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Ref: 001451

SPECIAL REPORT : SR99/006

Tensile Testing of Safety Line

Client : NSW Police Service
NSW Water Police Branch,
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Harris Street
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Client's Reference : Fax dated 5 July 1999.


Test Specifications : Australian Standard AS 2227:1992,
Yachting Harnesses and Lines- Conventional lines.

Australian Standard AS 1753:1990,
Webbing for Restraining Devices for
Occupants of Motor Vehicles.

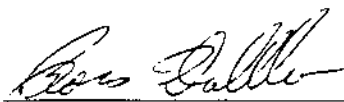
Test Items : One (1) Yachting harness and safety line,
from the 'Sword of Orion' yacht.

Date of Tests : 19 July 1999.

Report prepared by :


Date: 19 JAN 2000
Derek Wainohu (Cert. Mech. Eng)
Test Laboratory Manager.

Issued by :

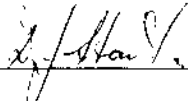

Date: 19 JAN 2000
Ross Dal Nevo (BE Mech)
Manager, Crashlab.



The tests, calibrations and/or measurements covered by this document are traceable to national standards of measurement.

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1. INTRODUCTION

The NSW Water Police Branch supplied a yachting harness and safety line for testing, as part of a Coronial Inquest into the 1998 Sydney to Hobart Yacht Race. A webbing safety line allegedly failed on the 'Sword of Orion' resulting in the helmsman being washed overboard. This report examines the performance of an identical safety line taken from the 'Sword of Orion' yacht to investigate whether the safety line was adequate for its application.

The yachting harness and safety line were supplied as an assembly, the harness was marked and identified as complying with Australian Standard AS2227 while the safety line had no marking or identification indicating that it complied with Australian Standard AS2227.

In March 1999 RTA Crashlab conducted dynamic drop tests on yachting harness and safety line samples supplied by NSW Water Police Branch. The results of that testing are contained in Crashlab - Special Report SR99/004. The failure of the safety lines reported in Special Report SR99/004 involved total failure of the stitching with no significant damage to the webbing itself. The lack of damage to the webbing of the failed samples is considered unusual. A stitched joint, other than that used to attach labels or for decorative purposes, typically causes significant damage to the webbing during failure. The lack of webbing damage tends to suggest that either the stitching had weakened significantly from its original strength or that the stitch pattern was significantly weaker than the webbing and not able to meet the strength requirements of AS2227 - Yachting Harnesses and Lines.

NSW Water Police Branch consulted Workcover NSW and RTA Crashlab to determine what would be required for the next phase of testing. It was recommended that tensile testing of the safety line would be conducted.

Australian Standard AS2227 - Yachting Harnesses and Lines was first published in 1978 and has been revised three times, 1983, 1986 and 1992.

- 1978 and 1983 Standards required webbing to comply with the requirements of AS1753.
- 1986 allowed webbing that did not comply with AS1753 as long as it met the dry breaking force tests in AS1753 of 22 kN.

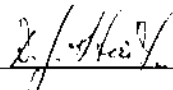
Essentially all revisions of AS2227 have required the hooks and other "non-deteriorating" components, i.e. load bearing stitch pattern, to meet a tensile force of 12 kN and webbing to meet a dry breaking strength tensile force of 22 kN.

The method of tensile testing as specified in Appendix A of Australian Standard AS1753:1990 Webbing for Restraining Devices for Occupants of Motor Vehicles was employed.

2. AIM

To determine the tensile failure load of a safety line, from the 'Sword of Orion'.

- Hooks and other "non-deteriorating" components i.e. stitch pattern.
- Webbing.

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3. DESCRIPTION

The Yachting harness and safety line was supplied to Crashlab as an assembly. The harness was marked and identified as being a TUFF Marine Australia yachting harness complying to AS2227. The safety line was detachable from the harness and did not bear corresponding identification labels to the harness, as required by AS2227. Therefore, it is unknown if the safety line supplied was an original component of an AS2227 compliant assembly.

The safety line from the 'Sword of Orion' did not have identifying labels, i.e. year of Australian Standard, model name, date of manufacture or serial number.

The safety line was hand marked with the text, 'SWORD OF ORION - RBYC B2000 - NO 4', and for identification during testing was assigned Crashlab test specimen number TS18396. Refer to Appendix A.

The safety line appeared to be in good general condition with no visual sign of significant damage or deterioration.

The safety line consisted of a length of webbing with hooks attached at both ends. The hooks were retained by the webbing being folded through an eye in the hook and then stitched in place. Two coloured threads were used, a yellow thread was used for the three stitched 'bar tacks' and a red thread used for the large rectangular stitch pattern with diagonals. The red thread appeared to be thinner than the yellow thread and similar to thread that is usually used for attaching labels. Refer to Sketch in Appendix C.

4. TENSILE TEST

4.1 Test Equipment

Crashlab is NATA registered for tensile testing of webbing to Australian Standard AS 1753. The test methodology and procedures used for the testing of webbing to AS2227 are the same as those used for the tensile testing of seat belt webbing to AS1753. Testing was conducted on an Avery Tensile Tester, Type No. 7108 DCN, Machine No. E70421, and identified by Crashlab equipment number of TCL 474. Refer to Photograph 1 in Appendix B.

Bollards were used to grip the webbing and prevent slippage and damage of the test specimen as per Australian Standard AS E35/BWG. Refer to Photographs 2 and 3 in Appendix B.

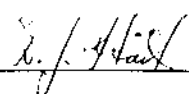
4.2 Test Description

Australian Standard AS2227 requires the hooks and other "non-deteriorating" components, i.e. load-bearing stitch patterns, to exhibit a minimum tensile force of 12 kN and for webbing to exhibit a minimum tensile force of 22 kN.

Three tensile tests were conducted on the test specimen;

1. Test one end of the safety line including hook and stitch pattern to 12 kN.
2. Test the other end of the safety line including hook and stitch pattern to 12 kN.
3. Test the webbing of the safety line to 22 kN.

The load range of the Avery Tensile Tester was set to 50,000 N full scale. The Avery was paced to ensure the specified time taken to obtain the required load. For this test program the following settings were used:

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Full Scale	Test Load	Pacer Reading
50 kN	12 kN	24% of full scale load in 60 seconds
50 kN	22 kN	44% of full scale load in 60 seconds

The safety line was unable to be threaded through the Bollard grips with a hook attached to both ends of the line. To enable the safety line to be attached to the Avery Tensile Tester via the Bollard grips, a hook was removed from one end of the line, the design of the hook enabled removal without interfering with the stitch pattern.

5. RESULTS

Test 1 G90096

The hook was attached to a fixture at the top head of the Avery and the webbing end was threaded through the Bollard grip on the bottom head. Refer to Photograph 2 in Appendix B.

The Avery Tensile Test machine was used to apply a static load to the specimen. A maximum load of 6 kN was achieved prior to failure of the stitch pattern. Refer to Test Results Details in Appendix A.

Test 2 G90097

The hook used in Test G90096 was removed from the specimen and the other hook replaced on the untested end of the safety line. This hook was attached to a fixture at the top head of the Avery and the webbing end was threaded through the Bollard grip on the bottom head. Refer to Photograph 2 in Appendix B.

The Avery Tensile Test machine was used to apply a static load to the specimen. A tensile failure load of 6.4 kN was recorded for this test and the mode of failure was the stitch pattern. Refer to Test Results Details in Appendix A.

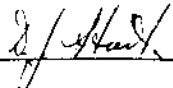
Test 3 G90098

The webbing from the specimen was threaded through the Bollard grips, which were used in both the top and bottom heads of the Avery. Refer to Photograph 3 in Appendix B.

The Avery Tensile Test machine was used to apply a static load to the specimen. A tensile failure load of 16.6 kN was recorded for this test. The webbing failed in the central region of the specimen away from both Bollard grips. Refer to Test Results Details in Appendix A.

6. COMMENTS

The stitching failed without significant damage to the webbing, which is unusual. A stitched joint, other than that used to attach labels or for decorative purposes, typically causes significant damage to the webbing during failure. The lack of webbing damage tends to suggest that either the stitching had weakened significantly from its manufactured strength or that the stitch pattern was significantly weaker than the strength requirements of AS2227.

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All revisions of AS2227 have a requirement for 'MARKING', this requires that the harness and safety line shall be clearly and indelibly marked with the Name, Trademark or other means of identification of the manufacturer, and the date of manufacture shall be marked on both harness and safety line.

Although the yachting harness supplied was marked in accordance with the requirements of AS2227, the safety line had no markings or identification. Had this product obtained Product Certification from Quality Assurance Services Pty Ltd (QAS) then both the harness and safety line would have been marked as per the requirements of AS2227.

The yachting harness and safety line had the appearance of being in good general condition with no visual sign of significant damage or deterioration. The hand marked identification of "Sword of Orion" was also in good legible condition with little sign of deterioration.

Although the general appearance of the harness and safety line indicated that the webbing was in "as new" condition this was inconsistent with the sewn labels bearing the marking and identification of 'Standards Australia' and the manufacturer, 'TUFF Marine Australia'. Both labels appeared to be "well weathered" with some signs of deterioration in the form of fraying. The symmetry and precision of the light gauge thread used in the rectangular stitch pattern did not appear to be typical of an automated manufacturing process but more consistent with a hand made prototype.

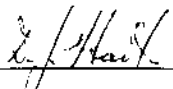
7. CONCLUSION

The tensile failure loads of the safety line from the 'Sword of Orion' and identified by Crashlab test specimen number TS18396 were as follows;

- The hooks and stitch patterns sustained an average tensile load of 6.2 kN
- The free length of webbing sustained a tensile load 16.6 kN

These results indicate that the safety line, in the condition tested, did not meet the strength requirements of AS2227 - Yachting Harnesses and Lines.

Although the harness and safety line were presented to Crashlab as a single assembly the lack of marking labels on the safety line questions both its integrity as part of the original assembly and its compliance with Australian Standard AS2227.

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APPENDIX A
TEST SPECIMEN DETAILS

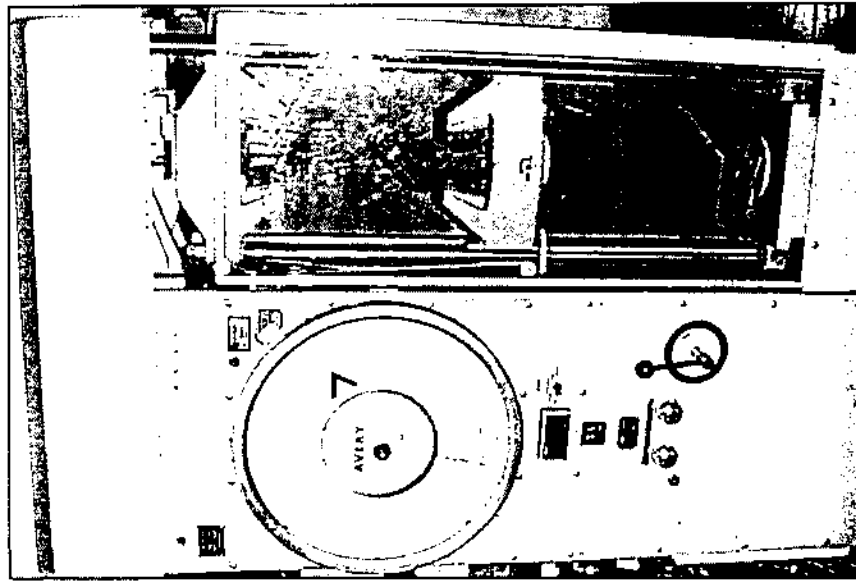
Specimen Number	Description	Identification Text Markings	Model	Serial Number	Date of Manufacture
TS18396	TUFF Marine Australia, Safety line	'SWORD OF ORION - RBYC B2000 No.4'	Unknown	Unknown	Unknown

TEST RESULT DETAILS

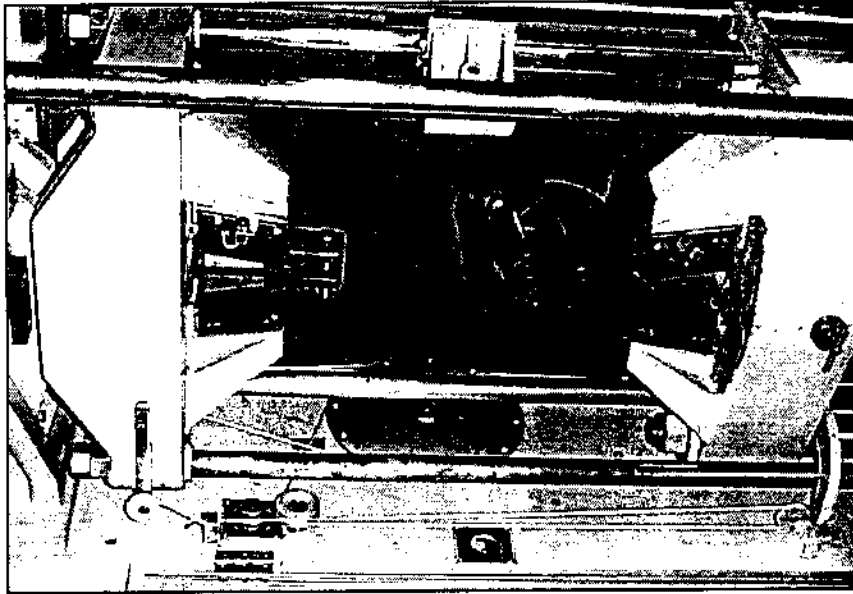
Test Number	Test Date	Specimen Number	Attachment Point	Pacer Recording	Peak Load (kN)	Load Criteria (kN)	Location of failure	Pass/Fail
G90096	19/7/99	TS18396	Hook and stitch pattern	24%	6.0	12.0	Stitch pattern	Fail
G90097	19/7/99	TS18396	Hook and stitch pattern	24%	6.4	12.0	Stitch pattern	Fail
G90098	19/7/99	TS18396	Webbing	44%	16.6	22.0	Webbing	Fail

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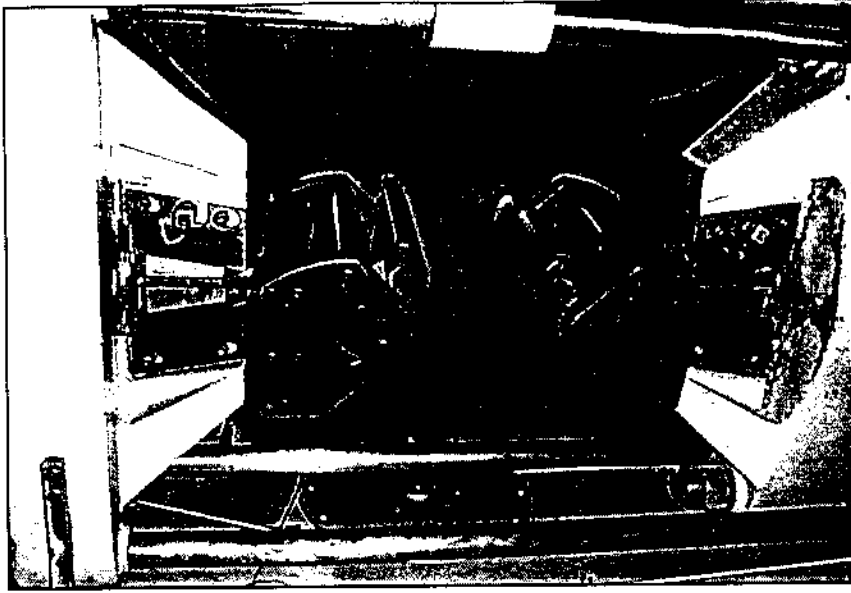
APPENDIX B - PHOTOGRAPHS



Photograph 1.



Photograph 2.



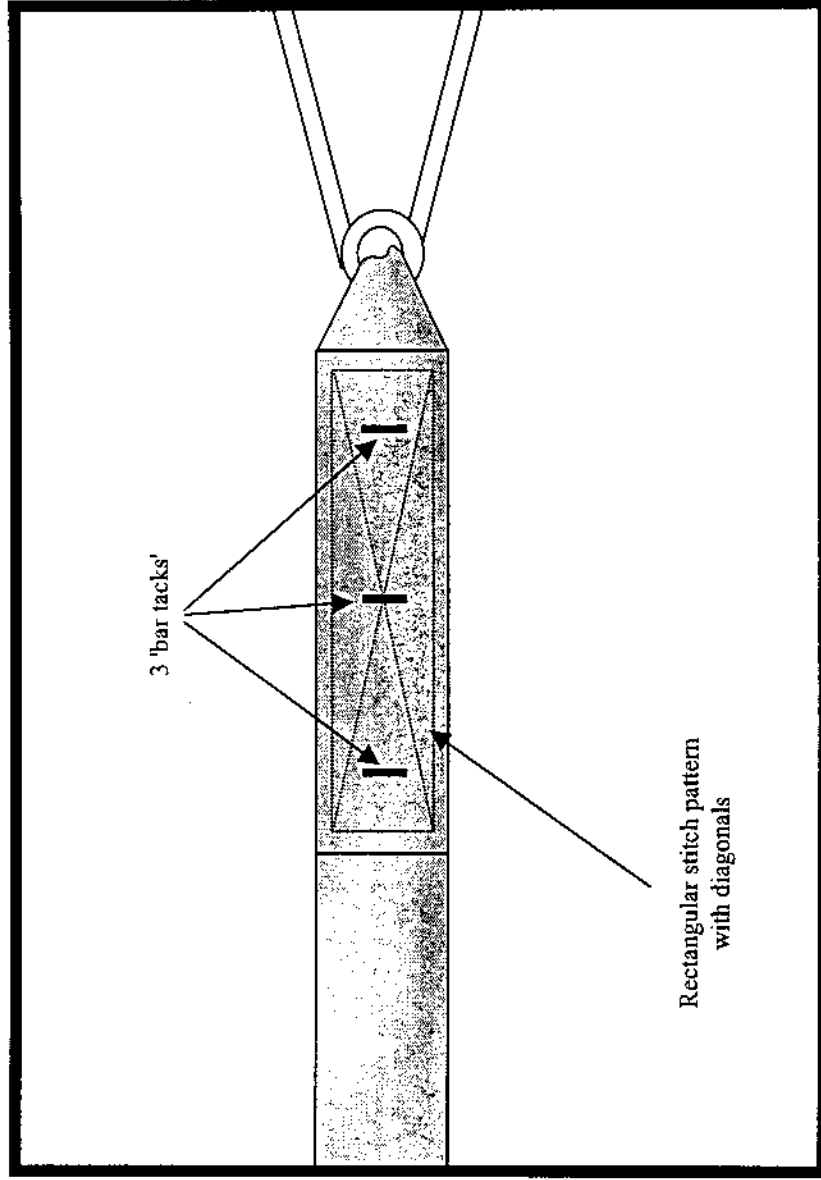
Photograph 3.

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D. J. [Signature]

Date : 19-01-00

APPENDIX C - SKETCH



Sketch of the stitch pattern

Checked By: *D. J. Smith* Date: 19-01-00