



CORONERS COURT OF QUEENSLAND

FINDINGS OF INVESTIGATION

CITATION: **Non-inquest findings into the death of Troy Ronald Hooper**

TITLE OF COURT: Coroners Court

JURISDICTION: Brisbane

DATE: 11 July 2017

FILE NO(s): 2012/3854

FINDINGS OF: Christine Clements, Brisbane Coroner

CATCHWORDS: CORONERS: Work place related death, camper trailer manufacturer, prototype boat rack, gas strut explosion, penetrating head injury, Issue with prototype design, risk assessment, training, supervision, staff qualifications and quality of gas strut.

Background

1. Troy Ronald Hooper lived at Defiance Road, Woodridge in Queensland with his partner and children. He died on 23 October 2012 in the Princess Alexandra Hospital. He was 24 years of age at the time of his death. He died due to a penetrating head injury sustained in an industrial accident at his workplace.
2. A full Workplace Health and Safety (WH&S) investigation was therefore conducted concerning Mr Hooper's death. WH&S investigators attended the scene immediately following the incident where police were also onsite. As part of the WH&S investigation, a number of witness statements were obtained, relevant items were seized and expert advice was sought.

Circumstances surrounding the death

3. Mr Hooper was employed as full time labourer by VH & MG Imports Pty Ltd, now known as Market Direct Group Pty Ltd (the Company). On or about 22 June 2012, Mr Hooper was inducted into the Company workplace and systems of work.
4. The operations of the Company involved manufacture and assembly of camper trailers. The Company imported trailers in bulk from a Chinese company (Wuxi Jinrong Machinery Co Ltd). The Company then manufactured and assembled various components to convert the trailers to camper trailers for sale to the public. The Company operated from a premises at Boundary Road in Coopers Plains.
5. In or about October 2012, the Company sought to develop a prototype boat rack for display at a camping show. This was to be a folding boat rack to be placed on top of the Company's standard 7 x 4 camper trailer. The Company foreman had commenced research options for the project approximately two weeks prior to the incident.
6. On 22 October 2012, the Company employed RB to assist in building the prototype. RB was a self-taught welder who had worked in that industry for six or seven years. RB provided a resume which stated that he had five years' experience with a manufacturer which fabricated folding boat racks for caravans and camper trailers. RB said that it had been designed before RB started at that workplace but he was involved with improvements to various products over the five year period.
7. The Company believed that RB was capable of designing and manufacturing folding boat racks from start to finish. RB was concerned that his skills and experience had been over-estimated since he was not a qualified worker and had never designed anything from scratch. In any event, RB was hired and was not inducted into the Company's workplace or its systems of work but was immediately tasked with fabricating the boat rack.
8. RB and the foreman talked about mounting the rack on the trailer in the best position and it was then left to RB to take the measurements. RB developed some basic measurements taking into account the clearances and basic size of boat frame. They searched on the internet to find out the size of the boat to be positioned. RB drew up a rough sketch and the foreman told him to use 40 x 40 steel which RB then welded into a frame. By the end of the day RB had completed the boat top frame and the frame that joined it to the camper trailer.

9. No risk assessment was undertaken on the work activity of designing, fabricating and attaching the boat rack to the camper trailer. No engineering plans, or drawings, or calculations were produced by any competent person for either the design of the boat rack frame, or the appropriate position for attachment points of the struts.
10. The next day, RB and the foreman began attaching the gas struts used to operate the boat rack. The foreman was experienced in using gas struts to lift heavier weights than those required by the boat rack operation. The foreman and RB opened and closed the boat rack to position the inner strut on the rack during which the welding on the boat rack cracked. Two inner struts were attached to the boat rack, and to the left side of the trailer front and back. The rack was re-welded and braced. An 85kg boat was then loaded on to the boat rack and they began opening and closing the rack.
11. At approximately 10:00am, the foreman contacted CW to attend the workplace, and to advise on placement and mounting of the struts on the folding boat rack. CW's company had supplied gas struts to the Company since 2011 and the struts supplied by CW were used by the Company to replace the Chinese struts provided with the imported camper trailers. The struts supplied by CW were of larger dimension (14mm shaft and a 28mm body) than the Chinese struts (10mm shaft and 22mm body) but the same pounds per square inch rating (2200 PSI).
12. The foreman and RB were working with Chinese struts. On arrival, CW advised on fitting a second pair of struts - outside the frame and facing in the opposite direction, and how to measure the arc necessary to allow the strut to close efficiently.
13. CW is a qualified boilermaker with 15 years in the industry. In that time he had gained extensive experience in gas struts, their various uses and had knowledge in relation to strut placement and their applications. CW also had knowledge of a number of 'don'ts' when working with gas struts:
 - Don't hit with a hammer,
 - Don't hit with anything else,
 - Don't lever the strut as this may cause damage to the strut, and impact its safe operation,
 - Don't weld in close proximity to the strut as gas in the strut may expand and compromise its integrity.
14. After CW left, the foreman and RB welded three bolts at different heights on the trailer and frame to determine the best position of the strut on the frame. Once the correct position was determined, and the strut attached, the remaining bolts were removed. The front outer strut, the third to be attached, was fitted. While RB then left, the foreman welded the bracing bracket between the strut and the boat rack.

15. The foreman instructed Mr Hooper and other co-workers to assist in testing the operation of the boat rack five or six times. These assistants loaded the boat on to the rack and strapped it down. The operation of the boat rack with boat on board was tested another five or six times.
16. At about 7:00pm, with further work still to be done on the boat rack, the assistants were instructed to remove the boat and assist with removal of the struts. They were instructed to hold the frame at a particular angle to facilitate easy removal of the struts. This placed the struts in a fully extended position. The upper and lower struts at the rear of the trailer were removed.
17. To loosen the lower strut on the front of the trailer, the foreman used a hammer to tap the strut and the claw of the hammer to lever it over the thread of the bolt welded to the frame. As the foreman was tapping the strut with the hammer, he heard an explosion and saw Mr Hooper falling backwards. The foreman tried to prevent Mr Hooper's head striking the concrete.
18. The strut had exploded, the piston rod remaining attached to the trailer, and the cylinder striking Mr Hooper above the right eye. He suffered a penetrating injury. Despite emergency service and medical intervention, Mr Hooper died that evening.

Autopsy

19. Autopsy examination was conducted on 24 October 2012 by forensic pathologist, Dr Milne. Examination was limited to external, imaging and review of medical records and toxicology testing.
20. CT imaging showed a near circular defect in the medial aspect of the left supraorbital ridge (around the eye). There were comminuted fragments of bone. There was no exit wound. There was a subarachnoid and intraventricular haemorrhage observed on imaging. Toxicology testing of samples taken at 2000 hours at the hospital were negative for alcohol and drugs.
21. Dr Milne concluded Troy Ronald Hooper died due to penetrating head injury as a consequence of the industrial accident.

Safety alerts released by Workplace Health and Safety

22. Following Mr Hooper's death, WH&S issued two public safety alerts (on 26 February 2013 and 19 April 2013) to highlight the potential risks associated with the use of gas struts.
23. These alerts outline the main ways in which gas struts fail, namely:
 - Most failures are due to a gradual loss of pressure to the gas which results in the strut being unable to support the load. The risks are that the component being supported will gradually creep down or drop without warning; and

- Struts can also fail if they have been internally damaged (for example by forced over-extension). There is a risk that the structure maintaining the gas pressure could give way and, with the sudden loss of restraining force, result in parts being ejected at high speed. In this instance, anyone in the area is at significant risk of severe injury or death due to the force of the impact.

24. WH&S warned that gas struts are usually installed or removed by hand which means that workers are very close to this potential hazard.

25. They also advised that it is not always possible to know if a gas strut is damaged internally before removing it. It may appear to be operating normally, but the removal process may trigger a failure, causing an explosive ejection of parts. Care must be taken to manage the risks presented by damaged struts.

26. WH&S warned that gas struts may fail for a range of reasons, including:

- Inappropriate design of the gas strut configuration (e.g. poor geometry subjecting the strut to over-extension, over-compression or side loading);
- Inappropriate use (e.g. incorrect application or overheating); and
- Physical damage (e.g. from corrosion, wear, collision, leakage or misuse).

27. WH&S recommended a number of actions:

- The person conducting a business or undertaking (PCBU) who installs or removes gas struts should review their operating procedures to determine whether risks from the failure of gas struts are adequately controlled;
- The PCBU should ensure all people installing or removing gas struts are appropriately trained;
- The work area should be isolated from workers and others not involved in the installation and removal procedure;
- Workers should wear appropriate personal protective equipment;
- The gas strut configuration should be designed by a competent person and in accordance with the manufacturer's recommendations, including design, operation, orientation, load capacity and geometry;
- Gas struts should be installed and removed by a competent person in accordance with the manufacturer's recommendations. This may require the use of special tools;
- Gas struts should be protected against over-extension, side loading and excessive heat;
- Do not weld or apply heat to struts or adjacent areas as they may explode;
- Do not dispose of gas struts in fires as they could explode;
- Maintain a safe distance from burning vehicles due to the risk posed by exploding struts;
- Do not crush or puncture pressurised struts. Seek the manufacturers' advice about appropriate methods of depressurizing; and
- Additional advice about the installation and removal of gas struts can be found in the manufacturer's instructions.

Initial Expert Advice

28. In August 2013, an expert report was obtained from an engineer who is the Senior WH&S Advisor (mechanical). In preparing the report, the expert inspected the trailer, the incident strut and conducted tests. Tests were conducted to determine if it was possible for a gas strut to fail from over extension and result in the cylinder being ejected at high speed.
29. Tests were also conducted to determine if the piston could be pulled off from the rod when the strut was subjected to over extension. In most cases the seal failed first. However, in two cases the piston did separate from the rod before the seal failed. It was found that the cylinder could be ejected at high speed if the gas strut was over extended.
30. The report concluded the incident occurred in the context of difficulty in removing the strut. The expert considered the calculations and measurements that showed the position of the mounts caused the strut to be overextended.
31. The expert made the following conclusions:
 - The geometry of the frame resulted in a significant tensile load being applied to the strut from overextension;
 - The strut was over extended when the frame was rotated through its range of motion. The over extension applied a tensile force to the strut tending to pull the piston off the rod when the strut reached the limit of its stroke. The failed strut was contained by the mounting points when it was on the frame and consequently appeared to function normally;
 - Once the piston had separated from the rod, the rod and cylinder were free to separate completely due to the extension force of the strut. When the worker removed the top end (cylinder) of the strut from the mount it was no longer constrained and was ejected at high speed striking him in the head causing his injury. The ejection of the cylinder occurred much quicker than normal extension without the slowing effect of the dampening force provided by the oil and gas passing through the holes in the piston.
 - This incident could have been avoided by designing the strut installation correctly;
 - The use of accurate drawings that show the arcs of the mounts of trigonometry to calculate them would have avoided over extension of the struts
 - The use of an installation tool to install pre-compressed struts and the placement of the mounting points to ensure the strut was always under compression would allow for variations in manufacturing tolerances and help prevent the occurrence of over extension even further; and
 - Consultation with a competent person or the strut manufacturer to ensure the design of the application was suitable for the struts would have prevented the incident.

The Workplace Health and Safety prosecution

32. On 4 February 2014, WH&S commenced a prosecution against the Company pursuant to section 32 of the WH&S Act. The following failures were alleged on the part of the Company:

- To develop safe work method procedures for workers carrying out the task of manufacturing and fabricating the boat rack prototype for attachment to camper trailers;
- To calculate the correct position of the struts to avoid overextension of the struts;
- To consult with a competent person or the strut manufacturer to ensure the design application was suitable for the struts;
- To provide adequate supervision to workers required to carry out the task of manufacturing and fabricating boat racks for attachment to a camper trailer; and
- To undertake any adequate risk assessment for the activity of manufacturing and fabricating boat racks for attachment to camper trailers, including the installation of struts in accordance with the Code of Practice 'How To Manage Work Health and Safety Risks' 2011.

33. WH&S said that control measures the Company could have implemented included:

- Undertake a risk assessment of the process of manufacturing and fabricating boat racks for attachment to camper trailers in accordance with the Code of Practice 'How To Manage Work Health and Safety Risks 2011', including the installation of struts, to ensure the risk, so far as reasonably practicable, from the hazards of using such struts was controlled;
- Preparing engineering plans of the boat rack, with calculations for the correct positioning of the struts;
- Preparing and instructing workers in safe work procedures for the use of gas struts;
- Utilising the services of a competent person to ensure the design application was suitable for the struts;
- Utilising the services of a competent person to ensure the struts were in good working order; and
- To provide adequate supervision to workers required to carry out the task of manufacturing and fabricating boat racks for attachment to a camper trailer.

34. During the proceedings, the Company and WH&S each sought their own expert opinion.

35. Both experts considered that the over-extension of a gas strut does not automatically result in exposure to a risk that the piston of the gas strut would explosively detach from the rod of the gas strut.

36. The absence of an 'o-ring seal' within the strut, which is a manufacturing defect, may have been a contributing factor to the piston and rod components of the strut separating. I note however that it is uncertain that the seal was in fact omitted during the manufacture. It is possible that seal may have been ejected during the failure.
37. All the experts agreed that the incident strut itself was of particularly poor quality and as a result, had very low tolerance for any kind of tension loading.
38. The mechanism by which the piston components of the strut were connected to the rod is a particularly poor one (either for that strut specifically or for that type of strut), meaning that the tensile forces required to separate the components were lower.
39. The incident strut generally was poorly designed as it did not incorporate 'fail-safe' design principles.
40. In the end it was accepted by the parties that:
- The strut involved in the incident explosively detached;
 - That it is more likely that the manner in which the struts were attached to the boat rack would be and were overextended;
 - The gas strut involved in the incident was of poor manufactured quality and had a particularly poor bond between the rod and the piston of the strut.
41. Both the experts indicated that failure of a gas strut in this manner is rare and neither had come across anything of this nature in the course of their extensive careers.
42. Her Honour Magistrate Tynan noted that the Company demonstrated its remorse in a number of ways. This included:
- All Chinese manufactured gas struts were disposed of immediately following the incident;
 - Production of the prototype ceased immediately upon the incident;
 - Contribution towards funeral costs; and
 - Co-operation with WH&S to facilitate statutory compensation entitlements.
43. Her Honour found that there was no question that the conduct of the Company in the fabrication of the prototype boat rack breached the WH&S Act and thus the duty of care owed to Mr Hooper. The absence of adequate drawings and specifications for a new design concept, the absence of adequate knowledge and training in key personnel of the appropriate operating conditions, the gas strut, and the fatal failure of the strut itself were considered to underpin the breach.
44. The fine imposed was \$90,000. She considered that the Company had otherwise been a good corporate citizen, and ordered that no conviction be recorded.

45. An appeal against sentence was heard in the District Court on 11 November 2016. The District Court delivered its decision on 17 March 2017. The appeal was granted and the original fine was increased from \$90,000 to \$125,000. The original decision was otherwise affirmed including the order not to record a conviction.

Further improvement actions taken by the Company

46. The Company subsequently advised the Coroners Court of Queensland:

- They rely on manufacturer's instructions and advice to install and remove gas struts and on information distributed by WH&S in relation to the accident and how to use gas struts correctly;
- They have invested in appropriate tools used in the application and disassembly of gas struts including sash clamps and hydraulic compression/release tooling;
- Gas struts are only attached to componentry via ball attachments, not using bolts (as involved in incident);
- All camper trailers are engineered using the latest available CAD Engineering and computerised Prototyping programs;
- All relevant staff are trained in the application and removal of gas struts;
- Training is reinforced through weekly Toolbox Meetings;
- Tools and safety equipment are provided for safe application and removal of gas struts; and
- The work area for installation and removal of gas struts is isolated from other work areas.

Information sought from Chinese Manufacturer

47. The Coroners Court also sought information from the Chinese Manufacturer in relation to the relevant conclusions reached by the experts. The Chinese company responded to say how sorry they were to hear of Mr Hooper's death.

48. The Chinese Company did not agree that the strut was of poor quality. They advised that there is a rubber 'o' ring in every piece. They considered it was a case of poor operation.

Conclusion

49. Mr Hooper's death was tragic and may have been preventable through:

- The use of adequate drawings and specifications for a new design as well as calculations to determine placement of struts to avoid over-extension;
- The development of a risk assessment and work method statement for the task of affixing the gas strut to the prototype;
- Engagement of an appropriate competent person to calculate, mathematically and geometrically, the correct attachment points for the struts;

- Ensuring that the struts were of good quality, fit for purpose and not subjected to over-extension; and
 - Training of key personnel of the appropriate operating conditions of gas struts.
50. In deciding whether to hold an inquest into Mr Hooper's death, public alerts which were released by WH&S have been considered. These were aimed at highlighting the potential risks associated with the use of gas struts.
51. The finalisation of the prosecution against the Company has also been taken into account.
52. The opinions of the experts are, that failure of a gas strut in this manner is rare. The application was not typical. Typically gas struts are not required to extend and compress during large arcs. They are normally used to extend fully over a smaller arc to hold open a lid for example.
53. The Company made a number of changes which may help improve work place safety in relation to the installation of gas struts. The holding of an inquest is therefore unlikely to provide any new information, or result in any recommendations being made.
54. In the circumstances it is not in the public interest to hold an inquest into this death.
55. The findings are also published on the Queensland Coronial website. The dissemination of information in this way is the most appropriate and likely means to raise awareness of such an unexpected death and thus help to prevent a similar death occurring in the future.
56. My sincere condolences are extended to Mr Hooper's family.
57. The focus of the coronial jurisdiction is to make the findings required by section 45 of the *Coroners Act 2003* (Act) where possible. There is sufficient evidence available to determine the cause of Mr Hooper's death as required by that section.
58. The formal findings required by section 45 of the Act are as follows:
- a) The identity of the deceased is Troy Ronald Hooper;
 - b) Mr Hooper was in the process of assisting to remove a gas strut from a camper trailer and boat rack prototype being developed by the Company. The strut was attached to both the camper trailer and boat frame by threaded bolts that had been temporarily welded in place.
59. Mr Hooper and his co-workers, were instructed to hold the frame at a particular angle to facilitate easy removal of the struts. This placed the struts in a fully extended position. The upper and lower struts at the rear of the trailer were removed.

60. To loosen the lower strut on the front of the trailer, the foreman used a hammer to tap the strut; and the claw of the hammer to lever it over the thread of the bolt welded to the frame. As the foreman was tapping the strut with the hammer, he heard an explosion and saw Mr Hooper falling backwards. The strut had exploded, the piston rod remaining attached to the trailer, and the cylinder striking Mr Hooper above the right eye.
61. Mr Hooper sustained a penetrating injury to the skull with one section of a gas strut entering the left frontal region of the skull near the eye. Ambulance officers were called and attended the scene at 1909 hours. Mr Hooper was in cardiorespiratory arrest and was resuscitated and developed spontaneous cardiac activity. He was transported to the Princess Alexandra Hospital. A CT image of the head showed the foreign body entering the left frontal region near the eye. The tip of the object abutted the top of the skull. Extensive haemorrhage on the surface of the brain and the spinal cord (subarachnoid haemorrhage) was observed.
62. Neurosurgical and intensive care assessment was conducted but no treatment to remedy the injury could be performed. Mr Hooper was declared deceased and the strut was removed by a neurosurgical doctor.
- c) Mr Hooper died due to penetrating head injury *due to or as a consequence* of the industrial accident.
 - d) Mr Hooper died at 23:16 on 23 October 2012.
 - e) Mr Hooper died at the Princess Alexandra Hospital in Queensland.

Christine Clements
Brisbane Coroner

11 July 2017