



BSI Standards Publication

# Refuse collection vehicles — General requirements and safety requirements

Part 5: Lifting devices for refuse collection  
vehicles

**National foreword**

This British Standard is the UK implementation of EN 1501-5:2011. Together with BS EN 1501-1:2011, it supersedes BS EN 1501-1:1998+A2:2009 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee B/508/1, Waste containers and associated lifting devices on refuse collection vehicles.

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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**Refuse collection vehicles - General requirements and safety  
requirements - Part 5: Lifting devices for refuse collection  
vehicles**

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exigences de sécurité - Partie 5: Lève-conteneurs pour  
bennes de collecte des déchets

Abfallsammelfahrzeuge und die dazugehörigen  
Schüttungen - Allgemeine Anforderungen und  
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Abfallsammelfahrzeuge

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## Foreword

This document (EN 1501-5:2011) has been prepared by Technical Committee CEN/TC 183 "Waste Management", 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of an identical text or by endorsement, at the latest by February 2012, and conflicting national standards shall be withdrawn at the latest by February 2012.

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 together with EN 1501-1:2011 supersedes EN 1501-1:1998+A2:2009.

It also updates and improves the description of and the requirements for the lifting devices of EN 1501-2:2005+A1:2009 (3.14 to 3.20 and 6.4), EN 1501-3:2008 (3.15 to 3.17, 4.4 and 6.5) and EN 14803:2006 (Figure A.1).

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(s).

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

The minimum essential criteria are considered to be of primary importance in providing safe, serviceable, economical and practical lifting devices.

This European Standard is one part of the series of co-ordinated standards EN 1501 about "Refuse collection vehicles — General requirements and safety requirements" dealing with specification; design, safety and testing of refuse collection vehicles (RCVs) and their associated lifting devices comprising the following parts:

- *Part 1: Rear loaded refuse collection vehicles;*
- *Part 2: Side loaded refuse collection vehicles;*
- *Part 3: Front loaded refuse collection vehicles;*
- *Part 4: Noise test code for refuse collection vehicles;*
- *Part 5: Lifting devices for refuse collection vehicles.*

The European Standards EN 1501-2:2005+A1:2009 and EN 1501-3:2008 will be revised after adoption of EN 1501-1 and this part of EN 1501.

For waste container lifting devices mounted on rear loaded RCVs, this Part 5 of the European Standard EN 1501 shall be enforced at the same time as Part 1 of this series.

In this document Annexes A and C are normative, Annexes B and ZA are informative.

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, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

## Introduction

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

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

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 requirements of the other standards, for machines that have been designed and built according to the requirements of this type C standard.

This European Standard should be read in conjunction with:

- the documents developed for refuse collection vehicles (EN 1501-1, EN 1501-2 and EN 1501-3) that are compatible with the waste container lifting devices specified in this standard;
- the documents developed for mobile waste containers (series of standards EN 840), for stationary waste containers (series of standards EN 12574) and for selective collection containers (series of standards EN 13071) that are compatible with the lifting devices specified in this European Standard;
- the documents developed for diamond and skip containers.

While producing this European Standard it was assumed that:

- only persons who have been appropriately trained will operate the lifting device;
- the guidelines issued by the chassis manufacturer have been taken into account;
- the guidelines issued by the RCV manufacturer have been taken into account;
- components without specific requirements are designed in accordance with the usual engineering practice and calculation codes, including all failure modes, of sound mechanical and electrical construction and made of materials with adequate strength and of suitable quality;
- harmful materials, such as asbestos, are not used as part of the lifting device;
- components are kept in good repair and working order, so that the required characteristics remain despite wear;
- this European Standard is designed for careful consideration by designers, manufacturers, suppliers and users of lifting devices and RCVs.

## 1 Scope

This European Standard deals with all significant hazards, hazardous situations and events relevant to lifting devices used for the emptying of designated waste containers into RCVs and their fitting onto the RCVs when they are used as intended and under conditions of misuse which are reasonably foreseeable by the manufacturer throughout their foreseeable lifetime as defined in Clause 4.

This European Standard is applicable to the design and construction of the waste container lifting devices and the mounting of other lifting devices so as to ensure that they are fitted for their function and can be operated, adjusted and maintained during their entire lifetime. It is not applicable to the end of life of the lifting devices.

This European Standard describes and gives the safety requirements of the lifting devices for emptying waste containers and their interfaces with the corresponding parts of the RCVs and shall be used in conjunction with Parts 1, 2 and 3 of EN 1501 for the rear, side and front loaded RCVs. It refers to EN 1501-4 for the noise test code.

This European standard is not applicable to:

- operation in severe conditions e.g. extreme environmental conditions such as:
  - temperatures below  $-25^{\circ}\text{C}$  and above  $+40^{\circ}\text{C}$ ;
  - tropical environment;
  - wind velocity in excess of 75 km/h;
- contaminating environment;
- corrosive environment;
- operation in potentially explosive atmospheres;
- lifting and transportation of persons;
- emptying waste containers other than those manufactured according to EN 840, EN 12574, EN 13071, and those described as paladin, diamond, skip containers;
- loading bulky waste by means of platform or forks;
- handling of loads the nature of which could lead to dangerous situations (e.g. hot wastes, acids and bases, radioactive materials, contaminated waste, especially fragile loads, explosives);
- operation on ships;
- fitting and operation on stationary compactors.

This European Standard is not applicable to machinery which is manufactured before the date of its publication by CEN.

## 2 Normative references

The following referenced documents are indispensable for the application of this document. 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 374-1:2003, *Protective gloves against chemicals and micro-organisms — Part 1: Terminology and performance requirements*

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

EN 818: 1996+A1:2008 (all parts) *Short link chain for lifting purposes*

EN 840-1:2004, *Mobile waste containers — Part 1: Containers with 2 wheels with a capacity up to 400 l for comb lifting devices, dimensions and design*

EN 840-2:2004, *Mobile waste containers — Part 2: Containers with 4 wheels with a capacity up to 1 300 l with flat lid(s), for trunnion and/or comb lifting devices — Dimensions and design*

EN 840-3:2004, *Mobile waste containers — Part 3: Containers with 4 wheels with a capacity up to 1 300 l with dome lid(s), for trunnion and/or comb lifting devices — Dimensions and design*

EN 840-4:2004, *Mobile waste containers — Part 4: Containers with 4 wheels with a capacity up to 1 700 l with flat lid(s), for wide trunnion or BG-and/or wide comb lifting device — Dimensions and design*

EN 840-5:2004, *Mobile waste containers — Part 5: Performance requirements and test methods*

EN 894-1:1997+A1:2008, *Safety of machinery — Ergonomic requirements for the design of displays and control actuators — Part 1: General principles for human interactions with displays and control actuators*

EN 894-2:1997+A1:2008, *Safety of machinery — Ergonomics requirements for the design of displays and control actuators — Part 2: Displays*

EN 894-3:2000+A1:2008, *Safety of machinery — Ergonomic requirements for the design of displays and control actuators — Part 3: Control actuators*

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

EN 1037:1995+A1:2008, *Safety of machinery — Prevention of unexpected start-up*

EN 1501-1:2011, *Refuse collection vehicles — General requirements and safety requirements — Part 1: Rear loaded refuse collection vehicles.*

EN 1501-2:2005+A1:2009, *Refuse collection vehicles and associated lifting devices — General requirements and safety requirements — Part 2: Side loaded refuse collection vehicles*

EN 1501-3:2008, *Refuse collection vehicles and their associated lifting devices — General requirements and safety requirements — Part 3: Front loaded refuse collection vehicles*

EN 1501-4:2007, *Refuse collection vehicles and their associated lifting devices — General requirements and safety requirements — Part 4: Noise test code for refuse collection vehicles*

EN 12574-1:2006, *Stationary waste containers — Part 1: Containers with a capacity up to 10 000 l with flat or dome lid(s), for trunnion, double trunnion or pocket lifting device — Dimensions and design*

EN 13071-1:2008, *Stationary waste containers up to 5 000 l, top lifted bottom emptied — Part 1: General requirements*

EN 13071-3:2011, *Stationary waste containers up to 5 000l, top lifted and bottom emptied — Part 3: Recommended lifting connections*

EN 13135-1:2003+A1:2010, *Cranes — Equipment — Part 1: Electrotechnical equipment*

EN 13135-2:2004+A1:2010, *Cranes — Equipment — Part 2: Non-electrotechnical equipment*

EN 13155:2003+A2:2009, *Cranes — Non-fixed load lifting attachments*

EN 13309:2010, *Construction machinery — Electromagnetic compatibility of machines with internal electrical power supply*

EN 13557:2003+A2:2008, *Cranes — Controls and control stations*

EN 14492-1:2006+A1:2009, *Cranes — Power driven winches and hoists — Part 1: Power driven winches*

EN 14803:2006, *Identification and/or determination of the quantity of waste*

EN 60204-1:2006, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements (IEC 60204-1:2005, modified)*

EN 60529:1991, *Degrees of protection provided by enclosures (IP code) (IEC 60529:1989)*

EN 61131-2:2003, *Programmable controllers — Part 2: Equipment requirements and tests (IEC 61131-2:2007)*

EN 61984, *Connectors — Safety requirements and tests (IEC 61984:2008)*

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

EN ISO 4414:2010, *Pneumatic fluid power - General rules and safety requirements for systems and their components (ISO 4414:2010)*

EN ISO 6743-4:2001, *Lubricants, industrial oils and related products (class L) — Classification — Part 4: Family H (Hydraulic system) (ISO 6743-4:1999)*

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 13849-2:2008, *Safety of machinery — Safety-related parts of control systems — Part 2: Validation (ISO 13849-2:2003)*

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

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

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 14121-1:2007, *Safety of machinery — Risk assessment — Part 1: Principles (ISO 14121-1:2007)*

ISO 3448:1992, *Industrial liquid lubricants — ISO viscosity classification*

ISO 4406:1999, *Hydraulic fluid power — Fluids — Method for coding the level of contamination by solid particles*

ISO 7000:2004, *Graphical symbols for use on equipment — Index and synopsis*

ISO 7241-1:1987, *Hydraulic fluid power — Quick-action couplings — Part 1: Dimensions and requirements*

ISO 11898-1:2003, *Road vehicles — Controller area network (CAN) — Part 1: Data link layer and physical signalling*

ISO 11898-2:2003, *Road vehicles — Controller area network (CAN) — Part 2: High-speed medium access unit*

ISO 11898-3:2006, *Road vehicles — Controller area network (CAN) — Part 3: Low-speed, fault tolerant, medium-dependent interface*

ISO 11898-4:2004, *Road vehicles — Controller area network (CAN) — Part 4: Time-triggered communication*

ISO 11898-5:2007, *Road vehicles — Controller area network (CAN) — Part 5: High-speed medium access unit with low power mode*

ISO 15817:2005, *Earth-moving machinery — Safety requirements for remote operator control*

IEC 60417-DB, *Graphical symbols for use on equipment*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 12100 and EN 1501-1 and the following apply.

#### 3.1

##### **refuse collection vehicle**

##### **RCV**

vehicle used for the collection and transportation of refuse (e.g. household waste, bulky waste, recyclable materials) based on loading via waste containers or by hand. It consists of a chassis-cab onto which a bodywork is mounted

#### 3.1.1

##### **rear loaded RCV**

RCV in which the waste is loaded into the body from the rear

NOTE See Figure A.1-1.

#### 3.1.2

##### **side loaded RCV**

RCV in which the waste is loaded into the body from the sides

NOTE See Figure A.1-2.

#### 3.1.3

##### **front loaded RCV**

RCV in which the waste is loaded into the body from the front

NOTE The trajectory of the waste container is over the top of the cab, parallel to the axis of the vehicle regardless of where the waste container is picked up (see Figure A.1-3).

#### 3.1.4

##### **travel movement**

unrestricted motorised movement of the RCV

#### 3.1.5

##### **positioning movement**

limited motorised movement of the RCV (e.g. when approaching and picking up a waste container)

#### 3.2

##### **lifting device**

mechanism fitted onto the RCV for loading refuse into its body

- 3.3**  
**waste container lifting device**  
mechanism fitted onto a RCV for emptying designated waste containers
- 3.3.1**  
**split waste container lifting device**  
two or more adjacent waste container lifting devices with their own independent functional spaces
- 3.3.2**  
**combined waste container lifting device**  
two or more waste container lifting devices which share a common functional space
- 3.3.3**  
**integrated waste container lifting device**  
waste container lifting device designed to be permanently attached to the body of the RCV
- 3.3.4**  
**demountable waste container lifting device**  
waste container lifting device designed to be detachable (e.g. bolted) from the body of the RCV
- 3.3.5**  
**interchangeable waste container lifting device**  
waste container lifting device designed to be capable of being fitted on different designated RCVs provided with one standard interface (mechanical, hydraulic, electrical, dimensional and functional aspects)
- 3.4**  
**mechanical interface**  
mechanical connections between the lifting device and the corresponding part of the RCV
- 3.5**  
**hydraulic/pneumatic interface**  
hydraulic/pneumatic connections between the lifting device and the corresponding part of the RCV
- 3.6**  
**electrical interface**  
electrical connections between the lifting device and the corresponding part of the RCV
- 3.7**  
**mounting frame**  
framework used to fit the interchangeable or demountable waste container lifting device on the RCV
- NOTE      The mounting frame is provided as a fixed opening, a demountable frame, or a swivel hinged frame.
- 3.8**  
**lifting carriage**  
sub-assembly onto which the pick-up system is normally fitted
- 3.9**  
**guide system**  
component(s) to laterally locate the pick-up system of the designated waste container
- 3.10**  
**locking system**  
mechanism which locks the pick-up system of the designated waste container to the waste container lifting device for emptying purpose

### 3.11

#### **pushing pad**

component of the lifting device onto which the front wall of the designated refuse container body rests when it is being lifted

### 3.12

#### **container restraint device**

system located towards the top of the loading opening of the RCV enabling the movement of the designated refuse container to be stopped progressively beyond the emptying angle of the lifting device

### 3.13

#### **lid opener**

device which opens the lid of the designated refuse container during the emptying cycle

### 3.14

#### **pick-up system**

part(s) of the lifting device intended to be in contact with the waste container for receiving its corresponding part with the purpose of holding, lifting and emptying it

#### 3.14.1

##### **comb pick-up system**

horizontal row of upward facing teeth and locking system to retain the designated waste container according to frontal receivers forms A, B, and C of EN 840-1, EN 840-2, EN 840-3 and EN 840-4 during emptying

NOTE See Figure A.2.

#### 3.14.2

##### **trunnion pick-up system**

pair of lateral arms with trunnion receiver and locking mechanism to retain the designated waste container according to lateral receivers type A of EN 840-2, EN 840-3, EN 840-4 and EN 12574-1 during emptying

NOTE See Figures A.4-1, A.4-2 and A.4-3.

#### 3.14.3

##### **double trunnion pick-up system**

pair of lateral arms with two trunnion receivers and locking mechanism to retain the designated waste container according to lateral receivers type B of EN 12574-1 during emptying

NOTE See Figure A.4-4.

#### 3.14.4

##### **diamond pick-up system**

triangular shaped element(s) with one corner of the triangle facing upwards and locking system to retain designated diamond waste container

NOTE See Figure A.5.

#### 3.14.5

##### **BG pick-up system**

pair of lateral arms and locking mechanism to retain the designated BG waste container complying with lateral receivers type B of EN 840-4 during emptying

NOTE See Figure A.6.

#### 3.14.6

##### **pocket pick-up system**

pair of lateral arms and locking mechanism to retain the designated waste container complying with lateral receivers type C of EN 12574-1 during emptying

NOTE See Figure A.7.

### 3.14.7

#### **clamping system**

mechanism which holds the designated waste container(s) by application of jaws

NOTE When these jaws overlap, it is called an overlapping clamp.

### 3.14.8

#### **skip pick-up system**

framework at the back end of the lifting device to catch and lock the trunnions/pivots or the trunnion bar of the skip container for lifting and or tipping it

NOTE See Figure A.1-4.

#### 3.14.8.1

##### **two chains skip pick-up system**

lifting device with two chains to lift, tip and put back on the ground the skip container by tipping it over against a frontal trunnion

NOTE See Figure B.3-1.

#### 3.14.8.2

##### **four chains skip pick-up system**

lifting device with four chains to lift, tip and put back on the ground the skip container which has to be tipped over against a fixed or moveable attachment on it

NOTE See Figure B.3-2.

#### 3.14.8.3

##### **skip container end position system**

system to limit the final position of the tipped skip container

### 3.15

#### **extending arm**

part of the waste container lifting device which goes outside of the RCV designed to pick up the designated waste container

### 3.16

#### **travel position**

defined position(s) of the lifting device (e.g. clamps, arms, extending arm, etc) for the purpose of travel movement of the RCV (according to road traffic regulations)

### 3.17

#### **rest position**

defined stable position of the lifting device without further movement of the device

### 3.18

#### **designated waste container**

waste container compatible with the lifting device

#### 3.18.1

##### **paladin container**

mobile cylindrical steel waste container with a capacity up to 1 m<sup>3</sup> designed for a clamping pick-up system

NOTE See Figure B.1-1.

### 3.18.2

#### **diamond container**

mobile waste container with a capacity from 60 l to 2,3 m<sup>3</sup> with a specific frontal receiver for a diamond pick-up system(s)

NOTE See Figure B.1-2.

### 3.18.3

#### **skip container**

stationary waste container not complying with EN 12574 larger than 2,5 m<sup>3</sup> designed to be handled either by a winch or specific skip lifting system

NOTE See Figure B.3.

### 3.19

#### **waste container emptying cycle**

succession of sequences to pick up, lift, hold and empty the designated waste container and put it back on the ground

### 3.20

#### **emptying operating mode**

mode of the waste container emptying cycle (e.g. manual, semi-automatic, automatic)

#### 3.20.1

##### **manual mode**

mechanism achieving each movement by a single command

#### 3.20.2

##### **semi-automatic mode**

mechanism achieving each sequence of movements (two or more movements in one sequence) by a single command

#### 3.20.3

##### **automatic mode**

mechanism achieving a complete cycle of movements by a single command

### 3.21

#### **container handling system**

lifting accessory consisting of a mechanism to connect the loader crane and the designated waste container (and its opening mechanism)

### 3.22

#### **container loading winch**

power driven mechanism located on the bodywork used for pulling, tipping waste container(s) by means of ropes, chains or belts wound in one or more layers onto a drum

### 3.23

#### **shaking**

alternating movement of the lifting device designed to dislodge the waste from the waste container when tilted

### 3.24

#### **operative**

person trained to operate the RCV

### 3.25

#### **working station**

location outside of the functional space where the RCV is operated during normal use; inspection, cleaning and maintenance are excluded

NOTE See Figures A.1-1, A.1-2 and A.1-3.

### 3.26

#### **visible space**

space visible directly and/or indirectly by the operative from his working station, either in or outside of the cab

NOTE See Figure A.1.

### 3.27

#### **functional space**

space covered by the movements of the lifting device and of the designated waste container(s) when lifted by a lifting device as specified by the manufacturer

NOTE See Figure A.1.

### 3.28

#### **loader crane**

powered crane fitted on the RCV and designed for loading its designated waste container into the bodywork

## 4 List of significant hazards

This clause contains all the significant hazards, risk areas and hazardous situations and events as far as they are dealt with in this standard, identified by risk assessment performed according to EN ISO 14121-1 as significant for this type of machinery and which require action to eliminate or reduce the risk.

The verification methods to be used to demonstrate conformity include:

- *V*: visual inspection verifies the required features of the components;
- *T*: test / check verifies that the features provided perform their function in such a way that the requirement is met;
- *M*: measurement verifies that requirements are met to the specified limits;
- *D*: drawings and/or calculations verify that the design characteristics of the components provided meet the requirements. Documents and instructions for use are available.

**Table 1 — List of significant hazards**

| N° | Hazard                                     | Hazardous situation                                | Safety requirement measures                            | Reference                                   | Veri-<br>fication |
|----|--------------------------------------------|----------------------------------------------------|--------------------------------------------------------|---------------------------------------------|-------------------|
| 1  | Crushing, trapping                         | Between waste container lifting device and body    | Design                                                 | 5.1.1.1.10,<br>5.3.3, 5.3.4,<br>5.10        | <i>D</i>          |
| 2  | Crushing, trapping                         | During operation in traffic                        | Comply with road regulation                            | 5.1.1.1,<br>5.1.1.10,<br>5.10, 5.17,<br>7.1 |                   |
| 3  | Crushing,<br>shearing                      | During use of the lifting device                   | Guards                                                 | 5.1.1.1                                     | <i>V</i>          |
| 4  | Crushing                                   | Below the container                                | Level between bottom of container and ground           | 5.1.1.2                                     | <i>T</i>          |
| 5  | Impact                                     | Impact with waste                                  | Design of the waste container lifting device           | 5.1.1.3                                     | <i>D</i>          |
| 6  | Impact                                     | Impact between container and compaction mechanism  | Design of the RCV                                      | 5.1.1.4                                     | <i>D, T</i>       |
| 7  | Crushing, trapping                         | Overload of the container                          | Design of the waste container lifting device           | 5.1.1.4                                     | <i>D</i>          |
| 8  | Crushing, trapping                         | Largest working load                               | Design of the waste container lifting device           | 5.1.1.4                                     | <i>D</i>          |
| 9  | Crushing, trapping                         | Largest working load                               | Load of test for the waste container lifting device    | 5.1.1.5                                     | <i>T</i>          |
| 10 | Crushing, impact                           | Container falling when lifted                      | Guide system                                           | 5.1.1.6                                     | <i>D, V</i>       |
| 11 | Crushing, impact                           | Container falling when lifted                      | Container locked on the pick-up system                 | 5.1.1.7                                     | <i>D, T</i>       |
| 12 | Crushing, impact                           | Container falling due to overload                  | Minimum emptying cycle time                            | 5.1.1.8                                     | <i>D, T</i>       |
| 13 | Crushing, impact                           | Container falling due to overload                  | Maximum speed of the container                         | 5.1.1.8                                     | <i>D, T</i>       |
| 14 | Crushing, impact                           | Container falling due to overload                  | Maximum acceleration of the container                  | 5.1.1.8                                     | <i>D, T</i>       |
| 15 | Crushing, impact                           | Container falling when released on the ground      | Stability of the container                             | 5.1.1.9                                     | <i>D, V</i>       |
| 16 | All hazards                                | Hazardous control of the lifting device            | Ergonomic control for the lifting device               | 5.1.2                                       | <i>D, V</i>       |
| 17 | All hazards                                | Hazardous control of the lifting device            | Marking of controls                                    | 5.1.2                                       | <i>D, V</i>       |
| 18 | Crushing,<br>trapping,<br>shearing, impact | During maintenance, resetting, repair or restoring | Manual mode achieved by selector                       | 5.1.2                                       | <i>D, V</i>       |
| 19 | Crushing,<br>trapping,<br>shearing, impact | Two or more lifting devices used simultaneously    | Simultaneous use not possible                          | 5.1.2                                       | <i>D, V</i>       |
| 20 | Crushing,<br>trapping,<br>shearing, impact | Split waste container lifting device               | Control situated outside the functional space          | 5.1.2                                       | <i>D, V</i>       |
| 21 | Crushing, impact                           | Lifting of container                               | Guidance of container during lifting                   | 5.2.1.1                                     | <i>D, V</i>       |
| 22 | Crushing, impact                           | Container falling from the comb                    | Design of the teeth of the comb                        | 5.2.1.2                                     | <i>D, T</i>       |
| 23 | Crushing,<br>trapping,<br>shearing, impact | Container falling during lifting                   | Container locked on the waste container lifting device | 5.2.1.3                                     | <i>D, T</i>       |
| 24 | Crushing                                   | Container falling during lifting                   | Container supported at the right place during lifting  | 5.2.1.4                                     | <i>D, T</i>       |

Table 1 (continued)

| N° | Hazard                               | Hazardous situation                                                      | Safety requirement measures                                  | Reference                                          | Verification   |
|----|--------------------------------------|--------------------------------------------------------------------------|--------------------------------------------------------------|----------------------------------------------------|----------------|
| 25 | Impact                               | Container falling during end of tipping motion                           | Damped tipping motion                                        | 5.2.1.4,<br>5.2.2.6                                | <i>D, T</i>    |
| 26 | Crushing, trapping, shearing, impact | Containers falling during lifting or collision between container and RCV | Design of the arms of trunnion pick-up system for containers | 5.2.2, 5.2.2.2,<br>5.2.2.3,<br>5.2.2.4,<br>5.2.2.5 | <i>D, V</i>    |
| 27 | Crushing, trapping, shearing, impact | Containers falling during lifting or collision between container and RCV | Design of the diamond pick-up system                         | 5.2.3,<br>5.2.4                                    | <i>D, V</i>    |
| 28 | Impact                               | Opening of the lid during the lifting                                    | Design of the lid opener                                     | 5.2.5                                              | <i>D, V</i>    |
| 29 | Crushing, trapping, shearing, impact | Emptying container with winch                                            | Design of the winch                                          | 5.2.6.1                                            | <i>D, V</i>    |
| 30 | Crushing, trapping, shearing, impact | Pick-up container with a two chains pick-up system                       | Design of the pick-up system                                 | 5.2.6.2                                            | <i>D, V</i>    |
| 31 | Crushing, trapping, shearing, impact | Pick-up skip container by four chains pick-up system                     | Design of the connections for skip                           | 5.2.6.3                                            | <i>D, V</i>    |
| 32 | Crushing, trapping, shearing, impact | Container falling due to absence of or bad end position system           | Design of the end position system                            | 5.2.6.5                                            | <i>D, V</i>    |
| 33 | Crushing, trapping, shearing, impact | Container falling during lifting                                         | Slack control                                                | 5.2.6.6                                            | <i>T</i>       |
| 34 | Crushing, trapping, shearing, impact | Container falling during lifting                                         | Catch for trunnion bar                                       | 5.2.6.4                                            | <i>D, T</i>    |
| 35 | Crushing, trapping, shearing, impact | Tipping of the RCV under too large a load                                | Design of stabilisation system                               | 5.2.6.7                                            | <i>D</i>       |
| 36 | Crushing, trapping, shearing, impact | Lifting of paladin container                                             | Design of clamping system                                    | 5.2.7                                              | <i>D, V</i>    |
| 37 | Impact                               | Waste falling during lifting of top lifted and bottom emptied container  | Design of container handling system                          | 5.2.8.1,<br>5.2.8.2                                | <i>D, T, V</i> |
| 38 | Crushing, trapping, shearing, impact | Waste container falls off caused by human error when using the crane     | Fitting of crane or winch                                    | 5.2.8.1                                            | <i>D, V</i>    |
| 39 | Crushing, trapping, shearing, impact | Unexpected movement of crane with waste container                        | Follow the operation manual of the chassis-cab and crane     | 5.2.8.1                                            | <i>V</i>       |
| 40 | Crushing, trapping, shearing, impact | Operating the loader crane without observing the functional space        | Fitting Illumination                                         | 5.2.8.1, 5.10,<br>5.12                             | <i>V</i>       |
| 41 | Crushing, trapping, shearing, impact | Emptying BG container                                                    | Design of pick up arms                                       | 5.2.4                                              | <i>D, T, V</i> |

Table 1 (continued)

| N° | Hazard                               | Hazardous situation                                                                | Safety requirement measures                                                         | Reference                        | Verification   |
|----|--------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|----------------------------------|----------------|
| 42 | Crushing, trapping, shearing, impact | Container falling during automatic or semi-automatic cycles on rear loaded RCV     | Rear protection of functional space and design of locking system and motion control | 5.3.1                            | <i>D, T, V</i> |
| 43 | Crushing, trapping, shearing, impact | Failure of mechanical interface                                                    | Design of mounting frame                                                            | 5.3.3, 5.3.3.2, 5.3.3.3          | <i>D, T</i>    |
| 44 | Impact                               | Waste falling during lifting of container                                          | Motion of the interchangeable waste container lifting device                        | 5.3.2, 5.3.4                     | <i>D, V</i>    |
| 45 | Impact, crushing                     | Operative falling on the lifting device, on the ground or in the compaction system | Safe footboard                                                                      | 5.3.5                            | <i>D</i>       |
| 46 | Crushing, trapping, shearing, impact | Hazardous control of the lifting device                                            | Design of hydraulic system                                                          | 5.3.6, 5.3.6.2, 5.3.6.3, 5.3.6.4 | <i>D</i>       |
| 47 | Crushing, trapping, shearing, impact | Hazardous control of the lifting device                                            | Hydraulic fluid                                                                     | 5.3.6.5                          | <i>D, T</i>    |
| 48 | Crushing, trapping, shearing, impact | Hazardous control of the lifting device                                            | Safe electrical interface                                                           | 5.3.7                            | <i>D</i>       |
| 49 | Impact, shearing                     | Part outside side loaded and front loaded RCV                                      | Design of waste container lifting device                                            | 5.4, 5.5                         | <i>D, T</i>    |
| 50 | Cutting, stabbing, puncture, burning | Impact from oil jet due to burst of hydraulic line                                 | Design of hose and relief valves                                                    | 5.5                              | <i>D, V</i>    |
| 51 | Stabbing, puncture                   | Impact from air jet due to burst of pneumatic line                                 | Design of hose                                                                      | 5.6                              | <i>D, V</i>    |
| 52 | Electrical hazard                    | Electrocution                                                                      | Design of electrical parts                                                          | 5.7, 5.11.8, 5.11.10, 5.12       | <i>D</i>       |
| 53 | Electrical hazard                    | Electromagnetic compatibility                                                      | Design                                                                              | 5.13                             | <i>D, M</i>    |
| 54 | All hazards                          | Misinterpretation of controls and lack of application of ergonomic principles      | Pictograms for operating controls                                                   | 5.8, 5.17                        | <i>V</i>       |
| 55 | Crushing, trapping, shearing, impact | Failure/dysfunction of control system                                              | Performance level of controls                                                       | 5.9.1.1, 5.9.3.1                 | <i>D, T</i>    |
| 56 | Crushing, trapping, shearing, impact | Unintentional starting                                                             | Design of controls                                                                  | 5.9.1.2                          | <i>D, T</i>    |
| 57 | Crushing, trapping, shearing, impact | All mechanical hazardous situation                                                 | Emergency stop                                                                      | 5.9.2.1, 5.9.2.2, 5.9.2.3        | <i>T</i>       |
| 58 | Crushing, trapping, shearing, impact | During emptying                                                                    | Selection of emptying mode                                                          | 5.9.3.2                          | <i>T</i>       |

Table 1 (continued)

| N° | Hazard                               | Hazardous situation                                      | Safety requirement measures                     | Reference      | Verification |
|----|--------------------------------------|----------------------------------------------------------|-------------------------------------------------|----------------|--------------|
| 59 | Crushing, trapping, shearing, impact | During operation of lifting device                       | Visual control of functional space              | 5.10           | V            |
| 60 | Crushing, trapping, shearing, impact | Failure of position sensor                               | Safety position sensor                          | 5.11.7         | V            |
| 61 | Crushing, trapping, shearing, impact | All mechanical hazardous situations                      | Design of remote and two-hand operating control | 5.11.2, 5.11.4 | D, T         |
| 62 | Crushing, trapping, shearing, impact | Container falling during lifting                         | Safety related interlocks                       | 5.11.3         | D, T         |
| 63 | Crushing, trapping, shearing, impact | Lifting device falling during maintenance                | Mechanical restraint device                     | 5.15           | V            |
| 64 | Crushing, trapping, shearing, impact | Lifting device falling due to loss of power supply       | Design                                          | 5.11.6         | D            |
| 65 | Crushing, trapping, shearing, impact | Uncontrolled movement due to failure of control circuits | Design of control circuits                      | 5.11.9         | D, V         |
| 66 | Crushing, trapping, shearing, impact | Lack of illumination                                     | Design of lighting                              | 5.12           | V            |
| 67 | Deafness                             | Noise                                                    | Design of the lifting device                    | 5.14           | D, M         |
| 68 | Impact                               | Handling of the lifting device                           | Design of the lifting device                    | 5.16           | V            |
| 69 | All hazards                          | Lack of signals and warning devices                      | Design of signals                               | 7.1            | V            |

## 5 Safety requirements and/or protective measures

### 5.1 General

Waste container lifting devices shall comply with the safety requirements and/or protective measures of this clause. In addition, the lifting devices shall be designed according to the principles of EN ISO 12100 for relevant but not significant hazards which are not dealt with by this standard.

All systems and components shall be specified and installed in accordance with their manufacturer's instructions.

#### 5.1.1 Design

##### 5.1.1.1 General

Any crushing and shearing hazards shall be avoided or minimized by design according to EN ISO 13857 and EN 349 or appropriate guard(s) according to EN 953 or protective equipment positioned according to EN ISO 13855.

The design shall take into account the dynamic impact of the lifting device on the connection between the waste container lifting device and the body of the RCV.

NOTE The lifting device and its placement should meet the requirements of the road traffic regulations.

#### **5.1.1.2 Distance to the ground**

To prevent foot injuries, the distance between the lower edge of the waste container lifting device and the level on which the RCV is standing shall be at least 120 mm or 320 mm for waste container lifting device which can operate on the kerbside. If the movement of the waste container lifting device down to the ground level is necessary, the distance between 120 mm (320 mm) and the horizontal ground shall be controlled by a hold-to-run control situated in a position where the waste container lifting device is in full view of the operative.

#### **5.1.1.3 Hopper**

The loading edge of the waste container lifting device and/or the body shall be designed taking into consideration the volume of the largest designated waste container emptied by the waste container lifting device and the volume of the hopper, in order to avoid waste falling out of the hopper.

When the hopper is emptied by the compaction mechanism at the same time as the waste container lifting device is being operated, the design shall be such that the designated waste container shall not collide with it.

#### **5.1.1.4 Load**

The waste container lifting device shall be provided with a device preventing emptying in excess of the maximum permissible load of the largest designated waste container.

The maximum working load for the lifting device is the weight of the largest designated waste container plus 1,1 times its nominal load. This shall be applied at the centre of gravity of the largest fully loaded waste container.

The nominal load of the loaded waste container is determined assuming a density of waste as defined in the standards of the EN 840 series, EN 12574 series or EN 13071 series.

#### **5.1.1.5 Tests**

The functional dynamic test load shall be 1,1 times the maximum working load for lifting up and down in the nominal cycle time. The functional static test load shall be 1,25 times the maximum working load.

#### **5.1.1.6 Guide system**

The pick-up system shall be provided with a guide system to laterally position the designated waste container on the waste container lifting device.

#### **5.1.1.7 Locking system**

The waste container lifting device shall be provided with a device to automatically lock and keep locked the designated waste container in the lifting position before the tilt of the waste container reaches 30° from vertical or before the height of the designated waste container reaches 2 000 mm from the horizontal level on which the RCV is standing, even if electrical, hydraulic or pneumatic energy fails.

In the automatic or semi automatic lifting mode, the device shall also verify that the designated waste container is locked in position when the locking system is not mechanically actuated during the whole locking sequence. The device shall be at least required performance level PL<sub>d</sub> according to EN ISO 13849-1, as defined in 5.9.1.1.

#### **5.1.1.8 Speed and acceleration**

The minimum waste container emptying cycle time, excluding the horizontal extension movement and dwell time, shall be 6 s for designated waste containers with a capacity up to 400 l, 10 s for designated waste containers with a capacity up to 1 700 l and 20 s for other waste containers.

The maximum peripheral speed of any reachable part of the waste container lifting device or of the largest designated waste container fitted on the lifting device shall not exceed 2,5 m/s for waste containers with a capacity less than 2 500 l and 1,5 m/s for waste containers with a capacity larger than 2 500 l, during the emptying cycle. This applies up to a height of 2 500 mm from the level on which the RCV is standing. The sampling frequency during the measurement shall be at least 10 Hz. The waste container shall be loaded at the nominal load.

The maximum absolute acceleration of the designated waste container transmitted from the waste container lifting device pick-up system during the emptying cycle shall not exceed  $30\text{m/s}^2$  for containers with a capacity less than 2 500 l and  $15\text{m/s}^2$  for containers with a capacity equal to or larger than 2 500 l. Testing shall be conducted with the container loaded with its nominal load. The sampling frequency during the measurement shall be 100 Hz.

#### 5.1.1.9 Release of the container

When the designated waste container is lowered to the ground and released from the waste container lifting device, it shall not fall over and shall remain stable.

#### 5.1.1.10 Locking of the waste container lifting device during travel movement of the RCV

During the travel movement the waste container lifting device shall not be capable of being operated. The waste container lifting device shall be positioned in its travel position and be automatically locked against any unintended movement, unless the travel position is different from the rest position. A hydraulic locking is accepted if a safety valve is fitted directly on the locking cylinder(s).

#### 5.1.2 Emptying operating modes and controls of the lifting device

The operating movements of control devices shall be consistent with their effect and user-friendly, for example:

— For button operated waste container lifting device:

Upper button = lift arm/lift carriage;

Lower button = lower arm/lower carriage.

— For lever (one axis) operated waste container lifting device, the operating direction of the lever shall correspond to the stated movement:

Pull or lift = lift arm/lift carriage;

Push or down = lower arm/lower carriage.

— For joystick (two axis) operated waste container lifting device, the operation direction shall correspond to the stated movement:

Pull = lift arm;

Push = lower arm;

Right = lift carriage;

Left = lower carriage.

The direction of movement achieved by a button, lever or mode selector shall be marked on or close to the control device and be clearly identified by an arrow highlighting the direction.

The control devices shall be switched over to manual mode with a mode selector for maintenance, repair, resetting or restoring, following degraded working conditions. The changeover operation shall not initiate any lifting or tilting operation. In any case, operations that could release lifted containers shall only be possible in the lowest lift position. The selection switch shall be protected against unauthorized activation (e.g. special key or code card).

When more than one lifting device is fitted on the RCV, it shall not be possible for the same operative to simultaneously operate the waste container lifting devices if this can give rise to any hazardous situation in the functional space.

It shall be impossible to use simultaneously the mechanisms of a combined waste container lifting device.

If the waste container lifting device can be activated from both inside and outside the cab, a selector switch shall be provided in the cab and the selected control mode shall be indicated to ensure that only one control is operable at any time.

## **5.2 Requirements for lifting the designated waste containers**

### **5.2.1 Comb pick-up system for waste containers according to EN 840 and EN 12574 series**

#### **5.2.1.1 Lifting carriage**

The lifting carriage shall be so designed as specified and illustrated in Figure A.2-1 to Figure A.2-5 that the positioning of:

- the two-wheeled container is done by a guide system;
- the four-wheeled container is done by the centre of the comb.

#### **5.2.1.2 Comb**

The design of the comb shall meet the dimensions of Figure A.2-1 if it is intended to pick up containers complying with EN 840-1, EN 840-2 or EN 840-3.

If the comb is suitable for an identification system according to EN 14803 and the designated waste container complies with EN 840-1, EN 840-2 or EN 840-3, the comb shall meet the dimensions of Figure A.2-2.

If the designated waste container complies with EN 840-4, the comb shall meet the dimensions of Figure A.2-3.

If the comb is suitable for an identification system according to EN 14803, and the designated waste container complies with EN 840-4, the comb shall meet the dimensions of Figure A.2-4.

Figure B.4 gives examples of the dimensions of the teeth.

#### **5.2.1.3 Comb locking system**

The locking system shall meet the dimensions of Figure A.2-5a for EN 840 waste containers frontal receivers forms A and B and Figure A.2-5b for EN 840 waste containers frontal receivers form C.

Its width shall be at least 90 % of the used comb width.

The locking system shall not interfere with the lid of the designated waste container and shall allow it to open freely.

#### 5.2.1.4 Container restraint device

The container restraint device shall be designed so as to damp the tipping motion of the container without catching or over stressing its frontal receiver.

During the entire emptying cycle and the shaking, the angle between any designated waste container and the pushing pad shall not exceed 25°.

The reaction forces of the restraint device shall not cause to the designated waste container any other wear than the normal superficial wear.

### 5.2.2 Trunnion pick-up system for containers of the EN 840 and EN 12574 series

#### 5.2.2.1 General

The minimum width of the contact surface for each arm at the load bearing point for the trunnion shall be 15 mm.

The length of the lateral lifting arms shall be such that the designated waste container keeps clearance from structural parts of the waste container lifting device during the entire emptying cycle (see dimension  $r$  in Figure A.4-1).

The design of the trunnion lifting device shall be such that the designated waste container is centred on the pick-up system.

#### 5.2.2.2 Trunnion pick-up system for containers according to EN 840-2 and EN 840-3

The shape of the trunnion receiver shall not protrude beyond the imaginary line by the radius of 145 mm centred on any possible container trunnion position while it is engaged in any position inside the slot.

The lid opening device for dome lid waste containers shall be designed and fitted in such a manner that the lid remains clear from the waste container's rear wall when the designated waste container is fully tipped.

The minimum opening of the lid shall be equal to  $\frac{3}{4}$  of its total movement.

The lid opener: shall operate with the lid up to  $\frac{1}{4}$  open of its total movement.

Dimensions and tolerances shall meet the requirements of Figure A.4-1.

#### 5.2.2.3 Trunnion pick-up system for containers according to EN 840-4

The distance between the arms shall meet the dimension of Figure A.4-2.

#### 5.2.2.4 Trunnion pick-up system for containers according to EN 12574-1

The pick-up system and the lid opener shall meet the dimensions of Figure A.4-3.

#### 5.2.2.5 Double trunnion pick-up system for containers according to EN 12574-1

The lateral arms located on the lifting carriage shall meet the dimensions of Figure A.4-4.

#### 5.2.2.6 Pushing pad

The pushing pad, central onto the axis of the lifting device, is composed of one or more part(s).

The pushing pad position in relation to the comb shall be according to Figure A.3-1 for designated waste container according to EN 840-1, EN 840-2 and EN 840-3 and Figure A.3-2 for designated waste container according to EN 840-4.

The contact surface area of the pushing pad onto the waste container shall be no less than 70 % of the projected area or the pressure exerted on the waste container with the nominal load by the pushing pad shall not exceed 80 kPa.

The pushing pad shall be designed so as to avoid that the waste container will be tipped over or slide away during the lifting sequence.

The surface of the pushing pad shall be made of a soft, flexible material.

#### **5.2.2.7 Container restraint device**

The container restraint device shall damp the tipping motion without any possibility for the container catching or over-stressing the trunnion.

During the entire emptying cycle and the shaking of the waste container complying with EN 840-2 and EN 840-4, the angle between the designated waste container and the lifting carriage shall not exceed 25°.

The reaction forces of the shock absorber shall not cause to the designated waste container any other wear than the normal superficial wear.

#### **5.2.3 Diamond pick-up system**

The diamond pick-up system shall be designed according to Figure A.5-1 for handling one two-wheeled container (Figure B.1-2).

The pick-up system shall be designed according to Figure A.5-1-1 and A.5-1-2 for handling two two-wheeled containers or one four-wheeled container (Figure B.1-2).

The designated waste container shall be locked onto its diamond pick-up system as described in 5.2.1.3.

The locking system shall meet the dimensions of Figure A.5-2. Its width shall be at least 90 % of the frontal receiver width. It shall not interfere with the lid of the waste container and shall allow it to open freely.

#### **5.2.4 BG pick-up system**

The pick up arms and the pick up range shall meet the dimensions of Figure A.6.

The length and configuration of the lateral lifting arms shall be such that the designated waste container keeps clearance from structural parts of the waste container lifting device during the entire emptying cycle and no waste falls beside the hopper (for small BG containers).

The design shall be such that the pick up points with BG adaptor of the designated waste container are centred by the waste container lifting device.

#### **5.2.5 Pocket pick-up system for waste container according to EN 12574-1**

For emptying dome lid containers, a lid opening device shall be provided. It shall be designed and fitted in such a manner that the lid remains clear from the rear wall of the container when the designated waste container is fully tipped.

The minimum opening of the lid shall be equal up to  $\frac{1}{4}$  of its total movement.

Dimensions and tolerances for the pick-up system and the lid opener shall meet the requirements of Figure A.7.

#### **5.2.6 Skip container pick-up system**

NOTE Examples of skip waste container pick-up system are shown in Figure A.1-4 and Figures B.2 and B.3.