Report 98-216

Coastguard rigid inflatable rescue craft *Rescue 1*

failure of buoyancy pontoons

Motiti Island, Bay of Plenty

8 December 1998

Abstract

On Tuesday, 8 December 1998, at about 1635, the Tauranga Volunteer Coastguard rigid inflatable vessel *Rescue 1* was responding to a Mayday call from a vessel near Motiti Island when it suffered a failure of the outer covers that secured the buoyancy bladders to the hull. The two starboard bladders separated from the hull and the port forward bladder deflated. The vessel continued to Motiti Island and attended the rescue before returning to Tauranga. There were no injuries.

Safety issues identified included:

- incorrect fitting of the envelope to the outer covers and bow of rigid inflatable vessels
- the lack of adequate washers securing the tongue and envelope
- the fitting of pressure relief valves to the bladders
- the determination of a safe speed at which to operate rigid inflatable vessels, in rough sea conditions.

Safety recommendations were made to the Managing Director of Naiad Inflatables (NZ) Ltd and the Chief Executive Officer of the Royal NZ Coastguard Federation to address the safety issues.

Rescue 1

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Glossary of abbreviations

EPIRB	emergency position indicating radio beacon
EFI	electronic fuel injection
GPS	global positioning system
hp	horse power
kg	kilogram
kPa	kilopascal
m	metres
mm	millimetres
MSA	Maritime Safety Authority
NZDT	New Zealand Daylight Time (UTC + 13 hours)
PVC	polyvinyl chloride
rpm	revolutions per minute
UTC	universal time (co-ordinated)
UV	ultraviolet
VHF	very high frequency

Glossary of terms

amidships	middle section of a vessel, mid length
aft	rear of the vessel
boltrope	rope sewn into the edge of a piece of material or a sail
bulwark	solid rail around the deck of a vessel to prevent entry of the sea
cable	0.1 of a nautical mile
chart datum	zero height referred to on a marine chart
chine	the join between the sides and the bottom of a vessel
deckhead	nautical term for ceiling
knot	one nautical mile per hour
lee	area sheltered from the wind
mayday	radiotelephone distress signal requesting immediate assistance
starboard	right hand side when facing forward
stability	property of a ship by which it maintains a position of equilibrium, or returns to that position when a force that has displaced it ceases to act
strake	a continuous line of plating or planking extending along a ship's side from forward to aft
superstructure	permanent erection above deck level

Transport Accident Investigation Commission

Marine Incident Report 98-216

Craft particulars:

Name:	*Rescue 1*
Type:	Naiad 8.5 m rigid inflatable rescue craft
Class:	Not classed (exempt from survey)
Construction:	Welded aluminium rigid hull with buoyancy chambers consisting of four inflated rubber bladders enclosed in, and secured by, fabric-reinforced PVC outer covers to form pontoons
Built:	In 1997, by Naiad Inflatables (NZ) Ltd Picton
Owner/Operator:	Tauranga Volunteer Coastguard Incorporated
Propulsion:	Two 200 HP EFI Mercury outboard engines fitted with counter rotating propellers
Speed:	45 knots (maximum at 5300 rpm) 30 knots (cruising at 4000 rpm)
Length (overall):	8.5 m
Breadth:	3.1 m
Weight:	2700 kg

Location: Motiti Island, Bay of Plenty

Date and time: Tuesday, 8 December 1998 at about 1635[1]

Persons on board: Crew: 4

Injuries: Nil

Nature of damage: Substantial to pontoon system

Investigator-in-Charge: Captain John Mockett

[1] All times in this report are in NZDT (UTC + 13 hours) and are expressed in the 24 hour mode

1. Factual Information

1.1 History of voyage

1.1.1 On Tuesday, 8 December 1998 at about 1530, Seacoms, a local volunteer marine radio station, received a distress call and attempted to contact the Tauranga Volunteer Coastguard (coastguard) headquarters by telephone, but could not get through as the line was engaged. The Seacoms operator then called one of the coastguard senior skippers on his mobile phone and advised him of the distress call.

1.1.2 The vessel in distress was *Propwash*, a 6 m runabout with 4 people on board. It was experiencing engine problems and drifting towards rocks in an area known as "the knoll" on the south-east tip of Motiti Island. (See Figure 1.) *Propwash* was not in immediate danger and a commercial fishing vessel *Marie* was standing by.

1.1.3 The skipper who received the call from Seacoms contacted the coastguard operations officer and advised him of the incident. He also contacted the coastguard radio operator and instructed her to call out the duty crew to prepare their vessel *Rescue 1* for launching in case they were required to assist.

1.1.4 As both the coastguard operations officer and the skipper that received the original call were in the vicinity they assisted with the launching of *Rescue 1*. Another coastguard skipper who had been working on his own vessel at the marina arrived to assist, as did one of the rostered crew members.

1.1.5 At 1603 the skipper of *Propwash* upgraded the distress call to a Mayday, because his attempts to anchor were unsuccessful. By this time the *Marie* was unable to assist due to the limited depth of water available, but remained standing by.

1.1.6 The volunteers launched *Rescue 1* at about 1605, started the engines and conducted a radio check. As they were now responding to a Mayday call they decided not to wait for the remainder of the rostered crew, but to proceed with a crew made up of the people in attendance. After a brief discussion they nominated a skipper and departed.

1.1.7 On the way out of the marina they picked up a small inflatable dinghy from another vessel in case it was needed to effect the rescue among the rocks. One of the crew checked the pressure of the bladders on *Rescue 1* by depressing each by hand. Only the port forward bladder required topping up with air, this was done using a bellows-type foot pump.

1.1.8 Weather conditions were 30 knot westerly winds with gusts up to 40 knots, good visibility, with passing showers. In the harbour, the sea conditions were choppy with many whitecaps. Outside the harbour, towards the area where the incident occurred, sea conditions were reported as westerly of 2 to 3 metres with no significant swell.

1.1.9 *Rescue 1* proceeded through the marina at slow speed and once clear increased speed to about 40 knots. This speed was maintained across the harbour and out through the entrance. As *Rescue 1* proceeded into open water, the lee provided by the land was lost and the following seas increased so the skipper reduced the speed to 35 knots.

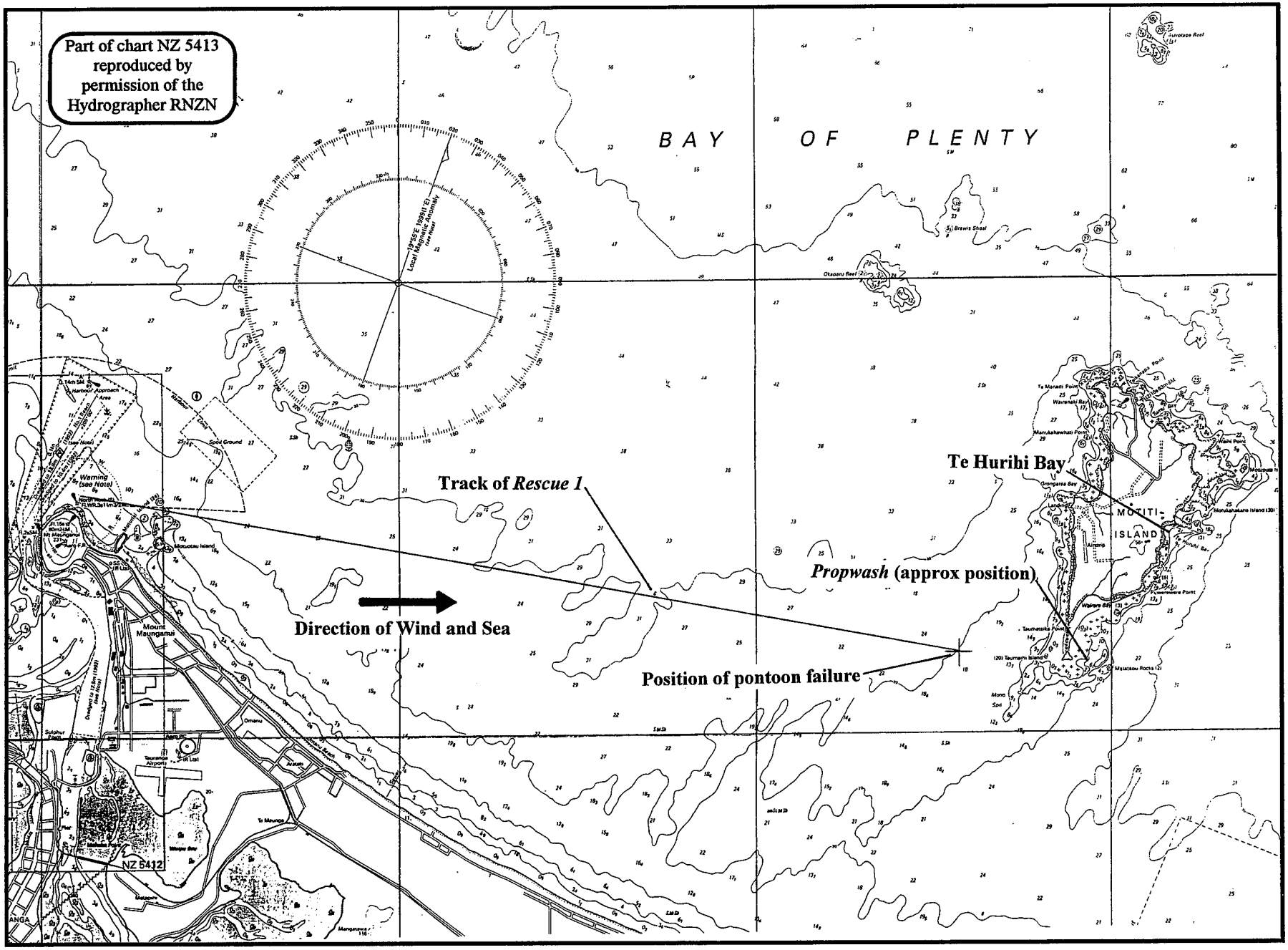


Figure 1
Section of chart NZ5413 showing the area in which the incident occurred

1.1.10 The crew reported that at 35 knots *Rescue 1* appeared to be handling the conditions well, overtaking the seas and occasionally becoming airborne, but landing evenly with a moderate amount of spray coming over the vessel. The 4 crew members were standing, using the wrap-around seat backs to brace themselves. Although the ride was bumpy they felt that it was not too uncomfortable or dangerous.

1.1.11 At about 1630, when approximately one mile from "the knoll", *Rescue 1* launched off one wave and came down on the back of the next one, creating a little more spray than had been previously experienced. Without any noise or warning the crew noticed a "flash of black" on the starboard side. The skipper immediately reduced speed to about 15 knots.

1.1.12 On inspection, the crew of *Rescue 1* discovered that the outer covers of the pontoons had torn free from the bow. The starboard side had split down the full length of the vessel releasing the two bladders. On the port side, the forward bladder had deflated but remained attached to the hull. The lower starboard boltrope had slid out of it's track and a 6 metre strip of the torn cover was trailing in the water behind the vessel, (see Figure 2).

1.1.13 The crew marked the position by using the man overboard facility on the global positioning system (GPS) and at 1635 used the Very High Frequency (VHF) radio to tell coastguard headquarters and Plenty Maritime Radio of the problem and their position.

1.1.14 The skipper of *Rescue 1* further reduced speed to about 10 knots and kept the sea astern while he assessed the seaworthiness of the vessel. Meanwhile the crew secured the damaged pontoons. After a period of running with the sea, the skipper concluded that the damage had not severely impaired the stability of the vessel. As Motiti Island was the closest point of land, and they were answering a Mayday call, he decided to carry on and render assistance to *Propwash.*

1.1.15 As *Rescue 1* entered the lee of Motiti Island the skipper increased the speed to 15 knots, which the vessel handled without any problem.

1.1.16 On reaching the scene, the crew of *Rescue 1* assessed the situation before getting a line across to *Propwash*, which they then towed to Te Hurihi Bay about 1.5 miles to the north, on the eastern side of Motiti Island. At about 1705, *Rescue 1* anchored and *Propwash* rafted up alongside so the crew of both vessels could determine their damage.

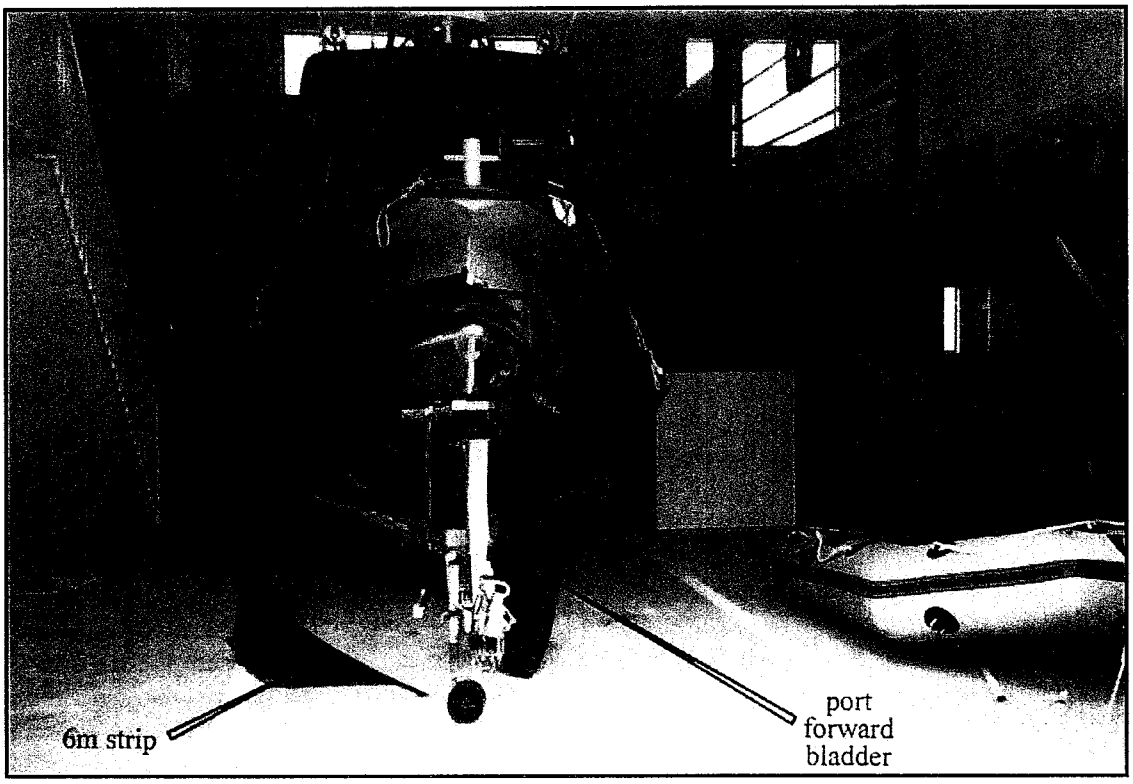
1.1.17 *Propwash* had a broken drive shaft and needed to be towed back to Tauranga. The skipper of *Rescue 1* decided that it would not be prudent to tow *Propwash*, considering the present condition of his own vessel. At 1710 he called coastguard headquarters and requested the stand-by rescue vessel, *Savannah City*, be sent to complete the rescue.

1.1.18 While waiting for *Savannah City*, the crew of *Rescue 1* launched the small inflatable dinghy and made an inspection of their vessel. They lashed the loose parts of the damaged pontoons more securely for the return trip to Tauranga.

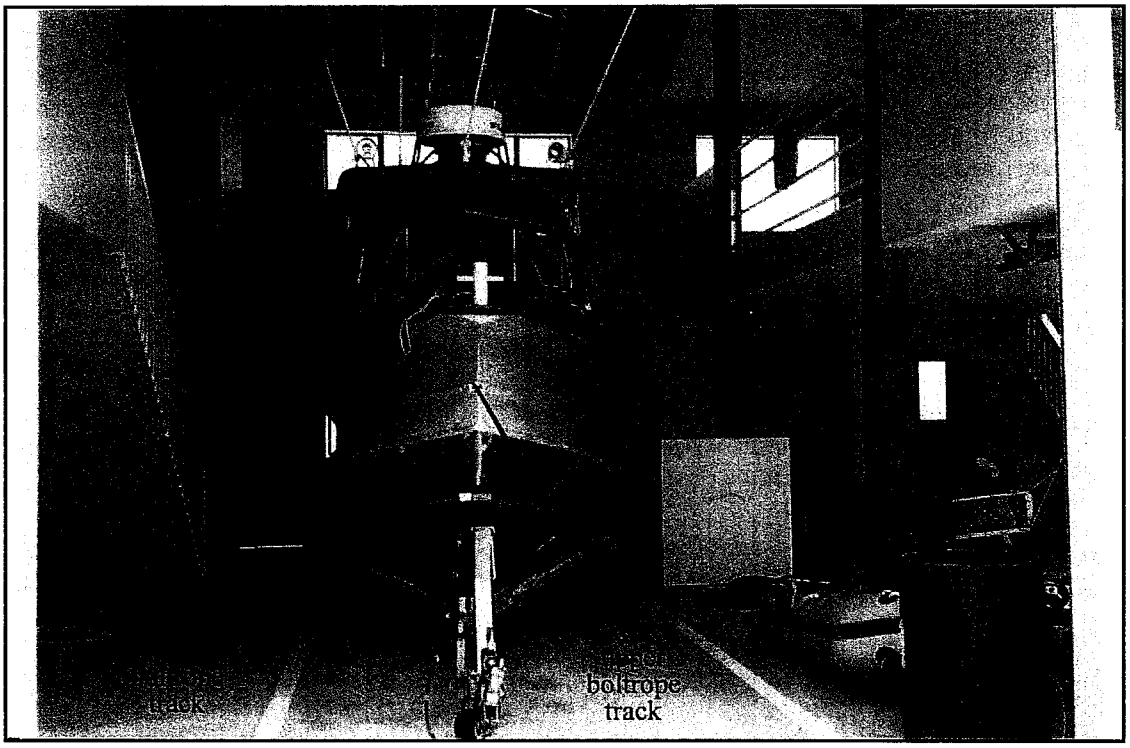
1.1.19 The skipper of *Rescue 1* contacted the manufacturer of the vessel by mobile phone and discussed the situation with the manager. The skipper was assured that the vessel would remain stable in it's present condition and that it was safe to proceed back to Tauranga.

1.1.20 A light fixed-wing aircraft that was often used by coastguard to assist with searches, was despatched at 1745 to locate the two bladders from *Rescue 1.*

1.1.21 *Savannah City*, which had departed Tauranga at 1800, was advised of the bladders position and retrieved them on the way to Te Hurihi Bay.



Damaged pontoon attached



Pontoons removed

Figure 2
***Rescue 1* at coastguard headquarters**

1.1.22 *Savannah City* arrived at Te Hurihi Bay at 1920 and one crew member from *Rescue 1* transferred across. A tow line was then connected to *Propwash,* and *Savannah City* commenced the tow back to Tauranga at 1932.

1.1.23 *Rescue 1* followed close behind the tow for the first part of the journey. As the crew became more confident in the vessel's stability and ability to handle the head sea conditions, they increased speed and went ahead of the tow.

1.1.24 *Rescue 1* arrived back in Tauranga without any further problems, where it was returned to the trailer and taken to coastguard headquarters.

1.2 Vessel information

1.2.1 *Rescue 1* was a purpose-built 8.5 m Naiad rigid inflatable rescue craft constructed mainly from aluminium, built in 1997 for coastguard. It was designed to be operated by a crew of 4, including the skipper.

1.2.2 An aluminium superstructure extended forward from about amidships enclosing a cockpit with a step down cabin leading forward. Aft of the cockpit was an open deck area surrounded by bulwarks to the height of the inflated pontoons, with a towing post fitted at the aft end. At the stern was a self-draining engine bay.

1.2.3 Across the forepart and down each side of the cockpit was a permanent windscreen which formed part of the superstructure. The cockpit deckhead was raised above this by aluminium supports to give extra head room. Between the deckhead and the frame around the windscreens was a removable clear plastic awning.

1.2.4 In the cockpit were 4 chairs, the seats of which could be folded up out of the way. The chair backs were designed and positioned to wrap around an occupant and provide support whether sitting or standing.

1.2.5 Across the front of the cockpit was a console housing the navigation and radio equipment. The steering wheel, engine controls and associated dials were on the starboard side. On top of the cockpit were 2 fixed searchlights, the radar scanner and radio aerials.

1.2.6 The communications equipment on *Rescue 1* consisted of 2 VHF radios, a citizen band radio, a mobile phone and a megaphone. Navigation equipment included a magnetic compass, echo sounder, radar and a GPS plotter.

1.2.7 Also on board was a wide range of safety and medical equipment including a Satfind 406 Emergency Position Indicating Radio Beacon (EPIRB).

1.2.8 *Rescue 1* was powered by two 200 hp EFI Mercury outboard motors with counter-rotating propellers, which gave a maximum speed of 45 knots at 5300 rpm and a cruising speed of 30 to 35 knots at 4000 to 4500 rpm.

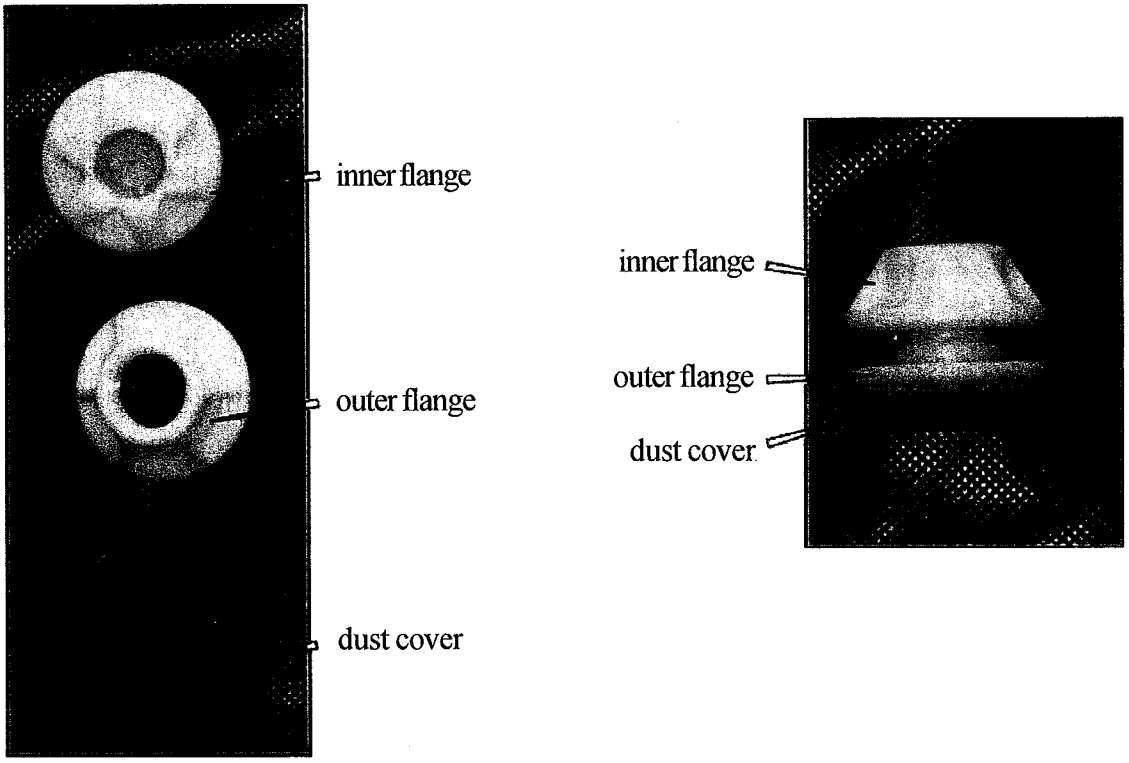


Figure 3
Pressure relief valve

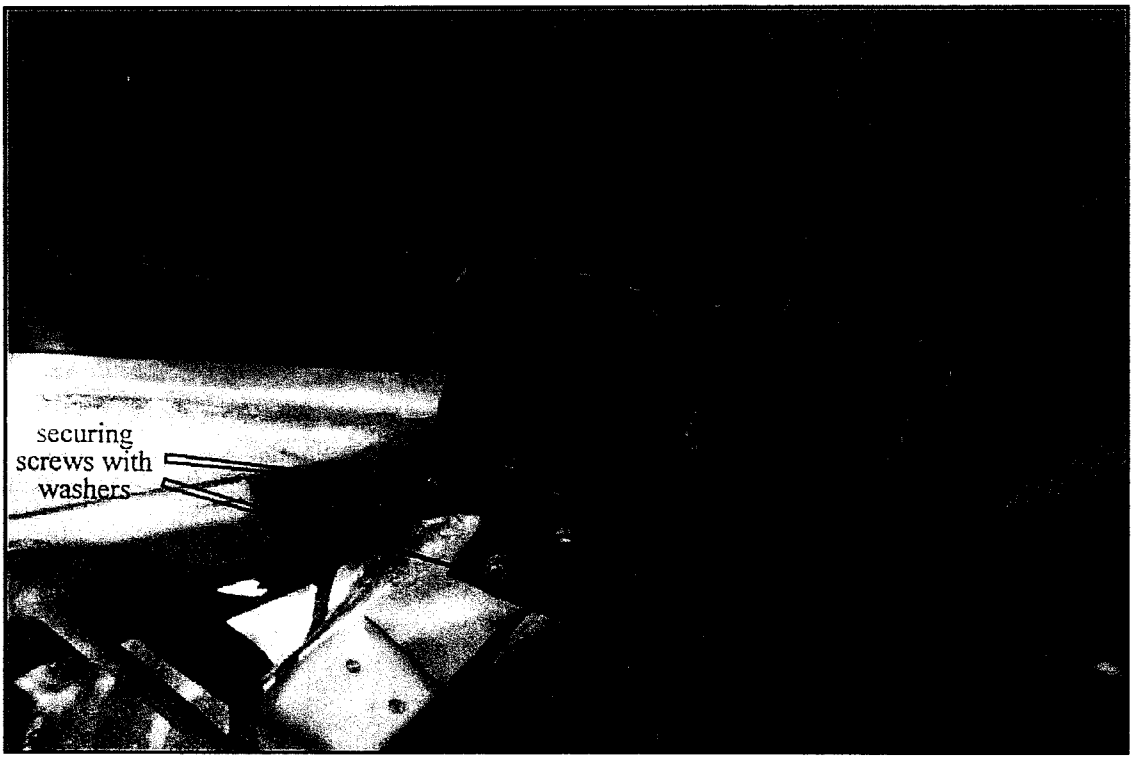


Figure 4
Envelope fitted to a similar vessel

1.3 Construction and securing arrangements of the pontoon

1.3.1 The rigidity and performance of the craft were provided by the aluminium hull. The pontoons provided reserve buoyancy and a softening of the ride. The rigid hull was constructed with an extended reverse chine for increased turning performance and support when on the plane. The chine extended to the bow to increase the lift in this area and helped deflect water away from the pontoon attachment. Water collecting on the internal deck drained away via two freeing ports in the transom.

1.3.2 Four rubber buoyancy bladders, 2 on each side, extended along the entire length of the craft. The 4 bladders were secured in place by a single set of removable outer covers, constructed from fabric reinforced polyvinyl chloride (PVC) to form the pontoons. The outer covers were attached to the hull by boltropes sewn and glued into the upper and lower edges and fed into aluminium extrusions that were welded to the hull; in much the same way as an awning is attached to a caravan. The boltropes ran the full length of the vessel on either side, the lower pair stopping at the edge of a securing tongue at the bow.

1.3.3 When *Rescue 1* was first delivered to the coastguard it was stored outside because an undercover storage facility at the headquarters was still being constructed. Consequently the pontoons were subject to large temperature variations which caused them to expand and contract considerably. After consultation with Naiad, the decision was made to fit a pressure relief valve in each bladder to avoid over-pressurising and damaging the outer covers.

1.3.4 On 30 March 1998, the outer covers were removed and pressure relief valves fitted to the bladders by members of the coastguard using instructions provided by Naiad, who also supplied the valves. The fitting involved gluing a reinforced patch with a precut hole on to the bladder and cutting a similar size hole in the bladder. The inner flange of the valve was then inserted through the hole and the outer flange was screwed on to form a seal between the two flanges and the rubber. A dust cover was then fitted, (see Figure 3).

1.3.5 The recommended working pressure of the bladders was a minimum of 10 kPa and a maximum of 17.5 kPa with 14 kPa considered by the manufacturer as ideal. The relief valves were designed to release pressure at 19.25 kPa. As there was no pressure gauge available, the pressure was judged by feel. The Naiad instruction manual equates 14 kPa to "a comfortable firm cushion to sit on". Using a bellows type foot pump, each bladder was filled or topped up with air through a valve that protruded through and was secured inside the rigid hull just above deck level.

1.3.6 When correctly fitted, the outer covers were pulled back tight against the aluminium hull at the bow, leaving a minimal gap for water to enter should the bow bury into a wave. A tongue was provided at the front of the outer covers which was secured to the bow using a self-tapping screw. The purpose of the tongue was to stop the pontoons from creeping forward and to help cover the inevitable small gap.

1.3.7 When the pontoons were originally fitted to the hull, Naiad made a double thickness patch (approximately 300 mm x 300 mm). It was shaped to fit the curve of the bow forming an envelope to cover the securing arrangement at the bow. The 2 forward edges were glued on to the outer covers. The other 2 sides of the envelope were secured by 2 screws through eyelets, on each side of the bow, aft of the screw which secured the tongue. This arrangement was a modification designed to deflect water away from any gap which would allow water to enter between the pontoons and the hull, (see Figures 4 and 5).

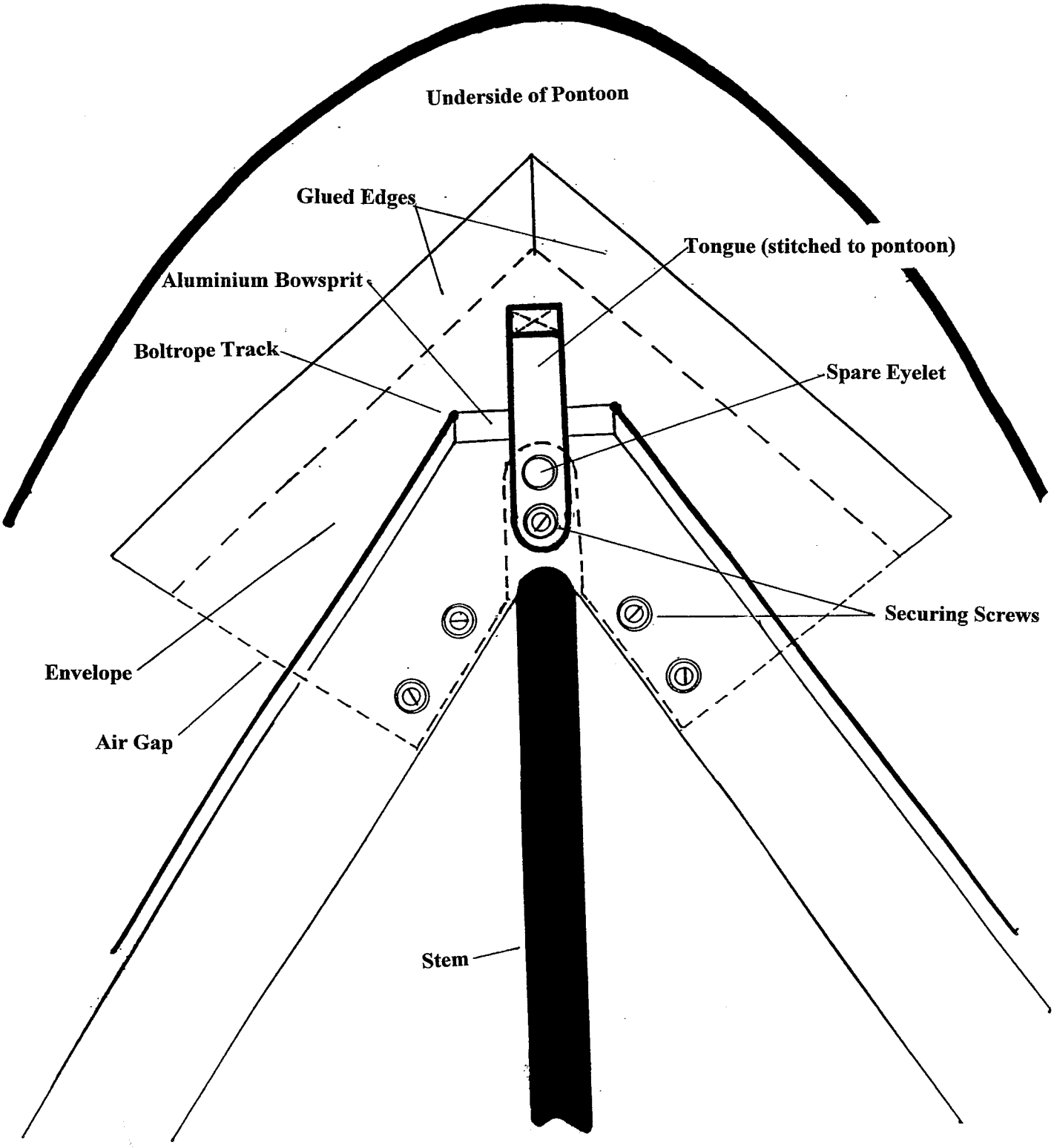


Figure 5
***Rescue 1* pontoon securing arrangement looking up under bow (diagram not to scale)**

1.3.8 Naiad management stated that, when the pontoons were originally fitted, washers would have been placed under the heads of the securing screws on the envelope and tongue.

1.3.9 The diameter of the heads of the 4 screws that secured the envelope was 11 mm and the internal diameter of the eyelets was 9 mm. Only the starboard forward screw had a washer between it and the eyelet. This washer had an external diameter of 13 mm. The eyelet on the tongue and it's securing screw were of the same dimensions and had no washer fitted between them, (see Figure 6).

1.3.10 A 190 mm wide PVC rubbing strake was also glued right around the pontoons, to protect the fabric from damage when coming into contact with objects such as wharves or other vessels.

1.4 Damage to the vessel

1.4.1 After removing the outer covers from *Rescue 1* they were inspected by an independent textile specialist to determine the origin and sequence of the tears.

1.4.2 At the bow, the tongue had torn off it's securing screw leaving the eyelet still attached by the screw to the bow. The tear in the tongue was from port to starboard. The 4 eyelets securing the envelope had pulled out without tearing the fabric and all the eyelets except the starboard aft one were missing; all the screws were still in place, (see Figures 6 and 7).

1.4.3 Where the envelope was glued to the outer covers, the PVC spread coat had pulled away from the base fabric for about 70 mm on each side. There was also a tear in the envelope from the middle of the U for about 130 mm toward the bow, (see Figure 8).

1.4.4 Both sides of the outer covers had torn almost identically for the first 800 mm, (see Figure 9). The starboard side of the outer covers was torn in a saw-tooth effect for the next 1.9 m which included tearing the rubbing strake, from there the tear continued to the stern. The port side tear stopped 800 mm from the bow.

1.4.5 The two starboard bladders had detached from the vessel, wrenching their filling valves out of the hull in the process. The port forward bladder had deflated and the pressure relief valve was missing but the bladder remained attached to the vessel, partially enclosed by the torn outer cover.

1.4.6 On inspection after the incident it was observed, by the indentation in the rubber, that the pressure relief valve fitted to the port forward bladder had been installed off centre to the precut hole, to the extent that it would barely have been air tight, (see Figure 10).

1.5 Personnel information

1.5.1 The skipper for the trip had been a member of the coastguard for 6 years and held a Boatmasters Certificate. He had been employed in the boating industry for the past 30 years as a retailer, valuer and accredited loss adjuster and had extensive pleasure boating experience.

1.5.2 Two of the 4 crew members were also volunteer skippers and long term members of the coastguard, both held senior positions within the coastguard, one as president and the other as safety and training officer. They both held a Boatmasters Certificate and had extensive pleasure boating experience.

1.5.3 The fourth crew member had been a member of coastguard for 2 years, he also had extensive pleasure boating experience. He was the only crew member from the duty roster.

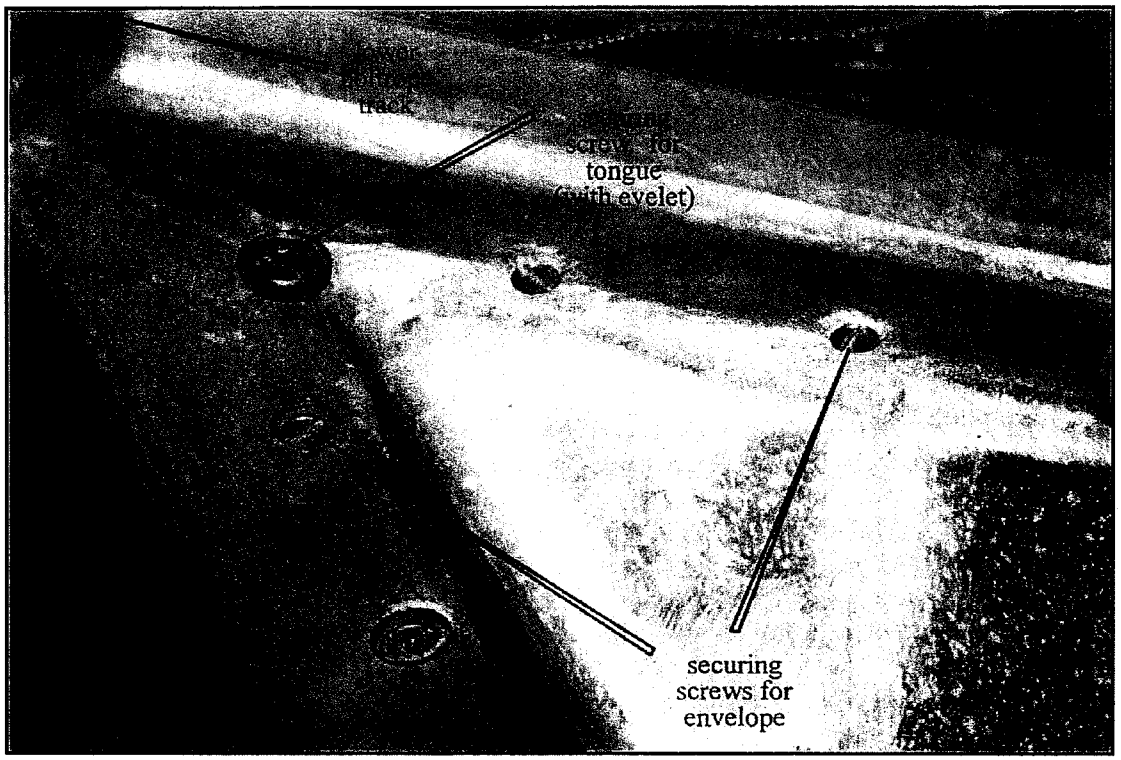


Figure 6
Securing arrangement at bow

Figure 7
Torn tongue and envelope

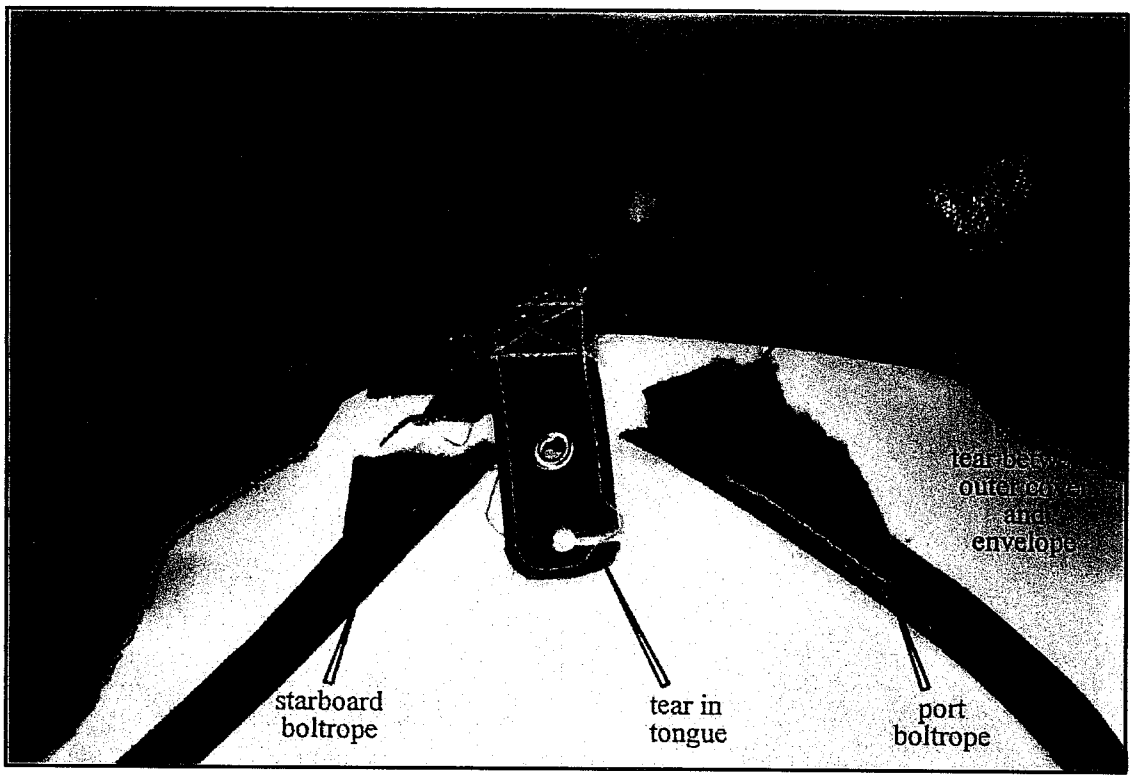


Figure 8
Tears at glued seams, envelope and lower boltropes

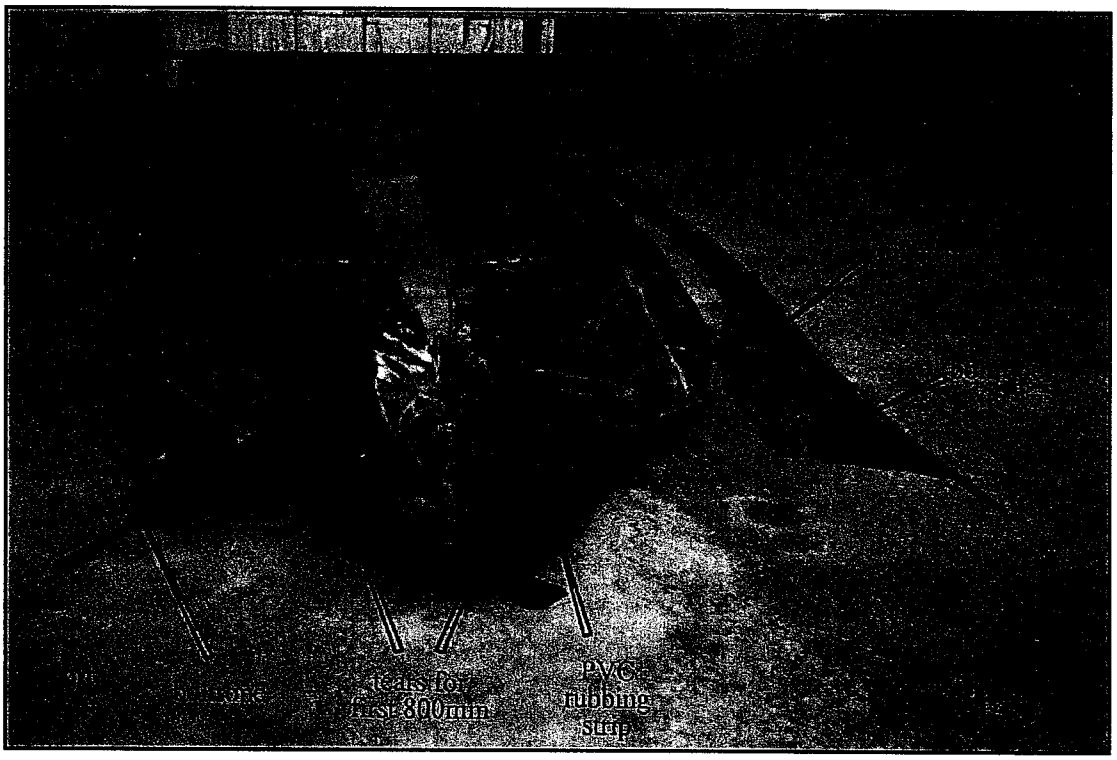


Figure 9
Damaged outer covers (note covers upside down)

Figure 10
Indentation in the port forward bladder caused by the offset fitting of the pressure relief valve

1.5.4 All of the crew members had been involved in previous rescues and had received regular training on *Rescue 1*. They had all attended various in-house courses and had completed coastguard training modules. None of the crew members held a commercial maritime qualification.

1.6 Survey and maintenance information

1.6.1 *Rescue 1*, being owned by the Tauranga Volunteer Coastguard, which was affiliated to the Royal New Zealand Coastguard Federation, was exempted by the Maritime Safety Authority (MSA) from the requirements of Part X of the Maritime Transport Act (Construction, Survey and Equipment) and from the requirements of the Shipping (Manning of Restricted Limit Ships) Regulations 1986. As such, *Rescue 1* was not required to be surveyed.

1.6.2 The exemption was subject to the following conditions:

- that the craft remained owned by the Tauranga Volunteer Coastguard,
- that MSA-approved coastguard safety officers (small-craft inspectors) considered the craft to be fit for it's intended use,
- that it was equipped with an adequate number of life-jackets for it's normal crew complement and appropriate safety equipment (as specified by the safety officer), and
- that the craft was not used for hire or reward.

1.6.3 Maintenance was conducted on an as-required basis, with the duty crew reporting in writing any defects to the safety officer. He then inspected the item and arranged for it to be rectified as soon as possible. The safety officer undertook a full inspection of the vessel fortnightly. He checked 51 items under 7 headings as documented on the safety check list. Under the heading of "Sponsons" it was required that he inspect the pontoons for 6 items, namely:

- cuts / chafes etc.
- U.V. deterioration
- tie down at bow
- secure at hull sleeve
- valves
- stitching.

1.6.4 Since these checks began in July 1997, the pontoons had been removed from the vessel twice; once to repair a glue failure at the seam on the port aft side of the outer covers and once to fit the pressure relief valves to the bladders. The only other recorded problems were minor air leaks, mainly from the port forward bladder, and the removal of the screws at the bow for greasing.

1.6.5 The engines were supplied and fitted by a local authorised Mercury agent. They were still under warranty and were regularly serviced by the dealer.

1.6.6 The pontoons on *Rescue 1* appeared in excellent condition with no visible damage to the seams and joins. There was no apparent wear from chafe.

1.6.7 There was no evidence to suggest that any of the tears had been present in the fabric before total failure occurred. The tears were fresh in appearance, with no fraying or ingrained dirt present.

1.6.8 In about November 1997, the port aft eyelet that secured the envelope to the bow was torn out when *Rescue 1* was being manoeuvred alongside a wharf. This was repaired by heat welding a piece of similar fabric on each side of the torn envelope forming a new securing point.

1.6.9 Since the completion of the storage facility in November 1998, *Rescue 1* had been stored on a trailer under cover at the coastguard headquarters situated at Sulphur Point Marina. It was launched at the boat ramp using a tractor stored in the same facility. When *Rescue 1* returned from an operation or exercise it was always refuelled and a check of the equipment was made so it was left in a state of readiness for future use. This minimised the time taken for pre-sailing checks and enabled a quicker response to emergency calls.

1.7 History of Naiad pontoon manufacturing

1.7.1 Since the first Naiad outer covers were constructed, the manufacturer has made a number of changes to design, fabric used and method of construction. Some changes were made to incorporate new technology as it became available, others were made to improve strength in areas that had failed in the past.

1.7.2 When the outer covers for *Rescue 1* were manufactured in March 1997, the fabric most commonly used was a product called Heywinkle 5551. At that time it was not available so Sioen B6000, a fabric with similar tear and tensile strengths was used instead. It was made from a polyester base cloth covered on both sides with a PVC spread coat and finished with a high gloss acrylic lacquer.

1.7.3 The envelope arrangement fitted to the bow of *Rescue 1* and other Naiad boats was a modification developed in March 1996, designed to restrict the entry of water into the pontoons and cover the securing arrangement at the bow. It was not intended to take any strain that may be placed on the pontoons in a seaway.

2. Analysis

2.1 *Rescue 1* was responding to a Mayday situation where 4 people were in immediate danger. As a result of the urgency, the vessel was being operated at a higher speed than would be prudent under normal circumstances in the prevailing weather conditions.

2.2 The crew of *Rescue 1* were experienced coastguard personnel and confident in the ability of the vessel to handle the sea conditions they encountered on this trip. They had all operated the vessel in worse conditions, in both exercise and rescue situations.

2.3 Rigid inflatable vessels are designed to perform well in rough sea conditions and at the same time provide a "soft" ride for the occupants. Due to the softening of the ride and the manner in which these vessels perform in a seaway, the operator may get little indication of the stresses being placed on the hull and pontoons.

2.4 Over the years, rigid inflatable vessels have gained a reputation for being robust, consequently their use in commercial operations has increased. Because of their ability to ride well in rough seas they have become particularly popular as rescue vessels. As their reputation has grown, so too has the belief that these vessels are virtually indestructible. With high powered, more efficient propulsion units these vessels are continuously being pushed to new limits.

2.5 The greater stresses being placed on both the hull and pontoons have necessitated on-going modifications to their design and the method by which the pontoons are attached to the hull.

2.6 Naiad has had a large share of the commercial market for rigid inflatable vessels in New Zealand, and at times has struggled to keep pace with the higher demands placed on these vessels. Inevitably, components will fail from time to time. If the pontoons are not properly fitted and maintained the risk of failure will increase.

2.7 Every vessel has it's limitations and will fail at the weakest point if those limits are exceeded. On rigid inflatable vessels this has proved to be at the join between the rigid aluminium hull and the inflatable pontoons in the vicinity of the bow. It is of significance that most failures have occurred when the vessels are running with a following sea.

2.8 Although it would be difficult to accurately calculate the forces placed on the bow of a 2700 kg vessel burying into a wave at 35 knots, they would be substantial.

2.9 The pontoons on *Rescue 1* had no indication of previous tears or damage at the bow. Indications were that the pontoons had failed in overload when the forces that they could reasonably be expected to endure were exceeded.

2.10 The weakest point appeared to have been at the glued seam between the envelope and the outer cover on the port side. The tear appears to have started at this point, (see Figures 8 and 11).

2.11 The pressure relief valves fitted to the bladders were designed to release air at 5.25 kPa above the optimum working pressure of the bladders. It is probable that air vented from the bladders, through the pressure relief valves, each time *Rescue 1* buried it's bow in a wave.

2.12 Because the outer cover fabric does not stretch significantly, it took only a small loss of air before the pontoons lost their tightness and sagged. Partially deflated pontoons cause greater stresses to be placed on the lower boltropes and securing arrangement, as the supporting effect of the upper section of the aluminium pontoon recess is lost.

2.13 From the time the pressure relief valves were fitted to the bladders, the safety check sheets showed a history of slight air loss from the port forward bladder. On the day of the incident the only bladder that needed topping up was the port forward one. This leak may have been caused by the incorrect fitting of the pressure relief valve to the bladder.

2.14 The envelope was intended to deflect water away from any gap between the pontoons and the aluminium hull. However it appeared to be fitted in such a way that it was taking most of the strain off the boltrope and tongue at the bow, something it was not designed to do.

2.15 When the bow buried in a wave the force was mostly absorbed by the envelope. The weakest part of the envelope, the repaired eyelet on the port side, failed first followed by the glued seam between the envelope and the outer cover on the port side.

2.16 The outer coating of the fabric at this seam pulled away from the base fabric and started the tear sequence. This tear appeared to have started about 100 mm from the start of the lower boltrope on the port side, (see Figure 8).

2.17 Once started, the tear appears to have travelled in both directions (see Figures 11 and 12) parallel to the lower boltrope along the line of least resistance, thus eliminating the effectiveness of this boltrope.

2.18 With the holding power of the boltrope gone, and the failure underway, there was little to prevent the tear progressing through the rest of the outer covers. The eyelets in the tongue and envelope had little holding effect as there were no washers between them and the securing screws.

2.19 On the port side of the outer covers the tear stopped 800 mm from the bow. This may have been due in part to the pontoons being partially deflated before *Rescue 1* buried it's bow in to the wave. At some time during the failure sequence, the pressure relief valve released from the port forward bladder due to it's incorrect fitting, this caused complete deflation of that bladder. This probably prevented the tear tracking the whole length of the outer cover on the port side.

2.20 The failure sequence would have happened in a matter of seconds.

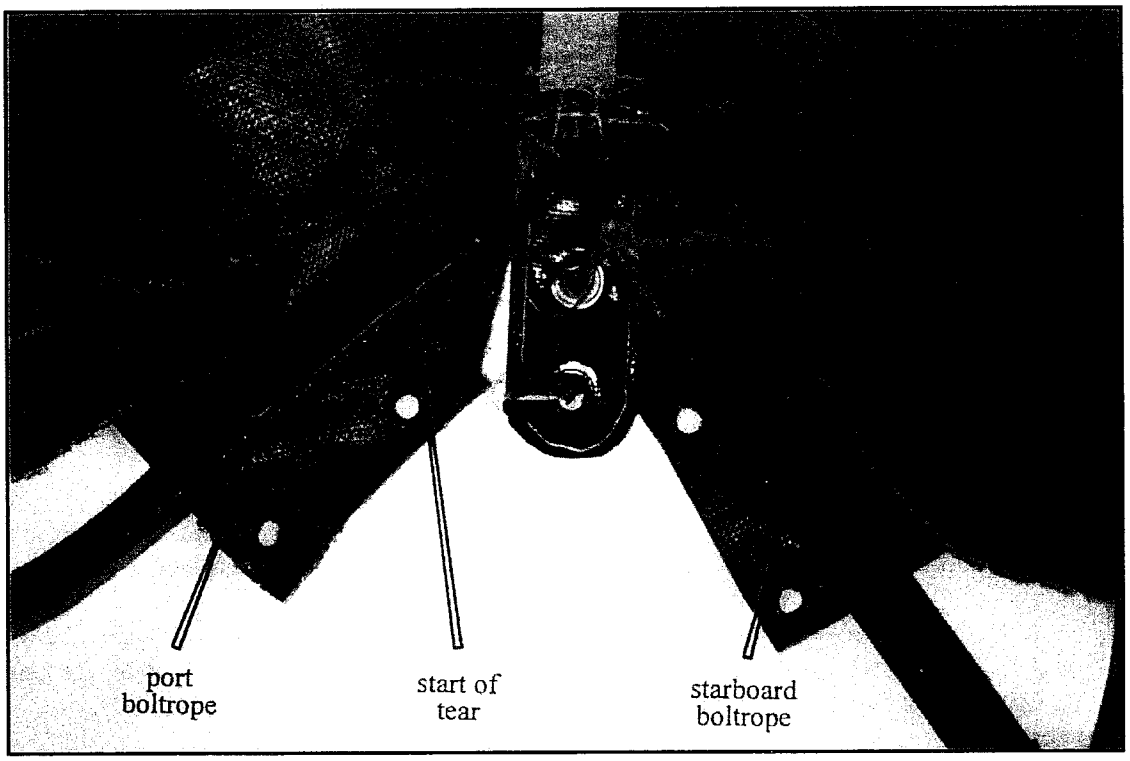


Figure 11
Tears to port and starboard lower boltropes

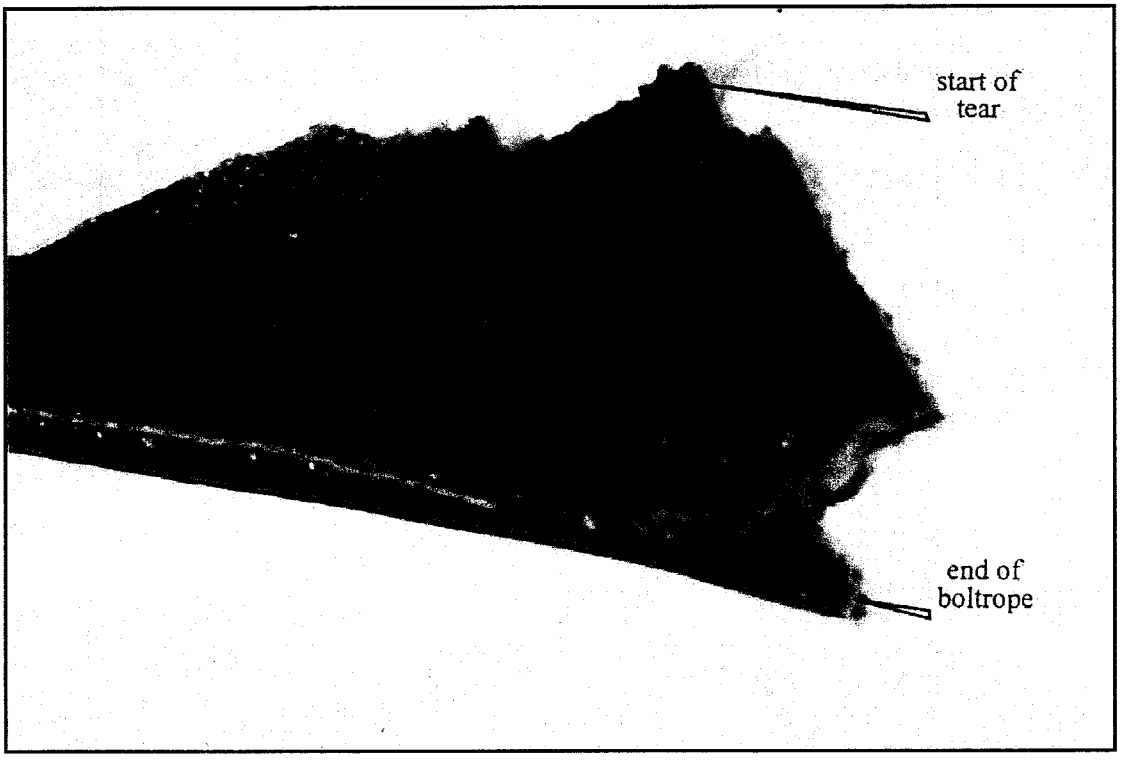


Figure 12
End of port boltrope showing start of tear

3. Findings

Findings and safety recommendations are listed in order of development and not in order of priority.

3.1 *Rescue 1* was exempt from survey and complied with the terms of it's exemption at the time of the incident.

3.2 *Rescue 1* was exempt from the requirements of the Shipping (Manning of Restricted Limit Ships) Regulations 1986 but was adequately crewed at the time of the incident.

3.3 The reputation and ability of rigid inflatable vessels to perform well in rough sea conditions in general, and the relatively comfortable ride the crew of *Rescue 1* were experiencing, appeared to have influenced the crew's judgement of an appropriate speed for the sea conditions at the time of the incident.

3.4 *Rescue 1* was responding to a Mayday call, however it was being operated too fast for the sea conditions experienced at the time of the incident.

3.5 The eagerness of the crew to execute a successful rescue, may have further influenced their judgement of an appropriate speed.

3.6 The failure of the pontoon system occurred when *Rescue 1*, travelling at about 35 knots in a 2 to 3 m following sea, launched off one wave and nosed into the back of the next.

3.7 The absence of adequate washers between the screws and the eyelets on the tongue and envelope, weakened the fastening arrangement of the pontoons to the bow.

3.8 The pontoons failed at the bow when the forces they should have been reasonably able to endure were exceeded.

3.9 The failure was initiated at the weakest point, the attachment of the envelope modification to the pontoons at the bow.

3.10 The manner in which the envelope was fitted to the pontoons and secured to the bow, caused it to take the initial destructive forces, something it was not designed to do.

3.11 The fitting of pressure relief valves to the bladders probably allowed air to be expelled from the bladders in the seaway.

3.12 The strain on the pontoon securing arrangement might have been increased by the loss of air pressure in the bladders, due to the venting of air through the pressure relief valves in the seaway.

3.13 More air might have been lost from the port forward bladder due to a leak caused by the offset fitting of the pressure relief valve.

3.14 The port forward bladder deflated due to the loss of it's pressure relief valve before or during the failure sequence.

3.15 The actions of the skipper and crew after the failure of the pontoons were well planned and appropriate under the circumstances.

4. Safety Actions

4.1 Following the incident repairs and modifications were carried out as follows;

- new outer covers were manufactured using a stronger fabric
- the new outer covers had continuous boltropes around the bow
- the pressure relief valves were removed from the bladders
- a solid plate was fitted between the securing screws and the envelope to secure the envelope to the bow
- an adequate washer was fitted between the screw and the hull to secure the tongue.

5. Safety Recommendations

5.1 On 31 March 1999 it was recommended to the Managing Director of Naiad Inflatables (NZ) Ltd that he:

5.1.1 Publish an article in the next issue of the Naiad newsletter, and specifically contact all known owners of Naiad vessels to whom an optional bow envelope attachment has been supplied, to convey that:

- If the envelope is to be attached, it should be fitted with sufficient tolerance to allow movement of the pontoon, without the glued seams or securing screws of the envelope taking any strain off the boltropes. This tolerance should also allow for a situation where the pontoon becomes partially deflated. (013/99)
- When securing the tongue and/or envelope to the bow, a washer or other load bearing device, of a size compatible with each eyelet and screw head, should be fitted between the eyelet and the screw head to reduce the possibility of the eyelet failing. (014/99)

5.2 On 9 June 1999 the Managing Director of Naiad Inflatables (NZ) Ltd indicated verbally that he would adopt the safety recommendations but felt that it was not necessary to respond in writing.

5.3 On 21 May 1999 it was recommended to the Chief Executive Officer of The Royal New Zealand Coastguard Federation that he:

5.3.1 Circulate a copy of the Commission's final report to all branches of the Coastguard and notify them of the following points:

- Rigid inflatable vessels are designed to handle rough weather conditions, and at the same time provide the occupants with a relatively comfortable ride.
- All vessels have their limitations and will fail if these limits are exceeded.
- When handling these vessels in extreme conditions, care must be taken not to let the sea-keeping capabilities of this type of vessel influence the judgement of the crew with regard to maintaining a safe operating speed for the conditions being experienced. (015/99)

5.4 On 24 May 1999 the Chief Executive Officer of The Royal New Zealand Coastguard Federation responded as follows:

5.4.1

a) The Royal New Zealand Coastguard Federation Inc intends to adopt the safety recommendations in the Transport Accident Investigation Commissions final report.

b) We intend to adopt the safety recommendations as soon as the final report is released, by issuing a safety notice to all Coastguard Affiliate units operating Rigid Hull inflatable vessels.

Approved for publication, 26 May 1999

Hon. W P Jeffries
Chief Commissioner