РОССИЙСКИЙ МОРСКОЙ РЕГИСТР СУДОХОДСТВА
RUSSIAN MARITIME REGISTER OF SHIPPING

ПРИЛОЖЕНИЕ К ПРАВИЛАМ И РУКОВОДСТВАМ
РОССИЙСКОГО МОРСКОГО РЕГИСТРА СУДОХОДСТВА

ПРОЦЕДУРНЫЕ ТРЕБОВАНИЯ, УНИФИЦИРОВАННЫЕ ИНТЕРПРЕТАЦИИ И РЕКОМЕНДАЦИИ МЕЖДУНАРОДНОЙ АССОЦИАЦИИ КЛАССИФИКАЦИОННЫХ ОБЩЕСТВ

SUPPLEMENT TO RULES AND GUIDELINES
OF RUSSIAN MARITIME REGISTER OF SHIPPING

IACS PROCEDURAL REQUIREMENTS, UNIFIED INTERPRETATIONS AND RECOMMENDATIONS

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СОДЕРЖАНИЕ
CONTENTS

Процедурные требования МАКО
IACS Procedural Requirements

Номер документа Document number	Название документа Document name	Примечание Note
1. PR No. 38 (Rev.2 Mar 2019)	Procedure for calculation and verification of the Energy Efficiency Design Index (EEDI)	Document is applied from 1 July 2019

Применение: Руководство по применению положений международной конвенции МАРПОЛ 73/78, часть VI, пункт 2.6.20.
Application: Guidelines on the Application of Provisions of the International Convention MARPOL 73/78, Part VI, para 2.6.20.

Унифицированные интерпретации МАКО
IACS Unified Interpretations

Номер документа Document number	Название документа Document name	Примечание Note
1. SC 191 (Rev.8 Apr 2019)	IACS Unified Interpretations (UI) SC 191 for the application of amended SOLAS regulation II-1/3-6 (resolution MSC.151(78)) and revised Technical provisions for means of access for Inspections (resolution MSC.158(78))	Document is applied for ships contracted for construction from July 2019

Применение: Правила классификации и постройки морских судов (2017), часть III, пункт 7.14.2.
Application: Rules for the Classification and Construction of Sea-Going Ships (2017), Part III, para 7.14.2.

2. SC 226 (Rev.1 Dec 2012)	IACS Unified Interpretations (UI) on the application of SOLAS regulations to conversions of Single-Hull Oil Tankers to Double-Hull Oil Tankers or Bulk Carriers	Document is applied from 1 January 2014

Применение: Правила классификации и постройки морских судов (2017), часть I, пункт 3.1.3.
Application: Rules for the Classification and Construction of Sea-Going Ships (2017), Part I, para 3.1.3.

3. SC 244 (Rev.1 Nov 2012) (Corr.1 Nov 2015)	Load testing of hooks for primary release of lifeboats and rescue boats	Document is applied from 1 January 2014

Применение: Правила по оборудованию морских судов (2017), часть II, пункт 1.3.2.1.
Application: Rules for the Equipment of Sea-Going Ships (2017), Part II, para 1.3.2.1.

4. SC 249 (Rev.1 Feb 2013)	Implementation of SOLAS II-1, Regulation 3-5 and MSC.1/Circ.1379	Document is applied from 1 July 2013

Применение: Правила технического наблюдения за постройкой судов и изготовлением материалов и изделий для судов, часть V, пункт 19.1.7.
Application: Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships, Part V, para 19.1.7.

5. MPC2 (Rev. 1 Aug 2015)	Operational manuals for oil discharge monitoring and control systems	Document is applied from 1 July 2016

Применение: Правила технического наблюдения за постройкой судов и изготовлением материалов и изделий для судов, часть V, пункт 19.7.2.1.
Application: Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships, Part V, para 19.7.2.1.

6. MPC6 (Rev. 1 Aug 2015) Calculation of aggregate capacity of SBT — Document is applied from 1 July 2016

Применение: Руководство по применению положений международной конвенции МАРПОЛ 73/78, часть II, пункт 3.5.1.1.

Application: Guidelines on the Application of Provisions of the International Convention MARPOL 73/78, part VI, para 3.5.1.1.

7. MODU 1 (Rev.1 Oct 2015) IACS Unified Interpretations for the application of MODU Code Chapter 2 paragraphs 2.1, 2.2, 2.3, 2.4 and revised technical provisions for means of access for inspections (resolution MSC.158(78)) — Document is applied from 1 January 2017

Применение: Правила классификации, постройки и оборудования плавучих буровых установок и морских стационарных платформ (2014), часть III, пункт 9.3.1.1.

Application: Rules for the Classification, Construction and Equipment of Mobile Offshore Drilling Units and Fixed Offshore Platforms (2014), Part III, para 9.3.1.1.

Рекомендации МАКО
IACS Recommendations

Номер документа Document number	Название документа Document name

1. Rec. No. 10 (Rev.3 October 2016, Corr. 1 Dec. 2016) Anchoring, Mooring and Towing Equipment

Применение: Правила классификации и постройки морских судов (2018), часть III «Устройства, оборудование и снабжение» (пункт 4.2.3)

Application: Rules for the Classification and Construction of Sea-Going Ships (2018), Part III «Equipment, Arrangements and Outfit» (para 4.2.3)

2. Rec. No. 47 (Rev.8 October 2017) Shipbuilding and Repair Quality Standard

Применение: Правила классификационных освидетельствований судов в эксплуатации (2018), часть I (пункт 5.13), приложение 2 (пункт 5.1.12), приложение 3 (пункт 7).
Правила технического наблюдения за постройкой судов и изготовлением материалов и изделий для судов, часть I, приложение 3 (пункт 7.4)

Application: Rules for the Classification Surveys of Ships in Service (2018), Part I (para 5.13), Appendix 2 (para 5.1.12), Appendix 3 (para 7).
Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships, Part I, Appendix 3 (para 7.4)

3. Rec. No. 55 (Rev.1 June 2016) General Cargo Ships – Guidance for Surveys, Assessment and Repair of Hull Structure

Применение: Правила классификационных освидетельствований судов в эксплуатации (2017), часть I (пункт 5.13), приложение 2 (пункт 5.1.12), приложение 3 (пункт 6).
Методические рекомендации по техническому наблюдению за ремонтом морских судов с Приложениями (2016), Приложение 1.

Application: Rules for the Classification Surveys of Ships in Service (2017), Part I (para 5.13), Appendix 2 (para 5.1.12), Appendix 3 (para 6).

4. Rec. No. 76 (Corr.1 Sept 2007) IACS Guidelines for Surveys, Assessment and Repair of Hull Structure – Bulk Carriers

Применение: Правила классификационных освидетельствований судов в эксплуатации (2017), часть I (пункт 5.13), приложение 2 (пункт 5.1.12), приложение 3 (пункт 2).
Методические рекомендации по техническому наблюдению за ремонтом морских судов с Приложениями (2016), Приложение 1.

Application: Rules for the Classification Surveys of Ships in Service (2017), Part I (para 5.13), Appendix 2 (para 5.1.12), Appendix 3 (para 2).

5. Rec. No. 96 (April 2007, Rev.1 May 2019) Double Hull Oil Tankers – Guidelines for Surveys, Assessment and Repair of Hull Structures

Применение: Правила классификационных освидетельствований судов в эксплуатации (2019), приложение 3 (пункт 10).
Application: Rules for the Classification Surveys of Ships in Service (2019), Appendix 3 (para 10).

6. Rec. No. 132 (Dec 2013) Human Element Recommendations for structural design of lighting, ventilation, vibration, noise, access & egress arrangements

Применение: Руководство по освидетельствованию условий труда и отдыха моряков на соответствие требованиям Конвенции 2006 года о труде в морском судоходстве (2016), пункты 2.1.22, 4.7.3.
Руководство по освидетельствованию жилых помещений экипажа (2015), пункты 2.1.16, 4.1.2.8.
Application: Guidelines on On-board Maritime Labour Convention, 2006 (MLC) Inspection (2016), paras 2.1.22, 4.7.3.
Guidelines on On-board Inspection for Crew Accomodation (2015), paras 2.1.16, 4.1.2.8.

7. Rec. No. 142 (June 2016) LNG Bunkering Guidelines

Применение: Правила классификации и постройки морских судов (2017), часть XVII, пункт 11.2.2.
Application: Rules for the Classification and Construction of Sea-Going Ships (2017), Part XVII, para 11.2.2.

8. Rec. No. 146 (Aug 2016) Risk assessment as required by the IGF Code

Применение: Правила классификации и постройки морских судов (2017), часть XVII, пункт 9.1.4.19.
Application: Rules for the Classification and Construction of Sea-Going Ships (2017), Part XVII, para 9.1.4.19.

9. Rec. No.149 (May 2017) Guidance for applying the requirements of 15.4.1.2 and 5.4.1.3 of the IGC Code (on ships constructed on or after 1 July 2016)

Применение: Правила классификации и постройки судов для перевозки сжиженных газов наливом (2019), часть VI, пункт 3.20.2.
Application: Rules for the Classification and Construction of Ships Carrying Liquefied Gases in Bulk (2019), Part VI, para 3.20.2.

10. Rec. No. 150 (May 2017) Vapour pockets not in communication with cargo tank vapour/liquid domes on liquefied gas carriers

Применение: Правила классификации и постройки судов для перевозки сжиженных газов наливом (2019), часть VI, пункт 3.16.11.
Application: Rules for the Classification and Construction of Ships Carrying Liquefied Gases in Bulk (2019), Part VI, para 3.16.11.

11. Rec. No. 151 (July 2017) Recommendation for petroleum fuel treatment systems for marine diesel engines

Применение: Правила классификации и постройки морских судов (2019), часть VIII, пункт 13.8.1.
Application: Rules for the Classification and Construction of Sea-Going Ships (2019), Part VIII, para 13.8.1.

РЕКОМЕНДАЦИИ МАКО

IACS RECOMMENDATIONS

No. 10 Anchoring, Mooring and Towing Equipment

(1982) (Rev.1 Aug 1999) (Corr. Dec 2004) Rev.2 Jun 2005) (Rev.3 Oct 2016) (Corr.1 Dec 2016)

1. Anchoring equipment

1.1 Anchoring equipment for ships having Equipment Number EN below 205 to 50.

(a) The anchoring equipment given here under applies to ships which are not covered under UR A1, i.e. for ships having $50 \leq EN < 205$.

(b) The design basis of the anchoring equipment, i.e. the Equipment Number EN, is that given in UR A1.

(c) These recommendations are applicable to ships operating in unrestricted service. Reductions of equipment may be considered for ships operating in restricted service.

Note:

References to UR A1 are preceded by 'A1' throughout this document.

1.1.1 Equipment number EN

The equipment of anchors and chain cables should be as given in Table 1 based on an Equipment Number EN calculated in compliance with A1.2.

No. 10 (cont)

Table 1 Anchoring equipment

	Stockless bower anchors		Stockless stream anchor	Stud link chain cable for bower anchors			Stream wire or chain	
					Min. diameter			
EN	No.	Mass per anchor (kg)	Mass per anchor (kg)	Total length (m)	Mild steel Gr. 1 (mm)	Special quality Gr. 2 or 3 (mm)	Length (m)	Breaking strength (kN)
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
50-70	2	180	60	220	14	12.5	80	64.7
70-90	2	240	80	220	16	14	85	73.5
90-110	2	300	100	247.5	17.5	16	85	80.0
110-130	2	360	120	247.5	19	17.5	90	89.2
130-150	2	420	140	275	20.5	17.5	90	98.1
150-175	2	480	165	275	22	19	90	107.9
175-205	2	570	190	302.5	24	20.5	90	117.7

1.1.2 Anchors

1.1.2.1 Types of anchors

1.1.2.1.1 Ordinary anchors

(a) The requirements under A1.4.1.1 should be complied with.

(b) The mass of stocked anchors, when used, and that of stream anchors, excluding the stock should be 80% and the mass of the stock should be 20% of the mass as given in Table 1 for stockless bower anchors.

1.1.2.1.2 High Holding Power (HHP) anchors

The requirements under A1.4.1.2 and A1.4.2 should be complied with.

1.1.2.1.3 Super High Holding Power (SHHP) anchors

The requirements under A1.4.1.3 and A1.4.2 should be complied with.

No. 10 (cont)

1.1.2.2 Installation of the anchors on board

The bower anchors should be connected to their chain cables and ready for use. The stream anchor should be ready to be connected with its cable.

1.1.2.3 Proof testing of anchors

The requirements under A1.4.4 should be complied with.

1.1.3 Chain cables and wire ropes for anchors

1.1.3.1 Chain cables

(a) The anchors should be associated with stud link chain cables of one of the grades under A1.5.2, Table 3. For equipment numbers EN up to 90, as an alternative to stud link chain cables, short link chain cables may be used.

(b) Wire ropes for anchors may be adopted in compliance with 1.1.3.3

1.1.3.2 Proof and breaking loads of stud link chain cables

(a) The breaking loads (BL) and proof loads (PL) should be in compliance with the requirements under A1.5.3.

(b) The test load values, rounded off from the loads defined in (a) above, which should be used for testing and acceptance of chain cables with diameter between 11 and 19 mm are given in Table 2.

Table 2 Test load values for stud link chain cables

Chain cable diameter	Grade 1		Grade 2		Grade 3	
	Proof load	Breaking load	Proof load	Breaking load	Proof load	Breaking load
(mm)	(kN)	(kN)	(kN)	(kN)	(kN)	(kN)
1	*2*	*3*	*4*	*5*	*6*	*7*
11	35.8	51	51	71.7	71.7	102
12.5	46	65.7	65.7	92	92	132
14	57.9	82	82	116	116	165
16	75.5	107	107	150	150	216
17.5	89	127	127	179	179	256
19	105	150	150	211	211	301

1.1.3.3 Wire ropes for anchors

In alternative to the stud link or short link chain cables under 1.1.3.1, wire ropes may be used for:

(a) bower anchors of ships below 40 m in length

(b) stream anchor as stipulated in Table 1.

No. 10 (cont)

The wire ropes under (a) above should have:

(i) length equal to 1.5 times the corresponding tabular length of chain cable (col. 5 of Table 1)

(ii) strength equal to that of tabular chain cable of Grade 1 (col. 2 and 3 of Table 2).

A short length of chain cable should be fitted between the wire rope and bower or stream anchor having a length of 12.5 m or the distance between anchor in stowed position and winch, whichever is less. All surfaces being in contact with the wire need to be rounded with a radius of not less than 10 times the wire rope diameter (including stem).

Table 3 Mass of stud link chain cables

Chain cable diameter (mm)	Minimum mass per length of 27.5 m With Dee shackle (Kg)	Minimum mass per length of 27.5 m With lugless shackle (Kg)	Chain cable diameter (mm)	Minimum mass per length of 27.5 m With Dee shackle (Kg)	Minimum mass per length of 27.5 m With lugless shackle (Kg)
26	410	405	78	3640	3535
28	480	475	81	3940	3820
30	550	545	84	4240	4105
32	620	615	87	4555	4405
34	700	690	90	4870	4705
36	785	775	92	5085	4905
38	875	860	95	5405	5210
40	965	950	97	5630	5425
42	1055	1040	100	5970	5745
44	1150	1130	102	6210	5970
46	1260	1240	105	6580	6320
48	1370	1345	107	6845	6575
50	1485	1455	111	7380	7080
52	1605	1575	114	7795	7475
54	1725	1690	117	8220	7870
56	1850	1810	120	8650	8270
58	1985	1945	122	8960	8550
60	2125	2075	124	9275	8835
62	2275	2220	127	9740	9270
64	2430	2370	130	10210	9710
66	2590	2525	132	10540	10005
68	2755	2685	137	11320	10750
70	2925	2850	142	12110	11500
73	3185	3100	147	12950	12300
76	3460	3360	152	13890	13200

1.2 Anchoring equipment for ships in deep and unsheltered water

1.2.1 Scope and application

The hereunder given recommendations address anchoring equipment for ships in deep and unsheltered water which is not covered by UR A1 and 1.1. These recommendations may be used to design or assess the adequacy of the anchoring equipment for ships intended to anchor in water with depth up to 120 m, current with up to 1.54 m/s, wind with up to 14 m/s

No. 10 (cont)

and waves with significant height of up to 3 m. The scope of chain cable, being the ratio between the length of chain paid out and water depth, is assumed to be not less than 3 to 4. Furthermore, these recommendations are applicable to ships with an equipment length, as defined in A1.2, of not less than 135 m.

1.2.2 Equipment Number for deep and unsheltered water

Anchors and chain cables should be in accordance with Table 4 and based on the Equipment Number EN_1 obtained from the following equation:

$$EN_1 = 0.628\left[a\left(\frac{EN}{0.628}\right)^{1/2.3} + b(1-a)\right]^{2.3}$$

where

$a = 1.83 \cdot 10^{-9} \cdot L^3 + 2.09 \cdot 10^{-6} \cdot L^2 - 6.21 \cdot 10^{-4} \cdot L + 0.0866$

$b = 0.156 \cdot L + 8.372$

L = Equipment length of the ship in compliance with A1.2

EN = Equipment Number calculated in compliance with A1.2.

No. 10 (cont)

Table 4 Anchoring equipment for ships in unsheltered water with depth up to 120 m

Equipment Number EN_1		High holding power stockless bower anchors		Stud link chain cable for bower anchors		
					Min. diameter	
Exceeding	Not exceeding	Number	Mass per anchor	Length	Special quality (Grade 2)	Extra special quality (Grade 3)
			(kg)	(m)	(mm)	(mm)
	1790	2	14150	1017.5	105	84
1790	1930	2	14400	990	105	84
1930	2080	2	14800	990	105	84
2080	2230	2	15200	990	105	84
2230	2380	2	15600	990	105	84
2380	2530	2	16000	990	105	84
2530	2700	2	15900	990	105	84
2700	2870	2	15800	990	105	84
2870	3040	2	15700	990	105	84
3040	3210	2	15600	990	105	84
3210	3400	2	15500	990	105	84
3400	3600	2	15400	990	105	84
3600	3800	2	16600	990	107	87
3800	4000	2	17800	962.5	107	87
4000	4200	2	18900	962.5	111	90
4200	4400	2	20100	962.5	114	92
4400	4600	2	22000	962.5	117	95
4600	4800	2	22400	962.5	120	97
4800	5000	2	23500	962.5	124	99
5000	5200	2	24000	935	127	102
5200	5500	2	24500	907.5	132	107
5500	5800	2	25000	907.5	132	107
5800	6100	2	25500	880	137	111
6100	6500	2	25500	880	142	114
6500	6900	2	26000	852.5	142	117
6900	7400	2	26500	852.5	147	117
7400	7900	2	27000	825	152	122
7900	8400	2	27000	825	-	127
8400	8900	2	27000	797.5	-	127
8900	9400	2	27000	770	-	132
9400	10000	2	27000	770	-	137
10000	10700	2	27000	770	-	142
10700	11500	2	27000	770	-	142
11500	12400	2	29500	770	-	147
12400	13400	2	31500	770	-	152
13400	14600	2	34500	770	-	157
14600		2	38000	770	-	162

1.2.3 Anchors

The bower anchors should be connected to their chain cables and positioned on board ready for use.

Anchors should be of the stockless High Holding Power (HHP) type. The mass of the head of a stockless anchor, including pins and fittings, should not be less than 60% of the total mass of the anchor. For the conditions of HHP anchors reference is made to A1.4.1.2 (a) and for the approval and/or acceptance of HHP anchors reference is made to A1.4.1.2 (c).

No. 10 (cont)

The mass, per anchor, of bower anchors given in Table 4 is for anchors of equal mass. The mass of individual anchors may vary to 7% of the tabular mass, but the total mass of anchors should not be less than that recommended for anchors of equal mass.

Suitable arrangements should be provided for securing the anchors when stowed, see 1.3.3.

For manufacture of anchors reference is made to UR W29. For proof testing of the anchors reference is made to A1.4.4.2.

1.2.4 Chain cables for bower anchors

Bower anchors should be associated with stud link chain cables of special (Grade 2) or extra special (Grade 3) quality. The total length of chain cable, as given in Table 4 should be reasonably divided between the two bower anchors. For the proof and breaking loads of stud link chain cables reference is made to A1.5.3, Table 4.

For manufacture of anchor chain cables reference is made to UR W18.

For the installation of the chain cables on board, 1.3 should be observed.

1.2.5 Anchor windlass and chain stopper

The windlass unit prime mover should be able to supply for at least 30 minutes a continuous duty pull Z_{cont}, in N, given by:

$$Z_{cont} = 35\ d^2 + 13.4\ m_A$$

where

d = chain diameter, in mm, as per Table 4
m_A = HHP anchor mass, in kg, as per Table 4

As far as practicable, for testing purpose the speed of the chain cable during hoisting of the anchor and cable should be measured over 37.5 m of chain cable and initially with at least 120 m of chain and the anchor submerged and hanging free. The mean speed of the chain cable during hoisting of the anchor from the depth of 120 m to the depth of 82.5 m should be at least 4.5 m/min.

For the hull supporting structure of anchor windlass and chain stopper reference is made to A1.7.

1.3 Installation of chain cables and anchors on board

1.3.1 Capacity and arrangement of anchor chain locker

(a) The chain locker should be of capacity and depth adequate to provide an easy direct lead of the cables through the chain pipes and a self-stowing of the cables. The chain locker should be provided with an internal division so that the port and starboard chain cables may be fully and separately stowed.

(b) The chain locker boundaries and their access openings should be watertight as necessary to prevent accidental flooding of the chain locker and damaging essential auxiliaries or equipment or affecting the proper operation of the ship.

(c) Adequate drainage facilities of the chain locker should be adopted.

No. 10 (cont)

1.3.2 Securing of the inboard ends of chain cables

(a) The inboard ends of the chain cables should be secured to the structures by a fastening able to withstand a force not less than 15% BL nor more than 30% BL (BL = breaking load of the chain cable).

(b) The fastening should be provided with a mean suitable to permit, in case of emergency, an easy slipping of the chain cables to sea, operable from an accessible position outside the chain locker.

1.3.3 Securing of stowed anchors

(a) To hold the anchor tight in against the hull or the anchor pocket, respectively, it is recommended to fit anchor lashings, e.g., a 'devil's claw'.

(b) Anchor lashings should be designed to resist a load at least corresponding to twice the anchor mass plus 10 m of cable without exceeding 40% of the yield strength of the material.

No. 10 (cont)

2. Mooring and towing equipment

2.1 Mooring lines

The mooring lines for ships with Equipment Number EN of less than or equal to 2000 are given in 2.1.1. For other ships the mooring lines are given in 2.1.2.

The Equipment Number EN should be calculated in compliance with A1.2. Deck cargo as given by the loading manual should be included for the determination of side-projected area A.

2.1.1 Mooring lines for ships with EN ≤ 2000

The minimum recommended mooring lines for ships having an Equipment Number EN of less than or equal to 2000 are given in Table 5.

For ships having the ratio A/EN > 0.9 the following number of lines should be added to the number of mooring lines as given by Table 5:

One line where $0.9 < \frac{A}{EN} \leq 1.1$,

two lines where $1.1 < \frac{A}{EN} \leq 1.2$,

three lines where $1.2 < \frac{A}{EN}$.

No. 10 (cont)

Table 5 Mooring lines for ships with EN ≤ 2000

EQUIPMENT NUMBER		MOORING LINES		
Exceeding	Not exceeding	No. of mooring lines	Minimum length of each line * (m)	Minimum breaking strength (kN)
1	*2*	*3*	*4*	*5*
50	70	3	80	37
70	90	3	100	40
90	110	3	110	42
110	130	3	110	48
130	150	3	120	53
150	175	3	120	59
175	205	3	120	64
205	240	4	120	69
240	280	4	120	75
280	320	4	140	80
320	360	4	140	85
360	400	4	140	96
400	450	4	140	107
450	500	4	140	117
500	550	4	160	134
550	600	4	160	143
600	660	4	160	160
660	720	4	160	171
720	780	4	170	187
780	840	4	170	202
840	910	4	170	218
910	980	4	170	235
980	1060	4	180	250
1060	1140	4	180	272
1140	1220	4	180	293
1220	1300	4	180	309
1300	1390	4	180	336
1390	1480	4	180	352
1480	1570	5	190	352
1570	1670	5	190	362
1670	1790	5	190	384
1790	1930	5	190	411
1930	2000	5	190	437

* 2.1.3 should be observed

2.1.2 Mooring lines for ships with EN > 2000

The minimum recommended strength and number of mooring lines for ships with an Equipment Number EN > 2000 are given in 2.1.2.1 and 2.1.2.2, respectively. The length of mooring lines is given by 2.1.3.

The strength of mooring lines and the number of head, stern, and breast lines (see Note) for ships with an Equipment Number EN > 2000 are based on the side-projected area A_1. Side projected area A_1 should be calculated similar to the side-projected area A according to A1.2 but considering the following conditions:

- For oil tankers, chemical tankers, bulk carriers, and ore carriers the lightest ballast draft should be considered for the calculation of the side-projected area A_1. For other ships the lightest draft of usual loading conditions should be considered if the ratio of the freeboard in the lightest draft and the full load condition is equal to or above two. Usual loading conditions mean loading conditions as given by the trim and stability booklet

No. 10 (cont)

that are to be expected to regularly occur during operation and, in particular, excluding light weight conditions, propeller inspection conditions, etc.

- Wind shielding of the pier can be considered for the calculation of the side-projected area A_1 unless the ship is intended to be regularly moored to jetty type piers. A height of the pier surface of 3 m over waterline may be assumed, i.e. the lower part of the side-projected area with a height of 3 m above the waterline for the considered loading condition may be disregarded for the calculation of the side-projected area A_1.

- Deck cargo as given by the loading manual should be included for the determination of side-projected area A_1. Deck cargo may not need to be considered if a usual light draft condition without cargo on deck generates a larger side-projected area A_1 than the full load condition with cargo on deck. The larger of both side-projected areas should be chosen as side-projected area A_1.

The mooring lines as given here under are based on a maximum current speed of 1.0 m/s and the following maximum wind speed v_w, in m/s:

v_w =	$25.0 - 0.002 (A_1 - 2000)$	for passenger ships, ferries, and car carriers with $2000\ m^2 < A_1 \leq 4000\ m^2$
=	21.0	for passenger ships, ferries, and car carriers with $A_1 > 4000\ m^2$
=	25.0	for other ships

The wind speed is considered representative of a 30 second mean speed from any direction and at a height of 10 m above the ground. The current speed is considered representative of the maximum current speed acting on bow or stern (±10°) and at a depth of one-half of the mean draft. Furthermore, it is considered that ships are moored to solid piers that provide shielding against cross current.

Additional loads caused by, e.g., higher wind or current speeds, cross currents, additional wave loads, or reduced shielding from non-solid piers may need to be particularly considered. Furthermore, it should be observed that unbeneficial mooring layouts can considerably increase the loads on single mooring lines.

Note:

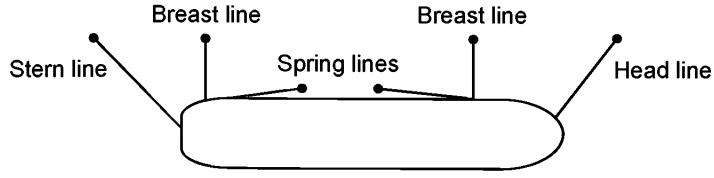
The following is defined with respect to the purpose of mooring lines, see also figure below:

Breast line: A mooring line that is deployed perpendicular to the ship, restraining the ship in the off-berth direction.

Spring line: A mooring line that is deployed almost parallel to the ship, restraining the ship in fore or aft direction.

Head/Stern line: A mooring line that is oriented between longitudinal and transverse direction, restraining the ship in the off-berth and in fore or aft direction. The amount of restraint in fore or aft and off-berth direction depends on the line angle relative to these directions.

No. 10 (cont)



2.1.2.1 Minimum breaking strength

The minimum breaking strength, in kN, of the mooring lines should be taken as:

$$MBL = 0.1 \cdot A_1 + 350$$

The minimum breaking strength may be limited to 1275 kN (130 t). However, in this case the moorings are to be considered as not sufficient for environmental conditions given by 2.1.2. For these ships, the acceptable wind speed v_w^*, in m/s, can be estimated as follows:

$$v_w^* = v_w \cdot \sqrt{\frac{MBL^*}{MBL}}$$

where v_w is the wind speed as per 2.1.2, MBL* the breaking strength of the mooring lines intended to be supplied and MBL the breaking strength as recommended according to the above formula. However, the minimum breaking strength should not be taken less than corresponding to an acceptable wind speed of 21 m/s:

$$MBL^* \geq \left(\frac{21}{v_w}\right)^2 \cdot MBL$$

If lines are intended to be supplied for an acceptable wind speed v_w^* higher than v_w as per 2.1.2, the minimum breaking strength should be taken as:

$$MBL^* = \left(\frac{v_w^*}{v_w}\right)^2 \cdot MBL$$

2.1.2.2 Number of mooring lines

The total number of head, stern and breast lines (see Note in 2.1.2) should be taken as:

$$n = 8.3 \cdot 10^{-4} \cdot A_1 + 6$$

For oil tankers, chemical tankers, bulk carriers, and ore carriers the total number of head, stern and breast lines should be taken as:

$$n = 8.3 \cdot 10^{-4} \cdot A_1 + 4$$

The total number of head, stern and breast lines should be rounded to the nearest whole number.

The number of head, stern and breast lines may be increased or decreased in conjunction with an adjustment to the strength of the lines. The adjusted strength, MBL*, should be taken as:

No. 10 (cont)

$MBL^* = 1.2 \cdot MBL \cdot n/n^* \leq MBL$ for increased number of lines,

$MBL^* = MBL \cdot n/n^*$ for reduced number of lines.

where n^* is the increased or decreased total number of head, stern and breast lines and n the number of lines for the considered ship type as calculated by the above formulas without rounding.

Vice versa, the strength of head, stern and breast lines may be increased or decreased in conjunction with an adjustment to the number of lines.

The total number of spring lines (see Note in 2.1.2) should be taken not less than:

Two lines where $EN < 5000$,

Four lines where $EN \geq 5000$.

The strength of spring lines should be the same as that of the head, stern and breast lines. If the number of head, stern and breast lines is increased in conjunction with an adjustment to the strength of the lines, the number of spring lines should be likewise increased, but rounded up to the nearest even number.

2.1.3 Length of mooring lines

The length of mooring lines for ships with EN of less than or equal to 2000 may be taken from Table 5. For ships with EN > 2000 the length of mooring lines may be taken as 200 m.

The lengths of individual mooring lines may be reduced by up to 7% of the above given lengths, but the total length of mooring lines should not be less than would have resulted had all lines been of equal length.

2.2 Tow line

The tow lines are given in Table 6 and are intended as own tow line of a ship to be towed by a tug or other ship. For the selection of the tow line from Table 6, the Equipment Number EN should be taken according to 2.1.

No. 10 (cont)

Table 6 Tow lines

EQUIPMENT NUMBER		TOW LINE	
Exceeding	Not exceeding	Minimum length (m)	Minimum breaking strength (kN)
1	*2*	*3*	*4*
50	70	180	98
70	90	180	98
90	110	180	98
110	130	180	98
130	150	180	98
150	175	180	98
175	205	180	112
205	240	180	129
240	280	180	150
280	320	180	174
320	360	180	207
360	400	180	224
400	450	180	250
450	500	180	277
500	550	190	306
550	600	190	338
600	660	190	370
660	720	190	406
720	780	190	441
780	840	190	479
840	910	190	518
910	980	190	559
980	1060	200	603
1060	1140	200	647
1140	1220	200	691
1220	1300	200	738
1300	1390	200	786
1390	1480	200	836
1480	1570	220	888
1570	1670	220	941
1670	1790	220	1024
1790	1930	220	1109
1930	2080	220	1168
2080	2230	240	1259
2230	2380	240	1356
2380	2530	240	1453
2530	2700	260	1471
2700	2870	260	1471
2870	3040	260	1471
3040	3210	280	1471
3210	3400	280	1471
3400	3600	280	1471
3600	-	300	1471

2.3 Mooring and tow line construction

Tow lines and mooring lines may be of wire, natural fibre or synthetic fibre construction or of a mixture of wire and fibre. For synthetic fibre ropes it is recommended to use lines with reduced risk of recoil (snap-back) to mitigate the risk of injuries or fatalities in the case of breaking mooring lines.

Notwithstanding the strength recommendations given in 2.1 and 2.2, no fibre rope should be less than 20 mm in diameter. For polyamide ropes the minimum breaking strength should be increased by 20% and for other synthetic ropes by 10% to account for strength loss due to, among others, aging and wear.

No. 10 (cont)

2.4 Mooring winches

2.4.1 Each winch should be fitted with brakes the holding capacity of which is sufficient to prevent unreeling of the mooring line when the rope tension is equal to 80% of the minimum breaking strength of the rope as fitted on the first layer. The winch should be fitted with brakes that will allow for the reliable setting of the brake rendering load.

2.4.2 For powered winches the maximum hauling tension which can be applied to the mooring line (the reeled first layer) should not be less than 1/4.5 times, nor be more than 1/3 times the rope's minimum breaking strength. For automatic winches these figures apply when the winch is set to the maximum power with automatic control.

2.4.3 For powered winches on automatic control, the rendering tension which the winch can exert on the mooring line (the reeled first layer) should not exceed 1.5 times, nor be less than 1.05 times the hauling tension for that particular power setting of the winch. The winch should be marked with the range of rope strength for which it is designed.

2.5 Mooring and towing arrangement

2.5.1 Mooring arrangement

Mooring lines in the same service (e.g. breast lines, see Note in 2.1.2) should be of the same characteristic in terms of strength and elasticity.

As far as possible, sufficient number of mooring winches should be fitted to allow for all mooring lines to be belayed on winches. This allows for an efficient distribution of the load to all mooring lines in the same service and for the mooring lines to shed load before they break. If the mooring arrangement is designed such that mooring lines are partly to be belayed on bitts or bollards, it should be considered that these lines may not be as effective as the mooring lines belayed on winches.

Mooring lines should have as straight a lead as is practicable from the mooring drum to the fairlead.

At points of change in direction sufficiently large radii of the contact surface of a rope on a fitting should be provided to minimize the wear experienced by mooring lines and as recommended by the rope manufacturer for the rope type intended to be used.

2.5.2 Towing arrangement

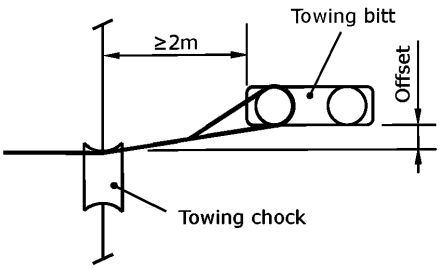
Towing lines should be led through a closed chock. The use of open fairleads with rollers or closed roller fairleads should be avoided.

For towing purpose it is recommended to provide at least one chock close to centreline of the ship forward and aft. It is also beneficial to provide additional chocks on port and starboard side at the transom and at the bow.

Towing lines should have a straight lead from the towing bitt or bollard to the chock.

For the purpose of towing, bitts or bollards serving a chock should be located slightly offset and in a distance of at least 2 m away from the chock, see figure below:

No. 10 (cont)



Warping drums should preferably be positioned not more than 20 m away from the chock, measured along the path of the line.

Attention should be given to the arrangement of the equipment for towing and mooring operations in order to prevent interference of mooring and towing lines as far as practicable. It is beneficial to provide dedicated towing arrangements separate from the mooring equipment.

For emergency towing arrangements for tankers reference should be made to SOLAS Chapter II-1, Regulation 3-4. For all ships other than tankers it is recommended to provide towing arrangements fore and aft of sufficient strength for 'other towing' service as defined in UR A2.0.

No. 10 (cont)

3. Anchoring and mooring equipment for fishing vessels

3.1 Anchoring equipment

3.1.1 Application

The following provisions apply to fishing vessels operating in unrestricted service. Reduction of equipment may be considered for fishing vessels operating in restricted services.

3.1.2 General recommendations

(a) Each ship should be provided with anchoring equipment designed for quick and safe operation in all foreseeable service conditions. Anchor equipment should consist of anchors, anchor chain cables and a windlass or other arrangements for dropping and weighing the anchors and for holding the ship at anchor.

(b) The equipment of anchors and chain cables given in Table 7 is based on the Equipment Number EN which should be calculated as follows:

$$EN = \Delta^{2/3} + 2Bh + 0.1A$$

where

Δ = moulded displacement, in t, to the maximum design waterline,
B = greatest moulded breadth, in m,
h = effective height, in m, from the maximum design waterline to the top of the uppermost house.
= $a + \Sigma h_i$
a = distance, in m, from the maximum design waterline to the upper edge of the uppermost complete deck at the side amidships,
h_i = height, in m, on the centreline of each tier of houses having breadth greater than B/4.

For the lowest tier h is measured at centreline from the upper deck or from a notional deck line where there is local discontinuity in the upper deck.

When calculating h, sheer and trim can be ignored.

A = side-projected area, in m^2, of the hull, within the length of the ship between perpendiculars, and of superstructures and houses above the maximum design waterline having a width greater than B/4.

Screens and bulwarks more than 1.5 m in height should be regarded as parts of houses when determining h and A.

3.1.3 Particular recommendations

(a) For ships below 40 m in length the anchor chain may be replaced with wire ropes of equal strength of the tabular anchor cables of Grade 1. Wire ropes of trawl winches complying with this recommendation may be used as anchor chain cables.

(b) When wire ropes are substituted for anchor chain cables then:

(i) the length of the ropes should be equal to 1.5 times the corresponding tabular length of chain cable (col. 5 of Table 7),

No. 10 (cont)

(ii) a short length of chain cable should be fitted between the wire rope and anchor having a length of 12.5 m or the distance between anchor in stowed position and winch, whichever is less,

(iii) all surfaces being in contact with the wire should be rounded with a radius of not less than 10 times the wire rope diameter (including stem).

(c) High holding power anchors of approved design may be used as bower anchors. The mass of each such anchor may be 75% of the tabular mass for ordinary stockless bower anchors.

(d) The tabular anchor equipment may be increased for ships fishing in very rough waters.

No. 10 (cont)

Table 7 Equipment for fishing vessels

Equipment Number		Stockless bower anchors		Stud link chain cables for bower anchors		
					Min. diameter (mm)	
Exceeding	Not exceeding	Number	Mass per anchor (kg)	Total length (m)	Mild steel (Grade 1)**	Special quality steel (Grade 2)**
1	*2*	*3*	*4*	*5*	*6*	*7*
30	40	2	80	165	11	-
40	50	2	100	192.5	11	-
50	60	2	120	192.5	12.5	-
60	70	2	140	192.5	12.5	* -
70	80	2	160	220	14	12.5
80	90	2	180	220	14	12.5
90	100	2	210	220	16	14
100	110	2	240	220	16	14
110	120	2	270	247.5	17.5	16
120	130	2	300	247.5	17.5	16
130	140	2	340	275	19	17.5
140	150	2	390	275	19	17.5
150	175	2	480	275	22	19
175	205	2	570	302.5	24	20.5
205	240	2	660	302.5	26	22
240	280	2	780	330	28	24
280	320	2	900	357.5	30	26
320	360	2	1020	357.5	32	28
360	400	2	1140	385	34	30
400	450	2	1290	385	36	32
450	500	2	1440	412.5	38	34
500	550	2	1590	412.5	40	34
550	600	2	1740	440	42	36
600	660	2	1920	440	44	38
660	720	2	2100	440	46	40

NOTES
* Alternative to stud link chain cables, short link chain cables may be considered.
** The steel grades of the chain cables are covered by UR A1, A1.5.2.

3.2 Mooring equipment

The mooring equipment is given by Table 8.

No. 10 (cont)

Table 8 Mooring lines for fishing vessels

Equipment Number		Mooring lines		
Exceeding	Not exceeding	Number	Minimum length of each line (m)	Minimum breaking strength (kN)
1	*2*	*3*	*4*	*5*
30	40	2	50	29
40	50	2	60	29
50	60	2	60	29
60	70	2	80	29
70	80	2	100	34
80	90	2	100	36.8
90	100	2	110	36.8
100	110	2	110	39
110	120	2	110	39
120	130	2	110	44
130	140	2	120	44
140	150	2	120	49
150	175	2	120	54
175	205	2	120	59
205	240	2	120	64
240	280	3	120	71
280	320	3	140	78
320	360	3	140	85.8
360	400	3	140	93
400	450	3	140	101
450	500	3	140	108
500	550	4	160	113
550	600	4	160	118
600	660	4	160	123
660	720	4	160	127

End of Document

No. 47 Shipbuilding and Repair Quality Standard

(1996) (Rev.1 1999) (Rev.2 Dec 2004) (Rev.3, Nov 2006) (Rev.4 Aug 2008) (Rev.5 Oct 2010) (Rev.6 May 2012) (Rev.7 June 2013) (Rev.8 Oct 2017)

Part A Shipbuilding and Remedial Quality Standard for New Construction

Part B Repair Quality Standard for Existing Ships

No. 47 (cont)

PART A

SHIPBUILDING AND REMEDIAL QUALITY STANDARDS FOR NEW CONSTRUCTION

1. **Scope**

2. **General requirements for new construction**

3. **Qualification of personnel and procedures**
   - 3.1 Qualification of welders
   - 3.2 Qualification of welding procedures
   - 3.3 Qualification of NDE operators

4. **Materials**
   - 4.1 Materials for structural members
   - 4.2 Surface conditions

5. **Gas Cutting**

6. **Fabrication and fairness**
   - 6.1 Flanged longitudinals and flanged brackets
   - 6.2 Built-up sections
   - 6.3 Corrugated bulkheads
   - 6.4 Pillars, brackets and stiffeners
   - 6.5 Maximum heating temperature on surface for line heating
   - 6.6 Block assembly
   - 6.7 Special sub-assembly
   - 6.8 Shape
   - 6.9 Fairness of plating between frames
   - 6.10 Fairness of plating with frames
   - 6.11 Preheating for welding hull steels at low temperature

7. **Alignment**

8. **Welding Joint Details**
   - 8.1 Typical butt weld plate edge preparation (manual welding and semi-automatic welding)
   - 8.2 Typical fillet weld plate edge preparation (manual welding and semi-automatic welding)
   - 8.3 Butt and fillet weld profile (manual welding and semi-automatic welding)
   - 8.4 Typical butt weld edge preparation (Automatic welding)
   - 8.5 Distance between welds

9. **Remedial**
   - 9.1 Typical misalignment remedial
   - 9.2 Typical butt weld plate edge preparation remedial (manual welding and semi-automatic welding)
   - 9.3 Typical fillet weld plate edge preparation remedial (manual welding and semi-automatic welding)
   - 9.4 Typical fillet and butt weld profile remedial (manual welding and semi-automatic welding)
   - 9.5 Distance between welds remedial
   - 9.6 Erroneous hole remedial
   - 9.7 Remedial by insert plate
   - 9.8 Weld surface remedial
   - 9.9 Weld remedial (short bead)

No. 47 (cont)

REFERENCES

A1. IACS Recommendation No.76 "Bulk Carriers - Guidelines for Surveys, Assessment and Repair of Hull Structure"
A2. TSCF "Guidelines for the inspection and maintenance of double hull tanker structures"
A3. TSCF "Guidance manual for the inspection and condition assessment of tanker structures"
A4. IACS UR W7 "Hull and machinery steel forgings"
A5. IACS UR W8 "Hull and machinery steel castings"
A6. IACS UR W11 "Normal and higher strength hull structural steels"
A7. IACS UR W13 "Thickness tolerances of steel plates and wide flats"
A8. IACS UR W14 "Steel plates and wide flats with specified minimum through thickness properties ("Z" quality)"
A9. IACS UR W17 "Approval of consumables for welding normal and higher strength hull structural steels"
A10. IACS UR W28 "Welding procedure qualification tests of steels for hull construction and marine structures"
A11. Annex I to IACS UR Z10.1 "Hull surveys of oil tankers", ~~and~~ Z10.2 "Hull surveys of bulk carriers", Z10.3 "Hull Surveys of Chemical Tankers", Z10.4 "Hull Surveys of Double Hull Oil Tankers" and Z10.5 "Hull Surveys of Double-Skin Bulk Carriers" ~~Annex I~~
A12. IACS UR Z23 "Hull survey for new construction"
A13. IACS Recommendation No. 12 "Guidelines for surface finish of hot rolled plates and wide flats"
A14. IACS Recommendation No. 20 "Non-destructive testing of ship hull steel welds"
A15. IACS Recommendation No.96 "Double Hull Oil Tankers- Guidelines for Surveys, Assessment and Repair of Hull Structures"
A16. IACS Recommendation No.55 "General Dry Cargo Ships- Guidelines for Surveys, Assessment and Repair of Hull Structures"
A17. IACS Recommendation No.84 "Container Ships- Guidelines for Surveys, Assessment and Repair of Hull Structures"

No. 47 (cont)

1. Scope

It is intended that these standards provide guidance where established and recognized shipbuilding or national standards accepted by the Classification Society do not exist.

1.1 This standard provides guidance on shipbuilding quality standards for the hull structure during new construction and the remedial standard where the quality standard is not met.

Whereas the standard generally applies to

- conventional merchant ship types,
- parts of hull covered by the rules of the Classification Society,
- hull structures constructed from normal and higher strength hull structural steel,

the applicability of the standard is in each case to be agreed upon by the Classification Society.

The standard does generally not apply to the new construction of

- special types of ships as e.g. gas tankers
- structures fabricated from stainless steel or other, special types or grades of steel

1.2 In this standard, both a "Standard" range and a "Limit" range are listed. The "Standard" range represents the target range expected to be met in regular work under normal circumstances. The "Limit" range represents the maximum allowable deviation from the "Standard" range. Work beyond the "Standard" range but within the "Limit" range is acceptable. In cases where no 'limit' value is specified, the value beyond the 'standard' range may be accepted subject to the consideration of the Classification Society.

1.3 The standard covers typical construction methods and gives guidance on quality standards for the most important aspects of such construction. Unless explicitly stated elsewhere in the standard, the level of workmanship reflected herein will in principle be acceptable for primary and secondary structure of conventional designs. A more stringent standard may however be required for critical and highly stressed areas of the hull, and this is to be agreed with the Classification Society in each case. In assessing the criticality of hull structure and structural components, reference is made to ref. A1, A2, ~~and~~ A3, A11, A15, A16 and A17.

1.4 Details relevant to structures or fabrication procedures not covered by this standard are to be approved by the Classification Society on the basis of procedure qualifications and/or recognized national standards.

1.5 For use of this standard, fabrication fit-ups, deflections and similar quality attributes are intended to be uniformly distributed about the nominal values. The shipyard is to take corrective action to improve work processes that produce measurements where a skew distribution is evident. Relying upon remedial steps that truncate a skewed distribution of the quality attribute is unacceptable.

2. General requirements for new construction

2.1 In general, the work is to be carried out in accordance with the Classification Society rules and under the supervision of the Surveyor to the Classification Society

No. 47 (cont)

2.2 Welding operations are to be carried out in accordance with work instructions accepted by the Classification Society.

2.3 Welding of hull structures is to be carried out by qualified welders, according to approved and qualified welding procedures and with welding consumables approved by the Classification Society, see Section 3. Welding operations are to be carried out under proper supervision by the shipbuilder. The working conditions for welding are to be monitored by the Classification Society in accordance with UR Z23 (ref. A12).

3. Qualification of personnel and procedures

3.1 Qualification of welders

3.1.1 Welders are to be qualified in accordance with the procedures of the Classification Society or to a recognized national or international standard. Recognition of other standards is subject to submission to the Classification Society for evaluation. Subcontractors are to keep records of welders qualification and, when required, furnish valid approval test certificates.

3.1.2 Welding operators using fully mechanized or fully automatic processes need generally not pass approval testing provided that the production welds made by the operators are of the required quality. However, operators are to receive adequate training in setting or programming and operating the equipment. Records of training and operation experience shall be maintained on individual operator's files and records, and be made available to the Classification Society for inspection when requested.

3.2 Qualification of welding procedures

Welding procedures are to be qualified in accordance with UR W28 (ref. A10) or other recognized standard accepted by the Classification Society.

3.3 Qualification of NDE operators

Personnel performing non-destructive examination for the purpose of assessing quality of welds in connection with new construction covered by this standard, are to be qualified in accordance with Classification Society rules or to a recognized international or national qualification scheme. Records of operators and their current certificates are to be kept and made available to the Surveyor for inspection.

4. Materials

4.1 Materials for Structural Members

All materials, including weld consumables, to be used for the structural members are to be approved by the Classification Society as per the approved construction drawings and meet the respective IACS Unified Requirements (see ref. A4, A5, A6, A7, A8, and A9). Additional recommendations are contained in the following paragraphs.

All materials used should be manufactured at a works approved by the Classification Society for the type and grade supplied.

No. 47 (cont)

4.2 Surface Conditions

4.2.1 Definitions

Minor Imperfections:	Pitting, rolled-in scale, indentations, roll marks, scratches and grooves
Defects:	Cracks, shells, sand patches, sharp edged seams and minor imperfections exceeding the limits of table 1
Depth of Imperfections or defects:	The depth is to be measured from the surface of the product

4.2.2 Acceptance without remedies

Minor imperfections, in accordance with the nominal thickness (t) of the product and the limits described in Table 1, are permissible and may be left as they are.

Imperfection surface area Ratio(%)	15～20%	5～15%	0～5%
$t < 20$ mm	0.2 mm	0.4 mm	0.5 mm
$20 \text{ mm} \leq t < 50$ mm	0.2 mm	0.6 mm	0.7 mm
$50 \text{ mm} \leq t$	0.2 mm	0.7 mm	0.9 mm

Table 1 Limits for depth of minor imperfection, for acceptance without remedies

No. 47 (cont)

Imperfection surface area Ratio (%) is obtained as influenced area / area under consideration (i.e. plate surface area) x 100%.

For isolated surface discontinuities, influenced area is obtained by drawing a continuous line which follows the circumference of the discontinuity at a distance of 20 mm. (Figure 1)

For surface discontinuities appearing in a cluster, influenced area is obtained by drawing a continuous line which follows the circumference of the cluster at a distance of 20 mm. (Figure 2)

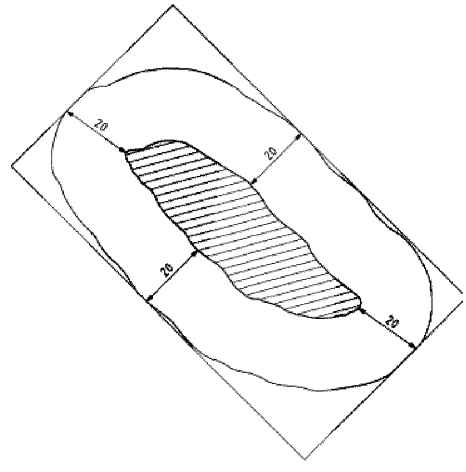


Figure 1 - Determination of the area influenced by an isolated discontinuity
(Ref. Nr. EN 10163-1:2004+AC:2007 E)

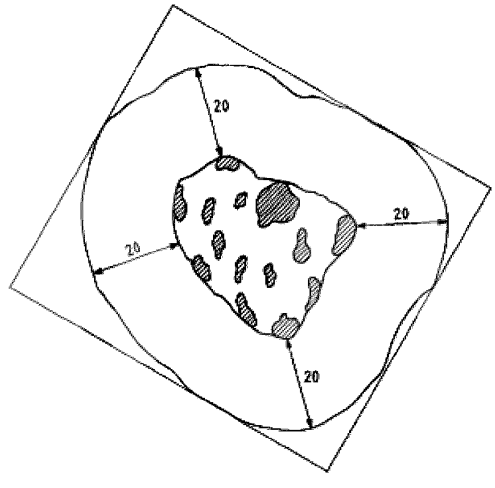


Figure 2 - Determination of the area influenced by clustered discontinuities
(Ref. Nr. EN 10163-1:2004+AC:2007 E)

No. 47 (cont)

4.2.3 Remedial of Defects

Defects are to be remedied by grinding and/or welding in accordance with IACS Rec.12 (ref. A12).

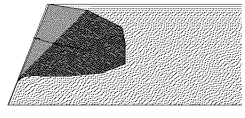
4.2.4 Further Defects

4.2.4.1 Lamination

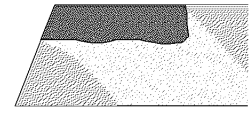
Investigation to be carried out at the steelmill into the cause and extent of the detected laminations. Severe lamination is to be remedied by local insert plates. The minimum breadth or length of the plate to be replaced is to be:

- 1600 mm for shell and strength deck plating in way of cruciform or T-joints,
- 800 mm for shell, strength deck plating and other primary members,
- 300 mm for other structural members.

Local limited lamination may be remedied by chipping and/or grinding followed by welding in accordance with sketch (a). In case where the local limited lamination is near the plate surface, the remedial may be carried out as shown in sketch (b). For limitations see paragraph 4.2.2.



(a)



(b)

4.2.4.2 Weld Spatters

Loose weld spatters are to be removed by grinding or other measures to clean metal surface (see Table 9.13), as required by the paint system, on:

- shell plating
- deck plating on exposed decks
- in tanks for chemical cargoes
- in tanks for fresh water and for drinking water
- in tanks for lubricating oil, hydraulic oil, including service tanks

5. Gas Cutting

The roughness of the cut edges is to meet the following requirements:

Free Edges:

	Standard	**Limit**
Strength Members	150 µm	300 µm
Others	500 µm	1000 µm

Welding Edges:

	Standard	**Limit**
Strength Members	400 µm	800 µm
Others	800 µm	1500 µm

No. 47 (cont)

6. Fabrication and fairness

6.1 Flanged longitudinals and flanged brackets (see Table 6.1)
6.2 Built-up sections (see Table 6.2)
6.3 Corrugated bulkheads (see Table 6.3)
6.4 Pillars, brackets and stiffeners (see Table 6.4)
6.5 Maximum heating temperature on surface for line heating (see Table 6.5)
6.6 Block assembly (see Table 6.6)
6.7 Special sub-assembly (see Table 6.7)
6.8 Shape (see Table 6.8 and 6.9)
6.9 Fairness of plating between frames (see Table 6.10)
6.10 Fairness of plating with frames (see Table 6.11)
6.11 Preheating for welding hull steels at low temperature (See Table 6.12)

7. Alignment

The quality standards for alignment of hull structural components during new construction are shown in Tables 7.1, 7.2 and 7.3. The Classification Society may require a closer construction tolerance in areas requiring special attention, as follows:

- Regions exposed to high stress concentrations
- Fatigue prone areas
- Detail design block erection joints
- High tensile steel regions

8. Welding Joint Details

Edge preparation is to be qualified in accordance with UR W28 (ref. A10) or other recognized standard accepted by the Classification Society.

Some typical edge preparations are shown in Table 8.1, 8.2, 8.3, 8.4 and 8.6 for reference.

8.1 Typical butt weld plate edge preparation (manual and semi-automatic welding) for reference - see Table 8.1 and 8.2
8.2 Typical fillet weld plate edge preparation (manual and semi-automatic welding) for reference - see Table 8.3 and 8.4
8.3 Butt and fillet weld profile (manual and semi-automatic welding) - see Table 8.5
8.4 Typical butt weld plate edge preparation (Automatic welding) for reference - see Table 8.6
8.5 Distance between welds - see Table 8.7

9. Remedial

All the major remedial work is subject to reporting by shipbuilder to the Classification Society for approval in accordance with their work instruction for new building.

Some typical remedial works are shown in Tables 9.1 to 9.13.

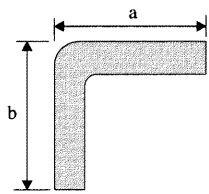
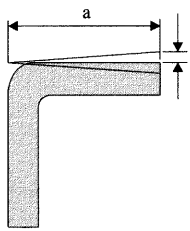
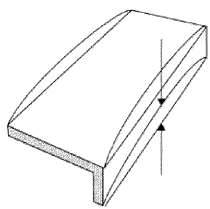
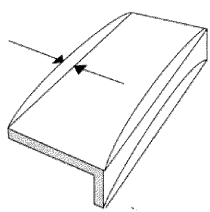
9.1 Typical misalignment remedial - see Tables 9.1 to 9.3
9.2 Typical butt weld plate edge preparation remedial (manual and semi-automatic welding) - see Table 9.4 and 9.5
9.3 Typical fillet weld plate edge preparation remedial (manual and semi-automatic welding) - see Tables 9.6 to 9.8
9.4 Typical fillet and butt weld profile remedial (manual and semi-automatic welding) - see Table 9.9

No. 47 (cont)

9.5 Distance between welds remedial - see Table 9.10
9.6 Erroneous hole remedial - see Table 9.11
9.7 Remedial by insert plate - see Table 9.12
9.8 Weld surface remedial - see Table 9.13
9.9 Weld remedial (short bead) - see Table 9.14

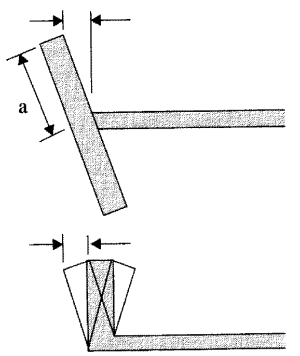
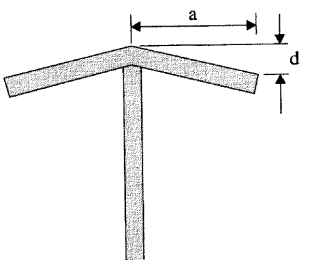
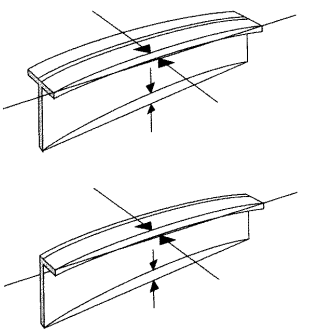
No. 47 (cont)

TABLE 6.1 – Flanged Longitudinals and Flanged Brackets

Detail	Standard	Limit	Remarks
Breadth of flange  compared to correct size	± 3 mm	± 5 mm	
Angle between flange and web  compared to template	± 3 mm	± 5 mm	per 100 mm of a
Straightness in plane of flange and web  	± 10 mm	± 25 mm	per 10 m

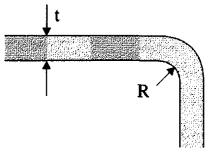
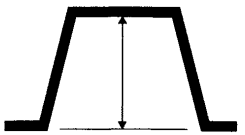
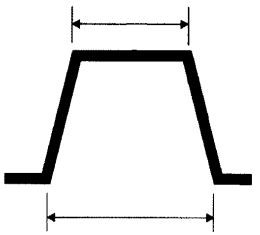
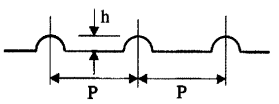
No. 47 (cont)

TABLE 6.2 – Built Up Sections

Detail	Standard	Limit	Remarks
Frames and longitudinal 	± 1.5 mm	± 3 mm	per 100 mm of a
Distortion of face plate 	$d \leq 3 + a/100$ mm	$d \leq 5 + a/100$ mm	
Distortion in plane of web and flange of built up longitudinal frame, transverse frame, girder and transverse web. 	± 10 mm	± 25 mm	per 10 m in length

No. 47 (cont)

TABLE 6.3 – Corrugated Bulkheads

Detail	Standard	Limit	Remarks
Mechanical bending 	R ≥ 3t mm R ≥ 4.5t mm for CSR ships Note 1	2t mm Note 2	Material to be suitable for cold flanging (forming) and welding in way of radius
Depth of corrugation 	± 3 mm	± 6 mm	
Breadth of corrugation 	± 3 mm	± 6 mm	
Pitch and depth of swedged corrugated bulkhead compared with correct value 	h : ± 2.5 mm Where it is not aligned with other bulkheads P : ± 6 mm Where it is aligned with other bulkheads P : ± 2 mm	h : ± 5 mm Where it is not aligned with other bulkheads P : ± 9 mm Where it is aligned with other bulkheads P : ± 3 mm	

Notes:

1. For CSR Bulk Carriers built under the "Common Structural Rules for Bulk Carriers" with the effective dates of 1 July 2010 and 1 July 2012, the standard is R≥2t mm.

No. 47 (cont)

2. For CSR ships, the allowable inside bending radius of cold formed plating may be reduced provided the following requirements are complied with.

When the inside bending radius is reduced below 4.5 times the as-built plate thickness, supporting data is to be provided. The bending radius is in no case to be less than 2 times the as-built plate thickness. As a minimum, the following additional requirements are to be complied with:

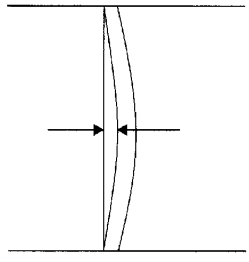
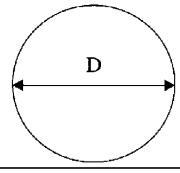
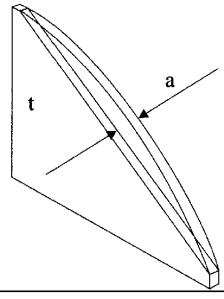
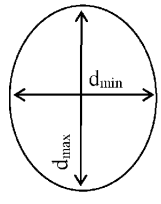
a) For all bent plates:
- 100% visual inspection of the bent area is to be carried out.
- Random checks by magnetic particle testing are to be carried out.

b) In addition to a), for corrugated bulkheads subject to lateral liquid pressure:
- The steel is to be of Grade D/DH or higher.

The material is impact tested in the strain-aged condition and satisfies the requirements stated herein. The deformation is to be equal to the maximum deformation to be applied during production, calculated by the formula $t_{as\text{-}built}/(2r_{bdg} + t_{as\text{-}built})$, where $t_{as\text{-}built}$ is the as-built thickness of the plate material and r_{bdg} is the bending radius. One sample is to be plastically strained at the calculated deformation or 5%, whichever is greater and then artificially aged at 250°C for one hour then subject to Charpy V-notch testing. The average impact energy after strain ageing is to meet the impact requirements specified for the grade of steel used.

No. 47 (cont)

TABLE 6.4 – Pillars, Brackets and Stiffeners

Detail	Standard	Limit	Remarks
Pillar (between decks) 	4 mm	6 mm	
Cylindrical structure diameter (pillars, masts, posts, etc.) 	± D/200 mm max. + 5 mm	± D/150 mm max. 7.5 mm	
Tripping bracket and small stiffener, distortion at the part of free edge 	$a \leq t/2$ mm	t	
Ovality of cylindrical structure 		$d_{max} - d_{min} \leq 0.02 \times d_{max}$	

No. 47 (cont)

TABLE 6.5 – Maximum Heating Temperature on Surface for Line Heating

Item		Standard	Limit	Remarks
Conventional Process AH32-EH32 & AH36-EH36	Water cooling just after heating	Under 650°C		
TMCP type AH36-EH36 (Ceq.>0.38%)	Air cooling after heating	Under 900°C		
	Air cooling and subsequent water cooling after heating	Under 900°C (starting temperature of water cooling to be under 500°C)		
TMCP type AH32-DH32 & AH36-DH36 (Ceq. ≤ 0.38%)	Water cooling just after heating or air cooling	Under 1000°C		
TMCP type EH32 & EH36 (Ceq. ≤ 0.38%)	Water cooling just after heating or air cooling	Under 900°C		

NOTE:

$$Ceq = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}(\%)$$

No. 47 (cont)

TABLE 6.6 – Block Assembly

Item	Standard	Limit	Remarks
Flat Plate Assembly			
Length and Breadth	± 4 mm	± 6 mm	
Distortion	± 10 mm	±20mm	
Squareness	± 5 mm	±10mm	
Deviation of interior members from plate	5 mm	10mm	
Curved plate assembly			
Length and Breadth	± 4 mm	± 8 mm	measured along the girth
Distortion	± 10 mm	± 20 mm	
Squareness	± 10 mm	± 15 mm	
Deviation of interior members from plate	5 mm	10 mm	
Flat cubic assembly			
Length and Breadth	± 4 mm	± 6 mm	
Distortion	± 10 mm	± 20 mm	
Squareness	± 5 mm	± 10 mm	
Deviation of interior members from plate	5 mm	10 mm	
Twist	± 10 mm	± 20 mm	
Deviation between upper and lower plate	± 5 mm	± 10 mm	
Curved cubic assembly			
Length and Breadth	± 4 mm	± 8 mm	measured along with girth
Distortion	± 10 mm	± 20 mm	
		± 15 mm	

No. 47 (cont)

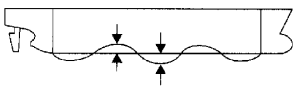
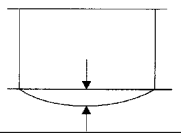
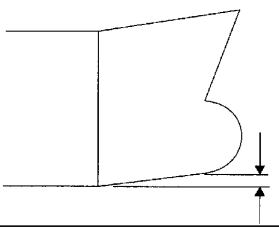
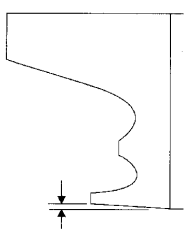
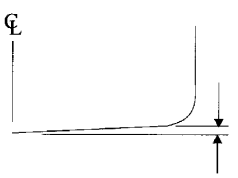
Squareness Deviation of interior members from plate Twist Deviation between upper and lower plate	± 10 mm ± 5 mm ± 15 mm ± 7 mm	± 10 mm ± 25 mm ± 15 mm	

TABLE 6.7 – Special Sub-Assembly

Item	Standard	Limit	Remarks
Distance between upper/lower gudgeon	± 5 mm	± 10 mm	
Distance between aft edge of boss and aft peak bulkhead	± 5 mm	± 10 mm	
Twist of sub-assembly of stern frame	5 mm	10 mm	
Deviation of rudder from shaft center line	4 mm	8 mm	
Twist of rudder plate	6 mm	10 mm	
Flatness of top plate of main engine bed	5 mm	10 mm	
Breadth and length of top plate of main engine bed	± 4 mm	± 6 mm	
NOTE: Dimensions and tolerances have to fulfill engine and equipment manufacturers' requirements, if any.			

No. 47 (cont)

TABLE 6.8 – Shape

Detail	Standard	Limit	Remarks
Deformation for the whole length 	± 50 mm		per 100 m against the line of keel sighting
Deformation for the distance between two adjacent bulkheads 	± 15 mm		
Cocking-up of fore body 	± 30 mm		The deviation is to be measured from the design line.
Cocking-up of aft-body 	± 20 mm		
Rise of floor amidships 	± 15 mm		The deviation is to be measured from the design line.

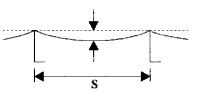
No. 47 (cont)

TABLE 6.9 – Shape

Item	Standard	Limit	Remarks
Length between perpendiculars	±L/1000 mm where L is in mm		Applied to ships of 100 metre length and above. For the convenience of the measurement the point where the keel is connected to the curve of the stem may be substituted for the fore perpendicular in the measurement of the length.
Moulded breadth at midship	±B/1000 mm where B is in mm		Applied to ships of 15 metre breadth and above, measured on the upper deck.
Moulded depth at midship	±D/1000 mm where D is in mm		Applied to ships of 10 metre depth and above, measured up to the upper deck.

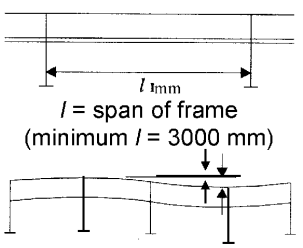
No. 47 (cont)

TABLE 6.10 – Fairness of Plating Between Frames

Item		Standard	Limit	Remarks
Shell plate	Parallel part (side & bottom shell)	4 mm	8 mm	
	Fore and aft part	5 mm		
Tank top plate		4 mm		
Bulkhead	Longl. Bulkhead Trans. Bulkhead Swash Bulkhead	6 mm		
Strength deck	Parallel part	4 mm	8 mm	
	Fore and aft part	6 mm	9 mm	
	Covered part	7 mm	9 mm	
Second deck	Bare part	6 mm	8 mm	
	Covered part	7 mm	9 mm	
Forecastle deck poop deck	Bare part	4 mm	8 mm	
	Covered part	6 mm	9 mm	
Super structure deck	Bare part	4 mm	6 mm	
	Covered part	7 mm	9 mm	
House wall	Outside wall	4 mm	6 mm	
	Inside wall	6 mm	8 mm	
	Covered part	7 mm	9 mm	
Interior member (web of girder, etc)		5 mm	7 mm	
Floor and girder in double bottom		5 mm	8 mm	

No. 47 (cont)

TABLE 6.11 – Fairness of Plating with Frames

Item		Standard	Limit	Remarks
Shell plate	Parallel part	±2 *l* /1000 mm	±3 *l* /1000 mm	*l* = span of frame (mm) To be measured between on trans. space (min. *l* = 3000 mm)
	Fore and aft part	±3 *l* /1000 mm	±4 *l* /1000 mm	
Strength deck (excluding cross deck) and top plate of double bottom	-	±3 *l* /1000 mm	±4 *l* /1000 mm	
Bulkhead	-		±5 *l* /1000 mm	
Accommodation above the strength deck and others	-	±5 *l* /1000 mm	±6 *l* /1000 mm	
 *l* = span of frame (minimum *l* = 3000 mm) To be measured between one trans. space.				

No. 47 (cont)

TABLE 6.12 – Preheating for welding hull steels at low temperature

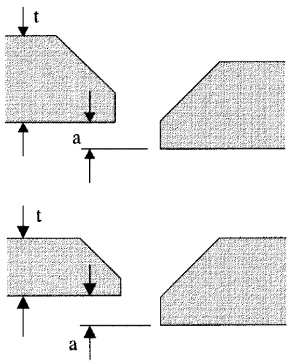
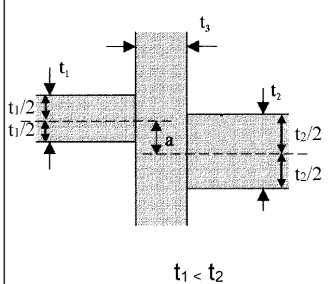
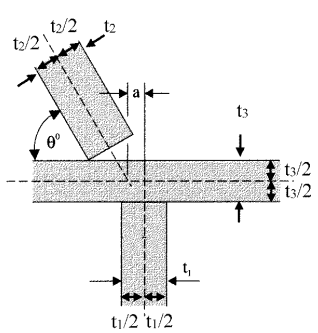
Item		Standard		Limit	Remarks
		Base metal temperature needed preheating	Minimum preheating temperature		
Normal strength steels	A, B, D, E	Below -5 °C	20 °C [1)]		
Higher strength steels (TMCP type)	AH32 – EH32 AH36 – EH36	Below 0 °C			
Higher strength steels (Conventional type)		Below 0 °C			

(Note)

1) This level of preheat is to be applied unless the approved welding procedure specifies a higher level.

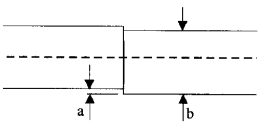
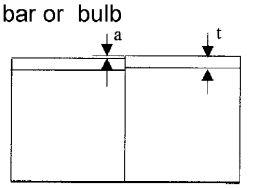
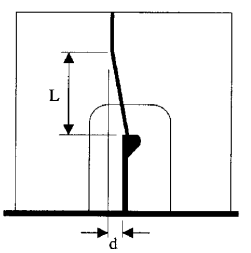
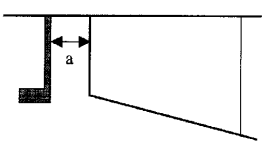
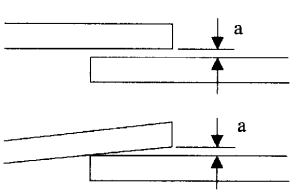
No. 47 (cont)

TABLE 7.1 – Alignment

Detail	Standard	Limit	Remarks
Alignment of butt welds 		$a \leq 0.15t$ strength member $a \leq 0.2t$ other but maximum 4.0 mm	t is the lesser plate thickness
Alignment of fillet welds  $t_1 < t_2$		Strength member and higher stress member: $a \leq t_1/3$ Other: $a \leq t_1/2$	Alternatively, heel line can be used to check the alignment. Where t_3 is less than t_1, then t_3 should be substituted for t_1 in the standard.
Alignment of fillet welds 		Strength member and higher stress member: $a \leq t_1/3$ Other: $a \leq t_1/2$	Alternatively, heel line can be used to check the alignment. Where t_3 is less than t_1, then t_3 should be substitute for t_1 in the standard.

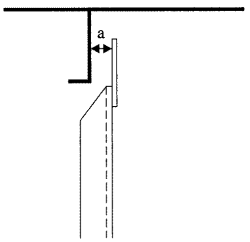
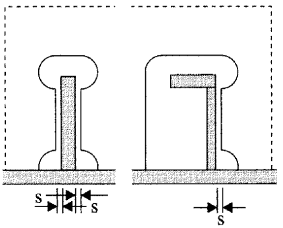
No. 47 (cont)

TABLE 7.2 – Alignment

Detail	Standard	Limit	Remarks
Alignment of flange of T-longitudinal  b (mm)	Strength member a ≤ 0.04b (mm)	a = 8.0 mm	
Alignment of height of T-bar, L-angle bar or bulb  	Strength member a ≤ 0.15t Other a ≤ 0.20t	a = 3.0 mm	
Alignment of panel stiffener  	d ≤ L/50		
Gap between bracket/intercostal and stiffener  	a ≤ 2.0 mm	a = 3.0 mm	
Alignment of lap welds  	a ≤ 2.0 mm	a = 3.0 mm	

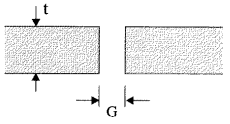
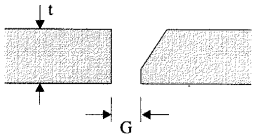
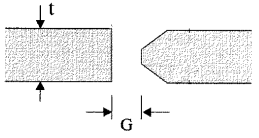
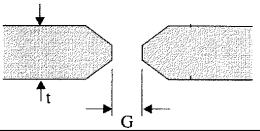
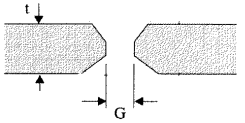
No. 47 (cont)

TABLE 7.3 – Alignment

Detail	Standard	Limit	Remarks
Gap between beam and frame 	a ≤ 2.0 mm	a = 5.0 mm	
Gap around stiffener cut-out 	s ≤ 2.0 mm	s = 3.0 mm	

No. 47 (cont)

TABLE 8.1 – Typical Butt Weld Plate Edge Preparation (Manual Welding and Semi-Automatic Welding) for Reference

Detail	Standard	Limit	Remarks
Square butt $t \leq 5$ mm 	$G \leq 3$ mm	$G = 5$ mm	see Note 1
Single bevel butt $t > 5$ mm 	$G \leq 3$ mm	$G = 5$ mm	see Note 1
Double bevel butt $t > 19$ mm 	$G \leq 3$ mm	$G = 5$ mm	see Note 1
Double vee butt, uniform bevels 	$G \leq 3$ mm	$G = 5$ mm	see Note 1
Double vee butt, non-uniform bevel 	$G \leq 3$ mm	$G = 5$ mm	see Note 1

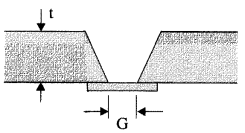
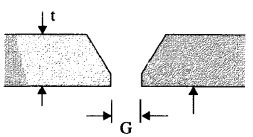
No. 47 (cont)

NOTE 1

Different plate edge preparation may be accepted or approved by the Classification Society in accordance with UR W28 (ref. A10) or other recognized standard accepted by the Classification Society.

For welding procedures other than manual welding, see paragraph 3.2 Qualification of weld procedures.

TABLE 8.2 – Typical Butt Weld Plate Edge Preparation (Manual Welding and Semi-Automatic Welding) for Reference

Detail	Standard	Limit	Remarks
Single Vee butt, one side welding with backing strip (temporary or permanent) 	G = 3 to 9 mm	G = 16 mm	see Note 1
Single vee butt 	G ≤ 3 mm	G = 5 mm	see Note 1

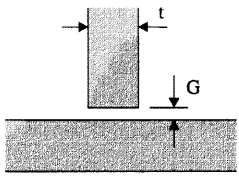
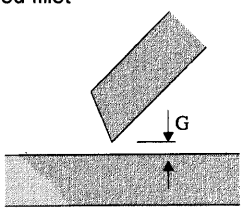
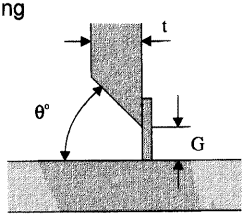
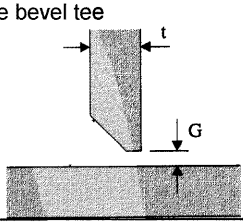
NOTE 1

Different plate edge preparation may be accepted or approved by the Classification Society in accordance with UR W28 (ref. A10) or other recognized standard accepted by the Classification Society.

For welding procedures other than manual welding, see paragraph 3.2 Qualification of welding procedures.

No. 47 (cont)

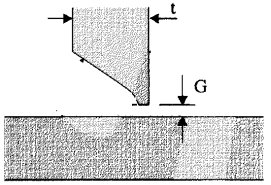
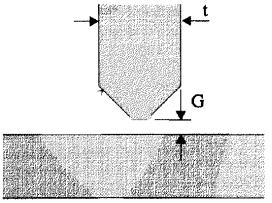
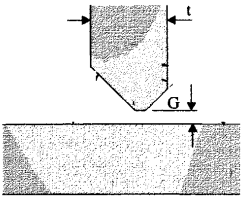
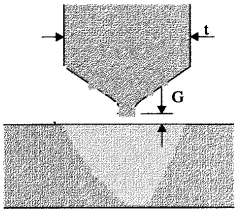
Table 8.3 – Typical Fillet Weld Plate Edge Preparation (Manual Welding and Semi-Automatic Welding) for Reference

Detail	Standard	Limit	Remarks
Tee Fillet 	G ≤ 2 mm	G = 3 mm	see Note 1
Inclined fillet 	G ≤ 2 mm	G = 3 mm	see Note 1
Single bevel tee with permanent backing 	G ≤ 4 to 6 mm θ° = 30° to 45°	G = 16 mm	Not normally for Strength member also see Note 1
Single bevel tee 	G ≤ 3 mm		see Note 1

NOTE 1
Different plate edge preparation may be accepted or approved by the Classification Society in accordance with UR W28 (ref. A10) or other recognized standard accepted by the Classification Society.
For welding procedures other than manual welding, see paragraph 3.2 Qualification of welding procedures.

No. 47 (cont)

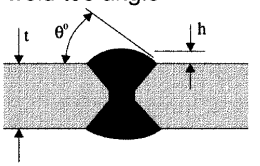
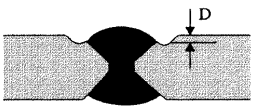
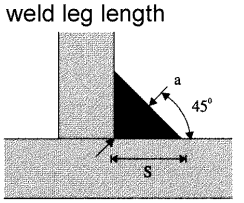
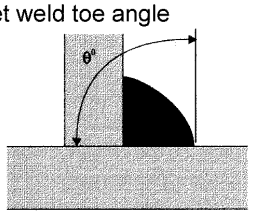
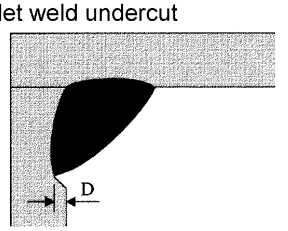
Table 8.4 – Typical Fillet Weld Plate Edge Preparation (Manual Welding and Semi-Automatic Welding) for Reference

Detail	Standard	Limit	Remarks
Single 'J' bevel tee 	G = 2.5 to 4 mm		see Note 1
Double bevel tee symmetrical t > 19 mm 	G ≤ 3 mm		see Note 1
Double bevel tee asymmetrical t > 19 mm 	G ≤ 3 mm		see Note 1
Double 'J' bevel tee symmetrical 	G = 2.5 to 4 mm		see Note 1

NOTE 1
Different plate edge preparation may be accepted or approved by the Classification Society in accordance with UR W28 (ref. A10) or other recognized standard accepted by the Classification Society.
For welding procedures other than manual welding, see paragraph 3.2 Qualification of welding procedures.

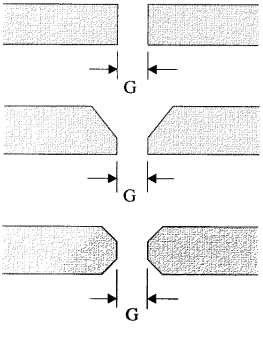
No. 47 (cont)

Table 8.5 – Butt And Fillet Weld Profile (Manual Welding and Semi-Automatic Welding)

Detail	Standard	Limit	Remarks
Butt weld toe angle 	$\theta \leq 60°$ $h \leq 6$ mm	$\theta \leq 90°$	
Butt weld undercut 		$D \leq 0.5$ mm for strength member $D \leq 0.8$ mm for other	
Fillet weld leg length  s = leg length; a = throat thickness		$s \geq 0.9s_d$ $a \geq 0.9a_d$ over short weld lengths	s_d = design s a_d = design a
Fillet weld toe angle 		$\theta \leq 90°$	In areas of stress concentration and fatigue, the Classification Society may require a lesser angle.
Fillet weld undercut 		$D \leq 0.8$ mm	

No. 47 (cont)

Table 8.6 – Typical Butt Weld Plate Edge Preparation (Automatic welding) for Reference

Detail	Standard	Limit	Remarks
Submerged Arc Welding (SAW)  	$0 \leq G \leq 0.8$ mm	G = 2 mm	See Note 1.

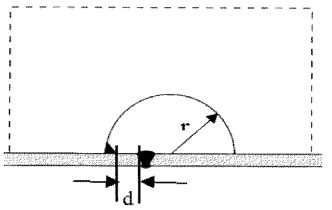
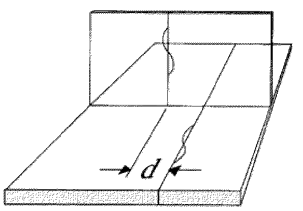
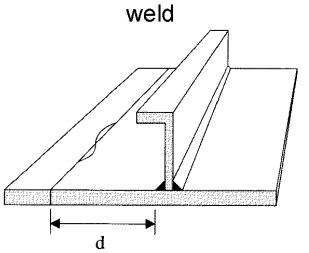
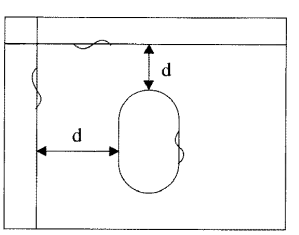
NOTE 1

Different plate edge preparation may be accepted or approved by the Classification Society in accordance with UR W28 (ref. A10) or other recognized standard accepted by the Classification Society.

For welding procedures other than manual welding, see paragraph 3.2 Qualification of welding procedures.

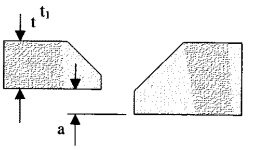
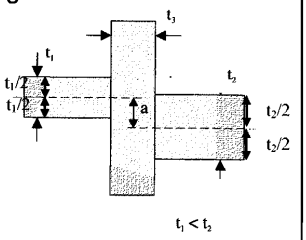
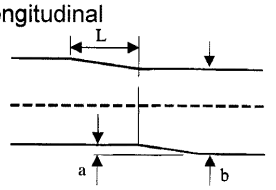
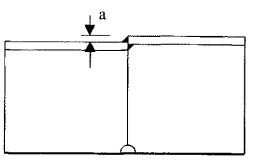
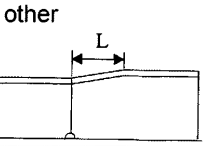
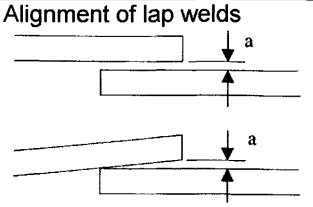
No. 47 (cont)

Table 8.7 – Distance Between Welds

Detail	Standard	Limit	Remarks
Scallops over weld seams 		for strength member $d \geq 5$mm for other $d \geq 0$mm	The "d" is to be measured from the toe of the fillet weld to the toe of the butt weld.
Distance between two butt welds 		$d \geq 0$ mm	
Distance between butt weld and fillet weld 		for strength member $d \geq 10$ mm for other $d \geq 0$ mm	The "d" is to be measured from the toe of the fillet weld to the toe of the butt weld.
Distance between butt welds 	for cut-outs $d \geq 30$ mm		
	for margin plates $d \geq 300$ mm	150 mm	

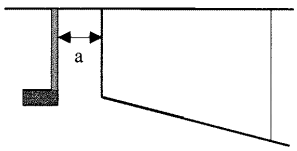
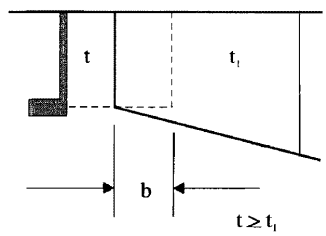
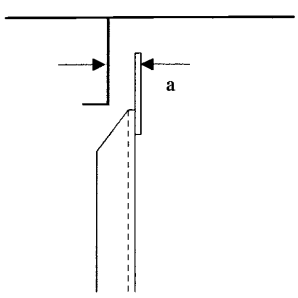
No. 47 (cont)

Table 9.1 – Typical Misalignment Remedial

Detail	Remedial Standard	Remarks
Alignment of butt joints 	Strength member $a > 0.15t_1$ or $a > 4$ mm release and adjust Other $a > 0.2t_1$ or $a > 4$ mm release and adjust	t_1 is lesser plate thickness
Alignment of fillet welds 	Strength member and higher stress member $t_1/3 < a \leq t_1/2$ - generally increase weld throat by 10% $a > t_1/2$ - release and adjust over a minimum of 50a Other $a > t_1/2$ - release and adjust over a minimum of 30a	Alternatively, heel line can be used to check the alignment. Where t_3 is less than t_1 then t_3 should be substituted for t_1 in standard
Alignment of flange of T-longitudinal 	When $0.04b < a \leq 0.08b$, max 8 mm: grind corners to smooth taper over a minimum distance L = 3a When $a > 0.08b$ or 8 mm: release and adjust over a minimum distance L = 50a	
Alignment of height of T-bar, L-angle bar or bulb 	When 3 mm < a ≤ 6 mm: build up by welding When a > 6 mm: release and adjust over minimum L = 50a for strength member and L = 30a for other 	
Alignment of lap welds 	3 mm < a ≤ 5 mm: weld leg length to be increased by the same amount as increase in gap in excess of 3 mm a > 5 mm: members to be re-aligned	

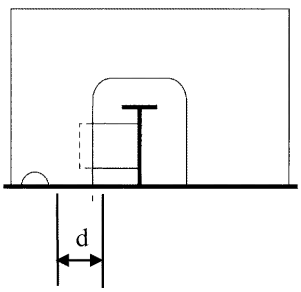
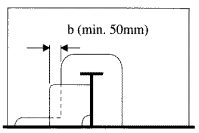
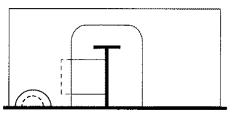
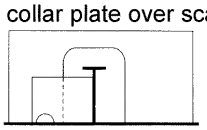
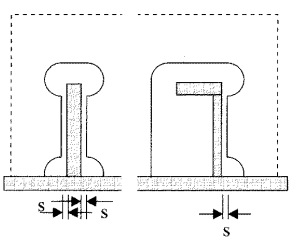
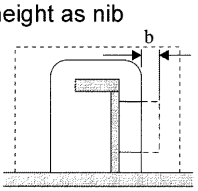
No. 47 (cont)

Table 9.2 – Typical Misalignment Remedial

Detail	Remedial Standard	Remarks
Gap between bracket/intercostal and stiffener 	When 3 mm < a ≤ 5 mm: weld leg length to be increased by increase in gap in excess of 3 mm	
	When 5mm < a ≤ 10 mm: chamfer 30° to 40° and build up by welding with backing	
	When a > 10 mm: increase gap to about 50 mm and fit collar plate  b = (2t + 25) mm, min. 50 mm	
Gap between beam and frame 	3 mm < a ≤ 5 mm: weld leg length to be increased by the same amount as increase in gap in excess of 3 mm a > 5 mm release and adjust	

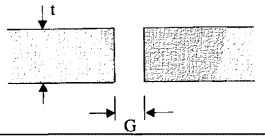
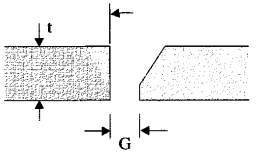
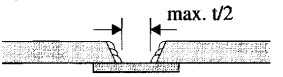
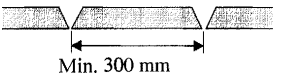
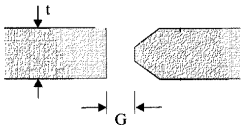
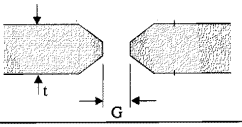
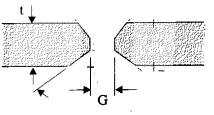
No. 47 (cont)

TABLE 9.3 – Misalignment Remedial

Detail	Remedial standard	Remarks
Position of scallop 	When d < 75 mm web plate to be cut between scallop and slot, and collar plate to be fitted  Or fit small collar over scallop  Or fit collar plate over scallop 	
Gap around stiffener cut-out 	When 3 mm < s ≤ 5 mm weld leg length to be increased by the same amount as increase in gap in excess of 2 mm	
	When 5 mm < s ≤ 10 mm nib to be chamfered and built up by welding	
	When s > 10 mm cut off nib and fit collar plate of same height as nib  20 mm ≤ b ≤ 50 mm	

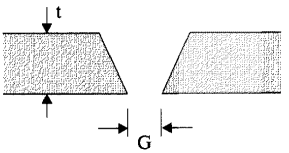
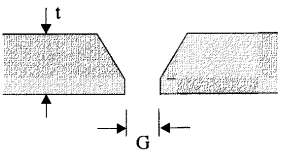
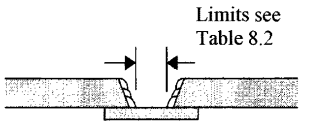
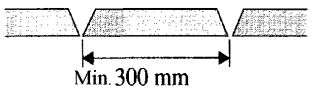
No. 47 (cont)

TABLE 9.4 – Typical Butt Weld Plate Edge Preparation Remedial (Manual Welding and Semi-Automatic Welding)

Detail	Remedial standard	Remarks
Square butt 	When G ≤ 10 mm chamfer to 45° and build up by welding When G > 10mm build up with backing strip; remove, back gouge and seal weld; or, insert plate, min. width 300 mm	
Single bevel butt 	When 5 mm < G ≤ 1.5t (maximum 25 mm) build up gap with welding on one or both edges to maximum of 0.5t, using backing strip, if necessary. Where a backing strip is used, the backing strip is to be removed, the weld back gouged, and a sealing weld made.  Different welding arrangement by using backing material approved by the Classification Society may be accepted on the basis of an appropriate welding procedure specification. When G > 25 mm or 1.5t, whichever is smaller, use insert plate, of minimum width 300 mm 	
Double bevel butt 		
Double vee butt, uniform bevels 		
Double vee butt, non-uniform bevel 		

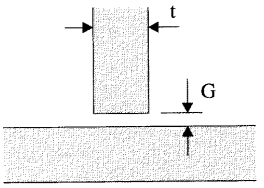
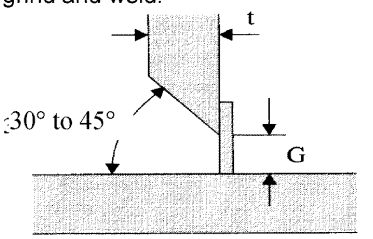
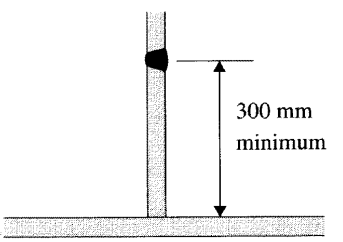
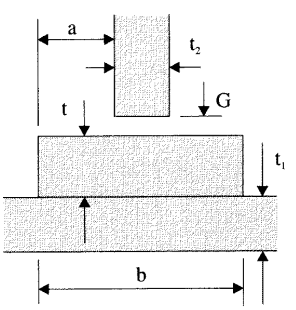
No. 47 (cont)

TABLE 9.5 – Typical Butt Weld Plate Edge Preparation Remedial (Manual Welding and Semi-Automatic Welding)

Detail	Remedial Standard	Remarks
Single vee butt, one side welding 	When 5 mm < G ≤ 1.5t mm (maximum 25 mm), build up gap with welding on one or both edges, to "Limit" gap size preferably to "Standard" gap size as described in Table 8.2. Where a backing strip is used, the backing strip is to be removed, the weld back gouged, and a sealing weld made. Different welding arrangement by using backing material approved by the Classification Society may be accepted on the basis of an appropriate welding procedure specification. When G > 25 mm or 1.5t, whichever is smaller, use insert plate of minimum width 300 mm.	
Single vee butt 	 	

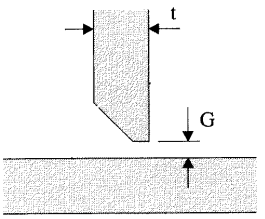
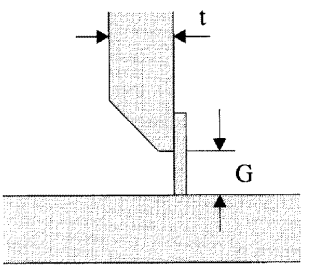
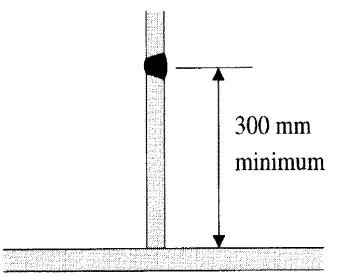
No. 47 (cont)

TABLE 9.6 – Typical Fillet Weld Plate Edge Preparation Remedial (Manual Welding and Semi-Automatic Welding)

Detail	Remedial standard	Remarks
Tee Fillet 	3 mm < G ≤ 5 mm – leg length increased to Rule leg + (G-2)	
	5 mm < G ≤ 16 mm or G ≤ 1.5t - chamfer by 30° to 45°, build up with welding, on one side, with backing strip if necessary, grind and weld. 	
	G > 16 mm or G > 1.5t use insert plate of minimum width 300 mm 	
Liner treatment 	$t_2 \le t \le t_1$ G ≤ 2 mm a = 5 mm + fillet leg length	Not to be used in cargo area or areas of tensile stress through the thickness of the liner

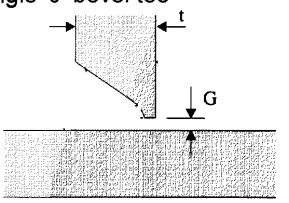
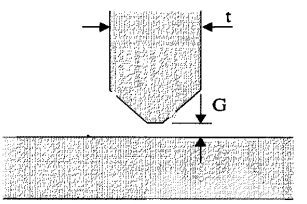
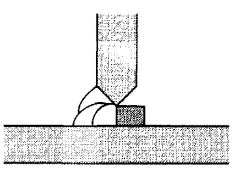
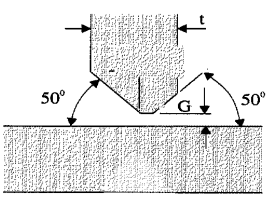
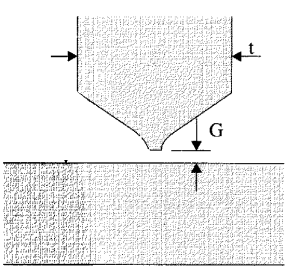
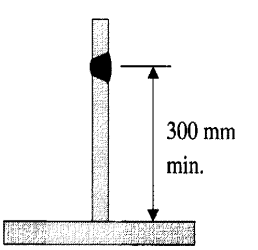
No. 47 (cont)

TABLE 9.7 – Typical Fillet Weld Plate Edge Preparation Remedial (Manual Welding and Semi-Automatic Welding)

Detail	Remedial standard	Remarks
Single bevel tee 	3 mm < G ≤ 5 mm build up weld	
	5 mm < G ≤ 16 mm - build up with welding, with backing strip if necessary, remove backing strip if used, back gouge and back weld. 	
	G > 16 mm new plate to be inserted of minimum width 300 mm 	

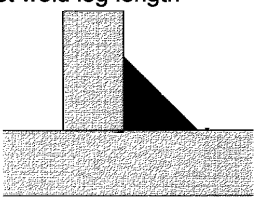
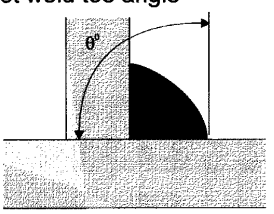
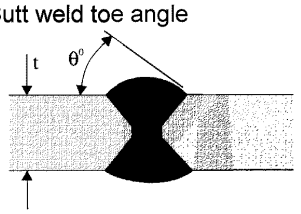
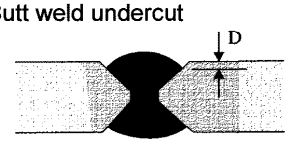
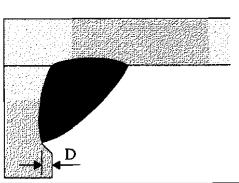
No. 47 (cont)

TABLE 9.8 – Typical Fillet Weld Plate Edge Preparation Remedial (Manual Welding and Semi-Automatic Welding)

Detail	Remedial standard	Remarks
Single 'J' bevel tee 	as single bevel tee	
Double bevel tee symmetrical 	When 5 mm < G ≤ 16 mm build up with welding using ceramic or other approved backing bar, remove, back gouge and back weld. 	
Double bevel tee asymmetrical 		
Double 'J' bevel symmetrical 	When G > 16 mm-insert plate of minimum height 300 mm to be fitted. 	

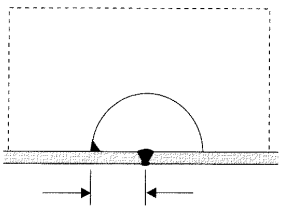
No. 47 (cont)

TABLE 9.9 – Typical Fillet and Butt Weld Profile Remedial (Manual Welding and Semi-Automatic Welding)

Detail	Remedial standard	Remarks
Fillet weld leg length 	Increase leg or throat by welding over	Minimum short bead to be referred Table 9.14
Fillet weld toe angle 	$\theta > 90°$ grinding, and welding, where necessary, to make $\theta \leq 90°$	
Butt weld toe angle 	$\theta > 90°$ grinding, and welding, where necessary, to make $\theta \leq 90°$	
Butt weld undercut 	For strength member, where $0.5 < D \leq 1$ mm, and for other, where $0.8 < D \leq 1$ mm, undercut to be ground smooth (localized only) or to be filled by welding Where $D > 1$ mm undercut to be filled by welding	
Fillet weld undercut 	Where $0.8 < D \leq 1$ mm undercut to be ground smooth (localized only) or to be filled by welding Where $D > 1$ mm undercut to be filled by welding	

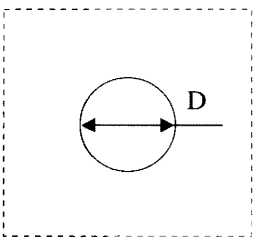
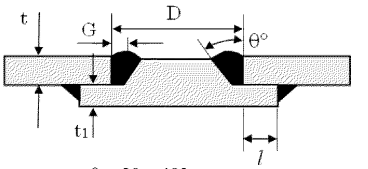
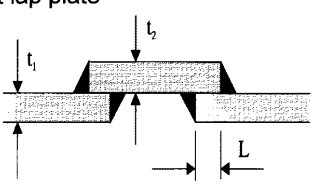
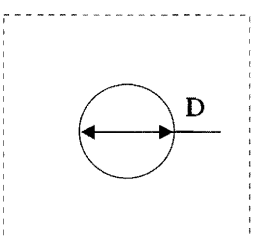
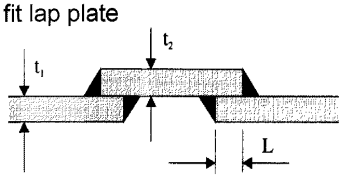
No. 47 (cont)

TABLE 9.10 – Distance Between Welds Remedial

Detail	Remedial standard	Remarks
Scallops over weld seams 	Hole to be cut and ground smooth to obtain distance	

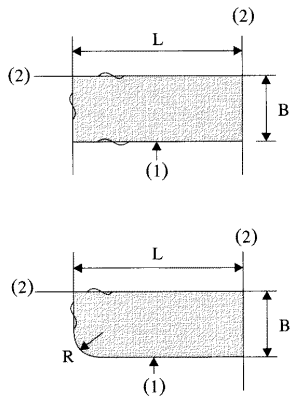
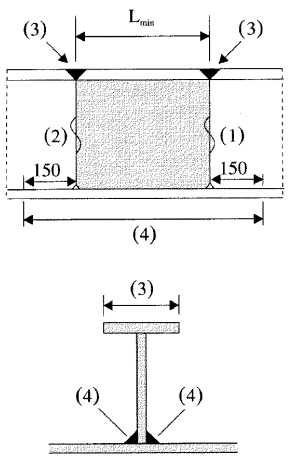
No. 47 (cont)

TABLE 9.11 – Erroneous Hole Remedial

Detail	Remedial standard	Remarks
Holes made erroneously D < 200 mm 	Strength member open hole to minimum 75 mm dia., fit and weld spigot piece  θ = 30 – 40° G = 4 – 6 mm 1/2t ≤ t1 ≤ t l = 50 mm Or open hole to over 300 mm and fit insert plate	Fillet weld to be made after butt weld
	Other open hole to over 300 mm and fit insert plate Or fit lap plate  $t_1 = t_2$ L = 50 mm, min	The fitting of spigot pieces in areas of high stress concentration or fatigue is to be approved by the Classification Society.
Holes made erroneously D ≥200 mm 	Strength member open hole and fit insert plate	
	Other open hole to over 300 mm and fit insert plate Or fit lap plate  $t_1 = t_2$ L = 50 mm, min	

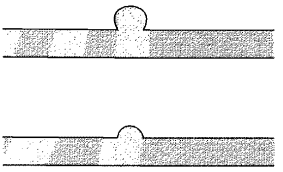
No. 47 (cont)

TABLE 9.12 – Remedial by Insert Plate

Detail	Remedial standard	Remarks
Remedial by insert plate 	L = 300 mm minimum B = 300 mm minimum R = 5t mm 100mm minimum (1) seam with insert piece is to be welded first (2) original seam is to be released and welded over for a minimum of 100 mm.	
Remedial of built section by insert plate 	$L_{min} \geq 300$ mm Welding sequence (1) →(2) →(3) →(4) Web butt weld scallop to be filled during final pass (4)	

No. 47 (cont)

TABLE 9.13 – Weld Surface Remedial

Detail	Remedial standard	Remarks
Weld spatter 	1. Remove spatter observed before blasting with scraper or chipping hammer, etc. 2. For spatter observed after blasting: a) Remove with a chipping hammer, scraper, etc. b) For spatter not easily removed with a chipping hammer, scraper, etc., grind the sharp angle of spatter to make it obtuse.	In principle, no grinding is applied to weld surface.
Arc strike (HT steel, Cast steel, Grade E of mild steel, TMCP type HT steel, Low temp steel)	Remove the hardened zone by grinding or other measures such as overlapped weld bead etc.	Minimum short bead to be referred Table 9.14

No. 47 (cont)

TABLE 9.14 – Welding Remedial by Short Bead

Detail	Remedial standard	Remarks
Short bead for remedying scar (scratch)	a) HT steel, Cast steel, TMCP type HT steel (Ceq > 0.36%) and Low temp steel (Ceq > 0.36%) Length of short bead ≥ 50 mm b) Grade E of mild steel Length of short bead ≥ 30 mm c) TMCP type HT steel (Ceq ≤ 0.36%) and Low temp steel (Ceq ≤ 0.36%) Length of short bead ≥ 10 mm	Preheating is necessary at 100 ± 25°C
Remedying weld bead	a) HT steel, Cast steel, TMCP type HT steel (Ceq > 0.36%) and Low temp steel (Ceq > 0.36%) Length of short bead ≥ 50 mm b) Grade E of mild steel Length of short bead ≥ 30 mm c) TMCP type HT steel (Ceq ≤ 0.36%) and Low temp steel (Ceq ≤ 0.36%) Length of short bead ≥ 30 mm	

NOTE:

1. When short bead is made erroneously, remove the bead by grinding.
2. $Ceq = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15} (\%)$

No. 47 Part B

Repair Quality Standard for Existing Ships

No. 47 (cont)

Part B - Shipbuilding and Repair Quality Standard for Existing Ships

CONTENTS:

1. Scope

2. General requirements to repairs and repairers

3. Qualification of personnel

3.1 Qualification of welders
3.2 Qualification of welding procedures
3.3 Qualification of NDE operators

4. Materials

4.1 General requirements to materials
4.2 Equivalency of material grades

5. General requirements to welding

5.1 Correlation of welding consumables to hull structural steels
5.2 General requirements to preheating and drying out
5.3 Dry welding on hull plating below the waterline of vessels afloat

6. Repair quality standard

6.1 Welding, general
6.2 Renewal of plates
6.3 Doubler on plates
6.4 Renewal of internals/stiffeners
6.5 Renewal of internals/stiffeners - transitions inverted angles/bulb profiles
6.6 Application of Doubling Straps
6.7 Welding of pitting corrosion
6.8 Welding repairs of cracks

No. 47 (cont)

REFERENCES

B1. IACS Recommendation 76 "Bulk Carriers - Guidelines for Surveys, Assessment and Repair of Hull Structure"

B2. TSCF "Guidelines for the inspection and maintenance of double hull tanker structures"

B3. TSCF "Guidance manual for the inspection and condition assessment of tanker structures"

B4. IACS UR W11 "Normal and higher strength hull structural steels"

~~5. IACS UR W3 "Thickness tolerances of steel plates and wide flats"~~

~~6~~B5. IACS UR W17 "Approval of consumables for welding normal and higher strength hull structural steels"

~~7~~B6. Annex I to IACS Z10.1 "Hull surveys of oil tankers", ~~and~~ Z10.2 "Hull surveys of bulk carriers", Z10.3 "Hull Surveys of Chemical Tankers", Z10.4 "Hull Surveys of Double Hull Oil Tankers" and "Z10.5 Hull Surveys of Double-Skin Bulk Carriers" ~~Table IV~~

~~8~~B7. IACS UR Z3 "Voyage repairs and maintenance"

~~9~~B8. IACS Recommendation 12 "Guidelines for surface finish of hot rolled steel plates and wide flats"

~~10~~B9. IACS Recommendation 20 "Non-destructive testing of ship hull steel welds"

B10. IACS Recommendation No.96 "Double Hull Oil Tankers- Guidelines for Surveys, Assessment and Repair of Hull Structures"

B11. IACS Recommendation No.55 "General Dry Cargo Ships- Guidelines for Surveys, Assessment and Repair of Hull Structures"

B12. IACS Recommendation No.84 "Container Ships- Guidelines for Surveys, Assessment and Repair of Hull Structures"

No. 47 (cont)

1. Scope

1.1 This standard provides guidance on quality of repair of hull structures. The standard covers permanent repairs of existing ships.

Whereas the standard generally applies to

- conventional ship types,
- parts of hull covered by the rules of the Classification Society,
- hull structures constructed from normal and higher strength hull structural steel, the applicability of the standard is in each case to be agreed upon by the Classification Society.

The standard does generally not apply to repair of

- special types of ships as e.g. gas tankers
- structures fabricated from stainless steel or other, special types or grades of steel

1.2 The standard covers typical repair methods and gives guidance on quality standard on the most important aspects of such repairs. Unless explicitly stated elsewhere in the standard, the level of workmanship reflected herein will in principle be acceptable for primary and secondary structure of conventional design. A more stringent standard may however be required for critical and highly stressed areas of the hull, and is to be agreed with the Classification Society in each case. In assessing the criticality of hull structure and structural components, reference is made to ref. B1, B2, ~~and~~ B3, B6, B10, B11 and B12.

1.3 Restoration of structure to the original standard may not constitute durable repairs of damages originating from insufficient strength or inadequate detail design. In such cases strengthening or improvements beyond the original design may be required. Such improvements are not covered by this standard, however it is referred to ref. B1, B2, ~~and~~ B3, B6, B10, B11 and B12.

No. 47 (cont)

2. General requirements for repairs and repairers

2.1 In general, when hull structure covered by classification is to be subjected to repairs, the work is to be carried out under the supervision of the Surveyor to the Classification Society. Such repairs are to be agreed prior to commencement of the work.

2.2 Repairs are to be carried out by workshops, repair yards or personnel who have demonstrated their capability to carry out hull repairs of adequate quality in accordance with the Classification Society's requirements and this standard.

2.3 Repairs are to be carried out under working conditions that facilitate sound repairs. Provisions are to be made for proper accessibility, staging, lighting and ventilation. Welding operations are to be carried out under shelter from rain, snow and wind.

2.4 Welding of hull structures is to be carried out by qualified welders, according to approved and qualified welding procedures and with welding consumables approved by the Classification Society, see Section 3. Welding operations are to be carried out under proper supervision of the repair yard.

2.5 Where repairs to hull which affect or may affect classification are intended to be carried out during a voyage, complete repair procedure including the extent and sequence of repair is to be submitted to and agreed upon by the Surveyor to the Classification Society reasonably in advance of the repairs. See Ref. ~~8~~ B7.

No. 47 (cont)

3. Qualification of personnel

3.1 Qualification of welders

3.1.1 Welders are to be qualified in accordance with the procedures of the Classification Society or to a recognised national or international standard, e.g. EN 287, ISO 9606, ASME Section IX, ANSI/AWS D1.1. Recognition of other standards is subject to submission to the Classification Society for evaluation. Repair yards and workshops are to keep records of welders qualification and, when required, furnish valid approval test certificates.

3.1.2 Welding operators using fully mechanised of fully automatic processes need generally not pass approval testing, provided that production welds made by the operators are of the required quality. However, operators are to receive adequate training in setting or programming and operating the equipment. Records of training and production test results shall be maintained on individual operator's files and records, and be made available to the Classification Society for inspection when requested.

3.2 Qualification of welding procedures

Welding procedures are to be qualified in accordance with the procedures of the Classification Society or a recognised national or international standard, e.g. EN288, ISO 9956, ASME Section IX, ANSI/AWS D1.1. Recognition of other standards is subject to submission to the Classification Society for evaluation. The welding procedure should be supported by a welding procedure qualification record. The specification is to include the welding process, types of electrodes, weld shape, edge preparation, welding techniques and positions.

3.3 Qualification of NDE operators

3.3.1 Personnel performing non destructive examination for the purpose of assessing quality of welds in connection with repairs covered by this standard, are to be qualified in accordance with the Classification Society rules or to a recognised international or national qualification scheme. Records of operators and their current certificates are to be kept and made available to the Surveyor for inspection.

No. 47 (cont)

4. Materials

4.1 General requirements for materials

4.1.1 The requirements for materials used in repairs are in general the same as the requirements for materials specified in the Classification Society's rules for new constructions, (ref. ~~5~~ B4).

4.1.2 Replacement material is in general to be of the same grade as the original approved material. Alternatively, material grades complying with recognised national or international standards may be accepted by the Classification Societies provided such standards give equivalence to the requirements of the original grade or are agreed by the Classification Society. For assessment of equivalency between steel grades, the general requirements and guidelines in Section 4.2 apply.

4.1.3 Higher tensile steel is not to be replaced by steel of a lesser strength unless specially approved by the Classification Society.

4.1.4 Normal and higher strength hull structural steels are to be manufactured at works approved by the Classification Society for the type and grade being supplied.

4.1.5 Materials used in repairs are to be certified by the Classification Society applying the procedures and requirements in the rules for new constructions. In special cases, and normally limited to small quantities, materials may be accepted on the basis of alternative procedures for verification of the material's properties. Such procedures are subject to agreement by the Classification Society in each separate case.

4.2 Equivalency of material grades

4.2.1 Assessment of equivalency between material grades should at least include the following aspects;

- heat treatment/delivery condition
- chemical composition
- mechanical properties
- tolerances

4.2.2 When assessing the equivalence between grades of normal or higher strength hull structural steels up to and including grade E40 in thickness limited to 50 mm, the general requirements in Table 4.1 apply.

4.2.3 Guidance on selection of steel grades to certain recognised standards equivalent to hull structural steel grades specified in Classification Societies' rules is given in Table 4.2

No. 47 (cont)

Items to be considered	Requirements	Comments
Chemical composition	- C; equal or lower - P and S; equal or lower - Mn; approximately the same but not exceeding 1.6% - Fine grain elements; in same amount - Detoxidation practice	The sum of the elements, e.g. Cu, Ni, Cr and Mo should not exceed 0.8%
Mechanical properties	- Tensile strength; equal or higher Yield strength; equal or higher - Elongation; equal or higher - Impact energy; equal or higher at same or lower temperature, where applicable	Actual yield strength should not exceed Classification Society Rule minimum requirements by more than 80 N/mm^2
Condition of supply	Same or better	Heat treatment in increasing order; - as rolled (AR) - controlled rolled (CR) - normalised (N) - thermo-mechanically rolled (TM)[1)] - quenched and tempered (QT)[1)] [1)] TM- and QT-steels are not suitable for hot forming
Tolerances	- Same or stricter	Permissable under thickness tolerances; - plates: 0.3 mm - sections: according to recognised standards

Table 4.1 Minimum extent and requirements to assessment of equivalency between normal or higher strength hull structual steel grades

No. 47 (cont)

Steel grades according to Classification Societies' rules (ref. ~~5~~ B4)							Comparable steel grades(1)			
Grade	Yield stress R_{eH} min. (N/mm^2)	Tensile strength R_m (N/mm^2)	~~Elongation A_5min.~~ Elongation A_5min. (%)	Average impact energy for t≤50mm Test ~~T~~temp. (°C)	(J, min.) L	T	~~ISO 630-80 4950/2/3/ 1981~~ EN 10025:1990 (2) ISO 4950-2:1995	~~EN~~ ~~EN 10025-93~~ ~~EN 10113-93~~ EN 10025 series:2004	ASTM A 131 GB 712-2011	JIS G 3106
A B D E	235	400-~~502~~ 520	22	+20 0 -20 -40	- 27 27 27	- 20 20 20	Fe 360B Fe 360C Fe 360D -	S235JR~~G2~~ S235J0 S235J2~~G3~~ S275NL~~/~~, S275ML	A B D E	~~SM41B~~SM400B ~~SM41B~~SM400B, SM400C ~~(SM41C)~~ -
A 27 D 27 E 27	265	400-530	22	0 -20 -40	27	20	Fe 430C Fe 430D -	S275J0~~G3~~ S275J2, S275N~~/~~, S275M S275NL~~/~~, S275ML	- - -	- - -
A 32 D 32 E 32	315	440-~~590~~570	22	0 -20 -40	31	22	- - -	- - -	AH32 DH32 EH32	~~SM50B,(SM50C)~~ SM490B, SM490C -
A 36 D 36 E 36	355	490-~~620~~630	21	0 -20 -40	34	24	Fe 510C Fe 510D, E355DD E355E	S355J0~~N/M~~ S355J2, S355N~~/~~, S355M S355NL~~/~~, S355ML	AH36 DH36 EH36	~~SM53B,(SM53C)~~ SM520B, SM520C - -
A 40 D 40 E 40	390	510-~~650~~660	20	0 -20 -40	~~41~~ 39	~~27~~ 26	E390CC E390DD E390E	S420N~~/M~~, S420M S420N~~/M~~, S420M S420NL~~/~~, S420ML	AH40 DH40 EH40	~~(SM58)~~SM570 - -

No. 47 (cont)

Note: (1) In selecting comparitable steels from this table, attention should be given to the requirements of Table 4.1 and the dimension requirements of the product with respect to Classification ~~Sociey~~ Society rules. Some steel grades as per national or international standard are defined with specified yield and tensile strength properties which depend on thickness. For thicknesses with tensile properties specified lower than those of the Classification Society's Rules, case-by-case consideration shall be given with regards to design requirements.
(2) EN 10025:1990 is superseded by EN10025 series.

Table 4.2 Guidance on steel grades comparable to the normal and high strength hull structural steel grades given in Classification Society rules

No. 47 (cont)

5. General requirements to welding

5.1 Correlation of welding consumables with hull structural steels

5.1.1 For the different hull structural steel grades welding consumables are to be selected in accordance with IACS UR W17 (see Ref.~~6~~ B5).

5.2 General requirements to preheating and drying out

5.2.1 The need for preheating is to be determined based on the chemical composition of the materials, welding process and procedure and degree of joint restraint.

5.2.2 A minimum preheat of 50° C is to be applied when ambient temperature is below 0° C. Dryness of the welding zone is in all cases to be ensured.

5.2.3 Guidance on recommended minimum preheating temperature for higher strength steel is given in Table 5.1. For automatic welding processes utilising higher heat input e.g. submerged arc welding, the temperatures may be reduced by 50° C. For re-welding or repair of welds, the stipulated values are to be increased by 25° C.

Carbon equivalent [1]	Recommended minimum preheat temperature (° C)		
	$t_{comb} \leq 50$ mm [2]	50 mm < $t_{comb} \leq 70$ mm [2]	$t_{comb} > 70$ mm [2]
Ceq ≤ 0.39	- -	50	
Ceq ≤ 0.41	- -	75	
Ceq ≤ 0.43	-	50	100
Ceq ≤ 0.45	50	100	125
Ceq ≤ 0.47	100	125	150
Ceq ≤ 0.50	125	150	175

Table 5.1 Preheating temperature

5.3 Dry welding on hull plating below the waterline of vessels afloat

5.3.1 Welding on hull plating below the waterline of vessels afloat is acceptable only on normal and higher strength steels with specified yield strength not exceeding 355 MPa and only for local repairs. Welding involving other high strength steels or more extensive repairs against water backing is subject to special consideration and approval by the Classification Society of the welding procedure.

5.3.2 Low-hydrogen electrodes or welding processes are to be used when welding on hull plating against water backing. Coated low-hydrogen electrodes used for manual metal arc welding should be properly conditioned to ensure a minimum of moisture content.

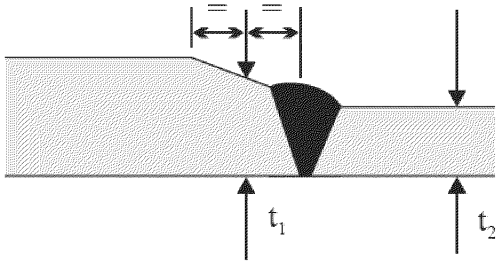
5.3.3 In order to ensure dryness and to reduce the cooling rate, the structure is to be preheated by a torch or similar prior to welding, to a temperature of minimum 5° C or as specified in the welding procedure.

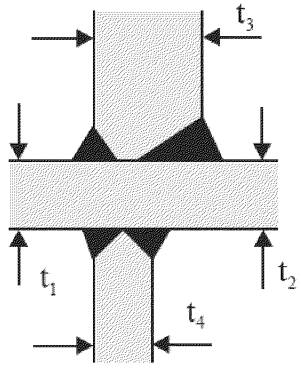
No. 47 (cont)

Notes:

1) $$Ceq = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}(\%)$$

2) Combined thickness $t_{comb} = t_1+t_2+t_3+t_4$, see figure





No. 47 (cont)

6. Repair quality standard

6.1 Welding, general

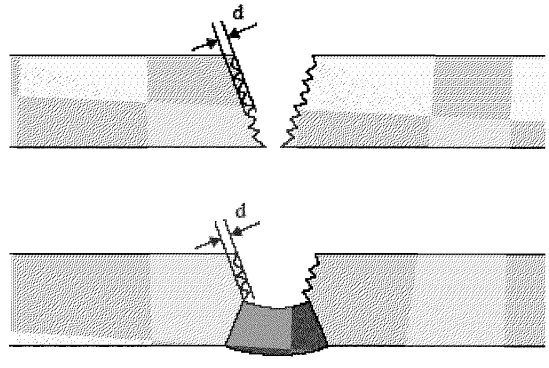


Fig 6.1 Groove roughness

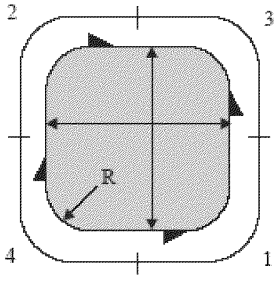
Item	Standard	Limit	Remarks
Material Grade	Same as original or higher		See Section 4
Welding Consumables	IACS UR W17 (ref. ~~6~~ B5)	Approval according to equivalent international standard	
Groove / Roughness	See note and Fig 6.1	d < 1.5 mm	Grind smooth
Pre-Heating	See Table 5.1	Steel temperature not lower than 5°C	
Welding with water on the outside	See Section 5.3	Acceptable for normal and high strength steels	- Moisture to be removed by a heating torch
Alignment	As for new construction		
Weld Finish	IACS Recommendation 20 (ref. ~~10~~ B9)		
NDE	IACS Recommendation 20 (ref. ~~10~~ B9)	At random with extent to be agreed with attending surveyors	

Note:

Slag, grease, loose mill scale, rust and paint, other than primer, to be removed.

No. 47 (cont)

6.2 Renewal of plates



R = 5 x plate thickness
min. 100mm

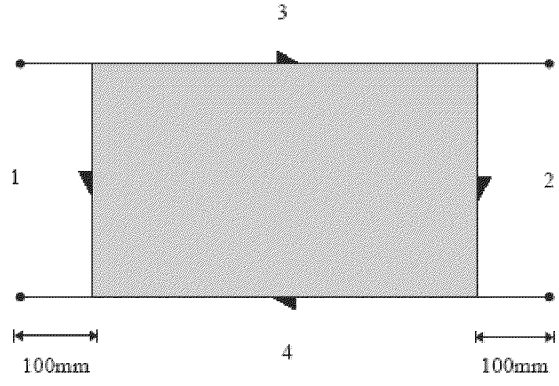


Fig 6.2 Welding sequence for inserts

Item	Standard	Limit	Remarks
Size Insert	Min. 300 x 300 mm R = 5 x thickness Circular inserts: D_{min} = 200 mm	Min. 200 x 200 mm Min R = 100 mm	
Marterial Grade	Same as original or higher		See Section 4.
Edge Preparation	As for new construction		In case of non compliance increase the amount of NDE
Welding Sequence	See Fig 6.2 Weld sequence is 1→ 2 → 3→4		For primary members sequence 1 and 2 transverse to the main stress direction
Alignment	As for new construction		
Weld Finish	IACS Recommendation 20 (ref. ~~10~~ B9)		
NDE	IACS Recommendation 20 (ref. ~~10~~ B9)		

No. 47 (cont)

6.3 Doublers on plating

Local doublers are normally only allowed as temporary repairs, except as original compensation for openings, within the main hull structure.

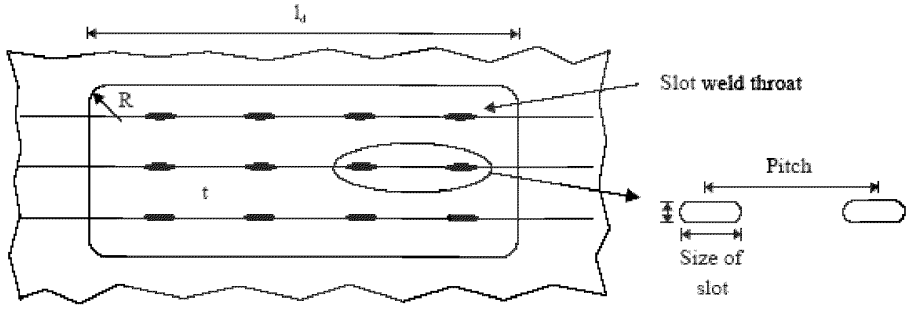


Fig 6.3 Doublers on plates

Item	Standard	Limit	Remarks
Existing Plating		General: t ≥ 5 mm	For areas where existing plating is less than 5 mm plating a permanent repair by insert is to be carried out.
Extent / Size	Rounded off corners.	min 300 x 300 mm R ≥ 50 mm	
Thickness of Doubler (td)	td ≤ tp (tp = original thickness of existing plating)	td > tp/3	
Material Grade	Same as original plate		See Section 4
Edge Preparation	As for [newbuidling] new construction		Doublers welded on primary strength members: (Le: leg length) when t > Le + 5 mm, the edge to be tapered (1:4)
Welding	As for [newbuidling] new construction		Welding sequence similar to insert plates.
Weld Size (throat thicknesss)	Circumferencial and in slots: 0.6 x td		
Slot Welding	Normal size of slot: (80-100) x 2 td Distance from doubler edge and between slots: d ≤ 15 td	Max pitch between slots 200 mm dmax = 500 mm	For doubler extended over several supporting elements, see Figure 6.3
NDE	IACS Recommendation 20 (ref. ~~10~~ B9)		

No. 47 (cont)

6.4 Renewal of internals/stiffeners

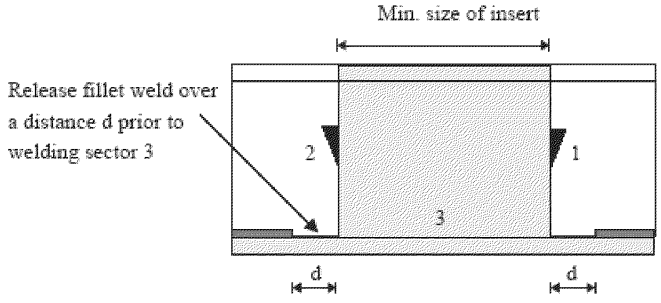


Fig 6.4 Welding sequence for inserts of stiffeners

Item	Standard	Limit	Remarks
Size Insert	Min. 300 mm	Min. 200 mm	
Marterial Grade	Same as original or higher		See Section 4.
Edge Preparation	As for new construction. Fillet weld stiffener web / plate to be released over min. d = 150 mm		
Welding Sequence	See Fig 6.4 Welding sequence is 1→ 2 →3		
Alignment	As for new construction		
Weld Finish	IACS Recommendation 20 (ref. ~~10~~ B9)		
NDE	IACS Recommendation 20 (ref. ~~10~~ B9)		

No.55

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GENERAL DRY CARGO SHIPS -

Guidelines for Surveys, Assessment and Repair of Hull Structure

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