

Report of an investigation
of an injury sustained during
the firing of cannon on
sv Grand Turk
while alongside at Portsmouth
on 24 August 2001

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Report No 15/2002
April 2002

Extract from
The Merchant Shipping
(Accident Reporting and Investigation)
Regulations 1999

The fundamental purpose of investigating an accident under these Regulations is to determine its circumstances and the causes with the aim of improving the safety of life at sea and the avoidance of accidents in the future. It is not the purpose to apportion liability, nor, except so far, as is necessary to achieve the fundamental purpose, to apportion blame.

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GLOSSARY OF ABBREVIATIONS AND ACRONYMS

C.I.P	-	Commission for International Proof
GP	-	General Practitioner (Medical)
IFOS	-	International Festival of the Sea
MCA	-	Maritime & Coastguard Agency
RYA	-	Royal Yachting Association
UTC	-	Universal Co-ordinated Time

GLOSSARY OF TERMS

Boot	An area at the extreme aft end of the 'entertainment' or 'between' deck.
COOLLAG	Trade name for particular type of insulation.
Powder monkey	Young person who is responsible for carrying gunpowder charge from deck storage position to cannon.
Pricker	A copper wire or rod, pointed at one end and formed into a ring or loop at the other. Used to pass down the vent to pierce the charge in the cannon prior to priming.
Wadding	A ball of rags pushed down the muzzle to provide a loose gas seal for the subsequent explosion.
Primed	Cannon loaded, with gunpowder trail to maincharge in place waiting to be ignited.
9lb cannon	A cannon capable of firing a cannon ball of 9 pounds weight (4kg)

SYNOPSIS



Grand Turk is a UK-flagged wooden replica of a three masted, three decked, 18th Century square-rigged sailing vessel, originally designed in about 1791 as a British Frigate. Although capable of sailing as a fully rigged vessel, she is fitted with two auxiliary engines and is licensed as both a Class V and a Class III passenger vessel. On 20 August 2001, *Grand Turk* left Dover for Gosport, Hampshire, where she was to take part in the International Festival of the Sea (IFOS).

After arrival at Gosport on 20 August 2001, she carried out several practice firings to welcome other vessels; the gun crew comprising the mate, third mate, the acting bosun, and a senior topman. On Thursday 23 August, the third mate was asked to take over as gun captain during the demonstration to be given the next day in front of an invited audience, the vessel having been chartered for the day. After discussions with the master and mate he chose his own team: two experienced members and a young lad of 17, who was keen but relatively inexperienced. During the day, the new gun crew carried out various practice routines, culminating in both loading and firing.

The following day, Friday 24 August at 1145, *Grand Turk*, which was now tied up alongside the north wall of HM Dockyard, Portsmouth, had the noon day gun loaded but not primed. The demonstration gun team was in position and dressed in period costume, with the guests grouped on the forward starboard side of the main deck with the second mate. At about 1156, No 4 cannon was prepared for the customary noon day firing. The master was standing port side forward to warn off any boats approaching from forward, while the mate was aft, keeping a general eye on the gun team, at the same time warning off any boats which might approach too close from astern.

Immediately after the noon cannon was fired, the reloading demonstration started. After the recoil, the acting bosun concentrated on securing the cannon carriage and serving the vent. The young lad pushed the swabber down the muzzle, "bottomed" it and pulled it out. As he turned to get the rammer, another crew member used the wormer on the debris. Immediately the wormer had been withdrawn, a new charge was placed just inside the muzzle. The young lad then began to push it down the barrel with the rammer. As he tapped the charge down against the breech, there was a loud bang, together with the customary cloud of smoke. When the smoke cleared, the young lad shouted out for help and was seen standing in front of the muzzle clasping his hands, which were covered in powder burns and blood.

He was immediately taken to hospital for treatment and subsequently transferred to Haslar Naval Hospital for surgery. He suffered the loss of his little finger down to the knuckle as well as serious damage to the adjacent two fingers on his left hand, and powder burns to his left arm and shoulder.

The cause of the premature ignition was debris from the previous firing being disturbed by the wrong sequence of swabbing and worming.

Recommendations have been made which, if implemented will reduce the risk of a similar accident in the future.



Grand Turk

SECTION 1 - FACTUAL INFORMATION

1.1 PARTICULARS OF VESSEL AND ACCIDENT

Vessel details

Name	:	<i>sv Grand Turk</i>
Type	:	Mega Yacht (three masted replica 1791 frigate)
Port of registry	:	London, UK
IMO number	:	900582
Built	:	Mamaris, Turkey 1997
Material	:	Wood, iroko & mahogany
Owner	:	Turk Phoenix Limited
Ship manager	:	Turk Phoenix Limited
Gross tonnage	:	314
Net	:	94
Overall length	:	46.30 metres
Hull length overall	:	36.27 metres
Beam	:	10.36 metres
Crew	:	12-40 (32 at time of accident)
Propulsion	:	Sail with twin screw auxiliary engines of 596kW

Accident details

Time and date	:	1203 on 24 August 2001
Location of incident	:	Moored alongside north wall of HM Dockyard, Portsmouth while participating in IFOS Portsmouth
Injuries	:	Blast damage to crewman gunner's left hand
Damage	:	None

1.2 BACKGROUND

- 1.2.1 *Grand Turk* was built in Turkey in 1997 as a 26 gun, three-masted frigate, designed on similar lines to a vessel constructed about 1791. The vessel was built with filming, period re-enactments, and corporate entertainment in mind, but with current passenger and crew safety requirements taken into account. Although capable of sailing as a fully rigged vessel, she is fitted with two auxiliary engines and twin propeller shafts and fixed bladed propellers. She is licensed as both a Class V and a Class III passenger vessel, to carry an absolute maximum of 155 passengers and crew. The minimum number of crew on board at any time is no fewer than 12 persons, six of whom must be at the specified rank and in possession of the appropriate certificates.
- 1.2.2 *Grand Turk's* 2001 itinerary started at Ramsgate on 19 May, and was scheduled to continue until she entered dry dock in Great Yarmouth in September. Following the dry dock she was to return to her normal winter berth in London.
- 1.2.3 Her detailed itinerary included visits to Dunkerque, Ostend, Harwich, Ipswich, Hull, Whitby, London, Dover, Calais, Dover, Gosport, Portsmouth, Poole, Dover and then Great Yarmouth. During these visits, the vessel was open to the public as well as being used for filming and corporate entertainment. During this period, apart from her permanent crew of 9 she was staffed by 23 volunteer crew members of both sexes, with ages varying between 16 and 73.

During the coastal voyages, the number and composition of the crew changes depending upon the volunteers' ability and physical condition, and the time available.

- 1.2.4 Before the start of the voyage, the master and Turk's managing director visit the ports concerned and discuss details as to the publicity, object of the visit, and who and what public access and official receptions will take place. Usually, during arrival, the crew dress in period costume, and cannons are fired for the benefit of television, press and the general public.

As there is a greater demand for public access during the weekend, the programme is designed so that the vessel arrives early/midweek and departs the following Monday. The early arrival allows for visits by special needs groups and organised school visits.

While *Grand Turk* is in harbour, and open to the public etc, she fires cannons at opening and closing times. Cannons are also fired at other times of the day to signify special events.

While the public is on board, some crew members are engaged in safety and security, while others are in period costume and are available to entertain the visitors and answer questions.

1.3 NARRATIVE

- 1.3.1 On 20 August 2001, *Grand Turk* left Dover for Gosport, Hampshire, where she was to take part in the International Festival of the Sea (IFOS) and the Americas Cup celebrations. During the voyage round the coast, both the small bronze signal cannons, and one of the larger 9lb cannons, were fired. These were loaded and fired by the first mate, one of the two licensed firearm holders on board the vessel. The other was the master.

During the working-up period for significant events such as IFOS and other potential filming occasions, any members of the crew who are interested in cannon firing can ask to be considered for one of the gun teams. Members of the crew showing an interest in cannon firing were asked to observe the loading and firing procedures carried out during the coastal voyage. During this observation period, it was noted that despite safety lectures, a number of the younger potential gun team members tended to get too close to the cannons during loading and firing demonstrations. For safety reasons, it was decided that observers would only be present when the first mate, plus the acting bosun, were conducting firing demonstrations.

- 1.3.2 On Monday evening 20 August, *Grand Turk* arrived at Gosport. The following day, the vessel owner, together with his guests, boarded *Grand Turk* to observe the “round the island” race as part of the Americas Cup celebrations. After sailing into the Solent, *Grand Turk* exchanged fire with the period ship *Mathew*, and with the square-rigged ship *Earl of Penbrook*. On both occasions the cannons were fired successfully and safely. The cannons were loaded and fired by the first mate assisted by the acting bosun, a senior topman, the foremast captain (third mate), and a topman. Later that day, the vessel returned to Gosport for the night.

On Wednesday 22 August, at 1330, *Grand Turk* again sailed into the Solent to the Nab Tower where, in conjunction with the Royal Navy, a cannon broadside was fired to welcome the American warship, *USS Winston Churchill* (**Figure 1**). With the first mate in charge, assisted by the gun team that had been in action the previous day, all six 9lb cannons and the three signal guns were fired. Later that day, the vessel moved from Gosport to her IFOS berth in Portsmouth.

- 1.3.3 After the cannon had been fired successfully, the master and first mate discussed and agreed that, for the demonstration the next day, the same basic gun team should be used, but with the foremast captain taking the lead part. This would allow the mate to keep a general eye on the guests on board and, more importantly, what boats were in the immediate vicinity when the cannons were to be fired.

On Thursday 23 August, the first mate asked the foremast captain (or third mate), to take over as gun captain for the duration of the coming demonstration. He had previous experience both of working with the gun team and being part of

a management team. Since a gun team of four was needed for the demonstration, the new gun captain included the two crew members who had been in the team the previous day, plus one new member not previously involved in firing demonstrations. This third member was a young lad of 17, keen but relatively inexperienced.

Figure 1



Cannon firing aboard *Grand Turk*



- 1.3.4 During the day, the demonstration gun team carried out six or eight “dry” gun drills, the first few being “talked” through so that everybody could become familiar with their position and duties. This was followed by a series of tool-handling exercises without loading the cannon. The last few rehearsals involved both loading and firing. Following the rehearsals, the gun team had a final debrief session with the gun captain before packing up for the day. During the practice sessions, the team was stopped by the second mate who pointed out that the 17 year old lad was standing too far in front of the muzzle. He should have stood further back and to the side when using the swabber.

The standard routine for reloading after firing is, first, the barrel is wormed using a two start, open end metal spiral fitted to a wooden pole. This is rotated against the end of the barrel to remove any debris left after the firing. After removing the wormer, the barrel is swabbed. The tool used is a wet sheepskin secured to a wooden pole. This should extinguish any residue sparks or embers remaining in the barrel after firing. Once this is withdrawn, the black powder charge is inserted in the muzzle and pushed down the barrel with the rammer; a wooden bung fixed to the end of a wooden pole. When the charge is down at the breech end, a tightly bound wad of old cloth is pushed down from the muzzle to rest against the charge. The cannon is now “loaded and wadded” but not primed. Once in this condition, the breech is covered with a lead cover until the cannon needs to be primed ready for firing.

The priming is usually carried out by the mate. He carries with him a horn container full of fine black powder. On priming the cannon, the lead cover is removed from the cannon breech, a “pricker” is briefly inserted in the vent to pierce the charge below in the cannon, and then black powder is poured from the horn into the vent hole until full. A small “tail” is left running back into a shallow depression a few inches from the vent. On the order to fire, the mate uses a slow match to ignite the black powder in the depression which then follows the tail down into the cannon igniting the charge.

- 1.3.5 On Friday 24 August, with *Grand Turk* tied up alongside the north wall of HM Dockyard, Portsmouth, the vessel’s charterers, *BAE Systems* and their guests, boarded the vessel to join in the International Festival of the Sea festivities. By about 1145, all six 9lb cannons on the port, or seaward side, of *Grand Turk* had been loaded and wadded but not primed. The demonstration gun team was in position and dressed in period costume (**Figure 2**).

The guests were standing in a group on the forward starboard side of the main deck, with the second mate standing in front of them with the gun display board (**Figures 3 & 4**). The board showed a cut away section of a cannon on which the various actions of loading, priming and reloading could be seen. It was the second mate’s duty to explain to the guests what happens during cannon firing, and to answer questions regarding the demonstration.

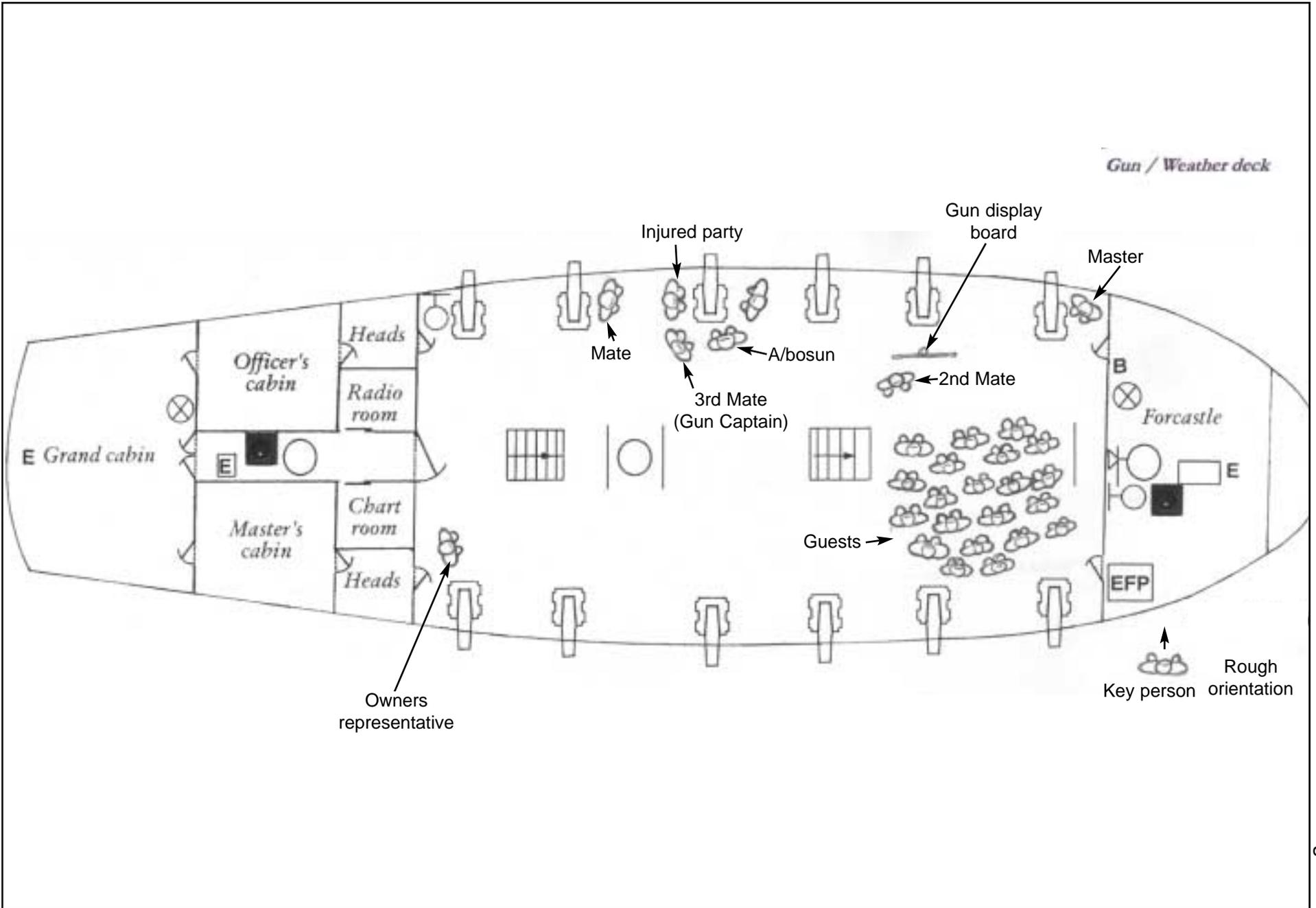


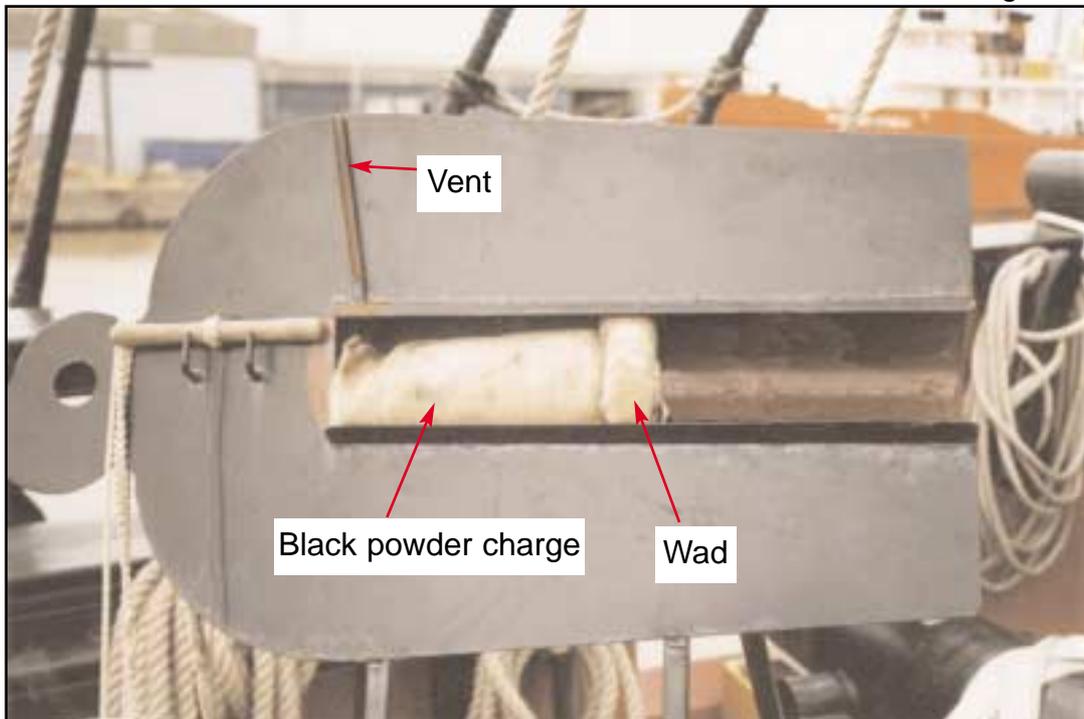
Figure 2

Figure 3



Forward starboard side of *Grand Turk's* main deck

Figure 4



Cut away model of cannon

At about 1156, No 4 cannon was prepared for the customary noon day firing. The gun captain removed the lead breech covering and, assisted by the acting bosun, the gun was primed. The master was standing on the port side forward, between No 1 cannon and the forecastle to warn off any boats approaching from forward while the mate was aft by No 5 cannon. He was keeping a general eye on the gun team while, at the same time, warning off any boats which might approach too close from astern.

- 1.3.6 The gun team was standing clear of the cannon, waiting to demonstrate the reloading and firing sequence once the noon day cannon had been fired. At noon, No 4 cannon was fired. Immediately the cannon had recoiled, the reloading demonstration started. The team was positioned round the cannon as follows: one crew member was standing at the muzzle end forward; the young lad was on the opposite side aft; the acting bosun was standing slightly forward at the breech end, while the gun captain was standing in a similar position aft.

With the gun carriage stopped, the acting bosun turned inboard to secure the “stopper”, a rope securing the cannon carriage to a ring bolt fitted in the deck. At the same time he kept one hand on the breech vent to prevent any air movement in or out of the cannon through the vent. Meanwhile, the young lad had pushed the swabber down the muzzle, “bottomed” it and pulled it out. As he turned to get the rammer, the other forward crew member used the wormer on the debris. As soon as the wormer had been withdrawn, the new charge was handed to the forward crew member by the “powder monkey” for insertion into the muzzle. The acting bosun, having secured the cannon, turned and was just in time to see the wormer being removed from the muzzle and the new charge being inserted. The young lad then began to push it down the barrel with the rammer.

At that moment, as the forward crew member turned away from the muzzle to pick up the wadding, the acting bosun stepped back away from the breech, while the gun captain turned away to pick up the horn container in preparation for priming.

- 1.3.7 The young lad was standing where he had been taught to stand, to the aft side of the muzzle with his body facing the side of the cannon. He was holding the rammer with his right hand below the left, with only his arms in front of the muzzle. As he tapped the charge down against the breech, ignition occurred.

There was a loud bang and a cloud of smoke. The young lad shouted out for help and was seen standing in front of the muzzle holding his hands together, covered in powder burns and blood. With the first mate, he quickly went aft and below for attention to his wounds, while the gun team attempted to calm down the situation. Because several crew members were showing signs of distress, the gun captain called them all aft on to the quarter deck out of sight of the guests.

While this was happening, the owner's representative and the master explained to the guests that there had been an unfortunate accident and that an ambulance had been called. By 1207, the ambulance had arrived and the injured crewman was taken to hospital. There were various visits and telephone conversations with official bodies during the next few hours, with a general acceptance that there should be no further cannon firing until the accident had been investigated. A visit by an MCA surveyor at 1520 resulted in a prohibition notice being issued. It stated that no further cannon firing was allowed once the remaining, loaded and wadded cannons had been discharged. This was to take place while the vessel was at sea.

- 1.3.8 At 1600, *Grand Turk* sailed from Portsmouth for the Solent, to undertake a 3 hour pleasure cruise/sail as originally programmed with BAE Systems guests on board. The vessel proceeded to the Nab Tower where the remaining five cannons were discharged safely. By 1920, *Grand Turk* had returned to Portsmouth and was secured alongside her berth on the north wall of HM Dockyard where the guests disembarked.

Contact was made with the hospital and the crewman's parents, and it was learned that as a result of the accident the lad had lost the little finger and severely damaged the "ring" finger on his left hand. He also suffered powder burns.

At the end of the festival, *Grand Turk* left Portsmouth for Poole, arriving there on 29 August on her scheduled coastal voyage plan.

1.4 PARTICULARS OF CREW

- 1.4.1 When *Grand Turk* operates as a sailing vessel, and she is only licensed to do so during daylight hours, she is required to have a minimum crew of 28. Nine of them are regular crew members and the remainder are volunteers. The nine regular crew comprise the master, first mate, second mate, cook, bosun, and four experienced seamen. Of this nine, only the master, first and second mates are employees of Turk Phoenix Limited. The others are contract staff who are employed on the vessel when she is in service during the summer months.
- 1.4.2 The master is 56 years of age, has been sailing as master on *Grand Turk* since 1997 and has a Class 5 Certificate of Competency with command endorsement. He stood by during her construction and has a thorough knowledge of her construction and handling characteristics. Before taking command of this vessel, he was engaged in a variety of power and sailing vessels on both river and deep sea craft. He possesses a valid firearms certificate relating to the keeping and firing of blank black powder charges in both 9lb and 2lb cannons. This certificate was issued by Surrey police under section 1(1) of the Firearms Act 1968. The master also possesses a further certificate allowing him to acquire and keep explosives on board *Grand Turk*, as issued by the Metropolitan Police 23 August 2001.

- 1.4.3 The mate is 53 years of age and has been involved in sailing craft of varying sizes since the early 1960s. He has a Class 5 dispensation to sail as mate on *Grand Turk* and, like the master, stood by the vessel during her construction in 1997. His experience has been on both river and deep sea craft, as well as with the film industry on period re-enactment scenes involving cannon firing. Like the master, the mate possesses a certificate permitting him to acquire and keep explosives on board *Grand Turk*, as issued by the Metropolitan Police 23 August 2001.
- 1.4.4 The 36 year old gun captain is a serving police officer, holds an RYA coastal/yachtmaster qualification, and has experience as watch officer on “tall ships” as well as mate on 24-metre yachts. She first sailed on *Grand Turk* as a volunteer in 1999 and held a position of responsibility on the vessel each time he joined. Before joining the vessel in 2001, he had had no personal involvement in cannon firing. He had been on board earlier in 2001 and rejoined *Grand Turk* at Dover on 17 August 2001.
- 1.4.5 The acting bosun is 21 years of age. He is currently a student at Durham University, and before joining *Grand Turk* had about 9 months accumulated sea time on square-rigged sailing vessels. He joined the vessel in London on 2 July 2001 and was involved on various maintenance duties while she was alongside in London. Before the vessel left London on 26 July he had no experience of cannon firing.
- 1.4.6 The third member of the gun crew is 20 years old, a student at Hull University, and was rated as senior top-man on the vessels. She has sailed regularly as a volunteer on *Grand Turk* since the summer of 1999. Before joining *Grand Turk* on 21 July 2001, she had not participated in any cannon firing.
- 1.4.7 The fourth member of the gun crew was a 17 year old sixth former from Whitby Community School, who joined the vessel in Whitby on 27 June for the voyage to London. He subsequently rejoined *Grand Turk* in London on 26 July as a volunteer top-man for the summer season. Before this voyage he had not been involved in cannon firing.

1.5 DESCRIPTION OF VESSEL (Figure 5)

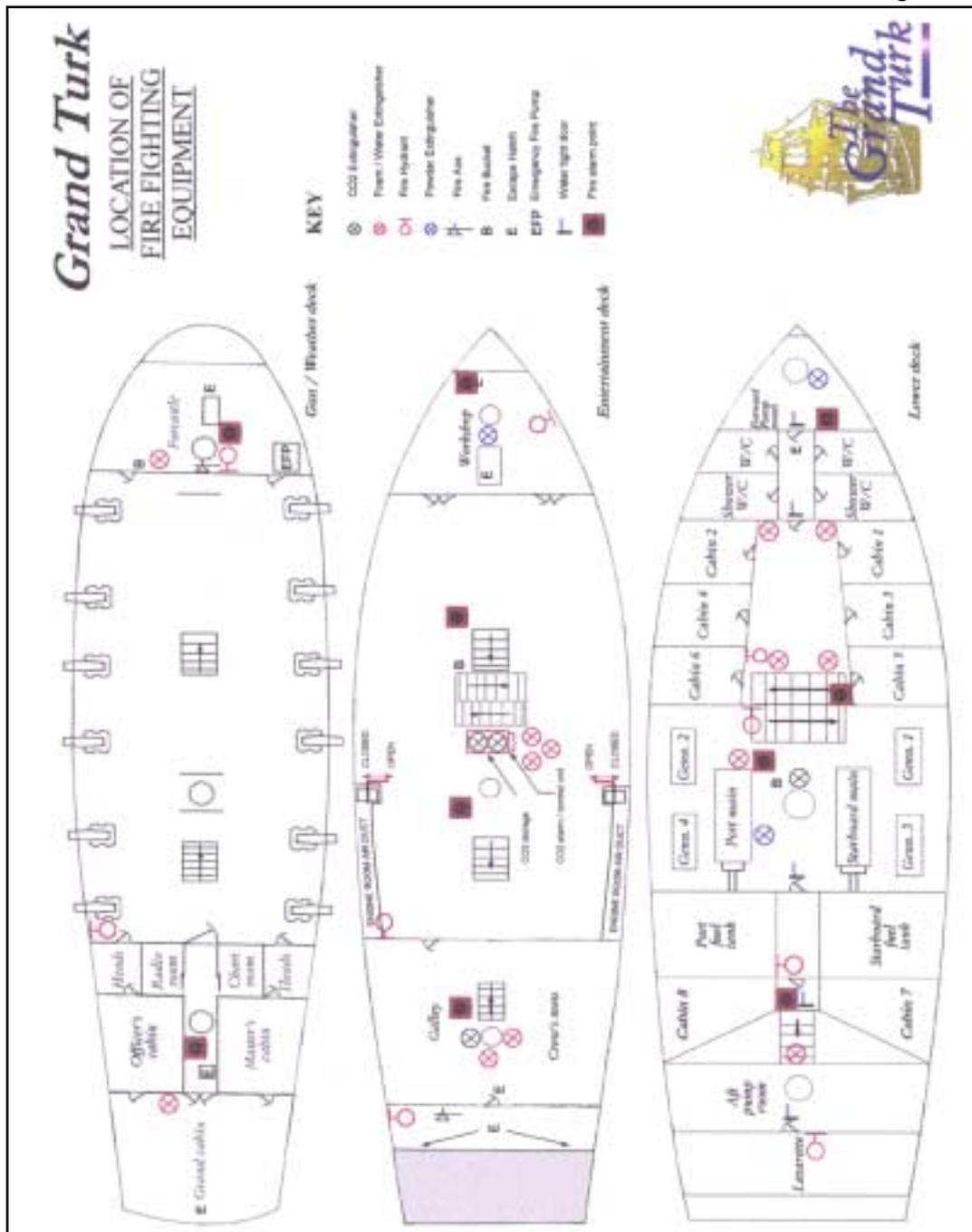
Grand Turk was built in Turkey. Her keel was laid in December 1996 and she was launched in September 1997. She is a wooden replica of a three masted square rigged 18th Century British frigate (6th rate ship of the line) originally designed about 1791. She has three decks: the gun or weather deck, the “between” or entertainment deck, and the lower or accommodation deck. There is a raised poop deck aft for navigating, and a raised forecastle forward.

The gun or weather deck houses the senior officers’ cabins aft, together with the radio room and chart room. The twelve 9lb cannons are secured on the open deck amidships, with a forecastle store forward. The next deck down, the “between” or entertainment deck, has the “boot” right aft which contains the

gunpowder magazine and other stores, then the galley and crew's mess, the volunteers' mess and recreational area amidships, and the workshop forward. The lower deck contains store areas, crew cabins, and with the engine room amidships.

In addition to being a fully rigged sailing vessel, *Grand Turk* is fitted with two auxiliary marine diesel engines, giving her a cruising speed of about 9 knots when under motor power. She complies fully with the requirements for a large commercial yacht and is registered under the "Megayacht Code". She is also registered by the London Borough of Tower Hamlets for the keeping of mixed explosives under the provisions of the Explosives Act 1875, as amended.

Figure 5



1.6 DESCRIPTION OF CANNONS & GUNPOWDER CHARGES

- 1.6.1 The twelve 9lb cannons carried on *Grand Turk* were made in the Black Sea port of Sevastapol, Ukraine, in 1997, by the local naval dockyard. They were constructed for theatrical appearance and designed solely for using black powder charges together with wadding material. All twelve are of similar construction and appearance, and were built specifically for this vessel and her involvement in the first of the TV series "Hornblower".

The bore of the cannon consists of a high tensile steel tube sealed at one end by a welded steel plug to form the breech. This steel tube is encased in moulded alloy designed to resemble the original 1790 cannon shape, together with trunnions. The cannon is mounted on a wooden gun carriage together with all the fittings necessary to enable cannon firing to take place.

- 1.6.2 On completion, each cannon was tested by firing black powder charges of increasing weight. The initial test carried out used a 300-gram charge, followed by a 600-gram charge and finally a 900-gram charge. After each firing, the cannon was inspected for cracks or any signs of stress. When none were found, the next level of charge was test fired. As it was intended that the maximum weight of charge to be fired was 500 grams, testing beyond the 900 gram level was not considered necessary. No proofmarks were stamped on the cannons on completion of the test firing. For the purposes of the firearms certificate, the master identified each cannon in its individual position with a reference number GT.1997/1 through to 12.

Since the vessel entered service in 1997, the twelve cannons have been fired successfully many times without incident, or any visible signs of stress on either the bore of the cannon or the metal casing.

- 1.6.3 Following the accident and the Keeper of Artillery, Royal Armouries, invited visit to *Grand Turk*, the owners were advised that, although the cannons have been test-fired using charges up to twice the weight of charges used during filming and demonstrations, it would be a prudent measure to have the cannons proof-tested at one of the UK testing houses.

This advice was not a reflection on the state of the cannons. Instead, it would show that, although current legislation does not require cannons with a muzzle diameter greater than 2" to be proof-tested, the company was conscious of the safety of volunteer members of the public closely involved in cannon firing.

The legislation relating to the proof of guns is contained in the Gun Barrel Proof Acts 1868, 1950 and 1978 together with various Rules of Proof, particularly those of 1925, 1954, 1986 and 1989 when the metric system was introduced. The importation of unproved arms into the UK is also subject to control under Section 122(4) of the 1868 Act as amended by the Act of 1978. Certain foreign proofmarks were accepted under a reciprocal agreement until June 1980, but, since that date, the UK has become a member of the International Proof Commission (C.I.P.) and recognises all proofmarks of other member nations.

It is understood that the company is not currently seeking to have a number of its cannons proof-tested as suggested by the Keeper of Artillery, Royal Armouries.

- 1.6.4 The current construction of the gunpowder cartridges had been developed by the mate after he had studied the actions of film and TV special effects technicians and others. This resulted in a 400-gram charge being contained in a thin plastic bag, such as a food freezer bag. This in turn was wrapped with tape until it formed a sort of sausage about 35mm in diameter (**Figure 6**). This was pushed down the barrel until it rested on the breech immediately below the vent. Loose gunpowder was then poured down the vent to provide a fire trail once a flame had been applied externally. In theory what followed was an explosion and the discharge of the wad.

In fact, because the charge was irregular in shape and did not fit the barrel properly, a drinking straw was often inserted through the vent and down to the charge. This was then filled and provided the fire trail. Without such a device, the amount of gunpowder required to build a connecting bridge between vent and charge could be quite substantial.

The charges were made by the mate, in the “boot” where the magazine was stowed. When required for firing, they were carried out on deck in a fireproof box and only brought forward to the guns when cannon firing was to be carried out (**Figure 7**).

Figure 6



Gunpowder charge for cannon



Fireproof box for transporting charges on to deck



Magazine containing gunpowder and tools for measuring out charges

1.7 TRAINING OF GUN CREWS

- 1.7.1 Following the launch and commissioning of *Grand Turk* in 1997, the cannons were used regularly for filming and TV events, usually using special effects technicians from the film industry for the actual firing. At the onset of the “Horatio Hornblower” television series, both the actors involved, as well as the then crew, undertook intensive training in the handling and firing of cannons. This training was carried out by the Trafalgar Gun Company and subsequently by the curator and historian from HMS Victory. The current mate was aboard during the whole of this training period, and he participated in all the training exercises and the actual filming.

It was from the experience gained during this period that the current gun drill was derived and included in the *Grand Turk* Training and Safety Manual.

- 1.7.2 The selection and training of gun crews is primarily the mate’s responsibility. Selection is based on a combination of the individual’s interest, attitude towards responsibility, and ability to work as part of a team. When the vessel is commissioned for the summer season, the crew, which is usually a mixture of “regular volunteers” and newcomers, is involved in getting to know the vessel, the work required, shipmates, and how to work as a team.

It is during this period, particularly when the cannons are being fired, that any members of the crew who are interested, ask to be included in the routines. Initially, they watch the mate loading and firing the small signal cannons, before learning the names and functions of the various tools and equipment used in the loading and firing. Learning is essentially “hands on”; studying the gun drill procedure as written in the Training and Safety Manual does not form part of the training. When in close proximity to cannon firing, some people find it uncomfortable and drop out, while others get enthusiastic and wish to become part of the gun team.

It is during this “working up” period that the master and mate observe individuals’ reactions, and discuss the suitability of each applicant before inviting them to become a member of a gun team. For special demonstrations, the selected team of four usually includes those who have had previous experience of cannon firing. On this particular occasion, one crew member had signal cannon experience, but little or none on the large cannon other than that carried out the previous day.

The gun captain, whose responsibilities include priming and firing the cannon, was usually the mate, but other responsible persons have assumed this role in the past. On this occasion it was the third mate. He had participated in earlier firings using both the wormer and the swabber, but had not, until the 23 August 2001, been placed in charge of a gun crew. He had had the procedure

explained to him by both the then bosun and the mate earlier in the year, but had not been given any formal instruction in a gun captain's duties and responsibilities. Neither had he seen, nor apparently was he aware, that a gun drill procedural document was available in the vessel's Training and Safety Manual.

- 1.7.3 This training procedure or gun drill for cannon firing was in force both before and at the time of the accident, and included in the vessel's Training and Safety Manual kept on board *Grand Turk*. A copy of that gun drill document is at **Annex 1**.

Under that procedure, items 17, 18, and 19 show the correct sequence to be followed immediately after the cannon has been fired. Note that the wormer is inserted in the muzzle first after firing, then the wet swabber is applied (**Figures 8 & 9**). With this sequence, any debris left after ignition is scraped off the rear and internal side walls of the cannon by the rotary action of the worm, and pulled out of the muzzle. This action exposes any remaining smouldering debris or sparks, which are then extinguished by similar rotary use of the wet swabber.

The movement of the gunpowder charge is tightly controlled, with the priming powder horn and slow match kept well apart. The mate prepares the charges in a secure area right aft called the "boot" - this is aft of the galley and crew mess on the entertainment deck. The gunpowder, weighing scales, tools etc used in the preparation of charges, are stored in a small chest magazine sited in this

Figure 8



Wormer

area. The magazine is itself kept locked, and the mate is the key holder. He, or the master as the other person with a firearms licence, must be present when the magazine is opened. *Grand Turk* is licensed under the Explosives Act 1875, as amended, to hold a maximum of 250kg of gunpowder at any one time. The magazine is lined internally with an insulation material similar to a rock wool called COOLLAG and has been inspected and passed for the storage of explosives by both the Trading Standards Officer for the London Borough of Tower Hamlets, and the Metropolitan Police. At any one time, *Grand Turk's* magazine contains a maximum of 10kg of black powder.

Figure 9



Wet swabber



1.8 KEEPER OF ARTILLERY, ROYAL ARMOURIES

1.8.1 Immediately following the accident, *Grand Turk's* master contacted the Keeper of Artillery, Royal Armouries, and asked for his assistance to establish what had caused the premature explosion. As the keeper was at the time on the Royal Armouries stand at the festival, he visited *Grand Turk* and discussed in detail with the master the circumstances. This discussion included safety needs and historical accuracy in gun drill routines. At the conclusion of the discussion, it was agreed that the keeper would provide training for gun crews at the Royal Armouries, Fort Nelson, as well as a copy of a standard form of muzzle loading gun drill used at the museum.

At a subsequent meeting, the keeper, who has extensive experience of black powder cannon firing, explained to the MAIB his preliminary conclusions and what, in his opinion, were the principal contributory factors to the accident. These were:

- *Failure to remove all debris of the previous firing.*
- *Cartridge material difficult to remove.*
- *Haste in reloading.*
- *Failure to serve the vent adequately.*

1.8.2 Following this meeting, the keeper sent *Grand Duke's* master a list of his observations on the importance of the correct procedure for blank firing on the vessel. He also sent a copy of the specimen muzzle loading gun drill as practised ashore.

Among the observations, three were of particular note; extracts of which are quoted below:

"Order of Operations".

The statement given by the crew shows that, on this occasion, worming was carried out after sponging. This kind of mistake serves as a reminder for the need for periodic review of procedures and for vigilance on the part of the gun captain and/or safety officer. Both historically and now, the procedure is first to worm the gun, using a worm of effective form and size, then to sponge.....

Cartridges

It seems to me that polythene or similar plastic material and heavy duty tape such as carpet or 'duck' tape present unnecessary problems. Such a cartridge is unlikely to be consumed fully on firing and its residue tends to be sticky and difficult to remove and might harbour unburned and smouldering remains of the powder charge.....

Serving the vent

The drill practised at the Royal Armouries is intended to be easy to learn and remember., based on the simple principal of serving the vent the whole time that the cleaning and loading actions are taking place.....Unless the vent server is wearing stout leather glove, s/he should wear a thumbstall and serve by pressing the thumb firmly on the vent throughout. No sound of air escaping should be heard.....

A copy of the observations document is in **Annex 2**.

SECTION 2 - ANALYSIS

2.1 AIM

The purpose of the analysis is to determine the contributory causes and circumstances of the accident as a basis for making recommendations to prevent similar accidents occurring in the future.

2.2 THE TRAINING OF GUN CREWS

- 2.2.1 The gun drill procedure, as written in *Grand Turk's* Training and Safety Manual, should, if followed correctly, have prevented any premature ignition of the gunpowder charge. Both the master and mate were familiar with the procedure and generally either monitored, or were involved in, all cannon firing exercises. It is, therefore, difficult to understand how the procedures for worming and swabbing became reversed, if indeed they did, during the dry run and practice firing carried out on Thursday 23 August 2001.

The gun captain, and all three of the gun crew, including the injured person, freely made statements about the incident before the MAIB's arrival. They all agreed that the procedure was to use the swabber first and then the wormer. Even during subsequent interviews all four remained under the impression that this was the correct procedure. It may be that what they were seeing in their minds' eyes was the sequence which was carried out immediately before the explosion, and not what was practised.

- 2.2.2 The correct procedure was available in the Training and Safety Manual, but only one of the gun crew acknowledges that she had read it. None of the others had read it or acknowledged its existence. Both the gun captain, and the rest of the gun crew, state that they had received guidance from the mate either as a group or individually on gun drill, but little or no instruction was given on the control of the operation. This failure to monitor the gun control was highlighted when the second mate, who had no involvement in gun drill, intervened, during that Thursday's training, to point out that one of the gun crew was too close to the front of the muzzle, and should have been standing at the side. Such an intervention would not have been necessary had the training been monitored correctly.

One of the main points raised by the Keeper of Artillery was that firm control of the procedure was needed at all times. It was this firm control that was missing from the outset, not because the new gun captain was incapable of providing it, but because he had not been properly briefed on its importance. Although he had sailed on *Grand Turk* for the previous two years, his experience of cannon drill was largely as an observer. He had practised as a gun crew member while on board earlier in the year, but after rejoining on 17 August did not become involved again until asked to assume the position of gun captain on the 23 August. He had been in control when his team carried out practice firing that same day but, significantly, there were no crowds or other distractions present.

2.3 THE CAUSE OF PREMATURE IGNITION

There can be very little doubt that the cause of the premature ignition of the gunpowder charge was the presence of red hot embers from the previous firing. Although the swabber had been used to damp down and/or put out any residual sparks or smouldering debris, the use of the wormer afterwards will have disturbed the damp or wet front of impacted cartridge material on the internal barrel surface - exactly what it is designed to do. In doing so however, it exposed sufficient smouldering material to melt the thin plastic casing of the cartridge and ignite the charge. Gunpowder burns, it does not detonate, neither does it explode under compression.

2.4 WHERE DID THE ROUTINE GO WRONG?

- 2.4.1 As has been mentioned previously, after the accident three of the four gun crew said that the training procedure was swabber first, then wormer. This was despite extensive pre-event training being carried out the day before, under the general eye of both master and mate. It has not been possible to establish how or when the confusion arose as to the correct procedure, or if the error had crept in unnoticed during the later stages of the training when the gun captain's attention was directed elsewhere.

The bosun, one of the experienced gun crew, pointed out that the mate had instructed him in the safe and controlled way to use cannons on the vessel. He had practised cannon firing about 20 to 30 times, with the sequence being worming, swabbing and loading. This suggests that during the practice session the day before the accident, it is likely that the correct sequence had been followed.

- 2.4.2 If it is accepted that, during the practice sessions, the correct reloading procedures had been followed, where and why did those procedures become reversed?

Considering the circumstances of the re-loading, this new gun crew were performing for the first time before an invited audience who were within 2 to 3 metres of the action. They were attending an international festival of the sea with other vessels, and there was a general air of expectancy and excitement, as well as a natural desire to impress both visitors and fellow shipmates alike.

The noon day gun had been loaded cold, and there had been a period with everything and everybody waiting for both the initial firing and the demonstration of quick reloading. Although the MAIB inspector was told that speed was not a requirement it is probable that some, if not all, would be keen to try and show how fast the reload sequence could be carried out. In this heady atmosphere of keen anticipation of a faultless demonstration, it is possible that enthusiasm overrode training and control was lost.

Nobody, either in the gun crew or among the experienced gunners on board, was watching the action. Everybody was engaged in their own duties, with nobody free to exercise the primary function of safety officer. Somebody should have been appointed to monitor the whole series of actions and been in a position to call for an immediate stop if the gun drill was not being followed correctly.

2.5 OWNER'S INVESTIGATION

- 2.5.1 Turk Phoenix Limited was shocked by the accident, and the injury to a member of the crew. The company reacted positively and was quick to engage a competent authority in cannon firing.

Immediately following the accident, the master spoke to the Royal Armouries to seek both advice and guidance as to how the accident could have occurred. Neither he, nor any of the other officers and crew, seem to have realised that the worming and swabbing sequence had been reversed. Such was the shock felt by all concerned that it did not cross anybody's mind that the accident could have been caused by anything other than a fault within the equipment or the gunpowder.

One suggestion was that perhaps the rammer head had been secured to the pole by steel or iron screws rather than brass, and that they had somehow caught the inside of the barrel, thus causing a spark.

- 2.5.2 It was only sometime afterwards that the master and mate, re-reading the statements made immediately after the accident, realised that the worming and swabbing routine had been reversed. Having not experienced any accidents during previous firings, they had assumed that, with the third mate in charge and a further two gun crew members having some experience, any supervision would be minimal. This assumption led to a serious gap in the overall control of the firing procedure. Both master and mate, who would normally have been expected to keep a watching brief on the operation, were occupied on keeping other boats clear of the firing area. What glimpses they had of the operation were only partial and at random intervals.

Subsequently, the company accepted the suggestions from the Keeper of Artillery regarding training and routines to be followed and, at the time of writing this report, are investigating both the construction of cartridges and the proofing of some of the cannons.

2.6 OTHER COMMENTS

2.6.1 The construction of the gunpowder charges, although of the correct weight, were not a proper fit in the barrel. They were based on a special effects design developed by the TV and film industry, and relied on other gadgets ie a straw, to function properly. As identified by the Keeper of Artillery, both the material used and the construction of the charge, need to be changed, and he has indicated that advice will be given on this matter.

2.6.2 There is also the question of under-age persons acting as volunteers on the vessel. Under Merchant Shipping legislation "Young Persons" are defined as under 18 years of age, and if employed, they are required to provide a letter of fitness from their GP. This provides protection for both the employer and employee against being asked to undertake jobs beyond their capability. In this case the vessel is licensed as a passenger vessel with a crew of 26, one of whom was under 18 years of age. Furthermore, under SI 1998 No 2411 (The Merchant Shipping and Fishing Vessels Health and Safety at Work Employment of Young Persons Regulations 1998), there is a mandatory requirement that no young person shall be engaged as a worker in any capacity unless the master has been presented with a young person's medical certificate.

It should also be mandatory for a master to obtain a letter of agreement from the parents before accepting a volunteer under-age. A signature from an underage person on an agreement is not enough. Youngsters can become over keen, to the extent that they will agree and sign to anything just to be considered.

2.6.3 One area of concern is the whole question of who had access to the Training and Safety Manual. Its prime purpose is to include details of all training activities and safety routines which involve officers and crew. As such, it needs to be readily available to all crew members at all times. It is the management's responsibility to ensure that the crew are aware of that fact, which was clearly not the case on this occasion.

Several crew members, including officers, had not read the manual and were unaware that it contained a section relating to gun drill. The management's failure to ensure that all crew members were aware of, and had read, the Training and Safety Manual was a serious management omission.

In so far as the gun crew were concerned, it should have been mandatory for every member to read that particular section, sign that they have read it, and be given their own copy. The master and mate's (who was the gunnery officer) failure to ensure that every gun crew member was aware of the written procedure, had seen it, and that it was readily available to them for further reference, was a basic management error. The Training and Safety Manual must be available to all the crew, volunteers or not and, as stated earlier, it is the master's responsibility to see that they are not only aware of that fact, but they have read the manual.

SECTION 3 - CONCLUSIONS

3.1 CAUSE

The cause of the premature ignition of the gunpowder charge was the exposure of thin plastic casing of the cartridge to smouldering debris from the noon day firing.

3.2 FINDINGS

1. The master possesses a valid firearm certificate relating to the keeping and firing of blank black powder charges in both 9-pound and 2-pound cannons. This certificate was issued by Surrey police under section 1(1) of the Firearms Act 1968. Both master and mate also possess certificates to acquire and keep explosives on board *Grand Turk* as issued by the Metropolitan Police, 23 August 2001. [1.4.2 and 1.4.3]
2. *Grand Turk* is a registered premises for the storage of mixed explosives, and is licensed by the London Borough of Tower Hamlets as complying with the licensing regulations of the Explosives Act 1875, as amended. [1.5]
3. Only one of the gun crew admitted to having read the correct procedure in the Training and Safety Manual; the others were not aware of its existence. Training was essentially “hands on” and by example. [2.1.2]
4. The post-accident recording by the gun crew that the correct sequence was swabber, then wormer, is considered to be based on what happened at the time, and not what necessarily had been practised the day before. [2.1.1 and 2.3.1]
5. Management failed to ensure that the new gun captain fully understood the need for firm control of gun crew operations, and to provide adequate overall supervision of the demonstration. [2.1.2]
6. In an atmosphere heavy with expectation and excitement, as well as the team’s natural desire to produce a faultless demonstration in front of an invited audience, it is likely that enthusiasm overtook training, which resulted in loss of attention to the correct procedures. Nobody was in overall control to monitor the actions of the gun crew. [2.3.2]
7. Management failed to ensure that each and every crew member was aware of, and had read, the Training and Safety Manual and, particularly in the case of the gun crews, the section on gun drill. [2.5.3]

SECTION 4 - RECOMMENDATIONS

Grand Turk's master is recommended to:

1. Follow the advice given by the Keeper of Artillery, Royal Armouries, on the correct procedures and training for the safe operation of period gun drill, as stated in his documents *Blank Firing on Grand Turk* and *Muzzle Loading Gun Drill*.
2. Ensure that all crew members involved in gun drill are fully conversant with the recommendations on safe operations of cannon firing, as advised by the Keeper of Artillery, Royal Armouries, and that all gun captains are aware of their command responsibilities for both their own safety and that of their gun crew.
3. Review the current construction of the black powder cartridges, immediately. Either suitable cloth or paper should be used in place of plastic bags. Guidance on this issue is to be obtained from the Keeper of Artillery, Royal Armouries.
4. Ensure that the vessel's Training and Safety Manual is available to all members of the crew, and that the vessel's standing orders include the mandatory reading of the manual.

Grand Turk's owner is recommended to:

5. Ensure that the training and operation recommendations of the Keeper of Artillery, Royal Armouries, are put into immediate effect by the master, together with the recommendations on the construction and use of black powder cartridges.
6. Monitor, at regular intervals, the standard of gun drill training, to ensure that suitably qualified and trained gun captains are always present during live firing.
7. Consider the use of a designated safety officer to oversee firing demonstrations.
8. Implement a regime whereby all under-age volunteers provide a signed letter of agreement from their parents, and a letter from their GP stating that they are fit to carry out normal shipboard duties.

Interim recommendations were published in the MAIB Safety Bulletin 1/2001, concerning safety shortcomings in relation to the cannon-firing procedures practised on board *Grand Turk*. These can be seen in **Annex 3** of this report.

**Marine Accident Investigation Branch
April 2002**

Training and Safety Manual - GUN DRILL 9LB CANNONS

Grand Turk

Training / Safety Manual



GUN DRILL 9LB CANNONS

1. All pre-made charges to be kept in the magazine, these charges to be brought to the gun deck [by a licenced crew member] immediately prior to loading the cannon in a fire proof box.
2. The cannon is pulled back until the breach lines are tight.
3. The inhaul is made fast.
4. Remove the lead vent patch and insert pricker in vent hole.
5. Check the inside of the gun for foreign objects and visually observe the pricker.
6. Insert in the muzzle end [400g] pre made charge.
7. Using rammer push charge towards breach end of the cannon until a movement is felt on the pricker.
8. Remove the pricker from the vent hole and seat the charge on the breach.
9. Insert soft rag wadding in the muzzle end and using rammer push to the breach end and compact the wadding.
10. Run the cannon out .
11. Prick the charge using a non ferrous pricker .
12. Prime the vent and flash pan.
13. Check all clear in front of the cannon.
14. Call "Stand Clear", "Firing".
15. Fire the cannon.
16. After recoil make fast in haul
17. Insert wormer to the breach end rotate and withdraw.
18. Serve the vent.
19. Insert saturated swabber push to breach end rotate and withdraw.
20. Cease serving the cannon.
21. Insert pricker in vent hole , continue drill as from item 6 above.

NOTE : if the cannon is not to be fired immediately the charge is NOT pricked and the vent and flash pan are NOT primed the lead vent patch be replaced and secured.

The powder for priming to be dispensed from the powder horn and when not in use kept in the fire proof box.

Keeper of Artillery - BLANK FIRING ON *GRAND TURK*

BLANK FIRING ON *GRAND TURK*

The following observations should be read in conjunction with a copy of my specimen muzzle loading gun drill.

- Gun tube. The guns of *Grand Turk* are composite Smooth Bore Muzzle Loaders. I am informed that the construction is of cast aluminium on steel tube; I have not used guns of this construction and I cannot comment on their condition or their suitability for firing. The blank charge being fired is not large for the size of gun so it is unlikely that the tubes are under any great strain. Some sort of independent inspection should be carried out at regular intervals to ensure that such a gun is still 'in proof'. It is good practice to keep a record of number of rounds fired from each gun if possible. In any case, but especially in a marine environment, the following is essential after firing: very thorough fresh water washing of the bore, using a stiff brush [originally known on land as a 'brush, piasaba' – much like an old-fashioned lavatory brush but fitting the bore and mounted on a suitable stave] as well as with the sponge, brushing out of the vent [with something like a pistol cleaning brush] and washing. When dry, if a gun is not to be used for some time, the bore should be oiled or treated with some such product as 'Waxoyl', fitted with a tampeon and a greased piece of tow put into the vent, then covered with the 'apron of lead'. It is especially important, since the method used for closing the barrel tube at the breech end is not apparent on the *Grand Turk* guns and corrosion can set in here, that the cleaning procedure is rigorous. If cavities here were left during manufacture or have formed subsequently due to corrosion, they could hold debris from powder charges and their cartridges. This could cause premature ignition on reloading. However, I think it is unlikely that this was the cause of the recent accident.
- Order of operations. The statement given by the crew show that, on this occasion, worming was carried out after the sponging. This kind of mistake serves as a reminder for the need for periodic review of procedures and for vigilance on the part of the gun captain and/or safety officer. Both historically and now, the procedure is first to worm the gun, using a worm of effective form and size, then to sponge. This is done even before the first round to ensure a clear bore. Two sponges may be used – dry and wet; in any case the very first sponging should be done dry or damp.
- Sponging. During gun firing, the sponging is of great importance. The sponge should not be too wet as this can cause a misfire or hangfire. The sponge needs to be fully home to the breech face and rotated firmly in both directions, ideally a full turn each way. The sponge must be visually inspected for signs of debris and/or unburned powder and repeated until satisfactory. If two sponges are available, one can be used wet and then sponging finished with the dry. Sponges should be washed thoroughly after cease firing and kept free of grit. Canvas covers for the sponge heads were often supplied.
- Cartridges. It seems to me that polythene or similar plastic material and heavy duty tape such as carpet or 'duck' tape present unnecessary problems. Such a cartridge is unlikely to be consumed fully on firing and its residue tends to be sticky and difficult to remove and might harbour unburned and smouldering remains of the powder charge. Suitable cloth or paper was commonly used. In either case, the cartridge should be formed to fit the bore of the gun easily but not too slack. It should approximate to a cylinder in shape, with a circular base (the forward end can be of any convenient form) and thus should sit firmly against the breech face and snug against the bottom of the vent. In firing small charges from large bores, it is sometimes difficult to make the cartridge of a suitable size and firmness. I have found that increasing the size of the cartridge by adding dry sawdust is useful, so long as the powder remains at the base of the cartridge and that, of course, it is loaded into the gun the right way round. The sawdust provides a useful wad, but there is no objection to loading another wad separately for effect.
- Ramming. The cartridge should be pushed home, not actually 'rammed'. If wadding is then loaded it should be pushed home in the same manner. It may then be seated with two or three firm strokes. The wearing of stout leather gauntlets for the ramming number is recommended but not universally observed on land. They can give worthwhile protection in the case of a premature. Wadding material on land was often hay but both on land and naturally at sea, oakum was used also. As mentioned above, sawdust can be used. Damp sand should not be used.
- Serving vent. The drill practised at the Royal Armouries is intended to be easy to learn and remember, based on the simple principle of serving the vent the whole time that the cleaning and loading actions are taking place. In other words, the vent is served before the worm enters the bore and this continues until the gun number approaches with the pricker to commence the priming sequence. I cannot see difficulty in ascertaining, by careful use of the rammer, that the charge is seated at the breech. In any case, if by some chance the charge is not fully home, this will be

revealed when pricking: the pricker will not make contact with the charge. Unless the vent server is wearing stout leather gloves, s/he should wear a thumbstall and serve by pressing the thumb firmly on the vent throughout. No sound of air escaping should be heard. If the sponge proves hard to manipulate due to air pressure two crewmembers should handle it together. The vent should be frequently cleaned using a small brush eg a .22 pistol cleaning bronze wire brush. This can be done after each firing before worming.

- Command. It can be useful to have a safety officer present who has no part in the gun drill. However, the experienced gun captain can exercise this role satisfactorily. Even when a safety officer is present, it remains the duty of the gun captain to ensure the proper performance of all stages of the drill and to be responsible for the safety of the crew and himself. He must be satisfied that the members of the crew know their duties. He must see that the drill is not carried out without undue haste and is stopped if necessary, even when under pressure from sponsors, spectators etc. to perform. Any failure to serve the vent must be corrected immediately, normally by the gun captain [eg by the sharp order 'Serve the vent! Mr...], but the safety officer or any member of the crew must shout 'Stop' [or agreed warning] if necessary to ensure that any failure to serve is corrected before the drill proceeds.
- Misfire drill. An agreed misfire procedure must be known by all the crew.

Preliminary conclusions

This accident seems to have occurred as a result of the unfortunate combination of a number of factors. As stated above, I think it is unlikely to have been caused by a defect in the gun tube. It is not in my view at all likely that grit or the mere speed of ramming caused a spark or sufficient heat to ignite the charge, even if ruptured in the bore. The relevant factors seem to me as follows:

- Failure to remove all debris of the previous firing.
- Cartridge material difficult to remove.
- Haste in reloading. Reloading after firing a ML gun is recognised to be the most dangerous part of the drill and the longer the pause between rounds the better.
- Failure to serve vent adequately. It is impossible to say whether serving the vent properly would have prevented this particular premature but it is always considered an essential precaution. This is because the possibility of embers remaining from the previous round cannot be ignored even though thorough drill should make that very unlikely.

Recommendations

- Change of cartridge material
- Revision of gun drill and re-training
- Time between firings to be increased

**NICHOLAS HALL
KEEPER OF ARTILLERY**

Safety Bulletin 1/2001

MAIB SAFETY BULLETIN 1/2001

Accident to crew member on board

Grand Turk

while alongside in HM Dockyard, Portsmouth

on 24 August 2001

Issued October 2001

MAIB SAFETY BULLETIN 1/2001

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

The *Merchant Shipping (Accident Reporting and Investigation) Regulations 1999* provide for the Chief Inspector of Marine Accidents to make recommendations at any stage of an investigation if, in his opinion, it is necessary or desirable to do so.

The Marine Accident Investigation Branch (MAIB) is carrying out an investigation of the premature ignition of black powder in a muzzle-loading cannon, and the subsequent injury to a crew member on board *Grand Turk* while alongside in HM Dockyard, Portsmouth on 24 August 2001. The MAIB will publish a full report on completion of the investigation.

The MAIB's initial inquiries have shown evidence of safety shortcomings in relation to the cannon-firing procedures practised on board this vessel, and in particular to the safety of gun crew members.

These concerns relate to :

- Changes in the construction of the black powder cartridges
- Gun drill and training
- Time between firings.



J S Lang
Rear Admiral
Chief Inspector of Marine Accidents

SAFETY RECOMMENDATIONS

Background

Grand Turk, a 26-cannon, three-masted frigate built in 1997 in the style of vessels circa 1791, was moored alongside the north wall of HM Dockyard, Portsmouth while acting as a private guest ship during the International Festival of the Sea.

One of the pre-arranged activities on *Grand Turk* was cannon fire firing a blank charge of black powder in one of the 9-pound reproduction cannons. On Friday 24 August 2001, all six 9-pound cannons on the port side were loaded and wadded, but not primed. At 1200, the noon cannon was fired. The reloading process started immediately in the following manner:

A wet sheepskin swabber was inserted in muzzle of cannon and pushed to breech before being removed.

A wormer was then inserted in muzzle, pushed to the breech, rotated, and withdrawn.

A 400gm charge was then inserted in the muzzle and pushed to the breech by the rammer.

Before the rammer could be removed, the black powder charge ignited prematurely, causing the rammer to be ejected with some force from the cannon, striking a crewman's left hand. The use of the wormer after the swabber is thought to have uncovered burning material, which subsequently ignited the charge.

The crewman's injuries resulted in the loss of his little finger down to the knuckle, as well as serious damage to the middle finger of his left hand.

Safety Recommendations

***Grand Turk's* master is recommended to:**

1. Follow the advice given by the Keeper of Artillery, Royal Armouries, on the correct procedures and training for safe operation of period gun drill, as stated in his documents *Blank Firing on Grand Turk* and *Muzzle Loading Gun Drill*.
2. Ensure that all crew members involved in gun drill are fully conversant with the recommendations on safe operations of cannon firing, and that all gun captains are aware of their command responsibilities for the safety of themselves and their gun crew.
3. Review the current construction of the black powder cartridges immediately. Either suitable cloth or paper should be used in place of plastic bags; guidance on this issue to be obtained from the Keeper of Artillery, Royal Armouries.

***Grand Turk's* owner is recommended to:**

1. Ensure that the training and operation recommendations of the Keeper of Artillery, Royal Armouries, are put into immediate effect by the master, together with the recommendations on the construction and use of black powder cartridges.
2. Monitor, at regular intervals, the standard of gun drill training to ensure that suitably qualified and trained gun captains are always present during live firing.