Information Document HSE OC234/16

INFORMATION DOCUMENT

HEALTH AND SAFETY EXECUTIVE

Manufacturing Sector - Engineering Section

GUIDANCE ON THE SAFE USE OF MAGNETIC LIFTING DEVICES

INTRODUCTION

1 This HSE Information Document provides advice to users and suppliers of magnetic lifting devices on reducing the risk of both injury to operators and other persons, and of damage to plant and equipment. It describes the hazards involved and some of the precautions that need to be considered when planning and carrying out handling activities using magnetic lifting devices.

2 The main concerns relate to electrically powered magnets but some of the issues discussed will be equally applicable to permanent magnets used for lifting operations.

3 This guidance has been prepared jointly with the Steel Stockholding Lead Authority Partnership (SSLAP), a tri-partite body comprising Wolverhampton CC, the National Association of Steel Stockholders (NASS) and the Health and Safety Executive (HSE). The UK Steel Association has also assisted in the preparation of the guidance.

BACKGROUND

4 Electrically operated magnetic lifting devices, in the form of either single or a group of magnets, suspended from chains or wires or otherwise attached to lifting equipment, can be used for lifting and transporting steel and most ferrous metal stock or manufactured components. They are widely used in many industrial sectors including metal/component manufacture and storage, shipbuilding, as well as the breaking and scrap handling industries.

5 Magnets can be round or rectangular or specially constructed for a particular purpose. A number of different types of magnet are available, for example:

flat pole plate magnets for handling sheet metals and bulk goods such as scrap iron etc
specially-shaped pole plate magnets for lifting pipes, round steel bars or sectional steel
magnets with adjustable pole fingers for lifting items of irregular shape
magnets with safety devices eg grab claws, as additional equipment.

Magnets can be provided with no power supply ie permanent magnets, or where power is supplied by cable from an external source or through an in-built battery.

6 The magnet, and any associated electrical equipment, should be designed for its intended purpose and constructed to withstand the environment in which it is required to operate.

WHAT IS THE HAZARD

7 When used correctly magnetic lifting devices will handle magnetic materials and components safely, and without the need for slingers. The principal hazard associated with their use is:

falling material
persons, plant and equipment, and services in the area of operation could be at risk from being struck by material being moved or which has become detached from the magnet, as well as from the potential consequences of failure of the lifting device, eg following loss of power.

Reported accidents have involved persons being struck by materials falling off magnets. In a typical incident, an employee at a large engineering company suffered serious leg injuries when a long length of flat steel peeled away from an electromagnet during lifting and fell to the ground. The single magnet being used was inappropriate for handling such a long length of material.

Other hazards:

electromagnetic field (EMF)
it is thought that the magnetic field around the magnet may interfere with implanted active body implants such as heart pacemakers, insulin pumps, or with communication equipment or plant controls in the area. If currents used are very large, the power frequency fields around the conductors may need to be assessed.

WHAT ARE THE LEGAL REQUIREMENTS

8 Under the Lifting Operations and Lifting Equipment Regulations 1998 (LOLER), magnetic 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).

9 The key requirements under LOLER and PUWER 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 and records of thorough examination kept available. Note: where the safety of lifting equipment depends on its installation, ag a crane, it should be thoroughly examined 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.

10 Electromagnetic lifting equipment supplied for the first time in the EU should meet the requirements of the Supply of Machinery (Safety) Regulations 1992. In particular, suppliers should ensure that the equipment:

- satisfies the Essential Health and Safety Requirements, especially the specific requirements for lifting equipment in Schedule 3, section 4
- has undergone an appropriate conformity assessment
- has a declaration of conformity and is CE marked
- the instruction handbook includes the 'limits of use', eg where the device cannot be so designed and constructed that inadvertent dropping of loads is avoided
- it is, in fact, safe.

11 Second-hand machinery suppliers have duties under Section 6 of the Health and Safety at Work etc Act 1974 and should ensure that :

- lifting equipment is fit for purpose and is safe
- application and limitations of the equipment are clearly defined
- information provided is adequate to ensure that the equipment can be used safely

12 Equipment suppliers should provide suitable technical information, particularly about the strengths and distribution of magnetic fields around the magnet for typical load configurations, so that users may complete appropriate risk assessments for its use and maintenance.

CARRYING OUT A RISK ASSESSMENT

13 Before recommending or supplying magnetic lifting equipment, suppliers should obtain sufficient information from the prospective user to ensure the:

- preparation of a requisition specification and provision of equipment which will be safe for that intended use; and
- provision of adequate information about the use for which the equipment was designed and tested
- prospective user understands that there maybe a risk of direct or indirect effects on their employees.

14 Magnetic lifting devices should not be treated as 'general purpose' pieces of lifting gear as they have to be designed to suit particular types of loads and environments. In all new applications, advice on the suitability of an existing device for the particular lift should be sought from the equipment manufacturer.

15 Employers should carry out a suitable and sufficient assessment of the risks, before new or existing magnetic lifting devices are specified for handling loads. This should consider whether such devices are the safest option, and if so, if the equipment is appropriate taking into account all the circumstances of the proposed operation. The assessment should be carried out by someone with knowledge of the stock storage and handling processes, as well as the capabilities and limitations of this type of lifting equipment. Employees and their safety representatives with first-hand knowledge of the hazards and risks involved should be consulted and given copies of completed risk assessments.

16 Some of the factors that have a bearing on the selection of lifting magnets and operating conditions, particularly the SWL, include:

- properties of load materials
- load weight, thickness, shape and area in contact with magnet
- stiffness or flexibility of the load
- range of sizes to be lifted and frequency of operations
- surface conditions of magnet and load
- temperature of magnet and load

(i) Properties of load materials
Magnet lifting is not appropriate for all steels. For example, some stainless steels are not magnetic and other types are only partially magnetic. When handling mixed steel types, it should be recognised that non/partially magnetic items are likely to fall away if magnetised pieces supporting them move.

(ii) Load weight, thickness, shape and area in contact with magnet
The surface area of the load and the proportion of the magnet face in contact with it, will dictate the number and size of magnets required for safe handling almost as much as the weight and thickness of the load. For example, a billet may only require a single two-pole magnet, whereas a thin plate section of equal weight may require a multiple arrangement of magnets.

Where the surface of materials is non-uniform eg corrugated or perforated sheet, flat lifting magnets can be used but must be rated according to the percentage of the load which actually contacts the magnet face, as well as the kind of “path” that the material offers to the magnetic flux from pole to pole.

It should also be borne in mind that where magnets are used to lift many pieces at the same time, for example when handling scrap, penetration of the load by the magnetic flux may be poor at the periphery of the load and part of it may fall off, even though the nominal SWL has not been exceeded.

(iii) Stiffness or flexibility of the load
Droop or overhang at the ends of a flexible load eg long bar, flat or thin sheet, may cause it to peel off the magnet under its own weight during handling operations. A number of magnets may be selected to give greater coverage over the load area rather than reliance being placed on weight-lifting ability alone. Proper configuration/positioning of the magnets should minimise the sag or droop of the overhanging portions of a load.

(iv) Range of sizes to be lifted and frequency of operations
Where assemblies of magnet are likely to be required to handle a range of load shapes and sizes, it is essential that the equipment supplier and/or the person carrying out the risk assessment are provided with sufficient information as to the likely demands on equipment. This should help them determine if magnetic lifting is feasible and safe and, if so, how the system should be configured so as to ensure it is safe for use.

(v) Surface condition of load and magnet
The effectiveness of a magnet falls rapidly as the distance between its face and the load ie the air-gap, is increased. Good contact between the surfaces of the magnet and the load is essential for the magnet to achieve optimum and safe performance. To maximise contact, both the magnet face and the load surface must be as smooth and clean as possible and the air gap kept to a minimum. The surface texture or finish of the load and the presence of paint, rust, oxide scale, oil, ice and snow etc and non-magnetic material on either surface will increase the air-gap, thus reducing the contact and, possibly, the magnetic effectiveness.

(vi) Temperature of load and magnet:
The temperature of the magnet and load should be taken into account as, for example, ferrous materials lose their magnetic properties with increasing temperature and cease to be magnetic at 768°C. Magnets should not be used for hot work unless specially designed for this duty and then only within the specified operating temperature limits.

SAFETY DEVICES AND PRECAUTIONS

17 The following safety devices and precautions should be considered -

(i) Warning devices
Equipment for lifting should be fitted with suitable warning devices and indicators eg to show when it is magnetised or operating at a reduced power level

(ii) Protection against failure of mains electrical supply
Except for the permanent magnet type, any interruption to the electrical supply could result in a release of the load. An auxiliary supply, by means of batteries which come into operation automatically on failure of mains supply, will normally support the load for up to 20 minutes and enable it to be manually lowered to the ground or restoration of the mains electrical supply to be effected. The condition of such batteries should be checked regularly. (Note: an auxiliary supply will not, of course, operate in the circumstances of other electrical failures such as cable breakage, contactor failure etc.)

Suitable power failure warning devices should be fitted for both mains supply and stand-by equipment. Also, the system should not be capable of being energised if the stand-by equipment is below the required power level.

(iii) Rating of cranes

When attached to a crane, the weight of the magnet and its accessories should be taken into account when assessing the load carrying capacity and safe operation of the crane.

Mobile cranes not only have to contend with the weight of the magnet but also the inertia effects during slewing and travel. Guidance should be sought from the crane manufacturer on any possible de-rating on the normal SWL when using magnets.

(iv) Protection against lifting excess material
When lifting plates etc from a stack, the magnetic field can be such that more material than required is magnetised, with those items furthest from the magnet liable to be easily displaced. A reduced-power or similar facility can be used to avoid lifting excess material.

(v) Lifting of bundles - protection against falling material
Where magnetic lifting devices are used to handle bundled materials, it is essential that appropriate risk control measures are in place to protect people, plant and equipment from the risk of falling material. In particular:

(a) the magnetic equipment used must be suited to the task; and

(b) the load should **never** be lifted by any banding wire/straps used to contain the material, as only the items closest to the magnet face are likely to be sufficiently magnetised to remain in place if the banding/strapping fails during handling.

(c) to reduce the risk of banding/strapping and jointing clips failing during handling, they must be "fit for purpose" ie of known SWL and adequate strength to withstand all the stresses from handling, and should be sufficient in quantity and so positioned around the bundle as to minimise the risk of the contents ‘peeling off’. For incoming materials, account should also be taken of possible damage during transit.

(d) persons should be prevented from entering any area where they could be injured if a bundle broke apart during lifting/handling.

Safe working practices/Safe operating procedures

18 Safe operating procedures should be prepared and kept readily available for each magnet lifting arrangement. In addition, tables detailing the maximum loads for each type of material eg plate, bar, tube, casting etc, the range of thickness of the materials, and different air gaps should be conveniently displayed.

19 The following safe working practices should be considered for inclusion in any operating procedures for the safe use of magnetic lifting devices, though some of them may be inappropriate for handling scrap:

- use the right equipment and be aware of the limitations of each device eg ‘lift only one piece of material at a time’, ‘unsuitable for scrap handling’ etc
- always follow the manufacturer’s instructions

- do not use magnet lifts to handle containers of gases or liquids
- check the thickness of materials before lifting. Check tables for lifting capacities for different thickness
- ensure that there is good contact between the surfaces of the magnet and the load. Magnetic efficiency could be affected by surface contamination
- take account of the rigidity of the load eg bundle shape and profile. Any lifting beam used must be fit for purpose
- where possible, use magnets only for handling single items. Fully assess the risk of items being lifted becoming detached/peeling off, where they are not in direct contact with the magnet ie magnetism is transmitted through one or more other items closer to the magnet
- never exceed the SWL. Where more than one magnet is used, the applied load on each magnet should not exceed that magnet's SWL
- consider installing permanent magnets with electromagnetic drop off ie in the event of a power failure battery backup will not be needed
- display warning notices at entrances to places where magnetic lifting is taking place. Prevent unauthorised access into 'lifting zones', especially at automatically controlled processes. Provide operators with safe places of work and ensure that they cannot be struck by displaced loads eg reinforced crane cabs
- never transport a loaded magnet where there is a risk of injury to any person should the load or part of it fall off. All movements of materials should be properly organised and managed to prevent injuries and damage to plant and key services. Travel routes should be clearly defined and maintained
- assess the risks involved before allowing the load to 'jump up' onto the magnet at the start of lifting. One way to avoid loads jumping onto magnets is to gently lower the de-energised magnet onto the load and, after the power has been switched on, allow it to settle for a few seconds to allow the magnetic field to reach its full strength
- transport loaded magnets at the lowest height possible, where practicable no higher than 1.5m above ground level. Where this is not practicable, other precautions should be considered
- de-energise the magnet when not loaded and never leave a load hanging in the air. Magnets should also be de-energised before unplugging to prevent a high back EMF being generated when they are switched off
- assess dangers of access to backs of vehicles eg to trim the load, where magnet lifts are used for loading lorries
- prepare arrangements for dealing with emergencies eg action to be taken in the event of power/equipment failure, displaced loads etc

Manual handling

20 Magnets used for lifting can be heavy and the risk assessment under the Manual Handling Operations Regulations 1992 should include all lifting equipment and accessories.

Personal Protective Equipment (PPE)

21 The selection and use of suitable workwear and other personal protective equipment (PPE) eg head protection, gloves, protective footwear etc, is important to help protect against any residual risks eg from falling loads.

Training of employees

22 Magnetic lifting devices should be operated only by fully trained persons who have been adequately informed, instructed and trained in the safe use of the equipment and the findings of any risk assessment. Training courses should cover the:

- potential dangers from the use of magnetic lifting equipment
- factors, including load configuration, which may cause equipment or lifting operation failure and how to avoid them
- precautions to reduce the risk of accident and injury to themselves and others
- principles for selecting the right equipment
- limitations on the use of the equipment
- arrangements for planning and carrying out safe lifting operations, including safe systems of work
- specific instructions on safe use issued by the manufacturer/supplier
- location and operation of the equipment controls
- scheme for examination, maintenance requirements and system for reporting defects
- emergency arrangements

Equipment maintenance

23 The manufacturer's instructions for the regular inspection and maintenance of the magnetic equipment should be followed. Where appropriate, inspection and maintenance schedules should include:

- power cables to the magnet – check for damage and ensure that they are properly supported
- magnet assembly – check for damage and that retaining bolts are kept tight
- magnet – check for deterioration of insulation resistance; check the value of coil resistance to ensure that "inter-turn" faults have not developed whilst in use
- electrical plug and socket connectors – check that mechanical strength, insulation and electrical conductivity are being maintained
- lifting tackle eg chains, rings etc associated with the magnet – thoroughly examine at appropriate intervals
- electrical back-up batteries - check their condition and that the battery back-up alarm works when the power is off.

Electromagnetic Fields (EMF)

24 Workers with active body implants eg heart pacemakers, may be affected by the EMF around magnets. Their medical specialist will have advised them of any risks associated with the implant. However, following the general rule of keeping people

clear of the lifting/transporting zone to protect them from any displaced load, should also ensure that risks from EMFs are reduced to a minimum.

Possible interference effects of EMFs on plant, equipment and controls should be properly assessed.

Further reading

1 *Safe Use of Lifting Equipment. Lifting Operations and Lifting Equipment Regulations 1998 Approved Code of Practice and guidance* L113 HSE Books ISBN 0 7176 1628 2

2 *Safe Use of Work Equipment. Provision and Use of Work Equipment Regulations 1998 Approved Code of Practice and guidance* L22 HSE Books ISBN 0 7176 1626 6

3 *Manual Handling Operations Regulations 1992: Guidance on Regulations* L23 HSE Books 0 7176 2415 3

4 *Board Statement on restrictions on human exposure to static and time varying electromagnetic fields and radiation* (Docs of the NRPB vol 4, No 5, 1993 HMSO, ISBN 0 85951 366 1)

HSE priced and free publications are available by mail order from HSE Books, PO Box 1999, Sudbury, Suffolk, and CO10 2WA. Tel: 01787-881165 Fax: 01787-313995. Website: ***www.hsebooks.co.uk***

For information about health & safety ring HSE's Infoline Tel: 08701-545500, Fax:02920-859260, e-mail: hseinformationservices@natbrit.com or write to HSE Information Services, Caerphilly Business Park, Caerphilly CF83 3GG. You can also visit HSE's website: ***www.hse.gov.uk***

This document contains notes on good practice which are not mandatory but which you may find helpful in considering what you need to do.