



USER'S MANUAL

Studlink Chains & Accessories

KATRADIS GROUP OF COMPANIES

MANUFACTURER OF SYNTHETIC, HMPE ROPES & SACRIFICIAL ANODES

PROVIDER OF WIRE ROPES, ANCHORS & CHAINS, VESSEL DECK EQUIPMENT, PORT EQUIPMENT

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Contents**Pages**

Guide for the installation & maintenance of studlink chains and accessories....	3-4
Installation of Kenter shackle.....	5
Installation of End shackle.....	6
Installation of Swivel shackle.....	7
Lead sealing.....	8
Maintenance – Things to pay attention.....	9
Removal of twist of studlink chain.....	10-12
Maintenance on board – Discard criteria.....	13-15

Guide for the installation & maintenance of studlink chains and accessories

Anchor chain & offshore mooring chain (hereunder called chain) are widely applied in trans-ocean vessels, inland ships, naval vessels, offshore oil drilling platform, and all kinds of buoys, beacons and military dock, etc. In the past, there were 2 types of production: Flash butt welding (denoted by the letter a after the grade) and cast steel (denoted by the letter b after the grade).

Chains and accessories conform to ISO 1704 specification, and the shipyard's equipment drawing should be approved by classification society.

Chemical composition of killed steel bars

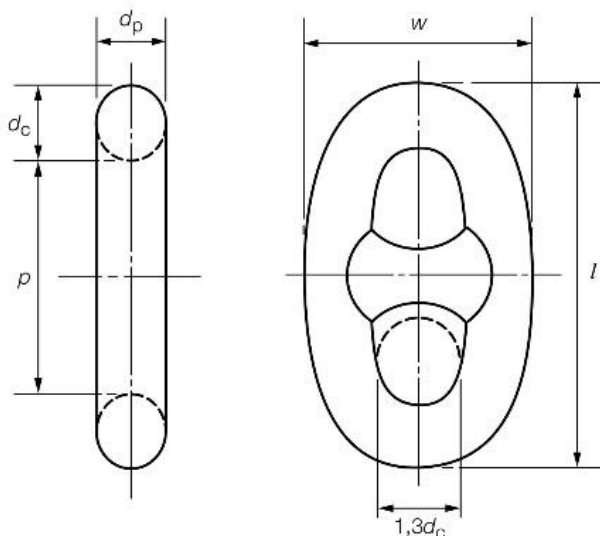
Grade	Chemical composition %												
	C max.	Si	Mn	P max.	S max.	Al	Nb max.	V max.	N max.	Cr max.	Cu max.	Ni max.	Mo max.
U1	0,20	0,15-0,35	0,40 min.	0,04	0,04	-	-	-	-	-	-	-	-
U2	0,24	0,15-0,55	1,60 max.	0,035	0,035	0,02 min. see Note 1	-	-	-	-	-	-	-
U3	0,33	0,15-0,35	1,90 max.	0,04	0,04	0,065 max. see Note 2	0,05 see Note 2	0,10 see Note 2	0,015	0,25	0,35	0,40	0,08

NOTES
 1. Aluminium may be partly replaced by other grain refining elements.
 2. To obtain fine grain steel, at least one of these grain refining elements must be present in sufficient amount.

Mechanical properties of chains and accessories

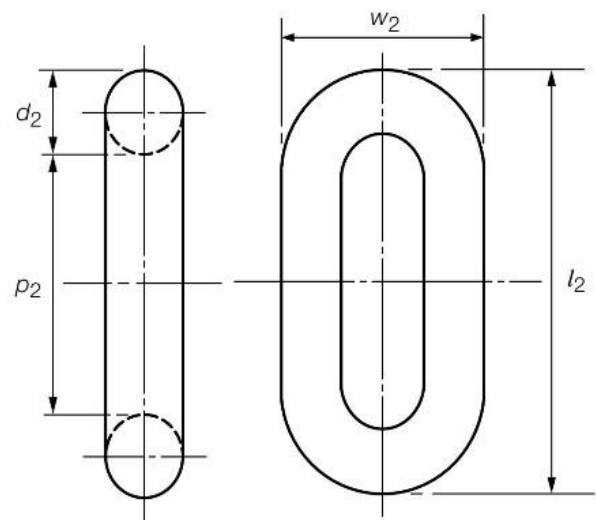
Grade	Yield point R_{eH} MPa ≥	Tensile strength R_m MPa ≥	Elongation A % ≥	Reduction of area Z % ≥	Impact energy		
					Test temp. °C	Test material J	Weldment J
1	—	370 ~ 490	25	—	—	—	—
2	295	490 ~ 690	22	—	0	≥27	—
3	410	690	17	40	0	≥60	≥50
					-20	≥35	≥27
4	490	770	12	50	-20	≥45	≥33

NOTE Impact testing is normally carried out at 0 °C.



d_c = nominal diameter at crown measured in plane of link
 d_p = nominal diameter at crown measured perpendicular to plane of link
 l = $6d_c$
 p = $4d_c$
 w = $3,6d_c$ to the nearest millimetre

Common link

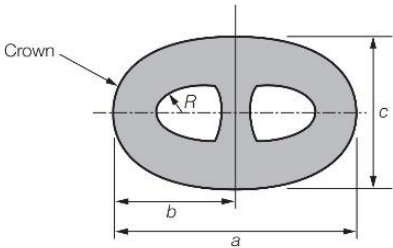


d_c = nominal diameter of common link
 d_2 = diameter of end link = $1,2d_c$
 l_2 = $p_2 + 2d_2 = 6,75d_c$
 p_2 = $4,35d_c$
 w_2 = $4d_c$

End link

Stud link tolerances

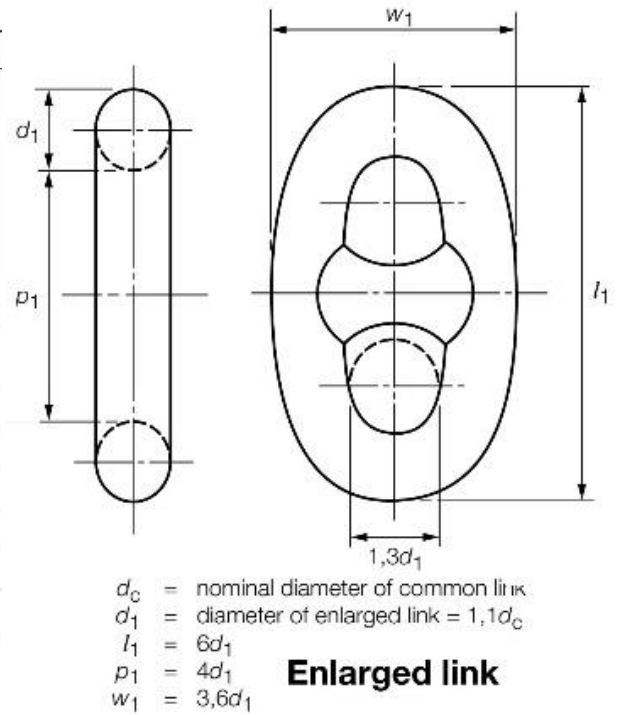
The internal link radii (R) and external radii should be uniform



Designation	Description	Nominal dimension of the link	Minus tolerance	Plus tolerance
a	Link length	$6d$	$0,15d$	$0,15d$
b	Link half length	$a^*/2$	$0,10d$	$0,10d$
c	Link width	$3,6d$	$0,09d$	$0,09d$
e	Stud angular misalignment	0 degrees	4 degrees	4 degrees
R	Inner radius	$0,65d$	0	—

d = nominal diameter of chain
 a^* = actual link length

Symbols



Before deploying the chains and accessories, inspection must ensure that the links & shackles are connected properly and chain lengths are not twisted.

Swivel shackle and the anchor are to be in such a connection that flexible rotation is possible.

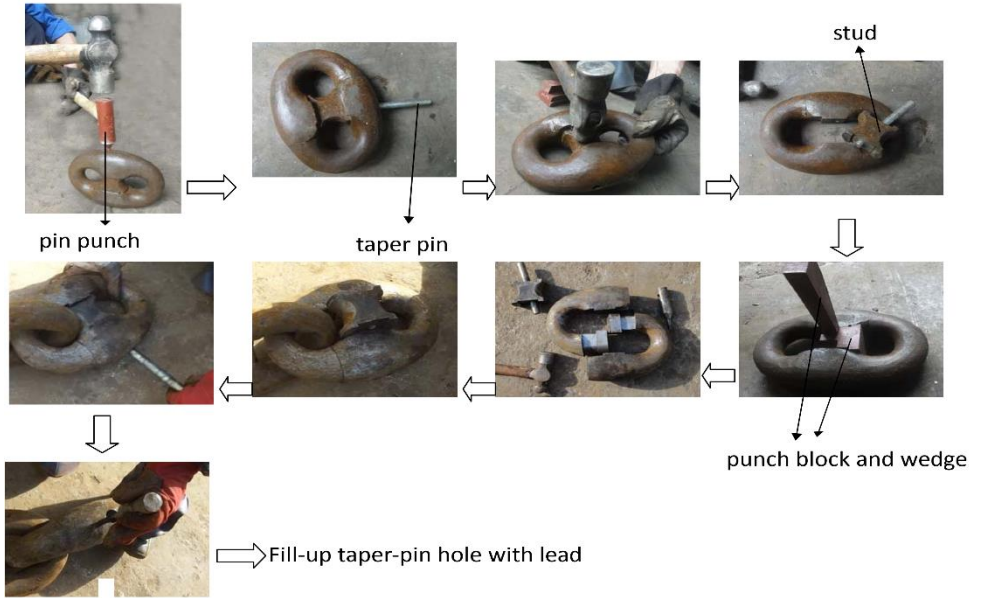
The taper-pin holes of Kenter shackle, end shackle and swivel shackle are to be sealed with lead. Should anything abnormal or nonconforming arises, the chains and accessories are not to be employed until solution is found. If, prior to employment, the chain and accessory are found seriously rusted due to bad storage or other reasons, which may impair future service of the products, replacement for new chains and accessories may be required. Surface rust is not considered as serious damage or wear, it can be wiped off by a wire brush.

Installation of Kenter shackle, end shackle, joining shackle and swivel shackle is laid out in the next pages.

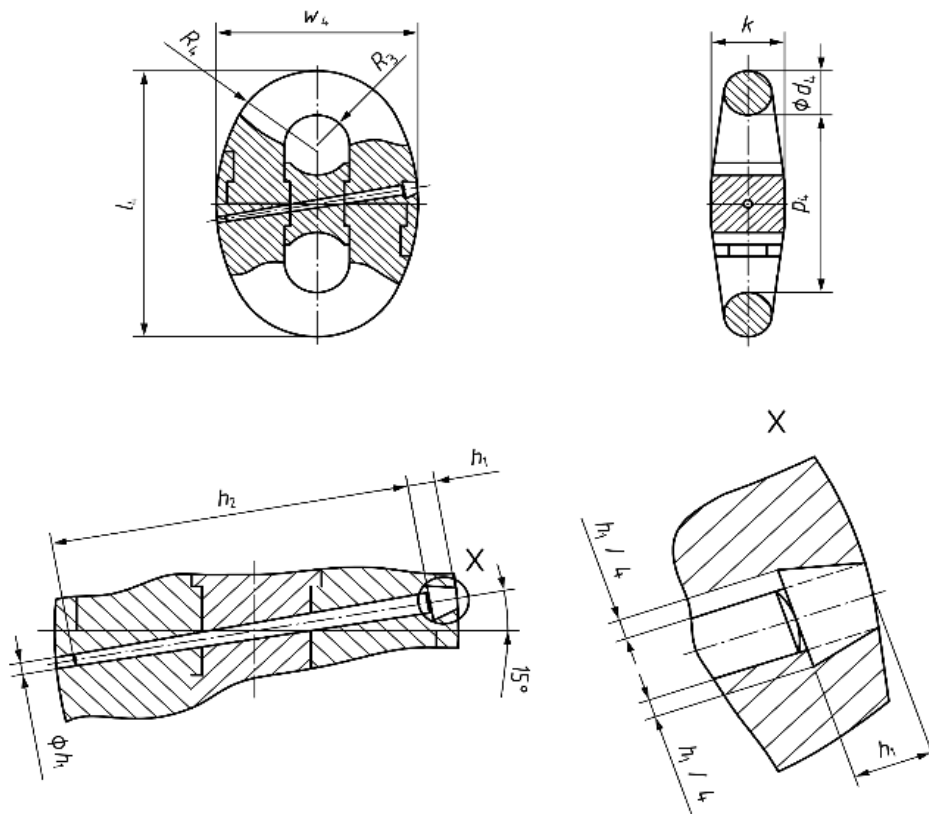
Chain lengths are transported to the anchored ship by barge and sometimes they are prepared (joined together) during this time. After reaching the ship, crew lowers the existing chain down to the barge where the last link is joined with Kenter shackle to the new chain and after that the chain starts to be reeled in towards the chain locker. If the new chain has not been prepared, this operation is effected on board to each new length that is heaved up.

1. Installation of Kenter shackle

- (1) Push out the taper-pin
- (2) Use a punch block and wedge (matching in size with the shackle) to disassemble the Kenter shackle: remove the stud with punch block, and divide the shackle into two half-links with punch block and wedge.
- (3) Connect chains to each half-link of the shackle.
- (4) Set the two half-links and install the stud and infix the taper-pin.
- (5) Fill-up the taper-pin hole with lead. (reference to procedure 3)



Dimensions of Kenter type joining shackle

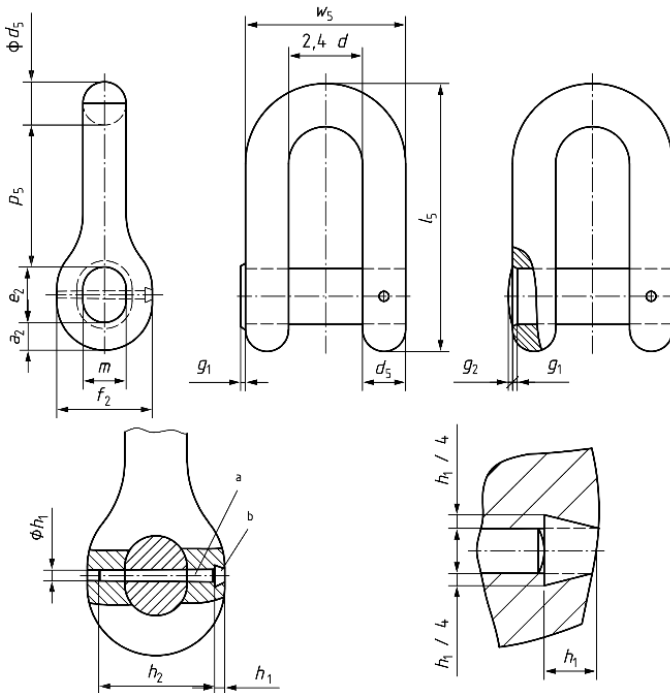
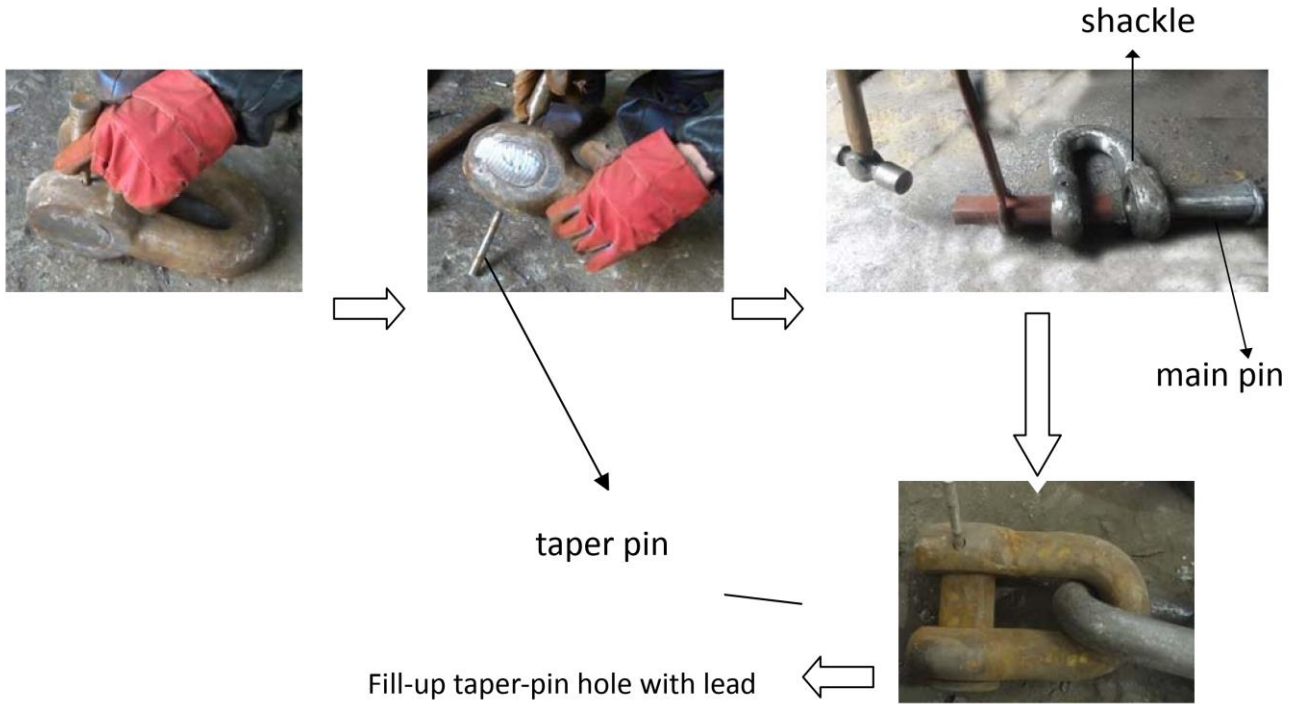


Key

d	nominal diameter of common link	h_1	nominal diameter of taper pin
d_4	nominal diameter of Kenter type joining shackle = d	h_2	nominal length of taper pin
l_4	$6 d$	k	$1,52 d$
p_4	$4 d$	R_3	$0,67 d$
w_4	$4,2 d$	R_4	$1,83 d$

2. Installation of End shackle

- (1) Extract the taper-pin out with a pin punch
- (2) Extract the main pin out with a shackle punch
- (3) Connect relevant chain, accessory or anchor with each end of the shackle.
- (4) Insert the main pin, infix the taper-pin
- (5) Fill-up the taper-pin hole with lead (reference to procedure 3)



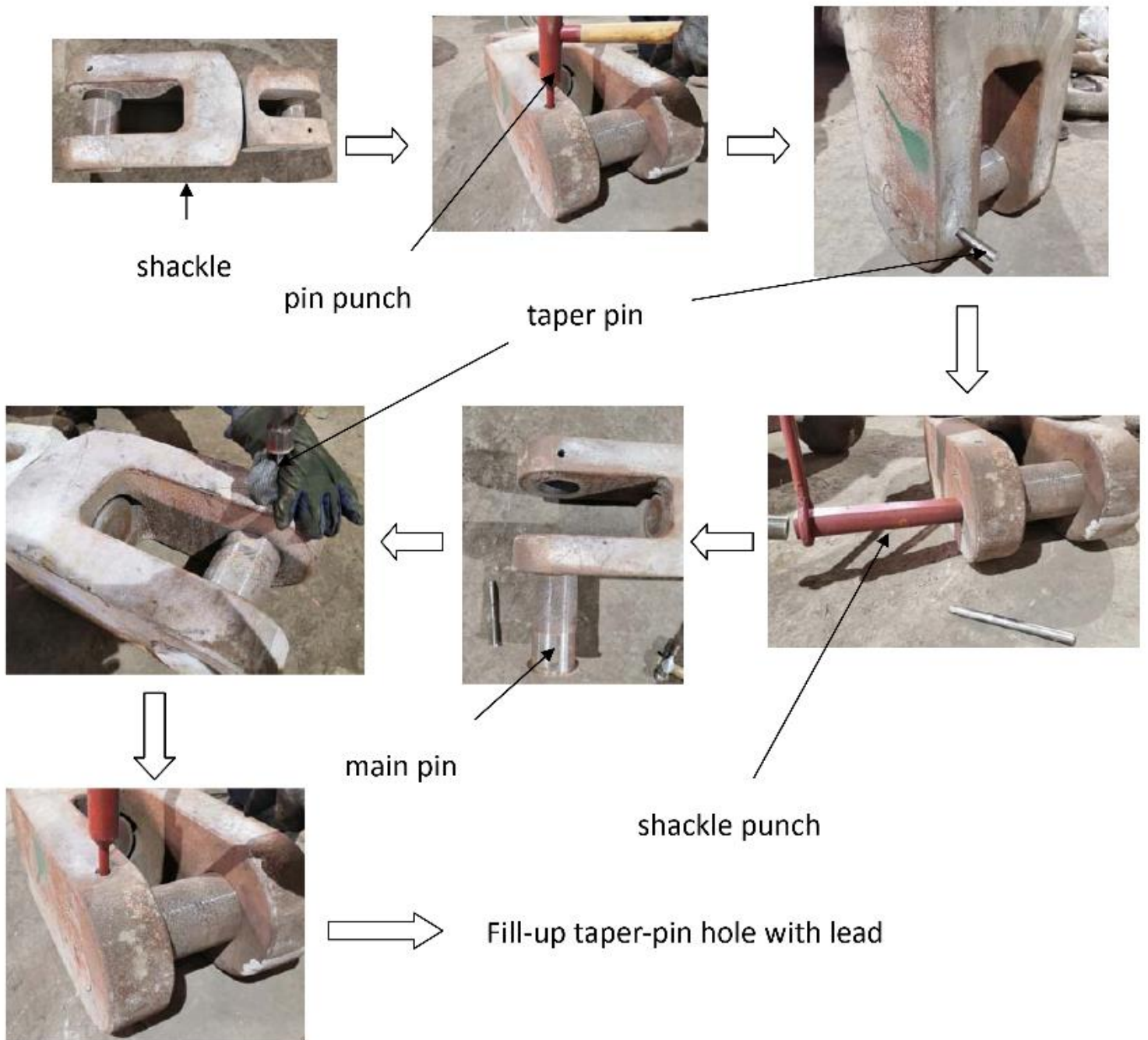
Dimensions of end shackle (also called "D" type anchor shackle)

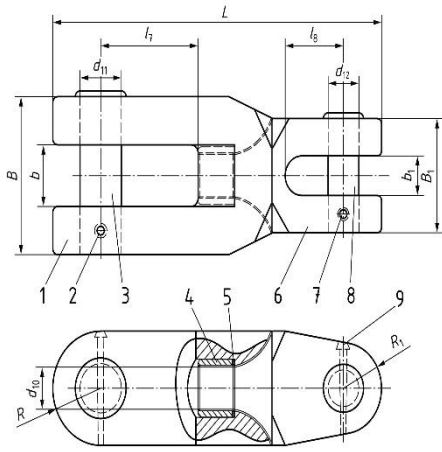
Key

- | | | | |
|-------|---|-------|-------------------------------|
| d | nominal diameter of common link | g_1 | $0,2 d$ |
| d_5 | nominal diameter of end shackle = $1,4 d$ | g_2 | $0,1 d$ |
| l_5 | $8,7 d$ | m | $1,4 d$ |
| p_5 | $l_5 - (d_5 + a_2 + e_2) = 4,6 d$ | h_1 | nominal diameter of taper pin |
| w_5 | $(4,8 \sim 5,2) d$ | h_2 | nominal length of taper pin |
| a_2 | $0,9 d$ | a | Retaining pin. |
| e_2 | $1,8 d$ | b | Dove tail chamber. |
| f_2 | $3,1 d$ | | |

3. Installation of Swivel shackle

- (1) Knock the taper-pin out with a pin punch
- (2) Knock the main pin out with a shackle punch.
- (3) Connect relevant chain, accessory or anchor with each end of the shackle.
- (4) Insert the main pin, infix the taper-pin and fill-up the taper-pin with lead.
- (5) Fill-up the taper-pin hole with lead. (reference to procedure 3)

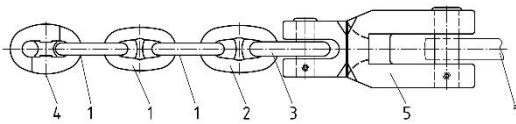




Key

- | | |
|---------------------|--------------------|
| 1 swivel for anchor | 6 swivel for chain |
| 2 retaining pin 1 | 7 retaining pin 2 |
| 3 bar 1 | 8 bar 2 |
| 4 nut | 9 stuffing |
| 5 washer | |

Type A swivel shackle

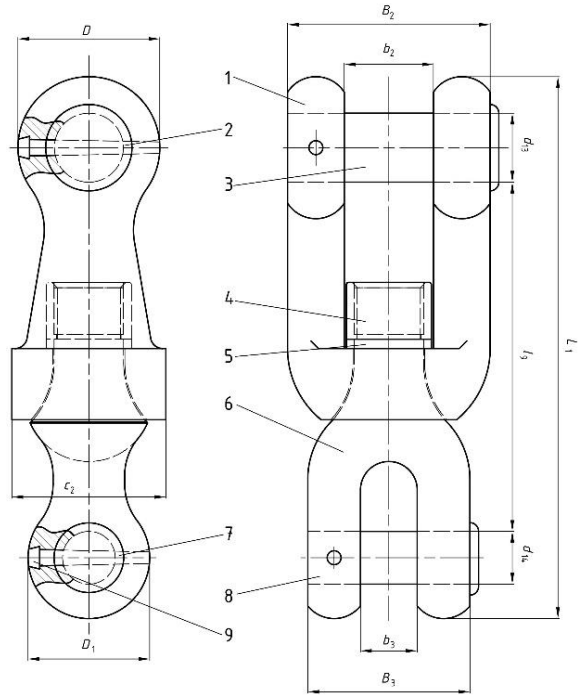


Key

- | | |
|-----------------|-------------------------------|
| 1 common link | 4 Kenter type joining shackle |
| 2 enlarged link | 5 type A swivel shackle |
| 3 end link | ⓐ Anchor stock. |

With Kenter type joining shackle and type A swivel shackle

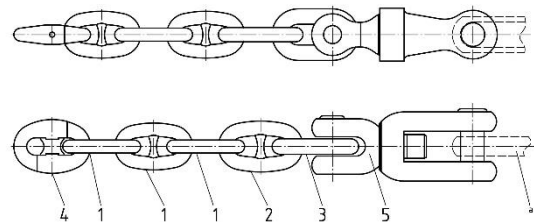
The 2 types of swivel shackles (that can be connected to the shank of the anchor or the "D" shackle).



Key

- | | |
|---------------------|--------------------|
| 1 swivel for anchor | 6 swivel for chain |
| 2 retaining pin 1 | 7 retaining pin 2 |
| 3 bar 1 | 8 bar 2 |
| 4 nut | 9 stuffing |
| 5 washer | |

Type B swivel shackle



Key

- | | |
|-----------------|-----------------------------------|
| 1 common link | 4 Kenter type joining shackle |
| 2 enlarged link | 5 type B swivel shackle |
| 3 end link | ⓐ Anchor stock or anchor shackle. |

With Kenter type joining shackle and type B swivel shackle

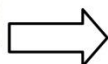
3. Lead sealing

- (1) Clean and remove any impurity of hole
- (2) Infix the taper-pin of Kenter shackle, end shackle, joining shackle and swivel shackle into the pin hole to a proper depth, and melt the lead through heating (e.g., flame jet, acetylene flame jet) to fill-up the hole; apply hammer hitting to prevent the lead from sloughing off. (see drawing 2). Lead seal must be inspected annually.

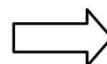
Lead pig or sheet lead



Clear up



heating the lead and fill-up



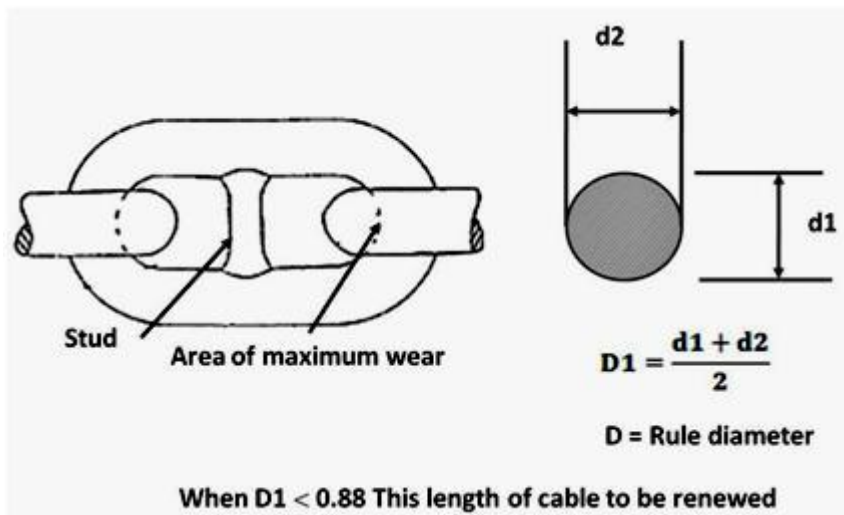
beat out

4. Maintenance – Things to pay attention

- (1) The shackle(s) has to be rejected if wear reaches 10% of body nominal dimension.
- (2) If prior to deployment, chains and accessories are found seriously corroded due to bad storage or other reasons, which may affect the future service of the products, replacement with new chains and accessories must be considered.
- (3) In order to prevent from stud loosen, it is not allowed to pull the stud by wire rope or other method during installation or service.

(4) **Replacement of chain cables** - **Permissible wear down of stud link chain cable:** When a length of chain cable is so worn that the mean diameter of a link at the crown, at its most worn part, is reduced by more than 12% from its required nominal diameter it must be renewed.

The mean diameter is half the value of the sum of the minimum diameter found in one cross section of the link and of the diameter measured in a perpendicular direction in the same cross-section (d_c & d_p measurements as shown in page 1 (d_2 & d_1 resp as per picture below).



5. Removal of twist of studlink chain

In case twist has incurred in the chain, it must be relieved the soonest possible. Below are some indicative causes and methods of relief:

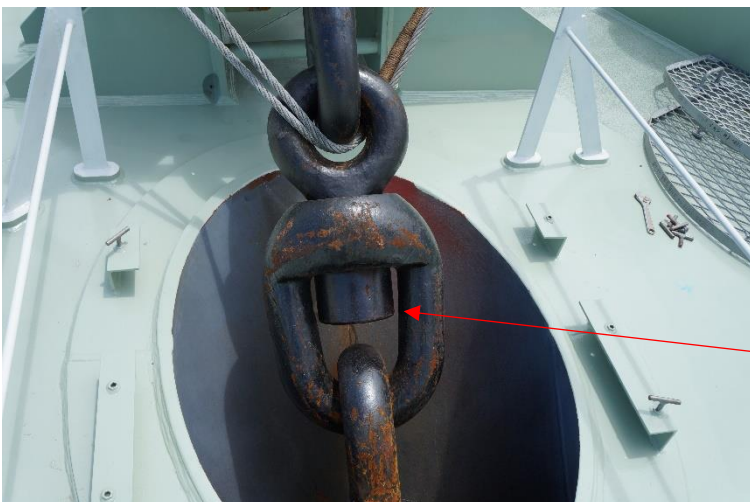
Twisting:



Possible Causes:



Distance between gypsy wheel and chain stopper is inappropriate or they are not aligned

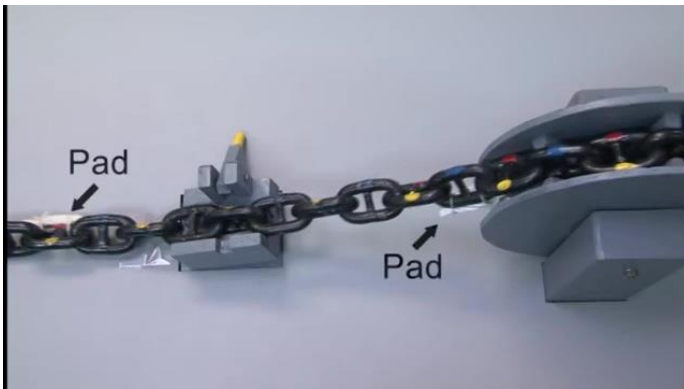


Swivel does not work properly

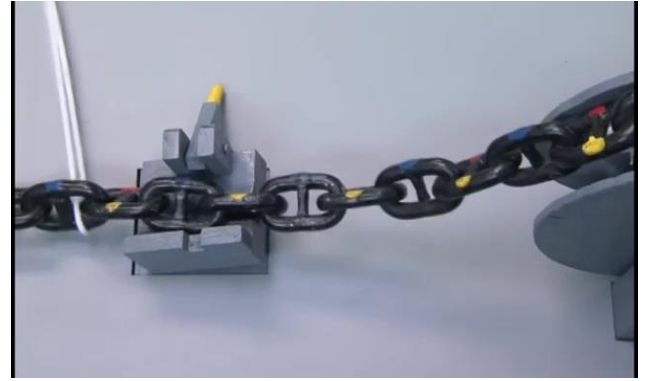
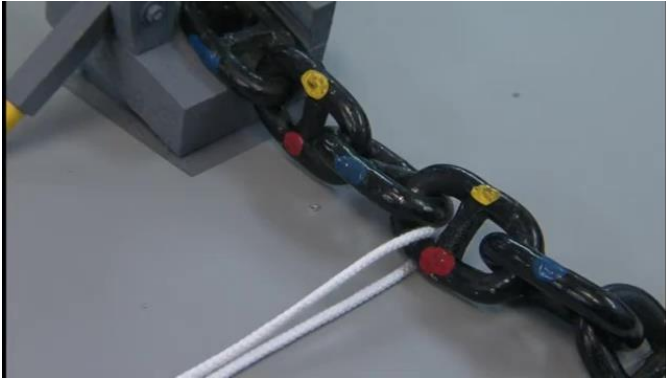
Indicative twist elimination measures:



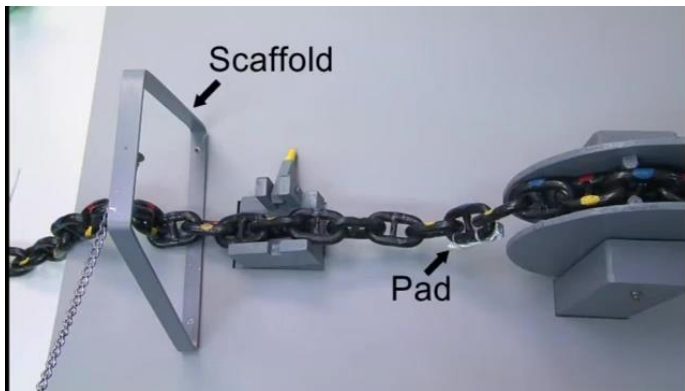
Using a crow bar, rotate the chain when loose opposite to the twist direction.



Using pads attached 1-2 meters apart depending on your ship's machinery locations, you can rotate the chain when the first pad enters the chain winch (the pad lifts the chain allowing for the rotation) and thus gradually eliminate the twist.



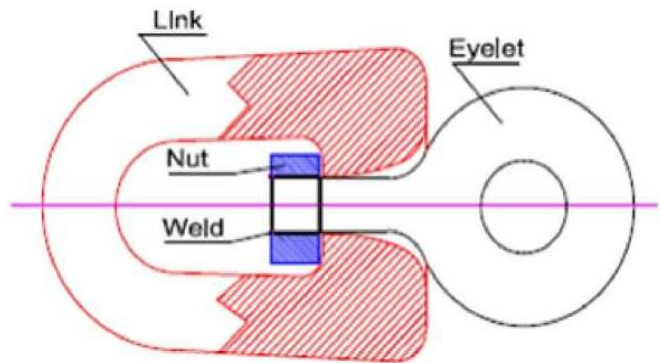
Using a cable or rope, attaching it to one link that has twisted, rotate the chain before entering the stopper, thus gradually eliminating the twist.



Setting up a scaffold and using a chain winch, you can lift the incoming anchor chain thus rotating it opposite to the twist direction in order to eliminate the twist.

6. Maintenance on board – Discard criteria

In the case of swivel eyelet axle wear down, consideration should be given to replacement where the maximum lateral movement equates to 5% of the eyelet axle diameter.



Swivel eyelet

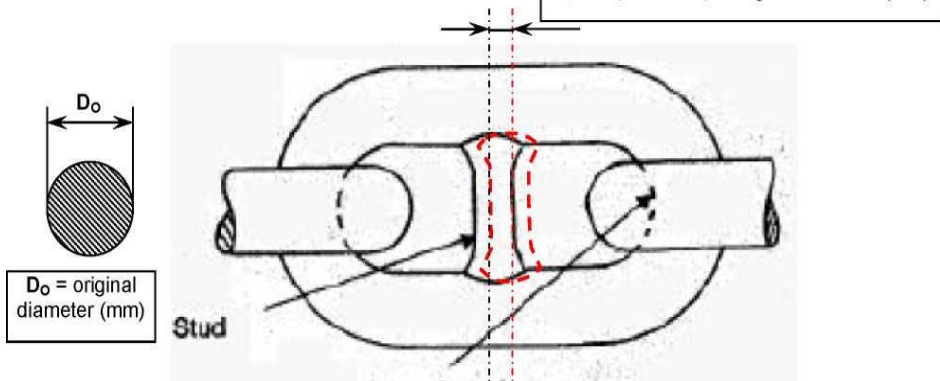
6.1 The Looseness of Studs in Anchor Chain Cable

6.1.1 During the Special Survey Hull (SSH) when the anchor chains are ranged, gauged and examined, there should be no looseness of studs within links of the anchor cable. Where loose studs exist, the affected cable should be replaced, or where considered feasible, welded in accordance with the procedure specification below.

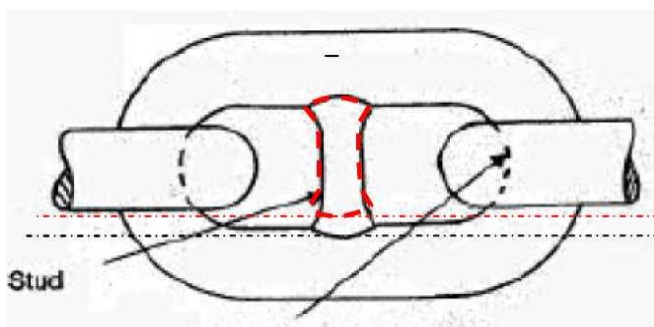
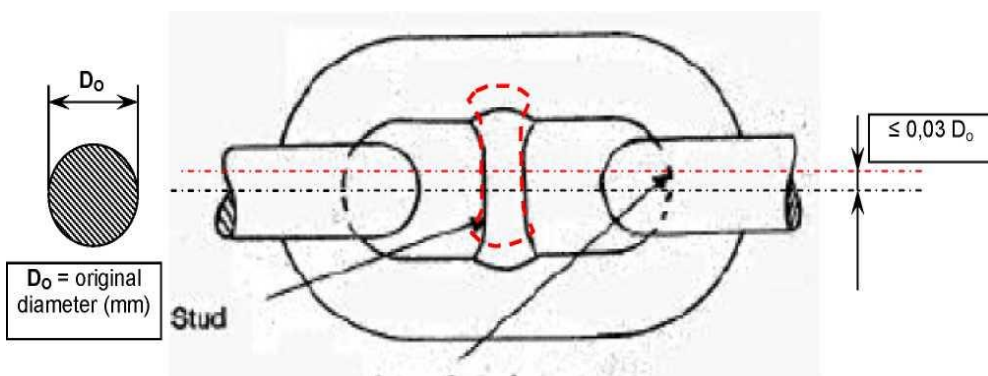
6.1.2 Loose studs in anchors cable found prior to the Special Survey may be permitted, subject to the following criteria:

Maximum Lateral Stud movement - 5% of cable diameter

$\leq 0,05 D_o$ where D_o = original diameter (mm)



Maximum Axial Stud movement - 3% of cable diameter



- 6.1.3 Where studs are missing from the anchor cable, the lengths of affected cable should be replaced.
- 6.2 The Securing by Welding of Chain Cable Studs in Service
- 6.2.1 Where it is proposed to secure loose anchor cable studs by welding, the proposal for repair is to be submitted to the Surveyor for evaluation and approval. The approval will be based on the conditions of the link to be repaired and of remaining links (see para. A1.6 Permissible Wear-down of Stud Link Chain Cable for Bower Anchors in UR A1).
- 6.2.2 Any such repairs should be carried out in a clean environment as far as practicable. The attachment of earthing straps to cable links should be specially considered prior to welding.
- 6.3 Welding Procedure Specification
- 6.3.1 Welds are to be made in accordance with a qualified and approved welding procedure and accepted by the Surveyor.
- 6.3.2 Welding consumables used are to be approved with grading 3 or 3Y. For Grades 1 and 2 chain cables consumables should have low hydrogen grading H15 or better and for Grade 3 chain cables a very low hydrogen grading of H5 or better.
- 6.3.3 A preheating temperature suitable to limit hardness and to prevent the risk of cold cracks is to be applied. In general, the following applies:
- Grade 1 and 2: 100°C
 - Grade 3: 175°C
- 6.3.4 The welding practice and the welding parameters are to be selected to permit a large single weld deposit to be made. A temper bead at the stud side is allowed and may be advisable depending on the link grade.
- 6.3.5 After welding, links should be wrapped to allow a slow cooling.
- 6.4 Welding Procedure Approval Tests
- 6.4.1 The approval test procedure should be representative of the actual welding conditions. The scope of testing of the test sample should include macrosection test specimens and hardness measurements.
- 6.4.2 The hardness of the weld metal and of the heat affected zone should not exceed:
- 380 Hv10 for Grade 1 and Grade 2 chain cables and for Grade 3 chain cables in the normalized and normalized and tempered conditions.
 - 420 Hv10 for Grade 3 chain cables in the quenched and tempered condition.
- 6.5 Repair Procedure
- 6.5.1 The abutting surfaces of the link and stud to be welded are to be ground to produce a good fit with an acceptable root gap to prevent cracking. The surfaces are to be free from moisture, grease, rust etc., just prior to welding.
- 6.5.2 Magnetic particle examination to check that the link is free from cracks is to be performed before welding at Surveyor satisfaction.
- 6.5.3 Welding is to be performed by qualified welders.
- 6.5.4 Welding consumables are to be dried adequately prior to welding in accordance with manufacturer's recommendation.
- 6.5.5 In general the stud should be welded at the end opposite to the flash butt weld of the link and it should be welded completely around the circumference.

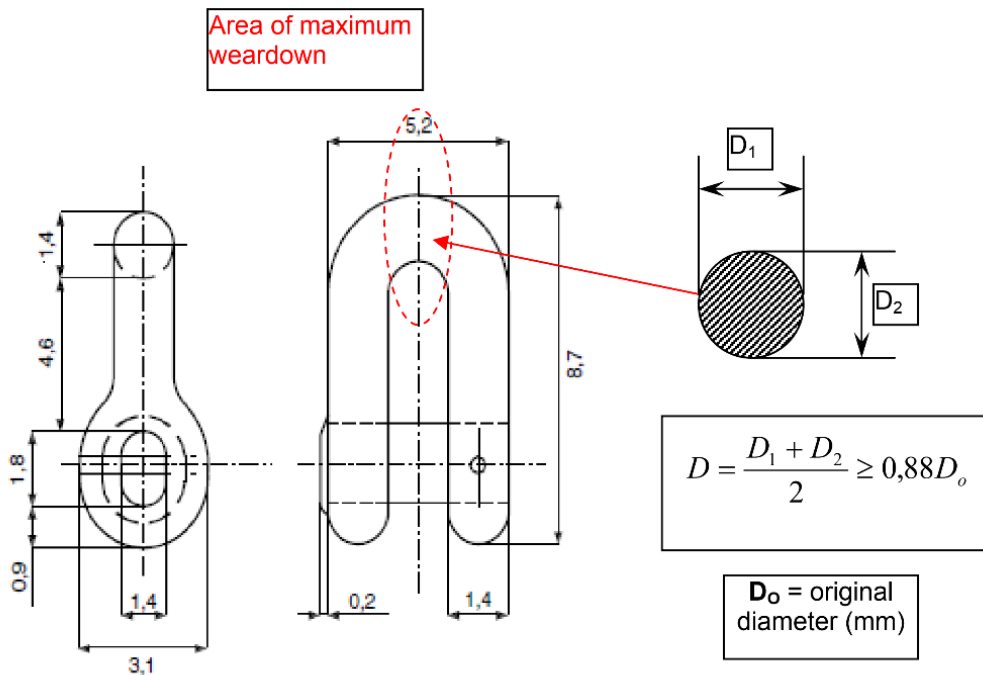
6.5.6 All weld stop-starts shall be grounded to remove any defects and to blend smoothly with the base material.

6.6. Examination

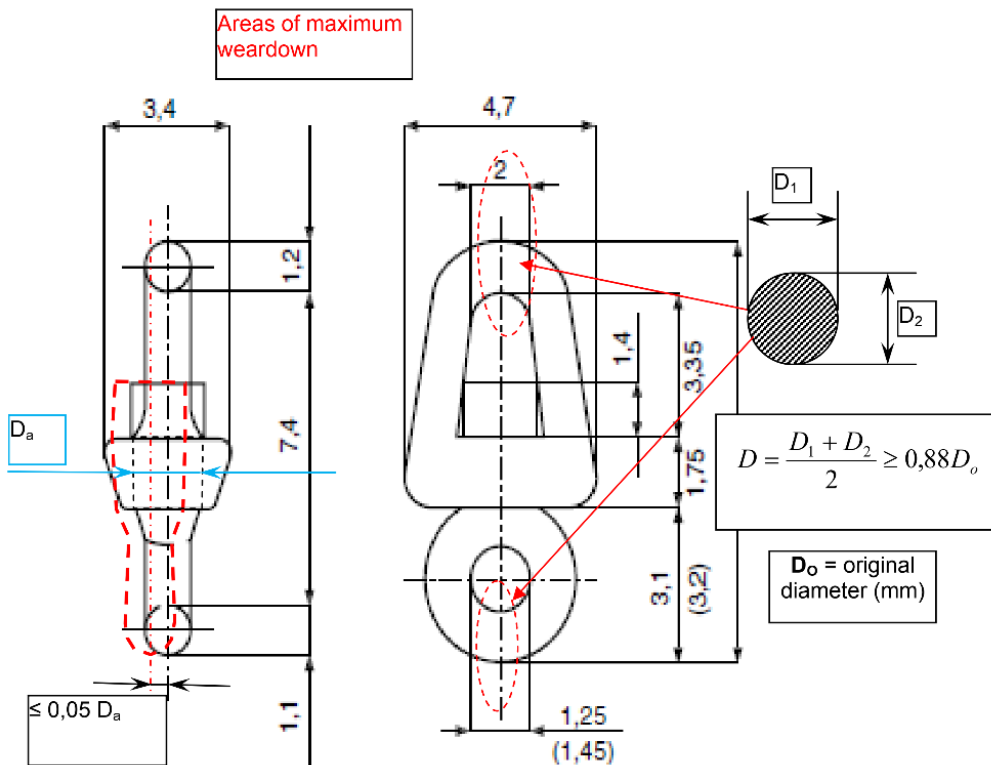
6.6.1 All welds are to be subjected to visual and magnetic or liquid particle examination. In the case of Grade 3 chain cables, inspection is recommended to be delayed for at least 48 hours after the weld has cooled to ambient temperature.

6.6.2 Studs should be located in the links centrally and at right angles to the sides of the link.

7. End shackle wear level: 12% of nominal diameter



8. Swivel wear level: As shown in the below picture



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