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Latest translated revision

This document is a translation from Swedish of LKAB Technical Instruction LKT 1520.520.004. In the event of disagreement concerning the interpretation and content of this text, the Swedish version shall have priority. The latest revision of this instruction can be obtained from e-mail address: tekadm.krn@lkab.com or tekadm.mbg@lkab.com

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References

AFS 2008:3	Machines
AFS 2006:6	Use of lifting devices and lifting gear
AFS 2005:15	Vibrations
SS-EN 795:2012	Swedish standard for personal fall protection equipment – Anchor devices.
LKT 1520.520.003	Design, manufacturing and use of Lifting eyelet

Definitions

Lifting eyelet:	Lifting gear that is a bracket for load carrying devices, for example wires, chains, ropes, looms, etc. for lifting loads.
Lifting equipment:	Components or equipment not mounted on lifting devices, which are located either between the lifting device and the load or on the load to connect it.
Hoist:	Device for lifting or lowering load.
Safety fastening:	Type of lifting eyelet.
Vibrations:	Mechanical oscillation of fixed objects. The dimension of the vibration is usually indicated as the acceleration amplitude of the vibration motion, expressed in unit m/s ² . In these regulations, the term vibration also includes transient vibration, such as shocks.

Background and purpose

There exists a need for LKAB to clarify the requirements for vibrators mounted on pockets, gutters, dumps and other facilities where there is a need to ensure emptying and freight flow.

The purpose for this instruction is to ensure that the design, construction, assembly and control of vibrators are performed in such a way that known risks are avoided and provide a similar assembly, thus reducing the risk of personal injury or damage to other equipment if vibrators dissolve from their attachment. The instructions shall be used when designing and constructing new facilities where there is deemed to be a need for vibrators and retrofitting of existing plants as well as for checking equipment already installed and inspection of new facilities.

Safety fastening which is a type of lifting eyelet that can be used on vibrators, LKAB has clarified the requirements for the manufacture and use of lifting eyelet (LKT 1520.520.003).

When purchasing and initial provision of vibrators, select models that are fitted with a safety bracket mounting to secure suspension. Existing vibrators not attached to wire or chain should be replaced with models safety bracket attachment. Existing vibrators that are deemed to have a wire or chain mount can be provided with it if possible. Welding on vibrators should be avoided if it is not possible to ensure that the required strength is achieved.

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Use

If the vibrator is fitted with a safety bracket attachment and there exists a risk of injury to a person or other equipment if the vibrator is released, it shall be fitted with a wire or chain according to the design shown under the section *Safety suspension*.

All screw joints relating to the mounting of the vibrator must be secured against unlocking, for example, with lock nut, locking pin or punch mark.

Design/manufacturing

Listed in this section should be applied to design and construction when manufacturing and assembly equipment is being developed in new plants where vibrators are to be mounted. This can also be applied for post-installation if there exists a need for documentation.

- Suspension and attachment shall be dimensioned based on the load data specified for the selected vibrator. The load data needs to be related to the strength of welds, steel and screw joints.

- Load data must be provided by the supplier for the selected vibrator.

- Instructions from the selected supplier regarding the assembly should be followed if there exists.

- The safety attachment and its upper attachment point must be dimensioned to handle applied loads when the vibrator is released. Refer to the section *Dimensioning instructions for safety suspension*.

Mounting at a new facility

This should be followed when a new facility is to be projected:

- Manufacturing of components according to the developed technical documentation.

- Perform installation according to the documentation provided for the plant.

- Install safety suspension according to any design described in the section *Safety suspension*.

Retrofitting

If there exists a need for a vibrator in existing facility to ensure drainage and freight flow, a risk assessment must be performed to determine the need for a safety suspension or other protection to prevent injury to persons or other equipment. If there exist such risks following instruction must be met:

- Documentation that shows production and assembly must be followed.

- Dimensioning the safety suspension and its upper attachment point shall be carried out as instructed in the section *Dimensioning instructions for safety suspension*.

- Install safety suspension according to any design described in the section *Safety suspension*.

Control/inspection

After completion of assembly on a new plant, retrofitting and checking of previously mounted vibrators, this instruction must be applied, which means:

- That this instruction has been followed.

- That any documentation that is otherwise available for the plant has been followed.

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If equipment is disconnected

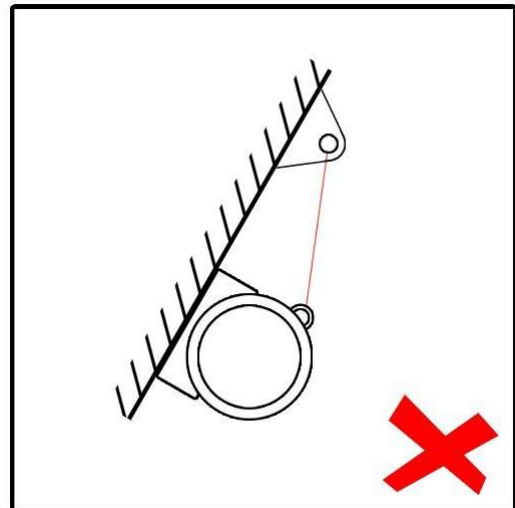
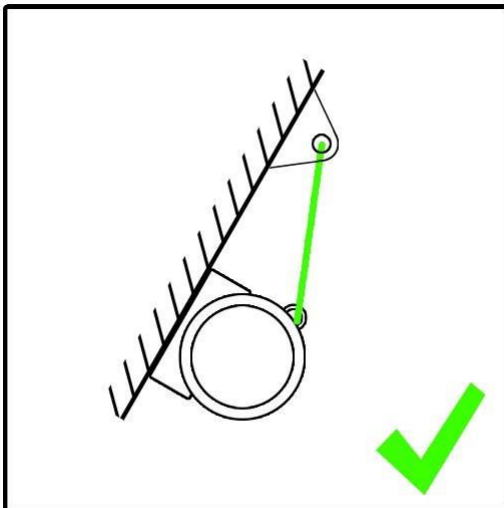
When the vibrator has detached from its attachment:

- Check the safety suspension and the other fasteners condition.
- Replace safety suspension if it is damaged.
- Repair and replace other attachment details if they are damaged.

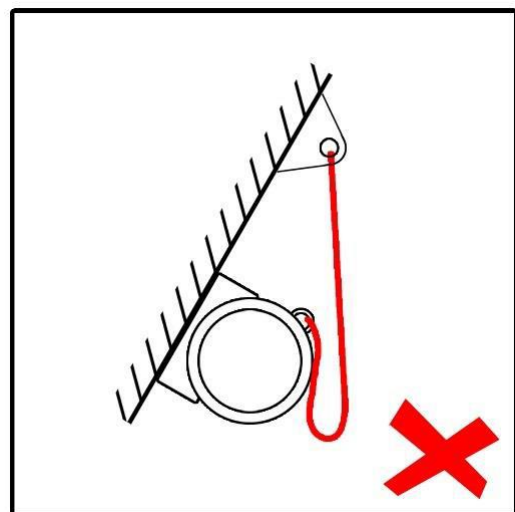
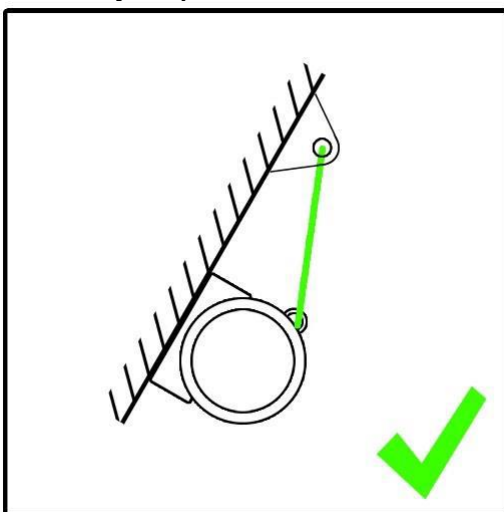
Risk assessment according to AFS 2006:6

3 § Working conditions shall be investigated and the risks assessed when lifting equipment and lifting gear shall be used. Risk assessment should always be performed on the intended installation and in addition to the risks that can be identified for that area, known risks included under *Examples of known risks* will be considered.

Examples of known risks

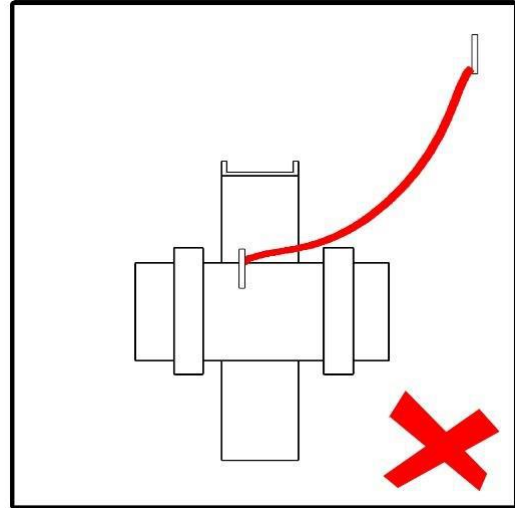
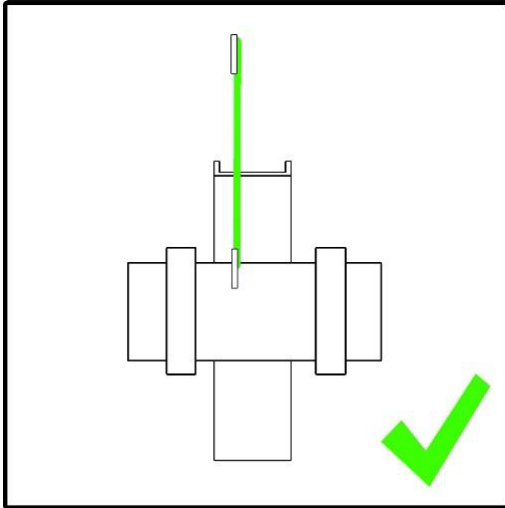


Use safety suspension that is dimensioned according to the selected vibrator.

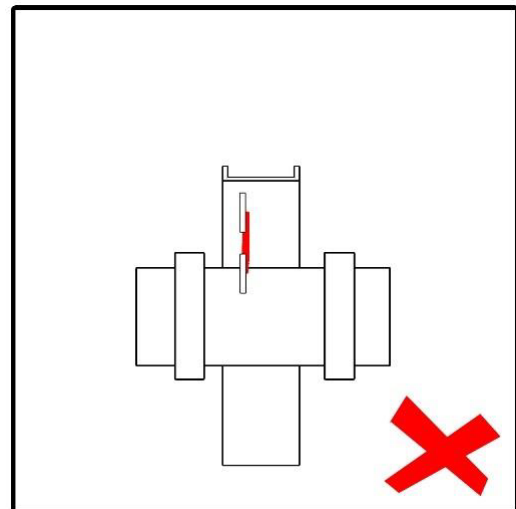
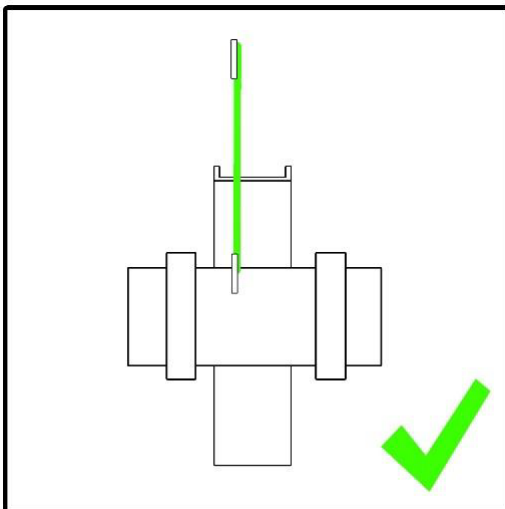


Mount the wire or chain as tight as possible without affecting the vibrator function.

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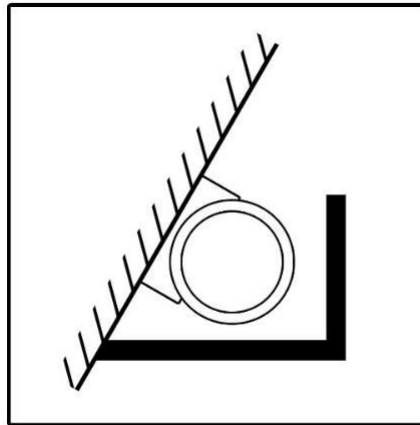


Mount the safety suspension so that the vibrator should move as short as possible if it loosens from its attachment, to avoid strain in wires, chains and safety bracket attachment.



Install safety suspension in parts that have enough strength. Not the same as vibrator mount!

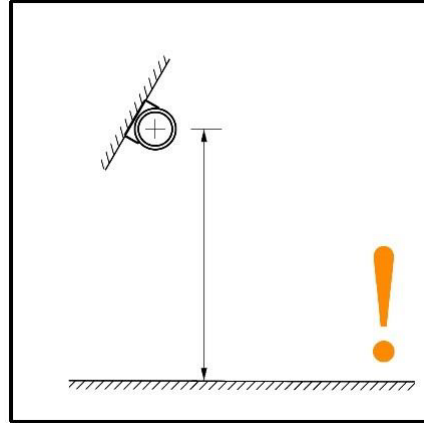
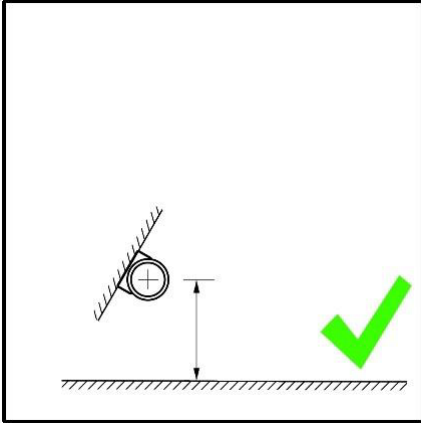
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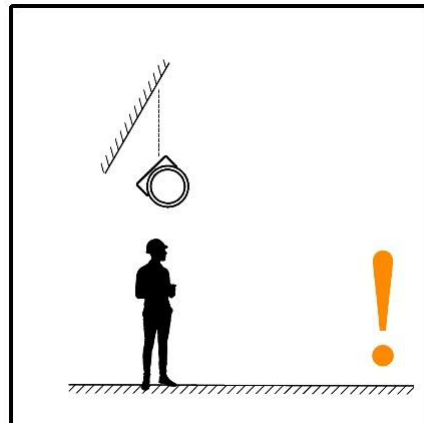
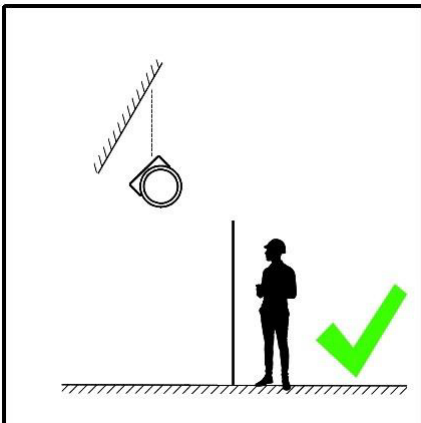
If there is no bracket for safety suspension on the vibrator, it is important to ensure that personal injury can be avoided if it is released. Is it not possible to install a safety suspension a protective device (net or shield for example) should be installed that prevents the vibrator from falling on someone if it loosens.

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Other recommendations



If it is possible, the vibrator should be mounted as close as possible to catch it if it loosens.

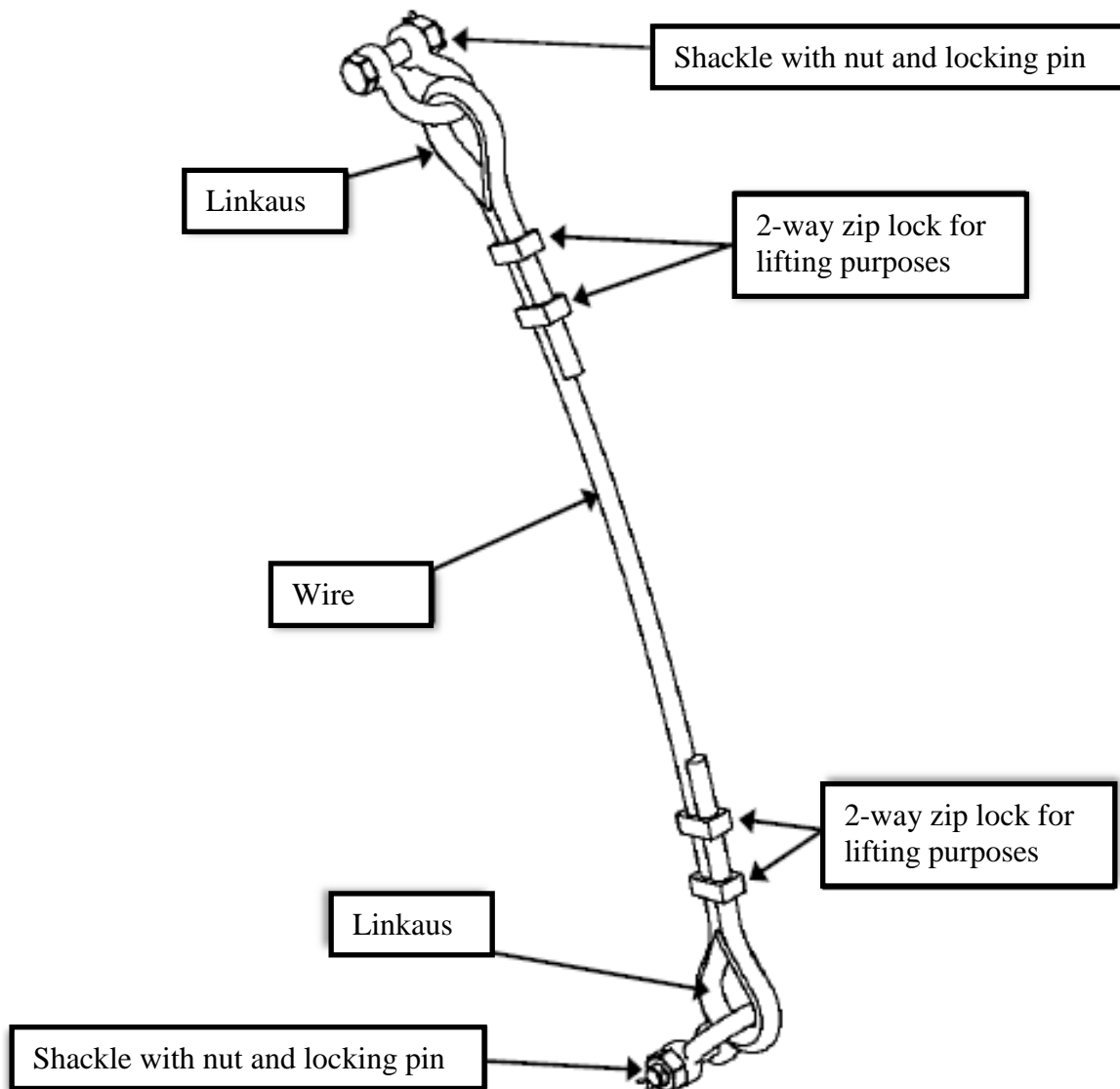


If there is a possibility, the vibrator should be installed separately from the area where people can stay.

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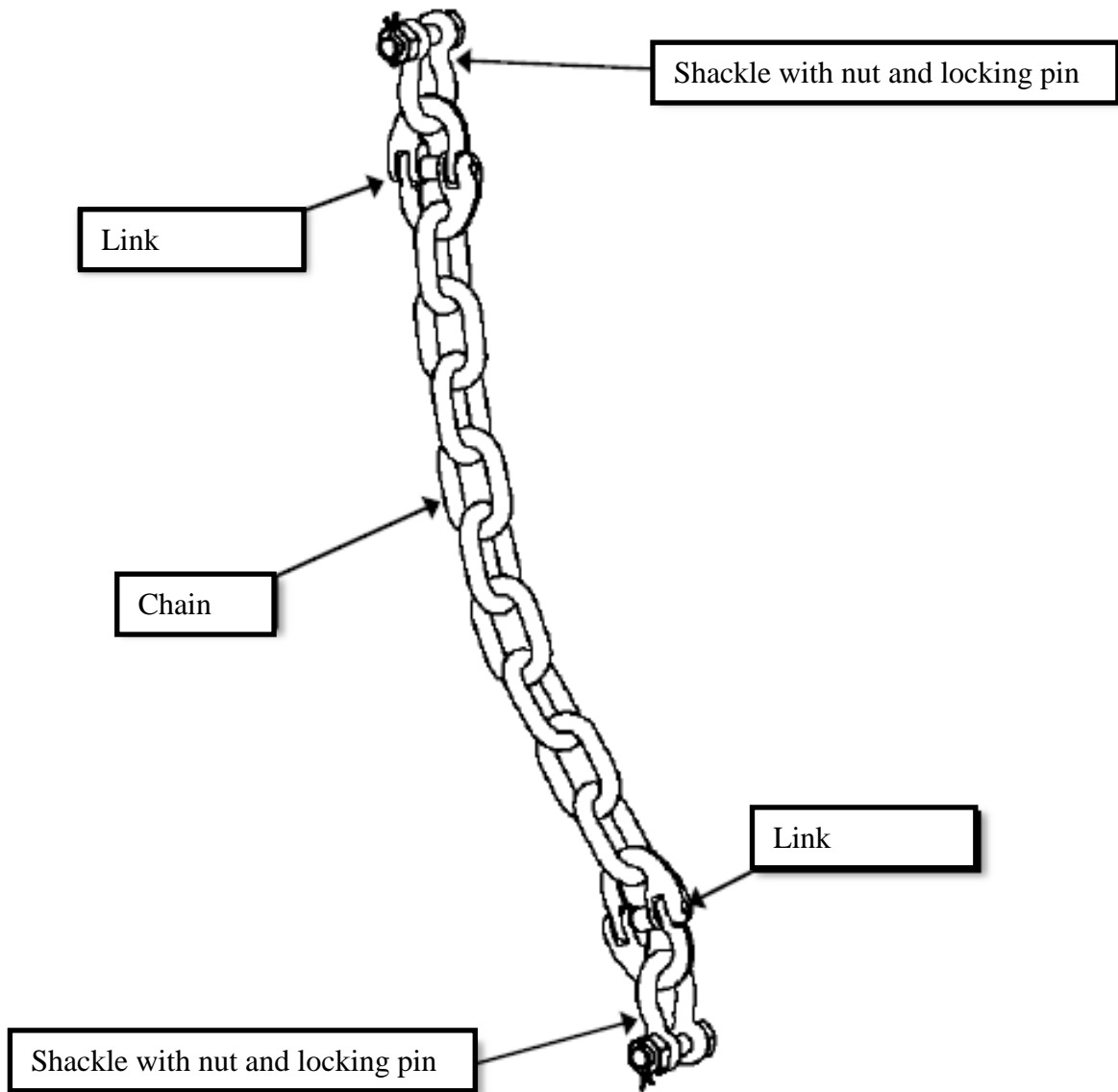
Safety suspension

Safety suspension with wire



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Safety suspension with chain



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Dimensioning instructions for safety suspension

The dimensions of the safety suspension attachment are obtained by multiplying the weight of the vibrator (m) with the gravity acceleration (g) and a safety factor (s) according to the following formula:

$$F = m * g * s \text{ [N] } m \text{ [kg]; } g \text{ [m/s}^2\text{]; } s \text{ [1]}$$

$$m = \text{weight of the selected vibrator [kg], } g = 9.81 \text{ [m/s}^2\text{], } s = 25$$

The calculated value is used to compare against the specified load for the selected wire or chain. F must be at least equal to the specified load on the selected wire or chain.

Example: The vibrator has a weight of 30 kg, $F = 30 * 9.81 * 25 = 7358 \text{ [N]}$ selects a wire or chain with a specified breaking load greater than 7.4 kN.

Other components to be included in the safety suspension are chosen regarding to calculated and selected wire or chain.

Motivation and reasoning of safety factor s

Part of the intentions of the instruction is to provide the conditions for an equivalent assembly and simplify the control of safety equipment. This reasoning is based on Swedish standard for personal fall protection – Anchor devices, SS-EN 795: 2012 and paragraph 5.3.4.

SVENSK STANDARD SS-EN 795:2012

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ICS: 13.340.60; 13.340.99



Personlig fallskyddsutrustning – Förankringsutrustning

Personal fall protection equipment – Anchor devices

5.3.4 Static strength

Install the anchor device in or on the static test apparatus specified in 5.2.3. Apply a static load of $(12 \text{ }_0^{+1}) \text{ kN}$ for $(3 \text{ }_0^{+0.25}) \text{ min}$; or, where any load bearing element or component is made from non-metallic material(s) and where evidence of durability is not provided by the manufacturer, $(18 \text{ }_0^{+1}) \text{ kN}$ for $(3 \text{ }_0^{+0.25}) \text{ min}$. Check that the anchor device holds the load.

Calculations on this type of load impact are possible to perform, however, the result of the estimated time of braking is affected, which gives an uncertain and coarse response. The braking time is affected by the performance of the assembly structure and it's included components material properties.

By testing it is possible to determine how different heights and weights affect the safety device and thus provide a better basis for the safety factor estimation and it is also possible to see how wires or chains affect the result. As a comparison, it is possible to see how attachment of personal fall protection equipment is tested, which is carried out by test load with a static load of 12 kN (approximately 1200 kg) for 3 minutes. It gives a safety factor of about 15 for a person weighing 80 kg.

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The chosen security factor s has a high margin of error and a low uncertainty level, since it is supposed to only provide details through calculations and provide a good margin of safety as well as smaller and lighter components.

Recommends mounting a separate lifting eyelet to avoid blending the requirements of lifting devices with the requirements to be made for safety suspension devices.

Dimensioning and detailed design of included components in the safety suspension must be performed on each individual assembly. When designing a safety suspension, the material properties must be confirmed for the vibrator lifting eyelet and safety fastening, as well as for components included in the safety suspension attachment (screw, nut, wire, chain, etc.).

Lift and safety attachment

The upper attachment point may be used when lifting the vibrator when mounted or disassembled. The attachment point should primarily provide a good security.

Suggestions for improvements

LKAB carries out continual improvements in accordance with the LKAB quality policy (SS-ISO 10006:2003, sections 8.2 and 5.2.7) and this also applies to instructions and codes of practice.

Comments and suggested improvements are welcome at the following e-mail address:

instructions@lkab.com

The LKAB internal address in Outlook: *SE SM Anvisningar LKT*

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Appendix

Vibrator with safety suspension of wire or chain.

