



Accident Report

Gas Explosion

Double Trouble

29 September 2007

Final Report Issued 17 April 2008





Photograph 1
Double Trouble

1. NARRATIVE

- 1.1.1 On the evening of 28 September 2007 the recreational motorised catamaran *Double Trouble* anchored in Deep Cove on the Coromandel Coast in the Hauraki Gulf. On board were two adults and four children.
- 1.1.2 The next morning the Skipper woke at approximately 0445 hours.
- 1.1.3 As he was in the process of turning on the califont-activated hot water tap and gas cooker a severe explosion occurred.
- 1.1.4 The vessel was effectively destroyed in the blast with sections of the cabin blasted from the hull (*See Photograph 2*).
- 1.1.5 The Skipper and crew suffered serious burns of varying degrees. The Skipper also sustained broken ankles.
- 1.1.6 One of the adults and two children were trapped in a forward berth and were only able to escape after kicking in a door that had jammed.
- 1.1.7 A fire had started on the bow and the Skipper's jacket was on fire.
- 1.1.8 After the Skipper extinguished both fires calls to emergency services were made on cell phones.
- 1.1.9 The spare gas bottle was observed to be venting gas after the explosion and thrown overboard by the crew.
- 1.1.10 Vessels from nearby Bays arrived to assist and a rescue helicopter arrived on the scene to transfer the crew to hospital.



Photograph 2

1.2 The Vessel

- 1.2.1 *Double Trouble* was a modern 30' motor vessel powered by twin 160 HP Volvo stern leg motors.
- 1.2.2 The vessel was jointly owned and had been purchased 18 months prior to the accident.
- 1.2.3 Two forward berths lead from the cabin. Accessible also from the cabin were two quarter berths in which the two older children were sleeping.
- 1.2.4 Two 6 kg LPG bottles were stored in a locker on the forward deck. A gas line within ducting pipe led from the gas locker aft to a califont and gas stove in the cabin. The gas bottle locker had a drainage hole. The ducting pipe was not sealed.

1.3 Investigation

- 1.3.1 The vessel was inspected by a Maritime New Zealand (MNZ) Investigator who interviewed the Skipper. The Ministry of Economic Development also investigated and commissioned Gas NZ, Gas Accident Investigators and Consultants, to examine the vessel and provide a report on the likely cause of the explosion. MNZ accepts and agrees with report's preliminary findings (*See Appendix 1 - Report (with consent of the Ministry of Economic Development)*).

2. COMMENT & ANALYSIS

- 2.1.1 Ullage valves in gas bottles can leak due to being not properly sealed when refilled. This can be due to ice forming within the valve or the 'o' ring not properly sealing.
- 2.1.2 LPG expands in volume 270 times from liquid to ambient pressure. At concentrations as low as 70 to 1 it can explode when ignited. The leaking ullage valve as described would have rapidly filled and, to a degree pressurized, the gas locker. Unable to fully escape out the drain hole the gas would have been pressure driven through the duct pipe in to the cabin where it would have expanded to a point where it was ignited by either the califont or cooker.
- 2.1.3 The explosion was substantial judging from the Skipper's description and the degree of damage to the vessel. It could easily have resulted in multiple fatalities.

2.2 Evidence

- 2.2.1 The Skipper had experienced no problems with the gas system prior to the explosion.
- 2.2.2 When he purchased the vessel he was told by the vendor's agent that no gas detection system was required as the forward gas locker had a drainage hole.

3. FINDINGS

- 3.1 Gas leaked from the spare LPG bottle in the forward locker from an improperly sealed ullage valve.
- 3.2 It is likely that the ullage valve was not properly sealed when filled the previous day at a local gas station.
- 3.3 The gas drainage hole in the locker was unable to discharge all the gas to the outside of the hull.
- 3.4 Due to the expansion rate within the locker the gas travelled through the unsealed duck pipe and accumulated in the cabin area.
- 3.5 The explosion occurred when either the califont or stove ignited.

4. SAFETY RECOMMENDATIONS

- 4.1 Gas explosions cause a serious hazard to mariners. Often they cause life threatening burns.
- 4.2 This explosion should serve as timely reminder to all mariners to check gas appliance systems to ensure they comply with Yachting New Zealand Safety Regulations SR Appendix 7 Gas Appliances Installation with reference to New Zealand Standard 5428:1996. Copies of the full standard should be consulted and are available from Standards New Zealand, Private Bag 2439, Wellington 6020; Tel: 04 498 5990.
- 4.3 Mariners should also consider alternate electrical systems.
- 4.4 Appliances should be properly ventilated.
- 4.5 Installation should be carried out by persons with a thorough knowledge of gas systems.
- 4.6 Gas vapour detection systems are highly recommended for all vessels with gas installations.
- 4.7 It is preferable that gas cylinders should be stored on deck away from any openings such as hatchways that could allow ingress in to the hull and any potential sources of ignition.
- 4.8 Connections and joints in lines should be checked on a regular basis by brushing with soapy water. Bubbles may indicate a leak.
- 4.9 Inadequate external ventilation whilst appliances such as cookers are in operation can cause fatal levels of CO₂. Ensure the area is fully ventilated.
- 4.10 Where metal tubing is used it should be connected with "long nut" flare fittings (vibrations can cause the "short nut" type used in refrigeration systems to fatigue and fail). Flexible line should have permanently attached end fittings such as a swaged sleeve or a sleeve and threaded insert.
- 4.11 **Gas Bottles**
- Bottles should be free of corrosion and rust.
 - Bottles should be stored upright at all times.
 - Bottles are legally required to be checked every 10 years.
 - Ullage valves should be checked before gas bottles are placed on board.
 - Gas bottles should always be switched off when not in use.
 - Always ensure bottles are switched off when refuelling is taking place.
 - At all times gas bottles should be handled with caution. They contain high pressure explosive substance that should be kept clear of any source of ignition.

4.12

Gas lockers

- Where gas bottles are stored inside a hull they should only be stored in a designated gas locker.
- Lockers should have adequate venting to outside the hull.
- Any ducting or aperture leading from the locker to the interior of the hull should be vapour tight to prevent ingress.
- Where appropriate the locker should be lined with corrosion-resistant material.
- Lockers should be able to be opened to the outside atmosphere.
- Lockers should be latched and gasketed.
- Venting should be from the lowest section of the locker. Where required a dedicated line should allow free drainage through an aperture of not less than 12.5 mm.
- The venting point to the outside the hull should be a reasonable distance above the waterline.
- Gas lines leading from the locker should be located at a high point in the locker.
- Where practicable any lines that join should do so within the locker with continuous runs from the gas locker bulkhead to each appliance.
- Gas cylinders should be securely and snugly fitted.
- No other items should be stored within a gas locker.

4.13

It is recommended a summary of this report be placed in the next MNZ publication Lookout to warn mariners of the dangers of gas leaks in vessels.

VESSEL DETAILS

Ship Name:	<i>Double Trouble</i>
Ship Type:	Motorised Recreational Catamaran
Flag:	New Zealand
Built:	2005
Construction Material:	Glass Reinforced Plastic
Length Overall (m):	30'
Accident Investigator:	Ian Howden