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SURVEY REPORT No: H14-531

THIS IS TO CERTIFY, that at the request of McElroys Lawyers, Auckland, New Zealand the undersigned surveyor has attended onboard the sailing yacht:

"STORM VOGEL"

While she was on the hardstand at Norship Marine, Cairns, Australia on the 03-11th July 2014, to ascertain the cause and nature of failure alleged to have occurred to a seawater seal on the swing keel on the 22/06/2014 at position 159.02 East and 16.20 South.

CONTENTS:

1. VESSEL DETAILS:

Name:	Storm Vogel
Registration:	Germany, XAL503
Type:	Koopman 48
Dimensions:	14.46m x 3.95m x 1.45/ 2.70m
Built:	1995, Wilhelmina Werft, Holland
Hull Material:	Aluminium
Owners:	Peter Wiedekamm

2. CIRCUMSTANCES:

2.1 The following has been derived from interviews with the owner and telephone conversation with Carl , the engineer from Norsand in New Zealand.

2.2 Prior to the yacht transiting to Cairns, Australia, Norsand in New Zealand had worked on the swing keel pin seal carrier to rectify an existing leak. The swing keel or pivot pin was not removed during this work, with the seal carrier having an O ring groove machined into it, an O ring fitted and a grease nipple fitted between the O ring and existing seal. From my understanding this was done on advice by email between a Dutch shipyard and the owner attached at appendix A. A new hydraulic ram was fitted in New Zealand also.

2.3 Norsand replaced one (1) seal carrier retaining stud with a stepped stud due to the original being found with the thread into the housing stripped.

2.4 Bearing clearances were taken by feeler gauge at Norsand and were reported to be acceptable.

2.5 Storm Vogel departed from Auckland, New Zealand on the 09/05/2014 arriving at Opua, Vanuatu on the 17/05/2014. The yacht then departed Opua, Vanuatu on the 19/06/2014,bound for Cairns, Australia.

2.6 On the 22/06/2014 at position 159.02 East and 16.20 South, the owner noticed water ingress into the yacht. On investigation it was found to be coming from the swing keel and a Mayday was broadcast and the ships EPIRB activated at 1920 hours.

2.7 Water was found to be coming from a gap between the swing keel shaft seal carrier and the swing keel casing. An accompanying yacht attended Storm Vogel and a bulk carrier in the area provided cement to carry out a temporary repair by bracing the seal carrier with timber and filling the space with cement.

2.8 Storm Vogel subsequently arrived at Cairns, Australia and was slipped at Norship Marine on the 30/06/2014.

3. FINDINGS:

3.1 On my initial attendance on the 03/07/2014, it had been found by Norship Marine engineers that Storm Vogel swing keel shaft seal carrier had four (4)x eight (8)mm stainless steel studs to bolt the seal carrier to the housing. Three (3) of these studs had sheared with one (1) on the aft bottom side remaining intact.

Original broken stud

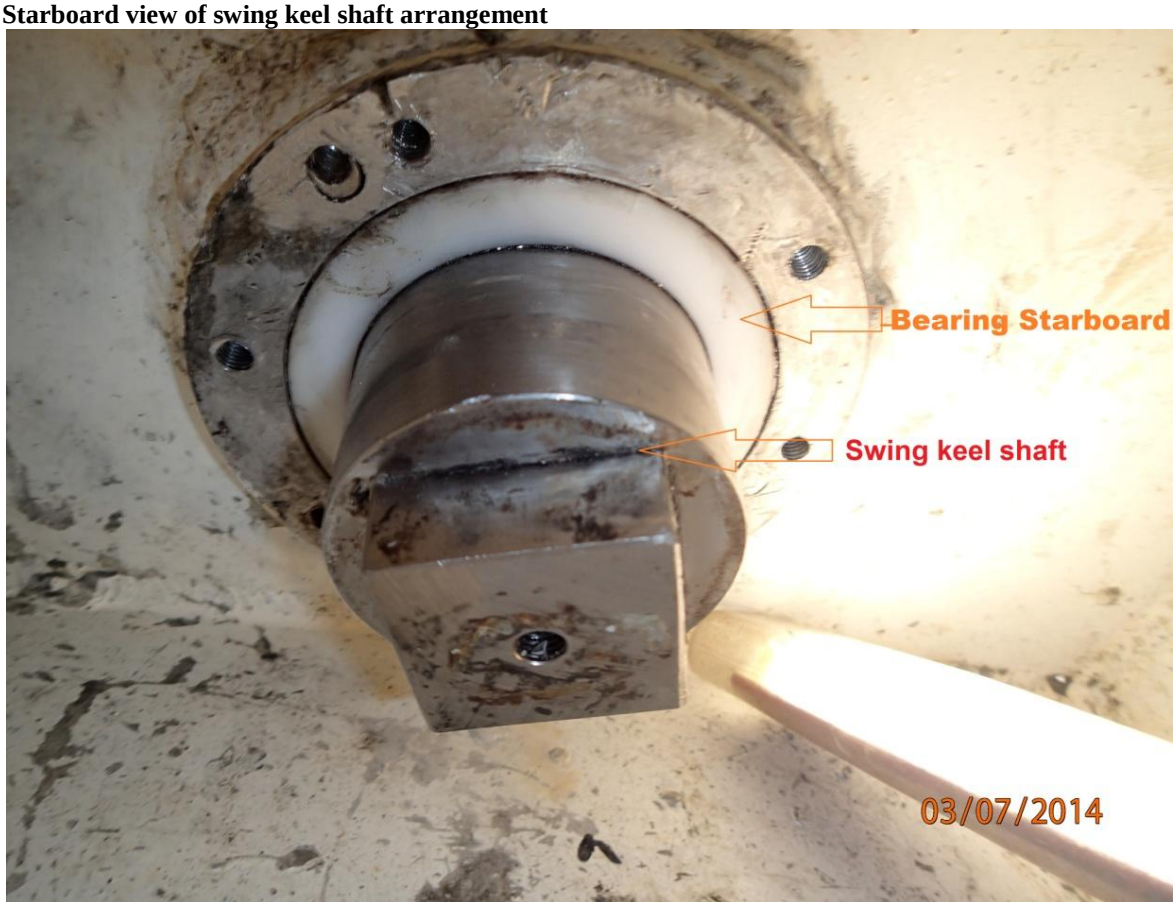
Original seal carrier

3.2 There were no apparent impact markings on the seal carrier to swing keel shaft face of the aluminium or the O ring fitted from visual inspection with the aid of a magnifying glass.

3.3 Norship had manufactured a new seal carrier to the same dimensions as the original including the O ring modification and grease nipple as done by Norsand in New Zealand.

3.4 The broken ends of the retaining studs in the housing could not be removed due to accessibility and four (4) new holes had been drilled and tapped.

Starboard view of swing keel shaft arrangement



3.5 The new seal carrier was then reassembled for testing. Storm Vogel was lifted and the swing keel extended on the 04/07/2014 with myself attending. There was movement detected between the swing keel body and the shaft by looking up between the swing keel and casing. It was then decided to remove the entire swing keel for analysis.

3.6 During removal of the swing keel it was found the retaining nut holding the bearing spigot on the port side (item 4 at appendix B) was loose and the bearing spigot had slipped diagonally onto the thread causing the shaft to drop and difficult to remove.

Port bearing spigot inside bearing

View of port side of shaft and bearing spigot

3.7 The old bearing clearances were measured and found to be 0.4mm on the starboard side and 0.35mm on the port side.

3.8 The distance between the starboard side of the shaft and the seal carrier inner aluminium is 1.00mm giving a clearance of 0.5mm each side. This would not allow much movement of the shaft due to the bearing spigot misaligning, before the shaft would contact the seal carrier housing on the starboard side.

3.9 The swing keel shaft fits into the swing keel on a taper with a keyway and key. The key was found extremely worn with both sides of the key worn concave and a clearance of 1.5mm in the keyway.

Key showing concave wear

Clearance of key in keyway

3.9.1 The taper was fitted with bearing blue into the swing keel and fitment was less than 30%. The contact area was on one side of the housing, approximately 60 degrees around from the keyway.

3.9.2 This is consistent with the key rolling inside the keyway, causing pressure on the shaft taper on one area and the wearing of the key concave and edges of the keyway in the swing keel to wear down.

Key fitted in swing keel keyway

View of swing keel top with shaft housing central

3.10 A new keyway and key were cut from the original 14mm to 16mm. New bearings were manufactured and the shaft taper scrape fitted to 80% + fitment. The swing keel was then refitted to Storm Vogel and tested satisfactorily.

View of starboard side of assembled swing keel shaft and hydraulic ram

View of swing keel during retesting

5. CONCLUSION:

5.1 From the wear and fitment apparent the key has been moving in the swing keel keyway for a considerable period of time.

5.2 The fitment of the shaft to the swing keel taper has allowed movement of the swing keel on the shaft, subsequently causing vibration and undesirable loading forces to the shaft.

5.3 In my professional opinion, this has most probably worked the retaining nut on the port side bearing spigot loose over time, allowing the spigot to misalign on the shaft and subsequent misalignment of the shaft in the bearing.

5.4 In turn this would cause contact of the shaft and the starboard side seal carrier to shear the three (3) retaining studs, allowing water to enter the vessel.

5.5 There has been no radial force on the retaining studs by the fact one (1) was still intact and minimal clearance between the shaft and the seal carrier housing.

7. COSTS:

7.1 An invoice for the slipping, hardstand and repair costs from Norship Marine, Cairns, Australia to the owner of Storm Vogel was 17,452.89 AUD.

This report is made without prejudice and is subject to the terms and conditions of underwriters liability

Given at Cairns, Queensland, this 25th day of July 2014

R.L.(Zac) Howells
MAIMS, MNI
AMSA/Maritime Safety Queensland Accredited Marine Surveyor #315

Appendix A:

Hello Peter,

....

It must be caused by the lack of grease at the seals I think. Taking out the complete centerboard is a big step. I would like to suggest to take out the Stormvogel, remove the hydraulic ram and big lever and remove the cap's. Then you can inspect the seals. If the are not completely filled with thick grease, this must be the solution.

I only possible leaks are:

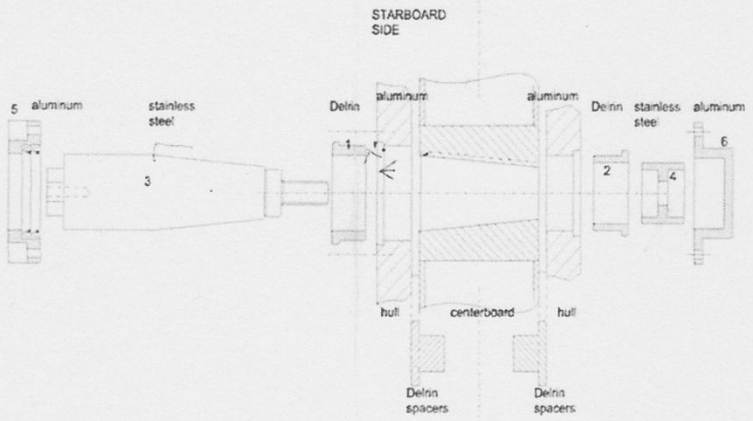
- Between item 6 and box-centerboard (new gasket or tightening nuts)
- Between item 5 and box-centerboard (new gasket or tightening nuts)
- Via the seals (add grease and reinstall used seals or new one's)

The movement of the centerboard cannot be eliminated. In the practice some clearance is needed. When the ship roll's and no pressure by sailing is on the centerboard (downwind for example) one can hear the centerboard moving.

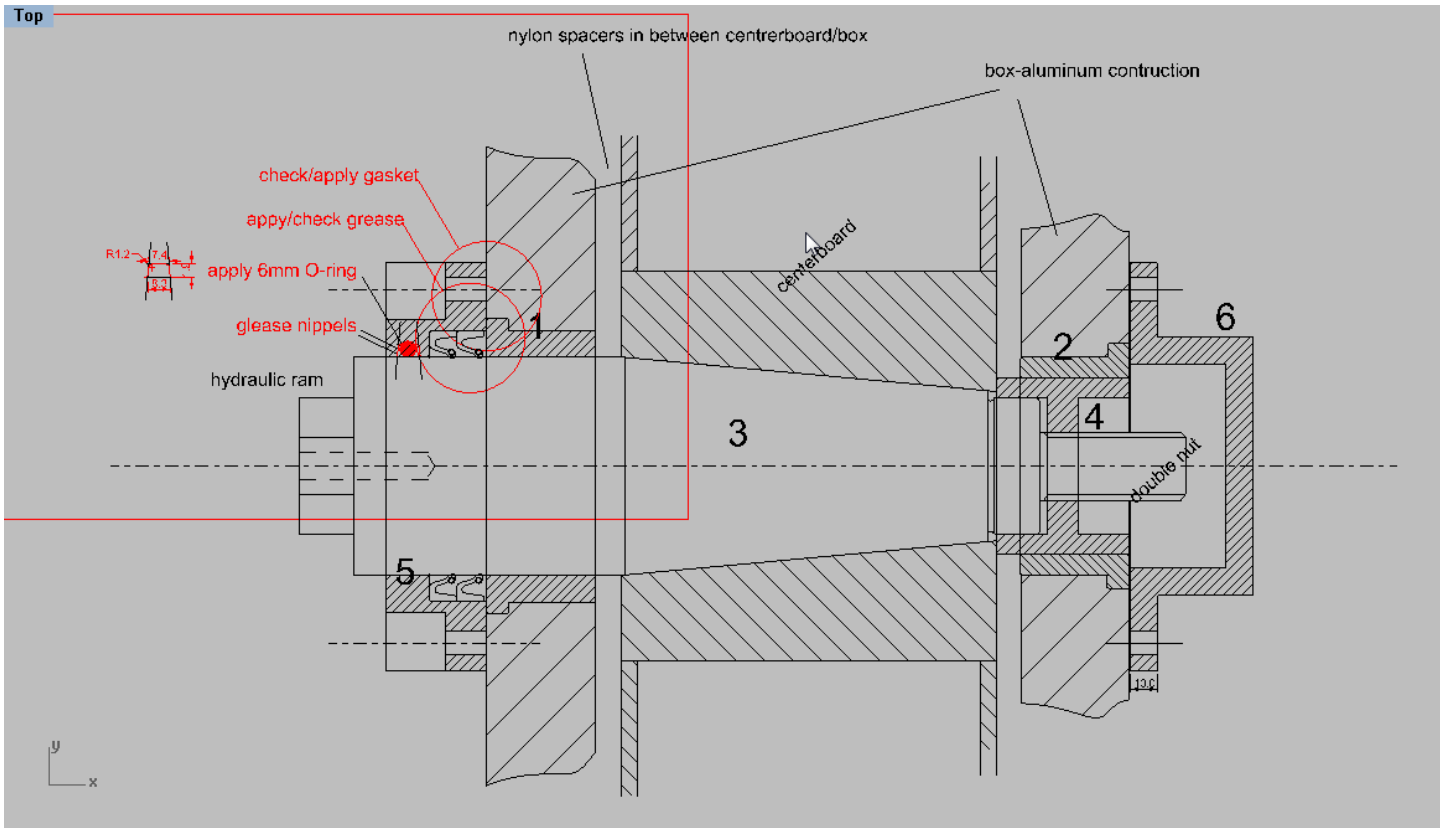
A seal cannot handle well these axial movements but a layer of grease can. One greased, using a thick grease, this should be ok.

Please find a mechanic who can do this. It is really not so hard as long as the ship is out of the water. Please make a test sail and see what happens.

Can you describe for me wat the actually leakage was and under which conditions?



Appendix B:


Top
nylon spacers in between centrerboard/box
box-aluminum contruction
check/apply gasket
appy/check grease
apply 6mm O-ring
glease nippels
hydraulic ram
centerboard
double nut
1
2
3
4
5
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