Annex A

W50RS specification

SCHAT HARDING

TECHNICAL SPECIFICATION
FOR WINCH W 50 RS

(R=Rescue, S=Single drum)

Winch type:	Single drum, gravity lowering, el.hoisting.
Safe working moment SWM:	11.7 kNm
Max. wirepull on 2.layer:	51 kN
Drum diameter:	406 mm
Drum length:	300 mm
Drum capacity (2 layers, Ø18mm wire):	44 m
Lowering capacity (Ø18mm wire):	40 m
Hoisting speed at 50Hz:	22 m/min. *
60Hz:	20 m/min.
Lowering speed:	Adjustable up to 90m/min.
Max. wirepull, hoisting:	51kN
El.motor, size:	7BA 160 L21 3 x 440V, 60 Hz, 3520/1750 rpm, 20/15 kW, In=34/26,8A, Is=276/189 A 3 x 380V, 50 Hz, 2930/1462 rpm, 17,5/13kW, In=34,5/26,9 A, Is=290/193 A
Heater:	220 V, 40 W
Starting method:	Direct on line
Protection grades	
El.motor:	IP56
Starter unit:	IP56
Push button control:	IP66
Limit switch:	IP67
Gear ratio, drum-El.motor:	1:232 * 1:175
Lowering brake:	Hydraulic
Holding brake:	Multiple disk brake
Paint specification:	See technical specification "Surface preparation"
Weight, incl. oil:	1350 kg
Weight, dry	1260 kg

WSP9708 – Edition 040421

15/20kW motor test certificate

MEZ

LÖNNE

Test Certificate

our order.............................: 790353
date..: 22.2.06
certificate no.........................: T96160M-404/4

your order...........: **NOBE040230/P2034175**
mark.....................: **MHI NAGASAKI H-2217**

UMOE SCHAT-HARDING SPOL s.r.o.
P.O.BOX 115
274 01 SLANY CZ

motortype...........................: **7BA160L21**
mounting.............................: **B5**

output (kW).......................: **15/20**
duty......................................: **S2-10MIN**

speed (min-1)...................: C-CW - 1752/3522

voltage (Vac)....................: Δ/YY 440

nominal current (A)..........: 27/34

power factor cos.phi..........: 4/4 load 0,84/0,91

efficienty (%)....................: 4/4 load 88,2/85,2

moment of inertia J (kgm) .: 0,054
mass (kg)............. ....: 116
frequency (Hz)........................: 60
starting torque d.o.l. (%).......... 246/234
no load current (A)..................: 11,9/10,5
starting current d.o.l. (%)......... 524/538
temp.rise surface (K).............. 52,4/53,8
temp.rise windings (K)............ 68/85

insulation class...................: F

protection class...................: IP 56 WITHOUT FAN AND FANCOVER

anti condensation heating : consumption (W)..............: 1 X 40 voltage (V)...............: 220

marine classfication.: according to DNV amb.temp...............: 45° C

high voltage dielectric test between phases and earth during 1 min (Vac)...: 2000
overload test during 15 seconds overload torque (% FLT).........................: 160
vibration severity according NEN/ISO 2373-1974 (half key)...............class "N" or as specified below.

bearings DE/NDE...: 6309-C3 6309-C3
spesial features.......: spesialshaft DE/NDE 35mm/33mm

motor serial numbers: **UD0505/197772-002-6**

UMOE SCHAT HARDING
s.r.o. Slaný
PŘÍJEM ZBOŽÍ 2
DATUM: 22.2.06
PODPIS: [redacted]

LÖNNE

Test House report

The TEST HOUSE

THE TEST HOUSE (CAMBRIDGE) LTD. JOB AND REPORT REFERENCE: T10388/ER

EXPERTS REPORT

COMMENTARY AND OPINION IN RESPECT OF INSPECTIONS AND TESTS COMPLETED ON A BROKEN FAST RECOVERY CRAFT HOIST ROPE FROM THE CAR CARRIER VESSEL MV TOMBARRA

For: Marine Accident Investigation Branch
Mountbatten House
Grosvenor Square
Southampton
SO15 2JU

This report comprises:

Text pages 1 to 5

UKAS DISCLAIMER
This project includes tests and examinations, some of which were completed against UKAS accredited procedures. The laboratory scope of UKAS accreditation does not, however, include the analysis of test data or the offering of professional opinions.

EXPERTS REPORT

COMMENTARY AND OPINION IN RESPECT OF INSPECTIONS AND TESTS COMPLETED ON A BROKEN FAST RECOVERY CRAFT HOIST ROPE FROM THE CAR CARRIER VESSEL MV TOMBARRA.

For: Marine Accident Investigation Branch
Mountbatten House
Grosvenor Square
Southampton
SO15 2JU

THE TEST HOUSE (CAMBRIDGE) LTD REFERENCE: T10388/ER
REPORT DATE: 9 March 2011

1. INTRODUCTION AND LOCATION OF SUPPORT EVIDENCE AND TEST DATA

This experts report relies on evidence and test results from a laboratory based failure analysis that had been jointly funded by MAIB and the ship owners P & I Club, and which was published in a factual Test House Report (Report Reference Number T10388F). All references to Figure and Appendix numbers in this report are to those presented in the earlier referenced factual report.

2. SAMPLES PROVIDED

MAIB had provided the samples from the broken hoist rope, as sealed evidence exhibits (Figures 1 to 9 inclusive). The break site in the rope was located some 5,550mm from the recovery hook (Figure 10).

3. RECEIPT INSPECTION

The rope appeared free from pre-existing mechanical damage, wear and fatigue cracking. It had been suitably lubricated with a lubricant that had penetrated to the core of the rope. The lubricant had also provided suitable external protection over the running part of the rope length (Figures 13, 14, 15, 16, 17, 20, 21, 22, 23 and 24).

Though not significant in the failure process, the short length of rope within the hook body was seen to be void of any lubricant, completely dry, and exhibiting surface corrosion (Figures 18 and 19). No evidence of significant corrosion damage was apparent in the main rope lengths, all of which exhibited clear evidence of a satisfactory grease maintenance regime.

4. ROPE CONSTRUCTION

The rope was of galvanised carbon steel wire type with a measured diameter of 12.3mm. Construction comprised a composite steel core wire of nineteen by seven wire strands and an outer lay of sixteen by seven wire strands. It was of right hand lay construction with a measured lay length of 75mm.

5. FRACTOGRAPHIC EXAMINATION

Wires at the break site (Figures 25 and 26) were seen to have consistently failed as a consequence of a single event tensile overload. Though isolated wires in the outer lay exhibited some evidence of mild surface corrosion (Figures 27 and 28), the rope was still judged to be in a sound serviceable condition. No significant rusting of core wires was apparent (Figures 31 and 32) and consequently the rope core was also judged to be fully serviceable.

Individual wires in both the ropes outer lay and core exhibited tensile overload fractures, which were largely of classical "cup and cone" type (Figures 29 and 33). Detailed examination of representative wire fracture surfaces confirmed that failures had consistently occurred via the ductile failure mechanism of microvoid coalescence (Figures 30 and 34).

Our inspections identified no evidence of wear or fatigue damage at the break site and as no new wire breaks occurred during our manipulation of the broken wire ends we concluded that the rope had not been critically fatigue damaged prior to the accident.

6. METALLOGRAPHIC EXAMINATION

Individual wire fractures in both the outer and inner rope lay were further confirmed, by metallographic examination, to have resulted from a single event tensile overload (Figures 35 and 38). Parent steel microstructures were free from anomalies (Figures 37 and 40) and individual wires exhibited evidence of a retained surface galvanized layer (Figures 36 and 39), the presence of which served to confirm that the rope had suffered no significant corrosion. The presence of retained surface galvanizing would also have served to protect any local areas of bare steel wire substrate.

7. VICKERS HARDNESS TEST

The Vickers hardness test data (Appendix 1) was free from anomalies and confirmed the rope to have been constructed from high tensile strength parent steel wire.

8. CHEMICAL ANALYSIS

The chemical analysis results (Appendix 2) were free from anomalies and typical of a high strength carbon steel wire.

9. BREAK LOAD TESTS

The break load tests on a sample from the bitter end and casualty site gave results that were very close to the original certified values for the rope (Appendix 3 pages 1 and 2). The break sites exposed no evidence of defects, pre-existing service wear or mechanical damage, and when due consideration was taken to lay disturbance associated with sampling, the results served to confirm that the rope was in very good near pristine condition.

10. CONCLUSIONS AND OPINION

The fast recovery craft hoist rope had failed in a single tensile overload event.

Prior to the failure the rope had been in demonstrably good condition and was free from service wear, mechanical damage, fatigue and significant corrosion wastage. The rope's apparently good serviceable condition was further confirmed by break load testing of samples removed close to the casualty site and from the winch drum bitter end; both of which yielded test results very similar to original rope certification.

The rope appeared free from pre-existing manufacturing defects and was found to have been constructed from anomaly free high strength steel wire that still retained a presence of protective surface galvanizing.

In conclusion, our laboratory based failure analysis and material characterisation failed to identify any material or metallurgical issues or defects that could have pre-disposed the rope to failure. In the apparent absence of defects and/or metallurgical anomalies in the rope, the accident investigators are advised to look elsewhere for the cause of failure, and in particular for the source of a tensile overload that must have been in excess of 133KN.

Though not significant in this failure, the short length of rope within the hook body was found to be completely dry and suffering surface corrosion. The rope in this location was under service loads and the owners should have taken reasonable steps to grease this rope dead end on a regular scheduled basis. In inaccessible rope locations and regions of ropes that are not subjected to pressure created by passage of the rope through guides or blocks, a thinner shell ENSIS type lubricant or similar generic product can often offer better levels of inter-strand penetration and improved protection from corrosion.

Report prepared and authorised by

[redacted]

Annex D

KPR report

MV Tombarra

Rescue Boat Winch Incident

7th February 2011

Electrical Report

KPR ENGINEERING (M&E) LTD

Control System Engineers
Pumping System Engineers
Electrical & Mechanical Contractors

Telephone: 01934 835098 Fax: 01934 876265
Email: sales@kpr-engineering.com

Contents

1. Introduction 1
2. Overview 1
3. Control Panel 1
   3.1 Overview 1
   3.2 Visual Inspection 1
   3.3 Outgoing Terminals 2
   3.4 Control Transformer 2
   3.5 Motor Contactors 2
   3.6 Overloads 3
4. Control Station 5
   4.1 Location 5
   4.2 Controls 5
5. Proximity Sensor 6
   5.1 Overview 6
   5.2 Inspection 6
   5.3 Fixings 6
   5.4 Water Ingress 6
   5.5 Programming of Sensor 6
   5.6 Testing 6
   5.7 Ratings 6
   5.8 Application 7
   5.9 Photographs 7
      5.9.1 Main Body 7
      5.9.2 Head 8
      5.9.3 Programming Jumper 8
6. Conclusion 9
7. Datasheets & Drawings 10
   7.1 Proximity Sensor Characteristics 10
   7.2 Proximity Sensor Detection Curves 11
   7.3 Proximity Sensors Operating Precautions 11
   7.4 Control Panel Schematic Diagram 12
   7.5 Proximity Switch Datasheet Provided by Schat Harding 13
   7.6 Additional Datasheets 14
   7.6.1 Proximity Sensor 14

1. Introduction

Following an incident with a winch on the MV Tombarra on Monday 7th February 2011, we were contacted by C F Spencer & Co Ltd to test the electrical systems associated with the winch and compile a report.

This report is compiled by:
[redacted]
Electrical Engineer
KPR Engineering (M&E) Ltd.

2. Overview

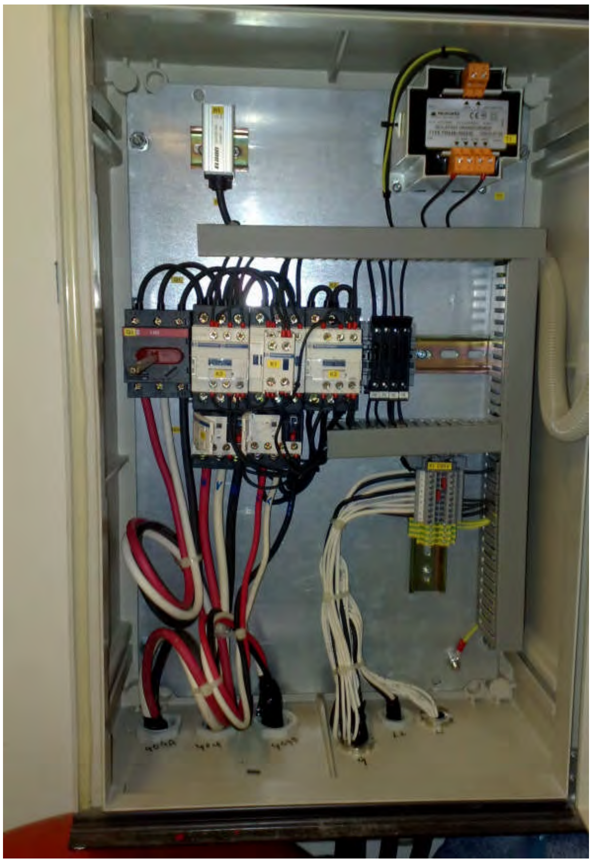
I was advised when attending site that the limit switch on the davit appeared to be unserviceable which meant that the winch continued to operate when it should of been disabled, this being the case my survey focused on the controls associated with the potentially failed limit switch.

3. Control Panel

3.1 Overview

There was a set of drawings provided in the control panel. The design of the control panel is fairly basic. The control panel enclosure is of plastic construction and is housed within the ship about 5 metres away from the davit. The control panel consists of:

- Incoming isolator
- 3 x Contactors
- 2 x Overloads
- Control Transformer
- Anti-Condensation Heater
- 3 Lamps
- Terminals



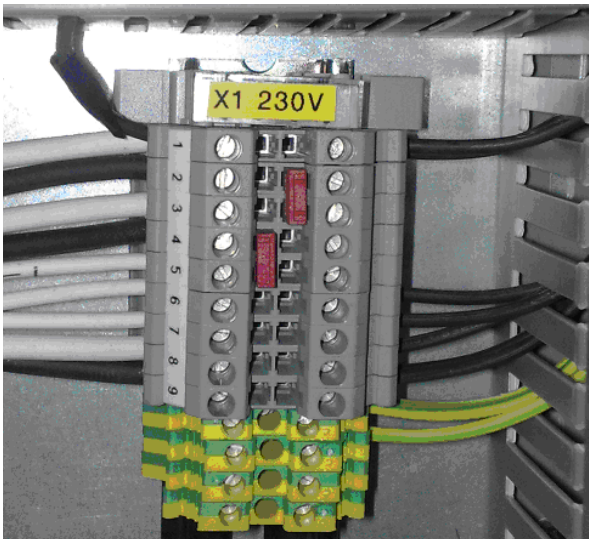
3.2 Visual Inspection

A visual inspection of the control panel was carried out. The cables were followed from point to point, which showed that the control panel was wired to the schematic drawing inside.

The supply to the panel is 440V 3 Phase AC.

3.3 Outgoing Terminals

The two external proximity sensors are connected between terminals 1 & 2 and 3 & 4.
Jumpers are fitted between the common terminals 2 & 3 and 4 & 5.
The cable seen on the outgoing side of terminal 1 is to do with the heater circuit.



3.4 Control Transformer

The transformer (rated 135VA) is used to provide a control voltage of 230V. The fuses on the primary and secondary side of the transformer were checked and are as follows:

Tag	Circuit	Part No	Type
F3	Transformer Primary	F4/450V	4A Quick acting
F4	Transformer Primary	F4/450V	4A Quick acting
F5	Transformer Secondary	T2A/250V	2A anti surge
F6	Heater	T1A/250V	1A anti surge

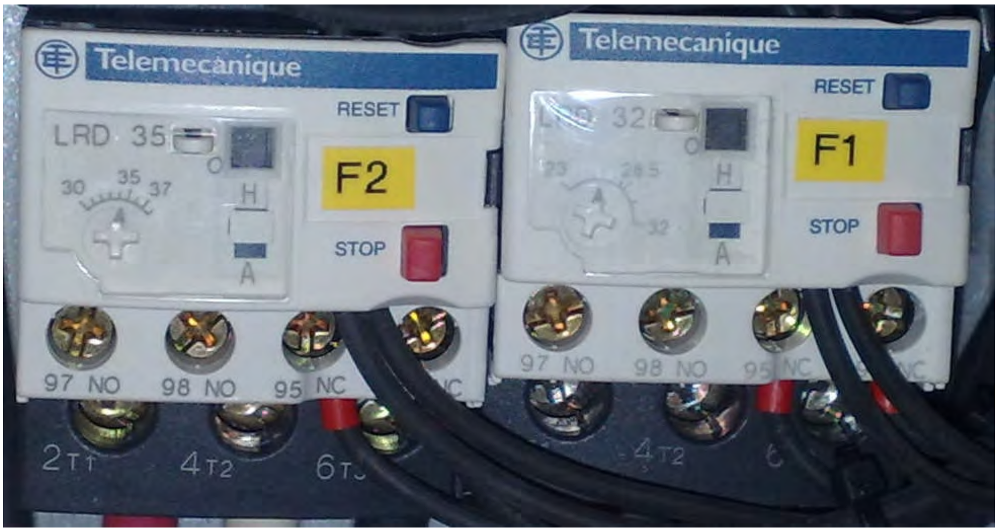
All fuses were intact.
There were no ratings shown for the fuses on the drawing in the panel. The drawing later provided showed the ratings and matched the fuses fitted.
The 0V leg of the transformer was earthed to the back plate of the control panel. The back plate of the control panel was not earthed to the ship.

3.5 Motor Contactors

The winch motor is a two-speed motor requiring three contactors for correct operation. I don't have details of the winch motor but it appears to be a pole amplitude type arrangement where the low speed arrangement is star or delta connected and the high-speed arrangement is double star connected.
Contactor K1 is used for low speed; contactors K2 and K3 are used for the high speed. Interlocks are used to prevent simultaneous operation of K1 and K3.

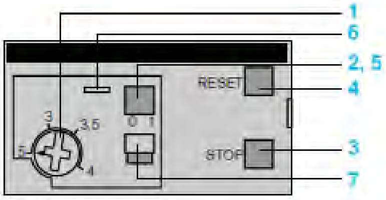
Tag	Type	Rating	Inrush	Sealed
K1	LC1D32	15kW	70VA	7.5VA
K2	LC1D38	18.5kW	70VA	7.5VA
K3	LC1D38	18.5kW	70VA	7.5VA

3.6 Overloads

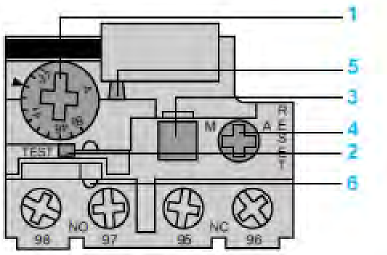


An extract from the overloads datasheet:

Description



LRD 01...35



LRD 3322...4369, LR2 D

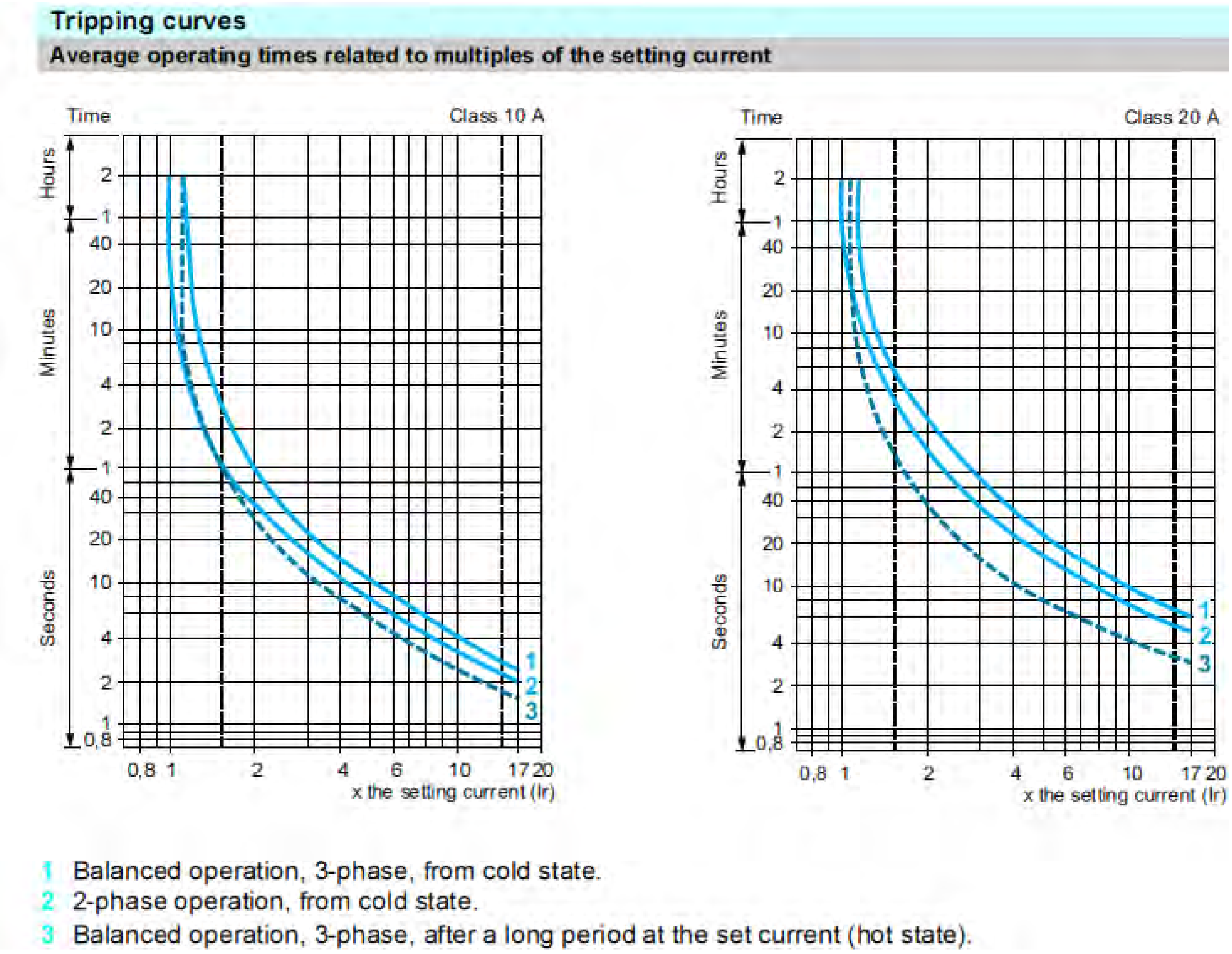
Model d 3-pole thermal overload relays are designed to protect a.c. circuits and motors against overloads, phase failure, long starting times and prolonged stalling of the motor.

1 Adjustment dial Ir.
2 Test button.
Operation of the Test button allows:
- checking of control circuit wiring,
- simulation of relay tripping (actuates both the N/O and N/C contacts).
3 Stop button. Actuates the N/C contact; does not affect the N/O contact.
4 Reset button.
5 Trip indicator.
6 Setting locked by sealing the cover.
7 Selector for manual or automatic reset. Relays LRD 01 to 35 are supplied with the selector in the manual position, protected by a cover. Deliberate action is required to move it to the automatic position.

The overloads are of the thermal type, manufactured by Telemecanique (Tesys range) and are intended for protection of the motor against overload.
The overloads are set to manual reset mode. When an overload occurs the blue reset button needs to be pressed to clear the overload. To set these overloads to auto reset the plastic tab (between the letters H and A on the photo) needs to be broken off and the switch below moved to the A position.
An overload is indicated by the flag (above the H in the photo) showing white. Neither overload was showing tripped at the time of my inspection although I understand testing of the winch was carried out the previous day.

Settings

Tag	Circuit	Type	Tripping Class	Rating	Setting
F1	Low Speed	LRD32	10A	23-32A	Approx 26A
F2	High Speed	LRD35	10A	30-38A	Approx 34A



Without details of the load that would have been put on the motor from the winch I cannot say if or when the overload would of tripped. However as can be seen from the tripping curves above, the following load currents are required to trip the overloads in the specified times.

Overload F1	**Cold State**	**Hot State**
2 Seconds	>17 x setting = >442A	13 x setting = 338A
5 Seconds	9 x setting = 234A	5.5 x setting = 143A
10 Seconds	5.1 x setting = 132.6A	3.2 x setting = 83.2A

Overload F2	**Cold State**	**Hot State**
2 Seconds	>17 x setting = >578A	13 x setting = 442A
5 Seconds	9 x setting = 306A	5.5 x setting = 187A
10 Seconds	5.1 x setting = 173.4A	3.2 x setting = 108.8A

4. Control Station

4.1 Location

Hand railing is provided to prevent unauthorised entry to the rescue boat davit area, the control station is mounted on the hand railing on the opposite side to the winch near to the side of the ship. The operator can view the rescue boat ascending from the control station location.

4.2 Controls

The control station consists of 3 buttons, an Emergency Stop button (lock-off type), a low pushbutton and a high pushbutton. Pressing the low button will cause the motor to run at low-speed. Pressing the high-button will cause the motor to run at high speed. The low and high pushbuttons are electrically interlocked, pushing both pushbuttons together will mean that the starter will not operate. The controls are non-latched, releasing the low or high pushbuttons will cause the motor to stop. The operator carries out the transition from high speed to low speed.

5. Proximity Sensor

5.1 Overview

The limit switches are of the inductive proximity sensor type. These are non-mechanical type switches, they operate by detecting the presence of a metallic object.

The proximity sensor is manufactured by Telemecanique part number XS7 C40FP260

5.2 Inspection

A visual inspection of the proximity sensor was carried out. The davit was in the retracted position and the detection plate was adjacent to the detection face of the proximity switch. Inspecting the relationship between the proximity sensor and the detection plate I was satisfied that the proximity sensor was correctly located and the detection plate was within the sensing range of the proximity sensor. The nominal sensing range of this sensor is 12mm, the detection plate was within 5mm. See datasheet at end.

5.3 Fixings

Four fixing locations are provided on the proximity sensor to secure it to the davit. Of these four fixings the back two fixings had screws in them done up tight. The top front fixing was missing; the bottom front fixing was partially undone but was tight due to rusting. The 2 secure fixings were sufficient to hold the sensor in place.

5.4 Water Ingress

I unscrewed and removed the front cover of the switch this is also where the sensor is actually housed. Upon removing the cover I noticed that there had been water ingress, at the bottom of the sensor there was brown rust marks where water had been and the lower electrical connection was badly corroded. There were also signs of corrosion on one of the two pins on the sensor. There was no sign of water still being present.

5.5 Programming of Sensor

On the back of the front cover there is a jumper bar, this is used to select NC (normally closed) or NO (normally open) operation. The sensor was set to NC as it should be, when the proximity sensor sees a metallic object the normally closed contact opens.

5.6 Testing

I tested for continuity between the two terminals on the body of the proximity sensor but this showed that the connections were isolated from each other. I reapplied power onto the control panel and returned to the proximity sensor. I tested for voltage and this showed that there was power to the top terminal but not the bottom terminal. Another gentlemen attempted to start the winch, but it didn't operate. This showed that the interlock if operated would of disabled the winch from running. I replaced the sensor head back into the body of the sensor and the gentlemen tried starting the winch again which resulted in it moving. As the detection plate was well within the detection range of the proximity sensor the winch should not of operated. My intention at this point was to remove the sensor and test it away from the davit but I found that all the screw fixings had rusted and I was unable to remove the sensor.

The ships electricians were called to remove and replace the sensor. The inspector was happy with what he had seen and I was allowed to leave.

I contacted the inspector the following day and he advised that they were able to fit the replacement sensor and that this new sensor disabled the winch motor as intended.

5.7 Ratings

These sensors are designed to carry a maximum of 500mA (inrush 2A), in the control circuit these proximity sensors only switch the contactor coils, as can be seen previously they have an inrush of

70VA, this equates to an inrush current of 0.304Amps, even if two contactors were pulled in together (K2 & K3), which isn't the case as there is an auxiliary from K2 in the control circuit of K3 then the maximum inrush would be 0.608A, this is well within the rating of the sensor (2A).
The hold-in VA is 7.5VA which equates to 0.033A, 0.066A for both K2 & K3, again this is well within the rating of the sensor (0.5A).

The manufacturers data does however stipulate *it is essential to connect a 0.4 A "quick-blow" fuse in series with the load.* See Proximity Sensors Operating Precautions at end.

5.8 Application

The proximity sensor is rated at IP67 and as such is suitable for the application.

We have checked with the manufacturer with regards to the mounting arrangement of this sensor. The sensor is a flush mountable type and as such we believe the way it is mounted is acceptable and if interference was an issue, this is likely to cause the switch to operate i.e. disable the starters.

We have also checked with the manufacturer with regards to the failure mode of the proximity sensor. They have advised as follows:

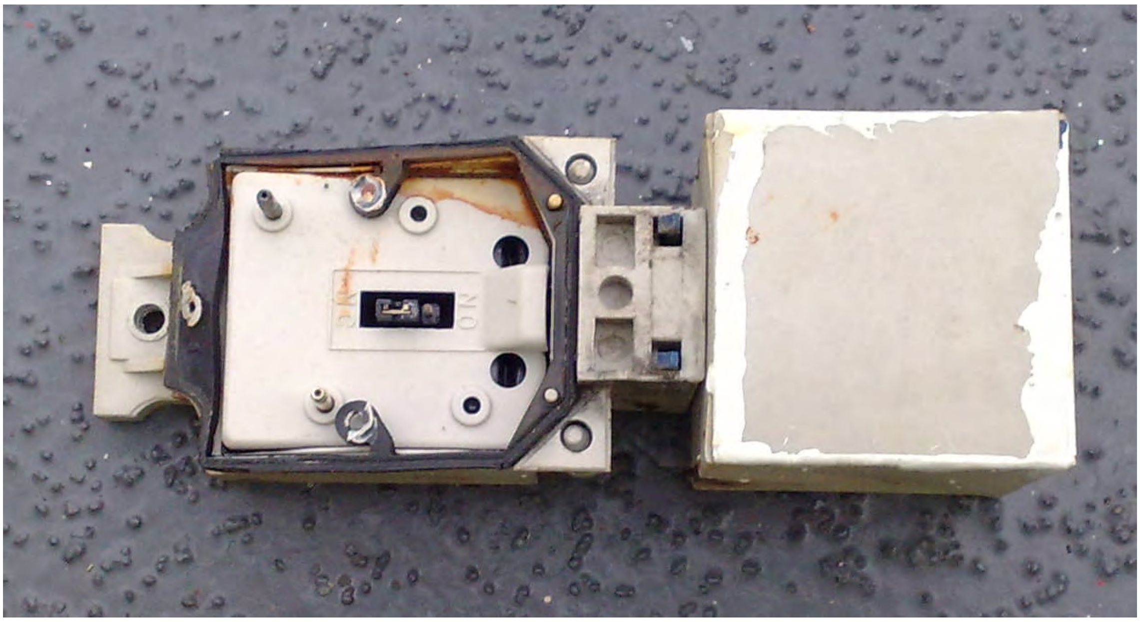
Any 'non redundant' sensor such as this standard proximity detector can fail either open circuit or short circuit and as such are not used in any safety related control systems.
Where the failure mode is important, pairs of limit switches (to achieve redundancy of operation in conjunction with a safety monitoring relay) with positive opening contacts are used as the arrangement can be installed in such a way to assure that welded contacts are forced open.

5.9 Photographs

5.9.1 Main Body

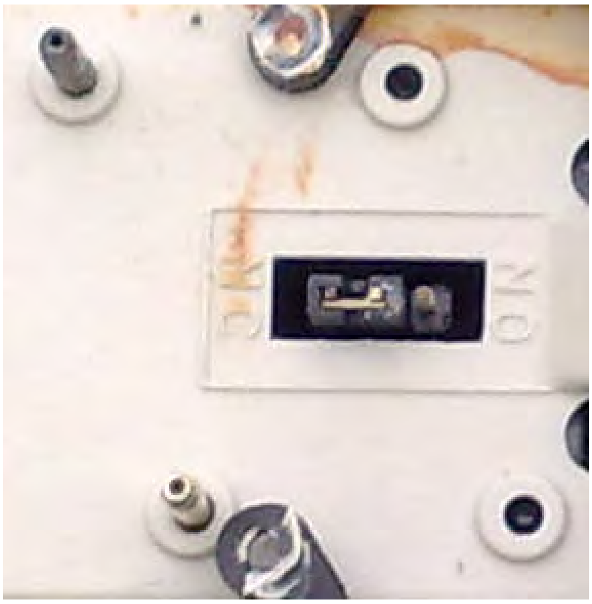
Proximity sensor body showing signs that there had been water ingress; the bottom electrical connection was badly corroded. This photo also shows 1 fixing screw missing and 1 fixing screw not driven home fully.

5.9.2 Head



This photo shows the underneath of the proximity sensor head. Again there are signs that there had been water ingress. The gasket looks to be intact, perhaps slight damage at the top left hand corner, this would be the bottom left corner when in place.

5.9.3 Programming Jumper



A close up of the NO/NC mode jumper, showing that the proximity sensor is in the normally closed mode. Slight corrosion can be seen on the upper pin, lower when in place.

6. Conclusion

- The overloads were set correctly.
- There were no wiring faults within the control panel preventing the proximity sensors from disabling the starter.
- There were no shorting links within the control panel or external to the control panel preventing the proximity sensors from disabling the starter.
- The starter would have been disabled had the davit proximity sensor gone open circuit.
- The davit proximity sensor was set to normally closed as it should be.
- The davit proximity sensor had failed short-circuit thus not stopping the winch motor when the davit was in the retracted position.
- Although a fuse of higher rating than recommended is used there is no evidence to suggest that a short-circuit had occurred causing the failure of the davit proximity sensor.
- There was evidence that there had previously been water ingress in the davit proximity sensor.

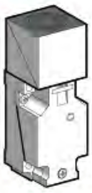
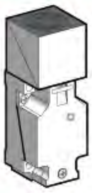
7. Datasheets & Drawings

7.1 Proximity Sensor Characteristics

References, characteristics

Inductive proximity sensors

Osiprox® Application
Plastic case, form C, plug-in
5 position turret head
a.c. or d.c. supply

Sensor		Flush mountable in metal		Non flush mountable in metal	
					
		AC	AC/DC	AC	AC/DC
Nominal sensing distance (Sn)		15 mm		20 mm	
References					
2-wire ∿	NO or NC programmable	XS7 C40FP260	–	XS8 C40FP260	–
2-wire ∿ or ⎓ universal model	NO or NC programmable	–	XS7 C40MP230	–	XS8 C40MP230
Weight (kg)		0.220	0.220	0.220	0.220
Characteristics					
Product certifications		UL, CSA, CE			
Degree of protection conforming to IEC 60529		IP 67			
Operating temperature		- 25…+ 70 °C			
Connection		Screw terminals, clamping capacity: 2 x 1.5 mm² *(1)*			
Operating zone		0…12 mm		0…16 mm	
Repeat accuracy		≤ 3% of real sensing distance (Sr)			
Differential travel		3…20% of real sensing distance (Sr)			
Output state indication		Yellow LED			
Rated supply voltage with protection against reverse polarity		∿ 24…240 V, 50/60 Hz	∿ 24…240 V, 50/60 Hz or ⎓ 24…210 V	∿ 24…240 V, 50/60 Hz	∿ 24…240 V, 50/60 Hz or ⎓ 24…210 V
Voltage limits (including ripple)		∿ 20…264 V	∿ or ⎓ 20…264 V	∿ 20…264 V	∿ or ⎓ 20…264 V
Current consumption, no-load		–			
Switching capacity		5…500 mA *(2)* (2 A inrush)	∿ 5…300 mA or ⎓ 5…200 mA *(2)*	5…500 mA *(2)* (2 A inrush)	∿ 5…300 mA or ⎓ 5…200 mA *(2)*
Residual current, open state		≤ 1.5 mA	0.8 mA on 24 V 1.5 mA on 120 V	≤ 1.5 mA	0.8 mA on 24 V 1.5 mA on 120 V
Voltage drop, closed state		≤ 5.5 V			
Maximum switching frequency		25 Hz	∿ 25 Hz, ⎓ 50 Hz	25 Hz	∿ 25 Hz, ⎓ 50 Hz
Delays	First-up	≤ 120 ms			
	Response	≤ 30 ms			
	Recovery	≤ 20 ms			

(1) Cable gland not included with sensor. For suitable 13P cable gland (XSZ PE13), see page 2/102.
(2) These sensors do not incorporate overload or short-circuit protection and therefore, it is essential to connect a "quick-blow" fuse in series with the load, see page 2/102.

7.2 Proximity Sensor Detection Curves

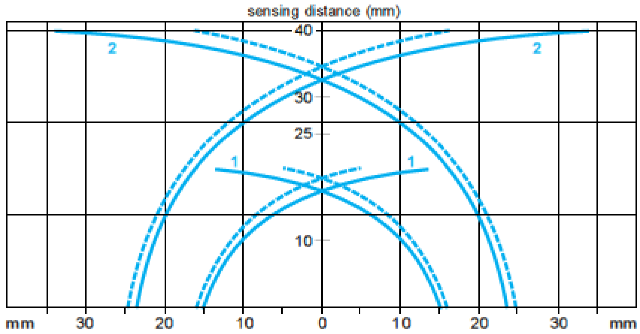
Inductive proximity sensors

Detection curves

Block type proximity sensors with increased sensing range

Form C

1 suitable for flush mounting, XS7-C40●●449
2 not suitable for flush mounting, XS8-C40●●449



Diameter of sensor	Dimensions of standard steel target	Operating zone
	mm	mm
XS7	60 x 60 x 1	0…16
XS8	120 x 120 x 1	0…32

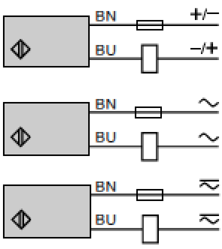
——— pick-up points
- - - - drop-out points
(object approaching from the side)

7.3 Proximity Sensors Operating Precautions

General

Inductive proximity sensors

Outputs (continued)



2

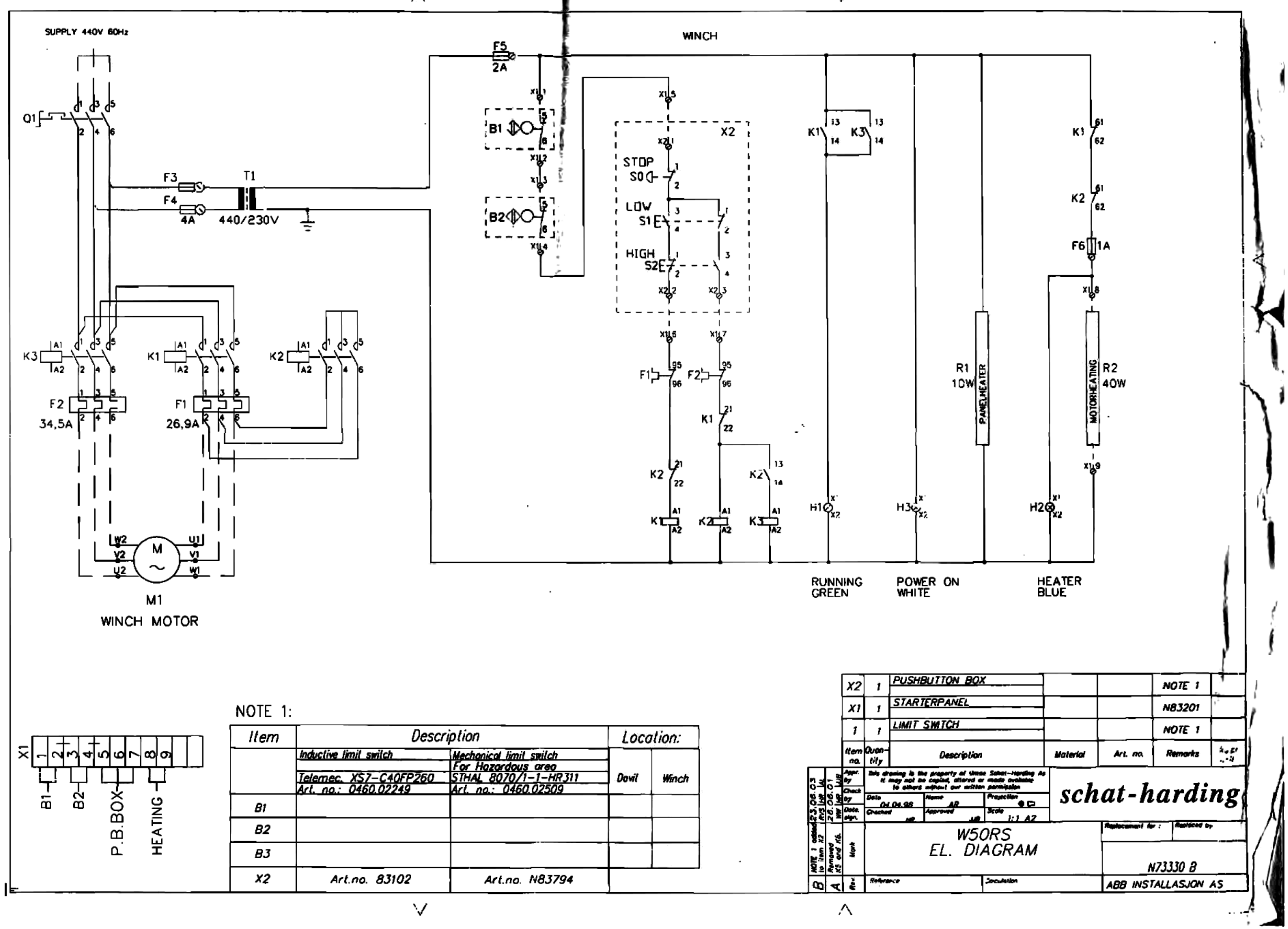
2-wire type ⎓, non polarised NO or NC output

■ **Specific aspects**
These sensors are wired in series with the load to be switched.
As a consequence, they are subject to:
□ a residual current in the open state (current flowing through the sensor in the "open" state),
□ a voltage drop in the closed state (voltage drop across the sensor's terminals in the "closed" state).

■ **Advantages**
□ Only 2 leads to be wired: these sensors can be wired in series in the same way as mechanical limit switches,
□ They can be connected to either positive (PNP) or negative (NPN) logic PLC inputs,
□ No risk of incorrect connections.

■ **Operating precautions**
□ Check the possible effects of residual current and voltage drop on the actuator or input connected,
□ For sensors that do not have overload and short-circuit protection (a.c. or a.c./d.c. symbol), it is essential to connect a 0.4 A "quick-blow" fuse in series with the load.

7.4 Control Panel Schematic Diagram



7.5 Proximity Switch Datasheet Provided by Schat Harding

XS7-C... / XS8-C...

Telemecanique

Caractéristiques / *characteristics*

Température de service / ***Operating temperature***	-25 → +70 °C 0 → +50 °C **

* 2A à l'appel / *2A inrush*		Tension nominale/ *Supply voltage*	Courant commuté/ *Switching capacity*	Références
2 fils / *2 wires*	AC	24...240V ∼	5...500 mA*	XS7/XS8-C40F●260
2 fils / *2 wires*	AC/DC	24...240V ≂	AC : 5...300 mA DC : 5...200 mA	XS7/XS8-C40M●230
2 fils / *2 wires*	DC	12...48V ⎓	1,5...100 mA Ⓚ	XS7/XS8-C40D●2130
3 fils/*3 wires*	DC	12...24V ⎓	0...200 mA Ⓚ	XS7-C40KPM40 (Fe/NFe)**
4 fils/*4 wires*	DC	12...48V ⎓	0...200 mA Ⓚ	XS7/XS8-C40P●440/449 XS7/XS8-C40N●440/449

Ⓚ Protection surcharge et courts-circuits / *Overload and short-circuit protection*

Sa1 : standard Sa2 : portée augmentée		Tension de déchet *Voltage drop*	Courant résiduel *Residual current*	Fréquence maxi / *Max. frequency* XS7-C	XS8-C
2 fils / *2 wires*	AC	≤ 5,5V	≤ 1,5mA	25Hz	25Hz
2 fils / *2 wires*	AC/DC	≤ 5,5V	≤ 1,5mA	25Hz	25Hz
2 fils / *2 wires*	DC	≤ 5,2V	≤ 0,8mA	150Hz	100Hz
3/4 fils / *3/4 wires*	DC	Sa1 Sa2 ≤ 2V	—	Sa1 1000Hz Sa2 500Hz	Sa1 1000Hz Sa2 500Hz

Mise en oeuvre / *Setting up procedure*

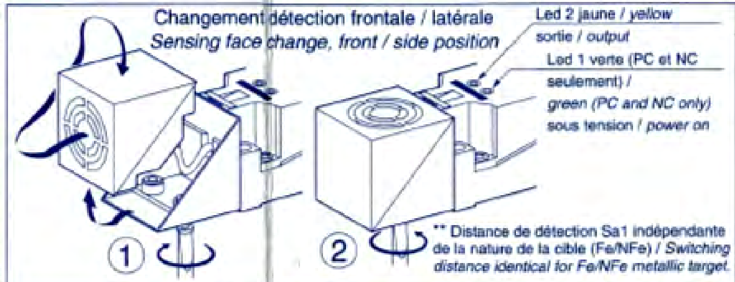
	XS7-C	XS8-C
Portée nominale / *Nominal sensing distance*	Sa1 = 15 mm Sa2 = 20 mm	Sa1 = 20 mm Sa2 = 40 mm
Cible / *Target* (Fe 360)	Sa1 = 45x45 mm Sa2 = 60x60 mm	Sa1 = 60x60 mm Sa2 = 120x120 mm
Dom. de fonctionnement / *Operating zone*	Sa1 = 0...12 mm Sa2 = 0...16 mm	Sa1 = 0...16 mm Sa2 = 0...32 mm

Distances à respecter au montage /
Mounting precautions minimum distances

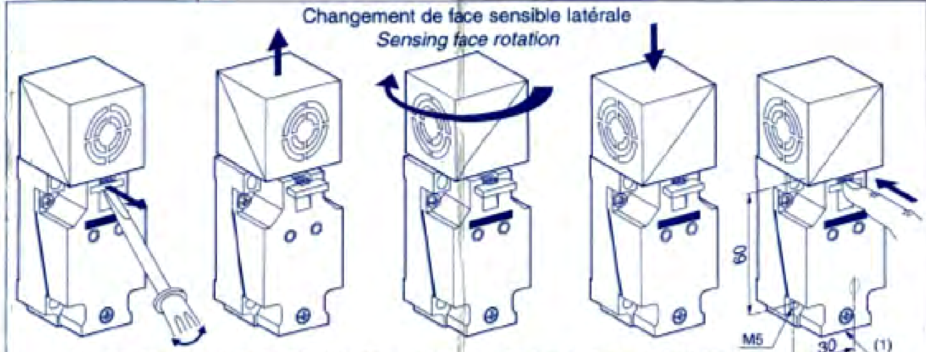
	XS7-C	XS8-C
D1 ≥	Sa1 = 40 Sa2 = 80	Sa1 = 60 Sa2 = 160
D2 ≥	Sa1 = 120 Sa2 = 240	Sa1 = 160 Sa2 = 320
D3 ≥	Sa1 = 45 Sa2 = 60	Sa1 = 60 Sa2 = 120

H ≥ 40

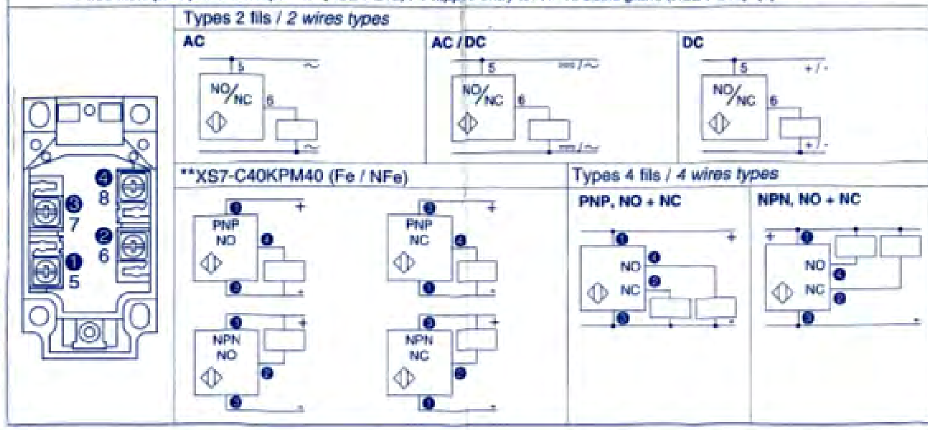
	NO Led jaune *yellow*	NO sortie/ *output*	NC Led jaune *yellow*	NC sortie/ *output*



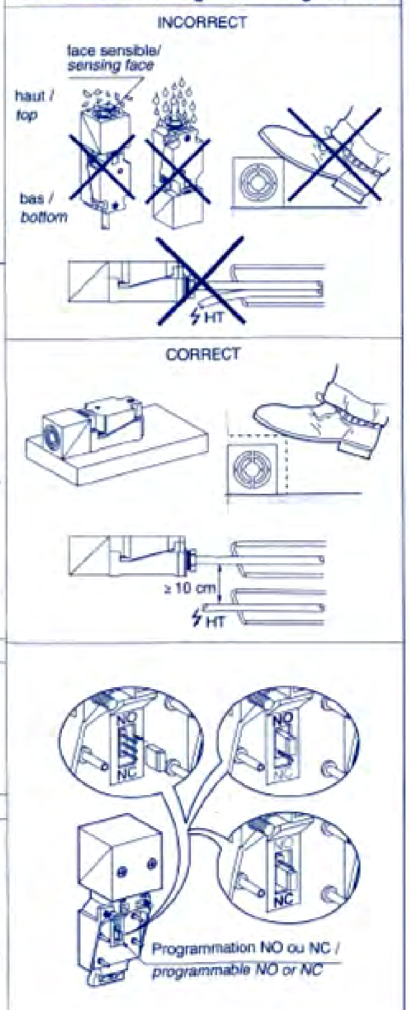
** Distance de détection Sa1 indépendante de la nature de la cible (Fe/NFe) / *Switching distance identical for Fe/NFe metallic target.*



1 trou fileté pour presse-étoupe 13P (XSZ-PE13) / *1 tapped entry for N° 13 cable gland (XSZ-PE13)* (1)



Conseils de montage / Mounting advice



7.6 Additional Datasheets

Additional datasheets for the various components can be found online at the following locations:

7.6.1 Proximity Sensor

http://www.neweysonline.co.uk/neweys/pdf/Telemecanique_Inductive_Proximity_Sensors_Osiprox_Technical.pdf

http://docs-europe.electrocomponents.com/webdocs/002c/0900766b8002c9d6.pdf

Annex E

ERA Technology - report 2011-0124

Client-in-confidence [1]

Your Ref: 8000085795

Our Ref: 04312-3062

ERA Technology
Cleeve Road, Leatherhead
Surrey KT22 7SA, UK
T. +44 (0) 1372 367000
F. +44 (0) 1372 367099

Web: www.era.co.uk/rfa
Direct Dial: +44 (0) 1372 36 7366
Direct Fax: +44 (0) 1372 36 7134
[redacted]

[redacted]
Marine Accident Investigation Branch,
Mountbatten House,
Grosvenor Square,
Southampton, SO15 2JU

10th March 2011

[redacted]

The following report details the failure analysis of the supplied proximity sensor limit switches.

Title: Rescue Boat Winch Incident Report for MAIB

ERA Project No. 04312-3062
ERA Report No. 2011-0124

1. Background

Following an incident on the MV Tombarra on Monday 7th Feb 2011 where a winch system continued to operate when it should have activated a limit switch and been electrically disabled, ERA RFA department have been asked to assess the limit switch which appears to have failed to operate correctly.

The aim of this work was to try and answer four questions.

1. Cause of failure (water ingress or otherwise).
2. Approximate timeframe since failure (if feasible).
3. Likelihood of maintaining IP67 protection rating after 5 years in service (open deck of ship).
4. Likelihood of identifying a degrading condition before actual failure.

[1] ERA Technology Limited provides this document in confidence to the client. The Client may use and copy the document in whole without alteration for its own business purposes including disclosure to third parties.

2. Identity of Samples

Three samples of proximity limit switch part number XS7-C40FP260 have been delivered.

1. New / unused sample - engraved with number 8B1016. Evidence bag reference MO1846497
2. Used sample which is thought to be operating normally – engraved with number 8B0546. Evidence bag reference MO1846498
3. Used sample which is thought to have failed – engraved with number 8B0546. Evidence bag reference 00478129

It is understood that samples #2 and #3 were deployed in a similar environments on the same ship, although sample # 3 may have been slightly less exposed. The working sample #2 appears much less "weathered" than the failed sample #3.

Important note – samples #2 and #3 were removed from the ship without the cable attached. It had been requested that the cable was detached from the ship outside of the units, and that the units were then delivered for assessment with the cable and the cable gland attached / un disturbed on the unit. Because the cables were removed, any information about seal failure at the cable / unit interface has been lost. Additionally any information about electrical integrity at the terminals inside the unit has been lost.

3. New / Unused Unit investigation – sample #1

To assess normal operation this part was removed from its connector base and wired to a standard 60W, 240V tungsten filament light bulb (to act as a suitable load for the circuit and indicate whether the unit operated as expected). Mains live was connected to terminal 5, the switched terminal 6 was connected to the lamp live, and the lamp neutral was connected to mains neutral. (see Figure 1: Internal connectors on sample #1). The system was tested in the normally open (NO) and normally closed (NC) configuration. The NO/NC configuration is set by a jumper switch – (see Figure 2: jumper switch on sample #1). When powered on the unit operation was tested by moving a piece of steel into proximity with the sensing face of the device (blue face on the end of the device). The device operated as expected when the metal came within 15mm to 17mm of the sensing face. With the jumper set to NC the light switched off when the metal was in proximity. With the jumper set to NO the light switched on when the metal came into proximity. Note – on the used samples #2 and #3 the jumper was set to the NC position.

4. Working Reference Unit – sample #2

4.1 External examination

The unit retained the printed details on the outside surface of the case (it may be significant that the failed sample #3 did not retain this printing).

4.2 Rubber gasket seal assessment

Looking at the rubber seal there is clear evidence of deterioration. The seal is beginning to split and the rubber is beginning to harden / perish. There is no evidence of water ingress into this unit – see Figure 6: Inside sample #2 , but the quality of the seal is considered to be compromised. See Figure 4: sample #2 rubber gasket seal, and compare with an un used and presumably younger example in Figure 3: sample #1 rubber gasket seal.

4.3 Electrical testing

Sample #2 was electrically tested in the same manner as sample #1. The jumper switch was in the NC position. The unit behaved in exactly the same way as sample #1. This system is considered to be in normal working order.

5. Failed Unit Investigation – sample #3

5.1 External examination

Sample #3 has lost its printed part number / electrical wiring information which was originally on the outside of the unit. Looking closely there are witness marks which show that this information was present, and the details are the same as samples #1 and #2. This suggests that sample #3 has been exposed to a greater amount of weathering than sample #2 – perhaps because it is located in a more exposed part of the ship – see Figure 7: printing loss comparing samples #2 and #3 . This increased weathering may be a factor in the rubber gasket failure which has caused the unit to leak water (see below). During removal from the ship the connector section has been sawn across the attachment

5.2 Rubber gasket seal assessment

There is significant deterioration of this seal – see Figure 5: sample #3 rubber gasket seal. The seal has almost certainly been compromised which has allowed salt water into the cavity. There is clear evidence of water ingress into the cavity. The angle of the water witness mark (rusty deposit on the cavity surface) is in agreement with the angle at which the unit was mounted on the ship. See Figure 8: Inside sample #3 cavity – connector section, and Figure 9: Inside sample #3 cavity – electronics section.

5.3 Electrical testing

Measuring between the internal connectors which are controlled by the circuit (indicated by the arrows in Figure 2: jumper switch on sample #1) when the unit was not powered, they were found to be open circuit. This implies that if corrosion inside the connector section of the device had caused electrical failure, the unit would fail open circuit (preventing motor operation). There is also no evidence of short circuit in this part of the device. The fault must therefore reside in the electronics control part of the device.

Sample #3 was electrically tested in the same manner as sample #1, and plugged into the sample#1 base. The unit was tested with jumper switch in both the NC and NO positions.

Jumper position	Metal in proximity	Metal not in proximity
NO	Light on continuously, drawing 0.2A AC	Light flickers, drawing 0.12A AC and 0.12A DC
NC	Light flickers, drawing 0.12A AC and 0.12A DC	Light on continuously, drawing 0.2A AC

This type of electrical failure is consistent with a semiconductor failure in a solid state switch. It is therefore necessary to disassemble the electronics section of the device and remove the epoxy potting which encases the circuitry.

5.4 Assessing electronics section of sample #1

It appears that there is an electrical fault in the potted electronics section of sample #3. To investigate this fault, and determine whether sea water ingress is responsible for the failure, it is necessary to "de pot" the electronics section. To test this process sample #1 electronics are to be "de potted". Assessing sample #1 before this process has revealed some defects in the potting layer, as indicated by the highlighted area in Figure 10: sample #1 electronics potting defect, where the exposed green of the circuit board can clearly be seen (the circuit board should be completely sealed by the potting compound). If the same potting defects are present in the failed sample then there is a chance that sea water has entered the device. This investigation is ongoing.

6. Conclusions

Returning to the objectives of this work

1. Cause of failure (water ingress or otherwise).

As the cable was removed from the samples we cannot definitively say where the water leak occurred, however the rubber gasket on the failed sample had degraded significantly and may well have leaked

2. Approximate timeframe since failure (if feasible).

It is not possible to estimate the timeframe since failure. The unit may have leaked sea water long before the electrical failure occurred.

3. Likelihood of maintaining IP67 protection rating after 5 years in service (open deck of ship).

Based on the deterioration of the rubber gasket, and the defects seen in the potting of the electronics of sample #1, there is a strong chance that the device will not maintain IP67 protection rating after 5 years, and this device is not considered fit for purpose in this application.

4. Likelihood of identifying a degrading condition before actual failure.

It would be necessary to periodically open the unit to visually check for water ingress and seal quality. This action may itself introduce a defect in the rubber gasket which will result in a water leak and lead to device failure. Identifying a degradation of the device before failure is therefore thought not to be simple.

7. Further Work

It is recommended that the electronics in the failed unit are de potted and assessed for evidence of corrosion damage and / or water ingress, and component failure. This will clarify whether the ingress of sea water into the connector cavity has lead to the device failure, or whether the electronics have failed for some other, possibly un identifiable reason.

report authorized - sent electronically

Report prepared by:	Checked by:
[redacted]	[redacted]

Figure 1: Internal connectors on sample #1

Figure 2: jumper switch on sample #1

Figure 3: sample #1 rubber gasket seal

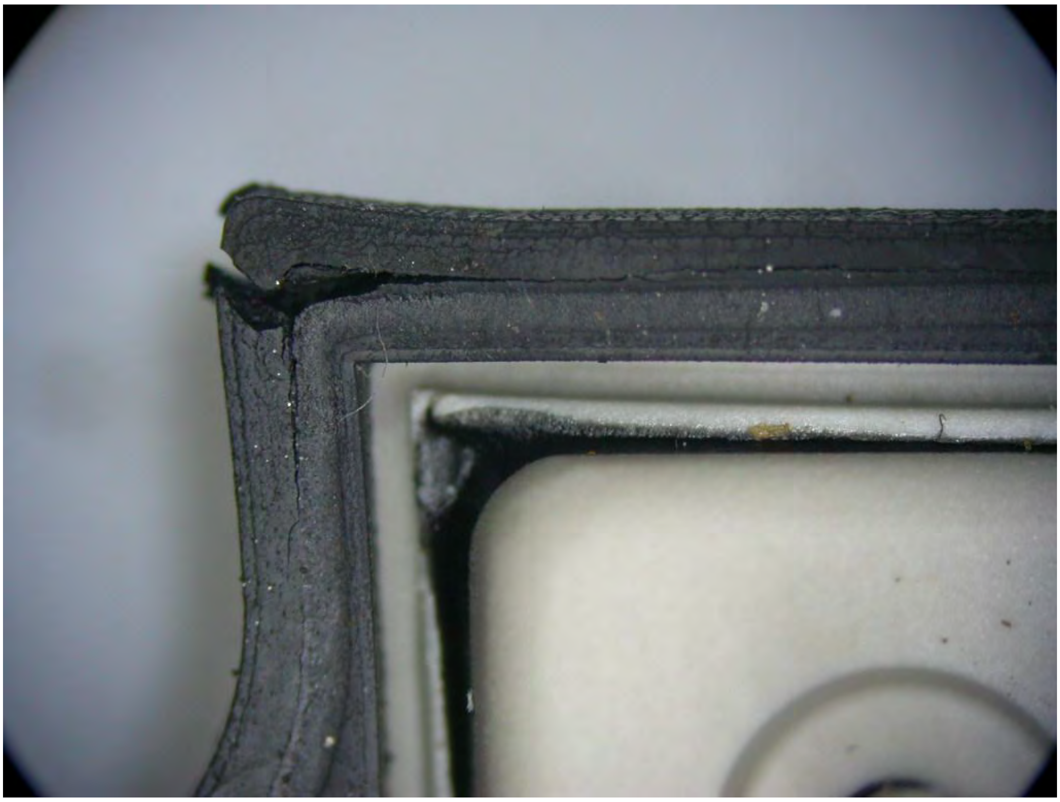


Figure 4: sample #2 rubber gasket seal

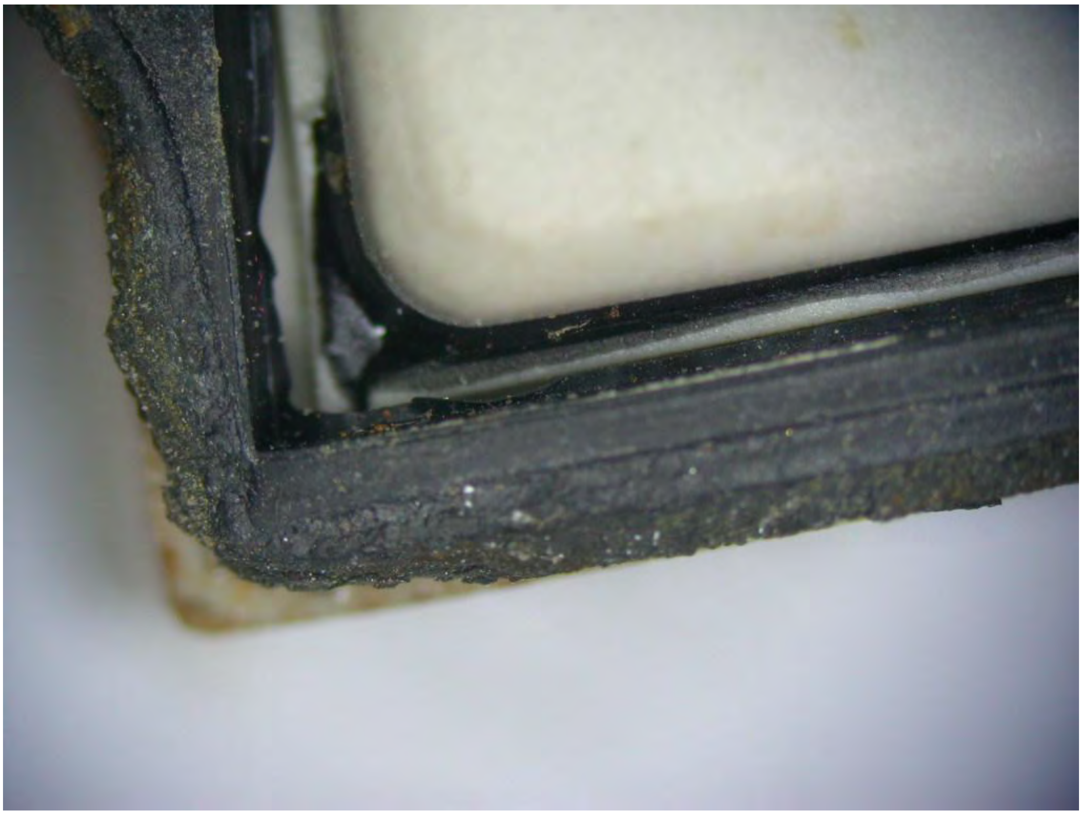


Figure 5: sample #3 rubber gasket seal

Figure 6: Inside sample #2

Figure 7: printing loss comparing samples #2 and #3

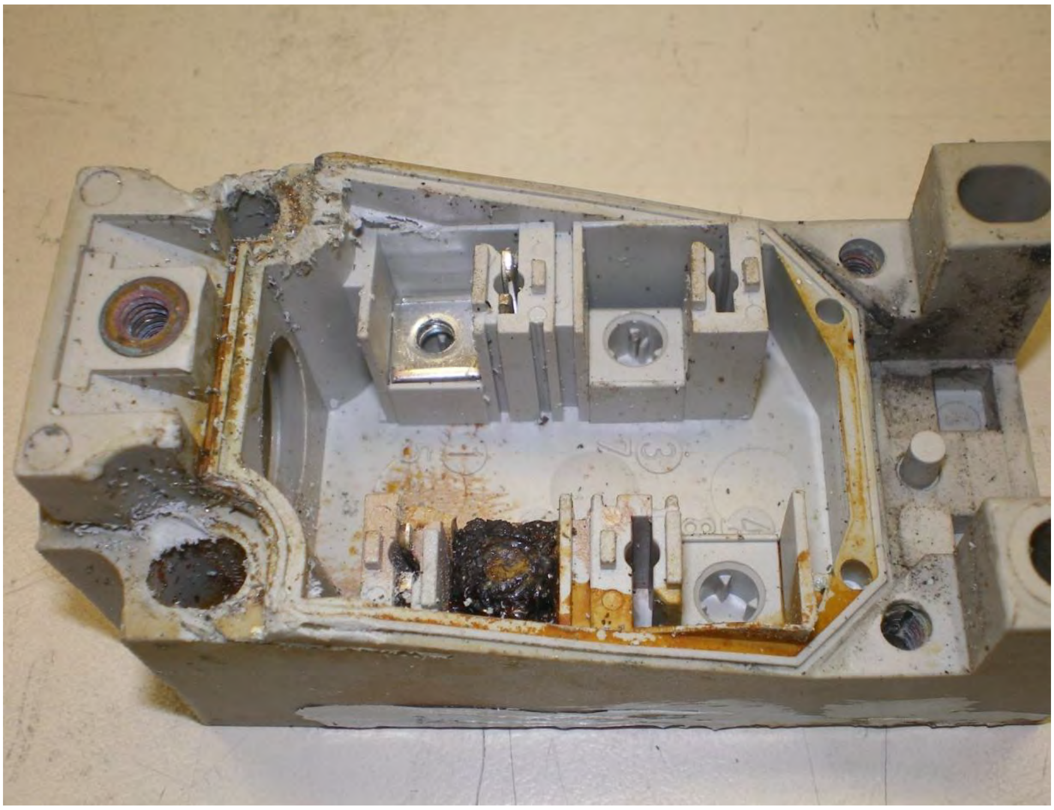


Figure 8: Inside sample #3 cavity – connector section

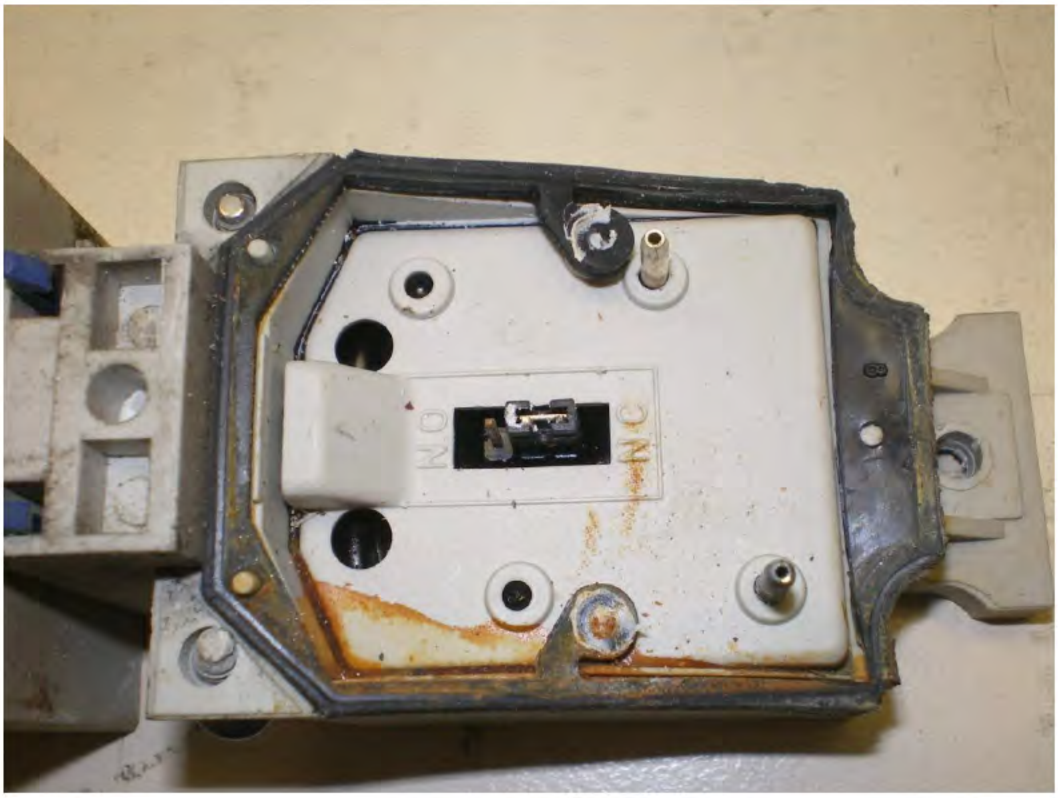


Figure 9: Inside sample #3 cavity – electronics section

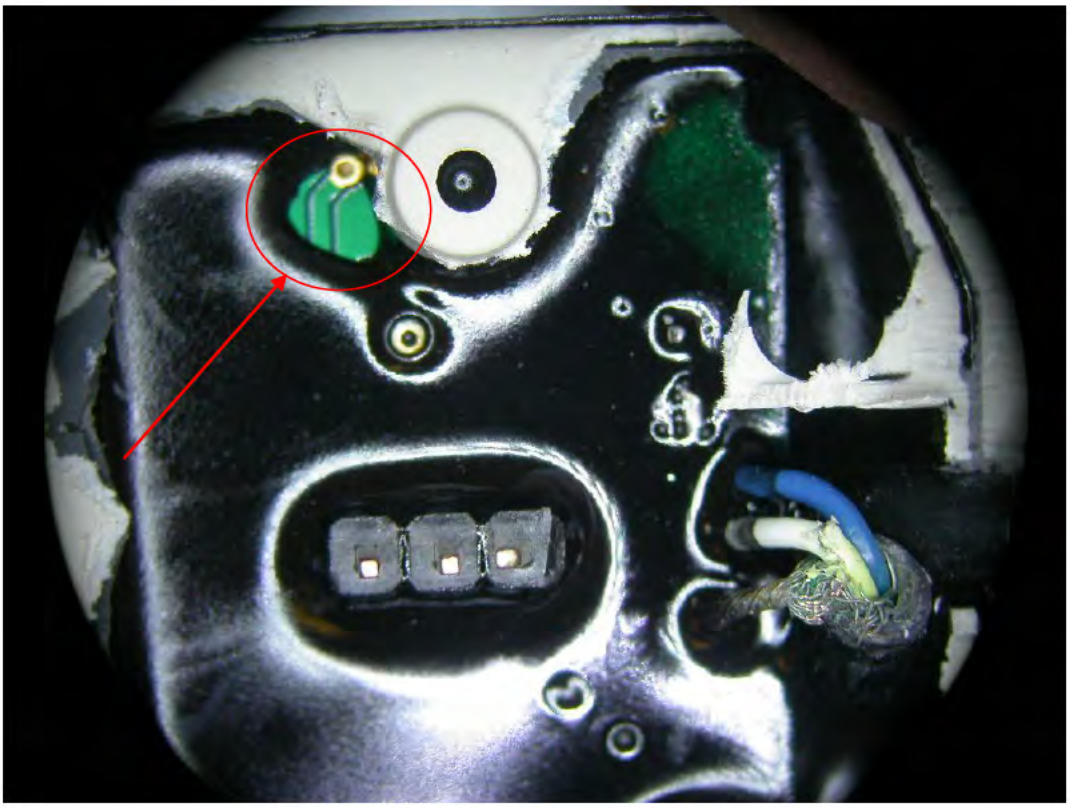


Figure 10: sample #1 electronics potting defect

ERA Technology - report 2011-0224 Issue 2

Client-in-confidence [1]

Your Ref: 110420RDB

Our Ref: 04312-3082

ERA Technology Limited
Cleeve Road, Leatherhead
Surrey KT22 7SA, UK
T. +44 (0) 1372 367350
F. +44 (0) 1372 367359

Web: www.era.co.uk/rfa
Direct Dial: +44 (0) 1372 367224
Direct Fax: +44 (0) 1372 367134
Email: [redacted]

[redacted]
Marine Accident Investigation Branch,
Mountbatten House,
Grosvenor Square,
Southampton,
SO15 2JU

4 May 2011

[redacted]

Title: Investigation of failed limit switch on MV Tombarra

ERA Project No. 04312-3082

ERA Report No. 2011-0224 Issue 2.

1. Background

Following an incident on the MV Tombarra on Monday 7th Feb 2011 where a winch system continued to operate when it should have activated a limit switch and been electrically disabled, ERA RFA department made an initial investigation of the limit switch in question to assess whether ingress of sea water into the electrical connections had been responsible. ERA report number 2011-0124 dated 10 March 2011 reported on that investigation. It showed that there had been water ingress to the electrical connections, but this alone was not the cause of the failure. MAIB then asked ERA to dismantle and decapsulate part of the device to further investigate.

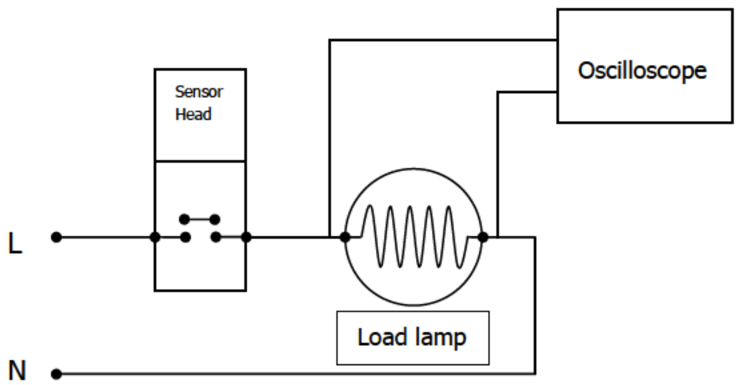
This document reports that second part of the investigation and should be read in conjunction with the first report.

[1] ERA Technology Ltd provides this document in confidence to the client. The Client may use and copy the document in whole without alteration for its own business purposes including disclosure to third parties.

2. Investigation of switch unit

2.1 Electrical Test

In the first report it was noted that, using a tungsten light bulb as a load, the failed limit switch made proper full connection in the 'on' condition, but in the 'off' condition gave a flickering low power connection. It was considered that this failure mode might represent a 'half wave' semiconductor failure; that is the switch unit was on for, say, the positive half of each mains cycle but off for the negative half. In order to assess this, as oscilloscope was connected across the load lamp, with the circuits as descried in the previous report (and below).



The scope trace showed that the failure was indeed a half wave failure: i.e. the negative part of the mains failed to switch off. See Figure 1. This test took place with the failed switch unit mounted into the 'socket' of the new unit. The 'socket' of the failed unit was thereby positively eliminated from suspicion.

2.2 Decapsulation of New unit

The sensor unit itself appeared to comprise two parts: The sensor part (behind the blue sensing face), and a connection part (with the two connection pins and the NO/NC jumper). The mechanical configuration provided near universal directional flexibility between them. The NEW unit was carefully dismantled, sawing or filing away parts of the casing piece by piece. It seemed likely that both of these parts contained active circuitry, but the two parts only had a low current screened signal cable between them (2 cores + screen)(Note: Figure 2 shows the construction, but the image is of the failed unit). It was therefore surmised that the power switching circuitry was in the connector part, with the sensor part only containing sensing circuitry and perhaps electronic buffering. The plug part of the unit was immersed in resin disintegrator until all the black encapsulant had been removed, and the circuit board was fully exposed. One component on this unit was visibly damaged during the process of its mechanical and chemical removal.

2.3 Decapsulation of Failed unit

The failed unit was then similarly separated into its two parts, the encapsulated board removed (Figure 2), and the resin chemically removed from it. The process on this unit was successfully carried out without any visible damage to the pcb or its components.

2.4 Electrical retest.

The decapsulated pcb of the failed unit was then reconnected up to its own sensor part, and retested as above. It operated as before: i.e. fully on when it should be ON, but only half-wave off when it should have been OFF. The decapsulation had therefore been completed without any circuit damage.

The decapsulated pcb of the failed unit was then reconnected up to the sensor part of the good unit, and retested as above. It operated as before: i.e. fully on when it should be ON, but only half-wave off when it should have been OFF. The sensor head of the failed unit was thereby positively eliminated from suspicion, and it was clear that the decapsulated pcb was the part with the failure.

It had been noted that whenever the decapsulated failed pcb had been connected up in a circuit to the mains supply (with either sensor unit as above) there had been an small instantaneous spark underneath (pin side) of the pcb. It was noted that this was becoming markedly worse and gave cause for concern. On close inspection it was clear that there was a small area of burn damage between two tracks. This was initially assumed to be due to decapsulation damage (decapsulant had removed some of the green insulation layer), and it was therefore cleaned up and coated in an electrically insulating sealant (See Figure 3). On retest, the unit worked perfectly: The fault had disappeared. Correct operation was confirmed in both NO and NC modes. It was therefore clear that this damage was not decapsulation damage, but was in fact the original fault.

Schneider had been requested and had supplied MAIB with a circuit diagram and board layout. MAIB forwarded these to ERA. Unfortunately when ERA put these alongside the hardware there were obvious differences in the board layout. It appeared that the drawings supplied were either an earlier or later version of the board in question: It was assumed that the circuit diagram suffered from the same problem. From a brief look at the pcb, it was clear that the 2 connection pins were connected to the ac corners of a full wave rectifier bridge integrated circuit. The short circuit which had been found effectively shorted one of the diodes of that bridge.

The operation of the circuit is not clear to us, in that we do not have the full circuitry (only the one pcb in question), and no knowledge of the sensor in conjunction with which it works. It is clear that the circuit is sophisticated in that it operates without any neutral or ground connection.

An attempt was made to recreate the fault by reapplying an external short circuit at the same point. This produced half wave conduction, regardless of whether or not there was metal present near the sensor head. A variety of resistors were used as a 'partial short circuit', and a resistors of 560Ω appeared briefly to produce the original problem, however the resistor rapidly burned out. This test was considered not fully conclusive.

2.5 Optical Review

Pictures taken during the process of cutting apart the failed unit were reviewed to see if there was any evidence of an encapsulation problem in that region of the short, which might have allowed sea water ingress. No such evidence could be seen. See Figure 4.

2.6 SEM-EDX Review

Energy Dispersive X-ray (EDX) analysis was used in the Scanning Electron Microscope (SEM) to determine whether any sea salt could be identified in the region of failure on the pcb. It was considered most unlikely that this would be successful, since the board had spent some hours in resin disintegrating fluid, and had also been thoroughly cleaned in the region of the failure to allow the insulating sealant to bond. As expected, no evidence of sea salt residue could be detected.

3. Summary

The pcb of the plug part of the failed sensor unit was successfully decapsulated without damage, and continued to operate with the same electrical fault.

Substitution of another socket base, and another sensor part of the head showed that the fault was certainly in the circuit of the plug part of the head.

The elimination of a short circuit on this board, which was initially though to derive from the decapsulation process made the fault disappear, strongly indicating that this was in fact the original fault.

Substitution of a fixed resistor for the fault short, gave rise to similar conditions to the fault condition, however rapid heating of the resistor made it difficult to be certain in this test.

Review of optical pictures taken during decapsulation showed no evidence of encapsulation failure in the region of the fault.

SEM-EDX analysis failed to find any evidence of sea salt ingress, although it is almost certain that even if there had been sea water ingress, any residues would have been removed during the decapsulation and board cleaning process. This test was therefore not definitive.

4. Conclusion

The earlier report showed that there clearly had been water ingress in to the electrical connection and head socket cavity of the sensor device, but that this did not appear to be the cause of failure since the head still malfunctioned on the laboratory bench when apparently completely dry.

This report has very strongly suggested that the actual failure was caused by a partial short circuit on the internal pcb. It is difficult to fully establish how this arose. No fault in the encapsulation in that region was apparent, and no evidence of sea water ingress was found. There was heat damage in the region of the short, including charred circuit board and chipped green surface insulation. While the heat damage was almost certainly caused by the fault and not the cause of the fault, the insulation damage could have been either a causal factor, or caused by the fault.

The first report showed that the proximity sensor unit was inadequate for the application, at the very least because the sensor head rubber seal had degraded significantly over its life, and whether through that seal or through the cable gland seal, water had ingressed into the unit.

It logically stands that if, as seems apparent, the operating procedure on the ship (either as formally written or as practically operated) permitted the sole stop function to rely on this proximity switch, then both the switch was inadequate for the purpose and the operating procedure was deficient, because there was no fail-safe function or back-up cut-out in the system. This is unacceptable in a safety critical function.

report authorized - sent electronically

Report prepared by:	Checked by:
[redacted]	[redacted]

Client sample disposal

All customer supplied samples will be disposed of 3 months after completion of the project unless otherwise agreed in writing. ERA reserves the right to charge reasonable costs for carriage and disposal where a customer wishes samples to be returned.

About ERA Technology Limited):

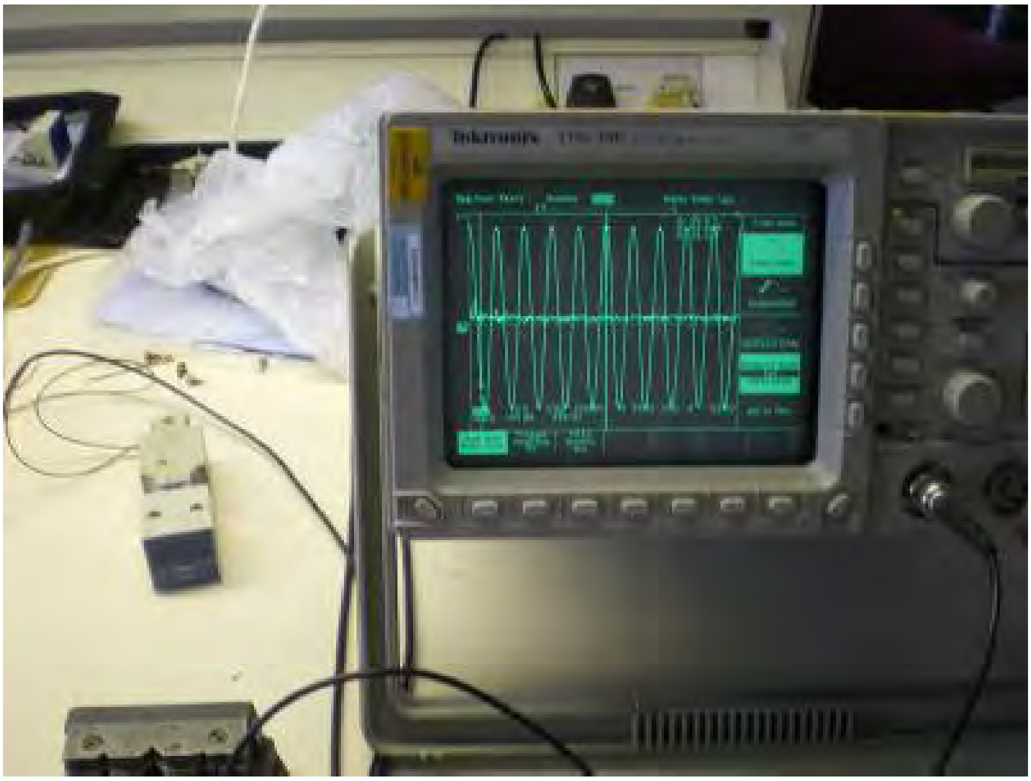
ERA was established in 1925 and employs about 240 people of whom about 80% are scientists/engineers qualified to first degree level or higher. It provides impartial expertise on technical and regulatory issues associated with products, manufacturing and design, across the whole manufacturing sector from consumer electronics, through aerospace to power systems and utilities.

Regulatory compliance capability

ERA has in depth capabilities concerning regulatory compliance (CE, EMC, LVD etc.) and in particular on the growing raft of environmental measures on substance restrictions (REACH, RoHS), ecodesign and waste (WEEE, batteries) and similar requirements worldwide. ERA consults for industry, trade associations and also for regulators and policy makers, and has carried out work for UK government and the European Commission to support both the RoHS and Ecodesign directives and well as advising on REACH. This included assistance in developing RoHS enforcement guidance, the definition of homogeneous material used in the RoHS directive and in development of the IEC disjointment guidance. As such it is in a good position to provide informed insight into regulation as it develops not just in terms of what is stated in regulation but what needs to done in practice. For more information go to www.era.co.uk/environment

Failure Analysis Capability

ERA has 40 years experience in failure analysis of electronic and other hardware. It has carried out thousands of investigation projects on failures ranging from miniature components up to whole systems or even power and chemical plant. It has a broad range of chemical analysis, electrical test, and mechanical testing equipment, as well as a powerful state-of-the-art Scanning Electron Microscope with many associated test probes. Our range of experts, including physicists, electrical and mechanical engineers, chemists and metallurgists, with background experience from research, through to manufacturing industry, offer a huge resource of knowledge to effectively diagnose the root causes of problems. For more information go to www.era.co.uk/forensics



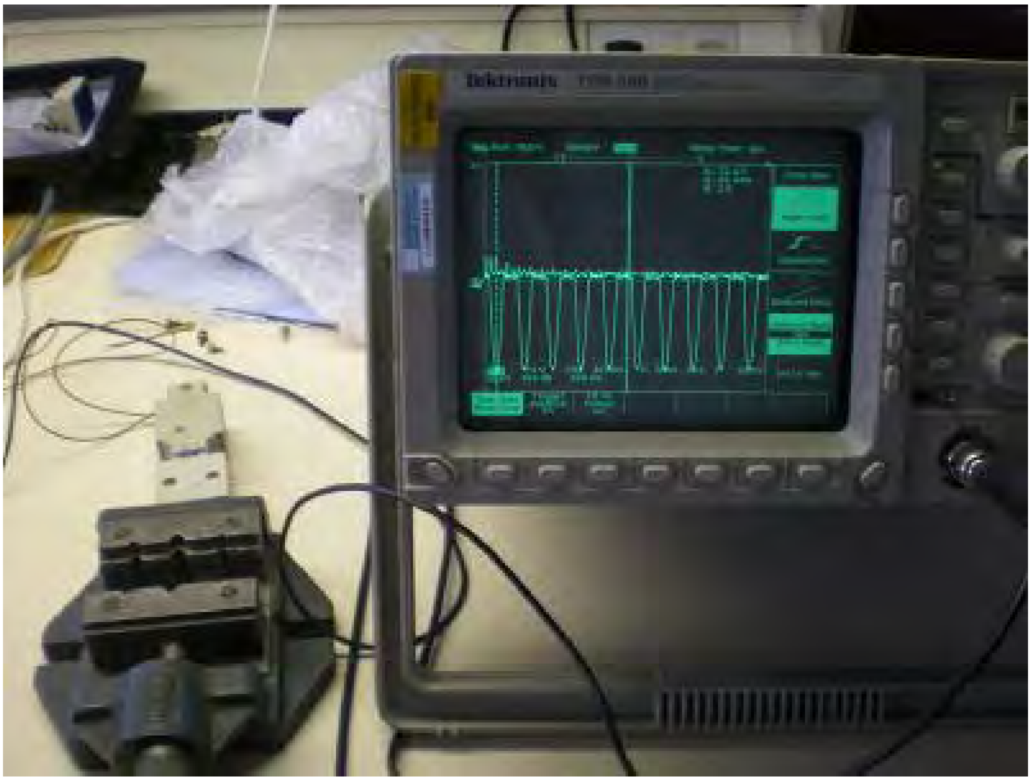


Figure 1: Failed Limit switch with load lamp connected along with monitor oscilloscope:
above: metal mass away from switch – power full on
below: metal mass close to switch – negative voltage fails to switch off.

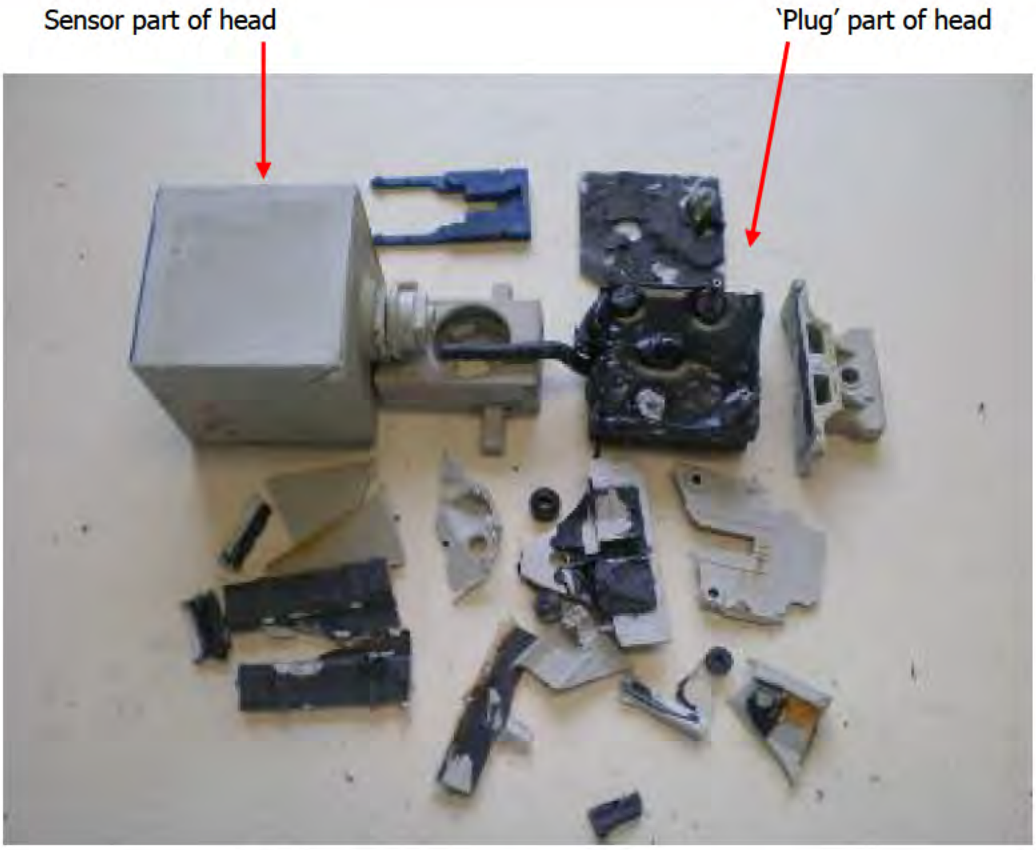


Figure 2: Failed unit partially dismantled

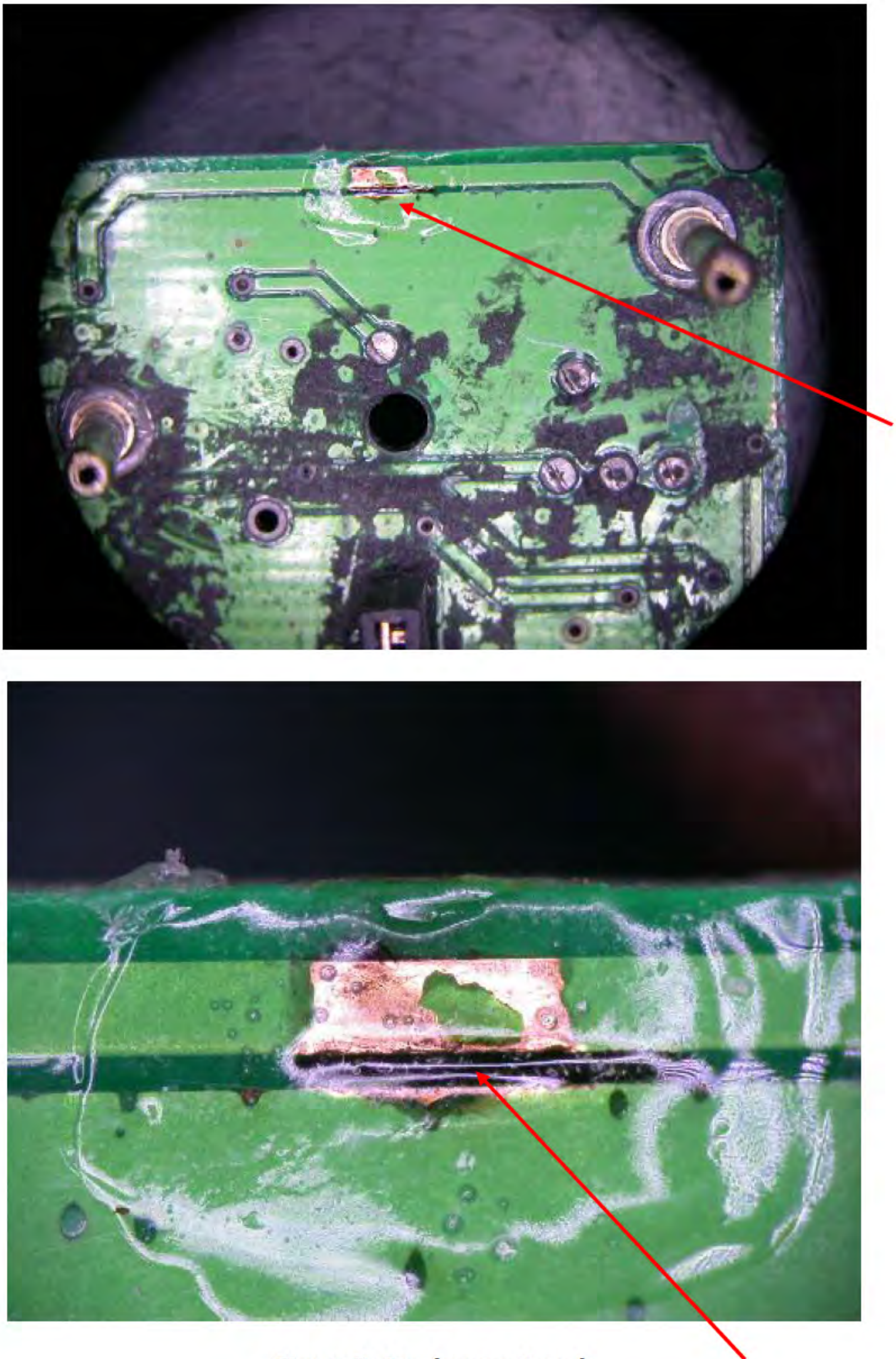


Figure 3: Arc damage to pcb

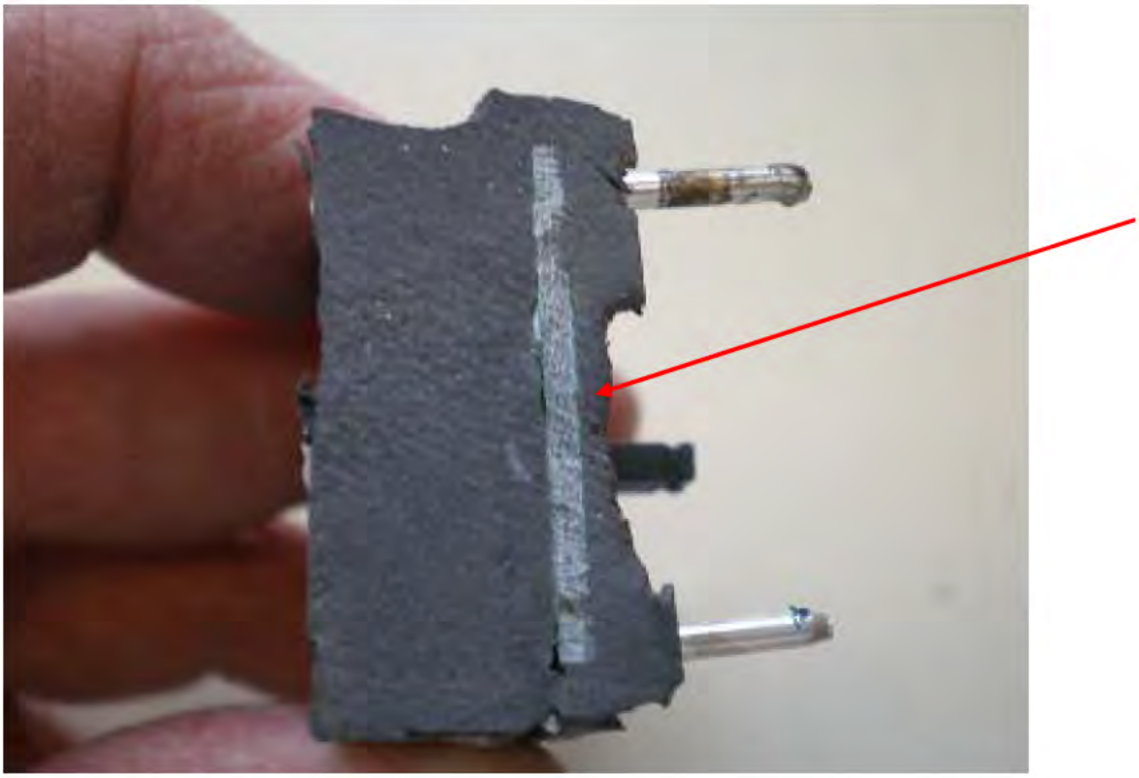


Figure 4:
Failed unit - partially decapsulated,
showing the region where the pcb was subsequently found damaged.
No encapsulation damage or fault is evident.

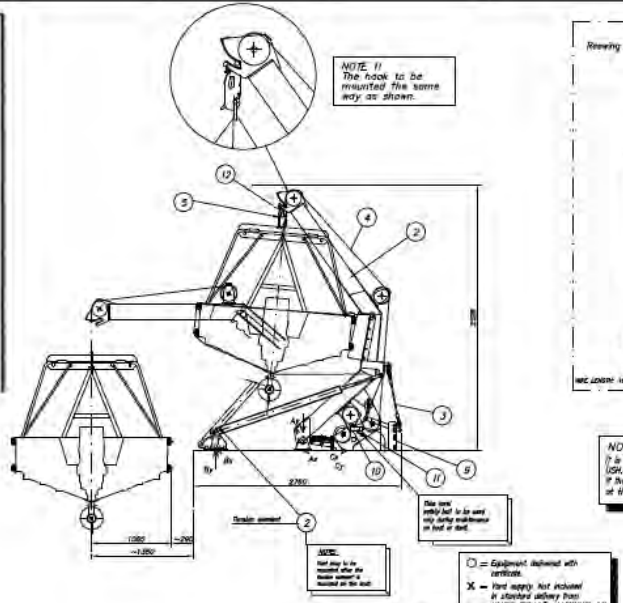
General Arrangement N65687 A

WINCH MAIN DATA:

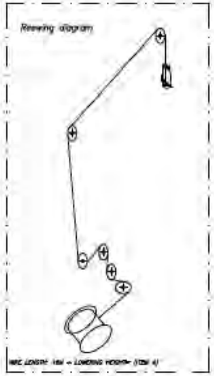
TYPE: W 50 RS
PROTOTYPE APPROVED MOMENT: M–11700 Nm.
HOISTING SPEED 60Hz 20 m/min.
LOWERING SPEED: Adjustable up to 90 m/min.
MAX.LOWERING HEIGHT: (WIRE ø13mm / 2 LAYERS): 57 M

ELECTRIC MOTOR DATA:

TYPE: 7BA132M21
VOLTAGE: 3x440V, 60Hz
CURRENT: (IN) 7,0/15,2 A
CURRENT: (IS) 12,1/19,4 A
EFFECT: 6,5/11,0 kW



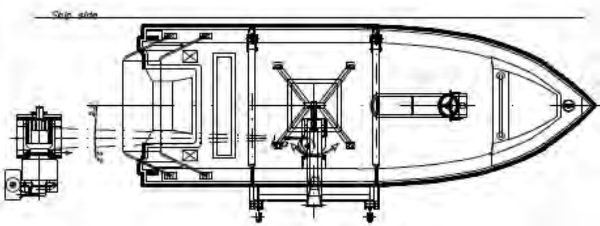
NOTE 1)
The hook to be mounted the same way as shown.



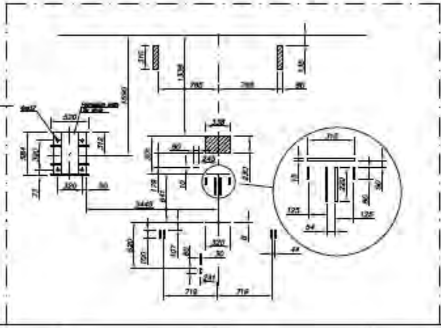
NOTE 2
It is important that USH, are being informed if there are any deviation of the deck angle.

○ = Equipment delivered with certificate.
X – Yard supply. Not included in standard delivery from UMOE SCHAT-HARDING AS

Port side version.



NOTE 3)
All grease nipples to be delivered with rubber caps



	[illegible]	[illegible]	[illegible]	Pos	Name, type, dimension	No. off	Art. no.	Material	Appr. unit	Notes
X				15	M20 Lock nut	4	yard supply	Galv.8.8		DIN985
X				14	M20 x 90 Bolt	4	yard supply	Galv.8.8		DIN931
○				13	Hanging off arr.	1	N73547			
				12	Wire grip	1				[illegible]
				11	Limit switch arr.	1	73162			
○	14,7	96,3	32,4	10	Sheave house on deck (Assembly)	1	64605			
				9	Bracket for lashing	2	92029			
				8	El.diagram	1	[illegible] N73330			
X				7	Winch foundation	1	N63189			
				6	Remote control arr.	1	N73894			
○	14,7	98,8	36,9	5	Release hook	1	92653			
○	27	182		4	Wire ø13 L=16m + LOWERING HEIGHT	1	01.70.20418			
				3	Lashing arrangement	1	N73982			
○	14,7	40,3	32,4	2	Davit SA 1,5 Assembly	1	64604			
○	17,8	78,2	26,4	1	Winch W50RS	1	N65437			

Date 29.05.04 — Scale 1:25 — A1

SCHAT HARDING

SA1,5/WHFRB6,5/W50RS
GENERAL ARRAGEMENT
STANDARD

N65687 A

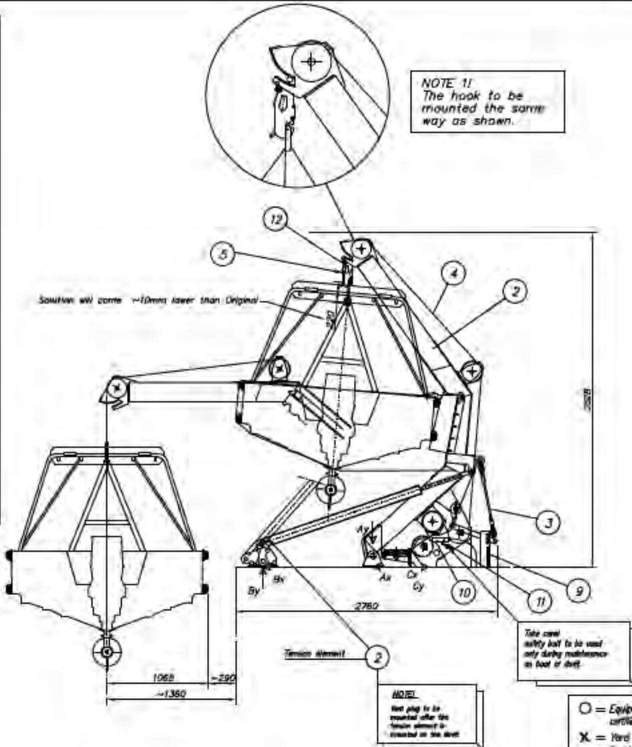
General Arrangement NB2625 F

WINCH MAIN DATA:

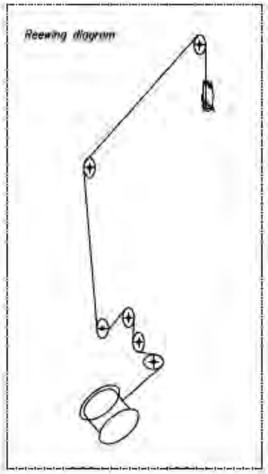
TYPE: W 50 RS
PROTOTYPE APPROVED MOMENT: M=11700 Nm.
HOISTING SPEED 60Hz: 20 m/min.
LOWERING SPEED: Adjustable up to 90 m/min.

ELECTRIC MOTOR DATA:

TYPE: 160 L 21
VOLTAGE: 3x440V, 60Hz
CURRENT: (IN) 34/26,8 A
CURRENT: (IS) 276/189 A
EFFECT: 20/15 KW



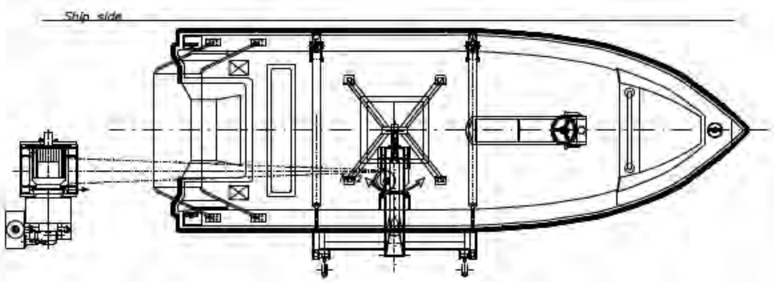
NOTE 1!
The hook to be mounted the same way as shown.



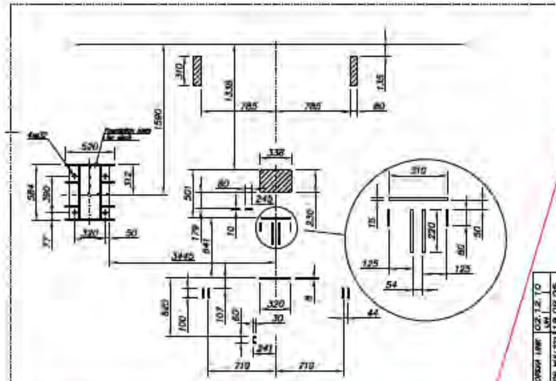
NOTE 2
It is important that USH. are being informed if there are any deviation at the deck angle.

O = Equipment delivered with certificate.
X = Yard supply. Not included in standard delivery from UMOE SCHAT-HARDING AS

Port side version.



NOTE !!
All grease nipples to be delivered with rubber caps



	SWL. mt.kN	Br. mt.kN	Tl. mt.kN	Pos	Name, type, dimension	No off	Art. no.	Material	kg.pr. unit	Notes
X				15	M30 Lock nut	4	yard supply	Galv.8.8		DIN985
X				14	M30 x 90 Bolt	4	yard supply	Galv.8.8		DIN931
O				13	Hanging off arr.	1	N73547			
				12	Wire grip	1				MIL N POS 5
				11	Limit switch arr.	1	73162			
O	14,7	86,3	32,4	10	Sheave house on deck (Assembly)	1	64905			
				9	Bracket for lashing	2	82629			
				8	D.diagram	1	203417-N73330			
				7	Winch foundation	1	N83168			
				6	Remote control arr.	1	NC0790			
O	14,7	88,2	36,8	5	Release hook	1	92633			
O	23,5	141		4	Wire ø12 CRANEMASTER 35 L=55m	1	0170.20450			
				3	Lashing arrangement	1	NC0791			
O	14,7	86,3	32,4	2	Davit SA 1,5 Assembly	1	64904			
O	17,6	79,2	26,4	1	Winch W50RS	1	N82858			

SCHAT HARDING

GENERAL ARRANGEMENT
SA1,5/WHFRB6,5/W50RS
WALLENIUS/MHI NAGASAKI

NB2625 F

ORDER NO.: 203417

O	23,5	141		4	Wire ø12 CRANEMASTER 35 L=55m	1	0170.20450

Annex I

Winch load test report

UMOE SCHAT-HARDING AS
N-5470 ROSENDAL

SCHAT HARDING

TEST REPORT

Test: **Winch Overload Test**

Winch type: **W50RS (SN: 1265/09)** **Doc.no** **2381**

Place: **Slany, Czech Republic** **Weather cond.:** **NA**

Date: **4th October 2011** **Person in charge of test:** [redacted]

AUTHORITY:

	MAIB	**MARINE ACCIDENT INVESTIGATION BRANCH**	[redacted]
	MAIB	**MARINE ACCIDENT INVESTIGATION BRANCH**	
	USH AS	**Umoe Schat-Harding AS**	
	USH SRO	**Umoe Schat-Harding spol. s r.o.**	

Requirements:
No special requirmets

Procedure:
Place the winch on test bench. Attach wire in a fixed point connected to a load cell for recording load.
For details see testing drawing NX2708.

Test 1.

Reel the wire on the winch drum. Use max. pull of electrical motor until it stall of. Use low speed and high speed of electrical motor for each test.
Motor type: 7BA132M21--(6.5/11kW) **UD1108/1384897-002-1**
Wire type: Steel wire rope - dia. 18mm galvanized (SWL = 40,2kN, BL=241kN) – **SN: 114497**
Load cell type: **DYNAFOR LLX (SN:H01055/10099 SB)**

After stall of:
- examine motor for damage
- examine wire for damage

Test 2.

Reel the wire on the winch drum. Use max. pull of motor until it stall of. Use low speed and high speed of electrical motor for each test.
Motor type: 7BA160L21 -(15/20kW). **UD0811/1179431-001-3**
Wire type: Steel wire rope - dia. 18mm galvanized (SWL = 40,2kN, BL=241kN) – **SN: 114497**
Load cell type: **DYNAFOR LLX (SN:H01055/10099 SB)**

After stall of:
- examine motor for damage
- examine wire for damage

Umoe Schat-Harding
S-H VV QC [redacted]

UMOE SCHAT-HARDING AS
N-5470 ROSENDAL

TEST REPORT

Results:

T est 1.

Wire broken (low speed) — ~~Yes~~/No
Wire broken (high speed) — ~~Yes/No~~ N/A
Comments:

Motor burned/damaged(low speed) — **Yes/~~No~~**
Motor burned/damaged(high speed) — ~~Yes/No~~ N/A
Comments:

	Maximum load in wire	max. ampers	remarks
1. attemp	11 300 kg	91A	
2. attemp	10 480 kg	89A	- motor burned

Test 2.

Wire broken (low speed) — ~~Yes~~/No
Wire broken (high speed) — ~~Yes/No~~ N/A
Comments:

Motor burned/damaged(low speed) — **Yes/No**
Motor burned/damaged(high speed) — ~~Yes/No~~ N/A
Comments:

	Maximum load in wire	max. ampers	remarks
1. attemp	21 000 kg	40A-> 90A	brake starting slipped
2. attemp	14 500 kg	48A	brake slipped
3. attemp	12 600 kg	39A	brake slipped

Signature:

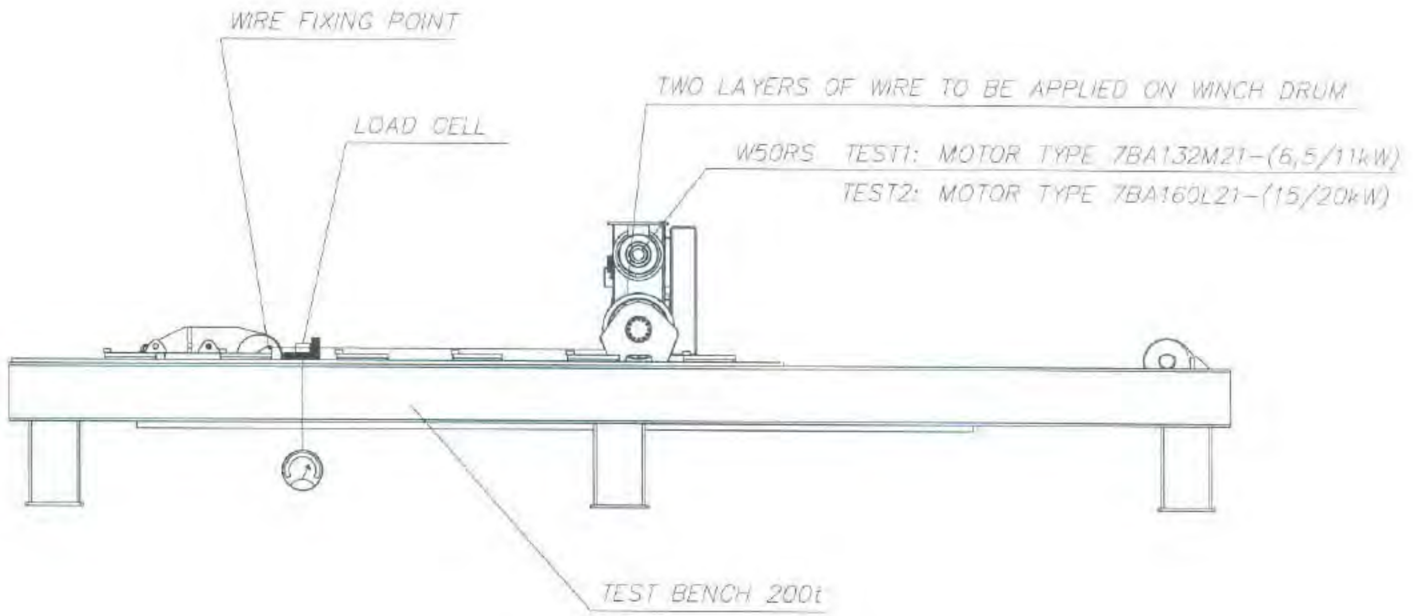
Umoe Schat-Harding
S-H [redacted] QC

[redacted] [redacted] [redacted] [redacted]

Enclosure:

Certificates for motors
Testing drawing NX2708
Assembly report for winch W50RS (SN:1265/09)
Wire certificate (dia. 18mm)

WINCH OVERLOAD TEST



[redacted]

SCHAT HARDING

NX2708

LÖNNE

TEST CERTIFICATE

our order............................: 1082035
date.....................................: 22.10.2007
certificate no.......................: T97132M-304/4.OIK

your order...........: NOBE040682/P2119031
mark.....................:MONTCO OFFSHORE INC

UMOE SCHAT-HARDING SPOL S.R.O
NETOVICKA 353
P.O. BOX 115
274 01 SLANY
CZECH REPUBLIC

motortype...........................: **7BA132M21**
mounting...........................: B5

output (kW).......................: 6,5/11
duty...................................: S2-10MIN

speed (min-1)...................: C-CW - 1745/3485

voltage (Vac)....................: Δ/YY 460

nominal current (A)..........: 12,2/18,5

power factor cos.phi..........: 4/4 load 0,79/0,92

efficienty (%).....................: 4/4 load 84,6/81,7

insulation class...................: F

protection class..................: IP 56 WITHOUT FAN AND FANCOVER

moment of inertia J (kgm^2) .: 0,024
mass (kg)...................................: 63
frequency (Hz)........................ 60
starting torque d.o.l. (%)......... 264/190
no load current (A)................ 7,5/6,4
starting current d.o.l. (%)........ 714/628
temp.rise surface (K)............. 52,3/42,9
temp.rise windings (K)........... 91/81,8

anti condensation heating : consumption (W).............: 25 voltage (V)...............:230

marine classification.: according to DNV amb.temp..............: 45 C

high voltage dielectric test between phases and earth during 1 min (Vac)...: **2000**
overload test during 15 seconds overload torque (% FLT).........................: **160**
vibration severity according NEN/ISO 2373-1974 (half key)............ class "N" or as specified below.

bearings DE/NDE...: 6308-2Z-C3 6308-2Z-C3
special features.......: Specialshaft DE / NDE 35mm / 33mm

motor serial numbers: **UD 1108/1384897-002-1**

LÖNNE

UMOE SCHAT HARDING
s. r. o. Slaný
PŘÍJEM ZBOŽÍ 2
DATUM: 7.9. [redacted]
PODPIS:

LÖNNE

Test Certificate

our order.............................: 790595
date.....................................: 20.1.09
certificate no.......................: T96160M-404/4

your order..........: **NOBE040533**
mark....................: **Vietnam Shipbuilding**

UMOE SCHAT-HARDING SPOL S.R.O
Netovicka 353
274 01 Slany

motortype..........................: **7BA160L21**
mounting...........................: B5

output (kW)......................: 15/20
duty...................................: S2-10MIN

speed (min-1)...................: C-CW - 1752/3522

voltage (Vac)....................: Δ/YY 440

nominal current (A)..........: 27/34

power factor cos.phi..........: 4/4 load 0,84/0,91

efficiency (%)....................: 4/4 load 88,2/85,2

insulation class.... ....: F

protection class..................: IP 56 WITHOUT FAN AND FANCOVER

moment of inertia J (kgm) .: 0,054
mass (kg)............ ....: 116
frequency (Hz)........................: 60
starting torque d.o.l. (%).......... 246/234
no load current (A)................ 11,9/10,5
starting current d.o.l. (%)......... 524/538
temp.rise surface (K).............. 52,4/53,8
temp.rise windings (K).......... 68/85

anti condensation heating : consumption (W)..............: 40 voltage (V)...............: 230

marine classfication.: according to DNV amb.temp...............: 45° C

high voltage dielectric test between phases and earth during 1 min (Vac)...: **2000**
overload test during 15 seconds overload torque (% FLT).........................: **160**
vibration severity according EN 34-14 (half key)............................... class "N" or as specified below.

bearings DE/NDE...: 6309-C3 6309-C3
spesial features.......: spesialshaft DE/NDE 35mm/33mm

motor serial numbers: **UD0811/1179431-001-3**
UD0811/1179431-001-5

LÖNNE

ASSEMBLY REPORT / *MONTÁŽNÍ ZPRÁVA*
WINCH RANGE (C)W50/80/120/125/150

W2-08-10518

Order No. / *Objednávka číslo:*	Customer / *Zákazník:*	Product / *Výrobek:*	Serial no. / *Sériové č.:*
DW2074231	VIETNAM-GROUP	W50R8	126509

Description / *Popis:*	Status Date/Sign. / *Stav, Datum Podpis:*	Remarks / *Poznámky:*
1. Oil filled – Planet gear. *Planetová převodovka - olej doplněn.*	3.3 [redacted]	YES / NO
2. Oil filled – Secondary gear/chain box. W-range approx. 11 litre CW-range approx. 5 litre W-OL-range approx. 15 litre *Sekundární převodová/řetězová skříň – olej doplněn.* *W- typ přibližně 11litrů* *CW-typ přibližně 5 litrů.* *W-OL-range approx. 15 litre*	3.3. [redacted]	YES / NO 11 litre
3. Free wheel mounted with oil *Volnoběžka namontována s olejem*	3.3. [redacted]	YES / NO
4. a) Hand crank is fitting/working. *Ruční klika je funkční.* *b) Hand pump is working/ Ruční pumpa je funkční*	3.3. [redacted] 3.3. [redacted]	YES / NO YES / NO
5. Limit switch is mounted. Limit switch type: ________ *Koncový vypínač je namontován.* *Typ koncového vypínače:*	✓	YES / NO / (N/A)
6. Wedge is fitting with correct wire diameter. (See davit arrangement for correct wire diameter) *Klín je vhodný pro dané lano.* *(Správný průměr lana -viz. sestava výložníku)*		Wire diameter: _____ mm */ Průměr lana.* YES / NO
7. Filled grease in all grease nipples. Check that the same type of grease nipple is used on the whole product. *Mazivem jsou vyplněny všechny maznice čepů.* *Zkontrolovat, že na produktu je použit pouze jeden typ maznic.*	✓	YES / NO / (N/A)
8. Ensure that a hole is drilled and bracket attached for remote control wire in the drum. *Zkontrolovat, že v bubnu je vyvrtán otvor a připojena konzola pro dálkové ovládání.*	3.3. [redacted]	YES / NO

SCHAT HARDING

SJ.05.038

ASSEMBLY REPORT / *MONTÁŽNÍ ZPRÁVA*
WINCH RANGE (C)W50/80/120/125/150

SN: 265/09

9.	Ensure that excess joint compound is removed from the flanges. *Zkontrolovat, že ze spojů byla odstraněna přebytečná spojovací směs.*	3.3. [redacted]	YES / NO
10.	Diverse data / *Jiné údaje* Serial No. El. motor, UD-0811/1179431-001-3 *Sériové číslo elektrického motoru* Serial No. gear-1: 1169360 *Sériové číslo převodovky-1.* Serial No., gear-2: 1169766 *Sériové číslo převodovky-2.* Serial No., Accumulator: 2008/70152 *Sériové číslo akumulátoru.* Serial No., Hydraulic pump: 27-E8-002 *Sériové číslo hydraulické pumpy.* Serial No.,Throttle block 1: 6712 *Sériové číslo škrticího ventilu 1.* Serial No.,Throttle block 2: – *Sériové číslo škrticího ventilu 2.* Serial No.,Connection block: – *Sériové číslo spojovacího ventilu* Serial No., Drum: 133 *Sériové číslo bubnu.* Serial No., Foundation: 133 *Sériové číslo základny.*		

11. If kanban parts are used, part name, drawing number and kanban traceability number should be filled out.

Pokud jsou použity kanbanové díly, je nutno vyplnit: Název dílu, číslo výkresu, kanbanové číslo.

Part name / *Název dílu:*	Draw. ref. included revision nr. / *Výkres včetně revizního čísla:*	Kanban ref.:	Remarks / *Poznámky:*
BEARING-SHAFT	72259	–	11497
BEARING-SOCKET	GH535	–	91524
MAIN SHAFT	73207	–	31544
OUTLET-ADAPTER	83051	–	23683

Date / *Datum:* 03 / 03 2009 Sign. / *Podpis:* [redacted]

DEXIM

Certificate of conformity

Umoe Schat-Harding, s.r.o.
Ouvalova 551
274 01 Slaný
Czech republic

Certificate no	**11_0384**
Date	**5/9/2011**
Order no	**NOBC 111 008**

Item no./ číslo artiklu:	0170.20529
Serial no./ výrobní číslo:	114497
Quantity/množstvi :	1off
Description/ popis:	Wire rope dia. 18,0 mms , plain ends
Nominal diameter/ Jmenovitý průměr:	18 mm
Actual diameter/ skutečný průměr:	18,56mm
Length/ délka:	55 m
Construction, surface treatment/ konstrukce, povrchová úprava:	Powerform 35, galvanized, non-rotating, 2160 N/mm^2
Minimu breaking load/ zaručená únosnost :	321 kN
Actual breaking load/ skutečné trhací zatížení	
Pull test no./ číslo tahové zkoušky:	
Factor of safety/ koeficient bezpečnosti:	6 : 1
Safety working load/ bezpečná pracovní zátěž:	53,5 kN
Supplier's certificate no./ číslo certifikátu dodavatele:	H 9256288/2

Signature/podpis : [redacted]

[redacted]

برنتن وولف واير روبس ش.م.ح

INSPECTION CERTIFICATE

Brunton-Wolf Wire Ropes FZCo.

Certificate Number	: H 926288/ 2	Date:05-06-20
Customer	: ROPENHAGEN A/S	
Customer Order Ref	: 3135	Date:26-03-2010
Works Order Number	: 902656/ 10	Date:01-04-2010
Reel Number	: 926288/2	Date of test:08-05-2010

Manufacturer : **BRUNTON WOLF WIRE ROPES FZCo.**

SPECIFICATION

Applied Standard	: Generally in accordance with UM-00
Nominal Diameter of Rope	: 18 mm
Construction	: Powerform 35 Preformed
Tensile Grade of Steel Wire	: 2160 N/mm2
Wire Finish/Material Grade	: Galvanised
Type of Core/Lay Direction	: STRAND / RHL
Length of Rope	: 1500.00 Mtr
Mass/Unit Length (Apprx.)	: 1.652 Kg/Mtr
Lubrication	: A1 / Elaskon SKU
Minimum Breaking Force	: 321.0 kN

[redacted]

RESULTS OF TEST & EXAMINATION

Measured Dia. Off-tension	: 18.560 mm
Measured Lay Off-tension	: 108.00 mm
Measured Breaking Force	: 326.0 kN

INDIVIDUAL WIRE TESTS

Sl. No.	Wire Dia	Tensile Strength (Avg)	Bend (Avg)	Torsion (Avg)	Knot Test	Wt.of Zinc Coating (Avg)
1	1.18 mm	2270 N/Sq.mm	16	26	NA	110 g/sqm
2	1.15 mm	2300 N/Sq.mm	14	32	NA	102 g/sqm
3	1.04 mm	2400 N/Sq.mm	18	34	NA	98 g/sqm
4	0.76 mm	2230 N/Sq.mm	16	28	NA	61 g/sqm
5	1.08 mm	2310 N/Sq.mm	18	28	NA	88 g/sqm
6	0.98 mm	2270 N/Sq.mm	16	30	NA	90 g/sqm

CHEMICAL ANALYSIS OF WIRE ROD

Sl.	Wire Dia	Carbon%	Manganese%	Silicon%	Sulphur%	Phosphorus%
1	1.18 mm	0.780	0.740	0.200	0.004	0.012
2	1.15 mm	0.780	0.740	0.200	0.004	0.012
3	1.04 mm	0.780	0.740	0.200	0.004	0.012
4	0.76 mm	0.780	0.740	0.200	0.004	0.012
5	1.08 mm	0.780	0.740	0.200	0.004	0.012
6	0.98 mm	0.780	0.740	0.200	0.004	0.012

This is to certify that the above tests have been carr[redacted]
out in accordance with the specification.

S[redacted]f
Com[redacted]son

2354/ 1

an usha martin & gustav wolf company

P.O. Box 17491
Jebel Ali Free Zone
Dubai - UAE

Tel.: +971 4 8838151
Fax: +971 4 8838152
E-mail : wireropes@bsme-uae.com
Website : www.bruntonwolf.com

BS EN ISO 9001

Certified by the American Petroleum Institute License number 9A - 0070

Address of exporter: **DEXIM DRUŽSTVO** Balasova 1251 Slaný 27401	CZECH REPUBLIC
Delivery address:	**Phytosanitary certificate** No.: CZ - 220604 00123
Kind of transport:	Country of destination:
Port of entry:	Country of origin: CZECH REPUBLIC
Kind of packaging: Wooden crosses	Quantity: 162 pieces

Declaration:
We herewith certify that the above specified items have been inspected and they do not contain any pest. We further certify that the subjects are newly manufactured in Czech Republic, destined to be exported to and have not been used for any other purpose.

Another declaration:

Desinsection:		City: Date: Name: [redacted] [redacted] Stamp and signature: CZ-0123 ST [redacted]
Preparation:	Heat Treatment	
Active Chemical:	Tememperature and time: 30 min./56°C	
Concentration:	Data: 18.2.2011	
Notica:		

OBJEDNÁVKA

Odběratel Umoe Schat-Harding spol. s r.o.

SCHAT HARDING

Sídlo společnosti:
Netovická 353
274 01 Slaný 1
Česká Republika

Kontaktní adresa:
Netovická 353
274 01 Slaný 1
P.O.BOX 115
Česká Republika

DIČ CZ26448394
IČO 26448394

Adresa dodávky
Netovická 353
274 01 Slaný 1
P.O.BOX 115
Česká Republika
Nákupčí: [redacted]
tl.: 00420-312515154
fax: 00420-312515170
E-mail: [redacted]@schat-harding.com

Registrace
Obchodní rejstřík
Městský soud v Praze
oddíl C, vložka 82917

Číslo objednávky NOBC111008
Strana 1

Vaše reference

Adresa dodavatele
DEXIM, DRUŽSTVO
Balasova 1251
274 01 Slaný

DIČ dodavatele CZ00550370
IČO dodavatele 00550370

Datum vystavení dokladu	18. Srpen 2011
Pož. datum příjmu	**5. Září 2011**
Kód způsobu platby	BANK
Kód způsobu dodávky	DDU
Kód dopravce	AD
Splatnost	30D od data faktury

Prosíme vyplnit a přiložit k dodacímu listu přílohu č.1 - Dlouhodobé prohlášení dodavatele pro produkty se statusem preferenčního původu

Číslo	Popis	Certifikát	Množství	Měrná jednot	Nákupní jedn. cena	Přihrádka
0170.20529_	LANO ⌀18mm, 2160N/mm2 ~~32x7~~ galvanized 35x7 Compacted MBL=321kN, bez ok -zatavené konce L=55M.............1 kus Projekt: BP089952 USH Rosendal WZ11-10307 Test W50RS	3.1	55,00	Metr	268,00	

Poznámky

Please state on your invoice your International Bank Account Number (IBAN) and SWIFT code of your Bank. [redacted]

Prosím o potvrzení objednávky. Děkuji

Vyřizuje: [redacted]

Umoe Schat - Hardi[redacted]
Netovická [redacted]
P. O. BOX 115, 2[redacted]
IČ: 26448394 DIČ

Certifikát 2.1 Prohlášení o shodě s objednávkou - vydává výrobce/prodejce. Obsahuje prohlášení o shodě [redacted] razítko a podpis prodávající společnosti.

Certifikát 2.2 Testovací zpráva - vydává výrobce/prodejce. Obsahuje prohlášení o shodě s objednávkou s odvoláním na č. objednávky, datum, razítko a podpis prodávající společnosti, zprávu o výsledcích zkoušek blíže nespecifikovaných pro daný výrobek.

Certifikát 3.1 Inspekční certifikát - vydává výrobce svou autoritou - oprávněnou osobou nezávislou na výrobním úseku. Obsahuje prohlášení o shodě s objednávkou s odvoláním na č. objednávky, datum, razítko a podpis prodávající společnosti, zprávu o výsledcích zkoušek specifických pro daný výrobek.

Certifikát 3.2 Inspekční certifikát - vydává výrobce svou autoritou - oprávněnou osobou nezávislou na výrobním úseku, oddělení, nebo nakupovanou autoritou, nebo autoritou stanovenou předpisem. Obsahuje prohlášení o shodě s objednávkou s odvoláním na č. objednávky, datum, razítko a podpis prodávající společnosti, zprávu o výsledcích zkoušek specifických pro daný výrobek.

Certifikáty dodat se zbožím.

Dodavatel zboží zodpovídá za případné škody a vícenáklady způsobené závadami na dodaném zboží.

Calibration protocol

Procedure for verifikation of weighs according to ČSN EN 45501 +AC ISO 9001
Client: UMOE SCHAT – HARDING spol. s.r.o.
Centre: Slaný Ouvalova 554 – laboratory
Type: electronic weigh dynafor LLX
Producer: Tractel SA
Production number / evidence number: H 01055 / 100099 SB
Category of nicety : IIII.
Weighing: 50t
Segment: 20Kg

Actual abnormalities of rihgtness – character – issue of test %
Data of meter:

Levels of force in kN	Dynamonter in kN	Error in kN	% Error
0,000	0,00	0,00	0,00
49,995	49,60	- 0,40	- 0,08
100,017	99,60	- 0,42	- 0,08
150,015	149,80	- 0,22	- 0,04
200,014	199,80	- 0,21	- 0,04
250,015	249,80	- 0,22	- 0,04
300,016	299,80	- 0,22	- 0,04
350,018	350,00	- 0,02	0,00
400,020	400,00	- 0,02	0,00
450,023	450,00	- 0,02	0,00
500,025	499,88	- 0,23	- 0,05
0,00	0,00	0,00	0,00

Calibration of weigh – set up zero positiv, exam by official weight.
Result: Equipment satisfied to requirement for weighs of 4th category niceness according to ČSN EN 45501+AC in agreement with § 9, par 2 act about metrology no. č.505/1990Sb. as amended by Act no. 119/2000 Sb. and no. č.137/2002 Sb. § 6 notice MPO č. 262/2000 Sb.

Slaný, 30 / 6 / 2011

Registration of Metrology
Institute Praha č. 147 – 01/92

Annex J

Marine Safety Forum Safety Flash

Marine Safety Forum – Safety Flash 11-07

Issued: 4th February 2011

Subject: **Broken davit wire during FRC launching from "Scorpion" davit**

SUMMARY OF EVENTS

A vessel was preparing to launch the FRC during re-validation trials. All checks were carried out. The crew boarded the FRC and the launching operation commenced. The boat with three crew members on board was lifted up. As soon as the davit swung out a loud "bang" was heard and the Coxswain noticed that the davit wire began unstranding approx. 1metre above the hook. The FRC was pulled as soon as possible and stowed on the davit. The FRC crew disembarked safely. The vessel returned to port for an investigation.

Photo 1 (Limit switch in activation position)

COMMENTS

After inspection of Davit, the following was noted:

The Docking Head limit switch did not work (photo 1). It was wrongly positioned and it did not stop the docking head being lifted further (photo 2). The strain applied to the wire was too high. As a result, full hydraulic pressure was applied to the davit wire, well above the breaking strain, and the wire almost parted.

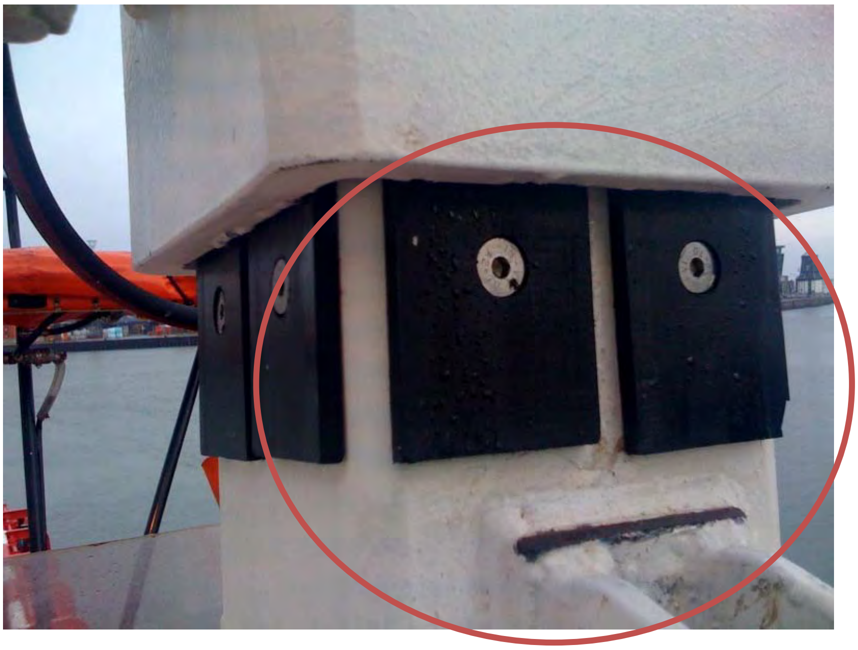


Photo 2 (Docking Head)

ACTIONS

- Davit Operators to make sure that when operating davit the Docking Head limit switch activates before the ram lug makes contact with the sleeve (see photo 2).
- Weekly checks to incorporate checking safe operation of limit switch.
- Risk Assessment for “FRC/DC Launch & Recovery” to be reviewed.

MAIB Safety Bulletin (MAIB 2/2011)

MAIB SAFETY BULLETIN 2/2011

Malfunction of a proximity switch, which resulted
in failure of a fall wire with the loss of one life
on the car carrier *Tombarra*

Marine Accident Investigation Branch
Mountbatten House
Grosvenor Square
Southampton
SO15 2JU

MARINE ACCIDENT INVESTIGATION BRANCH

MAIB SAFETY BULLETIN 2/2011

This document, containing safety lessons, has been produced for marine safety purposes only, on the basis of information available to date.

The Merchant Shipping (Accident Reporting and Investigation) Regulations 2005 provide for the Chief Inspector of Marine Accidents to make recommendations at any time during the course of an investigation if, in his opinion, it is necessary or desirable to do so.

Steve Clinch
Chief Inspector of Marine Accidents

NOTE

This bulletin is not written with litigation in mind and, pursuant to Regulation 13(9) of the Merchant Shipping (Accident Reporting and Investigation) Regulations 2005, shall not be admissible in any judicial proceedings whose purpose, or one of whose purposes, is to apportion liability or blame.

This bulletin is also available on our website: www.maib.gov.uk
Press Enquiries: 020 7944 6433/3387; Out of hours: 020 7944 4292
Public Enquiries: 0300 330 3000

BACKGROUND

At approximately 1550 (UTC) on 7 February 2011, the fall wire of the rescue boat on board the UK registered car carrier *Tombarra* parted when the vessel was alongside in Royal Portbury Docks, Bristol, UK. The accident occurred as the rescue boat reached its stowed position on the davit following a monthly drill. Hoisting was not stopped before the davit reached its stowed position. The proximity switch, that should have cut electrical power to the winch motor before the davit reached its stops, failed to function. The rescue boat and its four crew fell nearly 29m **(Figure 1)** into the water below. One of the boat's crew died and two were hospitalised.

Figure 1

Vessel and parted fall wire

The 12mm diameter fall wire had a certified minimum breaking load of 141kN. Its safe working load (SWL) was 23.5kN based on a factor of safety of six. The wire was fitted to a single-arm davit (SA 1.5) **(Figure 2)**, manufactured by Umoe Schat-Harding Equipment AS (Schat-Harding). The davit system was powered by a Schat-Harding W50 two-speed electric winch with a nominal pull of 50kN.

Figure 2

Davit system

The winch was operated by a control panel sited forward of the davit. The boat was hoisted using the buttons on the control panel until the davit was near the stowed position. It was then intended that hoisting be completed manually by the use of a winch handle adjacent to the winch motor. To prevent the inadvertent operation of the winch when the rescue boat was in its stowed position, an inductive proximity sensor/switch (Telemechanique XS7-C40FP260) was fitted on the davit **(Figure 3)**. The switch was intended to cut off power to the winch when the davit closed to within approximately 12mm of the sensor.

Figure 3

Proximity switch on davit

Annual inspections of the davit system had been conducted by Schat-Harding service engineers since the vessel was built in 2006. The last service was conducted in September 2010.

INITIAL FINDINGS

The fall wire was observed to be in good condition and when tested after the accident it achieved a breaking load of 137kN. The wire parted near the lower most davit sheave as the rescue boat reached its stowed position and the winch was still hoisting under power. Although the winch motor was rated with a nominal pull of 50kN, the maximum pull that it was capable of exerting when trying to overcome the increased resistance in the system during the final stages of hoisting would have rapidly exceeded the breaking load of the wire. The proximity switch, which should have prevented this situation from occurring, was tested in situ and was found to be defective.

Figure 4

Water ingress into proximity switch

The switch was installed in 2006, and prior to the accident it was not tested before hoisting was commenced. Inspection identified that the switch body had been penetrated by water **(Figure 4)**. However, detailed analysis highlighted that the switch malfunctioned due to an unrelated electronic fault. The MAIB is aware of both inductive proximity and mechanical limit switches fitted on other vessels that have also failed to operate correctly. However, none are known to have resulted in a similar accident.

The rescue boat was weighed and was approximately 450kg overweight (see MAIB Safety Bulletin 1/2011 for further details). Although the additional weight caused the davit's SWL to be exceeded, by itself it would not have caused the wire to fail.

SAFETY ISSUES

- The maximum pull of a hoist winch can exceed its nominal pull several-fold, and therefore is likely to exceed the breaking loads of other system components unless this is prevented by a properly functioning 'final stop' or safety device.
- The proximity switch fitted to the Schat-Harding SA 1.5 davit, and also known to be fitted to the SA 1.75 davit, is considered by its manufacturer to be inappropriate for use as a 'final stop' or safety device.
- The fitting of the proximity switch was not compliant with its manufacturer's instructions. As a result, the gland and cable entry were higher than the switch body and its susceptibility to water ingress was increased.
- Given the potential catastrophic consequences of the failure of the proximity switch fitted to the SA 1.5 and SA 1.75 davits, it is essential that owners of vessels fitted with these davits (over 320 vessels) are made aware of the potential limitations of the switches and the precautions to be taken.
- All devices (inductive and mechanical) fitted to davits to prevent overload must be maintained, tested and replaced in accordance with manufacturers' recommendations.

ACTION TAKEN

Schat-Harding has issued a Product Awareness Notice (PAN) to its customers highlighting the need to test the proximity switches fitted on its SA 1.5 and SA 1.75 davits on each occasion before hoisting operations commence, and recommends that the proximity switch is replaced every 2 years; it also highlights the need for caution when using pressure washers on deck.

RECOMMENDATION

S117/2011 Owners and operators of vessels equipped with boat davits should:

- In the case of vessels fitted with the Schat-Harding SA 1.5 and SA 1.75 davits, follow the advice contained in the PAN recently issued by the manufacturer or urgently contact Schat-Harding[1] if a PAN has not been received.
- Ensure that all devices (inductive or mechanical) fitted to boat davit systems to prevent overload are tested on each occasion before a boat is hoisted and that such devices are not relied upon during operation.
- Follow manufacturers' recommendations regarding the maintenance and periodic testing, examination and replacement of safety devices, seeking clarification from manufacturers where ambiguity exists.
- Verify the effectiveness of watertight seals on electrical equipment fitted to boat davit systems on weatherdecks.

Issued May 2011

[1] service@schat-harding.com

MAIB Safety Flyer to the Shipping Industry

MAIB
MARINE ACCIDENT INVESTIGATION BRANCH

FLYER TO VESSEL OPERATORS USING PROXIMITY SWITCHES ON DAVIT LAUNCHED SURVIVAL CRAFT

TOMBARRA - MALFUNCTION OF A DAVIT PROXIMITY SWITCH RESULTING IN THE FAILURE OF A RESCUE BOAT FALL WIRE WITH THE LOSS OF ONE LIFE

During the final stages of a rescue boat drill on board the car carrier *Tombarra* in Royal Portbury Docks, Bristol on 7 February 2011, the rescue boat was hoisted towards its stowed position on the davit.

The davit proximity switch that should have cut electrical power to the winch motor before the davit arm reached its stops failed to operate. As a result, when the rescue boat reached its stowed position, the winch rapidly overloaded the fall wire. The wire parted, and the rescue boat **(Figure 1)** plummeted about 29m into the water below, killing one of its four crew.

Figure 1: The rescue boat and crew after the fall wire failure

Onboard instructions to test the proximity switch prior to recovering the rescue boat at every drill were not followed. In addition, the davit system manufacturer's operating manual implied that the proximity switch should be used to stop the winch motor. Consequently, the proximity switch and not the control buttons were used by the winch operators to stop the winch motor.

The davit proximity switch **(Figure 2)** did not operate due to a short circuit of its printed circuit board. The short circuit had been caused by either moisture ingress or by transient power surges.

Inductive proximity switches can fail in either the 'ON' or 'OFF' state, depending on the exact failure mechanisms, and therefore both the failure mode, and the time of occurrence, can be unpredictable.

Figure 2: Proximity switch on davit (circled)

Safety Lessons

1. Safety devices (both inductive proximity switches and mechanical limit switches), fitted to davits, are intended to prevent the over- stressing of the falls and davit structure. They are not fitted for ease of operation.

2. Davit safety devices must always be tested prior to a rescue boat being hoisted.

3 Davit safety devices should not be relied upon. The davit winch must be stopped prior to the davit safety device operating.

4. Visual aids to prompt when winch motors should be stopped could be extremely beneficial.

5. Care must be taken when cleaning and painting electrical equipment on deck. High-pressure hoses must be used with caution.

This flyer and the MAIB's investigation report are posted on our website:

www.maib.gov.uk

For all other enquiries:

Marine Accident Investigation Branch
Mountbatten House
Grosvenor Square
Southampton
SO15 2JU

Tel: 023 8039 5500
Fax: 023 8023 2459
Email: maib@dft.gsi.gov.uk

Marine Accident Investigation Branch
July 2012

Wilhelmsen Ship Management safety bulletin

Wilhelmsen Ship Management

GHSEQ Safety Bulletin

Safety Alert from WSM Fleet ☒ Safety Alert from External Party ☐

Message No: **35/2011**

Subject: **Use of Limit Switches and Other Indicating devices**

☒	To be discussed at next Open Safety committee Meeting	☒	Message to form a part of handover documentation
☒	To be discussed and circulated onboard immediately	☒	Act in accordance with Prevention / Recommendation

This Safety Bulletin is to be read in conjunction with Safety Bulletin 34/2011

There have been a significant number of **serious damages including loss of life** within the fleet due to over-reliance on limit switches and other indicating devices, for example:

- Damages to external and internal ramps due to locking pins not being in the indicated position or failure to follow what the indicator was showing.
- Damages to davits and attached equipment due to limit switches being used to stop the davit when hoisting.

Indicator lights on locking pins on ramps and watertight doors, limit switches on hoists, davits and cranes and on many other items of equipment used onboard our vessels are there as a safety barrier in their operation and are not meant to be the sole indicator that a process is complete, or ready to commence.

A Risk Assessment of every operation involving a limit switch or an indicator light system should be carried out. These limiting or indicating devices should be itemised in the RA as items that pose a risk, in that when they fail, there are consequences which should be reduced by further actions. Where possible this should be by visual inspection.

It is crucial for personnel to understand how an indicator or limit switch works and precisely what is being indicated.

Personnel involved in the operation of this equipment should attend a demonstration of the system in use, showing how and when the limit switch or indicator activates.

Limit switches often do not indicate anything if they have failed and should not be relied upon to stop equipment.

Issued: 14 September 2011

Umoe Schat-Harding PAN

SCHAT HARDING

Product Awareness Notice	
Doc. no.: 2266	date: 14.04.2011
Doc. distributed to:	**USH Service Engineers, USH Management, Implied customers having SA1.5/1.75, Lloyds Register EMEA, MAIB, NMD, PSA.**
NB!! Document to be sent to Implied Customers.	
Manufacturer:	**Umoe Schat-Harding Equipment AS**
Product:	**Rescueboat Davit SA1.5 & SA1.75**
Production Period:	**all produced.**
Improvement Note Ref.:	**NA**

Description
A serious accident happened during a regular drill with a rescue boat where the rescue boat fell down to sea while it was being hoisted back up to stowed position. The davit wire snapped and the rescue boat with crew members fell the long distance to sea – causing fatality. Investigation is still being carried out in relation to this incident, there are several reasons for the incident. However during the ongoing investigation it has been concluded that the limit switch on the davit was broken, it was not working at all during the drill. The davit in question was the SA1.5 manufactured by Umoe Schat-Harding Equipment AS.

We strictly advice that all owners of this davit immediately verifies that the limit switch is operating as it should. The use of the davit should not be carried out before the limit switch has been tested and found in a fully working condition. Please note that the system is considered as safe if the limit switch is working as normal. Limit switch shall be checked before each lifeboat drill as referred to in manual.

Before use please study the davit manual carefully. The davit shall be hand cranked to fully stowed position. Avoid water entering inside the limit switch, we do not recommend that high pressure water is used directly on to this equipment for cleaning purpose, water might then enter the inside of the limit switch and make it fail.

As a precaution we advice that the limit switch should be replaced if it is more than two years old as recommended in davit manual.

- Enclosed pages from manual.

Best regards
[redacted] Equipment AS

[redacted]

Engineering Director

[redacted]

QA/HSE Director

E-mail contact address; ushedpan@schat-harding.com

2.11 HOISTING OF THE SURVIVAL CRAFT

1. Connect the painter to the painter release hook on craft. When survival craft is attached to the end link, ensuring that there is no twisting of rigging equipment.

2. The operator on deck at the ships side can then proceed with the hoisting by operating the starter box.

3. Before swing in the davit arm, painter line should be fitted. Crew should disembark. Hold the boat parallel with ship-side and swing-in the davit arm. (Fig. 7 chapt. 2)

Take care!
If survival craft is not parallel with ship-side when swing in, this can damage davit and survival craft . Painter line should always be used

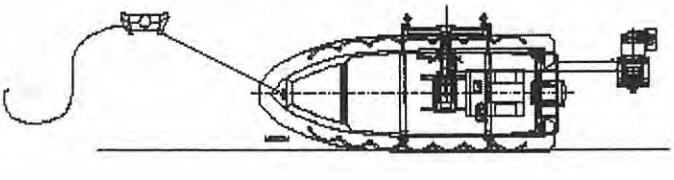
4. The survival craft is hoisted to the stowed position (pos. 1, fig. 1, chapt. 2).

5. The davit arm will stop approximately 100 mm from the stowed position because of the limit switch which will stop the winch motor. To complete stowage, the hand crank on winch has to be connected and operated.

6. Survival craft must be secured with lashings. Two around the boat to the tightening mechanism. These will at the same time as holding the boat in the stowed position hold the davit firmly in position to the deck.

7. When the craft is in the stowed position with lashings in position, the brake on the winch should be released so releaving the tension on the fall wire. This is under-taken so as not to have wire stretch.

Fig. 7



SCHAT HARDING

OPERATION AND MAINTENANCE MANUAL – SA1.5/1.75

3.8 MAINTENANCE CHECKLIST DAVIT

ITEM	Each lifeboat drill	Every 6 months	Every 30 months
Falls		Lubricate (see drawing)	Turn end to end
Wire sheaves		Lubricate (see drawing)	
Rigging equipment	Check function	Visual inspection	
Limit switches	Check function	Check mountings/cables	
Remote control system	Check function	Check sheaves/wires	
Weldings		Visual inspection	
Paintings		Visual inspection	

According to current regulations, the launching system shall be inspected and serviced thoroughly every year by Umoe Schat-Harding AS, or other person trained and certified by Umoe Schat-Harding (Ref. MSC Cir 1206).

4.0 RECOMMENDED SPARE PARTS

Recommended spare parts for an operational period of two years:

Item	Qty	Part name	Article number
1	10	Grease nipples R 1/8"	0290.00609
2	1	Limit switch end hoisting	0460.02219
3	2	Bushing o 60/60	0061.20859
4	2	Plug for tension element	0378.18469

5.0 SERVICE CENTRE AND PARTNERS

Schat-Harding has skilled authorized service personnel, all well trained and with great experience ready to assist our world wide customers that have equipment under our brand names. Our employees are ready to assist you with technical information, expedite delivery of spare parts, training of crew, quotations for refurbishing of old equipment, safety analysis or whatever your needs are with respect to lifesaving equipment.
We are here to maintain your safety onboard.