TÜRK LOYDU RULE CHANGE SUMMARY

TL NUMBER: 03/2021 JUNE 2021

Latest editions of TL Rules incorporate all rule changes. The latest rule revisions of a published rule are shown with a vertical line. Changes after the publication of the rule are written in red colour.

Please note that within this document added items are written in red and for deleted items strikethrough is applied. After the publication of relevant rule, those revisions are to be indicated with a vertical line. Following Rule Changes presented in English are also implemented into Turkish Version of Rules.

RULE CHANGE SUMMARY

CLASSIFICATION AND SURVEYS

No	Item
01	Section 3

CHAPTER 1 - HULL

No	Item
01	Section 3
02	Section 6
03	Section 11
04	Section 21
05	Section 22
06	Section 26

07	Section 28
08	Section 35
09	Section 36

CHAPTER 2 - MATERIAL

No	Item
01	Section 3
02	Section 5
03	Section 11

CHAPTER 3 - WELDING

No	Item
01	Section 4
02	Section 8
03	Section 10
04	Section 12
05	Annex C

CHAPTER 4 - MACHINERY

No	Item
01	Section 8
02	Section 11
03	Section 18
04	Section 19
05	Section 20

CHAPTER 5 – ELECTRICAL INSTALLATION

No	Item
01	Section 4
02	Section 10

CHAPTER 8 – CHEMICAL TANKERS

No	Item
01	Section 2

CHAPTER 9 – CONSTRUCTION AND CLASSIFICATION OF YACHTS

No	Item
01	Section 9
02	Section 10

CHAPTER 10 – LIQUFIED GAS TANKERS

No	Item
01	Section 2
02	Section 5
03	Section 13
04	Section 16
05	Section 18

CHAPTER 11 – FIRE FIGHTING SHIPS

No	Item
01	Section 1

CHAPTER 19 – INLAND WATER VESSELS

No	Item
01	Section 12

CLASSIFICATION AND SURVEYS

01. Section 3 - Surveys

Revision Date: May 2021

Entry into Force Date: 1 July 2021

Item A.11.2.1.2 was revised according to UR Z17 Rev.5 as below:

……

- Firms engaged in Cable Transit Seal Systems inspection on ships and Mobile Offshore Units.

PART A – CHAPTER 1 – HULL

01. Section 3 – Design Principles

Revision Date: April 2021

Entry into Force Date: 1 July 2021

Item A.2.3.2 and name of table 3.6 were revised according to UR S6 Rev.9 Corr.1 as below:

……

Table 3.6: For single side bulk carriers subjected to SOLAS regulation XII/6.4~~.3~~,

……

Table 3.6 Minimum material grades for single-side skin bulk carriers subjected to SOLAS regulation XII/6.4~~.3~~

02. Section 6 – Longitudinal Strength

Revision Date: May 2021

Entry into Force Date: 1 July 2021

Item D.1 was revised as below:

……

The calculation of the stresses can be carried out by an analysis of the complete hull. If no complete hull analysis is carried out, the most unfavorable values of the stress combinations according to Table ~~5~~6.3 are to be taken for σ_L and. τ_L respectively. The formulae in Table ~~5~~6.3 contain σ_{SW}, σ_{WV}, σ_{WH}, σ_{ST} and σ_{WT} according to 2. and τ_{SW}, τ_{WV}, τ_{WH}, τ_{ST} and τ_{WT} according to 3. as well as:

……

03. Section 11 – Watertight Bulkheads

Revision Date: April 2021

Entry into Force Date: 1 July 2021

Item A.4.2.2 was revised according to UI SC93 Rev.2 as below:

……

In cargo ships a stern tube enclosed in a watertight space of moderate volume, such as an afterpeak tank, where the inboard end of the stern tube extends through the afterpeak/engine room watertight bulkhead into the engine room is considered to be an acceptable solution satisfying the requirement of Chapter II-1, Regulation 12.1~~0~~1 of SOLAS 1974, as amended, provided the inboard end of the stern tube is effectively sealed at the afterpeak/engine room bulkhead by means of an approved watertight/oiltight gland system.

Item A.5.1.6 was revised according to UI SC156 Rev.2 as below:

5.1.6 For internal doors in watertight bulkheads in cargo ships and passenger ships~~, see~~ TL-I SC156 ~~Table 1~~ is to be applied.

04. Section 21 – Structural Fire Protection

Revision Date: April 2021

Entry into Force Date: 1 July 2021

Item B.9.1.4.16 and C.7.7 were revised according to UI SC147 Rev.2 as below:

9.1.4.16 Watertight doors below bulkhead deck, which also serve as fire doors are not to ~~be~~ close~~d~~ automatically in case of fire detection.

7.7 Watertight doors below freeboard deck, which also serve as fire doors are not to to ~~be~~ close~~d~~ automatically in case of fire detection.

05. Section 22 – Corrosion Protection

Revision Date: May 2021

Entry into Force Date: 1 July 2021

Item E.2.1.1.4 was revised in accordance with TL/2018/OB/09 as below:

Weld spatters, rough-rolled ends, laminations, rolling flaws etc. which have only become apparent immediately before or during the blasting work shall be remedied. Edges and welding seams shall be treated according to ~~Table 22.6 and Table 22.7 and transitions shall be gradual. Further specifications are given in~~ the Shipbuilding and Repair Quality Standard of the TL.

06. Section 26 – Stability

Revision Date: April 2021

Entry into Force Date: 1 July 2021

Item F.4.1.3 was revised according to UR L5 Rev.4 as below:

4.1.3 Type 3 software is to include pre-defined relevant damage cases for both sides of the ship according to the applicable rules for automatic check of a given loading condition.

07. Section 28 – Oil Tankers

Revision Date: April 2021

Entry into Force Date: 1 July 2021

Footnote (6) was revised according to Rec.110 Rev.2 as below:

(6) *Refer to part B, chapter 4, of the International Code on Intact Stability, 2008 (2008 IS Code), as amended; the Guidelines for the Approval of Stability Instruments (MSC.1/Circ.1229), annex, section 4, as amended; and the technical standards defined in part 1 of the Guidelines for verification of damage stability requirements for tankers (MSC.1/Circ.1461) (See also TL-G 110).*

08. Section 35 – Floating Docks

Revision Date: April 2021

Entry into Force Date: 1 July 2021

This section was generally revised.

09. Section 36 – Goal-Based Ship Construction Standards For Bulk Carriers and Oil Tankers

Revision Date: April 2021

Entry into Force Date: 1 July 2021

Item D.1.1 was revised according to UR Z23 Rev.7 as below:

……

- Details of equipment forming part of the watertight and weather tight integrity of the ship

  a Cable Transit Seal Systems Register, to be prepared by the shipbuilder for watertight cable transits. The Register can be in either a hard copy or digitized media. For an example of a register see TL-R Z23 Appendix 3 - Recommendatory Sample - Cable Transit Seal Systems Register. It is to include a marking / identification system, documentation referencing manufacturer manual(s) for each type of cable transit installed, the Type Approval certification for each type of transit system, applicable installation drawings, and a recording of each installed transit documenting the as built condition after final inspection in the shipyard. This is to include sections to record any inspection, modification, repair and maintenance.

……

PART A – CHAPTER 2 – MATERIAL

01. Section 3 – Rolled Steel Plates, Sections and Bars

Revision Date: May 2021

Entry into Force Date: 1 July 2021

Item J.2.2.1.1 was revised according to UR S33 Rev.3 as below:

2.2.1.1 Ultrasonic testing (UT) in accordance with TL-R W33 ~~or **TL**'s requirement~~ is to be carried out on all block-to-block butt joints of all upper flange longitudinal structural members in the cargo hold region. Upper flange longitudinal structural members include the topmost strakes of the inner hull/bulkhead, the sheer strake, main deck, coaming plate, coaming top plate and

all attached longitudinal stiffeners. These members are defined in Figure 3.14.

Items J.2.2.2.1 and 2.2.2.2 were revised according to UR S33 Rev.3 as below:

2.2.2.1 Acceptance criteria of UT are to be in accordance with TL-~~ G 20 or **TL**'s practice~~R W33.

2.2.2.2 The acceptance criteria may be adjusted under consideration of the appertaining brittle crack initiation prevention procedure and where this is more severe than that found in TL-~~ G 20~~R W33, the UT procedure is to be amended accordingly to a more severe sensitivity.

Item J.2.3.1.1 was revised according to UR S33 Rev.3 as below:

2.3.1.1 The procedure of the NDT is to be in accordance with TL-~~ G 20 or **TL**'s requirements~~R W33, irrespective of the applicability clause for new building in paragraph 1.1 of TL-R W33.

Item J.2.3.1.1 was revised according to UR S33 Rev.3 as below:

2.3.3.1 Where UT is carried out, acceptance criteria of UT are to be in accordance with TL-~~ G 20 or **TL**'s practice~~ R W33, irrespective of the applicability clause for new building in paragraph 1.1 of TL-R W33.

02. Section 5 – Steel Forgings

Revision Date: May 2021

Entry into Force Date: 1 July 2021

Item A.10.2 was revised according to Rec. 68 Rev.1 as below:

10.2 When required by the relevant construction rules, or by the approved procedure for welded composite components appropriate non-destructive testing is also to be carried out before acceptance and the results are to be reported by the manufacturer.

The extent of testing and acceptance criteria are to be agreed with TL-G 68 is regarded as an example of an acceptable standard.

03. Section 11 – Materials for Propeller

Revision Date: May 2021

Entry into Force Date: 1 July 2021

Contents of Section 11 were revised according to revisions of UR W24 Rev.4 and UR W27 Rev.2.

Item A.1 was revised according to UR W24 Rev.4 as below:

1. Scope

These Rules are applicable to the ~~moulding, casting~~ manufacture, testing and to the method for repairing of ~~new~~ propellers, propeller blades and propeller bosses made of cast copper alloys.

Where the use of alternative alloys is proposed, particulars of chemical composition, mechanical properties and heat treatment are to be submitted for approval.

By agreement with **TL**, these Rules may also be applied to the repair and testing of propellers which have been damaged in service.

Items A.2.1 and 2.2 were revised according to UR W24 Rev.4 as below:

2.1 Approval

All propellers and propeller components are to be ~~cast~~ manufactured by foundries approved by **TL** or an IACS Member Classification Society. ~~To this end, foundries shall furnish proof that they have available the requisite production facilities and qualified personnel in order to be able to manufacture propellers in the appropriate manner and~~ The castings are to be manufactured and tested in accordance with these Rules.

2.2 Application for approval

It is the manufacturer's responsibility to assure that effective quality, process and production controls during manufacturing are adhered to within the manufacturing specification. The ~~approval is to be applied for at~~ manufacturing specification shall be submitted to **TL** at the time of initial approval, and shall at least include the following particulars: description of the foundry facilities, copper alloy material specification, runner and feeder arrangements, manufacturing procedures, non-destructive testing and repair procedures. ~~The applications are to be accompanied by specifications of the propeller materials, manufacturing procedures, repair, NDT inspection procedures and a description of the foundry facilities, including the maximum capacity of the ladles.~~

Item A.2.4 was revised according to UR W24 Rev.4 as below:

2.4 Inspection facilities

The foundry is to have a suitably equipped laboratory, staffed by qualified personnel to perform tests on moulding materials, chemical analyses, mechanical tests ~~and~~, microstructural examinations of metallic materials and non-destructive tests.

Where ~~the requisite facilities are not available at the foundry, specifications are to be furnished giving all the necessary particulars of the~~ testing activities are assigned to other companies or other laboratory ~~which carries out the tests for the foundry~~, additional information required by **TL** is to be included.

Item A.4 was revised according to UR W24 Rev.4 as below:

4. ~~General Characteristics~~Quality of Castings

4.1 Freedom from defects

All castings must have a workmanlike finish and must be free from defects ~~liable to impair their intended use~~ which would be prejudicial to their proper application in service. Minor casting defects which are still visible after machining, such as small sand and slag marks, small cold shuts and scabs shall be removed by the manufacturer ~~(Cf Par 14)~~ in accordance with item 11.

4.2 Removal of defects

Casting defects which may impair the serviceability of the castings, such as major non-metallic inclusions, shrinkage cavities, blow holes and cracks are not permitted. They are to be removed by one of the methods described in 141. within the limits applicable for the endangered zone in question. A comprehensive report on the repairs carried out is to be made available to the Surveyor.

Item A.5 was revised according to UR W24 Rev.4 as below:

5.1 The verification of dimensions and the dimensional and geometrical tolerances ~~are governed by the data contained in the approval drawings or order documents~~ is the responsibility of the manufacturer.

~~These documents shall~~ The report on the relevant examinations is to be submitted to the Surveyor ~~at the time of testing~~, who may require checks to be made in his presence.

~~The accuracy and verification of the dimensions are the responsibility of the manufacturer, unless otherwise agreed.~~

5.2 All propellers are to be statically balanced in accordance with specified ISO 484 tolerance class (or equivalent) as specified in the approved drawings in presence of a surveyor. Dynamic balancing is required for propellers with an operating speed of more than 500 rpm or propellers with tip speed exceeding 60 m/s.

For further details see Part B, Chapter 4, Section 8, F.

Title of item 6, item 6.1 and table 11.1 were revised according to UR W24 Rev.4 as below:

6. Chemical Composition and ~~Microstructure~~ Metallurgical Characteristics

……..

The manufacturer is to maintain records of the chemical analyses of the production casts, which are to be made available to the Surveyor.

Alloy type	~~Chemical composition (%)~~							
	Cu%	**Al%**	**Mn%**	**Zn%**	**Fe%**	**Ni%**	**Sn%**	**Pb%**
CU1	52-62	0.5-3.0	0.5-4.0	35-40	0.5-2.5	max.1.0	max. 1.5	max. 0.5
CU2	50-57	0.5-2.0	1.0-4.0	33-38	0.5-2.5	3.0-8.0	max. 1.5	max. 0.5
CU3	77-82	7.0-11.0	0.5-4.0	max. 1.0	2.0-6.0	3.0-6.0	max. 0.1	max. 0.03
CU4	70-80	6.5-9.-0	8.0-20.0	max. 6.0	2.0-5.0	1.5-3.0	max. 1.0	max. 0.05

Item 6.2 was revised according to UR W24 Rev.4 as below:

……

In which ~~A is the algebraic sum of the following values~~:

~~1 : % Sn~~

~~5 : % Al~~

~~0.5 : % Mn~~

~~0.1 : % Fe~~

~~2.3 : % Ni~~

A= %Sn + 5x% Al -0.5x% Mn -0.1x% Fe -2.3x% Ni

Note :

The minus sign preceding the elements Mn, Fe and Ni signifies that these elements tend to reduce the proportion of beta phase.

The micro structure of alloy types CU 1 and CU 2 shall be verified by determining the proportion of alpha phase. For this purpose, at least one specimen shall be taken from each heat. The proportion of alpha phase shall be determined as the average value of 5 counts.

Items 7 and 8 was combined according to UR W24 Rev.4 as below:

7. Mechanical ~~Characteristics~~ Properties and Tests

7.1 Standardized alloys

The mechanical ~~characteristics must conform~~ properties are to ~~the data~~ comply with the values given in Table 11.2. These values are applicable to test specimens manufactured from cast samples separately in accordance with Fig. 11.1 or in accordance with specifications of a recognized ~~national~~ standard.

……

7.2 Other alloys

The mechanical properties of other alloys not ~~shown~~ ~~in~~ meeting the minimum values of Table 11.2 are to comply with the requirements set out in a specification which has been approved by **TL.**

~~8.~~ 7.3 ~~Inspections and~~ Tensile tests and specimens

~~The following inspections and~~ Tensile tests and specimens are to be ~~performed. The dimensions of test specimens and methods of testing are given~~ in accordance with Section 2.

~~8.1 Chemical composition~~

~~The manufacturer shall define the chemical composition of each ladle.~~

~~8.2 Tensile test~~

~~8.2.1~~ ~~The tensile strength, 0.2 % proof stress and elongation are to be determined by tensile test. For this purpose, at least one tensile test specimen is to be taken from each ladle charge.~~

~~8.2.2~~ Tensile test specimens are normally to be taken from separately cast sample pieces, see 7.1. The sample pieces are to be cast in moulds of the same moulding material as is used for the propeller casting. They must be cooled under the same conditions as the propeller itself. At least one tensile test specimen shall be taken from each ladle.

~~8.2.3~~ If propellers are subjected to heat treatment, the sample pieces are to be heat treated in the same way.

~~8.2.4~~ Where test specimens are to be taken from integrally cast sample bars, this is to be the subject of special agreement with **TL**. Wherever possible, the sample bars are to be located on the blades at a point lying between 0.5 and 0.6 R, where R is the radius of the propeller. The test sample material ~~may not~~ must be removed from the ~~propeller~~ casting by non thermal ~~cutting process~~ procedures.

~~8.3 Micrographic examination~~

~~The microstructure of the casting grades CU1 and CU2 is to be demonstrated by determining the proportion of alpha phase. For this purpose, at least one specimen is to be taken from each heat. The proportion of alpha phase is to be determined as the average value from 5 counts. In this case the requirements set out in 6.2 shall be met.~~

~~8.4 Surface quality and dimensions~~

~~8.4.1~~ ~~Propeller castings are to be monitored throughout all the production phases; after finish machining, the Surveyor is to carry out a comprehensive inspection of the entire surface. The inspection is also to include the bore of the boss.~~

~~8.4.2~~ ~~The manufacturer shall check the dimensions and then submit a report on the dimensional inspection to the Surveyor. The Surveyor may insist on dimensional checks being carried out in his presence.~~

~~8.4.3~~ ~~The Surveyor may require certain areas to be slightly etched (e.g. with iron chloride) to show up weld repairs.~~

Items 9, 10 and 11 were deleted and subsequent items were renumbered according to UR W24 Rev.4 as below:

~~**9. Non-Destructive inspections**~~

~~**9.1 Dye penetrant inspection**~~

~~**9.1.1** A dye penetrant inspection is to be carried out on "Zone A" endangered areas, cf. 12. in the presence of the Surveyor. A description of the tests and a standard for evaluation purposes are contained in 13.~~

~~A dye penetrant inspection is to be performed by the manufacturer on Zones "B" and "C"; if the Surveyor requests it, in his presence.~~

~~**9.1.2** Where repairs have been carried out by grinding or welding, the sites of these repairs are to be subjected to a dye penetrant inspection regardless of the location and/or danger area.~~

~~**9.2 Radiographic and ultrasonic inspection**~~

~~Where there is serious reason to doubt that the casting is free of internal defects, the Surveyor may require additional non-destructive tests to be carried out, e.g. radiographic and/or ultrasonic tests. In this case the following shall be noted: the standards for evaluation are to be agreed between manufacturer and **TL** in accordance with a recognized standard.~~

~~***Notes on procedure:***~~
~~*The absorption of X and gamma rays in copper-based alloys is greater than it is in steel. In the case of propellers made of bronze, X rays of 300 kV may normally only be used up to wall thicknesses of 50 mm, and Co 60 gamma rays only up to wall thicknesses of 160 mm. Owing to the restricted penetration thickness and other practical considerations, radiographic testing is not a suitable method for testing the thickest parts of large propellers.*~~

~~*Ultrasonic testing cannot, as a general rule, be performed on casting grades CU1 and CU2 due to the high absorption properties of these materials. Ultrasonic testing is possible for grades CU3 and CU4 at areas close to the surface.*~~

~~**9.3 Documentation on defects and tests**~~

~~All defects requiring the casting to be repaired by welding are to be preferably indicated in the drawings or in special sketches, in which their location and dimensions is to be clearly identified.~~

~~The test method is also to be indicated. These documents are to be submitted to the Surveyor prior to any repair welding being carried out.~~

~~**10. Identification and Marking**~~

~~**10.1 Identification**~~

~~The manufacturer must employ a production monitoring system which enables the castings to be traced back to their heat. On request, the Surveyor is to be provided with proof of the process.~~

~~**10.2 Marking**~~

~~Prior to final inspection by the Surveyor, the manufacturer shall mark the castings at least as follows:~~
~~- Grade of casting or corresponding abbreviated designation,~~

- ~~Manufacturer's mark,~~
- ~~Heat number, casting number or another mark enabling the manufacturing process to be traced back,~~
- ~~Specimen number,~~
- ~~Date of final inspection,~~
- ~~Number of **TL**'s test certificate,~~
- ~~Ice class symbol, where applicable,~~
- ~~Blade skew angle for high-skew propellers.~~

~~11. Certificates Issued by the Manufacturer~~

~~For each propeller the manufacturer is to submit to the Surveyor a certificate containing the following details:~~

- ~~Purchaser and order number,~~
- ~~Ship project number, if known,~~
- ~~Description of the casting and drawing number,~~
- ~~Diameter, number of blades, pitch and direction of turning,~~
- ~~Grade of casting and chemical composition of each heat,~~
- ~~Heat or casting number,~~
- ~~Final weight,~~
- ~~Results of the non-destructive tests and details of the test method, where applicable~~
- ~~Proportion of alpha phase in CU1 and CU2 alloys~~
- ~~Results of the mechanical tests~~
- ~~Casting identification number~~
- ~~Blade skew angle for high-skew propellers, cf. 12.1.~~

Renumbered item 8.2 was revised according to UR W24 Rev.4 as below:

8.2 Severity zones

In order to relate the scope of the tests to the effect of defects in propeller blades and avoid the risk of fatigue fractures following repairs, the blades are divided into three severity zones designated "A", "B" and "C".

……

Item 9 was added according to UR W24 Rev.4 as below:

9. Non-destructive testing

9.1 Qualification of personnel involved in NDT

Refer to Chapter 3 – Welding, Section 10 items J.2.3, 2.4 and, 2.5.

9.2 Visual testing

All finished castings are to be 100% visually inspected by the manufacturer. Castings are to be free from cracks, hot tears or other imperfections which, due to their nature, degree or extent, will interfere with the use of the castings. A general visual examination is to be carried out by the Surveyor.

9.3 Liquid penetrant testing

Liquid penetrant testing procedure is to be submitted to the Society and is to be in accordance with ISO 3452-1 or a recognized standard. The acceptance criteria are specified in item 10.

The severity zone A is to be subjected to a liquid penetrant testing in the presence of the Surveyor.

In zones B and C the liquid penetrant testing is to be performed by the manufacturer and may be witnessed by the Surveyor upon his request.

If repairs have been made either by grinding, straightening or by welding the repaired areas are additionally to be subjected to the liquid penetrant testing independent of their location and/or severity zone.

9.4 Radiographic and ultrasonic testing

When required by the Society or when deemed necessary by the manufacturer, further non-destructive testing (e.g. radiographic and/or ultrasonic testing) are to be carried out. The acceptance criteria or applied quality levels are to be agreed between the manufacturer and TL in accordance with a recognized standard.

Note: due to the attenuating effect of ultrasound within cast copper alloys, ultrasonic testing may not be practical in some cases, depending on the shape/type/thickness, and grain-growth direction of the casting.

In such cases, effective ultrasound penetration into the casting should be practically demonstrated on the item. This would normally be determined by way of back-wall reflection, and/or target features within the casting.

~~13~~10. Acceptance Criteria for ~~Dye~~Liquid Penetrant ~~Inspection~~ Testing

~~13~~10.1 ~~Inspection procedure~~ Definitions of liquid penetrant indications

~~The dye penetrant inspection is to be executed in conformity with a standard or specification approved by **TL.**~~

~~13.2 Definitions~~

~~13.2.1~~ Indication: In ~~dye~~ the liquid penetrant ~~inspection~~testing, an indication is classed as when bleeding of the indicating fluid is clearly visible from discontinuities in the material at least 10 minutes after the developer has been applied.

Relevant indication: Only indications which have any dimension greater than 1.5mm shall be considered relevant for the categorization of indications.

Non-linear indication: an indication with a largest dimension less than three times its smallest dimension (i.e. $l < 3$ w).

Linear indication: an indication with a largest dimension three or more times its smallest dimension (i.e. $l \geq 3$ w).

Aligned indications:

a) Non-linear indications form an alignment when the distance between indications is less than 2mm and at least three indications are aligned. An alignment of indications is considered to be a unique indication and its length is equal to the overall length of the alignment.

b) Linear indications form an alignment when the distance between two indications is smaller than the length of the longest indication.

~~13.2.2 Forms of indication~~

~~A distinction is made between circular, linear and aligned indications, see~~ Illustration of liquid penetrant indication is given in Figure 11.7.

~~13.3~~ 10.2 Acceptance standard

~~13.3.1 For evaluation purposes,~~ the test surface is to be subdivided into reference areas, each being 100 cm^2~~, as described in the definitions given in 13.2. The number and form of the indications encountered may not exceed the values specified in Table 11.3.~~ Each reference area may be square or rectangular with the major dimension not exceeding 250mm.

The area is to be taken in the most unfavourable location relative to the indication being evaluated.

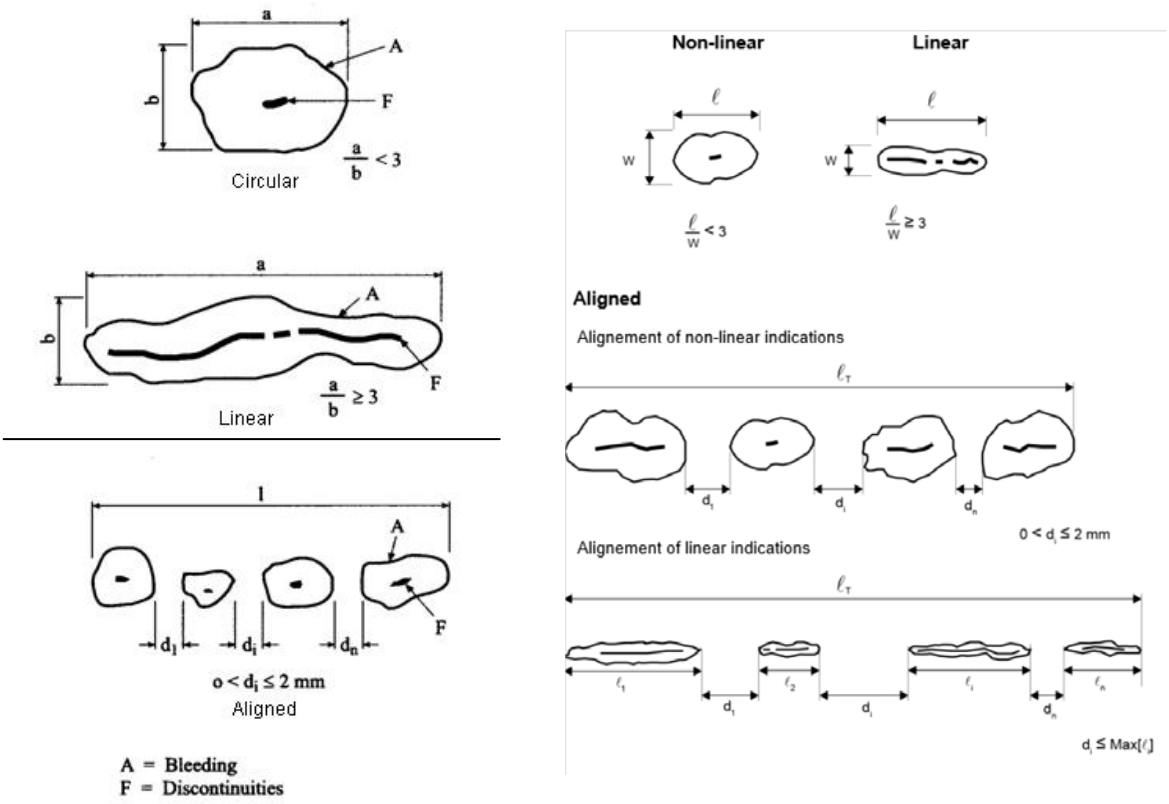
The relevant indications detected shall, with respect to their size and number, not exceed the values given in the Table 11.3.

~~13.3.2~~ For welding purposes prepared areas are always to be evaluated as Zone "A" regardless of their location. The same applies for weld sites when they have been finish machined and/or ground.

~~14.2.1~~ Defects are normally to be removed by mechanical methods such as grinding, chipping or milling. By consent of ~~the Surveyor~~ **TL**, repairs by welding may be performed provided that the specifications given in 141.3, 141.4 and 141.5 have been complied with.

~~14.2.2~~ After milling or chipping grinding is to be applied for such defects which are not to be welded. Grinding is to be carried out, in such a manner that the contour of the ground depression is as smooth as possible in order to avoid stress concentrations or to minimise cavitation corrosion. Complete elimination of the defective material is to be verified by liquid penetrant testing.

Figure 11.7 was revised according to UR W24 Rev.4 as below:



Item 14.3 was renumbered as 11.3 and was revised according to UR W24 Rev.4 as below:

~~**14.3.1**~~ Repairs by welding in Zone "A" are generally not permitted unless specially approved by **TL**

In some cases the propeller designer may submit technical documentation to propose a modified zone A based on detailed hydrodynamic load and stress analysis for consideration by **TL**.

~~**14.3.2**~~ Grinding is permitted to the extent that the blade thickness specified in the drawing is maintained.

~~**14.3.3**~~ Where grinding has to be carried out more deeply than described above, this is to be inspected and approved on a case by case basis by **TL**.

Item 11.6 was added according to UR W24 Rev.4 as below:

11.6 Repair documentation

The foundry is to maintain records of inspections, welding, and any subsequent heat treatment, traceable to each casting.

Before welding is started, full details of the extent and location of the repair, the proposed welding procedure, heat treatment and subsequent inspection procedures are to be submitted to **TL** for approval.

Renumbered item 12 was revised according to UR W24 Rev.4 as below:

12. ~~Repair by~~ Welding Repair Procedure

12.1 General ~~requirements~~

~~**15.1.1** Companies wishing to carry out welding work on propellers are to have at their disposal suitable workshops, lifting gear, welding equipment, test equipment and heat treatment facilities as well as qualified welders and welding supervisors to enable them to carry out the work properly. Proof is to be furnished to the Surveyor that these requirements are satisfied before welding work begins.~~

~~**15.1.2** The company in question is to prepare and submit to **TL** a specification containing all the welding details in the form of a WPS **(1)** such as preparation of weld sites, welding method, filler metals, preheating, subsequent heat treatment and test method.~~

~~**15.1.3** Before welding is carried out, a welding procedure approval test is to be carried out in the presence of the Surveyor. Every welder or welding machine operator is to demonstrate that he is entirely competent to perform the specified welds, using the same procedure, fillers and positions as required for the repair. The scope of the tests required for this is given in Annex A.~~

~~**15.1.4** Welding procedure approval tests and welder's qualification tests performed at the aforementioned test pieces remain valid for 3 years and include thicknesses up to 1.5 "t", with "t" being the thickness of the test piece. Welder's qualification tests performed at CU2 include CU1, those performed at CU4 include CU3.~~

~~**(1)** *WPS = Welding Procedure Specification.*~~

Before welding is started, manufacturer shall submit to **TL** a detailed welding procedure specification covering the weld preparation, welding parameters, filler metals, preheating and post weld heat treatment and inspection procedures.

All weld repairs are to be carried out in accordance with qualified procedures, and, by welders who are qualified to a recognized standard. Welding Procedure Qualification Tests are to be carried out in accordance with Annex A and witnessed by the Surveyor.

Table 11.3 was revised according to UR W24 Rev.4 as below:

Table 11.3 Permitted number and size of relevant indications in a reference area of 100 cm^2 as a function of the severity zones

Severity zones	Maximum number of indications	Type of indication	Maximum number for each type of indicaiton (1) (2)	Maximum permitted dimension "a" or "l" of indications [mm]
A	7	~~Circular~~ non-linear	5	4
		linear	2	3
		aligned	2	3
B	14	~~circular~~ non-linear	10	6
		linear	4	6
		aligned	4	6
C	20	~~circular~~ non-linear	14	8
		linear	6	6
		aligned	6	6

(1) *Individual, ~~circular~~ non-linear indications with a diameter of less than 2 mm in Zone "A" and with a diameter of less than 3 mm in the other Zones ~~may be disregarded~~ are not considered relevant.*

(2) *All or some of the total number of ~~circular~~ non-linear indications may be increased to the maximum permitted number of all indications where there are no linear/aligned indications.*

Renumbered item 12.2 was revised according to UR W24 Rev.4 as below:

12.2 Preparation of weld sites

Defects ~~which are required~~ to be ~~removed~~ repaired by welding are to be ground ~~down~~ to ~~the~~ sound ~~base~~ material ~~in conformity with the requirements stated in~~ according to 141.2. ~~To ensure that the defects have been completely removed by grinding, the grinding sites are to be subjected to a dye penetrant inspection in the presence of the Surveyor.~~

The weld grooves shall be prepared so as to ensure that the base of the groove is fully fused.

The resulting ground areas are to be examined in the presence of the Surveyor by liquid penetrant testing in order to verify the complete elimination of defective material.

Renumbered item 12.3 was revised according to UR W24 Rev.4 as below and all sub item number was deleted:

12.3 Welding repair procedure

~~**15.3.1**~~ Metal Arc welding is ~~recommended~~ to be used for all types of welding repair~~s to bronze~~ on cast copper alloy propellers.

~~Where the material thicknesses are less than 30 mm, gas welding (oxygen-acetylene) may be performed on casting grades CU1 and CU2 with satisfactory results.~~

……

Renumbered item 13.2 was revised according to UR W24 Rev.4 as below and all sub item number was deleted:

13.2 Hot straightening

Weld repaired areas may be subject to hot straightening, provided it can be demonstrated that weld properties are not impaired by the hot straightening operations.

……

Deleted items 10 and 11 were added as items 14 and 15 according to UR W24 Rev.4 as below:

14. Identification and marking

14.1 Identifications

The manufacturer is to adopt a system for the identification of all castings, which enable the material to be traced to its original cast. The Surveyor is to be given full facilities for so tracing the castings when required.

14.2 Marking

Each finished casting propeller shall be marked by the manufacturer at least with the following particulars:

- Grade of cast material or corresponding abbreviated designation
- Manufacturer's mark
- Heat number, casting number or another mark enabling the manufacturing process to be traced back
- Date of final inspection
- Number of **TL** test certificate
- Ice class symbol, where applicable
- Skew angle for high skew propellers.

15. Manufacturer's certificates

For each casting propeller the manufacturer is to supply to the Surveyor a certificate containing the following details:

- Purchaser and order number
- Shipbuilding project number, if known
- Description of the casting with drawing number
- Diameter, number of blades, pitch, direction of turning
- Grade of alloy and chemical composition of each heat
- Heat or casting number
- Final weight
- Results of non-destructive tests and details of test procedure where applicable
- Portion of alpha-structure for CU 1 and CU 2 alloys

- Results of the mechanical tests
- Casting identification No.
- Skew angle for high skew propellers, see 8.1

Revision Date: May 2021

Entry into Force Date: 1 July 2021

Item B.1.1 was revised according to UR W27 Rev.2 as below:

1.1 These rules are applicable to the manufacture, inspection and repair procedures of cast stainless steel propellers, blades and bosses.

Item B.2 was revised according to UR W27 Rev.2 as below:

2.1 All propellers, blades and bosses are to be manufactured by foundries approved by **TL** or an IACS Member Classification Society. ~~The scope of the procedure tests involved in the approval is to be agreed.~~ The castings are to be manufactured and tested in accordance with the requirementsof these rules.

2.2 Application for approval

It is the manufacturer's responsibility to assure that effective quality, process and production controls during manufacturing are adhered to within the manufacturing specification. The manufacturing specification shall be submitted to **TL** at the time of initial approval, and shall at least include the following particulars: description of the foundry facilities, steel material specification, runner and feeder arrangements, manufacturing procedures, non-destructive testing and repair procedures.

2.3 Scope of the approval test

The scope of the approval test is to be agreed with **TL**. This should include the presentation of cast test coupons of the propeller materials in question for approval testing in order to verify that the chemical composition and the mechanical properties of these materials comply with these rules.

2.4 Inspection facilities

The foundry is to have an adequately equipped laboratory, manned by experienced personnel, for the testing of moulding materials chemical analyses, mechanical testing, microstructural testing of metallic materials and non-destructive testing. Where testing activities are assigned to other companies or other laboratory, additional information required by **TL** is to be included.

Item B.3 was revised according to UR W27 Rev.2 as below:

3. ~~General Characteristics~~ Quality of Castings

3.1 Freedom from defects

All castings are to have a workmanlike finish and are to be free from imperfections ~~that could be considered to impair~~ defects which would be prejudicial to their proper application in-service ~~performance~~.

Minor casting defects which may still be visible after machining such as small sand and slag inclusions, small cold shuts and scabs shall be trimmed off by the manufacturer in accordance with item 11.

3.2 Removal of defects

Casting defects which may impair the serviceability of the castings, e.g. major non-metallic inclusions, shrinkage cavities, blow holes and cracks, are not permitted. They may be removed by one of the methods described in item

11 and repaired within the limits and restrictions for the severity zones. Full description and documentation must be available for the surveyor.

Item B.8 was renumbered as B.4 and subsequent items were renumbered and revised according to UR W27 Rev.2 as below:

~~8~~4. Dimensions, Dimensional and Geometrical Tolerances

~~8~~4.1 The verification of dimensions, the dimensional and geometrical tolerances ~~are~~ is the responsibility of the manufacturer ~~and~~

~~t~~The report on the ~~dimensional inspection is to be handed over~~ relevant examinations is to be submitted to the surveyor, who may require checks to be made in his presence.

~~8~~4.2 Static balancing is to be carried out on all propellers in accordance with specified ISO 484 tolerance class (or equivalent) and the approved drawings in presence of a surveyor.

Dynamic balancing ~~may be~~ is necessary for propellers running above 500 rpm or propellers with tip speed exceeding 60 m/s.

For further details see Part B, Chapter 4, Section 8, F.

~~4~~5. Chemical Composition

5.1 Typical cast steel poropeller alloys are groupped into four types depending on their chemical composition as given in Table 11.6. Cast steel whose chemical composition deviate from the typical values of Table 11.6 must be specially approved by **TL**.

5.2 The manufacturer is to maintain records of the chemical analyses of the production casts, which are to be made available to the Surveyor so that he can satisfy himself that the chemical composition of each casting is within the specified limits.

……

~~6~~7.1 The mechanical properties are to meet the requirements in Table 11.7. These values refer to the test specimens machined from integrally cast test bars attached to the hub or on the blade. The thickness of test coupon is to be in accordance with a recognized standard.

……

Item B.8 added according to UR W27 Rev.2 as below:

8. Definition of skew, severity zones

8.1 In order to relate the degree of inspection to the criticality of imperfections in propeller blades and to help reduce the risk of failure by fatigue cracking after repair, propeller blades are divided into three severity zones designated A, B and C. Definition of skew, and, severity zones are given in item A.

Item 9 was revised and existing item B.7 was renumbered as B.9.2 and revised according to UR W27 Rev.2 as below:

9. Non-Destructive Tests

9.1 Qualification of personnel involved in NDT

~~All finished castings are subject to non-destructive testing in accordance with the requirements given in 9.2 to 9.9.~~ Refer to Chapter 3 – Welding, Section 10 items J.2.3, 2.4 and, 2.5.

~~7.~~9.2 Visual Inspection

~~**7.1**~~ All finished castings are to be 100% visually inspected by the ~~surveyor~~ manufacturer. ~~The surveyor may require areas to be etched for the purpose of investigating weld repairs.~~

~~**7.2**~~ Castings are to be free from cracks, hot teats or other imperfections which, due to their nature, degree or extent, will interfere with the use of the castings. A general visual examination is to be carried out by the Surveyor.

~~**9.2** In order to relate the degree of non-destructive testing to the criticality of imperfections, propeller blades are divided into three severity zones designated A, B and C. Further a distinction is made between low skew and high skew propellers (See A).~~

9.3 Liquid penetrant testing

Liquid penetrant testing procedure is to be submitted to **TL** and is to be in accordance with ISO 3452-1 or a recognized standard. The acceptance criteria are specified in item10.

For all propellers, separately cast blades and hubs, the surfaces covered by severity zones A, B and C are to be liquid penetrant tested. Testing of zone A is to be undertaken in the presence of the surveyor, whilst testing of zone B and C may be witnessed by the surveyor upon his request.

~~**9.4**~~ If repairs have been made either by grinding or by welding, the repaired areas are additionally to be subjected to the liquid penetrant testing independent of their location and/or severity zone. Weld repairs are, independent of their location, always to be assessed according to zone A.

9.4 Magnetic particle testing

Magnetic particle testing may be used in lieu of liquid penetrant testing for examination of martensitic stainless steels castings.

Magnetic particle testing procedure is to be submitted to **TL** and is to be in accordance with ISO 9934-1 or a recognized standard.

9.5 Radiographic and ultrasonic testing

When required by **TL** or when deemed necessary by the manufacturer, further non-destructive testing (e.g. radiographic and/or ultrasonic testing) are to be carried out. The acceptance criteria or applied quality levels are then to be agreed between the manufacturer and **TL** in accordance with a recognized standard.

Note: due to the attenuating effect of ultrasound within austenitic steel castings, ultrasonic testing may not be practical in some cases, depending on the shape/type/thickness, and grain-growth direction of the casting.

~~**9.5** The following definitions relevant to liquid penetrant indications apply:~~

~~*Indication*: the presence of detectable bleed-out of the penetrant liquid from the material discontinuities appearing at least 10 minutes after the developer has been applied.~~

~~*Linear indication:* an indication in which the length is at least three times the width.~~

~~*Non-linear indication:* an indication of circular or elliptical shape with a length less than three times the width.~~

~~*Aligned indication:* three or more indications in a line, separated by 2 mm or less edge-to-edge.~~

~~*Open indication*: an indication that can be detected by the use of contrast dye penetrant.~~

~~*Non-open indication:* an indication that cannot be detected by the use of contrast dye penetrant.~~

~~*Relevant indication:* an indication that is caused by a condition or type of discontinuity that requires evaluation. Only indications which have any dimensions greater than 1.5 mm is to be considered relevant.~~

~~**9.6** For the purpose of evaluating indications, the surface is to be divided into reference areas of 100 cm^2, which may be square or rectangular with the major dimension not exceeding 250 mm. The area is to be taken in the most unfavorable location relative to the indication being evaluated.~~

~~**9.7** The indications detected may, with respect to their size and number, not exceed the values given in the Table 11.8.~~

~~**9.8** Where serious doubt exists that the casting are not free from internal defects, further non-destructive inspections are to be carried out upon request of the surveyor, e.g. radiographic and/or ultrasonic tests. The acceptance criteria are then to be agreed between the manufacturer and **TL**.~~

~~**9.9** The foundry is to maintain records of inspections traceable to each casting. These records are to be reviewed by the surveyor. The foundry is also to provide the surveyor with a statement confirming that non-destructive tests have been carried out with satisfactory results.~~

Item 10 was added and definitions are added from existing item B.5 according to UR W27 Rev.2 as below:

10. Acceptance criteria for liquid penetrant testing and magnetic particle testing

10.1 Definitions of liquid penetrant indications

Indication: In the liquid penetrant testing an indication is the presence of detectable bleed-out of the penetrant liquid from the material discontinuities appearing at least 10 minutes after the developer has been applied.

Relevant indication: ~~an indication that is caused by a condition or type of discontinuity that requires evaluation.~~ only indications which have any dimension greater than 1.5mm shall be considered relevant for the categorization of indications.

Non-linear indication: an indication with a largest dimension less than three times its smallest dimension (i.e. $l < 3$ w).

Linear indication: an indication with a largest dimension three or more times its smallest dimension (i.e. $l \geq 3$ w).

Aligned indications:

a) Non-linear indications form an alignment when the distance between indications is less than 2mm and at least three indications are aligned. An alignment of indications is considered to be a unique indication and its length is equal to the overall length of the alignment.

b) Linear indications form an alignment when the distance between two indications is smaller than the length of the longest indication.

Illustration of liquid penetrant indications is given in Fig. 11.8.

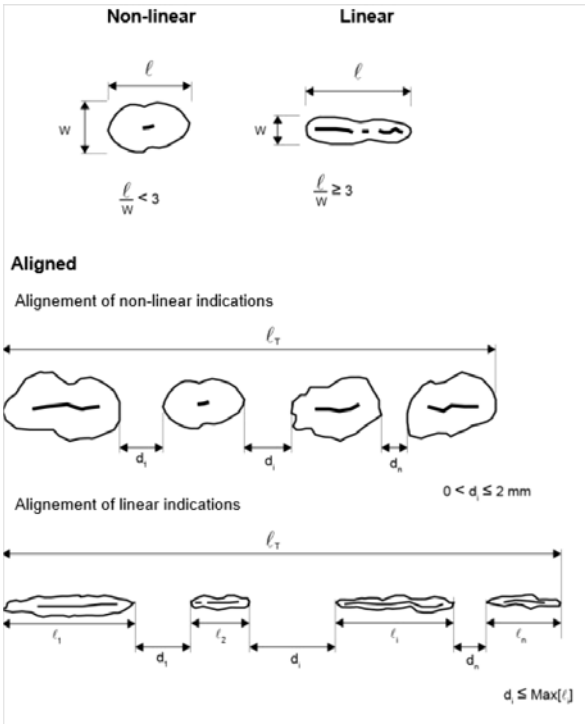


Figure 11.8 Shape of indications

10.2 Acceptance standard

The surface to be inspected is to be divided into reference areas of 100 cm2. Each reference area may be square or rectangular with the major dimension not exceeding 250mm.

The area shall be taken in the most unfavourable location relative to the indication being evaluated.

The relevant indications detected shall with respect to their size and number, not exceed the values given in the Table 11.8.

Areas which are prepared for welding are independent of their location always to be assessed according to zone A. The same applies to the welded areas after being finished machined and/or grinded.

Table 11.8 Allowable number and size of relevant indications in a reference area of 100 cm², depending on severity zones

Severity zone	Max. total number of indications	Indication type	Max. number for each type (1) (2)	Max. dimension of indication [mm]
A	7	Non-linear	5	4
		Linear	2	3
		Aligned	2	3
B	14	Non-linear	10	6
		Linear	4	6
		Aligned	4	6
C	20	Non-linear	14	8
		Linear	6	6
		Aligned	6	6

(1) *Single non-linear indications less than 2 mm in Zone A and less than 3 mm for other zones may be disregarded.*

(2) *The total number of non-linear indications may be increased to the maximum total number, or part thereof, represented by the absence of linear or aligned indications.*

Item B.10 was renumbered as B.11 revised according to UR W27 Rev.2 as below:

11. Repair of Defects

11.1 Defective castings are to be repaired in accordance with the requirements given in 11.2 to 11.7 and, where applicable, the requirements of item 12.

11.2 In general the repairs are to be carried out by mechanical means, e.g. by grinding, chipping or milling. The resulting grooves are to be blended into the surrounding surface so as to avoid any sharp contours. Complete elimination of the defective material is to be verified by liquid penetrant testing, or magnetic particle testing if applicable.

11.3 Weld repairs are to be undertaken only when they are considered to be necessary and have prior approval of the surveyor. ~~All weld repairs are to be documented by means of sketches or photographs showing the location and major dimensions of the grooves prepared for welding. The documentation is to be presented to the surveyor prior to repair welding.~~

……..

11.5 Grinding in severity zone A may be carried out to an extent that maintains the blade thickness. Repair welding is generally not permitted in severity zone A and will only be allowed after special consideration by **TL.**

In some cases the propeller designer may submit technical documentation to propose a modified zone A based on detailed hydrodynamic load and stress analysis for consideration by **TL**.

……..

11.8 Repair documentation

The foundry is to maintain records of inspections, welding, and any subsequent heat treatment, traceable to each casting.

Before welding is started, full details of the extent and location of the repair, the proposed welding procedure, heat treatment and subsequent inspection procedures are to be submitted to **TL** for approval.

Item B.10 was renumbered as B.11 revised according to UR W27 Rev.2 as below:

~~11~~12. Weld~~ed~~ing Repair Procedure

~~11~~12.1 ~~The sope of the procedure tests involved in the qualification is given in Annex B.~~

Before welding is started, manufacturer shall submit to **TL** a detailed welding procedure specification is to be submitted covering the weld preparation, welding positions, welding parameters, welding consumables, preheating, post weld heat treatment and inspection procedures.

~~11~~12.2 All weld repairs are to be ~~made~~ carried out in accordance with qualified procedures, and, by ~~qualified~~ welders ~~using qualified procedures~~ who are qualified to a recognized standard. Welding Procedure Qualification Tests are to be carried out in accordance with Annex B and witnessed by the Surveyor.

Defects to be repaired by welding are to be ground to sound material according to item 10.

The welding grooves are to be prepared in such a manner which will allow a good fusion of the groove bottom.

The resulting ground areas are to be examined in the presence of the Surveyor by liquid penetrant testing in order to verify the complete elimination of defective material.

……..

~~**11.8** The foundry is to maintain records of welding, subsequent heat treatment and inspections traceable to each casting repaired. These records are to be reviewed by the surveyor.~~

Renumbered items B.13 and 14 were revised according to UR W27 Rev.2 as below:

~~12~~3. Identification and marking

~~12~~3.1 ~~Prior to final inspection by the surveyor, each casting is to be suitably identified by the manufacturer with the following~~ The manufacturer is to adopt a system for the identification of all castings, which enable the material to be traced to its original cast. The Surveyor is to be given full facilities for so tracing the castings when required.

Each finished casting propeller shall be marked by the manufacturer at least with the following particulars:

- Heat number or other marking which will enable the full history of the casting to be traced,
- Grade of cast material or corresponding abbreviated designation

……..

~~13~~4. Document and Certification

……..

- Final ~~mass~~ weight,

……..

- Results of non-destructive tests and details of test procedure where applicable.

~~13.2~~ ~~The manufacturer is to provide a statement regarding non-destructive tests as required by 9.9 and, where applicable, records of weld repairs as required by 11.8.~~

Revision Date: May 2021

Entry into Force Date: 1 July 2021

Annex A was revised according to UR W24 Rev.4 as below:

1. General

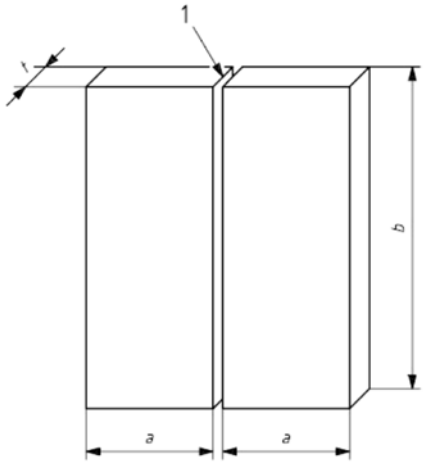
1.1 This document gives requirements for qualification tests of welding procedures intended for the repair of cast copper alloy propellers. ~~Testing is to be carried out using the same welding method, filler metal, the same preheating and stress-relieving heat treatment as is to be employed for the actual repair.~~

1.2 For the welding procedure approval the welding procedure qualification tests are to be carried out with satisfactory results. The qualification tests are to be carried out with the same welding process, filler metal, preheating and stress-relieving treatment as those intended applied by the actual repair work. Welding procedure specification (WPS) is to refer to the test results achieved during welding procedure qualification testing.

1.3 Welding procedures qualified at a manufacturer are valid for welding in workshops under the same technical and quality management.

2. Test Piece and Welding of Sample

2.1 ~~A~~ The test assembly, consisting of cast samples ~~at least 30 mm. thick~~ is to be ~~welded in the down-hand (flat) position (see Fig. 11.A.1). The dimensions of the test specimens to be taken from said test piece are given in Figure 11.A.2 and Section 2 Figure 2.6.~~ of a size sufficient to ensure a reasonable heat distribution and according to Fig. 11.A.1 with the minimum dimensions:



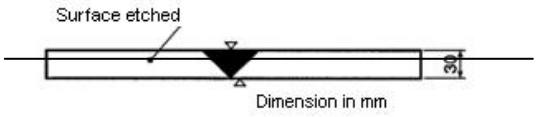
1: Joint preparation and fit-up as detailed in the preliminary welding procedure specification
a: minimum value 150mm
b: minimum value 300mm
t: material thickness.

Figure 11.A.1 Test piece for welding repair pprocedure

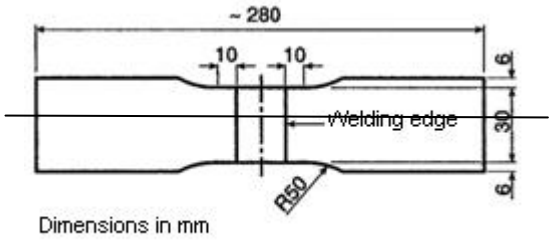
A test sample of minimum 30mm thickness is to be used.

2.2 Preparation and welding of test pieces are to be carried out in accordance with the general condition of repair welding work which it represents.

2.3 Welding of the test assemblies and testing of test specimens are to be witnessed by the Surveyor.



~~**Figure 11.A.2 Macrostructure test specimen**~~



~~**Figure 11.A.3 Tensile test specimen**~~

3. Examination and Tests

3.1 Test assembly is to be examined non-destructively and destructively in accordance with the Table 11.A.1 and Fig. 11.A.2:

Table 11.A.1 Type of tests and extent of testing

Type of test (1)	Extent of testing
Visual testing	100% as per article 3.2
Liquid penetrant testing	100% as per article 3.2
Transverse tensile test	Two specimens as per article 3.3
Macro examination	Three specimens as per article 3.4
*(1) bend or fracture test are at the discretion of **TL***	

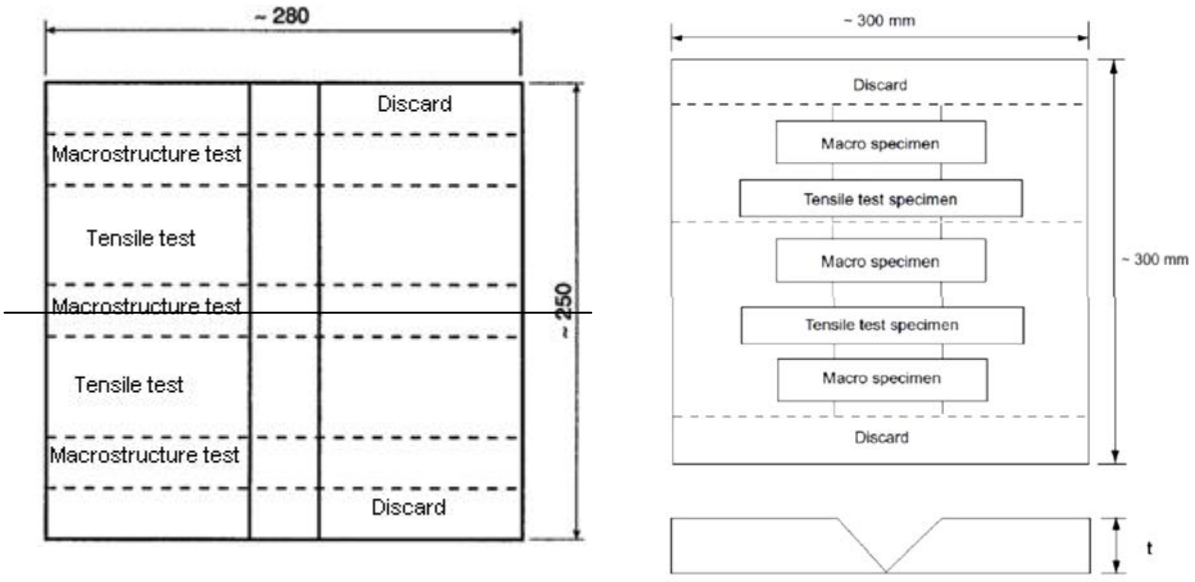


Figure 11.A.2 Test ~~piece~~ spiceman

3.~~1~~ 2 Non-destructive test

~~Following welding, the joint~~ Test assembly is to be ~~subjected to a 100 % dye~~ examined by visual and liquid penetrant testing prior to the cutting of test specimen. In case, that any post-weld heat treatment is required or specified, non-destructive testing is to be performed after heat treatment.

Cracks are not allowed. ~~The evaluation standard for zone "A" given in Table 11.3 is to apply.~~ Imperfections detected by liquid penetrant testing are to be assessed in accordance with item A.10.

3.~~2~~ 3 Macro~~structure~~copic ~~test~~ examination

Three ~~macrostructure~~ test specimens ~~must~~ are to be prepared and etched ~~as shown in~~ on one side to clearly reveal the weld metal, the fusion line and the heat affected zone (see Figure11.A.2).

An etching medium with the following constitule would be suitable for this purpose:

5 g. Ferric (III) – Chloride

30 ml. Hydrochloride acid

100 ml. Distilled water

The test specimens are to be examined for imperfections present in the weld metal and the heat affected zone. Cracks and lack of fusion are not permitted. Imperfections such as pores, or slag inclusions, larger than 3 mm. and cracks are not permitted.

3.~~3~~ 4 ~~Mechanical~~ Tensile test

Two tensile tests specimen ~~shall~~ are to be prepared as shown in Chapter 2 material Rules Section 2 Figure 2.6. ~~During testing, the requirements set out in Table 11.A.1 must be satisfied. Other forms of~~ Alternatively tensile test specimens ~~conforming~~ according to recognized standards ~~may be used~~ acceptable to **TL**. The tensile strength shall meet the values given in Table 11.A.2

Table 11.A.2 Tensile strength requirements

Alloy type	Tensile strength [N/mm^2] min.
CU1	370
CU2	410
CU3	500
CU4	550

3.5 Re-testing

If the test piece fails to comply with any of the requirements of this Appendix, reference is made to re-test procedures given in Chapter 3 – Welding, Section 12 item F.2.11.

4. Test record

4.1 Welding conditions for test assemblies and test results are to be recorded in welding procedure qualification record. Forms of welding procedure qualification records can be taken from **TL**'s rules or from relevant standards.

4.2 A statement of the results of assessing each test piece, including repeat tests, is to be made for each welding procedure qualification records. The relevant items listed for the WPS are to be included.

4.3 The welding procedure qualification record is to be signed by the Surveyor witnessing the test and is to include **TL**´s identification.

5. Range of approval

5.1 General

All the conditions of validity stated below are to be met independently of each other. Changes outside of the ranges specified are to require a new welding procedure test.

A qualification of a WPS obtained by a manufacturer is valid for welding in workshops or sites under the same technical and quality control of that manufacturer.

5.2 Base metal

The range of qualification related to base metal is given in Table 11.A.3.

Table 11.A.3 Range of qualification for base metal

Copper alloy material grade used for qualification	Range of approval
CU1	CU1
CU2	CU1; CU2
CU3	CU3
CU4	CU4

5.3 Thickness

The qualification of a WPS carried out on a weld assembly of thickness t is valid for the thickness range given in Table 11.A.4.

Table 11.A.4 Range of qualification for thickness

Thickness of the test piece, t (mm)	Range of approval
30≤ t	≥3 mm

5.4 Welding position

Approval for a test made in any position is restricted to that position.

5.5 Welding process

5.5.1 The approval is only valid for the welding process used in the welding procedure test. Single run is not qualified by multi-run butt weld test used in item A.

5.6 Filler metal

The approval is only valid for the filler metal used in the welding procedure test.

5.7 Heat input

The upper limit of heat input approved is 25% greater than that used in welding the test piece. The lower limit of heat input approved is 25% lower than that used in welding the test piece.

5.8 Preheating and interpass temperature

The minimum preheating temperature is not to be less than that used in the qualification test. The maximum interpass temperature is not to be higher than that used in the qualification test.

5.9 Post-weld heat treatment

The heat treatment used in the qualification test is to be specified in pWPS. Soaking time may be adjusted as a function of thickness.

Revision Date: May 2021

Entry into Force Date: 1 July 2021

Annex B item 1 was revised according to UR W27 Rev.2 as below:

1. ~~Preparation of Test Assembly~~ General

~~A test assembly of minimum 30 mm thickness is to be welded. The types of specimens to be prepared are shown in Figure 11.B.1.~~

1.1 This document gives requirements for qualification tests of welding procedures intended for the repair of cast steel propellers.

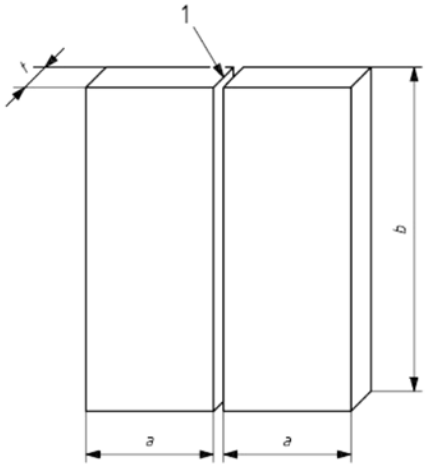
1.2 For the welding procedure approval the welding procedure qualification tests are to be carried out with satisfactory results. The qualification tests are to be carried out with the same welding process, filler metal, preheating and stress-relieving treatment as those intended applied by the actual repair work. Welding procedure specification is to refer to the test results achieved during welding procedure qualification testing.

1.3 Welding procedures qualified at a manufacturer are valid for welding in workshops under the same technical and quality management.

Annex B item 2 and 3 was added according to UR W27 Rev.2 as below:

2. Test piece and welding of sample

2.1 The test assembly, consisting of cast samples, is to be of a size sufficient to ensure a reasonable heat distribution and according to Fig. 11.B.1 with the minimum dimensions:



1: Joint preparation and fit-up as detailed in the preliminary Welding Procedure Specification
a: minimum value 150mm
b: minimum value 350mm
t: material thickness

Figure 11.B.1 Test piece for welding repair procedure

The dimensions and shape of the groove shall be representative of the actual repair work.

2.2 Preparation and welding of test pieces are to be carried out in accordance with the general condition of repair welding work which it represents.

2.3 Welding of the test assemblies and testing of test specimens are to be witnessed by

the Surveyor.

3. Examinations and tests

3.1 Test assembly is are to be examined non-destructively and destructively in accordance with Table 11.B.1 and Fig. 11.B.2:

Table 11.B.1 Type of tests and extent of testing

Type of test	Extent of testing
Visual testing	100% as per article 3.2
Liquid penetrant testing **(1)**	100% as per article 3.2
Transverse tensile test	Two specimens as per article 3.3
Bend test **(2)**	Two root and two face specimens as per article 3.4
Macro examination	Three specimens as per article 3.5
Impact test	Two sets of three specimens as per article 3.6
Hardness test	As per article 3.7
***(1)** Magnetic particle testing may be used in lieu of liquid penetrant testing for martensitic stainless steels.* ***(2)** For t≥12mm, the face and root bend may be substituted by 4 side bend test specimens.*	

Annex B item 2 was renumbered and revised according to UR W27 Rev.2 as below:

~~2.~~3.2 Non-Destructive Testing

~~Prior to sectioning, the t~~Test assembly is to be examined by visual~~ly inspected~~ and liquid penetrant test~~ed~~ing, or magneticparticle tasting if applicable, prior to the cutting of test specimen. In case, that any post-weld heat treatment is required or specified, non-destructive testing is to be performed after heat treatment.

No cracks are permitted. İmperfections detected by liquid penetrant testing, or magnetic particle testing if applicable, are to be assessed in accordance with B.~~9~~10.

Annex B item 4 was renumbered and revised according to UR W27 Rev.2 as below:

~~4.~~3.3 Tensile Testing

Two flat transverse tensile test specimens are to be prepared. Testing procedures are to be in accordance with ~~Annex A-2(Ref. TL- R W2.4.2.8.b)~~ Chapter 2 Material Rules, Section 2 item B.1.2.8.2.

The tensile strength is to meet the specified minimum value of the base material. The location of fracture is to be reported, i.e. weld metal, heat affected zone or base material.

Annex B item 5 was renumbered and revised according to UR W27 Rev.2 as below:

~~5.~~3.4 Bend Testing

T~~wo t~~ransverse ~~side~~ bend test~~s specimens~~ for butt joints are to be prepared in accordance with Section 2, or, according to a recognized standard. The ~~former~~ mandrel diameter is to be 4 x thickness except for austenitic steels, in which case the ~~former~~ mandrel diameter is to be 3 x thickness.

~~The test specimen, when visually inspected after bending, is to show no surface imperfections greater than 2 mm in length.~~

The bending angle is to be 180°. After testing, the test specimens are not to reveal any open defects in any direction greater than 3 mm. Defects appearing at the corners of a test specimen during testing are to be investigated case by case.

Two root and two face bend specimens are to be tested. For thickness 12 mm and over, four side bend specimens may alternatively be tested.

Annex B item 3 was renumbered and revised according to UR W27 Rev.2 as below:

3.5 Macro-Examination

Two macro-sections are to be prepared and etched on one side to clearly reveal the weld metal, the fusion line and the heat affected zone. ~~The sections are to be examined by eye (aided by low power hand lens, if desired) for any imperfections present in the weld metal and heat affected zone.~~ Cracks ~~or crack-like~~ and lack of fusion are not permitted. ~~i~~Imperfections~~,~~ such as slag inclusions and pores greater than 3 mm are not permitted.

Annex B item 6 was renumbered and revised according to UR W27 Rev.2 as below:

~~3.6.~~ ~~Charpy V-notch~~ Impact test~~ing~~

Impact test is ~~not~~ required, ~~except~~ where the base material is impact tested. Charpy V-notch test specimens are to be in accordance with Section 2. Two sets are to be taken, one set with the notch positioned in the center of the weld and one set with the notch positioned in the HAZ (i.e. the mid-point of the notch shall be at 1mm to 2mm from the fusion line), respectively.

The test temperature and impact energy are to comply with the requirement specified for the base material.

Annex B item 7 was renumbered and revised according to UR W27 Rev.2 as below:

~~3.7.~~ Hardness Test~~ing~~

~~One of t~~The macro-section~~s~~ representing the start of welding is to be used for HV~~5~~10 hardness testing. Indentations are to traverse 2 mm below the surface. At least three individual indentations are to be made in the weld metal, the heat affected zone (both sides) and in the base material (both sides). The values are to be reported for information.

Annex B item3.8 was added according to UR W27 Rev.2 as below:

3.8 Re-testing

If the test piece fails to comply with any of the requirements of this Appendix, reference is made to re-test procedures given in Chapter 3 – Welding, Section 12 item F.2.11.

Figure 11.B.1 was renumbered and revised according to UR W27 Rev.2 as below:

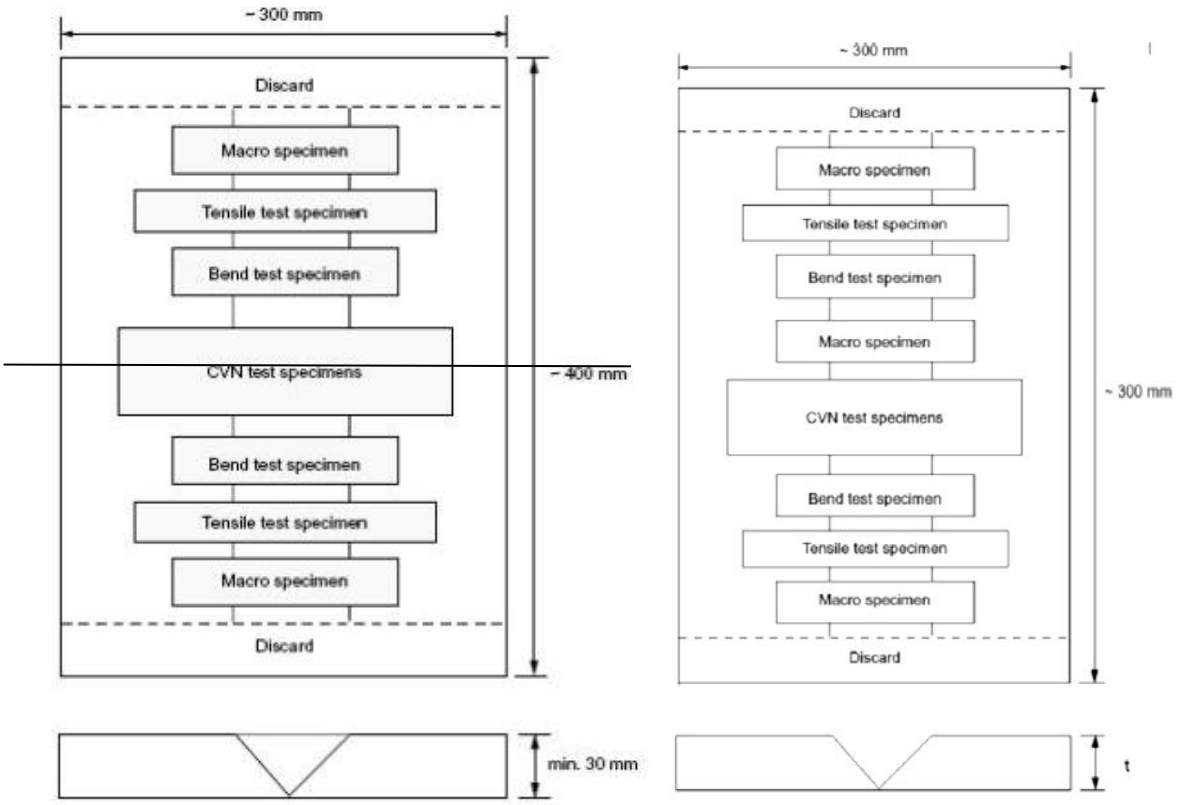


Figure 11.B.2 Weld test assembly

Items 4 and 5 was added according to UR W27 Rev.2 as below:

4. Test record

4.1 Welding conditions for test assemblies and test results are to be recorded in welding procedure qualification record. Forms of welding procedure qualification records can be taken from **TL**'s rules or from relevant standards.

4.2 A statement of the results of assessing each test piece, including repeat tests, is to be made for each welding procedure qualification records. The relevant items listed for the WPS are to be included.

4.3 The welding procedure qualification record is to be signed by the Surveyor witnessing the test and is to include **TL**´s identification.

5. Range of approval

5.1 General

All the conditions of validity stated below are to be met independently of each other. Changes outside of the ranges specified are to require a new welding procedure test.

A qualification of a WPS obtained by a manufacturer is valid for welding in workshops or sites under the same technical and quality control of that manufacturer.

5.2 Base metal

Range of approval for steel cast propeller is limited to steel grade tested.

5.3 Thickness

The qualification of a WPS carried out on a weld assembly of thickness t is valid for the thickness range given in Table 11.B.2.

Table 11.B.2 Range of qualification for thickness

Thickness of the test piece, t (mm)	Range of approval
15<t≤30	3mm to 2t
t>30	0,5t to 2t or 200mm, whichever is the greater

5.4 Welding position

Approval for a test made in any position is restricted to that position.

5.5 Welding process

5.5.1 The approval is only valid for the welding process used in the welding procedure test. Single run is not qualified by multi-run butt weld test used in item B.

5.6 Filler metal

The approval is only valid for the filler metal used in the welding procedure test.

5.7 Heat input

The upper limit of heat input approved is 15% greater than that used in welding the test piece.

The lower limit of heat input approved is 15% lower than that used in welding the test piece.

5.8 Preheating and interpass temperature

The minimum preheating temperature is not to be less than that used in the qualification test. The maximum interpass temperature is not to be higher than that used in the qualification test.

5.9 Post-weld heat treatment

The heat treatment used in the qualification test is to be specified in pWPS. Holding time may be adjusted as a function of thickness.

PART A – CHAPTER 3 – WELDING

01. Section 4 – Welding Procedure Tests, Production Tests

Revision Date: May 2021

Entry into Force Date: 1 July 2021

Items C.1.1 was revised as below:

1.1 To ensure that the description and evaluation of welding processes and positions, test results, etc. are as clear and uniform as possible, use shall be made of the terminology and symbols in the relevant standards (e.g. ISO/TR 25901-3, EN ISO 6947, ISO 6520-1, ISO 5817, ISO 10042) and, for internal defects, ~~Table 10.1 in Section 10~~ ISO 6520-1. The position of a defect or fracture must be indicated and may be designated as follows:

02. Section 8 – Execution of Welds

Revision Date: May 2021

Entry into Force Date: 1 July 2021

Items G.1.2 was revised as below:

2. For post-weld heat treatment, see Section 9; for the post-treatment of surfaces for non-destructive testing, see Section 10, ~~F~~D.1.

03. Section 10 – Non-Destructive Testing of Welds

Revision Date: May 2021

Entry into Force Date: 1 July 2021

Items from A to N were deleted and items A to I were added and existing item O relettered as J according to UR W33 New as below:

~~**A. General**~~

~~**1. Scope**~~

~~**1.1** These Rules apply to the performance of the non-destructive tests of welded joints according to the methods and scopes prescribed in Section 12 to 16 the various fields of application. See also Section 1, A.1. and A.2.~~

~~**1.2** They also apply to the performance of all non-destructive weld tests which are stipulated in other regulations, rules or technical instructions issued by **TL** and for which no specific details are given therein.~~

~~**2. Standards and Other Codes of Practice (1)**~~

~~**2.1** TL- G-20 and the standards etc. mentioned in the following paragraphs are an integral part of these Rules and shall also be complied with when performing the nondestructive weld tests. Where the standards contradict these Rules, the latter shall take precedence.~~

2.2 The performance of tests according to other, comparable codes of practice requires the prior consent of **TL**. For this purpose, the relevant codes of practice shall be submitted to **TL** together with the other inspection documents (See D 1.1) for examination and approval.

3. Requirements Applicable to the Inspection Department

The works' inspection department shall be as independent and free from the influence of the fabrication department as it is necessary to ensure that the inspection and the evaluation of the inspection results are carried out objectively. This applies in analogous manner to outside inspection bodies.

B. Test Methods, Appliances and Test Media

1. Test Methods

1.1 The choice of the test method to be used in each case is determined among other things by the component or weld shape, the material and the defects to be demonstrated (type and position). See Section 12 to 16.

1.2 Unless otherwise stated in the individual application-specific of Section 12 to 16 the following basic requirements apply:

---

(1) *Code: Regulations comprising globally recognised design requirements and conditions to be applied to design.*

- Up to a wall or weld thickness of approx. 30 mm, radiographic inspection is the preferred method; for larger thicknesses, ultrasonic inspection is to be used as the primary test method.
- For wall or weld thicknesses of approx. 10 mm and above, either radiographic or ultrasonic inspections may be performed, in consultation with **TL.**

- For radiographic inspection, X-ray sources shall be used wherever possible. Gamma ray sources may only be used with **TL**'s consent on the basis of an examination and recognition of the test method; see K.1.

- For magnetic materials, testing for surface cracks shall wherever possible be carried out by magnetic particle inspection; the use of liquid penetrant inspections for magnetic materials requires **TL**'s consent in each individual case.

1.3 The test method must be capable of reliably detecting the external and/or internal defects which may be present. Where necessary, this shall be achieved by using two or more test methods in combination. The particular test method(s) to be used shall be stated in the inspection schedule (see D.1.1).

2. Test Appliances and Media

2.1 The test appliances and media used must conform to the state of the art and the relevant standards and must be in perfect, serviceable condition. The Society may require an inspection of the test appliances and/or media used.

2.2 When making use of test equipment, test appliances, etc. owned by other, outside testing bodies, the works shall ensure that the conditions stated in 2.1 are satisfied.

C. Inspection Personnel, Supervisors

1. Inspection Personnel (Inspectors)

1.1 The non-destructive weld tests may only be performed by persons trained in the use of the test method concerned and possessing adequate practical experience. **TL** shall be supplied with appropriate documentary proof of such training and experience, e.g. conforming to ISO 9712.

1.2 Inspection of welds by ultrasonic means shall only be performed by inspectors holding a Level 2 certificate of accredited body (or equivalent) and having at least 2 years of proven practical testing experience who are recognized by **TL.**

1.3 For such recognition, **TL** may require verification of the suitability of the ultrasonic inspection personnel and of the test appliances and the test method under practical conditions in the works. In exceptional cases and where necessary for a restricted field of use, **TL** may, following successful verification, also recognize inspectors who do not hold the certificates specified in 1.2.

1.4 Application for such verification shall be made to **TL**'s Head Office, accompanied by the following information and documents:

- Documentary proof of the professional training of the inspection personnel and, where applicable, the inspection supervisors,

- A description of the test equipment (appliances, probes, etc.),
- A description of the test method (instrument setting, angles and scanning directions, instrument sensitivity, etc.),

- Method of determining the size of defects,

Form of the inspection report.

After successful verification, recognition may be linked to authorization of the inspector for the independent performance of certain tests and inspections (materials weld shapes) under his personal responsibility. The decision lies with **TL**.

Note:

The recognition and authorization of an inspector normally covers the inspection of normal butt and corner joints (e.g. the joints uniting deck stringers and sheer strakes) or approximately right-angled T joints in hull structural steels and/or other comparable structural steels. For the performance of further (more difficult) tests (e.g. on other materials and/or on acute-angled tube connections and weld shapes of comparable complexity), the authorization shall be subject to special review and supplementation.

2. Inspection Supervisors

2.1 An appropriately qualified works inspection supervisor shall be available for scheduling and monitoring the performance of the non-destructive weld tests and evaluating the results. The name of the inspection supervisor shall be given to **TL**; proof of his qualifications (in conformity with standards Level III certificate from accredited body or for welding supervisor to ISO 14731 standard with additional NDT training) shall be submitted to **TL**.

2.2 The inspection supervisor is responsible for ensuring that the non-destructive weld tests are competently and conscientiously carried out and recorded by suitable inspectors in accordance with these Rules, the relevant standards and the approved inspection schedule.

2.3 When using the services of outside inspection bodies, the works shall ensure that the above conditions are satisfied and shall inform **TL** accordingly.

D. Inspection Schedule, Inspection Reports

1. Inspection Schedule

1.1 Unless already stated in the other manufacturing documents (drawings, parts lists, etc.) to be submitted for approval, an inspection schedule for the non-destructive weld tests shall be drawn up, which must contain the following information:

- Components and welded joints to be tested,
- Scope and method of testing, areas to be tested, location of testing positions, see Section 12 to 16.
- Requirements applicable to the welded joints (for evaluation criteria, see Section 12 to 16.
- Testing standards and/or specifications, if it is intended to use standards or specifications different from those mentioned in these rules.

1.2 The location of testing positions shall be subject to agreement between the welding shop and the **TL**'s Surveyor, whereupon the inspection schedule shall be submitted to **TL**'s Head Office for approval. **TL** reserves the right to make changes to this inspection schedule even after approval has been given and especially to change the location of the individual testing positions or to extend the scope of testing (see H.) if the production process and/or test results suggest this to be necessary.

2. Inspection Reports

2.1 Reports shall be prepared on all (initial and repeat) tests, and these shall be submitted to the Surveyor together with the other documentation (e.g. radiographs). The inspection reports must contain all the necessary details according to Sections K. to N. relating to the particular test method used, the position at which the test was performed and the results obtained.

Note:

Where the test results are to be recognized in place of the prescribed welder's repeat tests in accordance with Section 3, E.3, the inspection reports shall also state the names or identification numbers of the welders.

2.2 Repeat tests (following repairs) and their results shall be specially identified in the inspection reports; see I.2.2. The results and documents relating to the initial test shall be submitted to **TL**'s Surveyor along with the results and documents relating to the repeat tests and also specifically if the repair was arranged for in-house.

2.3 Inspection reports shall be signed by the inspector and the test supervisor. Reports and documentation shall be kept for six years.

E. Timing of Inspection, Waiting Times

1. Non-destructive testing of welds shall as a general rule, not to be carried out until all the welding operations on the component concerned have been completed. In special cases, e.g. in the case of thick-walled components at risk of cracking, it may be advisable to carry out non-destructive tests, e.g. for surface crack examinations, as an interim measure (in the course of the welding work).

2. Before using the test methods described in K. to N., a visual inspection of the welded joints shall be performed. Surface defects which restrict the ability of the tests to produce meaningful results or which may lead to misinterpretation of the results shall be remedied before any further tests are performed.

3. Components which are subjected to post-weld heat treatment (e.g. stress relief heat treatment) shall as a general rule be inspected after heat treatment. Inspection of the welds for welding defects before heat treatment as well is recommended. **TL** may take previous inspections into account when establishing the final scope of inspection. Details shall be agreed with **TL** on a case-by-case basis.

4. In the case of higher-strength and especially high-strength (e.g. quenched and tempered) structural steels where the possibility of delayed cracking (e.g. due to the presence of hydrogen in the weld metal) cannot be ruled out, the tests shall not be carried out earlier than 48 hours after completion of the welding work. **TL** may demand longer waiting times (e.g. 72 hours up to a maximum of 7 days) or repetition of the tests (at least on a random sampling basis) after an appropriate waiting time.

5. Repetition of non-destructive tests shall be allowed for or may be demanded if the components or welded joints have been subjected to abnormal stresses (e.g. while in transit or during trial loading or pressure testing) before being stressed in normal service. The type and scope of these tests shall be agreed with **TL** on a case-by-case basis.

F. Preparation and Performance of Tests

1. Preparation of Areas to be Tested

1.1 The areas to be tested (surfaces of welds and of adjacent parts of the work piece) must be sufficiently clean and smooth for the respective test method. Irregularities in the welded joint (see E.2) remains of auxiliary welds, welding spatter, fragments of slag, etc. and any protective coatings or preservatives must be removed before the tests if they are liable to prevent them from being performed properly.

1.2 In special cases, e.g. ultrasonic testing for transverse defects (see L.4.3), grinding of the seam and the surface of the work piece may be necessary.

2. Performance of Tests

2.1 Non-destructive testing of welds shall be carried out in the manner described in Sections K. to N. The place and date of the tests shall be notified to the Society's Surveyor in good time. The Surveyor shall be given the opportunity to participate in or supervise the tests if he so wishes.

2.2 The individual positions (sections) to be tested shall be durably marked on the component or the welded joint in such a way that the test findings (e.g. weld defects requiring repair) can be unequivocally localized at any time up to the completion of all tests and, where applicable, repairs. If the dimensions are appropriately indicated (or a similar measure is used) in the drawings, inspection schedules and inspection reports, marking of the component may be dispensed with.

G. Evaluation of Test Results

1. Identification of Test Findings

In the case of radiographic testing and, where applicable, the methods of surface testing, the reference numbers and/or symbols conforming to ISO 6520-1 or, as applicable, in Table 10.1 (extract from the standard) may be used to identify (describe) test findings (e.g. welding defects). With regard to the description of defects in ultrasonic testing, see L.5.

2. Evaluation Criteria

2.1 Unless otherwise specified for the respective components or welded joints in Section 12 to 16 the evaluation categories according to ISO 5817 may be used as evaluation criteria for steel and those according to ISO 10042 for aluminium alloys.

2.2 In the inspection schedules, testing instructions, etc. to be drawn up by the welding shop (see D.1.), the evaluation categories to be determined according to the type and level of stress or, where necessary, other individual evaluation characteristics shall be assigned to the individual components and welded joints. With regard to the evaluation of results of ultrasonic testing in conjunction with the stipulations in the above-mentioned standards (evaluation categories), see L.5.

2.3 **TL** may consent to the use of different evaluation criteria or criteria conforming to other standards, etc. if they are approximately comparable to those mentioned in 2.1 and are suited to the particular test method used. Details shall be agreed with **TL** on a case-by-case basis.

3. Evaluation, Rating

3.1 The inspection results shall be evaluated by the testing department or body and/or the welding supervisory staff. The ultimate evaluation and the decision whether to leave defects in materials and welds as they are or to repair them is reserved for **TL**'s Surveyor.

3.2 The results may be rated according to Table 10.2 (in the case of radiographic inspection) or, in the case of ultrasonic testing or if a broader statistical evaluation is not required, by "leave as is" or "satisfied" or, as the case may be, "to be repaired" or "not satisfied".

Table 10.1 Symbols denoting defects (taken from ISO 6520-1)

Refence No. / symbol conforming to the IIW X ray manual		Description (1)
100	E	Crack
101	Ea	Longitudinal crack
102	Eb	Transverse crack
104	Ec	End crater crack
2011	Aa	Pore
2015	Ab	Elongated cavity (Gas pocket)
2016	Ab	Worm hole
2024	K	er pipe (End crater cavity)
301	Ba	inclusion
304	H	allic inclusion
4011	-	of side-wall fusion
4012	-	of inter-run fusion
4013	D	of root fusion
402	D	of penetration (Incomplete penetration)
5011	F	ercut, continuous
5012	F	ercut, intermittent
5013	-	nkage groove, groove in the root (see 515)
502	-	essive weld reinforcement (butt weld)
503	-	essive convexity (fillet weld)
504	-	essive root reinforcement
507	-	lignment of edges
510	-	through
511	-	mpletely filled groove
515	-	concavity (see 5013)
517	-	restart
(1) *For explanations and illustrations,see. ISO 6520-1.*		

Table 10.2 Evaluation ratings

Findings	Rating	Remarks
Weld free from detectable defects	1 = good	-
Minor defects such as isolated pores and small slag inclusions which do not reduce the strength or tightness of the welded joint	2 = serviceable	-
Avoidable defects such as small rows or clusters of pores, small slag lines, short root defects and minor lack of fusion	3 = leave as is	Repair not recommended for components subject to normal stresses. Short root defects and minor lack of fusion may be left only at non-critical points
Defects which must be avoided, e.g. coarse slag inclusions, accumulations of pores, generally all root defects and lack of fusion, and small isolated cracks	4 = to be repaired	Repair of defects required. Exceptions only for components without particular requirements on strength and tightness, but not at cracks.
Extensive major defects and cracks	5 = to be replaced	Replacement of the section of weld or of the entire welded joint required

H. Extension of the Scope of Inspection

1. If it is not certain that a defect to be repaired ends within the tested section of the weld, the adjacent sections of the weld shall also be inspected.

2. If major defects are found during inspections at random, the scope of inspection shall be extended. Unless otherwise agreed, for each section of weld to be repaired two more of the same length shall be inspected.

3. In the case of ultrasonic testing, **TL** reserves the right to carry out control tests at random on the basis of the inspection reports compiled by the firm's inspector or to require control tests to be performed by a second, independent testing authority. If major differences from the results of the initial tests performed in the firm are found, the scope of the control tests may be extended.

I. Repairs, Re-inspection

1. Repairs

1.1 Defects requiring repair on the basis of the evaluation shall be carefully grooved over a sufficient length (especially in the case of intersecting welds) and/or re-welded. Where a number of defects needing repair are located close together in a single section of weld, the entire section shall be machined out and re-welded.

1.2 Undercuts in need of repair, poor transitions to the surrounding material or other surface defects shall, where possible, be remedied by grinding out with smooth transitions to the surrounding material or, if they are too deep for this, they shall, with the Surveyor's consent, be ground out and repair- welded.

2. Re-inspection

2.1 Repaired welds shall be re-inspected. Where welds have been completely remade, retesting at least equal in scope to the initial inspection shall be performed at random in accordance with the Surveyor's instructions.

2.2 Re-inspections shall be specially indicated in the inspection reports and on the radiographs, e.g. by means of an "R" (= repair) next to the title of the film (see D.2.2).

J. Visual Inspection

1. The surfaces and back sides of the welds shall undergo a complete visual inspection, with the aid of optical (magnifying) appliances where necessary, to check their external characteristics. The following characteristics shall be checked:

- Completeness,
- Dimensional accuracy,
- Compliance with the specified weld shape,
- Absence from inadmissible external defects.

2. The dimensional accuracy shall be checked with suitable measuring instruments on a random sampling basis. When measuring fillet weld throat thicknesses, measuring gauges which measure with sufficient accuracy in throats which are not an exact right angle shall be used where necessary.

3. When checking for the correct shape of weld and external defects, attention shall be paid to the following:

- Weld reinforcement or top bead depression,
- Weld edge angles (transitions to surrounding material),
- Misalignment of edges,
- Undercuts,
- Visible pores and slag inclusions
- Fused weld spatter,
- Arc strikes on the surface of the base material,
- Concave root surface and incomplete root fusion,
- Cracks,
- Unequal side lengths (in the case of fillet welds).

With regard to the limits of acceptability, see G.2. and Section 12 to 16. Repairing of visible cracks is mandatory.

K. Radiographic Inspection

1. Radiation Sources, Appliances

1.1 Wherever possible, X-ray units shall be used as radiation sources for radiographic inspections. The radiation energy (tube voltage) shall lie within the energy limits specified in ISO 17636. Allowing for the differences in thickness of the component, the radiation energy (tube voltage) should be kept as low as possible within the permissible working range so as to obtain a high-contrast image.

1.2 Where justified in exceptional cases (e.g. by lack of accessibility), gamma ray sources - preferably Ir 192 or Se 75 - may be used as radiation sources, subject to **TL**'s consent in each instance; see 4.4.

2. Films, Intensifying Screens

2.1 Class C5 films conforming to EN ISO 11699-1 or G III conforming to ISO 5579 may normally be used in shipbuilding for X-raying steel. Class C3 or C4 and GI or GII films, as applicable, are to be used for the radiographic inspection of aluminium alloys and when using gamma rays to inspect steel. The use of class C3 or C4 and GI or GII films, as applicable, is obligatory in steam boiler, pressure vessel and pipeline manufacture (pipe class I and II).

Note:

*Annex A provides a summary of the classification of the most popular X-ray films currently on the market. This summary does not claim to be exhaustive and manufacturers of other X-ray films are invited to make the classification of their products by independent inspection institutes public and make the appropriate documents available to **TL** so that they can supplement the list.*

2.2 Front and rear 0,02 mm lead screens shall normally be used when radiographing steel. During radiography, the film and the screens must be kept in intimate contact in suitable cassettes, packs, etc. Radiographs may be made of aluminium alloys up to about 65 mm thick without the use of intensifying screens.

2.3 The use of salt intensifying screens and fluo-rometal screens is not allowed.

3. Radiographic Parameters

3.1 As a general rule, the radiographic parameters prescribed in ISO 17636 for test category A (general inspection procedure) shall be applied in shipbuilding and those for test category B (higher-sensitivity inspection procedure) shall be applied in steam boiler, pressure vessel and pipeline manufacture (pipe class I and II). In

special cases **TL** may stipulate application of test category B in shipbuilding as well. For radiographic inspection using X-rays and a film length of 480 mm, the distance between the film and the focal point shall normally be 700 mm, and in any case not less than the length of the film.

3.2 If several films are used to inspect a seam (e.g. for circumferential radiographs), they shall overlap at the ends in such a way that the full pattern of the weld can be traced without interruption.

3.3 When inspecting pipes with an outside diameter ≤ 90 mm, elliptical radiographs may be made Depending on the diameter and wall thickness of the pipe, two or more elliptical radiographs are to be mode so that the full length of the weld (the entire circumference of the pipe) is shown in the area of the radiographs capable of evaluation.

3.4 For larger-diameter pipes, either double-wall radiographs or, if the pipe diameter permits, central or single-wall radiographs shall be made. Care shall be taken to ensure that the film is capable of evaluation at both its ends. The area capable of evaluation shall only be the section of the weld in which the rays delimiting the beam do not cover more than 1.1 times the weld thickness that is radiographed with vertical irradiation.

The number of radiographs shall be determined accordingly.

3.5 In order to determine the image quality to EN 462-3 standard, at least one image quality indicator to EN 462-1 (wire indicator) shall, for each radiograph, be laid on the side of the weld away from the film and facing the radiation source and shall be radiographed together with the weld. Should this be impossible, the image quality indicator may, with **TL**'s consent and after the preparation of comparative radiographs designed to determine the changed index of image quality, be fixed to the work piece on the side close to the film (i.e. between the film and the weld). The film image must be marked with a corresponding identification ("N") to indicate that this arrangement was used, and appropriate mention must be made in the inspection report.

3.6 Each film image must be clearly and unmistakably identified by lead figures or letters simultaneously irradiated and depicted on the film. This identi-fication must be the same as that given in the inspection schedule and must enable any defects found to be readily located. The marking is to be located outside the weld area to be evaluated (the weld width plus at least 10 mm. on each side).

4. Film Processing, Density, Image Quality

4.1 The films must be processed in properly equipped darkrooms in such a way as to avoid any blemishes which interfere with their evaluation (e.g. fogging, scratches, dark crescent-shaped marks due to kinks in the film, etc.).

The instructions and recommendations issued by the film and chemical manufacturers are to be followed. Premature interruption of the developing process and reduction with chemicals of over-exposed films is not allowed.

4.2 The radiographic images must have a density (D) of at least 2,0 over the entire area for evaluation. The upper limit value depends on the brightness of the film viewers available for the evaluation, but should not exceed 2,5 to max. 3,0. Wide differences in density within a single radiograph are to be avoided.

4.3 The image quality shall be determined with an image quality indicator of the type prescribed in 3.5 and in accordance with EN 462-1. For category A inspection (see 3.1), image quality B is desirable for steel, with image quality A as the minimum requirement. In the case of aluminium alloys and test category B, image quality B must

be attained. The criterion in each case is the smallest wire of the image quality indicator which is still visible in the area to be evaluated, the density being uniform.

4.4 The works or the inspection department/ body must demonstrate on request by means of specimen radiographs that the required radiographic parameters and image quality can be attained.

5. Viewing Conditions, Evaluation, Inspection Report

5.1 Viewers with a luminous density to EN 25580/ISO 5580 sufficient for the required film density shall be used for the examination and evaluation of radiographs. Stops must be fitted to enable the field of view to be adapted to the film size for, or capable of, evaluation. The brightness must be adjustable.

5.2 The viewing and evaluation of radiographs shall take place in a dimly lit though not completely darkened room. Evaluation should only be performed after a sufficient period has been allowed for adaptation. Bright, dazzling areas within the field of view are to be screened. The use of magnifying glasses for the detection of fine details may be beneficial.

5.3 The following information is to be given in the inspection report, together with explanatory sketches where necessary:

- Works number, component, inspection schedule number, inspection position(s),
- Material, welding process,
- Thickness of work piece or weld, as appropriate,
- Date and time of test (see E.3. and elsewhere),
- Radiation source and size of tube focus or emitter,
- Tube voltage or activity at time of inspection,
- Radiographic arrangement to ISO 17636, position of wire indicator,
- Type of film, nature and thickness of intensifying screens,
- Test category, image quality index and image quality class,
- Symbols denoting defects and assessment in accordance with G.

The inspection report must also indicate whether the information relates to an initial radiograph or to a follow-up inspection after repair work has been carried out (see D.2.1 and I.2.2).

5.4 The initial evaluation shall be carried out by the welding supervisory staff and/or the works inspection department. Then the films (initial and follow-up radiographs, see D.2.1 and I.2.) shall be submitted to **TL**'s Surveyor for evaluation together with the inspection reports (see G.3.1).

L. Ultrasonic Inspection

1. Test Appliances and Accessories

1.1 The test appliances, probes and other acces-sories (calibration and reference blocks for adjusting the sensitivity, reference scales, etc.) shall conform to the state of the art and the relevant standards (e.g. EN 12223, EN ISO 7963/ISO 2400, EN ISO 17640 or ISO 16810 or related TS standards).

1.2 All possible echo heights within the range of instrument sensitivity used must be capable of being determined with the aid of an amplification control calibrated in dB and a suitable scale marking on the display. The interval between the switching stages shall not exceed 2 dB. Instruments not equipped with a calibrated amplification control may not be used.

1.3 Stepless controls must enable the ranges of adjustment available on the instrument to follow on from one another, as far as possible without any intervening gap. Within each individual range the time sweep must be continuously adjustable.

1.4 With regard to the geometrical characteristics of the sound field, especially the incidence and squint angles, the testing frequency and the resolution, the probes must lie within the tolerances specified in the standards mentioned above. The incidence and squint angles shall not in either case deviate by more than 2° from the nominal value or from the centre line of the probe. The angle of incidence and the probe index (of angle beam probes) shall be verified.

2. Calibration, Sensitivity Setting

2.1 The distance signal (time sweep) may be calibrated in projection distances "a", shortened projection distances "a'" or sonic distances "s" as desired or, if necessary, depth positions "b". Unless otherwise agreed, calibration in shortened projection distances "a'" is preferred for weld inspections, or in sonic distances "s" for parts of complex shape.

2.2 For calibration in accordance with 2.1 a calibration block to EN 12223 or EN ISO 7963/ISO 2400 shall be used when testing (hull) structural steels. Appropriate calibration or reference blocks shall be used for materials having other sound velocities (e.g. high-alloy steels and non-ferrous metals). Bore holes used for calibration shall not be larger than 2 mm and shall lie parallel to the testing surface. Where possible, calibration should not be performed at edges.

2.3 Depending on the intended method of echo height definition, the sensitivity setting shall be performed using calibration reflectors of known shape, position and size (e.g. large flat reflectors, side-drilled holes) in accordance with the provisions of ISO 16811. Unless otherwise agreed, the DGS method of inspection shall be used. With the DGS method, the sensitivity setting is to be carried out in accordance with the instrument manufacturer's instructions using calibration blocks to EN 12223 and EN ISO 7963/ISO 2400. Flat-bottom holes and grooves should not be used as calibration reflectors.

2.4 If necessary (e.g. for defects close to the surface), the sensitivity setting is to be corrected in accordance with ISO 16811. When testing unalloyed and low-alloy (hull) structural steels and where the sonic distances are not too far (see ISO 16811), the sound attenuation may normally be disregarded. A transfer correction to determine the coupling differences between the surface of the reference block and that of the test piece shall, however, be performed in every case. The value of the transfer correction shall be stated in the inspection report.

2.5 For more efficient detection of defects it is recommended that testing be performed with a test sensitivity (search sensitivity) increased by approximately 6 dB over the chosen registration level (see 5.1). However, the registration level setting is generally to be used when evaluating defect indications. All echo indications to be registered must attain at least 20 % of the display height even at the maximum sonic distance (see ISO 16811). In the case of electrogas welded seams, the inspection shall normally be performed with a sensitivity increased by 12 dB, and this fact shall be expressly stated in the inspection report with a reference to the welding process (e.g. EG + 12 dB).

3. Surface Preparation, Coupling

3.1 On both sides of the welded seam (see 4.1) the testing surfaces must be smooth and free from impurities liable to interfere with coupling. Rust, scale and weld spatter are to be removed so that the probes lie snugly against the surfaces, which should if necessary be ground. Firmly adhering paint need not be removed provided

that it does not interfere with the inspection and quantitative allowance can be made for the resulting loss of sensitivity when evaluating the echo heights.

3.2 Where angle beam probes have to be applied to the surface of the weld for the inspection of transverse defects (see 4.3), this shall also be prepared as a testing surface in the manner described above.

Notches, grooves and the like lying across the beam axis which produce false indications and may impair the test are to be removed.

3.3 Coupling to the testing surfaces prepared in accordance with 3.1 should be as uniform as possible and should not vary by more than ± 4 dB. If greater variations are found, the condition of the surface shall be improved. Where greater variations cannot be avoided, this fact must be stated in the inspection report. Running water, cellulose glue, oils, grease or glycerine may be used as coupling media.

4. Scanning Directions, Angle of Incidence

4.1 Unless otherwise agreed or stipulated, testing for longitudinal defects shall be performed from one surface and from both sides of the weld, as shown in Fig. 10.1. The testing area must embrace the weld metal itself and an area on both sides of the seam equal to about 1/3 of the wall thickness, subject to a minimum of 10 mm and a maximum of 20 mm. The testing surface must encompass a width at least equal to the full skip distance plus twice the length of the probe.

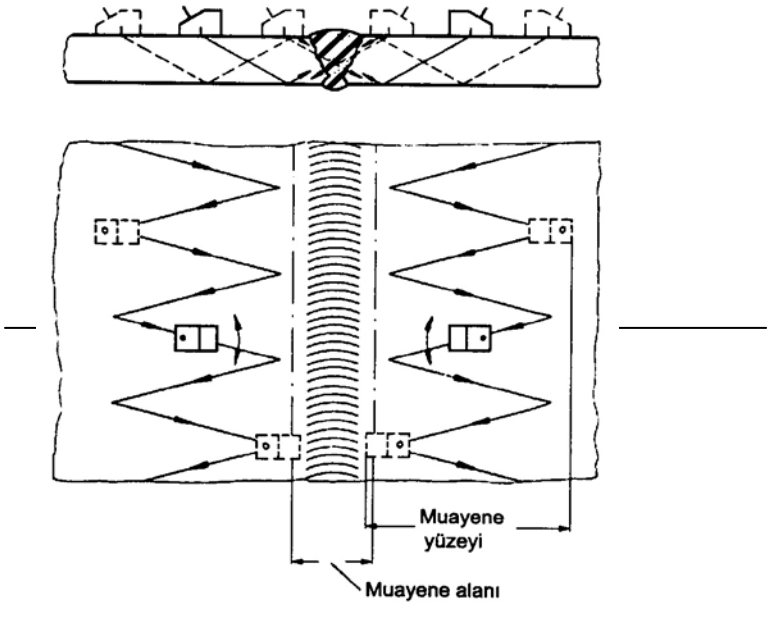
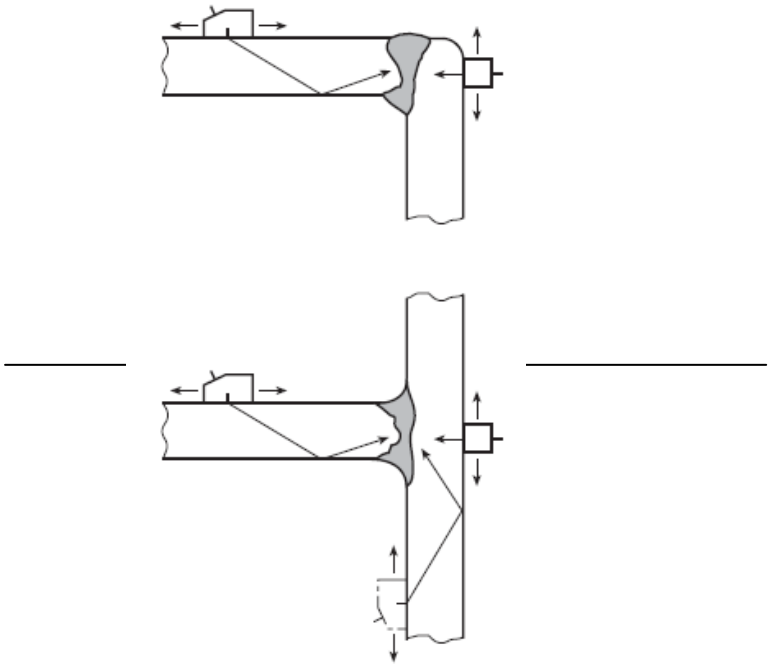


Figure 10.1 Testing for longitudinal defects

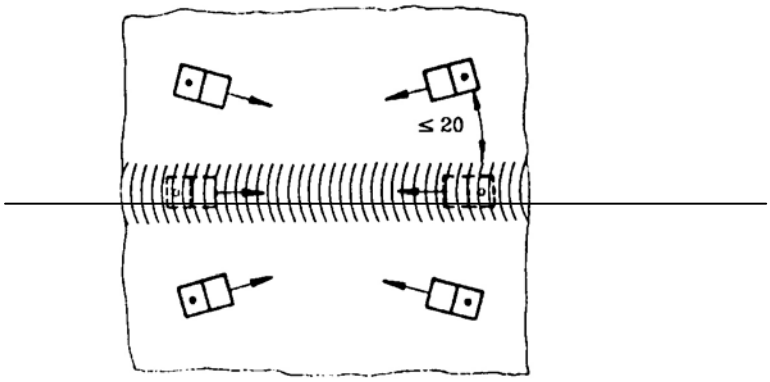
4.2 Depending on the weld geometry and the possible orientation of defects, it may be expedient to perform the test from both surfaces or (e.g. in the case of bevels) from only one side of the seam. With corner and T-joints, the testing shall normally be performed both from the side of the web and from that of the continuous (flange) plate using a standard probe, as shown in Fig. 10.2. Such probe arrangements differing from 4.1 shall be specially noted in the inspection report. The same applies in analogous manner to curved surfaces.



~~**Figure 10.2 Testing for longitudinal defects in corner and T-joints**~~

~~**4.3** Testing for transverse defects shall be performed from both sides of the weld in two directions along the seam as shown in Fig. 10.3 or - where the test requirements are more stringent - **on** the face of the weld which has been machined flush with the surface. **TL** may require that testing for transverse defects be performed with two probes connected in parallel. Where welds are made with a large weld pool (as in electroslag welding), testing for oblique defects shall also be performed at an angle of approximately 45° (see EN ISO 17640).~~

~~**4.4** With plate thicknesses (weld thicknesses) of less than 30 mm, testing may be performed with an angle of incidence of 70°. With thicknesses of 30 mm and over, two angles of incidence (70° and 45° or 60°) shall be used. Where the surface is curved, the necessary angle of incidence shall be determined in accordance with ISO 16811. With very large wall thicknesses (above about 100 mm), the inspection must be performed using a tandem technique (with fixed, mechanical coupling of two similar probes) for different depth zones.~~



~~**Figure 10.3 Testing for transverse defects**~~

5. Registration Level, Evaluation of Echo Indications

Note:

Recommendations on the evaluation of the findings of ultrasonic inspections of fusion-welded joints (in steel) according to ISO 5817. The information sheet also contains information on the usefulness and performance of ultrasonic inspections and the evaluation of form-related indications.

5.1 For tests carried out by the DGS method, the registration level (reference reflector size) for longitudinal and transverse defects is given by the diameters of the disc-shaped reflectors specified in Table 10.3 in relation to the wall thickness (weld thickness).

Table 10.3 Registration levels

Wall thickness (weld thickness)	**Diameter of disc-shaped reflector**	
	4 MHz	**2 MHz**
From 10 - 15 mm.	1,0 mm.	1,5 mm.
Over 15 - 20 mm.	1,5 mm.	2,0 mm.
Over 20 - 40 mm.	2,0 mm.	3,0 mm.
Over 40 - 60 mm.	3,0 mm.	4,0 mm.

Where the thickness is greater than 60 mm, the registration level will be determined on a case-by-case basis. For tandem testing, the registration level shall be determined by a 6 mm diameter disc-shaped reflector. For other methods of echo height definition (e.g. the reference block method), the registration level shall be determined in accordance with ISO 16811.

5.2 The registration of non-form-related echo indications which are observed when inspecting welded joints and whose echo heights attain or exceed the registration level (reference reflector size) specified in 5.1 are required only when expressly stipulated by **TL** or where subsequent repeat tests have to be performed. Otherwise only those echo indications shall be registered which exceed the repair limit value specified in 5.4.

5.3 One characteristic which is to be stated for the classification of echo indications is by how many dB the maximum echo height of the reflections found differs from the registration level defined in 5.1. In the case of the DGS method, the size of the (substitute) disc-shaped reflector may also be stated. Further characteristics to be stated are the registration lengths and half-value depths in accordance with EN ISO 17640. The location of reflections shall be defined by coordinates indicating the "longitudinal and transverse distances from a reference point" and the "depth position".

5.4 Unless otherwise stated in Section 12 to 16, echo indications produced by longitudinal defects which exceed the repair limit values shown in Table 10.4 (excess of registration lengths and/or echo heights above the registration level shown in Table 10.3) shall be regarded as weld defects which must be repaired.

5.5 Continuous echo indications which point to systematic weld defects (such as root defects due to incomplete penetration or rows of pores) call for repairs even if the repair limit values are not attained. Echo indications which point to the presence of cracks necessitate repairs in every case.

5.6 Echo indications produced by transverse defects shall in every case count as weld defects re-quiring repair unless they can be unequivocally associated with the indications produced by longitudinal defects and remain below the repair limit values stipulated in Table 10.4.

5.7 Where the evaluation of echo indications gives rise to doubt regarding the need for repair, recourse may be had to radiographic inspection to help in the assessment. However, echo indications obtained with welded seams 30 mm. or more in thickness which exceed the repair limit values invariably necessitate repair even if radiographic inspection fails to reveal any defects or fails to reveal them clearly.

6. Inspection Reports

6.1 Complete inspection reports as prescribed in EN ISO 17640 and containing the information listed below shall be prepared for all ultrasonic inspections in accordance with the inspection schedule; see D.1. The inspection reports must enable the inspections to be repeated identically. They must be signed by the person performing the inspection and the supervisor.

6.2 Inspection reports must contain the following general information:

- Clear identification of the component, the material, the welded joint inspected together with its dimensions and location (sketch to be provided for complex weld shapes and testing arrangements) and the welding process.

- Indication of any other rules (e.g. specifications, standards or special agreements) applied to the inspection.

- Place and time of the inspection, testing body and identification of the person performing the test.

6.3 Inspection reports must contain at least the following specific details relating to the inspection:

- Make and type of test equipment,
- Make, type, nominal frequency and angle of incidence of probes,
- Distance calibration (testing range),
- Sensitivity setting (calibration reflector used, instrument sensitivity, registration level),
- Correction values (for defects close to surface, transfer correction),
- Test sensitivity,
- Surface preparation, coupling media,
- Testing surfaces, testing directions, angles of incidence.

6.4 The test results (where these are to be stated in the inspection report; see 5.2) shall, wherever possible, be tabulated or shown on sketches with the following details:

- Coordinates of defects with indication of reference point,
- Maximum excess echo height (+ ... dB) compared with the given registration level (reference reflector size) or, where applicable, the diameter of the corresponding (substitute) disc-shaped reflector
- Defect characteristics (registration length, half-value depth).

Where echo indications below the repair limit values shown in Table 10.4 are also registered, each defect thus identified is to be allocated an assessment (e.g. leave as is or repair, k = acceptable or ke = not acceptable).

Table 10.4 Repair limit values

Evaluation category according to G.2.1	Wall thickness (weld thickness)) [mm]	Longitudinal defects			Transverse defects		
		Number of defects per m of weld seam	Registration length [mm]	Max. permissible excess echo height [dB]	Number of defects per m of weld seam	Registration length [mm]	Max. permissible excess echo height [dB]
B	10...15	10 and 3 and 1	10 20 10	6 6 12	3	10	6
	>15...20	10 and 3 and 1	10 20 19	6 6 12	3	10	6
	> 20...40	10 and 3 and 1	10 25 10	6 6 12	3	10	6
	> 40	10 and 3 and 1	10 30 10	6 6 12	3	10	6
C	10...20	10 and 3 and 1	15 30 10	6 6 12	3	10	6
	>20...40	10 and 3 and 1	15 30 10	6 6 12	3	10	6
	> 40	10 and 3 and 1	15 50 10	6 6 12	3	10	6
D	10...20	10 and 3 and 1	15 50 10	6 6 12	5	10	6
	>20...40	10 and 3 and 1	15 50 10	6 6 12	5	10	6
	> 40	10 and 3 and 1	20 50 10	6 6 12	5	10	6

M. Magnetic Particle Inspection

1. Test Appliances and Media

1.1 The test appliances and media used must conform to the state of the art and the relevant standards (e.g. DIN 54130, EN ISO 9934-3, EN ISO 9934-2, EN 571-1, EN ISO 3452-2 and EN ISO 3452-3). The magnetizing equipment must be provided with markings or measuring devices which indicate the magnetizing current strength at any time. **TL** may stipulate that measurements be performed to verify these data. Proof of the suitability of the test media shall be furnished on request.

1.2 Magnetic particles suspended in suitable, readily volatile vehicle liquids shall be used as test media for revealing the leakage flux due to discontinuities in the material. These magnetic particles may be black or fluorescent. Where black magnetic particles are used, the surface to be tested shall be coated with a permanent white paint, applied as thinly as possible, to provide a contrast.

~~**1.3** The proportion of magnetic particles in the vehicle liquid must conform to the manufacturer's instructions and shall be verified (e.g. by means of a test indicator or by a separation test using a glass centrifuge vessel to API MPMS Chapter 10.4). Dry test media may only be used for tests at elevated temperatures (e.g. on root passes).~~

~~**2. Magnetization Method and Field Strength**~~

~~**2.1** The choice of the method of magnetization depends on the geometry of the component and is to be agreed with **TL**. If possible, magnetization shall be effected by passing a current through the work piece or, in the case of minor localized inspections, by yoke magnetization using electromagnets or, if no other possibilities are given, permanent magnets.~~

~~**2.2** In special cases (e.g. where burn marks have to be avoided at all costs or for circumferential welds), it may be expedient to effect magnetization with a live conductor (a cable or coil). A combination of different methods of magnetization for the detection of variously orientated defects is allowed.~~

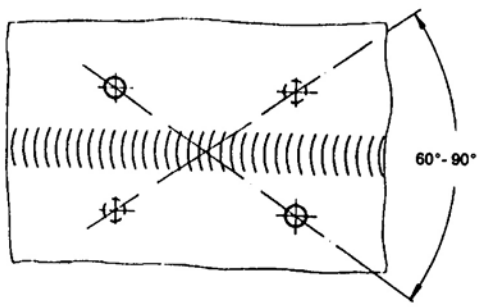
~~**2.3** Where a current is passed through the work-piece, alternating, direct, impulse or surge current may be used. AC or DC magnets may be used for yoke magnetization. Where the magnetizing current is passed through the workpiece, fusible supply electrodes should be used to prevent burn marks. Where AC is used, fusible electrodes are obligatory.~~

~~**2.4** The magnetizing field strength (effective tangential field strength) must be at least 20 A/cm (25 Oe) but shall not exceed 50 A/cm (62,5 Oe). The adequacy of the magnetization shall be checked at the time of the test by suitable means (e.g. test indicator) or with a tangential field strength meter.~~

~~**3. Preparation of Testing Surfaces, Direction and Duration of Magnetization**~~

~~**3.1** The testing surfaces must be free from loose scale, rust, weld spatter and other impurities. Notches, grooves, scratches, edges, etc. which may produce false indications are to be removed prior to inspection~~
~~Thin, dry layers of paint (e.g. shop primer, up to a coat thickness of 20 µm) may be left in place as long as they do not hinder the inspection.~~

~~**3.2** Magnetization must be effected, as shown in Fig. 10.4, in two different directions including an angle of not less than 60° and not more than 90° so as to enable variously orientated defects to be located.~~



~~**Figure 10.4 Directions in which magnetization is to be effected**~~

3.3 Magnetization must be continued as long as the testing surface is sprayed with magnetic particle suspension and for as long thereafter as any movement of the magnetic particle suspension can be detected, subject to a minimum of 5 seconds. Testing under conditions of remanent magnetization is not permitted.

4. Evaluation, Inspection Reports

4.1 Every accumulation of magnetic particles not due to a false indication indicates a discontinuity or crack in the material which is to be registered in the inspection report and repaired. In the case of small cracks (e.g. end crater cracks) this may be done by grinding. Larger cracks are to be machined out and repair-welded; see I.1.2.

4.2 Inspection reports relating to magnetic particle inspections must include the following details:

- Details of the component and weld concerned,
- Details of magnetization, with amperage where appropriate,
- Test arrangement (directions of magnetization, distance between electrodes or poles),
- Test media,
- Test results
- Place and time of the inspection, testing body and identification of the person performing the test.

N. Liquid Penetrant Inspection

1. Test Media

1.1 Coloured or fluorescent penetrant shall be used as penetrant media. Penetrant removers and developers must be compatible with the penetrant used. Proof of the suitability of the inspection system (penetrant, penetrant remover, developer) shall be furnished to **TL** on request.

2. Preparation of Testing Surfaces, Performance of Inspection

2.1 To allow the penetrant to enter any defects present, the testing surfaces must be completely free from scale, rust, greases, oils, paints or electrodeposits before the penetrant is applied. During this operation care should be taken to ensure that defects are not mechanically sealed by preliminary cleaning. The testing surfaces must be dry. The temperature of the work piece shall be between 5 °C and 50 °C.

2.2 Any method of applying the penetrant may be used. Care shall be taken to ensure that the testing surface is completely wetted throughout the entire penetration time. The penetration time shall be chosen in accordance with the manufacturer's instructions, but shall not be less than 15 minutes for work piece temperatures of 15 °C and over or less than 30 minutes where the temperature is below 15 °C. The penetrant shall not become dry during the penetration period.

2.3 Following penetration, the surplus penetrant shall be completely removed from the testing surface in such a way as to leave behind the penetrant lodged in any defects present. It is advisable first to wipe off the surplus penetrant with a cloth and quickly to remove only the remains with sparing use of the penetrant remover. The testing surface should then be dried as quickly as possible (max. 50 °C).

2.4 The developer is to be applied evenly and as thinly as possible immediately after removal of the surplus penetrant and drying. The testing surface should be just covered. The developing time should be about the same

~~as the time allowed for penetration. Visual inspection for defects shall begin as the developer is applied, but the final inspection can only take place after the expiry of the developing time. M.4.1 applies in analogous manner to the evaluation.~~

~~**3. Evaluation, Inspection Reports**~~

~~**3.1** Should an unequivocal evaluation of the indications be impossible, the entire inspection procedure, starting with preliminary cleaning, must be repeated. Where necessary, the surface quality shall also be improved. The repeat inspection must be performed with the same test system as on the first occasion. The conditions specified in standard ISO 3452-1 are also applicable.~~

~~**3.2** Inspection reports relating to penetrant medium inspections must include the following details:~~

~~- Details of the component and weld concerned,~~
~~- Test media (type, brand name),~~
~~- Description of the test procedure (temperature of the work piece, penetrant acting time, etc.)~~
~~- Test results,~~
~~- Place and time of the inspection, testing body and identification of the person performing the test.~~
~~- Inspection reports shall conform to the form provided in Annex B to ISO 3452-1.~~

A. General

1. This subsection gives minimum requirements on the methods and quality levels that are to be adopted for the non-destructive testing (NDT) of ship hull structure steel welds during new building ("hull structure" as defined in TL-R Z23).

2. The quality levels given in this subsection refer to production quality and not to fitness-for-purpose of the welds examined.

3. The NDT is normally to be performed by the Shipbuilder or its subcontractors in accordance with these requirements. **TL** may require witnessing of the testing.

4. It is the Shipbuilder's responsibility to assure that testing specifications and procedures are adhered to during the construction and the reports are made available to **TL** on the findings made by the NDT.

5. The extent of testing and the number of checkpoints are to be agreed between the Shipbuilder and the Classification Society. For criticality of structure reference is to be made to TL-R S6 Tables of Structural Member Categories and TL-CSR for Bulk Carriers and Oil Tankers

6. These rules cover conventional NDT methods. Advanced non-destructive testing (ANDT) methods such as phased array ultrasonic testing (PAUT), time of flight diffraction (TOFD), digital radiography (RT-D), radioscopic testing (RT-S), and computed radiography (RT-CR) are covered by TL-R W34.

7. Terms and Definitions

The following terms and definitions apply for this requirements.

NDT Non-Destructive Testing - the development and application of technical methods to examine materials or components in ways that do not impair their future usefulness and serviceability, in order to measure geometrical characteristics and to detect, locate, measure and evaluate flaws. NDT is also known as non-destructive examination (NDE), non-destructive inspection (NDI) and non-destructive evaluation (NDE).
RT Radiographic Testing
UT Ultrasonic Testing
MT Magnetic Particle Testing
PT Dye or Liquid Penetrant Testing
PWHT Post Weld Heat Treatment
VT Visual Testing

B. Application

1. Base Metals

1.1 This sub section applies to fusion welds made in normal and higher strength hull structural steels in accordance with TL-R W11, and TL-R W31, high strength steels for welded structures in accordance with TL-R W16 and connections welds with hull steel forgings in accordance with TL-R W7 and hull steel castings in accordance with TL-R W8. Base metal other than the above may be applied by **TL**.

2. Welding Processes

2.1 This subsection applies to fusion welds made using manual metal arc welding (shielded metal arc welding, 111), gas-shielded metal arc welding (gas metal arc welding, including flux cored arc welding, 13x), gas-shielded arc welding with non-consumable tungsten electrode (gas tungsten arc welding, 14x), submerged arc welding (12x), electro-slag welding (72x) and electro-gas welding processes (73). Terms and numbers according to ISO 4063 ("x" indicates that relevant subgroups are included). This subsection may also be applied to welding processes other than the above at the discretion of **TL**.

3 Weld Joints

3.1 This subsection applies to butt welds with full penetration, tee, corner and cruciform joints with or without full penetration, and fillet welds.

4. Timing of NDT

4.1 NDT shall be conducted after welds have cooled to ambient temperature and after post weld heat treatment where applicable.

4.2 For high-strength steels for welded structure with specified minimum yield stress in the range of 420 N/mm² to 690 N/mm², the tests shall not be carried out earlier than 48 hours after completion of the welding work. . For steel with specified minimum yield greater than 690 N/mm² NDT shall not be carried out before 72 hours after completion of welding. Regardless of yield strength consideration is to be given to requiring a delayed inspection where evidence of delayed cracking has been observed in production welds.

At the discretion of the surveyor, a longer interval and/or additional random inspection at a later period may be required, (for example in case of high thickness welds).

At the discretion of the surveyor, the 72 hour interval may be reduced to 48 hours for RT or UT inspection, provided there is no indication of delayed cracking, and a complete visual and random MT or PT inspection to the satisfaction of the surveyor is conducted 72 hours after welds have been completed and cooled to ambient temperature.

Where PWHT is carried out the requirement for testing after a delay period may be relaxed, at the discretion of the surveyor.

5. Applicable Methods for Testing of Weld Joints

5.1 The methods mentioned in this sub section for detection of surface imperfections are VT, PT and MT. The methods mentioned for detection of internal imperfections are UT and RT.

5.2 Applicable methods for testing of the different types of weld joints are given in Table 10.1.**Table 10.1: Applicable methods for testing of weld joints**

WELD JOINTS	PARENT MATERIAL THICKNESS	APPLICABLE TEST METHODS
Butt welds with full penetration	thickness < 8 mm **(1)**	VT, PT, MT, RT
	thickness ≥ 8 mm	VT, PT, MT, UT, RT
Tee joints, corner joints and cruciform joints with full penetration	thickness < 8 mm **(1)**	VT, PT, MT, RT **(3)**
	thickness ≥ 8 mm	VT, PT, MT, UT, RT **(3)**
Tee joints, corner joints and cruciform joints without full penetration and fillet welds	All	VT, PT, MT, UT (2), RT (3)

Notes:

*(1) In cases of thickness below 8mm **TL** may consider application of an appropriate advanced UT method..*

*(2) UT may be used to check the extent of penetration in tee, corner and cruciform joints. This requirement is to be agreed with **TL**.*

(3) RT may be applied however there will be limitations.

C. Qualification of personnel involved in NDT

1. The Shipbuilder or its subcontractors is responsible for the qualification and preferably 3rd party certification of its supervisors and operators to a recognised certification scheme based on ISO 9712.

Personnel qualification to an employer based qualification scheme as e.g. SNT-TC-1A or ANSI/ASNT CP-189 may be accepted if the Shipbuilder or its subcontractors written practice is reviewed and found acceptable by TL. The Shipbuilder or its subcontractors written practice shall as a minimum, except for the impartiality requirements of a certification body and/or authorised body, comply with ISO 9712.

The supervisors' and operators' certificates and competence shall comprise all industrial sectors and techniques being applied by the Shipbuilder or its subcontractors. Level 3 personnel shall be certified by an accredited certification body.

2. The Shipbuilder or its subcontractors shall have a supervisor or supervisors, responsible for the appropriate execution of NDT operations and for the professional standard of the operators and their equipment, including the professional administration of the working procedures. The Shipbuilder or its subcontractors shall employ, on a full-time basis, at least one supervisor independently certified to Level 3 in the method(s) concerned as per the requirements of item 1. It is not permissible to appoint Level 3 personnel; they must be certified by an accredited certification body. It is recognised that a Shipbuilder or its subcontractors may not directly employ a Level 3 in all the stated methods practiced. In such cases, it is permissible to employ an external, independently certified, Level 3 in those methods not held by the full-time Level 3(s) of the Shipbuilder or its subcontractors.

The supervisor shall be directly involved in review and acceptance of NDT Procedures, NDT reports, calibration of NDT equipment and tools. The supervisor shall on behalf of the Shipbuilder or its subcontractors re-evaluate the qualification of the operators annually.

3. The operator carrying out the NDT and interpreting indications, shall as a minimum, be qualified and certified to Level 2 in the NDT method(s) concerned and as described in item 1.

However, operators only undertaking the gathering of data using any NDT method and not performing data interpretation or data analysis may be qualified and certified as appropriate, at level 1.

The operator shall have adequate knowledge of materials, welding, structures or components, NDT equipment and limitations that are sufficient to apply the relevant NDT method for each application appropriately.

D. Surface Condition

1. Areas to be examined shall be free from scale, slag, loose rust, weld spatter, oil, grease, dirt or paint that might affect the sensitivity of the testing method.

Preparation and cleaning of welds for subsequent NDT are to be in accordance with the accepted NDT procedures, and are to be to the satisfaction of the surveyor. Surface conditions that prevent proper interpretation may be cause for rejection of the weld area of interest.

E. General Plan of Testing: NDT Method Selection

1. The extent of testing and the associated quality levels are to be planned by the Shipbuilder according to the ship design, ship type and welding processes used. For new construction survey reference is to be made to the NDT requirements of TL-R Z23 and the applicable parts of the TL-R Z23 enclosures Table 1 and Appendices**.**

2. For each construction, the Shipbuilder shall submit a plan for approval by **TL**, specifying the areas to be examined and the extent of testing and the quality levels, with reference to the NDT procedures to be used. Particular attention is to be paid to inspecting welds in highly stressed areas and welds in primary and special structure indicated in TL-R S6. The NDT procedure(s) shall meet the requirement stated in item F and the specific requirements of **TL**. The plan shall only be released to the personnel in charge of the NDT and its supervision.

In selecting checkpoints, emphasis shall be given to the following inspection locations:

Welds in high stressed areas

Fatigue sensitive areas

Other important structural elements

Welds which are inaccessible or very difficult to inspect in service

Field erected welds

Suspected problem areas

Block construction welds performed in the yards, or at subcontracted yards/facilities, are to be considered in selecting checkpoints.

For other marine and offshore structures the extent is to be agreed by **TL**.

If an unacceptable level of indications are found the NDT extent is to be increased.

3. The identification system shall identify the exact locations of the lengths of weld examined.

4. All welds over their full length are to be subject to VT by personnel designated by the Shipbuilder, who may be exempted from the qualification requirements defined in item C.

5. As far as practicable, PT or MT shall be used when investigating the outer surface of welds, checking the intermediate weld passes and back-gouged joints prior to subsequent passes deposition. MT shall be performed in ferromagnetic materials welds unless otherwise agreed with TL. Surface inspection of important tee or corner joints, using an approved MT or PT method, shall be conducted to the satisfaction of the surveyor.

6. Welded connections of large cast or forged components (e.g. stern frame, stern boss, rudder parts, shaft brackets...) are to be tested over their full length using MT (MT is the preferred method) or PT, (PT is to be applied for non-ferrous metals) and at agreed locations using RT or UT.

7. As given in Table 10.1, UT or RT or a combination of UT and RT may be used for testing of butt welds with full penetration of 8mm or greater. Methods to be used shall be agreed with **TL**. The method used shall be suited for the detection of particular types and orientations of discontinuities. RT and UT are used for detection of internal discontinuities, and in essence they supplement and complement each other. RT is generally most effective in detecting volumetric discontinuities (e.g. porosity and slag) whilst UT is more effective for detecting planar discontinuities (e.g. laminations, lack of fusion and cracks). Although one method may not be directly relatable to the other, either one would indicate conditions of inadequate control of the welding process.

8. In general start/stop points in welds made using automatic (mechanized) welding processes are to be examined using RT or UT, except for internal members where the extent of testing is to be agreed with the attending surveyor.

9. Where the surveyor becomes aware that an NDT location has been repaired without a record of the original defect, the shipyard is to carry out additional examinations on adjacent areas to the repaired area to the satisfaction of the attending surveyor. Reference is to be made to TL-R Z23.

10. Welds in thick steels (>50mm) used in container carrier, deck and hatch coaming areas are to be inspected in accordance with the additional requirements in Chapter 2 – Materials, Section 3 item J.2.

F. Testing

1. General

1.1 The testing method, equipment and conditions shall comply with recognized National or International standards, or other documents to the satisfaction of **TL**.

1.2 Sufficient details shall be given in a written procedure for each NDT technique submitted to the Classification Society for acceptance.

1.3 The testing volume shall be the zone which include the weld and parent material for at least 10mm each side of the weld, or the width of the heat affected zone (HAZ), whichever is greater. In all cases inspection shall cover the whole testing volume.

1.4 Provision is to be made for the surveyor to verify the inspection, reports and records (e.g. radiographs) on request.

2. Visual Testing (VT)

2.1 The personnel in charge of VT is to confirm that the surface condition is acceptable prior to carrying out the inspection. VT shall be carried out in accordance with standards agreed between the Shipbuilder and **TL**.

3 Liquid penetrant testing (PT)

3.1 PT shall be carried out in accordance to ISO 3452-1 or a recognized accepted standard and the specific requirement of **TL**.

3.2 The extent of PT shall be in accordance to the plans agreed with the attending surveyor and to the satisfaction of the surveyor.

3.3 The surface to be examined shall be clean and free from scale, oil, grease, dirt or paint so there are not contaminants and entrapped material that may impede penetration of the inspection media.

3.4 The temperature of parts examined shall be typically between 5°C and 50°C, outside this temperature range special low/high temperature penetrant and reference comparator blocks shall be used.

4. Magnetic Particle Testing (MT)

4.1 MT shall be carried out in accordance to ISO 17638 or a recognized accepted standard and the specific requirement of **TL**.

4.2 The extent of MT shall be in accordance to the plans agreed with the attending surveyor and to the satisfaction of the surveyor.

4.3 The surface to be examined shall be free from scale, weld spatter, oil, grease, dirt or paint and shall be clean and dry. In general, the inside and outside of the welds to be inspected need to be sufficiently free from irregularities that may mask or interfere with interpretation.

5. Radiographic Testing (RT)

5.1 RT shall be carried out in accordance to ISO 17636-1 or an accepted recognized standard and any specific requirement of **TL**.

5.2 The minimum inspected weld length for each checkpoint is to be specified in the approved NDT plan (see E.2) and shall follow the requirements of **TL**. For hull welds the minimum length inspected by RT is typically 300mm.

The extent of RT shall be in accordance to the approved plans and to the satisfaction of the surveyor.

Consideration may be given for reduction of inspection frequency for automated welds where quality assurance techniques indicate consistent satisfactory quality. The number of checkpoints is to be increased if the proportion of non-conforming indications is abnormally high.

5.3 The inside and outside surfaces of the welds to be radiographed are to be sufficiently free from irregularities that may mask or interfere with interpretation. Surface conditions that prevent proper interpretation of radiographs may be cause for rejection of the weld area of interest.

6. Ultrasonic Testing (UT)

6.1 UT shall be carried out according to procedure based on ISO 17640 (testing procedure), ISO 23279 (characterization) and ISO 11666 (acceptance levels) or accepted standards and the specific requirements of **TL**.

6.2 The minimum inspected weld length for each checkpoint is to be specified in the approved NDT plan (see E.2) and shall follow the requirements of **TL**.

The extent of UT shall be in accordance to the approved plans and to the satisfaction of the surveyor.

A checkpoint shall consist of the entire weld length or a length agreed with **TL**.

G. Acceptance Levels (Criteria)

1 General

1.1 This item details the acceptance levels (criteria) followed for the assessment of the NDT results. Techniques include but are not limited to: VT, MT, PT, RT and UT.

1.2 As far as necessary, testing techniques shall be combined to facilitate the assessment of indications against the acceptance criteria.

1.3 The assessment of indications not covered by this subsection shall be made in accordance with a standard agreed with **TL**. Alternative acceptance criteria can be agreed with **TL**, provided equivalency is established.

The general accepted methods for testing of welds are provided in Table 10.2 and Table 10.3 for surface and embedded discontinuities respectively. Refer to ISO 17635.

Table 10.2 Method for detection of surface discontinuities (All type of welds including fillet welds)

Materials	Testing Methods
Ferritic Steel	VT
	VT, MT
	VT, PT

Table 10.3 NDT for detection of embedded discontinuities (for butt and T joints with full penetration)

Materials and type of joint	Nominal thickness (t) of the parent material to be welded (mm)		
	t < 8	8 ≤ t ≤ 40	t > 40
Ferritic butt joints	RT or UT **(1)**	RT or UT	UT or RT **(2)**
Ferritic T-joints	UT **(1)** or RT **(2)**	UT or RT **(2)**	UT or RT **(2)**

Notes:

(1) *Below 8mm the Classification Society may consider application of an appropriate advanced UT method.*

(2) *RT may be applied however there will be limitations.*

2. Quality Levels

Testing requirements follows the designation of a particular quality level of imperfections in fusion-welded joints in accordance with ISO 5817. Three quality levels (B, C and D) are specified.

In general Quality level C is to be applied for hull structure.

Quality level B corresponds to the highest requirement on the finished weld, and may be applied on critical welds.

This standard applies to steel materials with thickness above 0.5 mm. ISO 5817 Table 1 provides the requirements on the limits of imperfections for each quality level. ISO 5817 Annex A also provides examples for the determination of percentage of imperfections (number of pores in surface percent).

All levels (B, C and D) refer to production quality and not to the fitness for purpose (ability of product, process or service to serve a defined purpose under specific conditions). The correlation between the quality levels defined in ISO 5817, testing levels/ techniques and acceptance levels (for each NDT technique) will serve to define the

purpose under specific conditions. The acceptance level required for examination shall be agreed with TL. This will determine the quality level required in accordance with the non-destructive technique selected. Refer to tables 10.4 to 10.9.

3 Testing Levels.

3.1 The testing coverage and thus the probability of detection increases from testing level A to testing level C. The testing level shall be agreed with TL. Testing level D is intended for special applications, this can only be used when defined by specification. ISO 17640 Annex A tables A.1 to A.7 provide guidance on the selection of testing levels for all type of joints in relation to the thickness of parent material and inspection requirements.

3.2 The testing technique used for the assessment of indications shall also be specified.

4. Acceptance Levels.

4.1 The acceptance levels are specified for each testing technique used for performing the inspection. The criteria applied is to comply with each standard identified in tables 10.4 to 10.9 (or any recognized acceptable standard agreed with TL).

4.2 Probability of detection (POD) indicates the probability that a testing technique will detect a given flaw.

5. Visual Testing (VT)

5.1 The acceptance levels and required quality levels for VT are provided in TL-G 47 and Table 10.4 below.

Table 10.4 Visual testing

Quality Levels (ISO 5817 applies) (1)	Testing Techniques / levels (ISO 17637 applies) (1)	Acceptance levels (2)
B	Level not specified	B
C		C
D		D
(1) Or any recognized standard agreed with **TL** and demonstrated to be acceptable **(2)** The acceptance levels for VT are the same to the quality levels requirements of ISO 5817.		

6. Penetrant Testing (VT)

6.1 The acceptance levels and required quality levels for PT are provided in Table 10.5 below.

Table 10.5 Penetrant testing

Quality Levels (ISO 5817 applies) (1)	Testing Techniques / levels (ISO 3452-1 applies) (1)	Acceptance levels (ISO 23277 applies) (1)
B	Level not specified	2X
C		2X
D		3X
(1) Or any recognized standard agreed with **TL** and demonstrated to be acceptable		

7. Magnetic Particle Testing (MT)

7.1 The acceptance levels and required quality levels for MT is provided in Table 10.6 below:

Table 10.6 Magnetic Particle Testing

Quality Levels (ISO 5817 applies) (1)	Testing Techniques / levels (ISO 17638 applies) (1)	Acceptance levels (ISO 23278 applies) (1)
B	Level not specified	2X
C		2X
D		3X
(1) Or any recognized standard agreed with **TL** and demonstrated to be acceptable		

8. Radiographic Testing (RT)

8.1 The acceptance levels and required quality levels for RT are provided in Table 10.7 below. Reference radiographs for the assessment of weld imperfections shall be provided in accordance to ISO 5817 or acceptable recognized standard agreed with TL.

Table 10.7 Radiographic Testing

Quality Levels (ISO 5817 applies) (1)	Testing Techniques / levels (ISO 17638 applies) (1)	Acceptance levels (ISO 23278 applies) (1)
B	B (class)	1
C	B **(2)** (class)	2
D	At least A (class)	3
(1) Or any recognized standard agreed with **TL** and demonstrated to be acceptable **(2)** For circumferential weld testing, the minimum number of exposures may correspond to the requirements of ISO 17636-1, class A		

9. Ultrasonic Testing (UT)

9.1 The acceptance levels and required quality levels for UT are provided in Tables 10.8 and 10.9 below:

Table 10.8 Ultrasonic Testing

Quality Levels (ISO 5817 applies) (1)	Testing Techniques / levels (ISO 17640 applies) (1)	Acceptance levels (ISO 11666 applies) (1)
B	at least B	2
C	at least A	3
D	at least A	3 **(3)**

(1) Or any recognized standard agreed with **TL** and demonstrated to be acceptable

(2) When characterization of indications is required, ISO 23279 is to be applied

(3) UT is not recommended but can be defined in a specification with same requirement as Quality Level C

Table 10.9 Recommended Testing and Quality Levels (ISO 17640)

Testing Level (1) (2) (3) (ISO 17640 applies)	Quality Level (ISO 11666 applies) (1)
A	C, D
B	B
C	By agreement
D	Special application

(1) POD increases from testing level A to C as testing coverage increases

(2) Testing Level D for special application shall be agreed with **TL**

(3) Specific requirements for testing levels A to C, are provided for various types of joints in ISO 17460 Annex A

9.2 UT Acceptance Levels apply to the examination of full penetration ferritic steel welds, with thickness from 8 mm to 100mm. The nominal frequency of probes used shall be between 2MHz and 5MHz. Examination procedures for other type of welds, material, thicknesses above 100 mm and examination conditions shall be submitted to the consideration of TL.

9.3 The acceptance levels for UT of welds are to be defined in accordance to ISO 11666 requirements or any recognized acceptable standard agreed with TL. The standard specifies acceptance level 2 and 3 for full penetration welded joints in ferritic steels, corresponding to quality levels B and C (Refer to table 10.8).

9.4 Sensitivity settings and levels. The sensitivity levels are set by the following techniques:

- Technique 1: based on 3mm diameter side- drilled holes
- Technique 2: based on distance gain size (DGS) curves for flat bottom holes (disk-shaped reflectors)
- Technique 3: using a distance-amplitude-corrected (DAC) curve of a rectangular notch of 1mm depth and 1mm width
- Technique 4: using the tandem technique with reference to a 6mm diameter flat-bottom hole (disk shaped reflector)

H. Reporting

1. Reports of NDT required shall be prepared by the Shipbuilder and shall be made available to TL.

2. Reports of NDT shall include the following generic items:

- Date of testing
- Hull number, location and length of weld inspected
- Names, qualification level and signature of personnel that have performed the testing
- Identification of the component examined
- Identification of the welds examined
- Steel grade, type of joint, thickness of parent material, welding process
- Acceptance criteria
- Testing standards used
- Testing equipment and arrangement used
- Any test limitations, viewing conditions and temperature
- Results of testing with reference to acceptance criteria, location and size of reportable indications
- Statement of acceptance / non-acceptance, evaluation date, name and signature of evaluator
- Number of repairs if specific area repaired more than twice

3. In addition to generic items, reports of PT shall include the following specific items:

- Type of penetrant, cleaner and developer used
- Penetration time and development time

4. In addition to generic items, reports of MT shall include the following specific items:

- Type of magnetization
- Magnetic field strength
- Detection media
- Viewing conditions
- Demagnetization, if required

5. In addition to generic items, reports of RT shall include the following specific items:

- Type and size of radiation source (width of radiation source), X-ray voltage
- Type of film/designation and number of film in each film holder/cassette
- Number of radiographs (exposures)
- Type of intensifying screens
- Exposure technique, time of exposure and source-to-film distance as per below:
- Distance from radiation source to weld
- Distance from source side of the weld to radiographic film
- Angle of radiation beam through the weld (from normal)
- Sensitivity, type and position of IQI (source side or film side)
- Density
- Geometric un-sharpness
- Specific acceptance class criteria for RT

Examinations used for acceptance or rejection of welds shall be recorded in an acceptable medium. A written record providing following information: identification and description of welds, procedures and equipment used, location within recorded medium and results shall be included. The control of documentation unprocessed original images and digitally processes images is to be to the satisfaction of the surveyor.

6. In addition to generic items, reports of UT shall include the following specific items:

- Type and identification of ultrasonic equipment used (instrument maker, model, series number), probes (instrument maker, serial number), transducer type (angle, serial number and frequency) and type of couplant (brand).
- Sensitivity levels calibrated and applied for each probe
- Transfer loss correction applied Type of reference blocks
- Signal response used for defect detection
- Reflections interpreted as failing to meet acceptance criteria

The method for review and evaluation of UT reports is required for adequate quality control and is to be to the satisfaction of the surveyor.

7. The shipyard is to keep the inspection records specified in item 2 to 6 for at least for 5 years.

I. Unacceptable indications and repairs

1. Unacceptable indications shall be eliminated and repaired where necessary. The repair welds are to be examined on their full length using appropriate NDT method at the discretion of the Surveyor.

2. When unacceptable indications are found, additional areas of the same weld length shall be examined unless it is agreed with the surveyor and fabricator that the indication is isolated without any doubt. In case of automatic welded joints, additional NDT shall be extended to all areas of the same weld length.

All radiographs exhibiting non-conforming indications are to be brought to the attention of the surveyor. Such welds are to be repaired and inspected as required by the surveyor. When non-conforming indications are observed at the end of a radiograph, additional RT is generally required to determine their extent. As an alternative, the extent of non-conforming welds may be ascertained by excavation, when approved by the surveyor.

3. The extent of testing can be extended at the surveyor's discretion when repeated non-acceptable discontinuities are found.

4. The inspection records specified in item H are to include the records of repaired welds.

5. The Shipbuilder shall take appropriate actions to monitor and improve the quality of welds to the required level. The repair rate is to be recorded by the shipyard and any necessary corrective actions are to be identified in the builder's QA system.

04. Section 12 – Welding of Hull Structures

Revision Date: May 2021

Entry into Force Date: 1 July 2021

Items I.1.2 was revised as below:

1.2 As stipulated in Section 10, ~~D~~E.2., ~~an inspection schedule~~ a plan shall be submitted to **TL** for approval before commencing the tests. **TL** reserves the right to modify this ~~schedule~~ plan even after it has been approved,

and in particular to extend the scope of the tests and/or change the individual testing positions if necessitated by fabrication operations and/or test results.

Footnote (5) on Table 12.10 was revised as below:

(5) *With regard to the requirements for ultrasonic testing, see Section 10, ~~I.5~~ G.9 (Tables 10.~~4~~8 and 10.9).*

05. Annex C – Applicable Sections for Bulk Carriers and Double Hull Oil Tankers with CSR Notation

Revision Date: May 2021

Entry into Force Date: 1 July 2021

Section 10 requirement was revised as below:

Sub-section	Paragraph	Applicable to CSR Vessels	Remarks
SECTION 10 - NON-DESTRUCTIVE TESTING OF WELDS			
A. GENERAL		Y	
B. ~~TEST METHODS, APPLIANCES AND TEST~~ MEDIA APPLICATION		Y	
C. ~~INSPECTION PERSONNEL, SUPERVISORS~~ QUALIFICATION OF PERSONNEL INVOLVED IN NDT		Y	
D. ~~INSPECTION SCHEDULE, INSPECTION REPORTS~~ SURFACE CONDITION		Y	
E. ~~TIMING OF INSPECTION, WAITING TIMES~~ GENERAL PLAN OF TESTING: NDT METHOD SELECTION		Y	
F. ~~PREPARATION AND PERFORMANCE OF TESTS~~ TESTING		Y	
G. ~~EVALUATION OF TEST RESULTS~~ ACCEPTANCE LEVELS (CRITERIA)		Y	
H. ~~EXTENSION OF THE SCOPE OF INSPECTION~~ REPORTING		Y	
I. ~~REPAIRS, RE-INSPECTION~~ UNACCEPTABLE INDICATIONS AND REPAIRS		Y	
~~J. VISUAL INSPECTION~~	-	~~Y~~	
~~K. RADIOGRAPHIC INSPECTION~~	-	~~Y~~	
~~L. ULTRASONIC INSPECTION~~	-	~~Y~~	
~~M. MAGNETIC PARTICLE INSPECTION~~	-	~~Y~~	
~~N. LIQUID PENETRANT INSPECTION~~	-	~~Y~~	
~~O~~J. REQUIREMENTS FOR NDT SUPPLIERS		Y	

PART B – CHAPTER 4 MACHINERY

01. Section 8 – Propellers

Revision Date: May 2021

Entry into Force Date: 1 July 2021

ItemS F.1 and F.2 in Section 8 of Chapter 4 were revised as below:

F. Balancing and Testing

1. Balancing

All propellers including monoblock propellers ready for mounting as well as ~~The finished propeller and~~ the blades of controllable pitch propellers and built fixed pitch propellers are required to undergo static balancing in accordance with specified ISO 484 tolerance class (or equivalent) as specified in the approved drawing in presence of a surveyor. Thereby the mass difference between blades of controllable-or built-up fixed-pitch propeller has to be not more than 1.5%.

Dynamic balancing is required for propellers with an operating speed of more than 500 rpm or propellers with tip speed exceeding 60 m/s. The manufacturer shall

demonstrate that the assembled propeller shall be within the specified limits.

For built-up propellers, the required static balancing may be replaced by an individual control of blade weight and gravity centre position.

2. Testing

2.1 Fixed pitch propellers, controllable pitch propellers and controllable pitch propeller systems and vane wheels are to be presented to **TL** for final inspection. ~~and verification of the dimensions~~.

The verification of dimensions, the dimensional and geometrical tolerances is the responsibility of the manufacturer.

The report on the relevant examinations is to be submitted to the Surveyor, who may require checks to be made in his/her presence.

……

2.4 The propeller blades shall be manufactured according to the specified tolerance class (ISO 484). As a minimum, verification of the following is required:

……

- Balancing (see also [~~2.5~~1])

……

~~**2.5** The complete propeller shall be statically balanced in accordance with specified ISO 484 tolerance class (or equivalent) in presence of a surveyor. Dynamic balancing shall be carried out for propulsion propellers with tip speed exceeding 60 m/s. The manufacturer shall demonstrate that the assembled propeller shall be within the specified limits.~~

~~For built-up propellers, the required static balancing may be replaced by an individual control of blade weight and gravity centre position.~~

02. Section 11 – Windlass and Winches

Revision Date: February 2021

Entry into Force Date: 1 July 2021

Item B.5 in Section 11 of Chapter 4 was revised and two items were added after item 5.1 and subsequent items are renumbered according to UR M79 Rev.1 as below:

5. Towing Winch Emergency Release Systems

5.1 Scope

5.1.1 This item defines minimum safety standards for winch emergency release systems provided on towing winches that are used on towing ships within close quarters, ports or terminals, including those ships normally not intended for towing operation in transverse direction.

5.1.2 This item is not intended to cover towing winches on board ships used solely for long distance ocean towage, anchor handling or similar offshore activities.

5.2 Purpose

5.2.1 The purpose of this item is to provide requirements to prevent the capsize of a tug when in the act of towage as a result of the towline force acting transversely to the tug (in beam direction) as a consequence of an unexpected event (could be loss of propulsion/steering or otherwise), whereby the resulting couple generated by offset and opposing transverse forces (towline force is opposed by thrust or hull resistance force) causes the tug to heel and, ultimately, to capsize. This capsize may be referred to as “girting”, “girthing”, “girding” or “tripping”. See Figure 11.3 which shows the forces acting during towage operations.

5.3 Definitions

5.3.1 **‘Emergency release system’** refers to the mechanism and associated control arrangements that are used to release the load on the towline in a controlled manner under both normal and ~~dead-ship~~ black out conditions.

5.3.2 **‘Maximum design load’** is the maximum load that can be held by the winch as defined by the manufacturer (the manufacturer’s rating).

~~‘Girting’ means the capsize of a tug when in the act of towage as a result of the towline force acting transversely to the tug (in beam direction) as a consequence of an unexpected event (could be loss of propulsion/steering or otherwise), whereby the resulting couple generated by offset and opposing transverse forces (towline force is opposed by thrust or hull resistance force) causes the tug to heel and, ultimately, to capsize. This may also be referred to as ‘girthing, ‘girding’ or ‘tripping’. See Figure 11.3 which shows the forces acting during towage operations.~~

5.3.3 **‘Fleet angle’** is the angle between the applied load (towline force) and the towline as it is wound onto the winch drum, see Figure 11.4.

……..

5.3~~5~~.1.6 Emergency release of the towline is to be possible in the event of a blackout. For this purpose, where additional sources of energy are required, such sources are to comply with 5.5.1.7. ~~An alternative source of energy is to be provided such that normal operation of the emergency release system can be sustained under dead-ship conditions.~~

5.3~~5~~.1.7 The ~~alternative~~ source~~s~~ of energy required by 5.~~3~~5.1.6 ~~is~~ are to be sufficient to achieve the most onerous of the following conditions (as applicable):

……..

(b) Where the winch design is such that the drum release mechanism requires continuous application of power (e.g. where the brake is applied by spring tension and released using hydraulic or pneumatic power) sufficient power is to be provided to operate the emergency release system (e.g. hold the brake open and allow release of the towline) ~~in a dead-ship situation~~ in the event of a blackout for a minimum of five minutes. This may be reduced to the time required for the full length of the towline to feed off the winch drum at the load specified in 5.~~3~~5.1.5 if this is less than five minutes.

5.3~~5~~.2 Operational requirements

5.3~~5~~.2.1 Emergency release operation must be possible from the bridge and from the winch control station on deck. The winch control station on deck is to be in a safe location. A position in close proximity to the winch is not regarded as “safe location”, unless it is documented that the position is at least protected against towline break or winch failure.

5.3~~5~~.2.2 The emergency release control is to be located ~~in~~ close ~~proximity~~ to an ~~the~~ emergency stop button for winch operation, if provided, and shall ~~both~~ ~~should~~ be clearly identifiable, clearly visible, easily accessible and positioned to allow safe operability.

……..

~~**5.3.2.10** The method for annual survey of the winch is to be documented.~~

~~**5.3.2.11** Where necessary for conducting the annual survey of the winch, adequately sized strong points are to be provided on deck.~~

……..

5.4~~6~~.1.3 The performance capabilities, as well as instructions for ~~and~~ operati~~on~~ng, ~~instructions~~ of the emergency release system are to be documented by the manufacturer and made available on board the ship on which the winch has been installed.

5.6.1.4 Instructions for surveys of the emergency release system are to be documented by the manufacturer, agreed by the Society and made available on board the ship on which the winch has been installed.

5.6.1.5 Where necessary for conducting the annual and special surveys of the winch, adequately sized strong points are to be provided on deck.

03. Section 18 – Fire Protection and Fire Extinguishing Equipment

Revision Date: May 2021

Entry into Force Date: 1 July 2021

Item B.1.6 was revised in Section 18 of Chapter 4 according to REC 58 Rev.2 as below:

1.6 To ensure the application of current installation and construction standards and to safeguard the observance of precautions for preventing the occurrence of fires during assembly, inspection and maintenance

works, reference is made to the guidelines for measures to prevent fires in engine rooms and cargo pump rooms as set out in MSC.1/Circ.1321 and TL-G 58.

Revision Date: May 2021

Entry into Force Date: 1 July 2021

Item G.2.1.3 was revised according to UI SC128 DEL as below:

2.1.3 Cylinders intended for flooding boiler rooms, machinery spaces, as well as cargo pump and compressor rooms must be equipped with quick- opening valves for group release enabling these spaces to be flooded with 85 % of the required gas volume within two minutes. ~~These requirements may be checked by suitable calculations.~~

Revision Date: May 2021

Entry into Force Date: 1 July 2021

Item K.2.7 was revised according to UI SC61 Del as below:

2.7 Operation of a deck ~~the~~ foam system at its required output ~~capacity~~ shall permit the simultaneous use of the minimum required number of jets of water at the required pressure from the fire ~~extinguishing system as per~~ main (see item E). Where the deck foam system is supplied by a common line from the fire main, additional foam concentrate shall be provided for operation of two nozzles for the same period of time required for the foam system. The simultaneous use of the minimum required jets of water shall be possible on deck over the full length of the ship ~~on deck~~, in accommodation ~~spaces~~, control stations, service spaces and machinery spaces.

~~A common line for the fire main and deck foam line can only be accepted provided it can be demonstrated that the fire hose nozzles can be effectively controlled by one person when supplied form the common line at a pressure needed for operation of the monitors.~~

~~Additional foam concentrate shall be provided for operation of two of these nozzles for the same period of time required for the operation of the foam system.~~

Revision Date: May 2021

Entry into Force Date: 1 July 2021

Items P.1.4 and Q.1.4 were revised in Section 18 of Chapter 4 as below:

UI SC87 Rev.2 was added to item Q.1.4.2 as a new paragraph as below:

P. Carriage of Dangerous Goods in Packaged Form

1. General

……

1.4 Certification

~~On request the "Document of Compliance for the Carriage of Dangerous goods" according to **SOLAS**, Chapter II-2, Regulation 19.4 may be issued after successful survey. These vessels will be assigned the Notation **DG**.~~

The **DG** additional notation assigned to the ship will remain valid as long as the "Document of Compliance for the Carriage of Dangerous goods" issued by **TL** remains valid.

……..

Q. Carriage of Solid Bulk Cargoes

1. General

……..

1.4 Certification

~~On request the following Certificates may be issued after successful survey:~~

- ~~The "Document of Compliance for the Carriage of Dangerous Goods" is issued according to **SOLAS**, Chapter II-2, Regulation 19.4. These vessels will be assigned the Notation **DG**.~~

- ~~The "Document of Compliance for the Carriage of Solid Bulk Cargoes" is issued in accordance with the requirements of the IMSBC Code. These vessels will be assigned the Notation **DBC**.~~

1.4.1 The **DBC** additional notation assigned to the ship will remain valid as long as the "Document of Compliance for Carriage of Dangerous goods" and "Statement of Compliance for the Carriage of Solid Bulk Cargoes" issued by **TL** remains valid.

1.4.2 Certification for carriage of solid dangerous bulk cargoes covers only those cargoes listed in Group B in the IMSBC Code except cargoes classified solely as MHB. Other solid dangerous bulk cargoes may only be permitted subject to acceptance by the Administrations involved. (MSC/Circ. 1120)

Note:

For requirements and certification of dangerous goods in packaged form see P.

……..

04. Section 19 – Machinery for Ice Class Notation

Revision Date: March 2021

Entry into Force Date: 1 July 2021

Coefficients B1, B2 and B3 (for open and nozzle propellers) given in Table 19.13 in Section 19 of Chapter 4 - Machinery Rules were updated according to the new corrrected values in Finnish-Swedish ice class rules as below:

Table 19.13 Values of coefficient B_1, B_2 and B_3

	Open propeller	Ducted propeller
B_1	0,00328 ~~0,00246~~	0,00223 ~~0,00167~~
B_2	1,0076 ~~0,947~~	1,0071 ~~0,956~~
B_3	2,101	2,471 ~~2,470~~

05. Section 20 – Tankers

Revision Date: February 2021

Entry into Force Date: 1 July 2021

Item C.8.1 in Section 20 of Chapter 4 was revised according to UR F7 Rev.3 & Corr.1 as below:

8. Gas Measurement and Detection

8.1 Portable instrument

Every oil tanker is to be provided with at least two portable gas detectors capable of measuring flammable vapour concentrations in air (%LEL) and at least two portable O2 analysers. Alternatively, at least two gas detectors, each capable of measuring both oxygen and flammable vapour concentrations in air (%LEL), are to be provided.

In addition, for tankers fitted with inert gas systems, at least two portable gas detectors are to be capable of measuring concentrations of flammable vapours in inerted atmosphere (% gas by volume).

~~At least one portable instrument for measuring oxygen and one for measuring flammable vapour concentrations, together with sufficient spares, is to be provided on board. Means for calibration of such instrument shall be provided.~~

~~The requirement which mention above for one portable instrument for measuring oxygen and one for measuring flammable vapour concentrations, and spares for both, is considered as being satisfied when a minimum of two instruments, each capable of measuring both oxygen and flammable vapour concentrations are provided onboard. Alternatively two portable instruments for measuring oxygen and two portable instruments for measuring flammable vapour concentrations could be provided onboard.~~

PART B – CHAPTER 5 – ELECTRICAL INSTALLATION

01. Section 4 - Installation Protection and Power Distribution

Revision Date: May 2021

Entry into Force Date: 1 July 2021

Items I.9.1.5 to 9.1.9 were added according to Rec. 52 Rev.2 as below:

9.1.5 Each consumer should be individually connected to the distribution panel bus bar and individually provided with short circuit protection.

9.1.6 An indicator should be mounted in a suitable place to indicate when batteries of the reserve source of energy are being discharged visible for responsible member of the crew.

9.1.7 For examples of power supply for equipment operated by AC, see TL-G 52.

9.1.8 Power supply for equipment operated by DC (See TL-G 52 for examples)

9.1.8.1 Where the equipment is fed via converters, separate converters should be provided and these should be located on the supply side of changeover facility.

9.1.8.2 The radio equipment and the navigation equipment should be provided with separate converters.

9.1.9 Power supply for equipment operated by either AC or DC (See TL-G 52 for examples)

9.1.9.1 Each consumer should be individually connected to the main source of electrical power and to a distribution bus bar of the panel which is fed from the emergency source of electrical power and also, in case of the radio equipment, from the reserve source of energy (radio batteries). These two circuits should be separated throughout their length as far as practicable.

9.1.9.2 The radio equipment and the navigation equipment should be provided with separate converters.

02. Section 10 – Computer Systems

Revision Date: May 2021

Entry into Force Date: 1 July 2021

Items A.2 and A.5 were revised according to Rec. 48 Rev.1 as below:

……

Note: For loading instrument/stability computer, ~~Rec No.~~ TL-G 48 may be considered.

……

- ISO 9001:~~2008~~ Quality Management Systems - Requirements

- ISO/IEC 90003: Software engineering - Guidelines for the application of ISO 9001~~:2008~~ to computer software

PART C – CHAPTER 8 – CHEMICAL TANKERS

01. Section 2 – Ship Survival Capability and Location of Cargo Tanks

Revision Date: May 2021

Entry into Force Date: 1 July 2021

Footnote (1) was revised according to Rec. 110 Rev.2 as below:

(1) *Refer to part B, chapter 4, of the International Code on Intact Stability, 2008 (2008 IS Code), as amended; the Guidelines for the Approval of Stability Instruments (MSC.1/Circ.1229), annex, section 4, as amended; and the technical standards defined in part 1 of the Guidelines for verification of damage stability requirements for tankers (MSC.1/Circ.1461) (See also TL-G 110).*

PART C – CHAPTER 9 Construction and Classification of Yachts

01. Section 9 – Electric Installations

Revision Date: May 2021

Entry into Force Date: 1 July 2021

Item A.1.2.1 was revised according to withdrawn standard ISO 10133:2012 by ISO 13297:2020 as below:

A. Documents to be Submitted and Applicable International Standards

1.1 Plans and documents

……

1.2 Applicable international standards

1.2.1 Yachts with length L_H not exceeding 24 m.

For yachts with length L_H not exceeding 24 m according to ISO 8666, the following standards apply:

- for direct current system installations which operate at a rated voltage not exceeding 50 V: ~~ISO 10133~~ ISO 13297;

02. Section 10 – Fire Protection

Revision Date: May 2021

Entry into Force Date: 1 July 2021

Items A.2.1, A.3, A.3.4, A.5.2.3.1, A.7, B.1.2, B.3.2 were revised according to withdrawn standard ISO 9094-1/-2 by ISO 9094 as below:

2.1 The requirements of this item apply to yachts with length (L_H) more than 24 metres according to ISO 8666. For yachts not more than 24 metres, the requirements of EN ISO Standard 9094~~-2~~ and the specific provisions for these yachts given in this Section are to be applied.

……

3. Protection of Spaces Containing Vehicles or Craft with Fuel in Their Tanks

General

The requirements contained in the following items apply to yachts having a length LH more than 24 m. According to ISO 8666. For yachts having a length LH not more than 24 m. The following requirements apply: ISO 11105 relevant to ventilation, ISO 8846 relevant to electrical equipment and ISO 9094~~-2~~ relevant to fire protection.

……

3.4 For yachts having a length L_H not more than 24 m, according to ISO8666, the following requirements apply: ISO 11105 relevant to ventilation, ISO 8846 relevant to electrical equipment and ISO 9094~~-2~~ relevant to fire protection.

……

5.2.3.1 Open Flame Gas Appliances

According to ISO 9094~~-1/-2~~ [4.3.2.2], for cooking units using fuel which is liquid at atmospheric pressure (see ISO 14895), open-flame burners are to be fitted with a readily accessible drip-pan.

……

7. Means of Escape

The requirements contained in this item are applcable to yachts of 24 m in length L_H and over according to ISO8666. For yachts of less than 24 m in length L_H according to ISO 8666, the requirements of ISO 9094~~-2~~ apply.

……

B. Fire Extinguishing Systems

1. General

……

1.2 The capacity and quantity of the medium are to be in compliance with Table 10.2.

For yachts having a length L_H not more than 24 m. according to ISO 8666, the requirements of ISO 9094-~~2~~ apply, as well as the relevant provisions of this Section.

……

3.2 The system is to be in compliance with Section 10, Appendix 2. For yachts not more than 24 m.in length L_H according to ISO 8666, the system may be in compliance with the requirements of EN ISO 9094-~~2~~.

PART C – CHAPTER 10 – LIQUEFIED GAS CARRIERS

01. Section 2 – Ship Survival Capability and Location of Cargo Tanks

Revision Date: May 2021

Entry into Force Date: 1 July 2021

Footnote (2) was revised according to Rec. 110 Rev.2 as below:

(2) *Refer to part B, Section 4, of the International Code on Intact Stability, 2008 (2008 IS Code), as amended; the Guidelines for the Approval of Stability Instruments (MSC.1/Circ.1229), annex, section 4, as amended; and the technical standards defined in part 1 of the Guidelines for verification of damage stability requirements for tankers (MSC.1/Circ.1461) (See also TL-G 110).*

02. Section 5 – Process Pressure Vessels and Liquid, Vapour and Pressure Piping Systems

Revision Date: March 2021

Entry into Force Date: 1 July 2021

Notes was added to items 5.4.4 and 5.13.2.4 according to UI GC32 New as below:

5.4.4 The design pressure of the outer pipe or duct of gas fuel systems shall not be less than the maximum working pressure of the inner gas pipe. Alternatively, for gas fuel piping systems with a working pressure greater than 1 MPa, the design pressure of the outer duct shall not be less than the maximum built-up pressure arising in the annular space considering the local instantaneous peak pressure in way of any rupture and the ventilation arrangements.

Note: *The expression "design pressure of the outer pipe or duct" in 5.4.4 is either of the following:*
.1 the maximum pressure that can act on the outer pipe or equipment enclosure after the inner pipe rupture as documented by suitable calculations taking into account the venting arrangements; or

.2 for gas fuel systems with inner pipe working pressure greater than 1 MPa, the "maximum built-up pressure arising in the annular space", after the inner pipe rupture, which is to be calculated in accordance with paragraph 9.8.2 of the IGF Code as adopted by MSC.391(95).

5.13.2.4 In double wall gas-fuel piping systems, the outer pipe or duct shall also be pressure tested to show that it can withstand the expected maximum pressure at gas pipe rupture.

Note: *The expression "maximum pressure at gas pipe rupture" in 5.13.2.4 is the maximum pressure to which the outer pipe or duct is subjected after the inner pipe rupture and for testing purposes it is the same as the design pressure used in 5.4.4.*

Revision Date: March 2021

Entry into Force Date: 1 July 2021

Note was added to item 5.6.5.1 according to UI GC33 New as below:

5.6.5 Cargo sampling connections

5.6.5.1 Connections to cargo piping systems for taking cargo liquid samples shall be clearly marked and shall be designed to minimize the release of cargo vapours. For vessels permitted to carry toxic products, the sampling system shall be of a closed loop design to ensure that cargo liquid and vapour are not vented to atmosphere.

Note: *Requirement 5.6.5.1 is only applicable if such a sampling system is fitted on board. Connections used for control of atmosphere in cargo tanks during inerting or gassing up are not considered as cargo sampling connections.*

Revision Date: March 2021

Entry into Force Date: 1 July 2021

Note was added to item 5.6.6 according to UI GC34 New as below:

5.6.6 Cargo filters

The cargo liquid and vapour systems shall be capable of being fitted with filters to protect against damage by extraneous objects. Such filters may be permanent or temporary, and the standards of filtration shall be appropriate to the risk of debris, etc., entering the cargo system. Means shall be provided to indicate that filters are becoming blocked, and to isolate, depressurize and clean the filters safely.

Note: *Means to indicate that filters are becoming blocked and filter maintenance is required is to be provided for fixed in-line filter arrangement and portable filter installations where dedicated filter housing piping is provided.*
Where portable filters for fitting to manifold presentation flanges are used without dedicated filter housing, and these can be visually inspected after each loading and discharging operation, no additional arrangements for indicating blockage or facilitating drainage are required.

03. Section 13 – Instrumentation and Automation Systems

Revision Date: March 2021

Entry into Force Date: 1 July 2021

Note was added to item 13.6.4 according to UI GC36 New as below:

13.6.4 Where indicated in column "f" in the table of Section 19 ships certified for carriage of non-flammable products, oxygen deficiency monitoring shall be fitted in cargo machinery spaces and cargo tank hold spaces.

Furthermore, oxygen deficiency monitoring equipment shall be installed in enclosed or semi-enclosed spaces containing equipment that may cause an oxygen-deficient environment such as nitrogen generators, inert gas generators or nitrogen cycle refrigerant systems.

Note: *Two oxygen sensors are to be positioned at appropriate locations in the space or spaces containing the inert gas system, in accordance with paragraph 15.2.2.4.5.4 of the FSS Code, for all gas carriers, irrespective of the carriage of cargo indicated by an "A" in column "f" in the table in chapter 19 of the Code.*

04. Section 16 – Use of Cargo As Fuel

Revision Date: May 2021

Entry into Force Date: 1 July 2021

Note was added to item 16.7.1.4 according to UI GC37 New as below:

16.7.1~~2~~.4 Unless designed with the strength to withstand the worst case overpressure due to ignited gas leaks, air inlet manifolds, scavenge spaces, exhaust system and crank cases shall be fitted with suitable pressure relief systems. Pressure relief systems shall lead to a safe location, away from personnel.

Note: A suitable pressure relief system for air inlet manifolds, scavenge spaces and exhaust system is to be provided unless designed to accommodate the worst-case overpressure due to ignited gas leaks or justified by the safety concept of the engine. A detailed evaluation regarding the hazard potential of overpressure in air inlet manifolds, scavenge spaces and exhaust system is to be carried out and reflected in the safety concept of the engine.

In the case of crankcases, the explosion relief valves, as required by Regulation 27.4 of SOLAS Chapter II-1 as amended by IMO resolutions up to MSC.436(99), are to be considered suitable for the gas operation of the engine. For engines not covered by said Regulation, a detailed evaluation regarding the hazard potential of fuel gas accumulation in the crankcase is to be carried out.

05. Section 18 – Operating Requirements

Revision Date: March 2021

Entry into Force Date: 1 July 2021

Note was added to item 18.9 according to UI GC33 New as below:

18.9 Cargo sampling

18.9.1 Any cargo sampling shall be conducted under the supervision of an officer who shall ensure that protective clothing appropriate to the hazards of the cargo is used by everyone involved in the operation.

18.9.2 When taking liquid cargo samples, the officer shall ensure that the sampling equipment is suitable for the temperatures and pressures involved, including cargo pump discharge pressure, if relevant.

18.9.3 The officer shall ensure that any cargo sample equipment used is connected properly to avoid any cargo leakage.

18.9.4 If the cargo to be sampled is a toxic product, the officer shall ensure that a "closed loop" sampling system as defined in 1.2.15 is used to minimize any cargo release to atmosphere.

18.9.5 After sampling operations are completed, the officer shall ensure that any sample valves used are closed properly and the connections used are correctly blanked.

Note: *Requirements 18.9.1 and 18.9.5 are only applicable if such a sampling system is fitted on board. Connections used for control of atmosphere in cargo tanks during inerting or gassing up are not considered as cargo sampling connections.*

Revision Date: March 2021

Entry into Force Date: 1 July 2021

Note was added to note 4 of table 18.1 according to UI GC35 New as below:

Note 4: The override system permitted by 13.3.7 may be used at sea to prevent false alarms or shutdowns. When level alarms are overridden, operation of cargo pumps and the opening of manifold ESD valves shall be inhibited except when high-level alarm testing is carried out in accordance with 13.3.5 (see 18.10.3.4)

Note: *In applying the second sentence of note 4 of table 18.1, a hardware system such as an electric or mechanical interlocking device is to be provided to prevent inadvertent operation of cargo pumps and inadvertent opening of manifold ESD valves.*

PART C – CHAPTER 11 – FIRE FIGHTING SHIPS

01. Section 01 – Equipment on Fire Fighting Ships

Revision Date: May 2021

Entry into Force Date: 1 July 2021

Number of pumps mentioned in Table 1.5 was revised as below:

Table 1.5 Required equipment for the different Notations

Equipment parameters	Notations affixed to the Character of Classification					
	FF1	FF2			FF3	
Water monitors:	2	2	3	4	3	4
Output [m³/h] per monitor	1200	3600	2400	1800	3200	2400
Length of throw [m] **(1)**	120	150			150	
Height of throw [m] **(2)**	45	70			70	
Pumps: (7)	1-2	2 - 4			2 -4	
Total pump capacity [m3/h]	2400	7200			9600	
Foam monitors:	–	–			2	
Duration of supply of foam concentrate for foam monitors [min]	–	–			30 **(3)**	
Foam capacity per monitor [litre/min]	–	–			5000	

PART C – CHAPTER 19 – INLAND WATERWAY VESSELS

01. Section 12 – Machinery and Systems

Revision Date: May 2021

Entry into Force Date: 1 July 2021

Item B.3.6.2 in Section 12 in Chapter 19 was revised according to item C.6.2.4 in Section 5 in Chapter 4 as below:

3.6.2 Stern tube bearings

Inside the stern tube, the propeller shaft should normally be supported by two bearings. In short stern tubes, the forward bearing may be dispensed with.

Where the propeller in the stern tube runs in bearings made of rubber or plastic, the length of the after bearing should equal approximately 3 - 4 times the shaft diameter, while the length of the forward bearing should be approximately 1 - 1.5 times the shaft diameter. Where the propeller shaft inside the stern tube runs in oil-lubricated white metal bearings, the lengths of the after and forward stern tube bearings should be approximately 2 and 0.8 times the shaft diameter respectively~~. Where the propeller shaft runs in greaselubricated, grey cast iron bushes the lengths of the after and forward stern tube bearings should be approximately 2.5 and 1 times the shaft diameter respectively.~~ The length of a grease lubricated bearing is to be not less than 4.0 times the rule diameter of the shaft in way of the bearing.

~~The peripheral speed of the propeller shafts in greaselubricated, grey cast iron bearings should not exceed 2,5 - 3 m/s, while that of propeller shafts in water-lubricated rubber bearings should not exceed 6 m/s.~~

Where the propeller shafts are intended to run in antifriction bearings within the stern tube, such bearings should be preferably cylindrical roller bearings with cambered rollers or bearing races and with an increased bearing clearance. The camber shall be sufficient to tolerate without adverse effects an angular deviation of 0,1 % between the shaft and the bearing axis. Self-aligning roller bearings may be used to carry the propeller shaft only if provision is made for the axial adjustment of such bearings.

For further information:
Bekir Sıtkı TÜRKMEN
Division Manager, Rule Development and Statutory Legislation
Tel: +90- 216 581 37 83
Fax: +90- 216 581 38 40
E-mail: tl_kural@turkloydu.org
Web: www.turkloydu.org

Form No: PL 084-01/12.02.2016