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Agricultural machinery — Robotic feed systems — Safety

Matériel agricole — Systèmes d'alimentation robotisés — Sécurité

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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Contents

Page

Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 3, *Safety and comfort*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 144, *Tractors and machinery for agriculture and forestry*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document is a type-C standard as specified in ISO 12100:2010.

This document is of relevance, in particular, for the following stakeholder groups representing the market players with regard to machinery safety:

— machine manufacturers (small, medium and large enterprises);

— health and safety bodies (regulators, accident prevention organizations, market surveillance, etc.)

Others can be affected by the level of machinery safety achieved with the means of the document by the above-mentioned stakeholder groups:

— machine users/employers (small, medium and large enterprises);

— machine users/employees (e.g. trade unions, organizations for people with special needs);

— service providers, e.g. for maintenance (small, medium and large enterprises);

— consumers (in case of machinery intended for use by consumers).

The above-mentioned stakeholder groups have been given the possibility to participate at the drafting process of this document.

The machinery concerned and the extent to which hazards, hazardous situations and 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 according to the provisions of this type C standard.

The purpose of this document is to establish specific design principles for semi-autonomous and autonomous functions of robotic feed systems (RFS) agricultural machinery. The application of other type C standards which deal with relevant significant hazards to the machinery covered in the scope of this document is explained in Clause 4.

The requirements of this document concern designers, manufacturers and their authorized representatives of feed systems. This document also includes information to be provided by the manufacturer to the user.

Agricultural machinery — Robotic feed systems — Safety

1 Scope

This document specifies the safety requirements and their verification for the design and construction of robotic feed systems (RFS) (see Annex A), which distribute feed and perform at least one of the following functions without the need of human interaction:

— storing of feed;

— loading of mobile feed unit (MFU);

— mixing;

— travelling;

— cleaning (residual feed);

— pushing feed.

Additionally, it provides the type of information, to be provided by the manufacturer, on safe working practices (including information about residual risks).

This document is for feeding livestock (e.g. cows, sheep, pigs).

This document does not apply to:

— systems designed to be used at a fixed location and that discharge feed at a remote location (e.g. chain conveyor feed systems, belt conveyor feed systems or liquid feed systems);

— tractors;

— systems designed for field application.

This document deals with all the significant hazards, hazardous situations and events relevant to RFS, see Annex B, when they are used as intended and under the conditions of misuse, which are reasonably foreseeable, by the manufacturer as listed in Clause 4, except for the hazards arising from:

— internal combustion engines of RFS;

— requirements for the connections to the main electric power supply;

— RFS with interchangeable equipment;

— emission of airborne noise.

NOTE 1 Hazards related to internal combustion engines of robotic feed systems (e.g. exhaust emissions in buildings) will be considered in separate standards

NOTE 2 The main electric power supply is subject to national regulations or codes

NOTE 3 Sudden loud noises may cause farm animals to become startled. It is advised to consider this with the design of the RFS.

Environmental aspects (except noise) have not been considered in this document.

This document is not applicable to feed systems manufactured before the date of its publication.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO 3691-4:2023, *Industrial trucks — Safety requirements and verification — Part 4: Driverless industrial trucks and their systems*

ISO 4254-1:2013, *Agricultural machinery — Safety — Part 1: General requirements*

ISO 7010:2019, *Graphical symbols — Safety colours and safety signs — Registered safety signs*

ISO 7731:2003, *Ergonomics — Danger signals for public and work areas — Auditory danger signals*

ISO 11684:2023, *Tractors, machinery for agriculture and forestry, powered lawn and garden equipment — Safety labels — General principles*

ISO 12100:2010, *Safety of machinery — General principles for design — Risk assessment and risk reduction*

ISO 13849-1:2023, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design*

ISO 13849-2:2012, *Safety of machinery — Safety-related parts of control systems — Part 2: Validation*

ISO 13850:2015, *Safety of machinery — Emergency stop function — Principles for design*

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 13856-3:2013, *Safety of machinery — Pressure-sensitive protective devices — Part 3: General principles for design and testing of pressure-sensitive bumpers, plates, wires and similar devices*

ISO 13857:2019, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs*

ISO 14119:2024, *Safety of machinery — Interlocking devices associated with guards — Principles for design and selection*

ISO 14120:2015, *Safety of machinery — Guards — General requirements for the design and construction of fixed and movable guards*

ISO 15817:2012, *Earth-moving machinery — Safety requirements for remote operator control systems*

ISO 16230-1:2015, *Agricultural machinery and tractors — Safety of higher voltage electrical and electronic components and systems — Part 1: General requirements*

ISO 16231-2:2015, *Self-propelled agricultural machinery — Assessment of stability — Part 2: Determination of static stability and test procedures*

ISO 18497-1:2024, *Agricultural machinery and tractors — Safety of partially automated, semi-autonomous and autonomous machinery — Part 1: Machine design principles and vocabulary*

ISO 25119-1:2018/Amd 1:2020, *Tractors and machinery for agriculture and forestry — Safety-related parts of control systems — Part 1: General principles for design and development — Amendment 1*

ISO 25119-2:2019, *Tractors and machinery for agriculture and forestry — Safety-related parts of control systems — Part 2: Concept phase*

ISO 25119-3:2018/Amd 1:2020, *Tractors and machinery for agriculture and forestry — Safety-related parts of control systems — Part 3: Series development, hardware and software — Amendment 1*

ISO 25119-4:2018, *Tractors and machinery for agriculture and forestry —Safety-related parts of control systems — Part 4: Production, operation, modification and supporting processes*

ISO 25119-4:2018/Amd 1:2020, *Tractors and machinery for agriculture and forestry —Safety-related parts of control systems — Part 4: Production, operation, modification and supporting processes — Amendment 1*

EN 703:2021, *Agricultural machinery — Safety — Silage loading, mixing and/or chopping and distributing machines*

EN 1175:2020, *Safety of industrial trucks — Electrical/ electronic requirements*

IEC 60204-1:2016, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements*

IEC 60825-1:2014, *Safety of laser products — Part 1: Equipment classification and requirements*

IEC 61000-6-2:2016, *Electromagnetic compatibility (EMC) — Part 6-2: Generic standards — Immunity standard for industrial environments*

IEC 61000-6-4:2018, *Electromagnetic compatibility (EMC) — Part 6-4: Generic standards — Emission standard for industrial environments*

IEC 61496-1:2020, *Safety of machinery — Electro-sensitive protective equipment — Part 1: General requirements and tests*

IEC 61496-2:2020, *Safety of machinery — Electro-sensitive protective equipment — Part 2: Particular requirements for equipment using active opto-electronic protective devices*

IEC 62485-6:2021, *Safety requirements for secondary batteries and battery installations — Part 6: Lithium-ion batteries for traction applications*

IEC 62619:2022, *Secondary cells and batteries containing alkaline or other non-acid electrolytes — Safety requirements for secondary lithium cells and batteries, for use in industrial applications*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 18497-1:2024 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
robotic feed system
RFS
feed system, either semi-autonomous or autonomous, consisting of various machinery performing the necessary functions to feed livestock

3.1.1
semi-autonomous robotic feed system
system comprising *feed robotic device(s)* (3.2.1) and any machinery, equipment, devices, or sensors supporting the feed robotic device(s) performing its feed task

3.1.2
autonomous robotic feed system
system comprising *feed robot(s)* (3.2.2) and any machinery, equipment, devices, or sensors supporting the feed robot performing its feed task

3.2
mobile feed unit
MFU
specific mobile device used to deploy the feed to the livestock, which is either a *feed robotic device* (3.2.1) or a *feed robot* (3.2.2) as part of an *RFS* (3.1)

3.2.1
feed robotic device
actuated programmable mechanism fulfilling the characteristics of feed robot but operating at a semi-autonomous level of autonomy

EXAMPLE Hanging MFU.

3.2.2
feed robot
actuated programmable mechanism operating autonomously

3.3
operator
local or remote positioned designated person who is responsible for the movement and operation of the RFS

3.4
feed storage area
designated area where one or more different *feed storage devices* (3.5) are located and/or where feedstuffs are stocked in bulk

3.5
feed storage device
stationary device for intermediate storage and processing of feedstuffs (e.g. feed bunker) as part of an *RFS* (3.1)

3.6
loading
transferring feedstuffs into the *MFU* (3.2)

3.7
loading area
designated area where the *loading* (3.6) is performed

3.8
service mode
mode of machine operation in which service is performed

Note 1 to entry: See ISO 4254-1:2013, 3.2 for the definition of service.

3.9
common zone
designated area open to all people which includes the autonomous operating zone of the RFS

3.10
caution zone
designated area part of a *common zone* (3.1) where there is an increased safety risk, e.g. due to inadequate clearance or where a *loading* (3.6) takes place

3.11
restricted zone
designated and physically separated area, which contains hazardous autonomous functions of the RFS in which only authorized persons are permitted to enter

3.12
non-contact protective system
non-contact protective equipment fitted to the MFU, having one or more detection zones that generates a signal prior to physical contact

Note 1 to entry: Non-contact protective equipment can include different types of technologies such as optical, laser, radar, etc.

3.13
MFU with ride-on capability
self-propelled MFU equipped with controls for manual operation by an onboard operator

3.14
continuous fixed structure
fixed objects belonging to the farm buildings restricting the path of the MFU over a long distance (e.g. walls, fences)

Note 1 to entry: Continuous fixed structures can also be boundaries for the path of the MFU.

3.15
non-continuous fixed structure
fixed objects belonging to the farm buildings restricting the path of the MFU over a limited distance (e.g. pillars, trusses, doorways)

4 Safety requirements and/or protective measures

4.1 General

The manufacturer's risk assessment shall account for the specific type of livestock for which the RFS is intended to be used.

When the RFS is intended to be used for other kind of animals other than livestock, the manufacturer shall perform an additional risk assessment for potential risks caused to this kind of animals.

Agricultural machinery (self-propelled ride-on, mounted, semi-mounted and trailed) shall conform with the relevant portions of machine-specific safety standards [e.g. ISO 4254 (all relevant parts), EN 703:2021] and this clause for protective or risk reduction measures of relevant significant hazards.

NOTE Portions of relevant machine-specific safety standards will not be applicable due to the potential unique characteristics of agricultural machinery semi-autonomous and autonomous functions. For example, portions of a safety standard that address requirements for a local operator station will not be applicable to a machine that does not have a local operator station.

RFS shall conform with the safety requirements and/or protective/risk reduction measures of this clause. In addition, the RFS shall be designed according to the principles of ISO 12100:2010 for relevant but not significant hazards, which are not dealt with by this document. Significant hazards resulting of interaction of the RFS with existing equipment on the farm (e.g. tower silo) is dealt with in Clause 5.

This applies especially for the interaction between the particular functions and parts of the RFS.

Unless otherwise specified in this document, the RFS shall conform to the requirements of ISO 13857:2019, Tables 1, 2, 3, 4 and 6 as appropriate.

Irregularities, loss or return of power supply or failure of the control system shall not lead to hazardous situations.

Provisions shall be taken to ensure continued safe operation of critical function(s) (e.g. opening of feed grabber, dropping feed, MFU rolling down from slope) resulting from failure of the power supply.

Hydraulic systems, if applicable, shall be in accordance with ISO 4254-1:2013, 4.13.

Mechanical movements, whether intended or unintended (e.g. effects from acceleration/deacceleration or lifting/holding of masses) shall not result in a situation hazardous to persons.

Performance Levels for safety related parts of control systems, shall be determined in accordance with ISO 25119-1:2018, ISO 25119-1:2018/Amd 1:2020 and ISO 25119-2:2019 and ISO 25119-3:2018, ISO 25119-3:2018/Amd 1:2020 and ISO 25119-4:2018, ISO 25119-4:2018/Amd 1:2020, or ISO 13849-1:2023 and ISO 13849-2:2012. See Annex C.

RFS shall comply with the requirements of electromagnetic compatibility as specified in ISO 4254-1:2013, 4.18 or shall comply with IEC 61000-6-2:2016 for immunity and IEC 61000-6-4:2018 for emission in industrial environments.

Laser product, if used, shall be in accordance with IEC 60825-1:2014. Laser products shall be mounted such that they do not create any risk for the operator.

Visibility of driving positions of MFU with ride-on capability shall be in accordance with EN 703:2021, 4.3.

Exposed parts of RFS shall not have sharp corners, edges, rough surfaces, etc. which can cause injury to persons or farm animals who can come into contact with the RFS.

4.2 Storage of feed

4.2.1 General

Access to potentially hazardous moving parts inside the feed storage area or feed storage device(s) shall be prevented.

This requirement is deemed to be fulfilled if the measures given in 4.2.2 and 4.2.3 are applied.

4.2.2 Feed storage devices

The height of the wall(s) of the feed storage device shall have a minimum height of 1,50 m, in accordance with ISO 13857:2019.

All walls shall be designed such that easy over climbing without additional means is prevented (e.g. by smooth surface, no horizontal structures).

Safety distances to the hazardous parts shall be in accordance with ISO 13857:2019, Tables 2 and 4.

If movable guards are used, they shall be of interlocking guard type or of interlocking guard with guard locking type according to ISO 14119:2024. Opening of interlocking guards of the feed storage device(s) where used shall automatically stop all the hazardous functions. It shall only be possible to re-enter the active state by an operator outside the feed storage device, at a safety distance in accordance with ISO 13857:2019, Tables 2 and 4.

A means of easily enabling climbing out of the feed storage shall be provided.

To enable the operator to check the feedstuff levels, when the upper edge of the feed storage device is at least 1,60 m from the ground, means shall be provided. These means shall be:

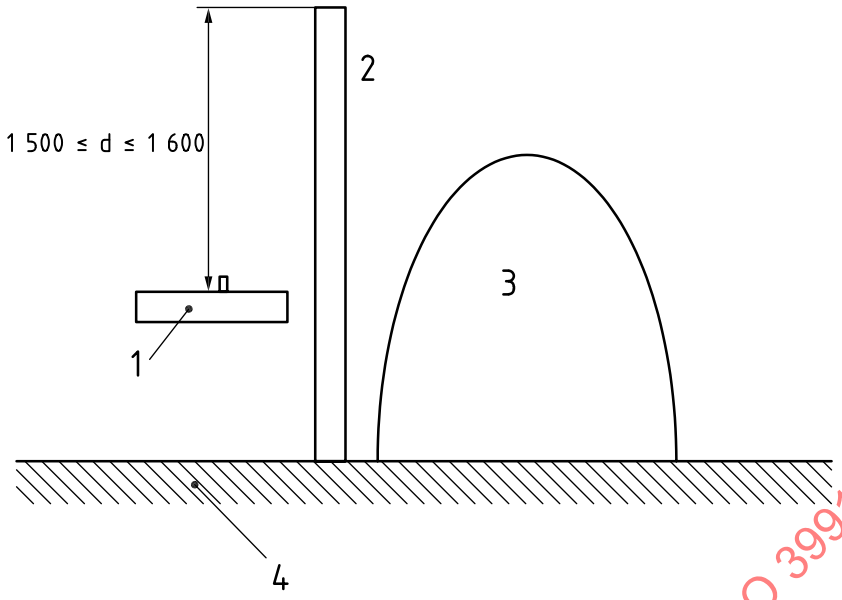
— an opening located at a convenient height and in accordance with ISO 13857:2019, Tables 1, 2, 3, 4 and 6; or

— a boarding means, the distance between the upper step and the upper edge of the compartment being not less than 1,50 m but not more than 1,60 m. See Figure 1; or

— observation means to allow indirect visibility from the operator position (e.g. by mirrors or a closed circuit camera system); or

— level indicators.

Dimensions in millimetres



Key

1 boarding mean
2 feed storage device
3 stored feed
4 ground

Figure 1 — Safety distances boarding means

These requirements shall be verified by measurement and inspection.

The feed storage device shall be marked with a warning sign according to ISO 11684:2023, C.4 (see ISO 11684:2023, Figure C.6).

For hazards arising from functions in autonomous mode of the feed storage device(s), the requirements of 5.3.3. apply.

4.2.3 Feed storage area

On a feed storage area, the requirements of 5.3.3 apply.

4.3 Loading

The requirements of these clauses apply to feed robots and feed robotic devices operating in autonomous mode.

The loading of the MFU shall not start unless the MFU is at its loading position.

If loading of the MFU is performed inside a feed storage area (according to 4.2.2), additional protective measures shall be taken to avoid persons entering the feed storage area along with the MFU.

If loading of the MFU is performed in a designated loading area, access to the hazardous parts shall be prevented.

Risks from feed stuffs falling down onto person(s) with loading shall be prevented either by shielding (the loading area remains a caution zone) or the loading area shall be designated as a restricted zone according to 5.3.3.

Risks from dangerous moving parts after they have been stopped shall be prevented either by shielding according to 4.2 (the loading area remains a caution zone) or designate the loading area as a restricted zone according to 5.3.3.

Provisions shall be made to avoid any overloading of weight of the MFU to prevent hazards resulting from overloading (e.g. inadequate braking).

The loading area shall be marked at the entrances to warn of RFS in accordance with 7.3.

4.4 Checking of the mixing

For checking of the mixing, the provisions of EN 703:2021, 4.6.2 shall apply.

If checking of the mixing requires climbing/ascending onto the MFU, EN 703:2021, 4.6.2 points c) or d) shall apply.

These means shall be equipped with an interlocking device in accordance with ISO 14119:2024 to stop travelling in autonomous mode of the MFU while checking the mixing.

4.5 Travelling

4.5.1 General

The requirements of these clauses apply to feed robots and feed robotic devices operating in autonomous mode.

Risk of uncontrolled movements in autonomous mode while travelling shall be addressed in accordance with EN 703:2021, 4.5.1.

4.5.2 Area of travelling and pathways

For proper visibility if normal lighting conditions (for example day light) are not sufficient, the pathway in the direct vicinity of the MFU or the MFU itself (e.g. its contours) shall be illuminated at a level no less than 15 lx measured at a distance of 500 mm from the MFU perimeter.

This does not apply to machines that are designed only for moving in a restricted zone.

Provisions shall be taken to prevent the MFU from leaving its designated areas.

The area of travelling of the MFU shall be marked in accordance with 7.3.2.

4.5.3 Safety distance along the route

4.5.3.1 General

Considering the general principles for risk reduction, the requirements of 4.5.3.2 and 4.5.3.3 shall be applied, in the given order, with respect to the function of the machine.

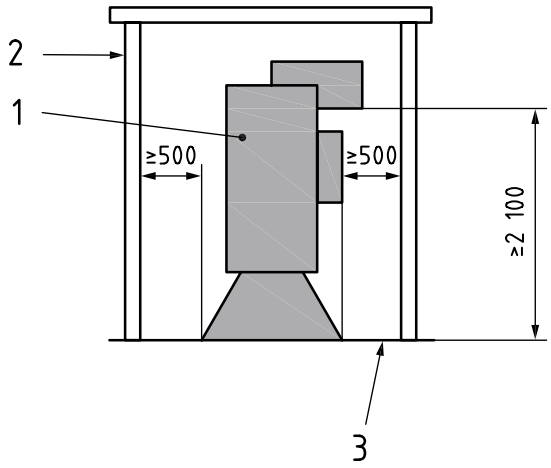
The safety distance as specified in this subclause as well as 4.5.3.2 and 4.5.3.3 shall be met up to a height of at least 2,10 m (see Figure 2).

4.5.3.2 Safety distances along the route of MFU and fixed structures

The horizontal distance between the outer edge of the MFU and fixed structures shall be at least 500 mm.

It shall not be possible to reduce the minimum safety distance of 500 mm between the MFU and fixed structures by the user as set by the manufacturer.

Dimensions in millimetres



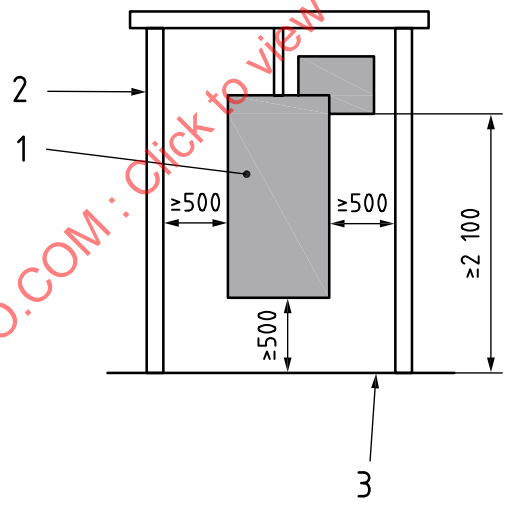
Key

1 MFU
2 fixed structures
3 ground

Figure 2 — Safety distances for wheeled MFU's between the MFU and fixed structures

The vertical distance between the lower edge of the rigid parts of the hanging MFU and fixed structures shall be at least 500 mm (see Figure 3).

Dimensions in millimetres



Key

1 MFU
2 fixed structures
3 ground

Figure 3 — Safety distances between hanging MFU and fixed structure

4.5.3.3 Deviations

Whenever the MFU is moving in a direction which for functional reasons (e.g. feed discharge) the minimum vertical and/or horizontal safety distance cannot be maintained:

— the obstacle protective system in accordance with 4.6.2 shall be active;

— the applicable provisions of Table 1 shall be implemented.

Table 1 — Provisions for travelling when the minimum vertical and/or horizontal safety distances cannot be maintained

	Vertical distance <500 mm	Horizontal distance <500 mm on one side		Horizontal distance <500 mm on both sides	
		non-continuous fixed structures	continuous fixed structure	non-continuous fixed structures	continuous fixed structure
Hanging MFU	— The zone shall be designated as a COMMON zone in accordance with 5.3.1 — if the minimum vertical safety distance, in case of a retractable or absence of a feed pushing device, is 350 mm or — if the feed pushing device conforms with test C1 of 4.6.2.2 or test C2 of 4.6.2.2 **Or** — The zone shall be designated as a CAUTION zone in accordance with 5.3.2	— The zone shall be designated as a COMMON zone in accordance with 5.3.1 — if the minimum horizontal safety distance of 500 mm shall be maintained on the opposite side and — if the maximum length of the non-continuous structure shall be ≤500 mm. **Or** — The zone shall be designated as a CAUTION zone in accordance with 5.3.2	— The zone shall be designated as a CAUTION zone in accordance with 5.3.2 — if the minimum horizontal safety distance of 500 mm shall be maintained on the opposite side **Or** — the zone shall be designated as a RESTRICTED zone in accordance with 5.3.3	— The zone shall be designated as a CAUTION zone in accordance with 5.3.2 — if the minimum horizontal safety distance on both sides shall be 350 mm. and — the maximum length of the non-continuous structure shall be ≤500 mm. **Or** — the zone shall be designated as a RESTRICTED zone in accordance with 5.3.3	— The zone shall be designated as a CAUTION zone in accordance with 5.3.2 — if the horizontal safety distance on both sides shall be 350 mm. **Or** — The zone shall be designated as a RESTRICTED zone in accordance with 5.3.3
Wheeled MFU	N/A				

4.6 MFU

4.6.1 General

Exposed parts of MFU shall not have sharp corners, edges, rough surfaces, etc. which can cause injury to persons or farm animals who can come into contact with the MFU.

Stability shall be ensured in all operational conditions.

The stability of the MFU shall be determined by:

— calculation based on empirical data for similar MFU. Such calculation shall take into account manufacturing variations and deflections of load, tyres, etc.; or

— stability testing in accordance with ISO 3691-4:2023, 5.3.2.

Stability for MFU with ride-on capability shall be ensured in accordance with ISO 16231-2:2015.

MFU with ride-on capability shall:

— ensure stability in accordance with ISO ISO 16231-2:2015;

— fitted with an appropriate protective structure, unless this increases the risk;

— equipped with an operator's seat in accordance with ISO 4254-1:2013, 5.1.2.

— ensure reduction of vibrations in accordance with ISO 4254-1:2013, 4.4, EN 703:2021, 4.1.8 and 6.1.

The strength of guards and barriers on MFU with ride-on capability shall be in accordance with ISO 4254-1:2013, 4.10. The MFU shall stop immediately when position is lost, and the operator shall be informed. Restarting shall only be possible on-site by the operator with a clear line of sight on the machinery.

Provisions shall be taken to prevent riding along or climbing on the MFU.

4.6.2 Obstacle protective system

4.6.2.1 General

The MFU shall be equipped with an obstacle protective system to prevent collision or crushing hazards with persons or other obstacles at all operational speeds.

If a pressure-sensitive protective device is used, the requirements of 4.6.2.2 apply.

If a non-contact protective system is used, the requirements of 4.6.2.3 apply.

Whenever the MFU is moving in a direction which for functional reasons (e.g. feed discharge) cannot be protected by an obstacle protective system:

— the zone shall be designated as a caution zone in accordance with 5.3.2;

— a safety distance shall be in accordance with 4.5.2. Measures shall be taken to ensure that persons lying on the ground are not overrun or crushed and shall be validated according to test C1.

NOTE Test C1 is used also for machines equipped only with a non-contact protective system in this case.

The operators manual shall include all limitations of the non-contact protective system [see 7.1 e)].

4.6.2.2 Pressure-sensitive protective devices

4.6.2.2.1 Performance of pressure-sensitive protective devices

4.6.2.2.1.1 General

Pressure-sensitive protective devices are allowed up to a travelling speed of 0,6 m/s.

Unless otherwise specified in this document, the pressure-sensitive protective device shall conform with the relevant requirements of ISO 13856-3:2013 or ISO 13856-2:2013.

The force to begin activation of the pressure-sensitive protective device shall not exceed 250 N.

For MFUs driving on the ground the maximum height between the ground and the lower edge of the pressure-sensitive protective device shall be 500 mm.

The pressure-sensitive protective device shall cover the entire width and be located in front of the vertical plane of the outermost edges (taking into account the actuating stroke of the pressure-sensitive protective device) of the MFU in every direction of travel.

The performance of the pressure-sensitive protective device shall be tested as follows. The following test shall be successfully passed:

— either test A1 in accordance with 4.6.2.2.1.2 and test B1 in accordance with 4.6.2.2.1.3; or

— test B1 in accordance with 4.6.2.2.1.3 and test C1 in accordance with 4.6.2.2.1.4.

Tests shall be performed at the maximum operational speed with 110 % load in the MFU.

4.6.2.2.1.2 Test A1

A cylindrical test piece with a diameter of 200 mm and a length of 600 mm shall be placed horizontally on the floor/ ground and perpendicular to the direction of travel of the MFU. The MFU shall approach the test piece and shall stop before a contact is made between the test piece and the rigid parts of the MFU or (parts) of its functional equipment.

This test shall be repeated with the test piece once at the positions left, centre and right in accordance with Figure 4.

The test piece shall be fixed relative to the floor/ground to prevent movement upon contact. The static force when the pressure-sensitive protective device is compressed to the position reached in a pressure-sensitive protective device stop shall not exceed 750 N.

If the pressure-sensitive protective device is at a height such that test A1 cannot be performed successfully, additional measures shall be implemented to ensure that persons lying on the ground are not overrun or crushed (for example by pushing them aside), therefore test C1 shall be performed.

For test A1, peak forces shall be dealt with in accordance with ISO/TS 15066:2016, Figure 4 and Table A.2 for transient contact.

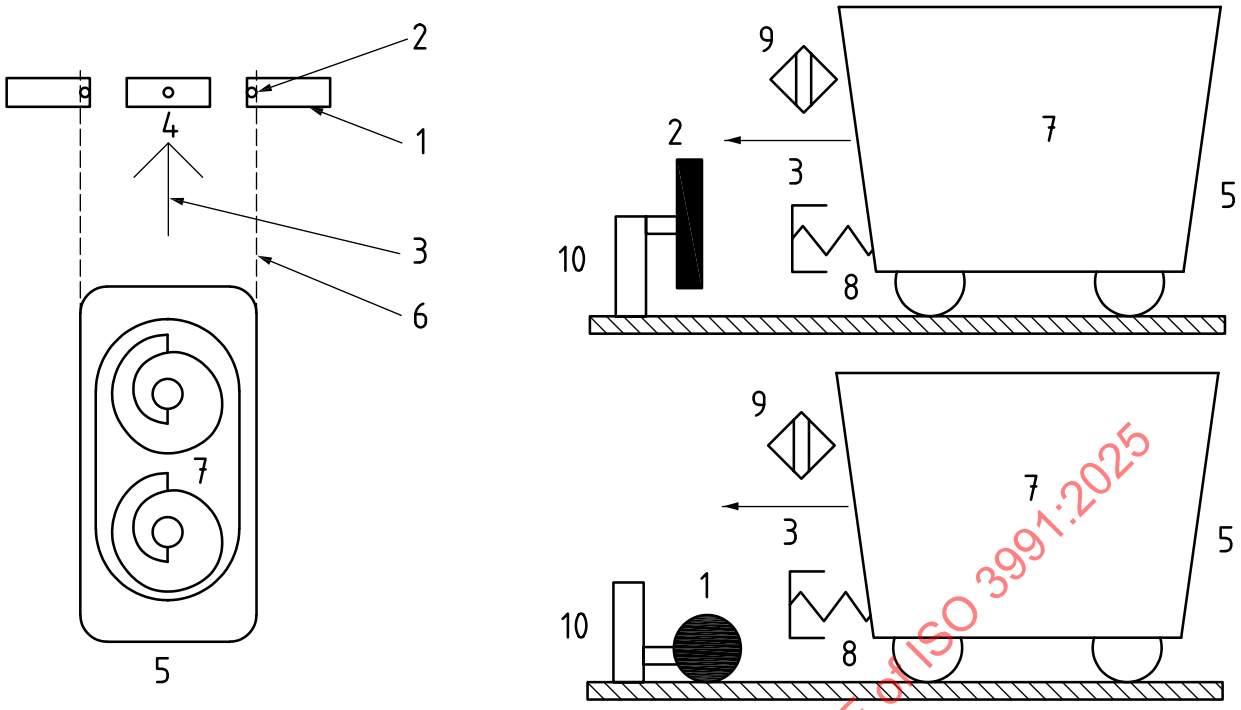
4.6.2.2.1.3 Test B1

A cylindrical test piece with a diameter of 70 mm and a length of 400 mm shall be set vertically to make contact with the pressure-sensitive protective device. The MFU shall approach the test piece and shall stop before a contact is made between the test piece and the rigid parts of the MFU or (parts) of its functional equipment.

This test shall be repeated with the test piece once at the positions left, centre and right in accordance with Figure 4.

For pressure-sensitive protective device, the test piece shall be fixed relative to the floor/ground to prevent movement upon contact. The static force when the pressure-sensitive protective device is compressed to the position reached in a pressure-sensitive protective device stop shall not exceed 400 N.

For test B1 peak forces shall be dealt with in accordance with ISO/TS 15066:2016, Figure 4 and Table A.2 for transient contact.



A) Top view **B) Side view**

Key

1 test piece (A)
2 test piece (B)
3 direction of MFU travel
4 MFU path
5 rear of the MFU
6 edge of MFU path
7 MFU
8 pressure-sensitive protective device
9 non-contact protective system
10 fixation

Figure 4 — Example of tests in specified direction of travel

4.6.2.2.1.4 Test C1

For pressure-sensitive protective devices that are at a height which do not allow test A1 to be completed successfully, test C1 shall be performed.

A test dummy representing a 6 year-old child (e.g. in accordance with ISO 19206-2:2018, Annex A), and dressed with suitable clothing, shall be placed on an even concrete floor, horizontal, perpendicular and centred to the direction of motion of the MFU.

The test shall be performed three times, and each test will be comprised of two runs.

— The first run shall be performed with the test dummy face-down.

— The second run shall be performed with the test dummy face-up.

The test is successful if the test dummy is pushed aside in less than 3 m (distance travelled by the MFU between contact on test dummy and the moment where the test dummy is out of the MFU path) or if the MFU is stopped.

Overrunning of the body/head/limbs or drawing-in of limbs of the test dummy is considered a failure.

4.6.2.2.2 Behaviour of obstacle protective system with pressure-sensitive protective device

If an obstacle or person activates the pressure-sensitive protective device of the MFU, a protective stop shall stop the travel movement in accordance with 4.6.3.

Travelling movement shall not recommence and the operator shall be informed. Restarting shall only be possible on-site by the operator with a clear line of sight on the machinery unless the conditions for automatic restarting are met.

Automatic restarting is allowed under the following conditions:

— the pressure-sensitive protective device is activated continuously for less than 5 s;

— less than five times activations of the pressure-sensitive protective device within a traveling distance of 1 metre and;

— the pressure is removed from the pressure-sensitive protective device (for example by driving in reverse direction).

The stop function with automatic restart shall:

— commence initial travelling only after a waiting period of at least 3 s.

NOTE Conditional automatic restarting is intended to avoid undesired downtime resulting from activations of the pressure-sensitive protective device by farm animals while distributing feed.

4.6.2.3 Non-contact protective system

4.6.2.3.1 Performance of non-contact protective system

4.6.2.3.1.1 General

Non-contact protective system shall be designed in accordance with IEC 61496-1:2020 and IEC 61496-2:2020, taking into account all intended environmental conditions that will negatively affect the operation of non-contact protective system.

IEC/TS 62889-1:2019 may be used for additional guidance.

A non-contact protective system shall be used with travelling speeds exceeding 0,6 m/s.

A non-contact protective system can be used with travelling speeds below 0,6 m/s.

A non-contact protective system shall be capable of detecting all of the following under foreseeable operating conditions:

— persons or other obstacles in the path of the MFU;

— persons approaching the MFU;

— the position of the MFU relative to detected persons or other obstacles;

— the boundary of the working area.

The manufacturer shall implement provisions to prohibit operation of the MFU beyond the limitations intended of the non-contact protective system.

The performance of the non-contact protective system shall be tested as follows.

Tests shall be performed at the maximum operational speed with 110 % load in the MFU.

If the non-contact protective system is not suitable to perform test A2 in accordance with 4.6.2.3.1.2 or B2 in accordance with 4.6.2.3.1.3, test C2 in accordance with 4.6.2.3.1.4 shall be performed.

Test C2 shall be repeated for all fails on test A2 and B2.

4.6.2.3.1.2 Test A2

A cylindrical test piece with a diameter of 200 mm and a length of 600 mm shall be placed horizontally on the floor/ground and perpendicular to the direction of travel of the MFU. The test piece shall have an external surface reflectance from 2 % to 6 % and optical density of 1,22 (e.g. black).

The MFU shall approach the test piece and shall stop before a contact is made between the test piece and the rigid parts of the MFU or (parts) of its functional equipment.

This test shall be repeated with the test piece once at the positions left, centre and right in accordance with Figure 4. Test A2 shall be conducted for all intended environmental conditions that will negatively affect the operation of the non-contact protective system.

4.6.2.3.1.3 Test B2

A cylindrical test piece with a diameter of 70 mm and a length of 400 mm shall be placed vertically on the floor. The test piece shall have an external surface reflectance from 2 % to 6 % and optical density of 1,22 (e.g. black).

The MFU shall approach the test piece and shall stop before a contact is made between the test piece and the rigid parts of the MFU or (parts) of its functional equipment.

These tests shall be repeated three times, one at the centre line of the detection zone and one at each end in accordance with Figure 4. Test B2 shall be conducted for all intended environmental conditions that will negatively affect the operation of the non-contact protective system.

4.6.2.3.1.4 Test C2

A test dummy representing a 6 year-old child (e.g. in accordance with ISO 19206-2:2018 Annex A) and dressed with suitable clothing with external surface reflectance from 2 % to 6 % and optical density of 1,22 (e.g. black), shall be placed on an even concrete floor, horizontal, perpendicular and centred to the direction of motion of the MFU.

The MFU shall approach the test dummy and shall stop before a contact is made between the test dummy and the rigid parts of the MFU or (parts) of its functional equipment.

This test shall be repeated with the test dummy once at the positions left, centre and right.

This test shall be repeated with the test dummy placed in vertical position.

The MFU shall approach the test dummy and shall stop before a contact is made between the test dummy and the rigid parts of the MFU or (parts) of its functional equipment.

A non-contact protective system may contain additional warning functions. The performance of these functions are not dealt with.

4.6.2.3.2 Behaviour of obstacle protective system with non-contact protective system

If a person or other obstacle is detected by the non-contact protective system of the MFU, physical contact shall be prevented.

If a protective stop is initiated, a protective stop shall stop the travel movement in accordance with 4.6.3.

Travelling movement shall not recommence and the operator shall be informed. Restarting shall only be possible on-site by the operator with a clear line of sight on the machinery unless the conditions for automatic restarting are met.

Automatic restarting is allowed under the following conditions:

— no person or obstacle is detected in the travelling path of the MFU by the non-contact protective system and;

— less than five times activations of the non-contact protective system within a traveling distance of 1 metre.

The stop function with automatic restart shall:

— commence initial travelling only after a waiting period of at least 3 s.

NOTE A non-contact protective system can contain additional warning functions. The performance of these functions are not dealt with.

4.6.3 Braking system

The MFU shall be equipped with means for stopping the travel movement, which:

— operates on the loss or failure of power supply;

— stops the MFU taking into account load, speed, friction, gradient and wear;

— maintains the MFU with 110 % of its maximum allowable load, stationary on the maximum operational gradient specified by the manufacturer;

— maintains stability in all braking conditions;

— operates on loss of control of speed or steering;

— removes the drive power.

4.6.4 Audible alarm

The MFU shall be equipped with an audible alarm. The duration of the audible alarm shall be at least 3 s.

The audible alarm shall be detectable by operators and bystanders in the vicinity and all around the periphery of the machine.

The audible alarm shall meet the requirements of ISO 7731:2003.

4.6.5 Visual alarm

A visual alarm shall be detectable by operators and bystanders in the vicinity and all around the periphery of the MFU.

A visual alarm shall be given when the MFU is in autonomous mode or semi-autonomous functions are activated for indication of:

— starting movement, the visual alarm shall start at least 3 s before movement; or

— increased danger levels during normal work cycles in autonomous mode or with semi-autonomous functions activated.

The visual alarm shall use flashing amber colour at a rate of 60 to 85 flashes per minute. If more than one lamp is used, all lamps shall flash in unison.

NOTE The visual alarm flash requirements originate from agricultural machinery lighting and marking standards. Local regulations can have specific requirements for visuals warnings and indications.

4.6.6 Additional requirements for hanging MFU

4.6.6.1 General

Hanging MFU shall be designed to prevent derailing and/or dropping and/or accumulation of substances/obstacles on tracks.

At any end of tracks, end stops shall be fitted.

Lateral forces caused by uncontrolled (e.g. swaying, swinging, gravity-induced) movement of the MFU shall not exceed 250 N.

4.6.6.2 Dimensioning of track, steelwork and carrier

If no further data are available, the following horizontal forces shall be assumed for calculation:

— drive direction: 10 % of vertical loads;

— lateral direction: 5 % of vertical loads.

4.6.6.3 Rollers of hanging MFU

Rollers moving in tracks at a height less than 2,7 m above the ground shall be safeguarded e.g. by wheel guards providing a maximum gap of 5 mm between guard and track or guard and roller or other guards.

4.6.6.4 Interruptions of tracks of hanging MFU

In the case of hanging MFU at points of interruption of tracks, e.g. switches or transfer points, there shall be devices which prevent the falling of any parts of the hanging MFU. These devices shall be one or a combination of the following:

— appropriate electrical interlocking systems inserting automatically mechanical end stops;

— mechanical interlocking systems.

4.6.6.5 Load securing

The design shall take into account the following situations in order to keep the load fixed to the hanging MFU:

— acceleration and deceleration;

— passing curves and switches;

— inclining and declining sections;

— emergency stop;

— crashing onto the hanging MFU ahead.

4.6.6.6 Multiple hanging MFU's

In case of multiple hanging MFU's, the minimum maintained distance between two following hanging MFU's shall be 500 mm.

4.7 Distributing

The requirements of these clauses apply to feed robots and feed robotic devices operating in autonomous mode.

When the MFU is moving, the distributing device shall be in accordance with EN 703:2021, 4.7.

When the MFU is empty and the MFU is not moving, the mixing and/or chopping device shall not run for more than 10 s with the discharge opening open (e.g. end of the feed run).

Provisions should be considered to minimize unintended nuisance activations of obstacle protective systems during distributing (e.g. cow activates pressure-sensitive protective device or non-contact protective system to gain more feed), however the safety requirements of this document for the obstacle protective systems shall be met.

4.8 Pushing feed/Cleaning

The requirements of these clauses apply to feed robots and feed robotic devices operating in autonomous mode.

While the MFU is pushing feed/cleaning (e.g. by rotating brushes), protection to avoid overrunning and drawing-in of upper and lower limbs shall be provided.

This shall be verified by performing either test C1 in accordance with 4.6.2.2.1.4 or test C2 in accordance with 4.6.2.3.1.4.

If the pushing feed/cleaning device is retractable and combined with an obstacle protective system, the positioning of the pushing feed/cleaning device is considered as a safety function.

4.9 Electrical safety

4.9.1 General

Electrical safety of the RFS shall be in accordance with IEC 60204-1:2016.

In addition, electrical parts of the MFU with on-board voltages in the range of 50 V AC to 1 000 V AC and 75 V DC to 1 500 V DC shall be in accordance with ISO 16230-1:2015.

4.9.2 Battery charging

Persons shall be protected against hazards due to accidental contact with the charging connections on the MFU and their charging systems in accordance with EN 1175:2020, 5.3.

Automatic charging systems shall be designed in such a way that the charging connections are only activated when the MFU is connected to them. When the MFU is removed from the charging points, the charging connections shall be deactivated. These requirements do not apply to:

— safe extra low voltage systems in accordance with IEC 60364-4-41:2005, 414;

— bus bars protected against contact by personnel.

The charging area shall be marked as a caution zone.

When nearing the charging station, the speed shall be gradually reduced to a maximum of 0,3 m/s. An audible alarm shall sound and the speed shall be maximum 0,3 m/s at least 3 s before the MFU is at 500 mm distance from the charging station.

Charging station shall not be located in areas where methane concentrates (manure) can reach the LEL (Lower explosion limit) -value of Methane.

NOTE Europe: LEL of methane set at 4,4 volume % or 44,000 ppm.

The MFU containing lead-acid batteries shall have suitable ventilation to prevent accumulation of gases and the formation of an explosive atmosphere, in accordance with EN 1175:2020, C.1.2.

The battery charging stations shall be ventilated in accordance with EN 1175:2020, C.1.2.

Lithium batteries, if used, shall be in accordance with IEC 62619:2022 and IEC 62485-6:2021.

4.10 Controls

4.10.1 Location

All controls of the RFS shall be located outside the restricted zone and operation shall not be possible from inside the restricted zone.

4.10.2 Controls for operational modes

4.10.2.1 General

A control for selection and locking of operational modes shall be provided.

Controls shall be provided to be used in emergencies, for maintenance or for other temporary tasks specified by the manufacturer, in addition to specific modes involving manual modes of operation:

— manual mode;

— service mode.

Controls shall be of the hold-to-run type and shall be designed to allow only intentional manual operation.

4.10.2.2 Remote control

The device used for remote control in manual modes of operation shall:

— be in accordance with ISO 15817:2012; or

— meet the following additional safety provisions:

  — the obstacle protective system (see 4.6.2) shall be active;

  — the travelling speed shall be limited to 0,3 m/s;

  — the emergency stop on the MFU shall be easily accessible by the local operator;

  — loss of signal, system latency or disconnect shall put the MFU in a safe state;

  — remote control of the MFU shall only be possible by one device at a time;

  — one device shall not be able to control multiple MFUs at a time;

  — the control system of the mobile unit shall have an access authorization system to prevent unauthorized use/control;

  — a transfer of the control to the remote control shall only be possible by an intentional action, e.g. login and logout process;

  — a transfer of the control to the remote control shall only be possible if the mobile unit is not travelling.

4.10.2.3 Ride-on controls

MFU with ride-on capability shall be equipped with a local operator station in accordance with ISO 4254-1:2013, 4.7 and 5.1.

The controls of the MFU with ride-on capability shall be in accordance with EN 703:2021, 4.2.

4.11 Operational modes

4.11.1 General

At start up, actuation of automated hazardous functions of the machinery shall be prevented.

Emergency stop device(s) and braking system(s) shall be operational in all operational modes.

The machine shall have a manual mode with controls to bring the machine in a safe state in the event of a fault or incident.

Switching modes of the RFS shall not create any hazard for the operator. Unintentional switching of modes shall be prevented.

Only one mode shall be active at a time.

Loss or failure of power supply shall stop all moveable parts of the machinery of the MFU and activates the braking system in accordance with 4.6.3. Inadvertent lowering of the cutting, loading and distributing tools shall be prevented.

Automatic startup after a failure of the power supply shall be prevented.

4.11.2 Manual mode

Ride on in manual mode shall be prevented if MFU is not in accordance with 4.10.2.3.

In manual mode, operation shall only be possible with a clear line of sight on the machinery.

In manual mode, the automated hazardous functions of the MFU shall be controlled by hold-to-run controls only (see 4.10.2).

Obstacle protective system(s) shall be active with speeds greater than 0,3 m/s.

4.11.3 Autonomous mode

Autonomous mode of an autonomous or semi-autonomous robotic feed system shall only be allowed when a command is issued by a local operator. For MFU with ride-on capability, activation of the autonomous mode shall only be possible from a safe position outside of the MFU or a delay of at least 10 s is given.

Obstacle protective system(s) shall be active.

The controls of the MFU shall be deactivated or the access shall be prevented in autonomous mode with the exception of switch-off or pause functions (e.g. emergency stop control devices, stop/pause button).

It shall be possible to stop the autonomous mode by an operator (local and/or remote).

Audible warnings according to 4.6.4 and visual warning according to 4.6.5 shall be active.

For an MFU with ride-on capability, autonomous mode shall not be allowed when the operator is on the MFU. An operator presence system shall be provided to detect if an operator is at a local operator station to ensure that automated functions in autonomous mode are de-activated when operator is present. If ride-on is possible 4.10.2.3 also applies.

4.11.4 Semi-autonomous robotic feed system

Automated hazardous functions of a semi-autonomous MFU operated in manual mode shall be controlled by hold-to-run controls-only (see 4.10.2).

The control of the non-automated functions shall be in accordance with EN 703:2021, 4.2.

For automated functions of a semi-autonomous MFU operated in autonomous mode 4.11.3 applies.

If ride-on is possible 4.10.2.3 also applies.

4.11.5 Service mode

The service mode shall only be available to the manufacturer or others if the manufacturer has given consent. Unauthorized operators shall be prevented from entering service mode.

Testing of automated hazardous functions of a semi-autonomous MFU operated in service mode shall be controlled by hold-to-run controls-only (see 4.10.2).

If ride-on is possible, 4.10.2.3 also applies.

4.12 Service and maintenance

The service operations shall be capable of being carried out in a safe way, for example with the power source stopped.

For maintenance and repair purposes, a lockable isolating switch (Lock-out Tag out) shall be provided for the entire system and if necessary, for sections. With this switch, it shall be possible to secure the system against unintended start.

If multiple lockable isolating switches are being used, the manufacturer shall clearly indicate which section(s) is/are controlled by each lockable isolating switch.

Provisions shall be made to facilitate diagnostic fault-finding.

For cleaning of internal parts, the provisions of EN 703:2021, 4.5.3 applies.

Restarting after service or maintenance shall only be possible by the local operator by an intentional action.

Safety-related parameters and functions of the software shall only be accessible for persons authorized by the manufacturer.

Software updates shall be authorized and functionally checked on-site, according to the specification of the manufacturer.

Supports for service and maintenance shall be in accordance with ISO 4254-1:2013, 4.11.

4.13 Emergency stop devices

The hazardous sections of the RFS shall have emergency stop devices, with which actual or impending hazards can be stopped. The emergency stop devices shall be designed in accordance with the requirements of ISO 13850:2015. Hazardous sections of the RFS are, for example:

— MFU;

— feed mixing and loading systems;

— handling systems, such as gantry crane.

The operation of all emergency stop devices should be unambiguous. If an emergency stop device only stops a section of the RFS, this shall be logical and shall not create new hazards.

4.14 Fire and explosion

The manufacturer shall give in the operator's manual recommendations about the number, type and location of the fire extinguishers [see 7.1 w)].

For MFU with ride-on capability:

— provisions shall be made for the attachment of portable fire extinguishers located near the operator's work station;

— ISO 4254-1:2013, 4.1 and 5.1.6 apply.

NOTE Concerning the type of extinguisher and classification of fires, national regulations or codes can apply.

4.15 Magnets and magnetic fields

The location of the magnet(s) used with the MFU to remove unwanted metals from the feed before distributing the feed to the cows shall be marked in accordance with ISO 7010:2019 – W006.

Persons shall be warned on risks of strong magnetics fields to cardiac pacemakers [see 7.1 u)] and shall be informed on the safety distance to magnets [see 7.1 v)].

5 System integration

5.1 General

An RFS generally consist of multiple machinery and shall be installed to fit each individual farm. Therefore, an additional risk assessment according to ISO 12100:2010 shall be conducted by the installer for every RFS installation to address individual farm circumstances.

Single machinery is excluded from this requirement.

Additional (national) legislation can also be applicable.

5.2 Layout design

The design of the RFS layout shall, following the general principles for risk reduction, consider all unique circumstances at the individual farm and provide additional risk reducing measurements at the farm for proper operation of the RFS.

At least the following factors shall be taken into account during the layout design process.

a) Establishing the physical limits (three dimensional) of the various parts of the RFS:
   1) scale and source for modelling the layout in design drawings;
   2) location and dimensions of the various parts within available facilities (scale);
b) workspaces, access and clearance:
   1) identifying the maximum operating space of the RFS, establishing restricted and operating areas, and identifying the need for clearances around obstacles such as building supports;
   2) traffic routes (other farm equipment like tractors, animal traffic, visitor routes, access doors);
   3) access and safe pathway to support services (electricity, water, ventilation) and control systems;
   4) access and safe pathway for service, cleaning, troubleshooting and maintenance purposes;
   5) cables/other hazards for slips, trips and falls;
   6) cable trays;
c) consideration of perimeter safeguarding:
   1) non-permitted areas (e.g. Public roads);
   2) common, caution and restricted zones;
d) location and amount of emergency stop devices;
e) location and amount of control panel(s).

The user shall be informed on the layout according to 7.2.

5.3 Zones

5.3.1 Common zone

A low-risk zone shall be designated as common zone [for example, barn entrances or pathways of the MFU that fulfils the clearances requirements (see 4.5.3)].

The common zone shall be marked in accordance with 7.3.2.

5.3.2 Caution zone

A medium risk zone shall be designated as caution zone (for example, loading area or caution zone of inadequate clearances).

When travelling in a caution zone the speed of the MFU shall be reduced to a maximum of 0,3 m/s.

The caution zone shall be marked in accordance with 7.3.2.

An audible alarm in accordance with 4.6.4 shall be generated on the MFU.

A visual alarm in accordance with 4.6.5. shall be activated on the MFU.

5.3.3 Restricted zone

A high-risk zone shall be designated as restricted zone (for example, feed storage area).

Access doors or gates to gain access into the restricted zone shall be equipped with interlocking devices in accordance with ISO 14119:2024. Entrance by persons into the restricted zone shall automatically stop all the hazardous functions. To restart the machinery and the interlocking devices for the restricted zone shall be only possible by a local operator outside the restricted zone.

To avoid over climbing:

— the door or gate shall have a minimum height of 1,80 m; or

— fixed or movable guards for restricting access into the restricted zone shall be in accordance with ISO 14120:2015. The guard shall have a minimum height of 1,80 m; or

— protective devices such as sensitive protective equipment (SPE) in accordance with IEC 61496-2:2020 or active optoelectronic protective device (AOPD) in accordance with IEC 61496-1:2020 shall be provided to stop all hazardous functions.

The restricted zone shall be marked at the entrances warning of RFS in accordance with 7.3.2.

6 Verification of the safety requirements and/or protective measures

Verification of the safety requirements and/or protective/risk reduction measures of the RFS shall be performed in accordance with Table 2.

Table 2 — List of safety requirements and/or protective/risk reduction measurements and their verification

Paragraph	Verification of	Design check	Calculation	Inspection visual/ audible	Measurement	Functional test
4.1	Conformance to relevant parts of ISO 4254 (all relevant parts), EN 703, ISO 13857 and ISO 25119 (all parts) or ISO 13849 1 and ISO 13849-2	X	X	X	X	X
4.2	Feed storage area or feed storage device(s)					
4.2.1	Prevention of overclimbing, checking of feedstuff levels with feed storage devices			X	X	X
4.2.2	Prevention of access to feed storage area			X		X
4.3	Loading of MFU only in loading position Prevention of access to dangerous part while loading Prevention of feedstuff falling down onto persons Prevention of overloading	X		X		X
4.4	Checking of mixing on the MFU			X	X	X
4.5						
4.5.1	Feeds robots and feed robotic devices operating in Autonomous mode					
4.5.2	Visibility of MFU with area of traveling and pathways Preventing MFU from leaving its designated area	X		X	X	X
4.5.3	Safety distances along the route				X	
4.5.3.2	Safety distances along the route of MFU to fixed structures				X	
4.5.3.3	Deviations			X	X	X
4.6						
4.6.1	Stability, loss of position and prevention of riding along			X		X
4.6.2	Obstacle protection					
4.6.2.1	Prevention of collision or crushing with persons or other objects	X	X	X	X	X
4.6.2.2	Pressure-sensitive protection device					
4.6.2.2.1	Performance of pressure-sensitive protection device	X			X	X
4.6.2.2.2	Behaviour of obstacle protective system with pressure-sensitive protective device				X	
4.6.2.3	Non-contact protective system					
4.6.2.3.1	Performance of non-contact protective system	X				X
4.6.2.3.2	Behaviour of obstacle protective system with non-contact protective system				X	
4.6.3	Braking system			X		X
4.6.4	Audible alarm			X		X
4.6.5	Visual alarm			X		X
4.6.6	Additional requirements for hanging MFU					
4.6.6.1	Prevention of derailing			X	X	X
4.6.6.2	Dimensioning of track, steelwork and carrier		X			
4.6.6.3	Rollers of hanging MFU				X	
4.6.6.4	Interruptions of tracks of hanging MFU					X
4.6.6.5	Load securing	X	X			

Table 2 *(continued)*

Paragraph	Verification of	Design check	Calculation	Inspection visual/ audible	Measurement	Functional test
4.6.6.6	Multiple hanging MFU's				X	
4.7	Distributing, distributing device				X	
4.8	Pushing feed/cleaning					X
4.9						
4.9.1	General electrical safety	X	X	X	X	X
4.9.2	Battery charging	X		X	X	X
4.10						
4.10.1	Location of controls			X		X
4.10.2	Controls for operational modes					
4.10.2.1	Controls for emergencies, maintenance or other temporary tasks			X		X
4.10.2.2	Remote control			X	X	X
4.10.2.3	Ride-on controls			X		X
4.11						
4.11.1	Prevention of actuation of automated functions at start-up and mode selection	X		X		X
4.11.2	Manual mode					X
4.11.3	Autonomous mode	X		X		X
4.11.4	Semi-Autonomous robotic feed system					X
4.11.5	Service mode					X
4.12	Service and maintenance	X		X		X
4.13	Emergency stop devices					X
4.14	Fire and explosion	X		X		X
5						
5.1	Installation of multiple machinery to fit each individual farm	X		X		
5.2	Layout design	X		X	X	
5.3	Zones					
5.3.1	Common zone			X	X	
5.3.2	Caution zone			X	X	
5.3.3	Restricted zone			X		X
7						
7.1	Operator manual			X		
7.2	Layout			X		
7.3	Marking					
7.3.1	General marking			X		
7.3.2	Safety signs			X		

7 Information for use

7.1 Operators manual

Comprehensive instructions and information on the safe use of the RFS and all aspects of maintenance to be performed by the operator shall be provided in the operator's manual. It shall be in accordance with of ISO 12100:2010, 6.4.

The information and items given in EN 703:2021, 6.1 apply.

In particular, the following points shall be emphasized:

a) riding along or climbing on the MFU is prohibited;

b) tampering with the obstacle protective systems is prohibited;

c) maintenance of illumination of the pathways;

d) risk from battery charging;

e) limitations of the obstacle protective systems used;

f) risks on high voltage electricity;

g) risks for children (unsupervised children in the operating area of the RFS are prohibited);

h) warnings related to residual risks of the RFS (e.g. obstacle protective system);

i) explanation of layout and zones;

j) explanation of signs and markings;

k) explanation of audible and visual alarms;

l) health risks due to dust. Dust particularly occurs at transfer and discharge points during the mixing of dry feed components, as well as during transport and discharge of feed with conveyor belt systems;

m) operation of the remote control shall be performed with clear view of the RFS and the surroundings;

n) lock-out tag-out of individual parts of the feed system;

o) location and usage of emergency stop devices;

p) residual risk of EMC emission by RFS, which may interfere with domestic equipment;

q) risks resulting from the application of laser sensors;

r) explanation of terms used (e.g. autonomous & semi-autonomous);

s) explanation of all modes (including ride on mode, if provided);

t) risk resulting from software updates;

u) risk of strong magnet(s);

v) safety distance to magnet(s);

w) recommendations about number, type and location of fire extinguishers.

7.2 Layout

A layout of the entire system, including identified zones, devices and travelling range(s) shall be displayed in a suitable location.

An overview of identified zones shall be available in the layout.

7.3 Marking

7.3.1 General

All machines shall be marked in accordance with ISO 4254-1:2013, 8.3.

7.3.2 Safety signs

As referenced within this document, RFS requiring notification through safety signs shall be in accordance with ISO 11684:2023 or ISO 7010:2019.

An example of a symbol for use in no-text safety signs only to describe the general hazard and exposure to RFS is given in Figure 5.

Figure 5 — Example of a symbol for use in no-text safety signs only (ISO 7010:2019-W018)

In accordance with ISO 11684:2023, pictorials showing hazard avoidance shall be included for the symbol in Figure 5 to be used in no-text safety signs.

Alternatively, text safety signs (or pictorial with text safety signs) following ISO 11684:2023 shall be used which describe the hazard, explain the potential consequences of exposure to the hazard, and instruct how to avoid the hazard. The safety signs shall be located at the entrance(s) of each identified zone (common zone, caution zone resulting and restricted zone) resulting from layout design [see 5.2 c)]. Examples of symbol with text safety signs are given in Figure 6.

Confusion with other markings and signs shall be avoided.