manufacturer's specification
	Thickness of liner		Cast iron, steel	≥12	–	
			Epoxy resin	≥20		
Alignment	Rigid connection	Power $P \leq 37$kw	Deviation	≤0.05	≤0.07	D_{36} – flange diameter
			Deflection	**≤0.10**×D_{36}/**1000**	**≤0.12**×D_{36}/**1000**	
		Power $P > 37$kw	Deviation	≤0.08	≤0.10	
			Deflection	**≤0.16**×D_{36}/**1000**	**≤0.20**×D_{36}/**1000**	

Table 3-3-3(end) **mm**

Items				Standard range	Allowable limits	Remarks
Alignment	Flexible connection	Offset		≤0.10	≤0.12	D_{36} – flange diameter
		Deflection		**≤0.30×D_{36}/1000**	**≤0.32×D_{36}/1000**	
Diesel generating set	Crank web deflection		Cold condition	–		In accordance with technical specifications of manufacturer
			Hot condition			

3.4 Deck machinery

3.4.1 Category The deck machinery as per their complexity and importance to be divided into class A, class B and class C, the contents of each class is shown as following:

a) Class A: heavy cargo crane/winch, windlass, anchor capstan;

b) Class B: mooring winch, cargo winch;

c) Class C: machinery other than of class A and class B.

3.4.2 Installation requirements The installation of deck machinery and manufacture of fastening fittings is to be in accordance with the requirements as defined in table 3-3-4

Table 3-3-4 **mm**

Items			Standard range	Allowable limits	Remarks
Liner	Outward taper		1:100	1:50	–
	Surface roughness R_a		0.0063	0.0125	
	Thickness	Class A,B	≥12	–	
		Class C liner (steel, copper sheet)	2 sheets	3 sheets	Half liner is not allowed
		Epoxy resin liner	≥20	–	As per manufacturer's specification
Installation	Clearance between liner and bed frame	Class A	≤0.06	≤0.10	Allowable inserting depth of feeler is not more than 10
		Class B	≤0.10	≤0.20	
		Class C	–		–
	Contact ratio between liners	Class A	≥60%	≥50%	
		Class B	≥50%	≥40%	
		Class C	–		

Table 3-3-4 (end) **mm**

Items			Standard range	Allowable limits	Remarks
Installation	Number of fastening and locking nuts	Class A	2 pieces	–	–
		Class B			
		Class C	–		

3.5 Installation of steering gear and fastening liner

The installation of steering gear and manufacture of fastening liner is to be in accordance with the requirements as defined in table 3-3-5

Table 3-3-5 **mm**

Items			Standard range	Allowable limits	Remarks
Plunger type	Interference of reamer bolt		0.01	0	–
	Coaxal and positioning errors of plunger hydraulic cylinder		≤0.10	Cylinder clearance within 75%	
	Alignment of assembled rigid coupling	Radial	≤0.07	–	
		Axial	≤0.05		
Rotating vane type	Surface contact ratio of rudder stock with the shaft liner cone area of steering gear		≥70%	–	Length of press trace is to be in accordance with technical document of manufacturer
	Length of interference press trace of top end nut of rudder stock		0.6 ~ 1.0		
	Alignment of couplings of hydraulic pump	Radial	≤0.07		
		Axial	≤0.05		
Liner	Contact ratio		≥60%	≥50%	–
	Bed frame clearance		≤0.05	–	Inserting depth of 0.05 feeler to be not more than 10
	Thickness of epoxy resin liner		≥20		As per maker's specification

3.6 Fabrication and installation of piping

3.6.1 Fabrication of piping is to be in accordance with the requirements as defined in table 3-3-6

Table 3-3-6 **mm**

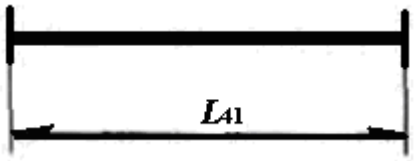
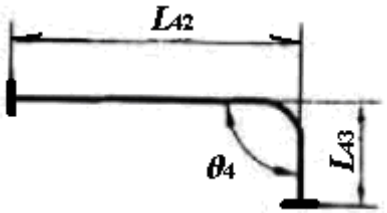
Items		Standard range	Allowable limits	Remarks
Length error of straight pipe  L_{41} – length of straight pipe	Deviation of length, ΔL_{41}	±3	±6	–
Length error of bent pipe  L_{42} – length of first section of bent pipe L_{43} – length of second section of bent pipe θ_4 – angle of bent pipe	ΔL_{42}			
	ΔL_{43}			
	$\Delta\theta_4$	±0.5°	±1.0°	

Table 3-3-6(continued) **mm**

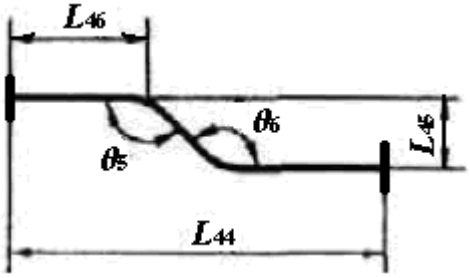
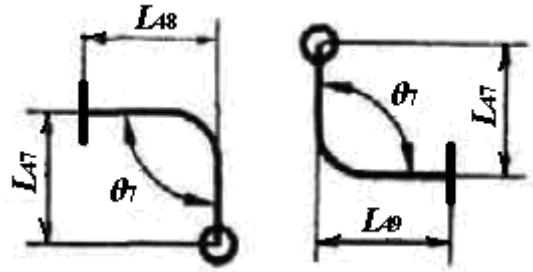
Items		Standard range	Allowable limits	Remarks
Length error of two directional bent pipe  L_{44} – total length of 2 directional bent pipe L_{45} – length between 2pcs **two directional bent pipe** L_{46} – length of beginning section of **two directional bent pipe** θ_5、θ_6 – angle of **two directional bent pipe**	ΔL_{44}	±3	±6	–
	ΔL_{45}			
	ΔL_{46}			
	$\lvert\theta_5 - \theta_6\rvert$	±1°	±2°	
Length error of three directional bent pipe  L_{47} – height of bent pipe L_{48}, L_{49} – length of straight section of bent pipe θ_7 – angle of bent pipe	ΔL_{47}	±3	±6	
	ΔL_{48}			
	ΔL_{49}			
	$\Delta\theta_7$	±0.5°	±1.0°	

Table 3-3-6(continued) **mm**

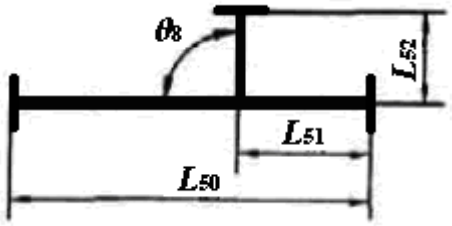
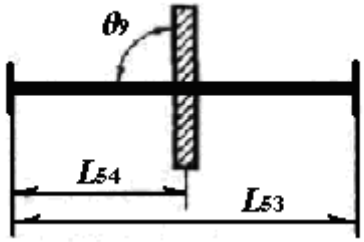
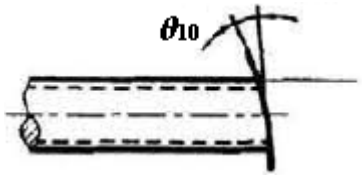
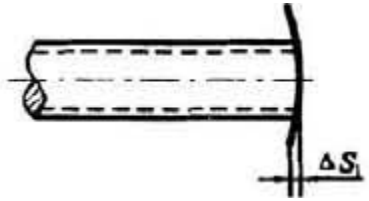
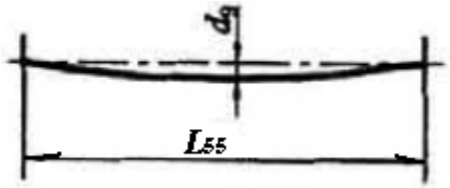
Items		Standard range	Allowable limits	Remarks
Length error of branch pipe  L_{50} – length of main pipe L_{51} – length between branch pipe position and main pipe one end L_{52} – length of branch pipe θ_8 – angle of bent pipe	ΔL_{50}	±3	±6	–
	ΔL_{51}			
	ΔL_{52}			
	$\Delta\theta_8$	±0.5°	±1.0°	
Deviation of pipe with penetration  L_{53} – length of straight pipe with penetration L_{54} – length between penetration flange and pipe one side flange θ_9 – angle of straight pipe and penetration flange	ΔL_{53}	±3	±6	
	ΔL_{54}			
	$\Delta\theta_9$	±0.5°	±1.0°	

Table 3-3-6(end) **mm**

Items		Standard range	Allowable limits	Remarks
Angular error of flange fixation to end of pipe: θ_{10} 	***DN*<150**	**30′**	–	***DN*** –nominal inner diameter of pipe
	***DN*≥150**	**20′**		
Deformation of flange face: ΔS_1 	***DN*<200**	≤0.5	<1.0	
	***DN*≥200~450**	≤1.0	<2.0	
	***DN*>450**	≤1.5	<2.5	
Deflection of pipe: d_9 	***DN*≥40**	**≤1.5 L_{55}/1000**	–	

***L*55** – length of straight pipe

3.6.2 Pipe connection is to be made in accordance with the requirements as defined in table 3-3-7

Table 3-3-7 **mm**

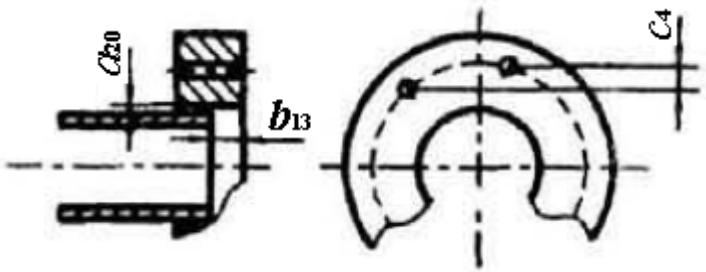
Items		Standard range	Allowable limits	Remarks
Lap welding of steel pipe with flange  a_{20} – clearance between pipe and flange inner side b_{13} – welding size between pipe end and flange inner side c_4 – deviation of bolt hole position on flange	b_{13}	K+1	–	K – leg size
	a_{20}	⩽1.5		
	c_4	⩽1.0		

Table 3-3-7(continued) mm

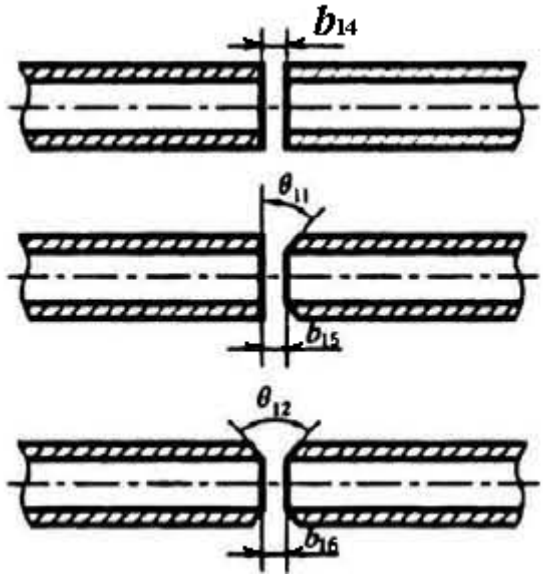
Items			Standard range	Allowable limits	Remarks
Grooves for butt welding of steel pipes  b_{14}, b_{15}, b_{16} – clearance between two pipes θ_{11}, θ_{12} – angle of pipe's grooves for welding t_{13} – thickness of pipe	$t_{13} \leqslant 3$	b_{14} *or* b_{15} *or* b_{16}	1.0 ~ 1.5	⩽3.0	–
	$3 < t_{13} \leqslant 6$	b_{14} *or* b_{15} *or* b_{16}	1.5 ~ 2.0		
		θ_{11} *or* θ_{12}	＞30°	⩽40°	
	$t_{13} > 6$	b_{14} *or* b_{15} *or* b_{16}	2.0 ~ 3.0	⩽4.0	
		θ_{11} *or* θ_{12}	⩾50°	⩽60°	

Table 3-3-7(continued) **mm**

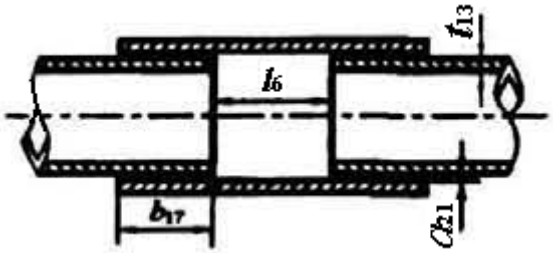
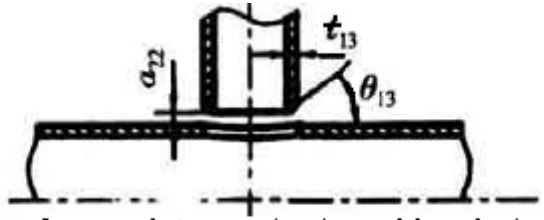
Items			Standard range	Allowable limits	Remarks
Sleeve joint of pipes  a_{21} – clearance between inserting pipe and sleeve joint b_{17} – length of pipe inserting into sleeve joint l_6 – distance between two inserting pipes t_{13} – thickness of pipe		a_{21}	≤1.5	≤2.0	–
		b_{17}	≥3 t_{13}	–	
		l_6	≥9.0		
Branch pipe  a_{22} — clearance between main pipe and branch pipe θ_{13} — groove's angle between branch pipe & main pipe t_{13} — thickness of pipe	t_{13}≤4	a_{22}	1.0 ~ 2.0	≤3.0	
	t_{13}>4	a_{22}	2.0 ~ 3.0	≤4.0	
		θ_{13}	≥45°	≤50°	

Table 3-3-7(continued) **mm**

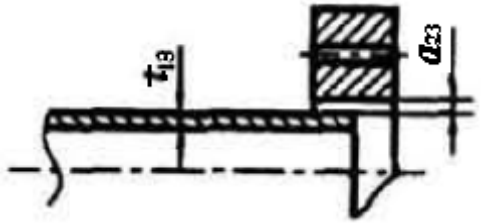
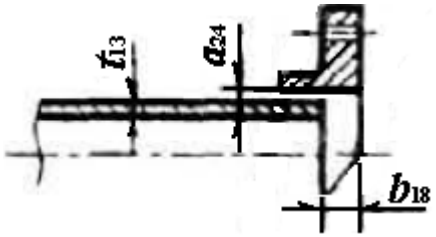
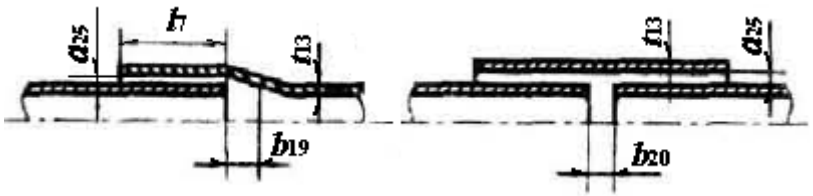
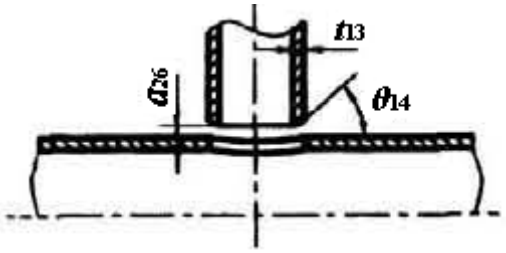
Items		Standard range	Allowable limits	Remarks
Flange brazing  a_{23} – clearance between inserting pipe and flange t_{13} – thickness of pipe	a_{23}	⩽0.2	–	–
Flange soldering  a_{24} – clearance between inserting pipe and flange b_{18} – distance between pipe end and flange t_{13} – thickness of pipe	a_{24}	⩽0.2		
	b_{18}	⩽1.0		

Table 3-3-7(end) **mm**

Items			Standard range	Allowable limits	Remarks
Soldering of sleeve joint  a_{25} – clearance of inserting pipe and sleeve joint b_{19} – gap between inserting pipe and reducing sleeve joint b_{20} – gap between two inserting pipes l_7 – length of inserting pipe t_{13} – thickness of pipe		a_{25}	≤0.2	–	–
		b_{19}	≤1.0		
		b_{20}	≤1.0		
		l_7	≥5 t_{13}		
Branch soldering  a_{26} – clearance between branch pipe & main pipe θ_{14} – angle of branch pipe's groove t_{13} – thickness of pipe	t_{13}≤3.0	a_{26}	≤1.0	≤2.0	
	3<t_{13}<6		≤1.5	≤3.0	
		θ_{14}	>45°	≤60°	

3.6.3 Bending of pipe is to be in accordance with the requirements as defined in table 3-3-8

Table 3-3-8 **mm**

Items				**Standard range**	**Allowable limits**	**Remarks**
Circularity ratio of pipe $E=(D_{max}-D_{min})/D_n\times 100$ Where: E – circularity ratio of pipe, % D_{max} – maximum outside diameter of bending section, mm D_{min} – minimum outside diameter of bending section, mm D_n – actual outside diameter of pipe, mm	**Steel and copper pipe**	$R_2 \leqslant 2DN$	**Cold bending**	–	–	R_2 – bending radius DN – nominal inner diameter of pipe
			Hot bending		10	
		$2DN < R_2 \leqslant 3DN$	**Cold bending**			
			Hot bending		8	
		$3DN < R_2 \leqslant 4DN$	**Cold bending**		10	
			Hot bending		8	
		$R_2 > 4DN$	**Cold bending**		10	
			Hot bending		5	

Table 3-3-8(continued) **mm**

Items				Standard range	Allowable limits	Remarks
Circularity ratio of pipe $E=(D_{max}-D_{min})/D_n\times 100$ Where: E – circularity ratio of pipe, % D_{max} – maximum outside diameter of bending section, mm D_{min} – minimum outside diameter of bending section, mm D_n – actual outside diameter of pipe, mm	**Aluminum and brass pipe**	$R_2 \leqslant 2DN$	**Cold bending**	–	15	R_2 – bending radius DN – nominal inner diameter of pipe
		$2DN < R_2 \leqslant 3DN$			10	
		$3DN < R_2 \leqslant 4DN$				
		$R_2 > 4DN$			8	

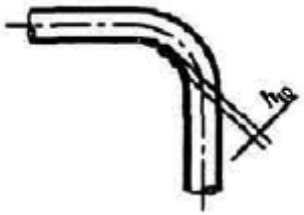
Table 3-3-8(continued) **mm**

Items				Standard range	Allowable limits	Remarks
Reducing ratio of pipe's thickness $F=[(t_a - t_b) / t_a] \times 100$ Where: F – reducing ratio of pipe's thickness, % t_a – original thickness of pipe, mm t_b – thickness of after bending pipe, mm	**Steel pipe**	$R_2 \leqslant 2DN$	**Cold bending**	–	–	R_2 – bending radius DN – nominal inner diameter of pipe
			Hot bending		20	
		$2DN < R_2 \leqslant 3DN$	**Cold bending**		25	
			Hot bending		10	
		$3DN < R_2 \leqslant 4DN$	**Cold bending**		20	
			Hot bending		5	
		$R_2 > 4DN$	**Cold bending**		15	
			Hot bending		5	

Table 3-3-8(continued) **mm**

Items				Standard range	Allowable limits	Remarks
Reducing ratio of pipe's thickness $F=[(t_a - t_b) / t_a] \times 100$ Where: F – reducing ratio of pipe's thickness, % t_a – original thickness of pipe, mm t_b – thickness of after bending pipe, mm	**Copper pipe**	$R_2 \leqslant 2DN$	**Cold bending**	–	–	R_2 – bending radius DN – nominal inner diameter of pipe
			Hot bending		20	
		$2DN < R_2 \leqslant 3DN$	**Cold bending**		30	
			Hot bending		15	
		$3DN < R_2 \leqslant 4DN$	**Cold bending**		25	
			Hot bending		10	
		$R_2 > 4DN$	**Cold bending**		20	
			Hot bending		10	

Table 3-3-8(end) **mm**

Items				Standard range	Allowable limits	Remarks
Reducing ratio of pipe's thickness $F=[(t_a - t_b) / t_a] \times 100$ Where: F – reducing ratio of pipe's thickness, % t_a – original thickness of pipe, mm t_b – thickness of after bending pipe, mm	**Aluminum and brass pipe**	$R_2 \leqslant 2DN$	**Cold bending**	–	25	R_2 – bending radius DN – nominal inner diameter of pipe
		$2DN < R_2 \leqslant 3DN$			20	
		$3DN < R_2 \leqslant 4DN$			15	
Bucking height of bending pipe, h_{10}  h_{10} – bucking height of bending pipe, mm				$\leqslant D_w \times 2\%$	–	D_w – actual outside diameter of pipe, mm

3.6.4 Pipe fixing is to be proceeded in accordance with the requirements as defined in table 3-3-9

Table 3-3-9 **mm**

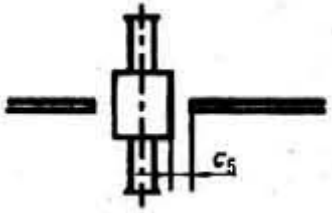
Items			**Standard range**	**Allowable limits**	**Remarks**
Hole	**Upper deck, shell plating and bulkhead**	**Roughness**	0.4	0.8	D_{37} – diameter of hole
		Dimension tolerance	$\leqslant D_{37}/100$	$\leqslant D_{37}/50$	
	Others	**Roughness**	0.8	1.5	
		Dimension tolerance	⩽3	⩽5	
Clearance of sleeve type penetration piece, C_5 			⩽2	⩽3	–

Table 3-3-9(continued) **mm**

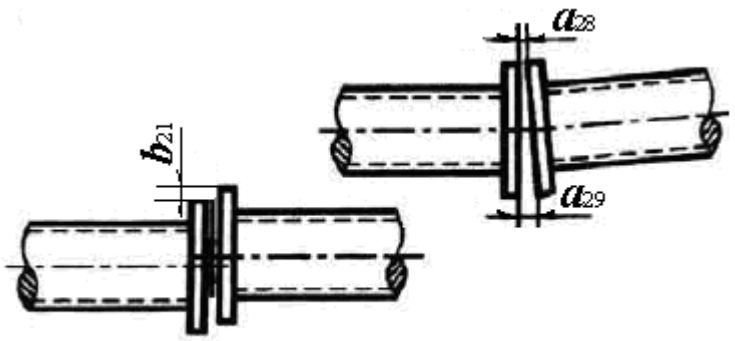
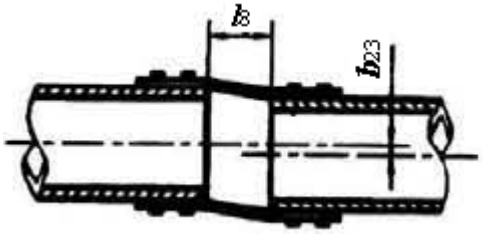
Items			Standard range	Allowable limits	Remarks
Alignment  $a_{27} = \lvert a_{28} - a_{29} \rvert$	Gap a_{27}	$DN \leqslant 100$	$\leqslant 1.5$	–	DN– nominal inner diameter of pipe
		$100 < DN \leqslant 200$	$\leqslant 2.0$		
		$200 < DN \leqslant 300$	$\leqslant 3.0$		
		$DN > 400$	$\leqslant 4.0$		
	Sag b_{21}		$\leqslant 1.5$		
Offset of flange bolt hole, b_{22}  			< 1		–
Alignment of clamped pipes  	**Offset of pipe centre, b_{23}**		< 3	< 5	
	Clearance between pipe ends, l_8		< 10	–	

Table 3-3-9(continued) mm

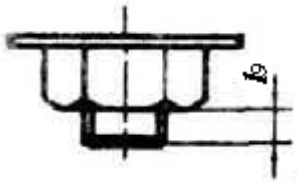
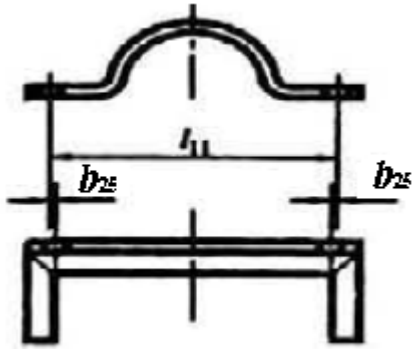
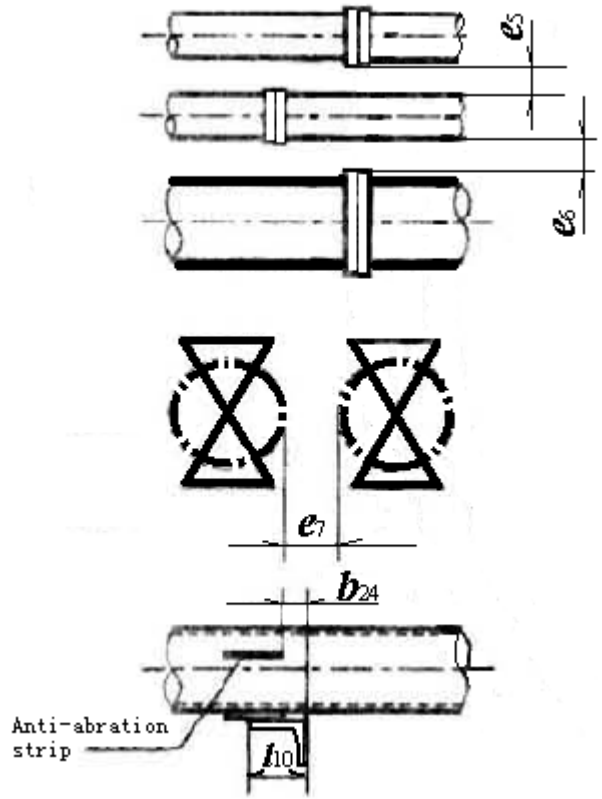
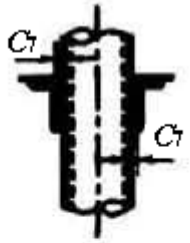
Items		Standard range	Allowable limits	Remarks
Pipe clamp 	**Clearance of U-shape pipe clamp or flat steel pipe clamp,** C_6	**1~3**	—	—
Pipe fastening 	**Extension length of bolt thread after fastening,** l_9	**(1~4)×pitch**		
Distance between brackets  l_{11}– distance between 2pcs bolt hole center	**Offset of bolt hole center on bracket with that on flat steel strip pipe clamp,** Δl_{11}	0~2		
	Offset at bolt hole center on bracket, b_{25}	±2		

Table 3-3-9(end) **mm**

Items		Standard range	Allowable limits	Remarks
Distance between pipes and pipe fittings  l_{10}– width of pipe support	**Distance between parallel pipes, crossover pipes and two adjacent pipes (including fittings),** e_5	＞20	＞10	–
	Distance between outside surface of insulated pipe and adjacent pipe fittings, e_6	＞30	–	
	Distance between adjacent parallel valves and handwheel, e_7	≥30		
	Assembling offset of pipe anti-abrasion strip from bracket, b_{24}	≤ $l_{10}/3$		

3.6.5 Mounting pipe extension rod is to be in accordance with the requirements as defined in table 3-3-10

Table 3-3-10 **mm**

Items			Standard range	Allowable limits	Remarks
	**Clearance between extension rod (operating rod) and bearing, C_7**	**$25 < D_{38} \leqslant 35$**	0.5~1.5	–	D_{38} – diameter of extension rod
		$D_{38} > 35$	0.5~2.0		
	Coaxiality of extension rod(per 5m)		⩽10		
	**Offset of extension rod from valve rod axis line**				
	Mounting angle of deck support for extension rod, θ_{15}		⩽1°		

4 ELECTRIC INSTALLATION

4.1 Cable laying

Cable laying is to be carried out in accordance with the requirements as defined in table 3-4-1

Table 3-4-1 **mm**

<table>
<tr><th>Items</th><th>Standard range</th><th>Allowable limits</th><th>Remarks</th></tr>
<tr><td>Number of layers</td><td>2 layers in general
(or thickness ≤50)</td><td rowspan="2">–</td><td rowspan="3">–</td></tr>
<tr><td>Breadth</td><td>≤200</td></tr>
<tr><td>Distance to heat source</td><td>≥100</td><td>No limit if effective means are adopted</td></tr>
<tr><td>Distance to moist bulkhead</td><td rowspan="2">≥20</td><td rowspan="4">–</td><td>Away from thermal insulation</td></tr>
<tr><td>Distance to fire-resisting bulkhead and deck</td><td rowspan="3">–</td></tr>
<tr><td>Distance to double bottom and lubrication oil tank and fuel oil tank</td><td>≥50</td></tr>
<tr><td>Distance of cable trunk to bulkhead and deck</td><td>≥30</td></tr>
</table>

Table 3-4-1(end) **mm**

Items		Standard range	Allowable limits	Remarks
Spacing between fixing brackets	**Curved space**	≤250	–	–
	Straight space	≤300		
Percentage of cable laid through pipe and trunk		≤40%		
Minimum inner radius of bend	Thermoplastic material and elastic material insulated cable (without metallic sleeve, armoured and metallic braided), D_{39}≤25	≥4D_{39}		D_{39}–cable outside diameter
	Thermoplastic material and elastic material insulated, metallic sleeve, armoured, braided and hard metallic sleeved cable, D_{39}>25	≥6D_{39}		
	Cable insulated by synthetic resin with thin metallic net or with complex shielded	≥8D_{39}		
Length of cable core entering equipment	**Lighting fixture**	≥150		–
	Switch, receptacle, connecting box, alarm bell, etc.	120		

4.2 Electric equipment installation

4.2.1 Electric equipment inside the accommodation spaces are to be installed according to the height requirements as defined in table 3-4-2

Table 3-4-2 **mm**

Items		Standard range	Allowable limits	Remarks
Concealed switch in cabin and passage (from center to floor)		1300~1600	–	–
Watertight switch in cabin and inner passage				
Watertight receptacle, receptacle with switch		1400		
Receptacle for deck lamp, telephone set, radio and TV (from center to desk top)		150		
Receptacle for wall fan		180		
Concealed receptacle at foot height		300		
High and low voltage receptacles		1400		
Berth lamp	**On side wall 300 to 400 from head of bed**	750		
	Middle over head side			

Table 3-4-2(end) **mm**

Items	Standard range	Allowable limits	Remarks
Wall lamp (from lower side to floor/from upper side to ceiling)	1700/200	–	–
Mirror lamp (from center to mirror upper side)	20~100		
Wall fan (from center to floor)	1800		
Ceiling fan (from lowest point to floor)	1900		
Fire alarm call point	1400		
Wall-mounted telephone			
Loud-speaker(with potentialmeter), alarm bell	1800		

4.2.2 Electric equipment installed in places outside accommodation spaces are to be in compliance with the height requirements as defined in table 3-4-3

Table 3-4-3 mm

Items		Standard range	Allowable limits	Remarks
Distribution panel, starter and control box (from upper side to floor/from lower side to floor)		1800/1200	–	–
Push button box (from center to floor)		1400		
Emergency push button box				
Switch, switch with receptacle	From fixed center to floor			
	Distance between when installed upper and down	250		
External passage lamp (from center to upper deck)		150~200		

5 PAINTING

5.1 Pretreatment of steel surface

5.1.1 Pretreatment of steel is to be performed in accordance with the requirements as defined in table 3-5-1

Table 3-5-1

Items			Standard range	Allowable limits	Remarks
Shot blasting	Steel plate of $t \geqslant 6$mm	Cleanness	Sa2.5 class	–	GB/T 8923
		Roughness	Medium class		GB/T 13288
	Steel sections of $t_x \geqslant 4$mm	Cleanness	Sa2.5 class	Sa2 class	GB/T 8923
		Roughness	Medium class	–	GB/T 13288
Pickling	Steel plate of $t \leqslant 6$mm, Steel sections of $t_x \leqslant 4$mm, Steel outfittings	Cleanness	No scale No rust No grease No dirt		–
Abrasive blasting	Steel plate of any size, Steel sections of any size		Sa2.5 class		GB/T 8923
		Roughness	Medium class		GB/T 13288
	Steel outfittings	Cleanness	Sa2.5 class	Sa2 class	GB/T 8923
		Roughness	Medium class	–	GB/T 13288

5.1.2 Application of shop primer is to be in accordance with the requirements as defined in table 3-5-2

Table 3-5-2 μm

Items		Standard range	Allowable limits	Remarks
Type of paint	Zinc primer	–		Approved by classification society in accordance with painting scheme
	Zincless primer			
Film thickness	Zinc primer	13~18	12~30	–
	Zincless primer	20~25	18~40	

5.2 Secondary de-rusting

Cleanness after secondary derusting is to be in compliance with the requirements as defined in table 3-5-3

Table 3-5-3

Items				Standard range	Allowable limits	Remarks
Position		Paint type	Surface treatment			
Shop primer damaged area, such as weld area, line and spot heating area, and naturally exposed area	Shell plating and exterior exposed location	Conventional paint[a], Chlorinated rubber paint	Abrasive blasting	Sa2 class	—	GB/T 8923
			Power tool	St2~ St3 class	Sa2 class	
		Epoxy resin paint, vinyl resin paint, polyurethane paint, epoxy-tar paint	Abrasive blasting	Sa2.5 class	—	
			Power tool	St3 class		
		Inorganic zinc paint	Abrasive blasting	Sa2.5 class		
	Interior space	Conventional paint, Chlorinated rubber paint	Abrasive blasting	Sa2 class		
			Power tool	St2 class		
		Epoxy resin paint, vinyl resin paint, epoxy-tar paint	Abrasive blasting	Sa2 class		
			Power tool	St2~ St3 class		
		Inorganic zinc paint	Abrasive blasting	Sa2.5 class		

Table 3-5-3(end)

Items				Standard range	Allowable limits	Remarks
Position		Paint type	Surface treatment			
Shop primer damaged area, such as weld area, line and spot heating area, and naturally exposed area	Interior of liquid tank (excluding fuel tank)	Conventional paint[a],	Abrasive blasting	Sa2 class	—	GB/T 8923
			Power tool	St2~ St3 class		
		Epoxy resin paint, vinyl resin paint, polyurethane paint, epoxy-tar paint	Abrasive blasting	Sa2.5 class	Sa2 class	
			Power tool	St3 class	—	
		Inorganic zinc paint	Abrasive blasting	Sa2.5 class		
	Fuel tank	Conventional paint	Power tool	St2 class		
Surface with intact shop primer	Chemical product tanker hull surface except cargo tank	Any paint	Abrasive blasting, Power tool	Remove powdery rust, grease and dirt		
	Interior of cargo tank of chemical product tanker	special paints for cargo tank of chemical product tanker	Abrasive blasting	Sa2.5 class		

Conventional paint[a], include oil-based paint, oil-modified synthetic resin based paint and bituminous paint. For fuel oil tank and lubrication oil tank, conventional paints imply those temporary protective paints based on petroleum resin and castor oil and conventionally used shop primer.

5.3 Surface cleaning

Surface cleaning before painting is to be performed in accordance with the requirements as defined in table 3-5-4

Table 3-5-4

<table>
<tr><th colspan="2">Items</th><th>Standard range</th><th>Allowable limits</th><th>Remarks</th></tr>
<tr><td>Moisture</td><td rowspan="2">Before applying any paint</td><td rowspan="3">Invisible to naked eye</td><td rowspan="3">–</td><td rowspan="7">–</td></tr>
<tr><td>Salt</td></tr>
<tr><td rowspan="2">Grease</td><td>Before applying inorganic zinc paint</td></tr>
<tr><td>Before applying others except inorganic zinc paint</td><td rowspan="4">Remove</td><td rowspan="2">With trace remained</td></tr>
<tr><td>Dust</td><td>Before applying any paint</td></tr>
<tr><td rowspan="2">Zinckic salt</td><td>Before applying inorganic zinc paint</td><td>With slight trace remained</td></tr>
<tr><td>Before applying others except inorganic zinc paint</td><td>With trace remained</td></tr>
</table>

Table 3-5-4(end)

Items			Standard range	Allowable limits	Remarks
Dust of gas cutting and welding	Before applying inorganic zinc paint		**Remove**	**With slight trace remained**	—
	Before applying others except inorganic zinc paint			**With trace remained**	
Chalk marking	Before applying inorganic zinc paint			**With slight trace remained**	
	Before applying chlorinated rubber paint, epoxy resin paint, vinyl resin paint and polyurethane resin paint			**With trace remained**	
	Before applying conventional paint			—	
Paint marking	Before applying inorganic zinc paint			**With slight trace remained**	
	Before applying chlorinated rubber paint, epoxy resin paint, vinyl resin paint and polyurethane resin paint	In case the marking paint is compatible	**No need to remove**	—	
		In case the marking paint is not compatible	**Remove**	**With trace remained**	
	Before applying conventional paint		**No need to remove**	—	

5.4 Quality of coating

The quality of the coating is to be in compliance with the requirements as defined in table 3–5–5

Table 3-5-5

Items			Standard range	Allowable limits	Remarks
Surface with high decoration requirement (exterior surface of superstructure, exposed surface of wheelhouse, accommodation cabins and interior passage)	**Defect**	Miss-out painting, bubble cavity, crackle, dry particles of paint	None	None	–
		Flowtrace, brush mark, ripple	Not obvious	Slight	
	Color		**In conformity with requirement**	–	
Surface with certain decoration requirement (shell plating, exposed deck, engine room and stores)	**Defect**	Miss-out painting, bubble cavity, crackle	None		
		Flowtrace, ripple	Not obvious	Slight	
	Color		**Not obviously different from requirement**	–	
Surface without decoration demand (such as cargo hold, cargo tank, void space and cofferdam, etc.)	**Defect**	Miss-out painting, bubble cavity, crackle	None		
		Flowtrace, ripple	Slight	Not serious	

5.5 Film thickness of coating

Film thickness of coating is to be in compliance with the painting specification. The deviation of the thickness of the film is to be in accordance with the requirements as defined in table 3-5-6

Table 3-5-6

Items		Standard range	Allowable limits	Remarks
Distribution of film thickness	Film thickness of over 85% measured points	**Up to required thickness**	–	For cargo tank of product tanker, the film thickness at over 90% measured points is to be up to the required film thickness, with film thickness at remaining measured points is to be 90% required thickness.
	Film thickness of remaining measured points	**Up to 85% of required thickness**		