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WHITEPAPER

SUPPORT INFORMATION

PROOF TESTING



Proof Testing

Technical White Paper

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Abstract

This article looks at the practicalities of proof testing, whilst identifying areas for improvement and providing a more effective and proportionate approach to equipment inspection. It also discusses ways to increase traceability without making the process more onerous.

It was written upon completion of an extensive research programme related to the launch of new software, Proof Test plus (or SW-PTP), that adds speed, accuracy and breadth to data recording and certification related to non-destructive load verification or proof load testing. However, this white paper is not exclusively related to that technology or the Radiolink plus load cells, load shackles or compression load cells that gather data for it.

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Proof Testing

What is a proof test?

In its simplest form, load testing involves applying a load to a structure or piece of equipment. A proof test is a type of load test that demonstrates the fitness of a load-bearing structure. Such tests may be required as part of a thorough examination in line with Lifting Operations and Lifting Equipment Regulations 1998 (LOLER) that place duties on people and companies who own, operate or have control over lifting equipment.

LOLER places emphasis on the experience of a competent person, who makes an informed decision as to what is appropriate based on their training. They determine if a proof test is necessary or helpful to assess a piece of lifting equipment.

A proof test is usually expressed as a percentage of the working load limit (WLL) that equipment is designed to withstand.

The exact requirements of proof testing and the extent of each test can vary depending on standards, equipment or industries involved, as well as individual requirements from customers or as part of manufacturers' own quality controls.

Lifting equipment manufacturers may carry out proof tests routinely or as a batch test in line with their own QA/QC procedures, but for goods for sale in the EU a minimum requirements is that of the Machinery Directive.

The Machinery Directive 2006/42/EC section 4.1.2.3 addresses the static and dynamic tests that must be performed on all lifting machinery ready to be put into service. These tests help satisfy the 'fitness for purpose' requirement of lifting machinery or lifting accessories discussed in section 4.1.3.

The Directive also states (line 20) that for certain types of machinery having a higher risk factor, a stricter certification procedure is desirable. A few examples of additional certification standards that may require load testing include:

- BS EN 14439: references proof of strength and stability of cranes, including out of service stability to account for wind loading.
- EN12079 and DNV2.7-1 standards set minimum criteria for design, material, production and testing of containers used in offshore applications, with specific guidance on proof testing.
- Maritime industries - Proof load testing is required for almost all lifting appliances and loose lifting gear in order to obtain Lloyds register certification. Other verification bodies such as Det Norske Veritas (DNV) and Bureau Veritas have similar requirements for lifting gear.

Standards for North America

There, proof load testing is performed to meet a number of standards predominantly set out by the following bodies:

- OSHA — Occupational Safety and Health Administration
- ASME — The American Society of Mechanical Engineers
- ANSI — American National Standards Institute

A few examples of standards that may require load tests to be performed on lifting equipment and accessories include:

- ASME B30.9: on lifting slings
- ASME B30.10-1.7: on hooks
- ASME B30.16: on overhead hoists (underhung)
- ASME B30.17: on overhead and gantry cranes and trolleys
- ASME B30.20: various below-the hook lifting devices
- ASME B30.20: for manual lever hoists
- ASME B30.26: for various lifting accessories: shackles, eyebolts, turnbuckles, links, rings, swivels and compression hardware.
- OSHA Section 1926.251(a)(4) covers special custom design lifting accessories that shall be proof-tested prior to use to 125% of WLL.
- ANSI N14.6: application specific for special lifting devices for shipping containers for nuclear materials weighing >4500kg.

Again, in mission critical industries, additional tests may be required. NASA for example specifies the occasions and frequency of proof load tests and periodic load tests to be performed on lifting devices and equipment (LDE's) in its NASA-STD-8719.9 technical standard on lifting.

What equipment is proof tested?

At the most basic level this could be any equipment or structure that lifts, holds, supports or resists a load. Typically the item will have a rated WLL, as mentioned previously.

Here are some non-exhaustive examples:

- Bollard pull tests
- Tug tests
- Crane tests (using water bags, block weights)
- Pad eye or fly point tests
- Crash barrier tests
- Lifting equipment tests (slings, chains, wire rope, hooks)
- Construction equipment tests (shoring columns, Acrow props, lintels)
- Lifting and spreader beam tests
- Hydraulic cylinder load tests

Some of those items will be proof tested in tension, for example, slings, chains, wire rope and cranes, while others will be tested in compression, for example, Acrow props, spreader beams and hydraulic cylinders.

How to proof test?

Numerous load-testing applications worldwide require a load cell to verify the load applied, from crane testing using water bags and a tension load link to cylinder testing using a hydraulic test rig and a compression load cell.

A load cell allows the test to be accurately measured and recorded. In safety critical industries the requirement to document test procedures and results has never been greater as users of lifting equipment call for more traceability and audit trails.

Why proof test?

A proof test ensures a lifting item works correctly and safely through its full cycle operation. In most cases, visual inspections often tell a lifting equipment engineer very little. One cannot tell the condition of the internal working parts or the history of the item. An old crane may be visually unappealing but perfectly maintained and in great working order versus a brand new crane that was heavily overloaded on its first use and is internally damaged. In the case of the latter, a visual inspection would be pointless.

Ask oneself, how does a user know the crane is structurally and mechanically sound without imposing a proof load on the machine? How do they check that the winch brake can hold the required line pull? How can they check that the boom hoist clutch is not slipping or the hydraulic lock valves or cylinder seals are not passing oil, without imposing the maximum load they are expected to carry?

Clearly, putting the equipment under load allows the competent person to complete a full assessment by watching and listening to the lifting equipment during operation. Thus, many engineers have a load link available to perform a load test on site.

To achieve the same level of assurance of no failures at capacity without a proof test would require an even deeper inspection schedule to compensate. The machine may need to be stripped down and inspected piece by piece, perhaps with non-destructive testing (NDT) being carried out on individual parts. Specific service intervals would need to be introduced to ensure regular replacement of parts based on hours in use and number of cycles.

According to Safety Assessment Federation (SAFed) figures, the five million equipment examinations conducted by its member companies each year identify a significant number of safety-related defects of up to 5% depending on equipment type. With this level of detection, a reduction in the scope or periodicity of examination is not advisable without alternative risk control measures.

Not always required

Even as a manufacturer of force measurement, load monitoring and suspended weighing load cell equipment, Straightpoint recognises that routine proof testing is not always beneficial and needs to be carried out as part of a broader assessment. Regular inspection, servicing schedules and replacement of parts based on hours of use / number of cycles are all alternatives and complementary activities to support safe lifting.

As the UK's Health & Safety Executive (HSE) states, routine load testing isn't a requirement. In a document titled, 'Thorough examinations and inspections of lifting equipment', it says, 'Most lifting equipment does not need routine testing as part of the thorough examination—in fact some overload tests can cause damage to lifting equipment. Where testing is deemed necessary, it may not need be undertaken at every thorough examination. The need for, and nature of, testing should be based on an assessment of risk—taking account of information from the manufacturer and other relevant information—as determined by the competent person.'

Proof testing equipment

Straightpoint manufactures a variety of equipment that can be used for proof testing. As referenced at the outset, its Proof Test plus (or SW-PTP) software records data gathered by a Radiolink plus load cell, load shackle or compression load cell. It then creates a pass or fail certificate that includes test data and graphs charting data from the load versus time throughout a test.

Information can be printed out directly as a PDF report, electronically transmitted or fed to an information centre in the cloud. It is important that there is traceability of proof test certification and that the load cell that did the test was accurate and calibrated. Where a load test is deemed beneficial the aim of Proof Test plus is to make that process more efficient.



