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Crane failure results in dropping of a heavy load

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Summary

A cylinder, full of a toxic chemical, weighing in total about 14 tonnes, was being moved by a permanently installed traversing overhead crane. The lift was achieved by attaching two independent hoist cables, via hooks and lifting beams, to the cylinder with one at each end. As the cylinder was lowered onto a weigh-scale, the hoist cable at one end failed and that end of the load fell. There were no injuries, no chemical release and no damage to the cylinder except for scratched paintwork. There was, however, considerable damage to the weigh-scale. The main cause of the incident was found to be a change in design of the lifting rope terminals.

Description of the incident

The overhead crane had dual hoists, each with its own block and spreader beam. The cylinder was attached to the spreader beams, via four lifting lugs, using chains and shackles. The weight of each cylinder was about 14 tonnes gross including 12 tonnes of contents.

The cylinder had been filled with liquid phase chemical and was being moved by the crane to the weigh-scale in accordance with standard procedures. When it was above the scale, the operator pressed the 'lower cylinder' button on the crane pendant to carry out check weighing. At this point, one of the two wire ropes failed causing one end of the cylinder to fall onto the scale, with the other end remaining suspended. The scale was extensively damaged but the cylinder was undamaged apart from paint scratches. There were no injuries. The cylinder was temporarily secured to allow its contents to solidify and then removed using specialist lifting equipment.

Discussion of the incident and events leading up to it

It was evident that the crane failed due to the fracture of a rope terminal securing one of the load-bearing wire ropes—in the threaded section immediately below where it is attached to the load equalizing beam. It was secured by means of two half nuts (see Figure 1). The threads immediately above the failure point were distorted due to wear and tear, and movement between contacting surfaces prior to failure. Metallurgical examination showed that failure initiated from cracking in the bolt threads.

When the rope terminal failed, the load rotated on the other rope on the same hoist, pulled the pulley off, then collapsed completely at that end of the lift. The lifting gear at the other end of the cylinder remained intact.

The failed terminal was attached to one of four new ropes that had been supplied and fitted about two years before the incident. These had replaced the original ropes that had been in use for about five years. The replacement rope terminals were shorter and of smaller diameter than the originals and to accommodate this, they were secured with two half nuts instead of two full ones. Calculations showed that this reduced the effective safe working load (SWL) by about 40–50% and meant that the crane had been operating at or above its effective SWL. This was concluded to be the prime root cause of the failure.

There was also some evidence of metal-to-metal contact between the load equalizing mechanism and the inside surfaces of the compensating beam (though this was more evident at the end which did not fail). This could have been a partial contributor to the failure of the terminal.

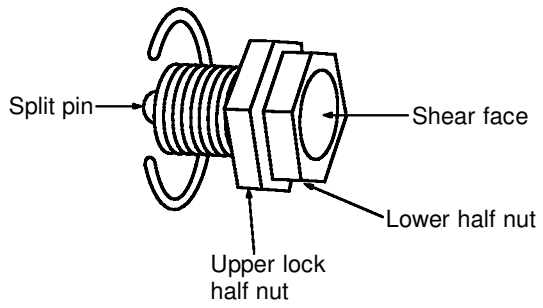

FIGURE 1: SHEARED SWAGED STUD ROPE TERMINAL

Actions taken to prevent a recurrence

The main actions centred around the installation of different sized rope terminals about two years earlier. The crane concerned and all other similar ones on the site were surveyed to ensure that those with rope terminals of this type (studs 'swaged') were secured with at least one full nut, a lock nut and a split pin. Swaging is the process of reducing the cross-section of a metal rod or stud by forcing it through a tapered aperture.

All changes to a design should be the subject of some form of risk assessment. This organization had a very comprehensive, long-standing system in place to ensure that this was done. However, this particular change had somehow not been put through that system.

The design of the rope terminal was reviewed and an improved arrangement implemented.

LEARNING FROM THE PAST
The IChemE Accident Database contains:

- 77 records of crane failures

See page 30 for more on The Accident Database