

Earth-moving machinery — Safety —

Part 3: Requirements for loaders

The European Standard EN 474-3:2006 has the status of a
British Standard

ICS 53.100

National foreword

This British Standard was published by BSI. It is the UK implementation of EN 474-3:2006. It supersedes BS EN 474-3:1996, which will be withdrawn on 1 November 2008.

The UK participation in its preparation was entrusted by Technical Committee B/513, Construction equipment and plant and site safety, to Subcommittee B/513/1, Earth moving machinery (International).

A list of organizations represented on B/513/1 can be obtained on request to its secretary.

The transition period is to allow stock of products manufactured to BS EN 474-3:1996 to be exhausted and for manufacturers to adopt the requirements of the revised standard.

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

Compliance with a British Standard cannot confer immunity from legal obligations.

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Foreword

This document (EN 474-3:2006) has been prepared by Technical Committee CEN/TC 151 "Construction equipment and building material machines — Safety", 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of an identical text or by endorsement, at the latest by May 2007, and conflicting national standards shall be withdrawn at the latest by November 2008.

This European Standard supersedes EN 474-3:1996.

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.

For bibliographic references, see EN 474-1:2006.

EN 474 "Earth-moving machinery — Safety" comprises the following parts:

- Part 1: General requirements
- Part 2: Requirements for tractor-dozers
- Part 3: Requirements for loaders
- Part 4: Requirements for backhoe-loaders
- Part 5: Requirements for hydraulic excavators
- Part 6: Requirements for dumpers
- Part 7: Requirements for scrapers
- Part 8: Requirements for graders
- Part 9: Requirements for pipelayers
- Part 10: Requirements for trenchers
- Part 11: Requirements for earth and landfill compactors
- Part 12: Requirements for cable excavators.

This European Standard is intended for use in combination with part 1 of the series.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, 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 part of EN 474 is a type C standard as stated in EN ISO 12100-1:2003.

The machinery concerned and the extent to which hazards, hazardous situations and 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 provisions of the other standards, for machines that have been designed and built according to the provisions of this type C standard.

1 Scope

This part of EN 474 deals with all significant hazards, hazardous situations and events relevant to loaders as defined in EN ISO 6165:2006, when they are used as intended and under conditions of misuse which are reasonably foreseeable by the manufacturer (see Clause 4).

This part also deals with fork application, single heavy object handling application, object handling application and log handling.

The requirements of this part are complementary to the common requirements formulated in EN 474-1:2006.

This part does not repeat the requirements from EN 474-1:2006, but adds or replaces the requirements for application for loaders.

This part specifies the appropriate technical measures to eliminate or reduce risks arising from the significant hazards, hazardous situations and events during commissioning, operation and maintenance of loaders.

This European Standard is not applicable to loaders manufactured before the date of publication of this European Standard by CEN.

2 Normative references

The following referenced documents are indispensable for the application of this European Standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 474-1:2006, *Earth-moving machinery — Safety — Part 1: General requirements*

EN ISO 2867:1998, *Earth-moving machinery — Access systems (ISO 2867:1994)*

EN ISO 3164:1999, *Earth-moving machinery — Laboratory evaluations of protective structures — Specifications for deflecting-limiting volume (ISO 3164:1995)*

EN ISO 3449:2005, *Earth-moving machinery — Falling-object protective structures — Laboratory tests and performance requirements (ISO 3449:2005)*

EN ISO 3457:2003, *Earth-moving machinery — Guards — Definitions and requirements (ISO 3457:2003)*

EN ISO 6682:1995, *Earth-moving machinery — Zones of comfort and reach for controls (ISO 6682:1986 including Amendment 1:1989)*

EN ISO 7096:2000, *Earth-moving machinery — Laboratory evaluation of operator seat vibration (ISO 7096:2000)*

EN ISO 12100-1:2003, *Safety of machinery — Basic concepts, general principles for design — Part 1: Basic terminology, methodology (ISO 12100-1:2003)*

ISO 2330:2002, *Fork-lift trucks — Fork arms — Technical characteristics and testing*

ISO 6016:1998, *Earth-moving machinery — Methods of measuring the masses of whole machines, their equipment and components*

ISO 7546:1983, *Earth-moving machinery — Loader and front loading excavator buckets — Volumetric ratings*

ISO 14397-1:2002, *Earth-moving machinery — Loaders and backhoe loaders — Part 1: Calculation of rated operating capacity and test method for verifying calculated tipping load*

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN 474-1:2006, EN ISO 12100-1:2003 and the following apply.

Terminology for loaders is specified in ISO 7131:1997 and the most common loaders are illustrated in Annex B of this European Standard.

NOTE Definitions used in EN and ISO standards referred to in this European Standard are also valid for this document.

3.1

loader

self-propelled crawler or wheeled machine, having a front-mounted equipment primarily designed for loading operation (bucket use), which loads or excavates through forward motion of the machine

NOTE 1 A loader work cycle normally comprises filling, elevating, transporting and discharging material.

NOTE 2 Derivative machinery; loaders can also be used for derivative application (see EN 474-1:2006, 3.1.2).

3.2

compact loader

loader with an operating mass (see ISO 6016:1998) of 4 500 kg or less, designed to work in confined spaces with the associated needs for greater manoeuvrability

3.3

skid steer loader

loader normally having an operator's station between attachment-supporting structures and steered by using variation of speed and/or direction of rotation between traction drives on opposite sides of a machine with fixed axles

3.4

swing loader

loader having a swing type lift arm with a swinging angle to the left and right from a straight position

NOTE A swing loader work cycle is normally similar to a loader cycle but additionally work can be done offset of the machine track.

4 List of additional significant hazards

See Annex A.

NOTE Annex A (normative) contains all the significant hazards, hazardous situations and events, as far as they are dealt with in this European Standard, identified by risk assessment as significant for this type of machinery and which require action to eliminate or reduce the risk.

5 Safety requirements and/or measures

5.1 General

Loaders shall comply with the requirements of EN 474-1:2006, as far as not modified or replaced by the requirements of this part.

5.2 Loaders with front access

5.2.1 General

For loaders with front access the reference to EN ISO 2867:1998 applies with the deviations given in 5.2.2 and 5.2.3.

5.2.2 Primary access opening

The primary opening shall not be less than:

- opening height 875 mm;
- opening width 550 mm.

5.2.3 Alternative egress opening (emergency exit)

An alternative opening shall be provided.

Minimum dimension of the emergency exit shall comply with 11.2.2 of EN ISO 2867:1998.

5.3 Operator's seat

EN 474-1:2006, 5.4.1 applies with the addition that the seat shall meet the requirements of the following input spectral class according to EN ISO 7096:2000:

- EM3 for wheel loaders greater than 4 500 kg;
- EM6 for crawler loaders;
- EM8 for compact wheel loaders less or equal than 4 500 kg;
- EM9 for skid steer loaders.

5.4 Rear window(s)

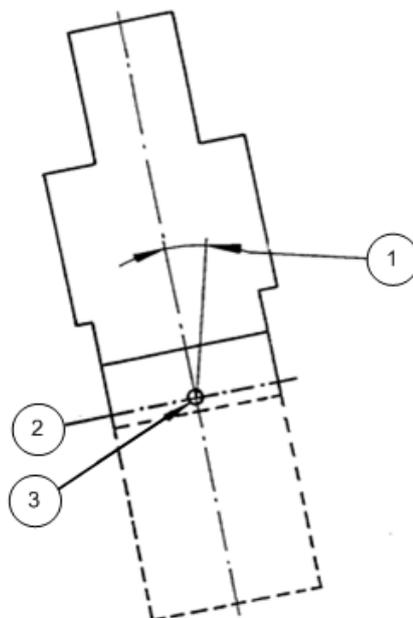
The requirements of EN 474-1:2006, 5.3.2.7 and 5.3.2.9 for the rear window(s) apply, with the exception that no motorized wiper(s) and washers are required for loaders with a cab width less than or equal to 750 mm measured outside of the cab in the height of SIP.

5.5 Protection

5.5.1 Roll-over protective structures (ROPS)

EN 474-1:2006, 5.3.3, applies with the following addition for compact loaders:

The portion of deflection-limiting volume (DLV) above the LA (SIP) line according to EN ISO 3164:1999 is allowed to deviate (lean) up to 15° laterally as shown in Figure 1, when the minimum energy requirement is met. Portion below the LA (SIP) line of DLV can be disregarded.

**Key**

- 1 up to 15°
- 2 LA
- 3 Seat index point (SIP)

Figure 1 — Deflection-limiting volume (DLV), front view

5.5.2 Falling object protective structures (FOPS)

EN 474-1:2006, 5.3.4 applies with the following addition for compact loaders:

Machines with an operating mass less than or equal to 700 kg according to ISO 6016:1998 shall be designed and built so that a FOPS can be fitted. If a FOPS is fitted, it shall meet the performance requirements of EN ISO 3449:2005, level 1.

5.5.3 Fenders

EN 474-1:2006, 5.14.7 does not apply to compact loaders with front access.

5.5.4 Operator's controls and indicators

EN 474-1:2006, 5.5 applies with the following additions for compact loaders with front access:

Controls for lifting and lowering the loader linkage, machine movement and hydraulically controlled attachments (e. g. multi-purpose bucket) shall be either automatically mechanically secured, e. g. by a safety bar; or automatically deactivated when the operator leaves/enters the operator's compartment.

5.5.5 Guarding for loaders

Loaders shall be fitted with side protection that prevents the operator from reaching the trapping parts between the side arm(s) and fixed parts of the machine when the operator is seated in the operator's position. Opening in the guards shall comply with EN ISO 3457:2003. For the lower limbs, guards are required within the zone of reach according to EN ISO 6682:1995 with a minimum height of 200 mm from the floor plate.

NOTE EN 294:1992 is not fully complied with as this would cause the hazard of restricted visibility to the working area.

5.5.6 Restraint systems for machines with front access

5.4.1.5 of EN 474-1:2006 applies with the exception that the safety bar, see 5.5.4 of this European Standard, can be used as a restraint system provided that the test criteria of EN ISO 6683:1999 are met.

5.6 Stability

5.6.1 General

EN 474-1:2006, 5.11 applies with the additions given in 5.6.2 to 5.6.7 below.

All rated capacities as defined hereafter are based on tests and/or calculations of machines being on level and firm supporting surface.

The mass of the load, its density and the location of its centre of gravity as well as the mass of the attachment and the attachment bracket, if fitted, shall be included in the determination of the rated operating capacity and the size/capacity of the attachment.

Loaders do not need boom lowering control device as defined in ISO 8643:1997.

Hoses shall withstand four times the operating pressure.

To provide a sufficient stability the rated operating capacity in intended operations shall be determined as specified in 5.6.2 to 5.6.7

5.6.2 Bucket application

The rated operating capacity shall be determined according to ISO 14397-1:2002.

The volumetric rating of bucket shall be determined according to ISO 7546:1983.

NOTE The mass, volumetric rating of bucket and density of the material have to be taken into account when the bucket capacity is selected for a specific application.

5.6.3 Fork application

5.6.3.1 General

The rated operating capacity is based on the use of forks and shall be determined by the criteria specified in 5.6.3.2 to 5.6.3.4.

5.6.3.2 Rated load

The tipping load shall be determined according to ISO 14397-1:2002 (except for stability factor stated in 4.1) and with the fork in a horizontal position. The rated load as a percentage of tipping load shall not exceed the applicable value specified in Table 1.

Table 1 — Stability factors in fork application

Rated load as a percentage of tipping load	
Ground condition	Wheel loader
Rough terrain	60
Firm and level ground	80

Stability factors to determine rated load of wheel loaders with skid steering shall not exceed 50 % and crawler loaders, or skid steer track loaders, shall not exceed 35 % of the tipping load.

5.6.3.3 Hydraulic lift capacity

It shall be possible to control the rated load in all positions foreseen by the manufacturer, considering all relevant hydraulic circuits involved.

NOTE The hydraulic lift capacity is the maximum mass that can be lifted in any arm position with the fork in horizontal position limited by the hydraulic circuit working pressure according to ISO 14397-2:2002.

5.6.3.4 Rated operating capacity

The rated operating capacity shall be determined either by:

- the rated load specified in 5.6.3.2 or
- the hydraulic lift capacity specified in 5.6.3.3,

whichever is less.

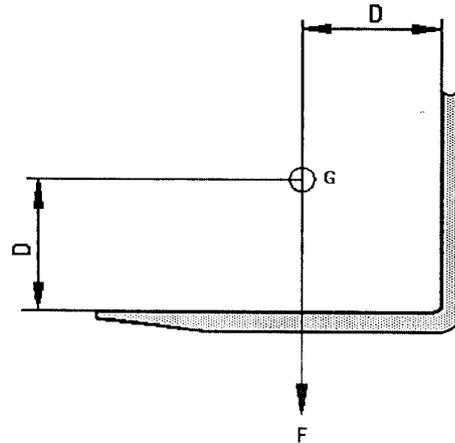
5.6.3.5 Fork size

To select the fork arm size and to determine the load centre gravity distance (D) as shown in Figure 2, the specifications in Table 2 shall be followed.

Table 2 — Load centre distance

Load F (N)			Distance D (mm)
F	≤	10 000	400
10 000	< F ≤	50 000	500
50 000	< F ≤	100 000	600
100 000	< F ≤	200 000	900
F	>	200 000	1 200

Fork arms shall meet the performance requirements stated in ISO 2330:2002.



Key

- D distance in millimetres (see tables 2 and 4)
- F load in Newton
- G centre of gravity

Figure 2 — Load centre distance with fork arms

5.6.4 Log handling application

5.6.4.1 General

The rated operating capacity is based on a log grapple application and shall be determined by the criteria specified in 5.6.4.2 to 5.6.4.4.

5.6.4.2 Rated load

Tipping load shall be determined according to ISO 14397-1:2002 (except for stability factor stated in 4.1) with the log grapple fitted. The rated load as percentage of tipping load shall not exceed the applicable value specified in Table 3.

Table 3 — Stability factors in log handling

Rated load as a percentage of tipping load		
Ground condition	wheel loaders	crawler loaders
Rough terrain	75	50
Firm and level ground	85	60

5.6.4.3 Hydraulic lift capacity

It shall be possible to control the rated load in all positions foreseen by the manufacturer, considering all relevant hydraulic circuits involved.

NOTE Hydraulic lift capacity is the maximum mass that can be lifted in any arm position with the log grapple fitted limited by the hydraulic circuit working pressure according to ISO 14397-2:2002.

5.6.4.4 Rated operating capacity

The rated operating capacity shall be determined either by:

- the rated load specified in 5.6.4.2 or
- the hydraulic lift capacity specified in 5.6.4.3,

whichever is less.

5.6.5 Single heavy object (non palletised single heavy object) application

5.6.5.1 General

The rated operating capacity is based on the use of a single heavy object handling device (for a non palletised load) and shall be determined by the criteria specified in 5.6.5.2 to 5.6.5.4.

5.6.5.2 Rated load – Transport mode

Tipping load shall be determined according to ISO 14397-1:2002 (except for stability factor stated in 4.1), with the block handling attachment (e. g. stone fork) in a fully roll back and carry position;

- the rated load in Table 4 is only valid for speeds less than or equal to 10 km/h;
- the rated load according to this mode, as percentage of tipping load, shall not exceed the applicable value specified in Table 4 when operating on a flat, hard surface.

Table 4 — Stability factors in single heavy object handling in transport mode

Rated load as a percentage of tipping load		
Ground condition	wheel loaders	crawler loaders
Firm and level ground	80	60

5.6.5.3 Hydraulic lift capacity

It shall be possible to control the rated load in all positions foreseen by the manufacturer, considering all relevant hydraulic circuits involved.

NOTE Hydraulic lift capacity is the maximum mass that can be lifted in any arm position with the fork in horizontal position limited by the hydraulic circuit working pressure according to ISO 14397-2:2002.

5.6.5.4 Rated operating capacity

The rated operating capacity shall be determined either by:

- the rated load as specified in 5.6.5.2 or
- the hydraulic lift capacity specified in 5.6.5.3,

whichever is less.

5.6.5.5 Handling attachment

The centre of gravity distance (D) of the attachment is shown in Figure 2.

Table 5 — Load centre distance

Load F (N)			Distance D (mm)
F	≤	100 000	600
100 000	< F ≤	200 000	900
F	>	200 000	1 200

NOTE 1 To indicate the rated operating load for a single heavy object handling attachment a transversal, square cross section of the load should be considered.

NOTE 2 The specifications in Table 5 should preferably be selected.

5.6.6 Object handling application

5.6.6.1 General

The rated operating capacity is based on use of (a) lifting accessory(ies) and the attachment and shall be determined by criteria given in 5.6.6.2 to 5.6.6.4.

5.6.6.2 Rated load

Tipping load shall be determined according to ISO 14397-1:2002, and with the load attached to the actual load hooking points as specified by the manufacturer. The rated load, as a percentage of tipping load, shall be determined according to ISO 14397-1:2002, Clause 4.

5.6.6.3 Hydraulic lift capacity

It shall be possible to control the rated load in all positions foreseen by the manufacturer, considering all relevant hydraulic circuits involved.

NOTE Hydraulic lift capacity is the maximum mass that can be lifted in any arm position with the hooking points fitted, limited by the hydraulic circuit working pressure according to ISO 14397-2:2002.

5.6.6.4 Rated operating capacity

The rated operating capacity shall be determined either by:

- the rated load specified in 5.6.6.2 or
- the hydraulic lift capacity specified in 5.6.6.3,

whichever is less.

5.6.7 Other applications

The rated operating capacity of derivative machinery shall be determined by the manufacturer according to the load specification given in 5.6.2 to 5.6.6 whereby the comparable hazard has to be considered.

6 Information for use

EN 474-1:2006, 7.2, applies with the following additions:

The manufacturer shall provide information of the rated operating capacity as well as the corresponding operating conditions:

- bucket application according to 5.6.2;
- fork application according to 5.6.3;
- log handling according to 5.6.4
- single heavy objects according to 5.6.5;
- object handling according to 5.6.6;
- other applications according to 5.6.7.

Annex A (normative)

List of significant additional hazards – Loaders

The list of significant hazards in EN 474-1:2006, Annex A, applies with the following additions:

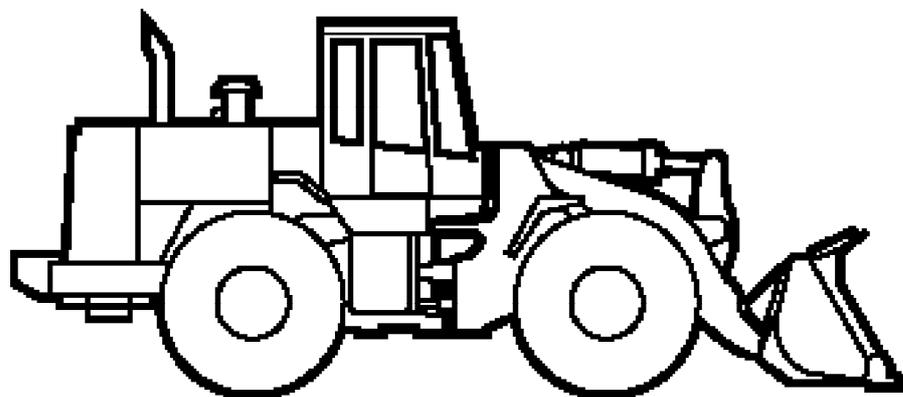
Table A.1 — List of additional significant hazards

No.1)	Hazard	Relevant clauses of this European Standard
	Hazards, hazardous situations and hazardous events	
1	Mechanical hazards due to: — machine parts or working tools, e. g.: — attachment, attachment brackets and/or equipment — object and log handling	5.6 5.6
1.1	Crushing hazard	5.5.1, 5.5.2, 5.5.5
16	Loss of stability/overturning of machinery	
16.1	Rated operating load with bucket, fork, single heavy object, object handling, log handling and other applications	5.6
	Additional hazards, hazardous situations and hazardous events due to mobility	
19	Linked to the operator's station on the machine	
19.1	Fall of persons during access to (or at/from) the operator's station	5.2
19.4	Mechanical hazards at the operator's station(s): a) contact with the wheels; b) rollover; c) fall of objects, penetration by objects	5.5.3 5.5.1 5.5.2
19.5	Insufficient visibility from the operator's station(s)	5.4
19.7	Inadequate seating	5.3
20	Due to the control system	
20.3	Inadequate design of manual controls and their mode of operation	5.5.4
24	Insufficient instructions for the operator (operation manual, signs, warnings and markings)	6
25	Mechanical hazards and hazardous events	
25.1	from load falls, collision, machine tipping caused by	
25.1.1	lack of stability	5.6
25.1.2	Uncontrolled loading – overloading – overturning moments exceeded	5.6

1) Number refers to Annex A of EN 474-1:2006.

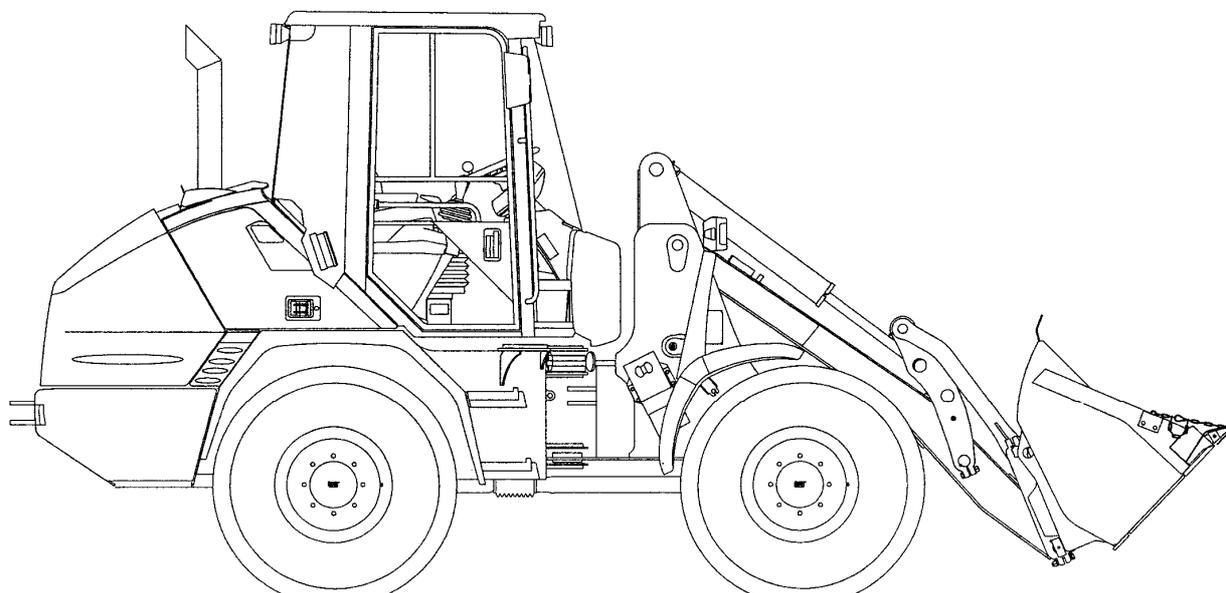
Annex B (informative)

Illustrations



NOTE Wheel loader with an operating mass greater than 4 500 kg.

Figure B.1 — Wheel loader



NOTE Wheel loader with an operating mass $\leq 4\,500$ kg, designed to work in confined spaces and with a need for greater manoeuvrability.

Figure B.2 — Compact wheel loader

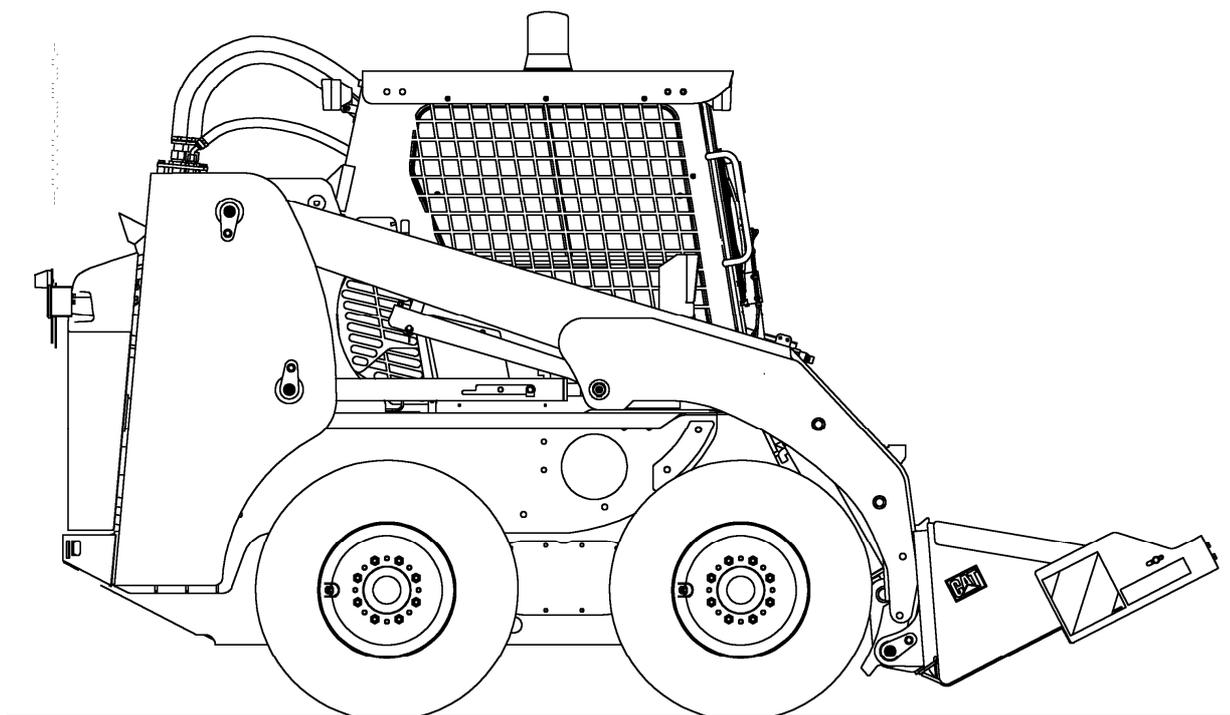


Figure B.3 — Skid steer loader

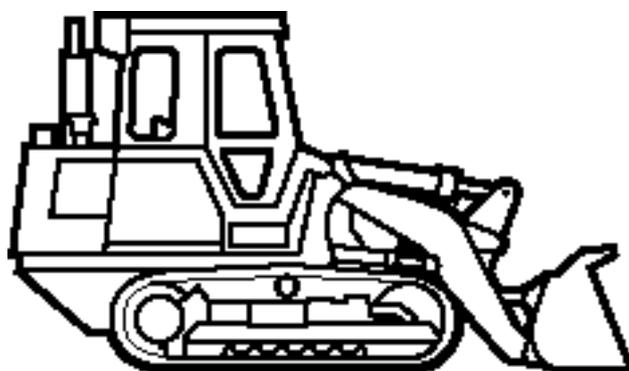


Figure B.4 — Crawler loader

NOTE Crawler or wheel loader with an optional attachment, which does not change the safety requirement of the base machine but modifies the application for use.

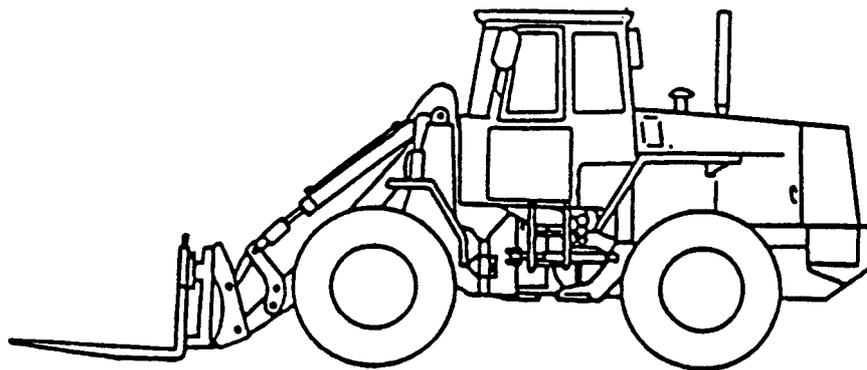
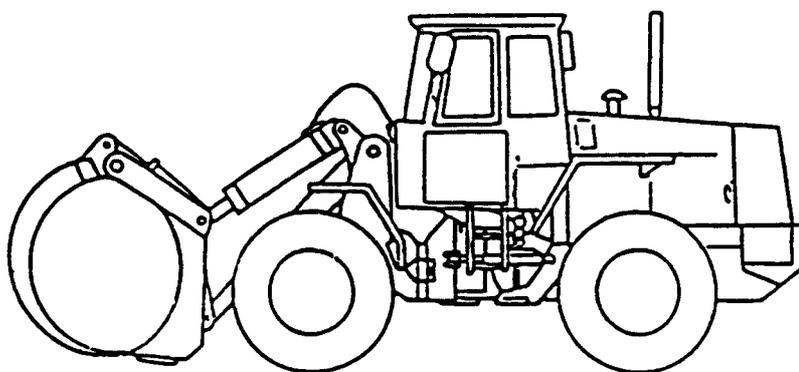


Figure B.5 — Wheel loader with fork arms



NOTE Crawler or wheel loader with an optional attachment, which does not change the safety requirement of the base machine but modifies the application for use

Figure B.6 — Wheel loader with grapple

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 98/37/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 a means of conforming to Essential Requirements of the New Approach Directive Machinery 98/37/EC, amended by 98/79/EC.

Once this standard is cited in the Official Journal of the European Communities under that Directive and has been implemented as a national standard in at least one Member State, 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.

Bibliography

- [1] EN ISO 6165:2006, *Earth-moving machinery — Basic types — Identification and terms and definitions (ISO 6165:2006)*
- [2] ISO 7131:1997, *Earth-moving machinery — Loaders — Terminology and commercial specifications*
- [3] ISO 8643:1997, *Earth-moving machinery — Hydraulic excavator and backhoe loader boom-lowering control device — Requirements and tests*
- [4] ISO 14397-2:2002, *Earth-moving machinery — Loaders and backhoe loaders — Part 2: Test method for measuring breakout forces and lift capacity to maximum lift height*

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