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Machines for compacting waste materials or recyclable fractions — Compactors — Safety requirements

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee MCE/3/16, Recycling machines.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Machines de compactage pour déchets ou matières recyclables - Compacteurs - Prescriptions de sécurité

Maschinen zum Verdichten von Abfällen oder recyclebaren Materialien - Verdichter - Sicherheitsanforderungen

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Foreword

This document (EN 16486:2014) has been prepared by Technical Committee CEN/TC 397 “Project Committee - Baling presses - Safety requirements”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by January 2015 and conflicting national standards shall be withdrawn at the latest by January 2015.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive.

For relationship with EU Directive, see informative Annex ZA, which is an integral part of this document.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

This European Standard is a type C standard as stated in EN ISO 12100:2010.

The machinery concerned and the extent to which hazards, hazardous situations and hazardous events are covered are indicated in the scope of this document.

When provisions of this type C standard are different from those which are stated in type A or B standards, the provisions of this type C standard take precedence over the provisions of the other standards for machines that have been designed and built in accordance with the provisions of this type C standard.

1 Scope

This European Standard specifies the safety requirements for the design, manufacture and information for the safe use of compactors that compact waste material or recyclable fractions (e. g. paper, plastics, textiles, cans, cardboard, mixed waste), hereafter referred to as materials.

This European Standard applies to:

— compactors using a horizontally moving screw, pendulum or plate as compacting part and where the materials move horizontally; and

— compactors that are mechanically fed and/or fed by hand.

These compactors can be:

— static compactors;

— transportable compactors;

— traversing systems.

The scope includes:

— any integral mechanical feed equipment (e.g. bin lift);

— feed hoppers/openings;

— any integral pre-conditioning equipment in the hopper (e.g. perforators, pre-crushing devices and shredders);

— any integral material flow control equipment;

— the interface between the compactor and any feed equipment (except those excluded from the scope).

The scope of this European Standard does not cover:

— compactors that are covered by EN 1501 (all parts);

— underground compactors, however if these compactors can be used above ground this standard applies;

— compactors using thermal technologies for compaction;

— vacuum compactors;

— compactors where materials are compacted vertically;

— containers for static compactors, however the interface between the compaction unit and the container is included;

— bins in which materials are collected for feeding into the compactor;

— any up-stream pre-treatment equipment that is not integral to the machine and is used to treat the materials before they are fed into the feed opening of the compactor;

— vehicles including lifting equipment used to collect and transport the compactor or container;

— cranes, lift trucks or other transportable plant used to load materials into the feed hopper/opening and the hazards arising out of using this equipment to load;

— any suction or dust control equipment.

This European standard does not cover the lifting and transport of transportable compactors.

This European Standard does not apply to hazards arising from the materials being processed (e.g. asbestos, clinical waste, aerosol containers).

All hazards mentioned in Clause 4 are dealt with in this European Standard.

This European Standard is not applicable for compactors which are manufactured before the date of its publication as an EN.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 349:1993+A1:2008, *Safety of machinery - Minimum gaps to avoid crushing of parts of the human body*

EN 574:1996+A1:2008, *Safety of machinery - Two-hand control devices - Functional aspects - Principles for design*

EN 620:2002+A1:2010, *Continuous handling equipment and systems - Safety and EMC requirements for fixed belt conveyors for bulk materials*

EN 953:1997+A1:2009, *Safety of machinery - Guards - General requirements for the design and construction of fixed and movable guards*

EN 1837:1999+A1:2009, *Safety of machinery - Integral lighting of machines*

EN 60204-1:2006, *Safety of machinery - Electrical equipment of machines - Part 1: General requirements*

EN 60529:1991, *Degrees of protection provided by enclosures (IP Code)*

EN 61496-1:2004, *Safety of machinery - Electro-sensitive protective equipment - Part 1: General requirements and tests*

CLC/TS 61496-2:2006, *Safety of machinery – Electro-sensitive protective equipment – Part 2: Particular requirements for active opto-electronic protective devices (AOPDs) (IEC 61496-2:2006)*

CLC/TS 61496-3:2008, *Safety of machinery – Electro-sensitive protective equipment – Part 3: Particular requirements for active opto-electronic protective devices responsive to diffuse reflection (AOPDDR) (IEC 61496-3:2008)*

EN 62262:2002, *Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code) (IEC 62262:2002)*

EN ISO 3744:2010, *Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Engineering methods for an essentially free field over a reflecting plane (ISO 3744:2010)*

EN ISO 3746:2010, *Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Survey method using an enveloping measurement surface over a reflecting plane (ISO 3746:2010)*

EN ISO 3747:2010, *Acoustics - Determination of sound power levels and sound energy levels of noise sources using sound pressure - Engineering/survey methods for use in situ in a reverberant environment (ISO 3747:2010)*

EN ISO 4413:2010, *Hydraulic fluid power - General rules and safety requirements for systems and their components (ISO 4413:2010)*

EN ISO 4871:2009, *Acoustics - Declaration and verification of noise emission values of machinery and equipment (ISO 4871:1996)*

EN ISO 9614-2:1996, *Acoustics - Determination of sound power levels of noise sources using sound intensity - Part 2: Measurement by scanning (ISO 9614-2:1996)*

EN ISO 11200:2014, *Acoustics - Noise emitted by machinery and equipment - Guidelines for the use of basic standards for the determination of emission sound pressure levels at a work station and at other specified positions (ISO 11200:2014)*

EN ISO 11201:2010, *Acoustics - Noise emitted by machinery and equipment - Determination of emission sound pressure levels at a work station and at other specified positions in an essentially free field over a reflecting plane with negligible environmental corrections (ISO 11201:2010)*

EN ISO 11202:2010, *Acoustics - Noise emitted by machinery and equipment - Determination of emission sound pressure levels at a work station and at other specified positions applying approximate environmental corrections (ISO 11202:2010)*

EN ISO 11204:2010, *Acoustics - Noise emitted by machinery and equipment - Determination of emission sound pressure levels at a work station and at other specified positions applying accurate environmental corrections (ISO 11204:2010)*

EN ISO 12100:2010, *Safety of machinery - General principles for design - Risk assessment and risk reduction (ISO 12100:2010)*

EN ISO 13849-1:2008, *Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design (ISO 13849-1:2006)*

EN ISO 13850:2008, *Safety of machinery - Emergency stop - Principles for design (ISO 13850:2006)*

EN ISO 13855:2010, *Safety of machinery - Positioning of safeguards with respect to the approach speeds of parts of the human body (ISO 13855:2010)*

EN ISO 13856-1:2013, *Safety of machinery - Pressure-sensitive protective devices - Part 1: General principles for design and testing of pressure-sensitive mats and pressure-sensitive floors (ISO 13856-1:2013)*

EN ISO 13856-2:2013, *Safety of machinery - Pressure-sensitive protective devices - Part 2: General principles for design and testing of pressure-sensitive edges and pressure-sensitive bars (ISO 13856-2:2013)*

EN ISO 13857:2008, *Safety of machinery - Safety distances to prevent hazard zones being reached by upper and lower limbs (ISO 13857:2008)*

EN ISO 14119:2013, *Safety of machinery - Interlocking devices associated with guards - Principles for design and selection (ISO 14119:2013)*

EN ISO 14122-1:2001, *Safety of machinery - Permanent means of access to machinery - Part 1: Choice of fixed means of access between two levels (ISO 14122-1:2001)*

EN ISO 14122-2:2001, *Safety of machinery - Permanent means of access to machinery - Part 2: Working platforms and walkways (ISO 14122-2:2001)*

EN ISO 14122-3:2001, *Safety of machinery - Permanent means of access to machinery - Part 3: Stairs, stepladders and guard-rails (ISO 14122-3:2001)*

EN ISO 14122-4:2004, *Safety of machinery - Permanent means of access to machinery - Part 4: Fixed ladders (ISO 14122-4:2004)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 12100:2010 and the following apply.

3.1
compactor
machine, consisting of a compaction unit and container that compacts loose materials into a container (materials can include, but are not limited to, paper, plastics, textiles, cans, cardboard and mixed waste)

Note 1 to entry: A compactor can consist of e. g. a control system and control station, mechanical feed equipment such as a bin lift, feed hopper, compaction chamber, compacting equipment, container and any associated container closing device. Compactors can be manually or mechanically fed.

Note 2 to entry: Compactors can be:

— static, i. e. the compaction unit is fixed at one location and the container is transportable;

— transportable and used at different locations, i. e. it is transported to and from different locations by e.g. road vehicles;

— part of a traversing system.

3.1.1
static compactor
compactor on which the compaction unit is fixed and the container is not integral with the compactor

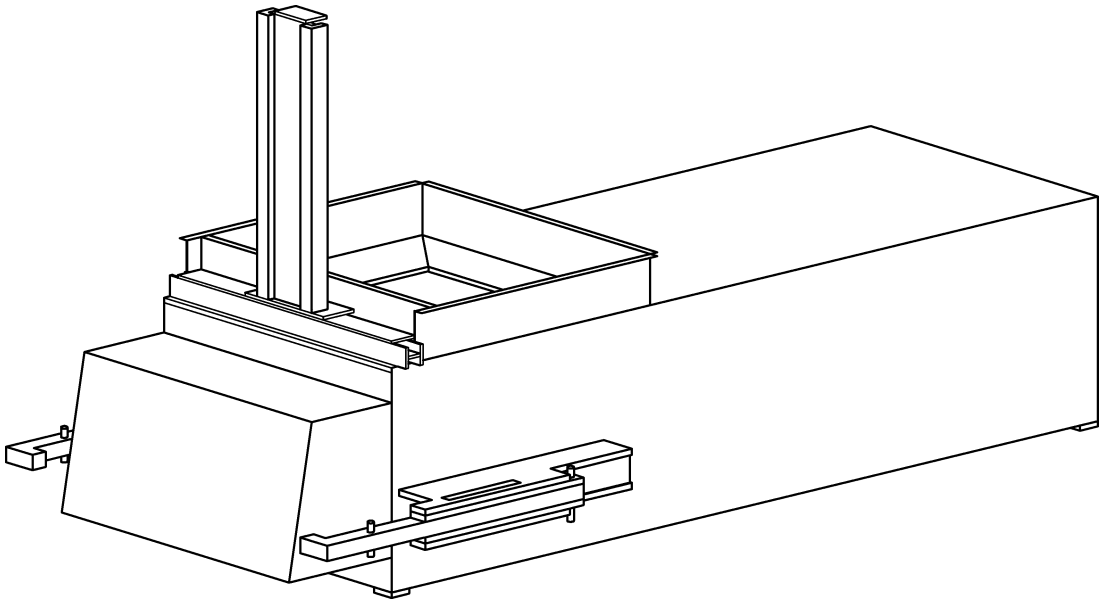

Figure 1 — Example of a static compactor

3.1.2
transportable compactor
self-contained compaction unit and container, which can be transported as a complete unit

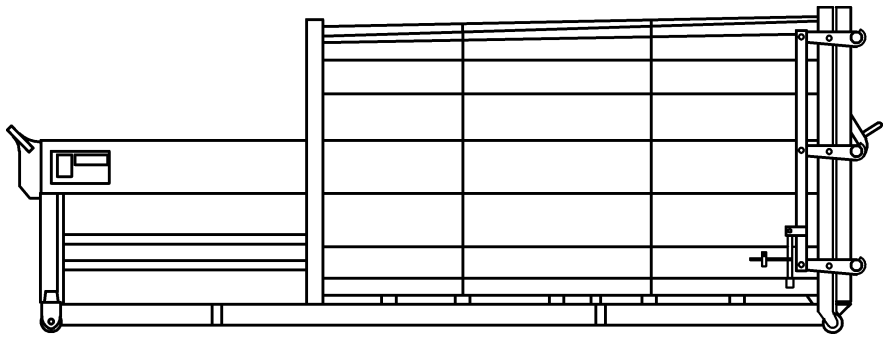

Figure 2 — Example of a transportable compactor

3.2
container
the material-receiving container into which the loose material is compacted by the compaction unit

Note 1 to entry: On a transportable compactor the container is an integral part of the compactor.

Note 2 to entry: On a static compactor the container is not an integral part of the compactor, however the interface between the compaction unit and the container is covered in this standard, see Scope.

3.3
coupling device
mechanism for clamping the container to the main body of the compaction unit and holding it in position

3.4
traversing system
installation composed of:

— either several containers that are placed on a carrier system that traverses (e.g. on rails) in front of a static compactor;

— or several containers that are placed in front of a traversing compactor (e.g. on rails)

Note 1 to entry: Where the containers traverse only the compactor, the carrier system and the interface between the compactor and containers are covered by this standard

3.5
integral pre-conditioning equipment
equipment that is mounted/fixed to the compactor and is used to treat the material being fed into the compactor to help compaction, e.g. perforators, rufflers, pre-crushers and shredders

Note 1 to entry: These devices can be fixed, or inserted into and retracted from, the feed hopper.

3.6
integral material flow control equipment
equipment that is mounted/fixed to the compactor and helps material in the feed opening flow into the compaction chamber and/or prevent blockages or bridging, e.g. forced feeding device for screw compactors

3.7
feed equipment
equipment used for feeding materials to be compacted into the compaction chamber

3.8
integral feed equipment
mechanical feed equipment i.e. conveyor or bin lift that is:

— mounted/fixed to the compactor;

— the power supply and control system of which are linked into the compactors systems

3.9
bin lift
mechanical feed equipment for lifting a bin containing materials and tipping the contents into the compaction chamber of the compactor

3.10
bin
container, usually fitted with wheels, in which material are collected ready for feeding into the compaction chamber of the compactor

3.11
feed hopper
chute through which materials being fed to the compactor are guided into the compaction chamber

3.12
feed opening
opening through which materials are fed into the compaction chamber

3.13
manual feeding
loading materials directly into the feed hopper/opening by hand

3.14
mechanical feeding
loading materials into the feed hopper/opening by mechanical means, e.g. conveyors, bin lifts

3.15
compaction chamber
chamber into which material is fed and in which one or more compacting parts move to press and compact the material into the receiving container

3.16
compacting part
device for the compacting process/movement; the device can be a plate, a screw or a pendulum

3.17
compacting equipment
all components directly involved in pressing the loose materials into the container and compacting them inside the container (e.g. hydraulic system, compacting parts, compaction chamber)

3.18
compaction unit
the part of the compactor containing the compacting equipment

3.19
cycle of the compacting part
complete forward and reverse movement of the compacting part or a complete 360° rotation

3.20
multiple cycle
operating mode in which the machine cycles during a pre-set time, then stops automatically

3.21
automatic initiation of cycles
operating mode in which the successive cycles of compacting equipment are initiated by either a sensing device detecting the presence of materials to be compacted or by time delay

3.22
container closing device
device inserted across the container feed opening to prevent the compacted materials falling out of the container when it is separated from the compaction unit for transport. This device can be e. g.:

— a series of pins and tubes, or

— a frame, or

— cables, or

— a power or manually-operated door

3.23
discharge door
door that allows emptying compacted materials out of the container

3.24
control station
place from which the compactor is started, stopped or controlled by an operator

3.25
access platform
permanent platform that allows access at height for operating and feeding the compactor (including viewing the interior of the feed hopper and/or compacting chamber), troubleshooting or maintenance

Note 1 to entry: Access platforms can be fixed to the compactor, floor or building structure.

3.26
work station
a position in the vicinity of the machine which is intended for the operator

EXAMPLES: control station, feeding position, bin lift operation control station.

3.27
maintenance
combination of all technical, administrative and managerial actions during the life cycle of an item intended to retain it in, or restore it to, a state in which it can perform the required function

[SOURCE: 2.1 of EN 13306:2010]

3.28
troubleshooting
identification and rectification of operational failures (e. g. clearing blockages or removing unwanted items from the compaction chamber)

3.29
sensitive protective equipment (SPE)
equipment for detecting persons or parts of persons which generates an appropriate signal to the control system to reduce risks to the persons detected

Note 1 to entry: The signal can be generated when a person or part of a person goes beyond a predetermined limit – for example enters a hazard zone – (tripping) or when a person is detected in a predetermined zone (presence sensing), or in both cases.

[SOURCE: 3.28.5 of EN ISO 12100:2010]

4 List of significant hazards

Table 1 lists the significant hazards that are present on compactors. It cross-references the subclauses of this standard in which the corresponding safety requirements and/or protective measures are specified.

Table 1 — List of significant hazards

	Significant hazards	Applicable subclauses
4.1	**Mechanical hazards**	
4.1.1	**General** Impact or crushing when the compactor or container is being placed into its normal operating position. Impact, crushing or shearing while clearing blockages. Impact, crushing or shearing by unintended movement of the compacting parts and any powered vertically operating ancillary equipment attached to the compactor (e.g. powered dejamming or closing device). Injury during cleaning and maintenance procedures. Impact or crushing by movement of a power-operated movable guard.	5.1.1, 5.2.4, 7.2.2, 7.2.4, 7.2.5, 7.2.8
4.1.2	**Feed equipment area** Impact, crushing and shearing between the bin lift and the compactor, or between moving parts of the bin lift, or being picked up by moving parts of the bin lift mechanism. Drawing-in and crushing between moving transmission parts of the bin lift. Being struck by the bin in the event of it falling out of the bin lift while in a raised position. Being struck by material falling from the bin when it is in a raised position. Falling onto the conveyor. Falling when walking on conveyors. Drawing-in and crushing between moving transmission parts of conveyors. Being struck by material falling from the conveyor.	5.1.1.2, 5.1.2, 5.2.1, 5.2.4, 7.2.4, 7.3.2

4.1.3	**Feed hopper/opening area and compaction chamber** Reaching into, or falling down the feed hopper/opening into the compaction chamber during loading, cleaning, troubleshooting or maintenance, followed by crushing or shearing by the compacting parts. Crushing, shearing, drawing-in or impact by integral pre-conditioning/material flow control equipment in the feed hopper including residual rotation during retraction. Crushing and shearing between the integral pre-conditioning equipment and fixed parts when the equipment is inserted into, or retracted from, the feed hopper. Crushing, shearing or impact by the compacting parts during compaction. Drawing into the screw by material on screw compactors. Crushing and shearing by the compacting parts after entering the feed hopper/opening for troubleshooting, cleaning and maintenance. Crushing or shearing by the compacting parts after gaining access into the compaction chamber through maintenance and inspection openings. Crushing, shearing or impact by unintended movement of the compacting part caused by failure of an electrical or hydraulic component. Impact from being struck by objects ejected from the compactor. Being struck by materials being fed into the compaction chamber during troubleshooting, cleaning or maintenance. Being struck or buried by material when clearing a blockage in a feed hopper equipped with an access door. Impact due to a horizontally-hinged lid or door, used for closing the feed hopper/opening, unexpectedly falling into the closed or open position.	5.1.1.1, 5.1.1.2, 5.1.3, 5.2.1, 5.2.4, 5.3, 5.4, 7.2.2, 7.2.5, 7.3.2
4.1.4	**Area behind the compacting parts** Crushing by moving parts associated with the drive mechanism or hydraulic ram powering the compacting parts. Crushing and/or shearing between the compacting parts and fixed parts.	5.1.1.2, 5.1.4, 5.2.4,
4.1.5	**Container closing devices** Impact or crushing by moving parts of the container closing devices. Impact, crushing or shearing by moving compacting parts where it is possible to reach through holes designed for container closing devices.	5.1.1.2, 5.1.5, 5.2.4, 7.2.9
4.1.6	**Interface between compaction unit and container on static compactors** Impact or crushing by the closing and opening of the coupling device. Crushing or shearing by the compacting parts after gaining access into the compaction chamber through the opening at the interface between the compaction unit and the container. Impact caused by a breakage of container closing devices that consist of pins (e.g. Polytetrafluoroethylene (PTFE) pins) or cables.	5.1.6, 5.2.4, 7.2.4, 7.2.9
4.1.7	**Emptying process of transportable compactors** Impact or crushing as a result of the discharge door opening. Impact or crushing due to sudden opening of the discharge door as a result of pressure from the compacted materials or as a result of failure of the main closing system.	5.1.7
4.1.8	**Handling of transportable compactors** Impact, shearing or crushing from handling transportable compactors.	5.1.8, 7.2.10

4.1.9	**Traversing systems** Impact or crushing from the traversing operation. Crushing and shearing between moving and fixed/moving parts. Impact from falling off the traversing compactor. Impact from materials being loaded during traversing. Electric shock or burns from electrical components. Crushing, shearing or impact as a result of derailment. Tripping or falling on the guiding device for a traversing system. Tripping, entanglement or electrical hazards by cables or hoses dragging on the floor or becoming entangled in the compactor.	5.1.9, 5.2.2, 5.2.4, 5.3, 7.2.9
4.2	**Hazards due to failures in the control system or unexpected start-up**	5.2 7.2.2
4.3	**Electrical hazards** Electric shock or burns due to direct or indirect contact with live parts.	5.3, 7.2.2
4.4	**Hazards from hydraulic equipment** Hazards arising from unintentional release of liquids under pressure from the hydraulic system, particularly from hoses and their fittings.	5.4 7.2.2
4.5	**Slip, trip and fall hazards** Impact resulting from tripping or slipping on access platforms and/or associated steps or stairways provided at working positions to which access is needed for operation, maintenance, cleaning or troubleshooting. Impact due to an external fall from height from any raised working position to which access is required for operation, maintenance, cleaning or troubleshooting.	5.5
4.6	**Hazards generated by noise** Hearing loss, tinnitus, physiological disorders, loss of balance or awareness, tiredness, accidents due to interference with auditory signals and speech communication due to noise, generated by movement of the compacting equipment, integral pre-conditioning, material flow control and feed equipment.	5.6, 7.2.3, Annex A
4.7	**Hazards due to neglecting ergonomic principles in the design of the machine** Musculoskeletal disorders resulting from: — repetitive efforts to load materials into the feed hopper or compaction chamber; — bending, lifting and reaching when installing or removing container closing devices or as a result of excessive efforts to put the container closing devices into place when the container is overfilled; — bending, lifting and reaching when installing or removing coupling devices; — excessive efforts or bad postures when opening the discharge door; — poor ergonomic design of traversing systems.	5.7
4.8	**Hazards due to poor or non-existent organisation, training or instructions**	7

5 Safety requirements and/or protective measures

5.1 Mechanical hazards

5.1.1 General

5.1.1.1 Basic requirements

Compactors shall comply with the safety requirements and/or protective measures of this clause. In addition, the machines shall be designed in accordance with the principles of EN ISO 12100:2010 for relevant but not significant hazards, which are not dealt with by this document (e. g. sharp edges).

It is advisable that a dialogue take place between the manufacturer and the user regarding the installation and positioning of the machine (see informative Annex B).

Compactors shall be designed and constructed to allow safe access for cleaning. Access points shall be safeguarded in accordance with EN 953:1997+A1:2009. Other design features (e. g. collection trays) should be considered to reduce the need for access to clean.

Compactors shall be designed in such a way that mirrors or closed circuit television cameras can be installed in order to give the operator a good view into the feed hopper or the compaction chamber. Compactors with closed feed hoppers/openings are exempted from this requirement.

The control station shall be arranged to allow the operator a good view of the compactor, especially of the conveyor or bin lift and the feed hopper/opening. A good view can be direct and/or with visibility aids.

Compactors shall be designed and constructed so that the risk of blockages of the material being processed is reduced to the lowest level.

NOTE Measures for reducing the risk of blockages include e. g.:

— where a series of conveyors is used to transfer materials to the feed hopper/opening then the speed should increase from one conveyor to the next;

— swan neck conveyors;

— level detection sensors monitoring the feeding and the compacting processes;

— automatic diversion flaps and chutes that divert the continuously fed material elsewhere;

— material levelling devices that act to limit the depth of the material travelling on the conveyor;

— feed hoppers with smooth internal surfaces that include no ledges (on which material might bridge);

— feed hoppers that have a uniform cross section (as opposed to a reducing cross section) for the whole of their length;

— on compactors fed by bin lifts, ensuring that the internal volume of the compacting chamber and/or hopper is greater than the volume of the biggest bin;

— on compactors fed by bin lifts where the feed hopper will not take the whole volume of the bin, ensuring that the bin lift cannot tip the contents of a bin into the feed hopper until the compacting part is fully retracted;

— retention devices to prevent the compacted material moving backwards into the compaction chamber (e.g. flaps, non- return safety catches or teeth).

Compactors shall be designed and constructed so that any blockages that do occur can be cleared without a person having to gain direct access onto, or into, the hazard areas listed in 4.1.3, e. g. by providing a powered dejamming device (such as a pneumatic ram) above the feed hopper. If this is not possible, see 7.2.8.

Unintended movement of the compacting parts and any powered vertically operating ancillary equipment (e.g. powered dejamming or closing device) attached to the compactor shall be prevented by one of the following:

— a check valve fitted to the hydraulic or pneumatic cylinders to protect against dangerous movement in the event of a hose or pipe failure in the hydraulic or pneumatic system;

— a self-locking irreversible transmission with mechanical drive;

— a spring-applied brake with motor fitted to the mechanical drive;

— a mechanical restraint device.

Compactors shall be equipped with a lockable power isolator for maintenance. See also 7.2.5.

Maintenance and inspection doors shall be designed as interlocking guards in accordance with 5.1.1.2 and 5.2.4.

5.1.1.2 Safeguards

The design of the compactor shall ensure that wherever possible crushing, shearing, impact, puncture and drawing-in points are eliminated. Where these hazards cannot be eliminated, safeguarding shall be applied using one or a combination of the following.

— Fixed guards that are in accordance with EN 953:1997+A1:2009.

— Movable interlocking guards that are in accordance with EN 953:1997+A1:2009 and EN ISO 14119:2013. The interlocking guards shall be positioned in accordance with EN ISO 13855:2010 so that opening one of them stops the movement of any dangerous part of machinery before any part of a person enters the danger zone.

— Sensitive protective equipment (SPE) as defined in EN ISO 12100:2010, 3.28.5, that is in accordance with the relevant standards: EN ISO 13855:2010, EN ISO 13856-2:2013, EN 61496-1:2004, CLC/TS 61496-2:2006 and/or CLC/TS 61496-3:2008. If SPE will only work within a range of temperatures then the manufacturer shall specify this range in the instruction handbook. See 7.2.2. A dialogue between the manufacturer and user should take place to identify the correct range of temperatures for the environment the machine will be working in (see Annex B).

Movable guards shall not be self-closing; closing a movable guard shall be by intentional action. When they are open movable guards shall remain fixed to the body of the compactor.

Movable interlocking guards that are power-operated shall, unless the powered movement is incapable of causing injury (i.e. closing force at leading edge ≤ 75 N), be fitted with trip devices to their leading edges that are in accordance with EN ISO 13856-2:2013. When actuated the device shall immediately stop or reverse the closing movement of the guard. See also 5.2.4. Reversing the movement shall not create further hazards.

Where material is fed into a compactor from a vehicle, normal safeguards at the feed hopper/opening may be made inoperative only if alternative protective devices that prevent or protect people getting into the danger zone are installed (e.g. laser, SPE, radar sensors). This safety function shall be in accordance with PL_r d, see 5.2.4.

5.1.1.3 Safety distances

Minimum gaps to avoid crushing shall comply with EN 349:1993+A1:2008.

Positioning of protective equipment shall comply with EN ISO 13855:2010. See also 7.2.4.

Any opening in fixed or movable guards shall comply with EN ISO 13857:2008, Tables 3, 4 and 7.

5.1.2 Feed equipment area

5.1.2.1 Compactors fed by integral bin lifts

5.1.2.1.1 General

The bin lift shall be designed to be compatible with the bins that are expected to be used (see e. g. EN 840-1, EN 840-2, EN 840-3 and EN 840-4). It is advisable that a dialogue take place between the manufacturer and user concerning the interface between bin and bin lift. See informative Annex B.

Persons shall be safeguarded against hazards arising from the movement of bin lifts. This shall be achieved by the requirements in 5.1.2.1.2 or 5.1.2.1.3.

NOTE Useful guidance on bin lifts can be found in EN 1501–5:2011.

5.1.2.1.2 Automatically operated bin lifts

On automatically operated bin lifts, i.e. bin lifts that do not require hold-to-run control devices for their operation, access to the moving parts shall be prevented by a combination of fixed guards and/or movable interlocking guards and/or SPE.

The interlocking guard and the SPE shall be in accordance with 5.1.1.2 and movement of the bin lift shall only be possible if the interlocking guard is closed or the SPE is reset and a start command has been given. Where practicable, the guards should be fitted as close as possible to the bin lift to prevent persons remaining in the area of movement of the bin lift.

SPE and interlocking guards shall be positioned in accordance with EN ISO 13855:2010.

The safety function shall be in accordance with PL_r d, see 5.2.4.

5.1.2.1.3 Manually operated bin lifts

On manually operated bin lifts the same protective measures as on automatic bin lifts should be applied. However PL_r c may be used.

Alternatively, it is acceptable to operate the bin lift if the following conditions are met:

— a hold-to-run control or two-hand control device is provided, see also 5.2.4;

— the control position is at a safe distance (as referenced in the appropriate standard, EN ISO 13857:2008 or EN ISO 13855:2010);

— good visibility of the danger zones during the whole travel of the bin lift (i.e. bin lift mechanism, container being lifted, the opposite side of the bin and the surrounding areas) at the control position is ensured;

— the peripheral speed of the lifting device does not exceed 0,5 m/s (measured with the largest bin that is allowed to be lifted);

— a visible and/or audible signal is emitted during the whole travel of the bin lift.

Access to danger zones where the operator does not have good visibility shall be prevented by fixed or interlocking guards.

See also 7.2.4

5.1.2.2 Compactors fed by integral conveyors

Conveyors and their emergency stops shall be in accordance with EN 620:2002+A1:2010.

NOTE For troughed belt conveyors useful guidance can be found in BS 8438.

In case of loading compactors with integral conveyors, the loading area of the conveyor shall be safeguarded by protective structures (e.g. fences, sidewalls of the conveyor or feed hopper that have no footholds) with a minimum height of 1 100 mm.

If the height of the protective structure is less than 1 100 mm from the reference plane then one of the following means shall be used:

— sensitive protective equipment (SPE) e.g. personal detection equipment or transponders, that causes the compactor and the conveyors to stop before a person reaches a distance of 2 m from the highest point of the conveyor, see also 5.2.4

— a hold-to-run control device for conveyors, positioned in such a way that the operator has a good visibility of the danger area, see also 5.2.4

To protect people who have climbed or fallen onto the conveyor, additional emergency stop devices that act in accordance with 5.2.3 shall be provided. These shall be triggered by pull cords positioned above and along the conveyor. It shall be possible to actuate them at the beginning and at the discharge point of the conveyor as well as at least every 3 m along the whole conveyor system.

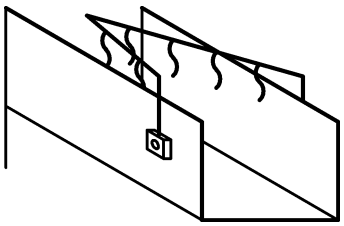

Figure 3 — Example of 'V' configuration pull cords

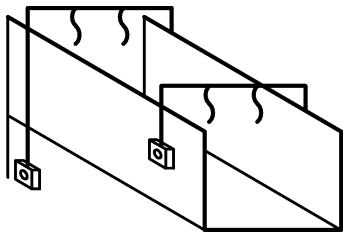

Figure 4 — Example of goalpost configuration pull cords

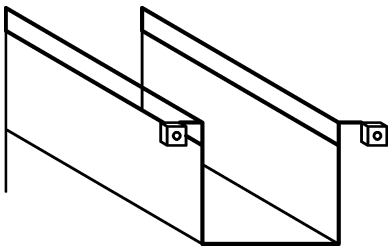

Figure 5 — Example of lateral configuration pull cords

If a danger of material falling down exists, the integral conveyor shall be fitted with fixed guards along the underside of the whole of its length except for the point at which the overspill is allowed to fall to the floor. At this point, a vertical chute or cage shall be fitted to direct the overspill safely to floor level and to prevent people walking into the spill zone.

See also 7.3.2.

5.1.3 Feed hopper/opening area and compaction chamber

5.1.3.1 Prevention of access to the compacting parts, integral pre-conditioning equipment and material flow control equipment on manually-fed compactors

5.1.3.1.1 Compactors with manual initiation of cycles

Access to the moving compacting parts or other dangerous moving parts in the feed hopper or in the compaction chamber shall be prevented by safety distances as specified in EN ISO 13857:2008, Table 2. This can be achieved either by the design of the compactor or by fixed guards and/or movable interlocking guards and/or sensitive protective equipment (SPE) in accordance with 5.1.1.2 and 5.2.4.

Opening the movable guards or activating the SPE shall stop the dangerous movements of the compacting parts and other dangerous parts until the guard has been closed again or the SPE has been reset. See also 5.2.4.

SPE and interlocking guards shall be positioned in accordance with EN ISO 13855:2010.

From the position of the control device for the compacting part, the operator shall have a good view of the danger zones.

If the integral pre-conditioning equipment and/or integral material flow control equipment creates a drawing-in hazard then a pressure sensitive device e.g. a trip bar or trip wire shall be installed at the feeding side of the feed hopper/opening and shall stop the machine when actuated The pressure sensitive device shall be in accordance with EN ISO 13856-2:2013. This safety function shall be in accordance with PL_r d, see 5.2.4.

In the case of screw compactors, additionally a pressure sensitive protective device e. g. a trip bar or trip wire shall be installed at the feeding side of the feed hopper/opening and shall stop the machine when actuated. The pressure sensitive device shall be in accordance with EN ISO 13856-2:2013. This safety function shall be in accordance with PL_r d, see 5.2.4.

To prevent access by unauthorised people measures shall be taken to enclose the feed hopper/opening e. g. a lockable lid or door. The measures taken shall take into account ergonomic principles so that they do not create manual handling hazards when covering or uncovering the feed hopper/opening.

See also 7.2.2 and 7.3.2.

5.1.3.1.2 Compactors with automatic initiation of cycles

Access to the feed hopper/opening area shall be prevented by fully enclosing guards (including the roof). Doors fitted to allow feeding of the compactor shall be designed as interlocking guards in accordance with 5.1.1.2 and 5.2.4.

Interlocking guards shall be positioned in accordance with EN ISO 13855:2010.

Opening the interlocking guards shall stop the dangerous movements of compacting parts and other moving parts and inhibit the automatic cycle initiation system until the guard has been closed again This safety function shall be in accordance with PL_r d, see 5.2.4.

When the interlocking guards are closed again an actuator shall be activated by the operator to allow the automatic cycle initiation system to return to its normal mode of operation. From the position of the actuator, the operator shall have a good view of the danger zones.

See also 5.2.1, 7.2.2 and 7.3.2.

5.1.3.2 Prevention of access to compacting parts, integral pre-conditioning equipment and material flow control equipment on mechanically-fed compactors

5.1.3.2.1 Compactors with manual initiation of cycles

Access to the moving compacting parts or other dangerous moving parts in the feed hopper or in the compaction chamber shall be prevented by safety distances as specified in EN ISO 13857:2008, Table 2. This can be achieved either by the design of the compactor or by fixed guards and/or movable interlocking guards and/or sensitive protective equipment (SPE) in accordance with 5.1.1.2 and 5.2.4.

Opening the interlocking guards or activating the SPE shall stop the dangerous movements of the compacting parts and other dangerous parts until the guard has been closed again or the SPE has been reset. See also 5.2.4.

SPE and interlocking guards shall be positioned in accordance with EN ISO 13855:2010.

From the position of the control device for the compacting part, the operator shall have a good view of the danger zones.

See also 7.2.2 and 7.3.2.

5.1.3.2.2 Compactors with automatic initiation of cycles

Access to the feed hopper/opening area shall be prevented by fully enclosing guards (including the roof). Doors fitted to allow feeding of the compactor shall be designed as interlocking guards in accordance with 5.1.1.2 and 5.2.4.

Interlocking guards shall be positioned in accordance with EN ISO 13855:2010.

Opening the interlocking guards shall stop the dangerous movements of compacting parts and other moving parts and inhibit the automatic cycle initiation system until the guard has been closed again. This safety function shall be in accordance with PL_r d, see 5.2.4.

When the interlocking guards are closed again an actuator shall be activated by the operator to allow the automatic cycle initiation system to return to its normal mode of operation. From the position of the actuator, the operator shall have a good view of the danger zones.

See also 5.2.1, 7.2.2 and 7.3.2.

For conveyor fed compactors an opening for feeding is acceptable if the height of the lower edge of the opening is 1 400 mm minimum above the reference plane. In addition, the reach over distance through the feed hopper/opening to the compacting part or other dangerous moving parts shall be in accordance with EN ISO 13857:2008, Table 2.

For conveyor fed compactors safeguards in accordance with 5.1.1.2 and 5.2.4 shall be provided to prevent access into the feed hopper/opening. The safeguards shall be designed so that no intervention (e. g. clearing blockages) is possible at the feed hopper/opening when the machine is in operation.

This safety function shall be in accordance with PL_r d, see 5.2.4.

5.1.3.3 Prevention of access to compacting parts, integral pre-conditioning equipment and material flow control equipment on mechanically and manually fed compactors

For compactors which are designed and constructed to be mechanically and manually fed the requirements of 5.1.3.1 and 5.1.3.2 shall be fulfilled.

5.1.3.4 Prevention of access to moving parts during insertion and retraction of the integral pre-conditioning equipment or material flow control equipment

Access to of the integral pre-conditioning and/or material flow control equipment while it is inserted into and retracted from in the feed hopper shall be prevented as follows:

— in accordance with 5.1.1.2 and 5.2.4; or

— insertion and retraction shall only be possible while the equipment is stopped. If the movement is powered, the crushing hazard when inserting or retracting the equipment shall be minimised (e. g. by means of a two-hand control device or hold-to-run control device). See also 5.2.4.

5.1.3.5 Protection against lids or doors falling open or closed

Any horizontally-hinged lid or door used for closing the feed hopper/opening shall be designed to prevent unintended closing or opening movements e.g. by a spring weight compensation system or by a mechanical latch that becomes effective with each movement of the lid or door or by a gas strut/damper. See also 7.2.5.

Lids or doors shall be designed to ensure safe operation by users e.g. to prevent sudden opening.

5.1.3.6 Protection against being struck or buried by material when clearing a blockage in a feed hopper equipped with an access door

See 7.3.2.

5.1.4 Area behind the compacting parts

Access to dangerous moving parts of the drive mechanism or ram shall be prevented by fixed or movable interlocking guards in accordance with 5.1.1.2. The safety function shall be in accordance with PL_r d, see 5.2.4.

5.1.5 Container closing devices

Static compactors shall allow for the positioning of container closing devices as defined in 3.22.

Where pins and tubes are used for closing off the container, the compactor shall either have:

— a design where the tubes are retained in the compacting part; or

— a design to prevent the tubes moving.

For openings for pinning off devices EN ISO 13857:2008, Table 4 shall apply. Where this is not practicable access to the dangerous parts shall be prevented by e.g. movable guards or retractable covers or pins.

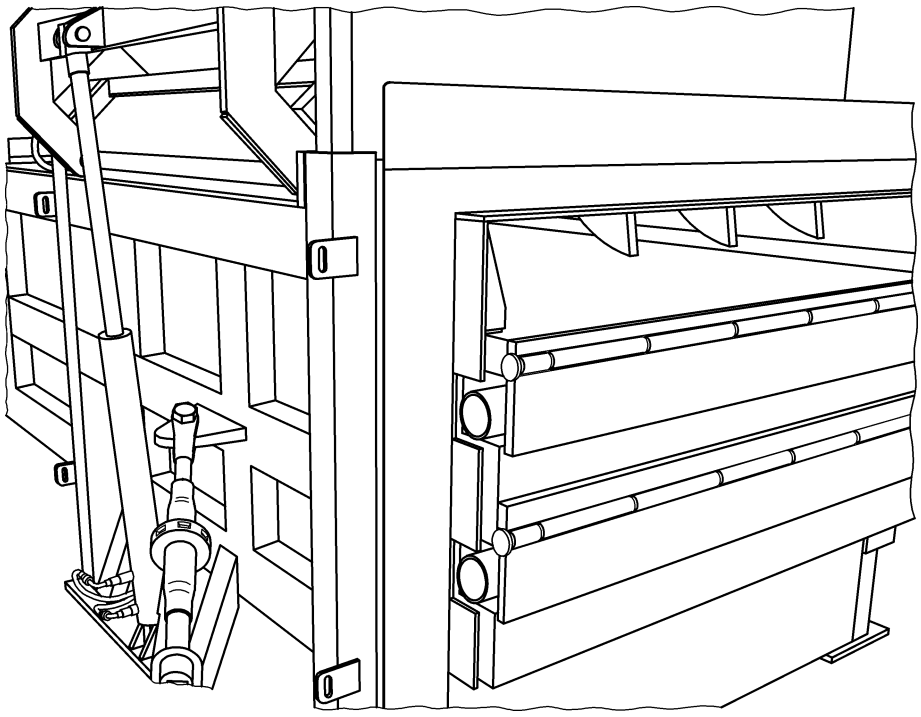

Figure 6 — Example of pins and tubes used for closing off the container

If it is necessary for container closing to move the compacting part to a defined intermediate position, this movement shall only be possible with guards closed. See also 5.2.4. If movement is controlled by a manual control actuator then the intermediate position of the compacting part shall be clearly marked.

Access to the powered parts of the container closing device shall be prevented by movable interlocking guards that are in accordance with 5.1.1.2 and 5.2.4.

See also 7.2.9.

5.1.6 Interface between compaction unit and container on static compactors

The container coupling device shall be designed so that it cannot be released suddenly or swing down unexpectedly.

The operator shall have good visibility of the danger zone. Good visibility can be provided by e.g. direct line of sight, mirrors or CCTV.

On static compactors with manually activated powered coupling and decoupling of containers:

— where the control position for the coupling device is positioned at least 2 m from the danger area then a hold-to-run control device shall be used to activate the movement;

— where the control position for the coupling device is positioned at less than 2 m from the danger area then a two-hand control device, compliant with EN 574:1996+A1:2008 and positioned in accordance with EN ISO 13855:2010 shall be provided.

On static compactors equipped with fully automatic coupling and decoupling devices, access to the movement of the coupling/decoupling devices shall be prevented by a combination of fixed and/or interlocking guards. Opening interlocking guards shall stop all dangerous movements.

If the container is removed from the compactor an interlock shall be used to prevent the compactor from operating.

See also 5.2.4, 7.2.4 and 7.2.9.

5.1.7 Emptying process of transportable compactors

Discharge doors that are vertically hinged shall be designed so that they cannot open suddenly and in excess of the design opening width.

Discharge doors that are top hinged shall be fitted with a propping device to hold the door in the open position. This allows safe access into the container for cleaning or maintenance. The propping device shall be designed so that it can be operated easily and safely. It shall not leave its support position unintentionally. An opening of at least 500 mm between the lowest edge of the door and the structure of the compactor shall be ensured.

Discharge doors shall be fitted with a progressive opening system and with restraint devices in case of failure of the main closing system.

5.1.8 Handling of transportable compactors

Transportable compactors shall be designed and constructed to allow safe handling and tipping operations. Consideration shall be given at least to e.g.:

— securing components that may move during transportation including hook bar, doors, bin lift, safety cage, power pack and compacting parts;

— preventing leakage of operating fluids including hydraulic fluids, oil;

— strengthening areas where lifting points are attached including rear door, hinges, catches.

The sub frame, hook bar and lifting points shall be designed and constructed to be interchangeable with expected vehicle handling equipment. This may be defined in national standards or guidance.

See also 7.2.10 and Annex B.

5.1.9 Traversing systems

5.1.9.1 General requirements

5.1.9.1.1 Safeguarding provisions

During traversing operations where persons other than the operator/driver are likely to be in the area, the area shall be suitably isolated from access, e.g. by fixed guards and interlocking guards. See also 5.2.4.

On fully automatic installations, access to the area of movement of the traversing system shall be prevented by full area safeguarding.

Access to moving transmission parts shall be prevented by fixed guards.

Measures shall be taken to prevent collision with pedestrians e.g. pressure sensitive edges, radar etc. See also 5.2.4.

Design measures shall be taken to prevent unauthorised use. See also 5.2.2.

Fuel or oil systems shall be contained to prevent spillage during traversing operations.

See also informative Annex B.

5.1.9.1.2 Control devices, actuators and systems

The traversing system shall be designed to ensure that only one person can operate the machine.

The speed of traverse for traversing systems shall not exceed 0,1 m/s.

It shall not be possible for the traversing element of the system to move while the compactor and container are still coupled together.

The control system for traversing systems shall only allow traversing in one direction at any one time i.e. not left/right movement at the same time as backward/forward movement. See also 5.2.4.

The control device for the traversing element shall be a hold-to-run control device. If there is a risk of the traversing system continuing to move by inertia for longer than 0,1 m then releasing the hold-to-run control device shall automatically apply the brake. See also 5.2.4.

Where control actuators for the traversing system and coupling device are provided on the traversing equipment they shall be mounted:

— on the moving element (compactor or container);

— at the opposite end of the interface between the compactor and the container.

When the operator can contact the coupling device from the control station for docking operations then a two-hand control device compliant with EN 574:1996+A1:2008 shall be provided. See also 5.2.4.

All control actuators on the traversing system shall be clearly labelled as to their function.

5.1.9.1.3 Guiding systems

The traversing system shall be designed to be compatible with its guiding system and shall minimise the risk of derailment or deviating from its intended path e.g. by deflectors to remove obstacles from the track.

The traversing system shall be designed so it cannot over-run or fall off the end of its track at the end of its travel.

Guiding systems shall be designed and installed to reduce trips and falls.

Any cabling or hoses on traversing systems shall be designed to ensure they do not become a hazard e.g. becoming a trip or electrical hazard, dragging on the floor or becoming entangled in machinery. Examples of design measures include overhead cable gantries. Where cable drums are provided they shall be mounted on the traversing element.

See also 7.2.9.

5.1.9.1.4 Braking systems

The traversing system shall be designed to have a braking system that is capable of slowing down and stopping the equipment during its intended and foreseeable use. The braking system shall be capable of keeping the traversing element at a standstill.

5.1.9.1.5 Work positions

To prevent the operator and/or driver from falling off the traversing system during operation, any platform provided on traversing compactors e.g. for loading, driving shall have steps and handrails around the platform in accordance with EN ISO 14122-3:2001. The steps and handrails shall be integral to the compactor and shall be independent of the control system.

Lighting shall be provided in accordance with EN 1837:1999+A1:2009, e.g. at the operator's station, coupling area, on control actuators.

5.1.9.1.6 Warning signs or devices

Traversing systems shall have an acoustic and/or visual warning device that begins 5 s before operation of the machinery. Warning devices shall not be able to be disabled unintentionally. If the warning device fails its failure shall be made apparent to the operator.

Wherever necessary there shall be signs affixed to the equipment outlining instructions for use, adjustment and maintenance.

There shall be hazard warning signs against approaching the machine that are legible at a safe distance.

5.1.9.2 Additional requirements for traversing systems controlled from a fixed control station

For traversing systems where the control actuators are actuated by an operator at a fixed control station which is not mounted on the traversing element, in addition to the general requirements given in 5.1.9.1, the operator from the control station shall have good visibility of all the operations they will be controlling e.g. the traversing function and operations at the interface between the compactor and container. Good visibility shall be provided by e.g. direct line of sight, mirrors or CCTV.

5.1.9.3 Additional requirements for pedestrian controlled traversing systems

For traversing systems where the control actuators are actuated by a pedestrian walking with the traversing element the following shall apply in addition to the general requirements given in 5.1.9.1:

— where control actuators are mounted on a pendant, the lead shall be designed to allow safe operation and shall prevent the operator contacting dangerous moving parts;

— where the control actuators are mounted directly on the traversing element, they shall be designed and mounted to ensure the operator is not in the line of travel and cannot be run over.

5.1.9.4 Additional requirements for ride-on traversing systems

Where the driving position of the traversing system is located on the traversing element then the following shall apply in addition to the general requirements given in 5.1.9.1:

— the control actuators shall be located on the traversing element so that it is not possible to actuate them unless the operator is at the designated operating position. If it is possible to reach the control actuators from outside the designated driving position additional measures shall be taken to prevent the machine being operated e.g. a pressure sensitive floor in accordance with EN ISO 13856-1:2013 or an enclosed operator cab;

— any foot pedals provided for operation shall be designed to prevent a risk of incorrect operation and shall have a slip resistant surface that is easy to clean;

— provisions shall be made to ensure the operator has good visibility of all the operations they will be controlling from the driving position e.g. the traversing function and operations at the interface between the compactor and container. Good visibility can be provided by e.g. direct line of sight, mirrors or CCTV;

— the driving position shall be located to prevent the driver contacting dangerous moving parts of machinery or additional safeguards, e.g. an enclosed operator cab or fixed guards shall be provided; a secondary emergency braking mechanism, e.g. a mechanically linked handbrake, electrical brake that brakes when power is cut, air spring brake shall be provided should the primary braking system fail.

5.1.9.5 Additional requirements for remotely controlled (cableless) traversing systems

For traversing systems where the control actuators are actuated by an operator through a remote control device the following shall apply in addition to the general requirements given in 5.1.9.1:

— the traversing function of a traversing system shall not be started by remote control devices, unless starting through a remote control device is only possible from a pre-defined, non-movable safe position where good visibility is provided;

— remote control devices shall be in accordance with EN 60204-1:2006, 9.2.7;

— devices shall be provided to prevent the traversing system colliding with the operator whilst it is operating e.g. a proximity sensor;

— cableless control devices shall be designed so that they cannot be activated unintentionally e. g. when placed in a pocket.

5.1.9.6 Additional requirements for multi-function controlled traversing systems

For traversing systems that can be controlled by a combination of the following:

— traversing systems controlled from a fixed control station;

— pedestrian controlled traversing systems;

— ride-on traversing systems;

— remote controlled (cableless) traversing systems,

all the general requirements for traversing systems specified in 5.1.9.1 and the requirements specified in each of the applicable subclauses above shall apply.

Only one control position shall be active at the same time. See also 5.2.4. The selection of the control position shall only be possible at the main control station e.g. by using a lockable selector

5.2 Hazards due to failures in the control system or unexpected start-up

5.2.1 Control devices, actuators and systems

For compacting equipment powered by an internal combustion engine it shall only be possible to start the engine when all control devices for compaction or movement are in neutral.

Compactors shall not be started by means of cableless remote control devices, unless starting is only possible from pre-defined zones which afford good visibility of the danger zones. In addition see 5.2.3. Cableless remote control devices shall be in accordance with EN 60204-1:2006, 9.2.7.

If a pendant is used as a control actuator its design shall prevent the operator reaching the dangerous moving parts being operated by the pendant.

Control actuators shall be designed so that unintentional operation is prevented.

The control system shall ensure that the compacting parts move backwards at the start cycle. This safety function shall be in accordance with PL_r d, see 5.2.4. This does not apply to screw compactors. See also 7.2.2.

5.2.2 Prevention of unauthorised operation

It shall be possible to secure the compactor against unauthorised operation including unauthorised operation by members of the public. Examples to achieve this include lockable control boxes, key-operated switches. The key can be mechanical or electronic. The key shall be only removable when the switch is in the “OFF” position. With the switch in the “OFF” position all movements of the compactor, including any mechanical feed equipment such as a bin lift, shall be prevented.

The devices preventing unauthorised operation shall be placed at to the control station.

5.2.3 Emergency stop

Emergency stop devices shall comply with EN ISO 13850:2008 stop category 0 or 1, whichever provides the shorter stopping time. Operating an emergency stop actuator shall stop the complete compactor, including any mechanical feed equipment, without creating additional risks. Emergency stop actuators shall be placed at readily accessible points including at least the following positions:

— at each control station, including any remote control device;

— at each feed and/or working position;

— on two opposite sides of the machine.

See also 5.1.2.2.

After activation of an emergency stop the restart of the machine shall only be possible at the main control station.

The emergency stop function shall be in accordance with PL_r c, see 5.2.4.

5.2.4 Required performance levels PL_r

The required performance levels PL_r of the safety related parts of the control system (see EN ISO 13849-1:2008) shall be in accordance with PL_r c for all safety functions.

However the following safety functions shall be in accordance with PL_r d:

— alternative protective devices allowing to make the normal safeguards inoperative where material is fed into a compactor from a vehicle (see 5.1.1.2);

— SPE and interlocking guards at automatically operated bin lifts (see 5.1.2.1.1);

— pressure sensitive device e. g. a trip bar or trip wire installed at the feeding side of the feed hopper/opening if the integral pre-conditioning equipment and/or integral material flow control equipment creates a drawing-in hazard (see 5.1.3.1.1);

— pressure sensitive protective device e.g. a trip bar or trip wire installed at the feeding side of the feed hopper/opening on screw compactors (see 5.1.3.1.1);

— interlocking guards preventing access to the compacting parts and integral pre-conditioning and material flow control equipment on compactors with automatic initiation of cycles (see 5.1.3.1.2 and 5.1.3.2.2);

— interlocking guards preventing access to dangerous moving parts of the drive mechanism or ram (see 5.1.4);

— control function ensuring that the compacting parts move backwards at the start cycle (see 5.2.1).

5.3 Electrical hazards

Electrical equipment shall be in accordance with EN 60204-1:2006.

Minimum degrees of protection shall be as follows:

— compactor: IP 55 as specified in EN 60529:1991;

— main power socket: IP 44 as specified in EN 60529:1991 and designed to prevent ingress of water;

— IK08 as specified in EN 62262:2002.

When fitting electrical and electronic components, the compactor manufacturer shall comply with the information for use provided by the component manufacturer.

If electrical equipment will only work within a range of temperatures then the manufacturer shall specify this range in the instruction handbook. A dialogue between the manufacturer and user should take place to identify the correct range of temperatures for the environment the machine will be working in (see Annex B).

See also 7.2.2.

5.4 Hazards from hydraulic equipment

Hydraulic equipment shall comply with EN ISO 4413:2010. In particular:

— uncontrolled release of pressurised fluids shall be prevented;

— connections shall be designed to prevent unintended loosening;

— hoses and their fittings shall be designed to prevent hoses being pulled from their fittings. This shall be achieved by a positive connection between hose and fitting. Suitable connections include flanged connections, bordered screw connections or conical nipple connections. Compression joints shall not be used;

— hoses shall be fastened securely to prevent whiplash should they become detached from their fittings.

If hydraulic equipment will only work within a range of temperatures then the manufacturer shall specify this range in the instruction handbook. See 7.2.2. A dialogue between the manufacturer and user should take place to identify the correct range of temperatures for the environment the machine will be working in (see Annex B).

5.5 Slips, trips and falls

If operation, maintenance, cleaning or troubleshooting cannot be performed from floor level, work stations situated at height shall be provided with access means in accordance with EN ISO 14122-1, EN ISO 14122-2, EN ISO 14122-3 and EN ISO 14122-4.

5.6 Hazards generated by noise

5.6.1 Noise reduction at source by design

Compactors shall be designed and constructed so that risks resulting from the emission of airborne noise are reduced to the lowest level. This shall take into account technical progress and the availability of means of reducing noise, particularly at source. Useful guidance is given in EN ISO 11688-1:2009.

NOTE EN ISO 11688-2:2000 gives useful information on noise generation mechanisms in machinery.

Examples of current measures to reduce noise at source include:

— choice of low-noise machine components (motors, transmission systems);

— use of vibration damping material for vibrating surfaces;

— use of elastic transmission to prevent structure-borne noise from being transmitted to sound-radiating parts of the machine.

5.6.2 Noise reduction by protective measures

Protective measures that may be taken at design stage to reduce noise emission include:

— fitting acoustic enclosures around machine parts;

— screening of parts of the machine generating high noise levels;

— vent silencers for pneumatic systems.

5.6.3 Information connected with noise hazards

See 7.2.3 and Annex A.

5.7 Hazards due to neglecting ergonomic principles in the design of the machine

The compactor shall be designed in accordance with EN ISO 12100:2010, 6.2.8.

The compactor shall be designed so as to facilitate access to the back of the compacting parts for cleaning purposes (e.g. access doors). For access doors see also 5.1.4.

The technical design of the discharge door shall be such that easy opening is possible (maximum operating forces shall be taken into consideration).

6 Verification of the safety requirements and/ or protective measures

Conformity to the safety requirements and/or protective measures shall be verified as specified in Table 2.

Noise measurement shall be performed in accordance with Annex A.

A functional test comprises a test of function and efficiency of the protective equipment using:

— the specifications in the information for use;

— the safety-relevant design documents and wiring diagrams;

— the requirements stated in Clause 5 of this standard and in the cross-referenced applicable standards.

Table 2 — Verification of the safety requirements and/ or protective measures

Subclause	Visual inspection	Functional test	Measurement	Calculation
5.1.1.1 Basic requirements	x	x		x
5.1.1.2 Safeguards	x	x	x	x
5.1.1.3 Safety distances			x	x
5.1.2.1 Compactors fed by integral bin lift	x	x	x	x
5.1.2.2 Compactors fed by conveyor systems	x	x	x	x
5.1.3.1 Prevention of access to the compacting parts and integral pre-conditioning and material flow control equipment on manually-fed compactors	x	x	x	x
5.1.3.2 Prevention of access to compacting parts and integral pre-conditioning and material flow control equipment on mechanically-fed compactors	x	x	x	x
5.1.3.3 Prevention of access to compacting parts and integral pre-conditioning and material flow control equipment on mechanically and manually fed compactors	x	x	x	x

5.1.3.4 Prevention of access to moving parts during insertion and retraction of the integral pre-conditioning equipment or material flow control equipment	x	x	x	x
5.1.3.5 Protection against lids or doors falling open or closed	x	x		
5.1.4 Area behind the compacting parts	x	x	x	x
5.1.5 Container closing devices	x	x	x	x
5.1.6 Interface between compaction unit and container on static compactors	x	x	x	x
5.1.7 Emptying process of transportable compactors	x	x	x	
5.1.8 Handling of transportable compactors	x	x		
5.1.9.1 Traversing systems, general requirements	x	x	x	x
5.1.9.2 Additional requirements for traversing systems controlled from a fixed control station	x			
5.1.9.3 Additional requirements for pedestrian controlled traversing systems	x	x		
5.1.9.4 Additional requirements for ride-on traversing systems	x	x		x
5.1.9.5 Additional requirements for remote controlled (cableless) traversing systems	x	x		x

5.1.9.6 Additional requirements for multi-function controlled traversing systems	x	x	x	x
5.2.1 Control devices, actuators and systems	x	x		x
5.2.2 Prevention of unauthorized operation	x	x		
5.2.3 Emergency stop	x	x	x	x
5.2.4 Required performance levels PL_r				x
5.3 Electrical hazards	x	x	x	
5.4 Hazards from hydraulic equipment	x	x		
5.5 Slips, trips and falls	x		x	
5.6 and Annex A Hazards generated by noise	x		x	x
5.7 Hazards due to neglecting ergonomic principles in the design of the machine	x		x	

7 Information for use

7.1 General Information

Each compactor shall be accompanied by an instruction handbook (see EN ISO 12100:2010, 6.4.5).

The manufacturer shall inform the user about residual risks due to placing the compactor into its operating position, so that necessary protective measures can be taken (e. g. signs, lighting, visibility aids, restriction of access, supervision).

7.2 Information for safe operation

7.2.1 General

The instruction handbook shall contain all the information needed for operating the compactor safely.

7.2.2 Instructions for operation

The most important information required for safe operation of the compactor, as specified in the instruction handbook, shall be attached to the machine at the workstation. The information shall preferably be given in pictograms. The meaning of pictograms shall be explained in the instruction handbook.

The instruction handbook shall include at least the following instructions and information:

— procedures to release a trapped person, including the direction of movement of the compacting parts when control actuators are pressed;

— follow the detailed operating instructions for this machine;

— do not climb onto the machine or reach through the feed hopper/opening while the machine is operating;

— removing covers or fixed guards may only be performed by an authorised person and only when the machine has been isolated from the power supply and the isolator locked in the “OFF” position;

— the persons who are responsible for operating the compactor shall be instructed accordingly;

— the function of all safety devices shall be checked at regular intervals as specified by the machine manufacturer. Where a check reveals a malfunction of a safety device, or where there are obvious deficiencies that compromise safety, the compactor shall be taken out of use immediately and shall not be operated again until the defects have been remedied. The machine shall be also taken out of use immediately if faults that affect safety occur during operation. All faults shall be reported immediately;

— protective devices shall not be disabled or used improperly;

— when not in use the compactor shall be secured against unauthorised operation by locking the main control device and/or removing the key;

— never overfill the container. Once the container is full to its design capacity any further materials should be held in a separate collecting skip or holding area and should not be fed into the compactor until the full container has been removed and replaced by an empty one;

— do not compact materials that could lead to dangerous situations or damages to the machine (e.g. objects that could be ejected from the compactor, explosive materials, metals, demolition waste);

— wear appropriate personal protective equipment;

— when the container is being replaced the driver of the transport vehicle shall have good visibility of the area between the compaction unit and the container;

— the range of temperatures for which the machine and its protective equipment are designed;

— follow instructions for cleaning procedures to prevent water ingress into the main power socket and control panel.

7.2.3 Information on noise

The instruction handbook describing the compactor shall:

— give the declared noise emission values of the machine in accordance with A.7 of Annex A and EN ISO 4871:2009, A.2.2, as dual-number noise emission values;

— refer to the noise test code specified in Annex A to this standard upon which the determination of the noise emission values of the machine is based and state which basic noise measurement standards have been used;

— contain information on possible methods of installation to minimise noise emission;

— inform the users that they shall assess the noise hazard arising when materials used are different from those used for the noise declaration.

7.2.4 Installation instructions

The manufacturer shall state if the compactor is suitable for use in areas that are accessible to the public.

If any part of the machine shall be assembled on site then the manufacturer shall provide full instructions.

The manufacturer shall:

— recommend to install the compactor on an adequate and plane ground;

— state the dimensions needed for safe operation of the machine, including allowing space for opening doors and covers and for carrying out other operations such as pinning off, with an additional clearance of a minimum of 500 mm;

— recommend to take measures to facilitate access for cleaning and maintenance, in particular for static compactors;

— state that if it is compatible with the machine installation, the danger zone generated by the movement of the bin lift should be marked on the ground;

— recommend to provide adequate lighting for the area where the compactor is to be installed.

7.2.5 Setting and maintenance instructions

The manufacturer shall provide instructions for safe setting and maintenance of the compactor containing at least the following information:

— Before performing maintenance work ensure that the main switch (mains power isolator switch) or the separate power disconnecting devices are switched off, and will remain off, by locking them in the OFF position with a personal padlock or equivalent.

— Before maintenance or troubleshooting is carried out in the compaction chamber ensure that measures are taken to prevent additional material being loaded into the compactor.

— How to discharge residual energies due to e.g. accumulators, pressures or back pressures generated by compacted materials.

— Carry out planned maintenance and periodic servicing in accordance with the manufacturer’s instructions.

— Ensure that maintenance and servicing are carried out by competent and authorised persons who are fully familiar with the compactor and its associated devices.

— Ensure that components having a limited safe working life (e.g. components with fatigue limits such as hydraulic hoses) are checked for wear and serviceability at predetermined intervals.

— Ensure that deficiencies or damage that compromise safety are rectified immediately or reported for repair. Stop the compactor immediately if there is evident danger for operators or equipment and ensure it is not restarted until the defect has been rectified.

— Perform maintenance work from the working positions assigned for that purpose.

— Ensure that maintenance schedules are adequate for safe operation of any horizontally hinged doors. Particular attention shall be given to gas struts, dampers, spring weight compensation systems and any powered opening/closing devices.

7.2.6 Spare parts list

The manufacturer shall provide a list of spare parts together with information on the maximum limits of wear and the length of durability in e.g. years, months or number of working hours.

7.2.7 Preventing faults and fault recovery

The manufacturer shall provide the user with a list of faults that may be expected to occur on the compactor and its associated devices together with information about the measures to be taken for preventing faults and for fault recovery. For safety critical components the maximum operational life time shall be specified.

7.2.8 Information for preventing and removing blockages

The manufacturer shall provide information for preventing blockages e.g. ensure that the type and quantity of material to be processed are suited to the compactor's capacity in accordance with the manufacturer's specification.

The manufacturer shall provide information for troubleshooting including clearing blockages. See also the Note in 5.1.1.1.

7.2.9 Information relating to connections between the compactor, container and any traversing systems

The manufacturer shall:

— inform the user that the container closing device shall be suitable for the nature of the compacted materials (especially when compacting materials that expand when pressure is released) and for the compacting pressure;

— provide the interface dimensions between the static compactor and container, including e.g. heights of pinning off devices, coupling devices, the bottom of the compactor in relation to the ground and position of the presence detector of the container;

— provide information relating to compatible containers (e.g. matching opening dimensions) that can be used with the compaction equipment or traversing equipment (this should take account of national regulations, agreements and standards);

— provide detailed information about the coupling and decoupling of containers e.g. suggest a guiding device;

— provide information relating to the safe placement and/or connection of the compactor or container on any traversing system.

7.2.10 Transportable compactors

The instruction handbook shall indicate that in order to minimize any potential dangers caused by transport, consultation should take place between the manufacturer and the user (see Annex B). Furthermore, reference should be made to the current national standards and regulations (also regarding cargo securing equipment).

7.2.11 Information on examinations and/or inspections

7.2.11.1 General

The manufacturer shall give information on the examinations and/or inspections required for a safe operation of the compactor, which shall comprise at least the following aspects.

7.2.11.2 Periodic examination and/or inspections

Periodic examinations and/or inspections by an authorized, competent person shall be performed in accordance with national regulations. The manufacturer shall recommend a proper period for examinations and/or inspections according to the operating conditions and at least every 12 months.

The periodic examination and/or inspection is a visual and functional inspection. It comprises an examination and/or inspection of the state of the components and devices of the compactor as well as confirming that all safety devices are present, in a good state of repair and in effective working order.

The examination and/or inspection involves at least the following:

— a visual and functional check of all safety devices and systems including associated control devices;

— a visual and functional check of all emergency stop switches, pull cords, trip devices and safety switches;

— a check of transmission elements such as drive chains and belts to ensure they have not become loose and not started to wear;

— a check for leakages on hydraulic lines, valves, and cylinders;

— a check of hoses for damage;

— a check of the clearances between the compacting parts and the side walls and bottom of the compaction chamber;

— a check of electrical equipment;

— a check of the general mechanical condition of the equipment, especially:

  — the means by which the compaction units on static compactors are anchored to the ground;

  — the coupling devices on static compactors;

  — the guards;

  — lifting elements of transportable compactors;

  — hinges and interlock of the emptying door.

7.2.11.3 Examinations and/or inspections following repair and modification

Following repairs and modifications which can affect the safety of the machine, the parts worked on and/or the compactor shall be examined and/or inspected. The extent of the examinations and/or inspections depends on the nature and extent of the repair or modification carried out.

7.2.11.4 Records of examinations and/or inspections

Records of examinations and/or inspections should be documented as required by national regulations. However, it is recommended that the results should be recorded in writing. It is also recommended that these

records should contain the findings of the first and subsequent periodic examinations and/or inspections as well as examinations and/or inspections performed following repairs and modifications. Where applicable, the records should include type test certificates and test certificates for tests performed during the compactor manufacture.

7.3 Marking

7.3.1 Manufacturer's plate

Each compactor or assembly shall be fitted with a manufacturer's plate containing at least the following information:

— the designation of the machinery;

— the business name and full address of the manufacturer and, where applicable, of his authorised representative;

— CE marking;

— year of construction, that is the year in which the manufacturing process was completed;

— designation of series or type;

— serial number, if any, or machine number;

— electrical connection values.

In addition on transportable compactors:

— unladen weight (ULW);

— maximum loaded weight;

— usable capacity;

— nominal power in kW.

7.3.2 Safety signs

The compactor shall be equipped with all the signs necessary for safe use (see EN ISO 12100:2010, 6.4.4).

The sign shown in Figure 7 shall be securely affixed to the compactor to indicate that reaching or going into the feed hopper/opening is prohibited:

Figure 7 — Sign prohibiting reaching or going into the feed hopper/opening

The sign shown in Figure 8 shall be securely affixed to conveyors to indicate that going onto the conveyor is prohibited:

P024

Figure 8 — Sign prohibiting access to the conveyor

The sign shown in Figure 9 shall be securely fixed to the access doors to indicate the risk of being struck or buried by material when clearing a blockage:

W035

Figure 9 — Sign for the risk of being struck or buried under the material

The signs shall be placed as close as possible to the hazard they represent and in a visible position.

Annex A
(normative)

Noise test code

A.1 Scope

This noise test code specifies all the information necessary to carry out efficiently and under standardized conditions the determination, declaration and verification of the noise emission of compactors. It specifies noise measurement methods and operating and mounting conditions that shall be used for the test.

Noise emission characteristics include emission sound pressure levels at workstations and the sound power level. It is necessary to determine these parameters so that:

— manufacturers can declare the noise emitted;

— users can compare the noise emitted by different compactors on the market; and

— designers can control noise at source at the design stage.

Using this noise test code ensures reproducibility when determining the noise emission characteristics within specified limits determined by the grade of accuracy of the basic airborne noise measurement method used.

A.2 Determination of emission sound pressure level at the work station(s)

A.2.1 Basic standards

A-weighted emission sound pressure levels shall be determined at each work station defined in the instruction handbook using one of the following standards:

— EN ISO 11201:2010 (engineering grade of accuracy) that gives an engineering method for measuring emission sound pressure levels of machinery and equipment in an essentially free field over a reflecting plane with no environmental correction; or

— EN ISO 11202:2010 that gives a method for measuring emission sound pressure levels of machinery and equipment *in situ* with an environmental correction using a simplified method yielding engineering grade or survey grade; or

— EN ISO 11204:2010 that gives a method for measuring the emission sound pressure levels of machinery and equipment yielding engineering grade or survey grade.

If the machine is fed manually one of the defined work stations shall be where materials are fed in at the feed opening.

For any compactor where the work station(s) are undefined or cannot be defined, A-weighted sound pressure levels shall be measured at a distance of 1 m from the surface of the machinery and at a height of 1,60 m from the floor or access platform. The position and value of the maximum sound pressure level shall be indicated.

Whenever practical, an engineering method (engineering grade of accuracy) shall be used. See EN ISO 11200:2014 for further guidance.

Measurements shall be carried out at least once at each microphone position. The duration of each measurement shall be for a whole cycle of the compacting part.

For compactors that emit an A-weighted sound pressure level higher than 80 dB, the sound power level shall also be measured.

A.2.2 Measurement uncertainty

If an engineering method is used, the standard deviation of reproducibility for A-weighted levels is:

$$\sigma_{RA} = 1{,}5dB$$

The standard deviation of reproducibility may be much larger if a survey method is used.

NOTE EN ISO 4871:2009 provides a method for deriving the total measurement uncertainty from the value of the standard deviation of reproducibility.

A.3 Determination of sound power levels

A.3.1 Basic standards

The A-weighted sound power level shall be determined using one of the following standards:

— EN ISO 3744:2010, EN ISO 3746:2010, EN ISO 3747:2010 that give methods for determining the sound power level of machinery and equipment from sound pressure measurements; or

— EN ISO 9614-2:1996 that gives methods for determining the sound power level of machinery and equipment using sound intensity measurements.

Whenever practical, an engineering method (engineering grade of accuracy) shall be used.

Measurements shall be carried out at least once at each microphone position. The duration of each measurement shall be a whole cycle of the compacting part.

When either EN ISO 3744:2010 or EN ISO 3746:2010 is used, the measurement surface shall be parallelepiped, and the measurement distance shall be 1 m.

For compactors that have a height above ground of ≥ 2,0 m, instead of determining the sound power level, sound pressure levels shall be measured. Sound pressure levels shall be measured at a distance of 1 m from the surface of the machinery and at a height of 1,60 m from the floor or access platform and at 2 m intervals around the perimeter of the compactor. The position and value of the maximum A-weighted sound pressure level shall be declared.

A.3.2 Measurement uncertainty

If an engineering method is used, the standard deviation of reproducibility is:

$$\sigma_{RA} = 1{,}5dB$$

The standard deviation of reproducibility may be much larger if a survey method is used.

NOTE EN ISO 4871:2009 provides a method for deriving the total measurement uncertainty from the value of the standard deviation of reproducibility.

A.4 Installation and mounting conditions for the noise measurement

The compactor shall be installed and mounted as indicated by the manufacturer in the instruction manual (see 7.2 of this standard).

A.5 Operating conditions

Two measurements shall be taken. One measurement shall be a cycle under no-load conditions. The second measurement shall be a cycle under full load conditions.

A cycle includes one cycle of the compacting part as defined in 3.19 and one cycle of any integral auxiliary equipment as defined in 3.5, 3.6 and 3.8.

The conditions for the test shall be stated by the manufacturer in the noise declaration.

The machine and hydraulic fluid shall be at normal operating temperature.

The operating conditions shall be the same for determining both emission sound pressure level at work stations and sound power level.

A.6 Information to be recorded and reported

A.6.1 General

The information to be recorded by the person taking the measurements and reported in the test report shall include all the data that the basic standards used require to be recorded and reported, i.e. precise identification of the compactor under test, mounting and operation conditions, acoustic environment, instrumentation and acoustical data.

At least the data specified in A.6.2 to A.6.5 shall be recorded and reported.

A.6.2 Compactor data

— type, serial number, year of manufacture of the compactor;

— type of feed equipment.

A.6.3 Standards used

— this noise test code;

— basic standards selected for noise measurement in accordance with this noise test code.

A.6.4 Noise data

— measured and/or calculated noise emission values, and associated measurement uncertainty.

A.6.5 Installation and operating conditions

— detailed description of the installation and operating conditions of the compactor during noise measurement.

A.7 Declaration and verification of noise emission values

Declaration and verification of noise emission values shall be made in accordance with EN ISO 4871:2009.

Noise emission values under no load and under load (see A.5) shall be given in the noise declaration. Details of the load conditions shall be given.

The noise declaration shall be a dual number declaration as defined in EN ISO 4871:2009 i.e. the measured value and the measurement uncertainty shall be indicated separately. It shall include the following:

— the A-weighted emission sound pressure level at the work station(s):

  — if this does not exceed 70 dB, this fact shall be indicated;

  — if this exceeds 70 dB the value measured shall be indicated;

— the A-weighted sound power level where the A-weighted emission sound pressure level is above 80 dB, however see A.3.

The noise declaration shall mention explicitly that noise emission values have been obtained in accordance with this noise test code and indicate which basic standards have been used. The noise declaration shall clearly indicate any deviation(s) from this noise test code and/or from the basic standards used.

If undertaken, the verification shall be conducted by using the same mounting and operating conditions as those used for the initial determination of noise emission values.

Annex B
(informative)

Preliminary dialogue between manufacturer and user

A preliminary dialogue should take place between the manufacturer and the future user mainly about the following topics:

— installing the compactor including consideration for removing and changing containers;

— additional safety measures that may be required when the compactor is installed in places where unauthorised persons may have access;

— the capability of the compactor to compact the expected materials with the frequency it is expected to operate;

— the required range of temperatures that the machine and its protective equipment will be operating in;

— managing oils and liquids leaking from the materials;

— access to the compaction chamber for cleaning and maintenance;

— the correct safeguarding arrangements where compactors are used in a split level situation (e.g. the compactor on the ground and fed from a loading dock by a shovel);

— the operating specification for multiple cycle mode dependent upon the type of materials being compacted and feed equipment type;

— use of sensitive protective equipment (SPE) if selected;

— feed equipment to be installed and necessary safeguards;

— selection and configuration of trip wires on conveyors that take into account the width, size and design of the conveyor;

— the compatibility of bin lifts with the bins that are expected to be used;

— installation of visibility aids into the feed hopper or the compaction chamber;

— safety precautions for the transportation of transportable compactors;

— safeguarding the area of movement of traversing systems;

— providing adequate lighting for traversing systems in areas of poor visibility e.g. at control stations, coupling device area;

— noise declaration and use of declared values.

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 2006/42/EC

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide one means of conforming to Essential Requirements of the New Approach Directive 2006/42/EC on machinery.

Once this standard is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of this standard confers, within the limits of the scope of this standard, a presumption of conformity with the relevant Essential Requirements of that Directive and associated EFTA regulations.

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

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