

Allen screws it up badly

USING allen screws without any locking arrangement is becoming an increasingly common cause of engine room fires due to failures in low-pressure fuel system pipelines of medium-speed diesel engines.

According to Canberra's Marine Incident Investigation Unit, in just one year it investigated four engine room fires caused by the failure of flanged joints in fuel pipelines secured by socket head cap (allen) screws. In the same year, the MIIU received information on two similar failures in which the outbreak of a fire was prevented.

Allen screws are commonly used on medium-speed diesel engines, although it is well known that such engines have vibration problems. Vibration tends to either loosen or cause the fatigue failure of incorrectly tightened screws or bolts. The clamping force applied to an allen screw is critical to ensure that such a screw does not loosen or fail as a result of fatigue caused by vibration. This clamping force, or simply the extent to which a screw is tightened, is known as "preload". According to the MIIU, the application of an appropriate preload is the primary defence against fatigue failure or loosening.

These findings are in MIIU's report on yet another engine room fire on *Aurora Australis*, which occurred on January 14, 1999 at about 0630 while the vessel was heading to the Antarctic. The fire was extinguished by about 1200. The port main engine was eventually started at about 2345 and the vessel returned to Fremantle with a tug escort.

As part of its investigation, the MIIU pressurised the fuel system. This resulted in an atomised spray of fuel in a fan shape that extended almost 2.5 metres. The spray came from a narrow gap in a sheet metal protective cover over two flanged pipe joints where the low-pressure fuel supply and spill pipes joined the forward end of the engine.

When the sheet metal cover was removed, the MIIU found that the flanged joint on the fuel return pipe had failed. Of the four screws securing the flange, the upper two had broken, the left lower screw was quite loose and the fourth had lost its preload. As a result, the joint had opened up by about 3 mm and the fuel spray had ignited as it was close to the starboard turbo-charger and the exhaust system.

Under Solas II-2/A, 15.5.1, oil fuel and lubricating oil pipelines should be screened or otherwise suitably protected to avoid as far as practicable oil spray or oil leakage on hot surfaces or into machinery intakes.

The vessel's starboard engine was the Wärtsilä VASA 12V32 turbo-charged diesel engine. However, the sheet metal covers were not supplied by Wärtsilä, hav-

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ing been fabricated by contractors about two years earlier. The MIIU found that the cover was not a good fit as it had a gap along the side adjacent to the engine. It was also badly cracked.

On *Aurora Australis*, the failed allen screws measured 8 x 30 mm and were of grade 8.8 high-tensile steel. According to a table supplied by Wärtsilä, the applicable torque for screws of this size and grade was 25 Nm.

When MIIU attempted to measure the torque of the screws at the flanged joint on the fuel return pipe, it found that because of the bend of the pipes adjacent to the flanges, it was extremely difficult, if not impossible, to use even a common type of torque wrench to tighten three of the eight screws.

When the torque wrench was applied to three screws that were still in place after the fire and to which a torque wrench could be applied, all three started to move at 10Nm, indicating that the correct torque had not been applied previously.

This was not the first engine room fire on *Aurora Australis*. In July 1998, the vessel suffered severe damage from an engine room fire caused by the ignition of fuel spray from a ruptured flexible hose. These hoses had been used to overcome the persistent vibration problems that this vessel had been experiencing for some time.

The investigation of that incident revealed several flaws with the way in which flexible hoses were installed and maintained and that Solas and IMO guidelines and Marine Orders published by the Australian Maritime Safety Authority were not followed (see *Fairplay*, January 6, 2000).