



NO. 94-108

PLEASANT POINT RAILWAY

PLEASANT POINT

13 MARCH 1994

ABSTRACT

On 13 March 1994, a tubular glass sight gauge in the cab of a restored steam locomotive broke, discharging steam and oily water from a lubricator. The fireman fell from the cab and received severe injuries. The locomotive was operated by the Pleasant Point Railway and Historical Society, at Pleasant Point. The safety issue identified in this investigation was the need to replace sight glass tubes on old steam locomotives with modern borosilicate glass, and placing a screen in front of the tubes to deflect any discharge away from persons in the cab.

TRANSPORT ACCIDENT INVESTIGATION COMMISSION

RAIL ACCIDENT REPORT NO. 94-108

Train Type and Number:	Restored steam locomotive passenger train
Locomotive:	D16
Date and Time:	13 March 1994 1325 hours
Location:	Pleasant Point
Type of Occurrence:	Fireman fell from locomotive
Persons on Board:	Crew: 3 Passengers: Nil
Injuries:	Crew: 1 fatal Passengers: Nil Others: Nil
Nature of Damage:	Sight glass on lubricator broken
Information Sources:	Transport Accident Investigation Commission field investigation
Investigator in Charge:	Mr W J D Guest

1. NARRATIVE

- 1.1 The Pleasant Point Railway and Historical Society restores old locomotives and other items of rolling stock, and preserves railway memorabilia. The Society owns a short stretch of track which was once part of the Fairlie Branch of New Zealand Railways. At the eastern end of the track at Keanes Crossing the Society has built its headquarters and workshop, while at the western end, approximately 1.6 km away, the Society has acquired the former Pleasant Point Railway Station. As part of its activities, the Society occasionally runs restored locomotives and carriages along its track to give the public the opportunity to ride in an old-fashioned style.
- 1.2 On Sunday 13 March 1994 the Society planned to use locomotive D16 for such an excursion.
- 1.3 D16 is a small steam locomotive built in Scotland in 1878. After service with New Zealand Railways, it was sold to New Zealand Refrigerating Ltd in 1918 and was used at the Pukeuri Freezing Works until 1973. The Company preserved it at Pukeuri until 1985, when it donated the locomotive to the Pleasant Point Railway and Historical Society.
- 1.4 The Society restored D16 to working order, and obtained a boiler certificate for it. The Society also had strict rules about the operation of the locomotive, and required the engine driver to have complied with the relevant sections of the Boilers, Lifts, and Cranes Act 1950 concerning training and examination.
- 1.5 On 13 March 1994, the engine driver fired the boiler in the morning in time for the afternoon's activities which were to commence at 1330 hours. He was assisted by a fireman. By 1300 hours the steam pressure was normal (150 psi), and the engine driver turned on the steam to the lubricator, ran the locomotive out of the shed, coupled it to the train (a wood wagon, two carriages, and a guard's van) and undertook a brake test. All functions on the locomotive worked normally.
- 1.6 The lubricator was a device which supplied a small quantity of oil into the steam to the cylinders to reduce wear and corrosion inside the cylinders. The oil was fed through two small jets at the bottom of two glass tubes full of water from the boiler. Steam playing across the surface of the water at the top of the device atomised the oil and carried it into the cylinder. The amount of oil passing through the jets was adjustable by valves, and the engine driver and fireman could see how much oil was being used by counting the rate at which drops floated upwards through the sight glasses. Photographs of the lubricator, and of its location in the cab are shown as Fig. 1 and Fig. 2.
- 1.7 At 1320 hours, D16 left the Society's depot at Keanes Crossing and headed towards Pleasant Point Station, working up to its normal speed of 15 mph (25 km/h). The engine driver and fireman were in their usual positions. The engine driver was standing on the right hand side of the cab, while the fireman was standing on the left hand side.
- 1.8 At 1325, when the train was about halfway towards Pleasant Point Station, the lubricator oil level sight glass on the fireman's side broke without warning. Steam and oily hot water blew into the cab, directly towards the upper chest and face of the fireman.
- 1.9 The engine driver heard the noise of the escaping steam and water, and looked to his left. The steam formed a cloud which obscured his vision, but he saw the fireman disappear out of the doorway. Realising that something was wrong and that the source of the steam was the lubricator, he closed the throttle and then closed the isolating valve for the lubricator. He applied the brakes and stopped the train.

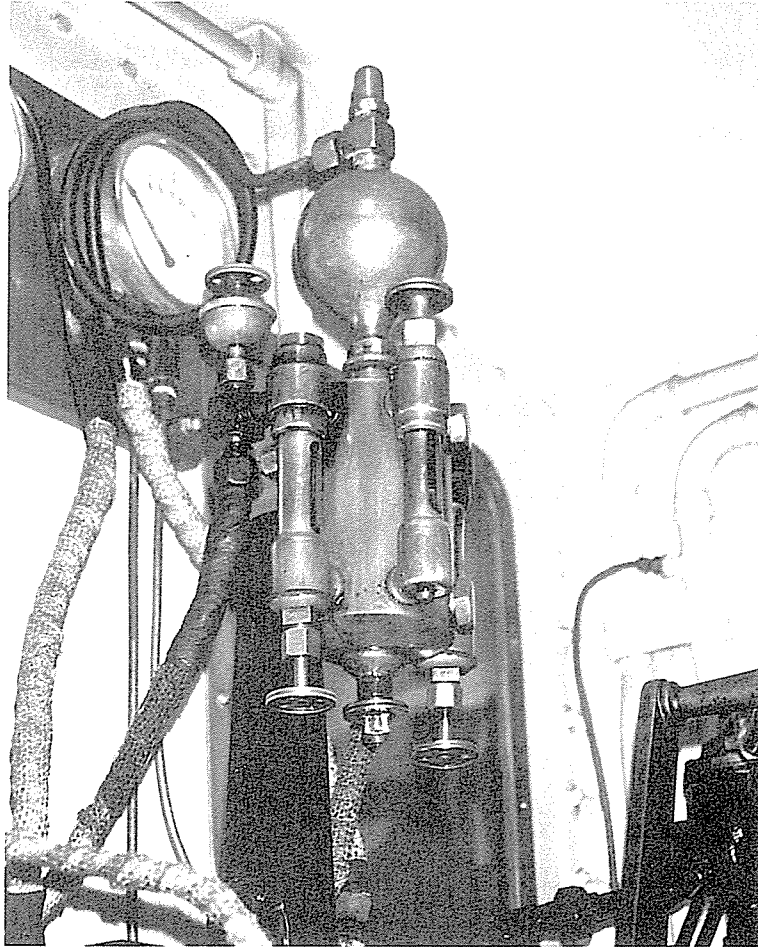


Fig 1: The Nathan Sight-Feed Condensation Lubricator.

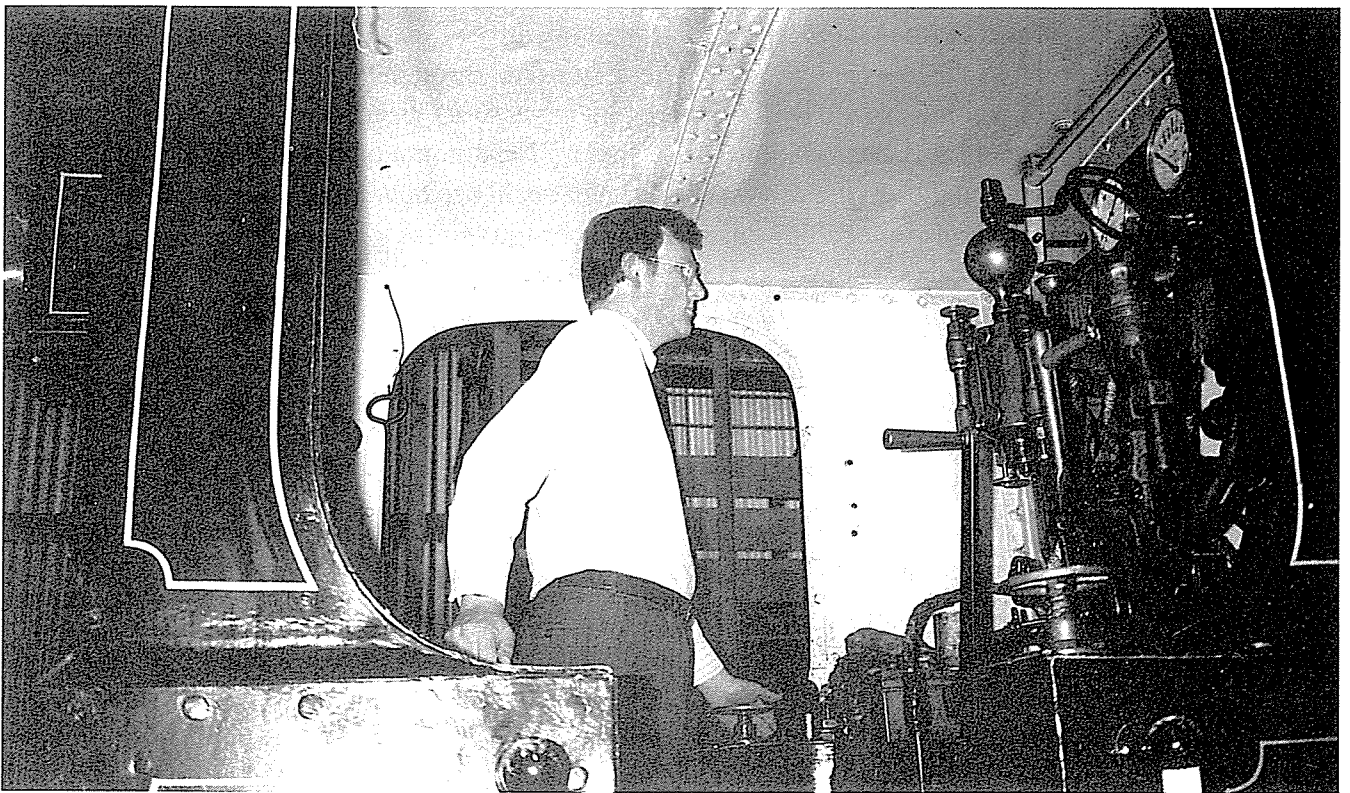


Fig 2: The normal position of the Fireman in the cab of D16.

- 1.10 The engine driver crossed the cab and looked out. The fireman was lying on the ground near the track behind the train. The engine driver returned to his position, blew the whistle three times (which was the Society's emergency signal) to attract the attention of staff at Pleasant Point, wound on the handbrake and went to give assistance.
- 1.11 The guard saw the fireman on the ground as the train went past. He did not know that it was the fireman, but realised that there had probably been an accident, and he pulled the emergency stop lever. He then noticed that the train was already stopping.
- 1.12 It was evident to the driver that the fireman was seriously injured, and he asked a nearby resident who had heard the emergency whistle and had come to the site to call an ambulance. A member of the Society who was on duty as a crossing keeper arrived in his car, and was sent to Pleasant Point Station to alert the first aid staff of the accident.
- 1.13 The Society had a policy of having a qualified first aider on duty on any open day. The person on duty on 13 March was a member of the St John Ambulance Brigade. He was driven immediately to the accident site and commenced first aid. He continued to assist the ambulance staff and eventually drove the ambulance to Timaru Hospital while the staff took care of the fireman.
- 1.14 The fireman had not been burned or scalded by the discharge from the lubricator. He had fallen from the cab of the locomotive and sustained serious head injuries. He was transferred to the intensive care unit at Christchurch Hospital but died a few days later.
- 1.15 After an inspection, the train was reversed to the depot and D16 was shut down pending an investigation into the accident.
- 1.16 The lubricator was a "Nathan Sight-feed Condensation Lubricator". Its origin is uncertain, but a book "Lubrication of Locomotives" (Ahrons, E.L.; London: The Locomotive Publishing Co. Ltd., undated but circa 1919) states "...the Nathan is in extensive use in America and also on the continent of Europe". The book describes only one model of the Nathan lubricator, but it is known that there were later versions also bearing the name "Nathan". Several of the early type on D16 are still in existence on restored steam locomotives in New Zealand.
- 1.17 This model of the Nathan lubricator has tubular sight glasses but no external safety shield. No data was available on the frequency of sudden failure of the glasses in service, but no anecdotal evidence of any unexplained breakage could be found.
- 1.18 The Society had been in contact with the engine driver who operated D16 at Pukeuri for 27 years, and members of the Society had a further ten years experience. No-one could recall a similar event.
- 1.19 New Zealand Railways owned and operated an F class locomotive with a Nathan lubricator from 1881 until it was gifted to the Railway Historical Trust in 1993. There was no record of sudden breakages of the sight glasses in service, and no external shield over the glasses.
- 1.20 There is no New Zealand, foreign, or international standard specification or code of practice for steam locomotive lubricators. There are standards and codes of practice for boilers and boiler fittings, but a lubricator is an instrument which uses steam and water from a boiler, and is not a boiler fitting.
- 1.21 However, some guidelines can be extrapolated from relevant standards. British Standard 759: "Valves, gauges, and other safety fittings for application to boilers and to piping installations for and in connection with boilers—Part 1: Specification for valves, mountings, and fittings" requires (in clause 19.1) the following for tubular water level gauges:
- "...the glass [of which] shall comply with BS 3463"
- "Where tubular water level gauges are fitted, effective protection shall be provided which shall not obstruct the reading of the gauge".

1.22 British Standard 3463:1975 “Specification for observation and gauge glasses for pressure vessels” was adopted as New Zealand Standard 5301 in 1977. The 1975 edition of this standard is a revision of the first edition issued in 1962. Prior to 1962 there was no British or New Zealand standard for observation and gauge glasses on pressure vessels.

1.23 There was no statutory or regulatory requirement for the sight glasses on D16 to be upgraded to comply with the 1975 version of the standard. The locomotive had been built prior to the first edition of the standard, and the sight glasses had not been identified as a safety problem requiring a change by regulation. However, a modern standard generally incorporates recent good practices on the basis of experience of service life and quality, and the recommendations of BS3463:1975 were used as a basis for assessing the sight glasses in use in the lubricator on D16.

1.24 The foreword to the code outlines changes made since the 1962 edition. A relevant change was “The use of soda-lime glass for tubular glasses is ... no longer permitted”. The preferred material for sight glass tubes is borosilicate glass.

1.25 The foreword also said: “Attention was drawn to the requirements of the [UK] Factories Act 1961 Section 32(2)(d) in relation to protector glasses for gauge glasses”. While this section was not repeated in full, it may be inferred from the rest of the standard that the UK Factories Act requires protector glass over tubular sight glasses. The standard sets out a specification for protector glasses: ½" thick toughened glass, with bevelled edges.

1.26 Clause 8 of the standard requires that the cut ends of the tubes should be “fused and flame cooled to prevent severe ring stress”.

1.27 Boiler water level sight glasses on steam locomotives are usually tubes, and are widely recognised as prone to sudden breakage. In most steam locomotives, they are covered by plate glass safety shields. The shields are commonly ¼" toughened glass rather than the ½" thickness required in the latest version of BS 3463, but they have been successful in more than a century of service.

1.28 The parts of the broken tubular sight glass were recovered from D16. It was apparent that the ends of the tube had not been fused, and the maker of the glass could not be identified.

1.29 The engine driver and other staff of the Pleasant Point Railway and Historical Society did not believe that the sight glass had been subjected to any unusual mechanical or thermal shock.

1.30 Glass is prone to breakage if microscopic defects or surface scratches develop. It would have been possible for a minor scratch to have occurred on the surface of the sight glass during routine maintenance or cleaning in the locomotive cab. A small scratch may not be visible to the naked eye, but can still be the point from which a break will propagate at a future time.

1.31 No door or restraint device such as a chain was fitted to the exits of the cab of D16. They have not been fitted to steam locomotives because engine crews may have to leave the cab quickly if a problem occurs with the firebox or a boiler fitting. The discharge that occurred in D16 was the type of event that necessitated a quick exit.

2. FINDINGS

2.1 The steam locomotive D16 had been restored to original specifications and was in good working order, with a current boiler certificate.

2.2 The engine driver was properly trained and held a valid permit to operate D16.

- 2.3 The fireman was experienced in the operation of D16, although he did not hold a permit to drive it.
- 2.4 The engine driver and fireman followed correct procedures in firing D16 and preparing it for work.
- 2.5 D16 was travelling at approximately 15 mph (25 km/h) when the lubricator oil level sight glass on the Nathan lubricator broke, discharging steam and oily water towards the fireman.
- 2.6 The sight glass failure was probably due to an undetected crack or flaw of unknown origin.
- 2.7 The fireman fell from the cab, probably as a result of the fright or start caused by the sudden discharge from the lubricator, and was seriously injured.
- 2.8 It was tragic that the fireman was critically injured by falling from the cab, but this accident does not justify the fitting of doors or restraints at cab exits.
- 2.9 The staffing and safety procedures of the Pleasant Point Railway ensured that qualified first aid assistance was quickly available.
- 2.10 The Nathan lubricator was not designed to have a safety shield in front of the tubular sight glasses.
- 2.11 The Nathan lubricator (and others like it) had given long service without sudden failure of the sight glasses.
- 2.12 Modern practice is to use borosilicate glass for tubular sight glasses on boiler fittings, with the tubes correctly treated by expert technicians after cutting.
- 2.13 Borosilicate glass was not available when the Nathan lubricator was designed.
- 2.14 Modern practice is to place a glass safety shield over tubular sight glasses on boiler fittings as a precaution against sudden failure.
- 2.15 The Nathan lubricator was not a boiler fitting in terms of any code of practice, but the water in it was condensate under boiler steam pressure.
- 2.17 If a safety shield had been fitted in front of the sight glasses, the discharge from the broken glass would not have ejected directly towards the fireman, and he may not have fallen.

3. SAFETY RECOMMENDATIONS

- 3.1 As a result of this investigation, it was recommended to the Pleasant Point Railway that they:
 - 3.1.1 Replace the tubular sight glasses in the Nathan lubricator of locomotive D16 with borosilicate glass tubes that comply with or a similar to the specifications contained in NZS5301:1977, and have been heat treated to relieve the stresses caused by cutting (048/94); and
 - 3.1.2 Install a screen in front of the tubular sight glasses on the Nathan lubricator similar in design to the screen provided for boiler water level sight gauges on most steam locomotives (049/94).

- 3.2 The Pleasant Point Railway advised that the sight glass tubes have been replaced with borosilicate glass, and that a safety shield will be designed and installed.
- 3.3 It was recommended to the Land Transport Safety Authority that:
- 3.3.1 They advise all operators of steam locomotives of the need to use borosilicate glass tubes in sight gauges, with all such gauges to have a safety screen in front of them (050/94)
- 3.4 The Land Transport Safety Authority responded:
- “We agree with your recommendation that operators of steam locomotives use borosilicate glass tubes in sight gauges. However the Authority would like to seek operators comments regarding the installation of a safety screen.”*

12 October 1994

M F Dunphy
Chief Commissioner