Guidance on the thorough examination of electrically operated vacuum lifting devices

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INTRODUCTION

Electrically operated vacuum lifting devices, in the form of either single vacuum pads or grouped configurations, suspended from chains, wires or otherwise attached to lifting equipment, can be used for lifting and transporting most ferrous and non-ferrous metal stock or manufactured components. They are widely used in many industrial sectors including aircraft, shipbuilding, rolling mills, glazing, plastics, building and general engineering.

Vacuum pads can be round, rectangular or of a specific form constructed for a particular purpose. For larger component forms the pads could be mounted on single, twin and cross beam structures. A number of different types of vacuum are available, which include:

Self Priming Vacuum Lifting Device

Equipment, which includes one or more suction pad(s) and which utilises the load to create the vacuum.

Non-self Priming Vacuum Lifting Device

Equipment, which includes one or more suction pad(s) and which utilises an external source of energy to create the vacuum.

Note: Electro-pneumatic vacuum lifting devices can be energised by mains power, battery or by stand-alone generator.

LEGAL REQUIREMENTS

Under the Lifting Operations and Lifting Equipment Regulations 1998 (LOLER), vacuum lifting devices that are an integral part of machinery are classed as "lifting equipment"; those that can be fitted to and taken off lifting equipment are considered to be 'accessories for lifting'. 'Lifting equipment' and 'accessories for lifting' are both 'work equipment' within the meaning of the Provision and Use of Work Equipment Regulations 1998 (PUWER).

The key requirements under the LOLER and the PUWER 98 are:

- **suitability** — any lifting device must be suitable for the purpose for which it is to be used or provided.
- **safe use** — every lifting device must be clearly marked with its safe working load (SWL) and must not be operated above its SWL.
- **maintenance** — lifting equipment must be maintained in an efficient state, in efficient working order and in good repair.
- **thorough examination and inspection** — lifting equipment must be thoroughly examined and, where appropriate inspected, by a competent person at least every 12 months, 6 months for 'accessories for lifting', or in accordance with a scheme of examination. Records of thorough examination should be made in accordance with the prescribed particulars contained within the LOLER, Schedule 1.

  NOTE: Where the safety of lifting equipment depends on its installation, e.g. a crane, it should be thoroughly examined after assembly and before being put into service at a new site or location.
- **information and training** — employers are required to ensure that employees are adequately informed, instructed and trained in the safe use of equipment.

STANDARDS

The European Harmonised Standard (EN 13155) has been produced as one means for non-fixed lifting attachments used on cranes to conform to the essential health and safety requirements of the Machinery Directive, as amended.

For items, which are fixed to other types of lifting equipment, this standard could be used as a best practice guide to the safe operation of vacuum lifting devices.

EQUIPMENT CHARACTERISTICS

Electrical Characteristics

Pure electrical problems usually result in complete failure. Shorts or open circuits resulting from insulation breakdown can initiate problems. Insulation breakdown can be as a result of age, but is also compounded by impact loading, which the device may sustain during in-service use.

A safety device should be provided, which automatically warns of a danger condition where vacuum losses cannot be compensated. The warning signal should be optical or acoustic, depending upon the circumstances of use for the vacuum lifting device. The warning signal should operate even in the event of complete power failure.

For non-self priming vacuum lifting devices either at least one stand-by vacuum reservoir or battery should be provided to supply power in case of supply failure. In the event of supply failure, the vacuum lifting device should be capable of holding the working load limit for at least 5 minutes. Where areas are cordoned off and controlled such that no person works in the vicinity of the raised load then the requirement for stand-by vacuum reservoirs and/or battery supply may not be considered necessary, after a suitable and sufficient risk assessment has been completed.

Mechanical Characteristics

The vacuum assembly is normally mounted within a yoke, which is in turn connected either directly to a single suction pad or lifting beam structure configuration. At the upper structural cross beam or member there should be a suitable means of attachment to the lifting equipment. Depending on the type of vacuum lifting device the assembly will comprise of the necessary pneumatic circuit valve work, piping, pumps, electric motors and reservoirs for adequate and safe function.

The shape of the suction pads should be matched to that of the intended load. Furthermore, where more than one suction pad is used in conjunction with a lifting beam, the layout of the suction pads should also be matched to that of the load. Additional the suction pad seal ring should be suited to the intended load (i.e. neoprene for oil resistance and silicone for high temperature use).

For vacuum lifting devices intended for use on construction sites a secondary positive holding device should be fitted or there should be two vacuum reservoirs each fitted with non-return valves. Each vacuum reservoir should be connected to a separate set of suction pads. In turn, each set of suction pads should be capable of sustaining at least 2 times the working load limit.

Lifting Accessories

For lifting equipment suspension, a multiple leg high tensile chain sling and/or shackle arrangement either of standard design or of special construction is necessary. Certification in the form of a declaration of conformity and the visible marking of safe working loads are statutory requirements and should be made available for scrutiny as deemed necessary at the time of the thorough examination.

EXAMINATION PROCESS

Examination Scope

Some of the most significant points, particular to vacuum lifting devices, which need to be taken into account when carrying out an examination are as follows:

- Assess the integrity of the lifting chains and/or shackles retaining the vacuum lifting device.
- Assess the integrity of the yoke and/or lifting beam structure supporting the vacuum assembly and suction pads.
- Assess the integrity of the anchorage lugs for the lifting chains and/or shackles.
- Assess the structural condition of the suction pads.
- Assess the condition and any evident damage of the suction pad seals.
- Assess the condition of the safety vacuum reservoir.
- Assess the condition of the pneumatic circuit valve work, piping, pumps and electric motors.
- Assess the condition of the terminal box.
- Assess the condition of trailing cables, terminations and support trunking, if applicable.
- Assess the function of the automatic warning devices.
- Assess the condition and function of additional safety devices.
- Assess the function of control panel indicators.
- Assess the function of the operating controls.
- Assess the suitability of the marking of operator instructions and controls.
- Assess the suitability of the marking of the Working Load Limit (WLL) or the Safe Working Load (SWL) whichever is applicable to the particular item.

Functionality Testing

Where practicable a common load should be raised clear of a support (no higher than 150mm). This should be held for a maximum of 1 minute proving cross travel and long travel motions of the lifting equipment, as applicable.

For non-self priming vacuum lifting devices the function of the vacuum safety reservoir and/or stand-by battery should be checked by raising and lowering a common load with the mains supply isolated.

Where concern exists regarding the functionality of the vacuum lifting device then a full load test should be called for to supplement the subsequent thorough examination.