



BSI Standards Publication

Food processing machinery — Bulk milk coolers on farms — Requirements for performance, safety and hygiene

National foreword

This British Standard is the UK implementation of EN 13732:2022. It supersedes BS EN 13732:2013, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee MCE/3/5, Food industry machines.

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

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Refroidisseurs de lait en vrac à la ferme - Prescriptions
pour les performances, la sécurité et l'hygiène

Nahrungsmittelmaschinen - Behältermilchkühlanlagen
für Milcherzeugerbetriebe - Anforderungen an
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European foreword

This document (EN 13732:2022) has been prepared by Technical Committee CEN/TC 153 “Machinery intended for use with foodstuffs and feed”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by January 2023, and conflicting national standards shall be withdrawn at the latest by July 2025.

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

This document supersedes EN 13732:2013.

In comparison with the previous edition, the following changes have been made:

- a) addition of continuous system of milking in the scope;
- b) updating of normative references;
- c) specification of stainless steel equivalence;
- d) new informative annex regarding estimation and measurement of energy consumption;
- e) technical and editorial modifications.

This document has been prepared under a Standardization Request given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s) / Regulation(s).

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

Any feedback and questions on this document should be directed to the users' national standards body. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organisations 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, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

This document is a type-C standard as stated in EN 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 or hazardous events are covered are indicated in the Scope of this document.

When requirements of this type-C standard are different from those which are stated in type-A or type-B standards, the requirements 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.

1 Scope

1.1 This document specifies requirements for design, performance, safety and hygiene of refrigerated bulk milk coolers and the related methods of test.

NOTE The informative Annex K gives some elements regarding the estimation and calculation of energy consumption.

This document deals with all significant hazards, hazardous situations and events relevant to bulk milk coolers on farm, when they are installed, used and maintained as intended by the manufacturer (see informative Annex A).

It applies to refrigerated bulk milk tanks with air-cooled condensing units and automatic control intended for installation on farms or at milk collection points. It applies to tanks for two milkings (24 h), four milkings (48 h) and six milkings (72 h), in which the cooling takes place totally (non-pre-cooled milk) or partially (in case of pre-cooled milk) within the tank. It also applies to tanks in combination with a continuous system of milking (e.g. milking with robot).

1.2 This document does not cover:

- mobile tanks;
- tanks intended to be tilted for drainage;
- equipment for delivering the milk to the tank;
- equipment for pre-cooling of the milk;
- the hazards due to the use of other energy than electrical energy;
- pressure aspect of vacuum tanks (tank of which the inner vessel is designed to operate at a pressure below atmospheric pressure);
- calibration requirements for the measurement of the milk volume.

1.3 This document is not applicable to bulk milk coolers on farms which are manufactured before the date of its publication as EN.

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.

EN 378-1:2016+A1:2020, *Refrigerating systems and heat pumps — Safety and environmental requirements — Part 1: Basic requirements, definitions, classification and selection criteria*

EN 378-2:2016, *Refrigerating systems and heat pumps — Safety and environmental requirements — Part 2: Design, construction, testing, marking and documentation*

EN 378-3:2016+A1:2020, *Refrigerating systems and heat pumps — Safety and environmental requirements — Part 3: Installation site and personal protection*

EN 378-4:2016+A1:2019, *Refrigerating systems and heat pumps — Safety and environmental requirements — Part 4: Operation, maintenance, repair and recovery*

EN 1005-3:2002+A1:2008, *Safety of machinery — Human physical performance — Part 3: Recommended force limits for machinery operation*

EN 1672-2:2020, *Food processing machinery — Basic concepts — Part 2: Hygiene and cleanability requirements*

EN 10088-2:2014, *Stainless steels — Part 2: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes*

EN 60204-1:2018, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements*

EN 60335-1:2012¹⁾, *Household and similar electrical appliances — Safety — Part 1: General requirements*

EN 60335-2-34:2013, *Household and similar electrical appliances — Safety — Part 2-34: Particular requirements for motor-compressors*

EN 60529:1991²⁾, *Degrees of protection provided by enclosures (IP Code)*

EN 61310-1:2008, *Safety of machinery — Indication, marking and actuation — Part 1: Requirements for visual, acoustic and tactile signals*

EN ISO 1211:2010, *Milk — Determination of fat content — Gravimetric method (Reference method) (ISO 1211:2010)*

EN ISO 3651-2:1998, *Determination of resistance to intergranular corrosion of stainless steels — Part 2: Ferritic, austenitic and ferritic-austenitic (duplex) stainless steels — Corrosion test in media containing sulfuric acid (ISO 3651-2:1998)*

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

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

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

EN ISO 11202:2010³⁾, *Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions applying approximate environmental corrections (ISO 11202:2010)*

¹⁾ As impacted by EN 60335-1:2012/AC:2014, EN 60335-1:2012/A11:2014, EN 60335-1:2012/A13:2017, EN 60335-1:2012/A1:2019, EN 60335-1:2012/A2:2019 EN 60335-1:2012/A14:2019 and EN 60335-1:2012/A15:2021.

²⁾ As impacted by EN 60529:1991/A1:2000, EN 60529:1991/A2:2013 and EN 60529:1991/AC:2016-12.

³⁾ As impacted by EN ISO 11202:2010/A1:2021.

EN ISO 11463:2020, *Corrosion of metals and alloys — Guidelines for the evaluation of pitting corrosion (ISO 11463:2020)*

EN ISO 11688-1:2009, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 1: Planning (ISO/TR 11688-1:1995)*

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

EN ISO 13732-1:2008, *Ergonomics of the thermal environment — Methods for the assessment of human responses to contact with surfaces — Part 1: Hot surfaces (ISO 13732-1:2006)*

EN ISO 13849-1:2015, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design (ISO 13849-1:2015)*

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

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

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

EN ISO 14122-2:2016, *Safety of machinery — Permanent means of access to machinery — Part 2: Working platforms and walkways (ISO 14122-2:2016)*

EN ISO 14122-3:2016, *Safety of machinery — Permanent means of access to machinery — Part 3: Stairs, stepladders and guard-rails (ISO 14122-3:2016)*

EN ISO 21920-3:2022, *Geometrical product specifications (GPS) — Surface texture: Profile — Part 3: Specification operators (ISO 21920-3:2021)*

ASTM G48-11:2015, *Standard test methods for pitting and crevice corrosion resistance of stainless steels and related alloys by use of ferric chloride solution*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 12100:2010, EN 1672-2:2020 and the following apply.

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

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1 refrigerated bulk milk tank

equipment for refrigeration and bulk storage of refrigerated raw milk freshly milked

Note 1 to entry: In the following text, "refrigerated bulk milk tank" is referred as "tank".

Note 2 to entry: Milk freshly milked is milk less than 2 h after being milked.

3.2

silo tank

vertical closed tank designed to be standing on a flat horizontal surface

Note 1 to entry: See Figure 1.

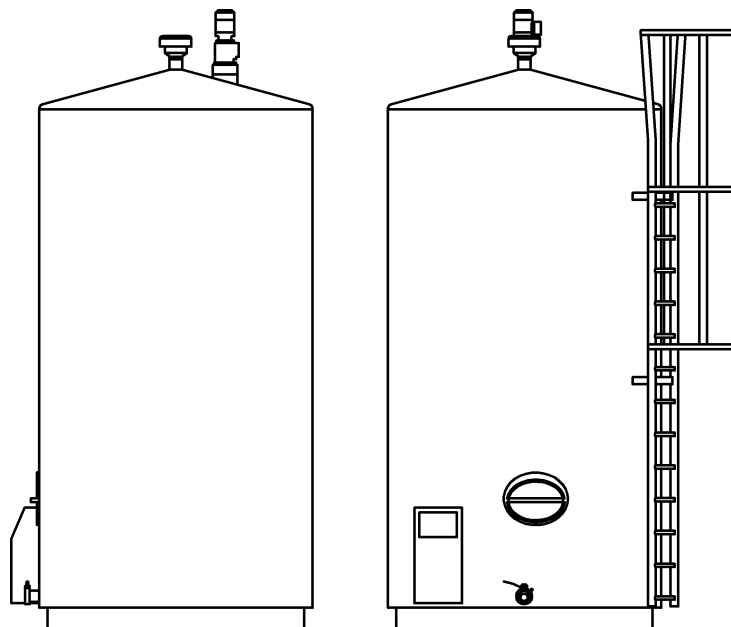


Figure 1 — Examples of silo tank

3.3

open tank

tank equipped with a lid which in the open position allows manual washing of the inner vessel

Note 1 to entry: See Figure 2.

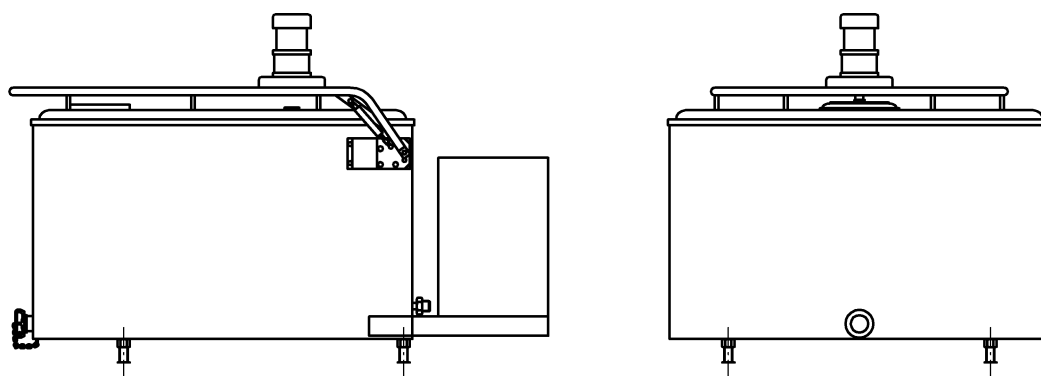


Figure 2 — Example of open tank

3.4 closed tank

horizontal tank equipped with automatic washing of the inner vessel and manhole with a cover for inspection

Note 1 to entry: Access through the manhole is only for maintenance.

Note 2 to entry: See Figure 3.

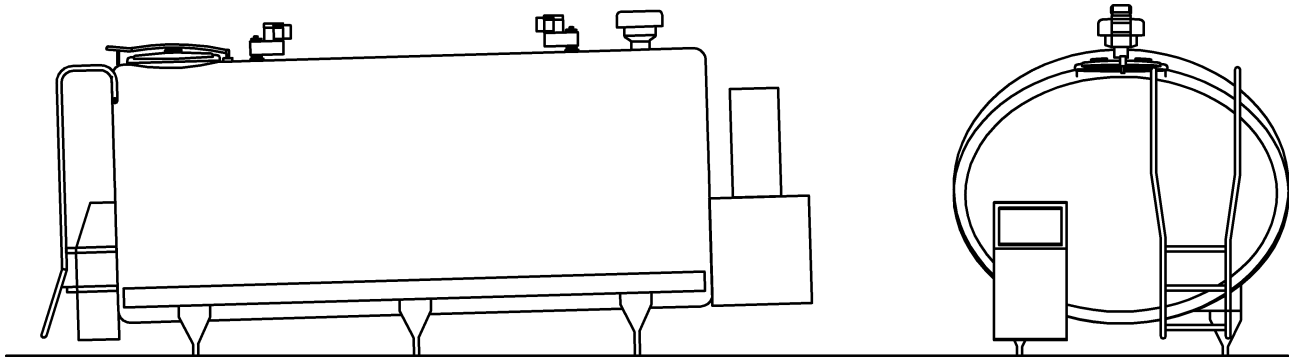


Figure 3 — Example of closed tank

3.5 pre-cooled milk

milk partially or completely cooled to storage temperature before entering the tank

3.6 automatic control

arrangement by which the equipment functions under normal operating conditions, without requiring action by the operator

3.7 agitator

device to mix the milk to promote heat transfer and to ensure uniform distribution of butter fat

3.8 reference position

position specified by the manufacturer for correct installation and operation of the tank

3.9 maximum volume

V_m
volume to which the inner vessel in its reference position and without agitation may be filled without overflowing (expressed in l)

3.10 rated volume

V_r
volume of the maximum permissible filling of the tank under operating conditions as stated by the manufacturer (expressed in l)

3.11**direct cooling system**

cooling system in which the evaporator of the refrigerating system is in direct thermal contact with the milk or the inner vessel

3.12**indirect cooling system**

cooling system in which the evaporator of the refrigerating system is not in direct thermal contact with the milk or the inner vessel and the heat is transferred from the milk to the refrigerant through a cooling medium

3.13**batch filling tank**

tank intended to be filled by a number of milkings

3.14**ice bank tank**

tank with an indirect integrated cooling system in which the cooling medium is water and in which ice is built on the evaporator

3.15**milking**

batch of milk (or test water) which is added to the tank and cooled in a specific cooling time

3.16**tank for two milkings**

tank intended for cooling and storing milk where the milk is added in two batches, each with a volume equal to 50 % of the tank rated volume

3.17**tank for four milkings**

tank intended for cooling and storing milk where the milk is added in four batches, each with a volume equal to 25 % of the tank rated volume

3.18**tank for six milkings**

tank intended for cooling and storing milk where the milk is added in six batches each, with a volume equal to 16,7 % of the tank rated volume

3.19**operating conditions**

state during which the tank is in use for the cooling and storage of milk in accordance with its design requirements and all accessories are functioning effectively

3.20**ambient atmosphere**

atmosphere surrounding the tank and in front of the air-cooled condenser of the refrigerating system

3.21**mean temperature**

calculated average of the different temperatures (in °C) of a medium (air, test water, milk) measured at different measuring points, at the same time

3.22

ambient temperature

mean temperature of the ambient atmosphere (in °C)

3.23

performance temperature

PT

ambient temperature (in °C) to be used when measuring the milk cooling time

3.24

safe operating temperature

SOT

highest limit of the range of ambient temperatures (in °C) at which the equipment is required to function

3.25

initial temperature

IT

mean temperature (in °C) of the milk to be cooled at the time of the commencement of the cooling test

3.26

storage temperature

mean temperature (in °C) to which the milk to be cooled is reduced for storage

3.27

cooling time

time (in h) required to cool a milking from initial temperature to +4 °C

3.28

cooling cycle

period between two successive milk collections

3.29

specific energy consumption

energy consumption in watt-hours per litre (Wh/l) of cooled milk, measured as the mean consumption of all components (excluding cleaning) during a cooling test under the test conditions appropriate to the performance class

Note 1 to entry: The specific energy consumption may be also estimated as indicated in the informative Annex K.

3.30

milk

bovine mammary secretion without either addition thereto or extraction therefrom, untreated and not standardised, complying with Code of Principles concerning milk and milk products, international standards and standard methods of sampling and analysis for milk products of the Joint FAO/WHO Food Standards Programme

Note 1 to entry: Food and Agriculture Organisation (FAO)/ World Health Organisation (WHO).

3.31

water

water, suitable for human consumption, meeting the requirements specified in Directive 98/83/EC relating to the quality of water intended for human consumption

3.32**test water****TW**

water used for test purpose in place of milk

Note 1 to entry: The cooling time for water is nearly the same as that for milk.

3.33**filling**

volume of the milk (or TW) in the tank

3.34**temperature of the milk**

mean temperature of the milk (or TW) at a particular moment

Note 1 to entry: See E.1.5.

3.35**compact and plug-in tank**

tank where the condensing unit(s) is (are) mounted on the tank and the equipment which leave(s) the manufacturer and which does not require further refrigerant and installation work to be in full working condition

3.36**tank for continuous flow**

tank designed for cooling milk when added continuously at a rate of x l/h where x is expressed in steps of 25 l/h

3.37**minimum and maximum flow**

minimum and maximum average milk flow rates (expressed in l/h) at which a tank for continuous flow is designed to operate

3.38**minimum cooling volume**

minimum quantity or flow rate at which the tank may operate without formation of ice:

- two milkings tanks: $V_r \times 0,2$;
- four milkings tanks: $V_r \times 0,1$;
- six milkings tanks: $V_r \times 0,067$;
- continuous flow tank: according to the minimum flow given by the manufacturer

4 Safety requirements and/or protective measures — Performance**4.1 General**

Machinery shall comply with the safety requirements and/or protective measures of this clause.

In addition, the machine shall be designed according to the principles of EN ISO 12100:2010 for hazards relevant but not significant, and for hazards arising under the conditions of misuse which are reasonably foreseeable and which are not dealt with by this document.

4.2 Mechanical hazards

4.2.1 Lids and covers

4.2.1.1 Lids / open tanks

For open tanks, the open and closed positions of the lid shall be stable. The opening and closing operations shall require an intentional action.

Hinged lids of open tanks shall have a means to keep them in the open position (e.g. spring, hook, bracket, etc.) or the centre of gravity of the lid shall be at least 15° over the balancing position.

4.2.1.2 Covers / closed tank

For closed tanks having one or more manholes, the locking of the cover of this manhole(s) in the closed position shall require an intentional action. Furthermore, it shall be clearly and visibly marked, adjacent to the manhole(s), that (see also 6.2 and 6.3):

- before the closing of the cover, it shall be checked that nobody is in the vessel;
- before entering the tank, it shall be necessary to read the instruction handbook.

For closed tanks, each opening greater than 240 mm (maximum diameter in the case of a circular or maximum axis in case of an elliptical opening, side length in the case of a square), and which is located more than 1,35 m above the inner floor shall be provided with a fixed guard requiring a tool to enable access or shall be fitted with an interlocking device to stop agitation and cleaning functions of the tank. If a fixed guard is used, it shall comply with EN ISO 14120:2015.

For reasons of hygiene and safety, the design and instruction for use shall avoid the need to enter the tank in normal operation.

4.2.2 Agitators

Access to agitator attached to the lid of open tanks shall be safeguarded by interlocking the lid with the agitator movement in accordance with EN ISO 14119:2013. When opening the lid, the agitator shall stop within 2 s. The safety-related parts of the control system shall comply at least with the appropriate performance level determined in accordance with EN ISO 13849-1:2015.

For agitators not attached to the lid (closed tanks, see dimensions in 4.2.1.2), a warning sign close to the manhole(s) or inspection opening(s) shall warn of the possible automatic start of the agitator (see also Clause 6). The touching with the rotating agitators blade through the manhole shall be avoided and safety distances shall be applied according to EN ISO 13857:2019.

4.2.3 Refrigerating system

The refrigerating system shall comply with EN 378-1:2016+A1:2020 and EN 378-2:2016.

4.2.4 Stability

Tanks shall be stable independent of the level of filling. If not stable by itself the manufacturer shall define the fixing mode.

Tanks with a mass of 75 kg or more when empty shall be so constructed that under normal operating conditions, it shall not tilt when subjected to an external horizontal force of 750 N applied in any direction at highest point of the outer shell, according to the test method given in Clause 5.

If the tank is equipped with a step or a platform, it shall not tilt when subjected to an external vertical force of 1200 N applied on this step or platform.

4.3 Electrical hazards

The electrical equipment shall comply with:

- either EN 60204-1:2018 and the specific requirements stated in Annex C; or
- EN 60335-1:2012¹⁾, with the specific requirements stated in Annex D.

4.4 Thermal hazards and hazards generated by materials and substances used

The design of automatic cleaning equipment shall ensure that no cleaning products and hot water may be splashed or sprayed against an operator either during “pick up” of concentrated product or during the cleaning cycle (e.g. hoses tightened (e.g. spanner) or tubing fastened (clips), shields over product dispensing units).

An audio or visual signal (see 6.2) shall indicate that the automatic cleaning is in progress (including pauses and delays).

The temperature of the touchable outside walls shall conform to EN ISO 13732-1:2008, 4.2.1, for a time of contact of 1 s.

Safety sign(s) shall warn about the remaining hazards, and the instruction handbook shall give advice on the use of proper protective wear (see 6.2/6.3).

The safety signals, visual and audio, shall comply with EN 61310-1:2008.

4.5 Hygiene

4.5.1 Adequate cooling and safe storage of milk

4.5.1.1 Control of the cooling system

The cooling of the first milking shall be started either manually or automatically. Then the control equipment shall ensure that cooling starts automatically after commencing to add the second and following milkings.

The equipment for the control of the milk temperature shall operate satisfactorily (see 4.5.1.2.3 and 4.5.1.2.5) with any volume of milk between the minimum cooling volume and 100 % of the rated volume of the tank at any milk temperature from 0 °C to +35 °C and at any ambient temperature between +5 °C and the Safe Operating Temperature (SOT). This requirement shall include the filling with high volumes during a short time period (conventional milking: batch filling) and with small amounts of milk throughout the day (tanks for continuous flow as used with automatic milking systems).

On a direct cooling system the agitator shall operate whenever the condensing unit of the refrigerating systems is operating.

On an indirect cooling system the agitator shall operate whenever the cooling medium circulation is operating.

4.5.1.2 Cooling and agitation performances

4.5.1.2.1 Performance classes

4.5.1.2.1.1 General

The performance classes of a tank shall be specified according to 4.5.1.2.1.2 to 4.5.1.2.1.6.

4.5.1.2.1.2 Classification according to number of milkings

The numeral “2” shall designate a tank for two milkings.

The numeral “4” shall designate a tank for four milkings.

The numeral “6” shall designate a tank for six milkings.

The figure “F” shall designate a tank designed to operate in continuous flow.

4.5.1.2.1.3 Classification according to ambient temperature

Classification shall be according to Table 1.

Table 1 — Classification according to ambient temperature

Classification	Performance temperature (PT) °C	Safe operating temperature (SOT) °C	Energy consumption temperature (ECT) °C
A	38	43	20
B	32	38	15
C	25	32	10

4.5.1.2.1.4 Classification according to milk cooling time

Classification for batch filling and continuous flow shall be according to Table 2.

Table 2 — Classification according to milk cooling time

For batch filling		For continuous flow	
Classification	T_1 Specified cooling time for all milkings from +35 °C or P XX °C to +4 °C h	T_5 Specified cooling time from +35 °C or P XX °C to 10 °C h	T_6 Specified cooling time from +35 °C or P XX °C to 4 °C h
0	2	/	1
I	2,5	1	3
II	3	2	5
III	3,5	3	7

Classification for continuous flow shall be:

F with the addition of the ambient temperature classification and the flow rate of milk

EXAMPLE F 100-200 B II

where

F = Flow

100 = minimum flow (l/h)

200 = maximum flow (l/h)

B = Ambient class temperature

II = cooling time

4.5.1.2.1.5 Classification according to milk inlet temperature

Addition of "P" in case of pre-cooled milk at P XX °C.

XX: Pre-cool temperature defined by the manufacturer

See 4.5.1.2.1.6 for examples.

4.5.1.2.1.6 Examples of performance class marking

In case of non-pre-cooled milk: 4 B II

In case of milk pre-cooled to 18 °C: 4 B II P18

In case of continuous flow milk pre-cooled to 18 °C: F 100-200 B II P18

In case of continuous flow milk pre-cooled completely to 4 °C: F 100-200 B II P4

4.5.1.2.2 Milk cooling rate

When a tank for two milkings is either empty or contains 50 % of its rated volume of milk at +4 °C, and 50 % of the rated volume of milk at +35 °C or P XX °C (in case of pre-cooled milk) is added in one batch, all of the milk shall be cooled to +4 °C in not more than the specified cooling time (see Table 2).

When a tank for four milkings is either empty or contains 25 %, 50 % or 75 % of the rated volume of milk at +4 °C, and 25 % of the rated volume of milk at +35 °C or P XX °C (in case of pre-cooled milk) is added in one batch, all of the milk shall be cooled to +4 °C in not more than the specified cooling time (see Table 2).

When a tank for six milkings is either empty or contains 16,7 %, 33,3 %, 50 %, 66,7 % or 83,3 % of its rated volume of milk at +4 °C and 16,7 % of the rated volume of milk at +35 °C or P XX °C (in case of pre-cooled milk) is added in one batch, all of the milk shall be cooled to +4 °C in not more than the specified cooling time (see Table 2).

When a tank for continuous flow has milk added at a flow rate greater than or equal to its rated minimum rated flow, but less than or equal to its maximum rated flow, all of the milk shall be cooled from initial temperature to +10 °C and then to +4 °C in not more than the specified cooling time (see Table 2).

The above requirements shall apply at ambient temperatures between +5 °C and the performance temperature (PT).

4.5.1.2.3 Storage of the milk

Under normal operating conditions the storage temperature of the milk, between cooling periods shall be not higher than +4 °C. This requirement shall apply at ambient temperatures between +5 °C and the PT.

4.5.1.2.4 Thermal insulation

The tank shall be provided with thermal insulation the efficiency of which shall be such that at the PT the rate of rise of the mean temperature of the milk, initially at +4 °C, shall not exceed +3 °C in 12 h when the rated volume is allowed to stand undisturbed, without agitation nor refrigeration.

4.5.1.2.5 Freezing of the milk

Ice shall not form in the milk under the milk surface during either cooling or storage when the tank is used in ambient temperature between +5 °C and the PT and,

- a) in the case of a batch filling tank, the tank is filled with milk to a volume value of:
 - 1) for two milking tanks: between 20 % and 100 % of its rated volume;
 - 2) for four milking tanks: between 10 % and 100 % of its rated volume;
 - 3) for six milking tanks: between 6,7 % and 100 % of its rated volume.
- b) or in the case of a tank for continuous flow, when milk is added at a rate between the minimum flow and maximum flow rate.

4.5.1.2.6 Agitation of the milk

Operating of the agitator shall not cause milk to overflow when the tank contains any volume of milk up to 100 % of its rated volume.

The agitator shall be capable of producing a uniform distribution of the fat throughout the milk, so that the fat content of samples, randomly selected from the tank, does not differ by more than 0,1 g of fat per 100 g of milk.

This requirement shall be achieved by operating the agitator for not more than 2 min, when the tank contains any volume of milk between 10 % and 100 % of its rated volume at +4 °C and after allowing to stand unagitated for 1 h.

For tanks utilising a continuous agitation system, this requirement shall be achieved by operating the agitator for not more than 10 min.

These requirements shall be achieved without the formation of froth or butter.

The milk used for these agitation tests shall be bulk raw whole milk with fat content of 4 g ± 0,5 g per 100 g of milk at a temperature of +4 °C ± 1 °C.

4.5.1.2.7 Safe operating temperature

The tank shall be capable of cooling any milking or continuous flow as detailed in 4.5.1.2.2, under automatic control without time limit, when the equipment is operated at the specified SOT.

However, the cooling time of the first milking of the batch filling tank shall not exceed the specified cooling time as given in Table 2 by more than 25 %.

4.5.2 Prevention of milk contamination

4.5.2.1 General

4.5.2.1.1 The design and construction of tanks shall comply with the requirements of EN 1672-2:2020 and the following.

4.5.2.1.2 The following parts shall be considered to be in the food area as defined in EN 1672-2:2020:

- inside surfaces of the inner vessel;
- outside surfaces of components inside the inner vessel;
- the inner part of the lid(s),

- the inner part of the outlet including valve and connections.

The manufacturer shall define adequate solutions for cleaning and disinfection (see Clause 6 and for automatic cleaning Annex F).

4.5.2.1.3 The following parts shall be considered to be in the splash area as defined in EN 1672-2:2020:

- the outside parts of the equipment at the proximity of manholes;
- and other openings where splashing may occur.

The inner parts of the cleaning circuit shall comply with the requirements for splash areas.

4.5.2.1.4 Materials in contact with cleaning water and chemicals shall be resistant to cleaning and disinfecting agents in normal conditions of dosage and temperature so that they shall not impart a taint to milk.

4.5.2.2 Inner vessel

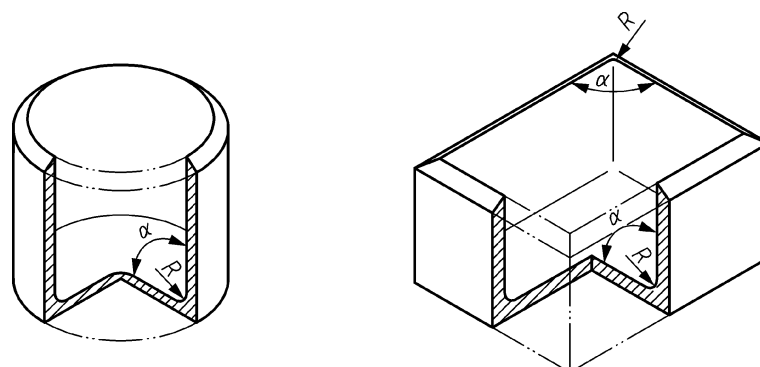
Any bridge or bracket required to be supported from the top of the inner vessel shall be welded to it and provided with upturned edges not less than 10 mm high. The bridge or bracket shall be designed in such a way that liquid is drained away from the inner vessel.

All joints shall be welded and shall have a surface finish, strength and corrosion resistance not less than as specified hereafter.

Inner vessel and all attachments which are in or may come into contact with milk shall:

- be manufactured from austenitic stainless steel or from a material complying with relevant European specifications (see Bibliography);
- have a surface roughness $R_a \leq 1 \mu\text{m}$ where R_a is as defined in EN ISO 21920-3:2022;
- use a grade of steel which quality shall be at least equivalent to that of stainless steel X5CrNi18-10 (1.4301), as defined in EN 10088-2:2014, especially with regard to resistance to corrosion. Annex I shall be used to verify the equivalence of stainless steel.

All inside corners of the inner vessel shall have radii R not less than 20 mm (see Figure 4) unless the angle $\alpha > 135^\circ$ (2,36 rad). All other corners in the inner vessel shall have radii not less than 3 mm.



Key

R radius

α angle

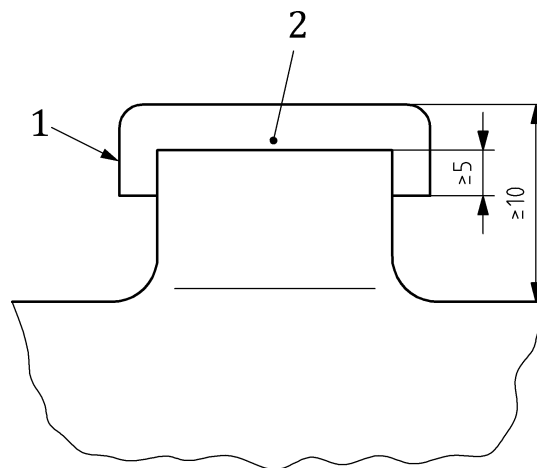
Figure 4 — Inside corners

Every component which is permanently attached within the inner vessel shall be welded to it. The welds shall have radii not less than 3 mm and the angles shall be not less than 90° (1,57 rad). All components which are not practical to be welded to the inner vessel shall be fastened so that they may be easily removed for cleaning.

4.5.2.3 Openings and lids in connection with the inner vessel

- a) Each opening on the horizontal surface shall have upturned edges not less than 10 mm high.
- b) Each opening shall be provided with a lid which overlaps the opening and has adequate downturned edges not less than 5 mm high to protect the milk from contamination (see Figure 5).

Dimensions in millimetres



Key

- 1 lid
- 2 opening

Figure 5 — Opening

- c) On tanks to be cleaned manually the openings and lids shall be so constructed that all internal parts of the inner vessel may be cleaned safely from outside, when standing next to the tank.
- d) Openings and lids shall have all inside corners constructed to provide internal radii of not less than 3 mm.
- e) Any aperture in a lid or in a bridge which forms part of a tank lid assembly shall also be provided with a cover. All apertures and covers shall comply with above requirements with regard to upturns, downturns and radii.
- f) Lids and covers over openings and apertures shall provide the inner vessel with a degree of protection against the ingress of foreign solid parts and water not less than IP 43 as detailed in EN 60529:1991²⁾.

4.5.2.4 Thermometers

Glass thermometers and thermometers with mercury shall not be used.

4.5.2.5 Agitators

The agitation device shall be so designed and constructed that:

- a) shaft seals shall be provided against any contamination of the milk which may enter the inner vessel from outside;
- b) material and surface roughness in the food area shall comply with 4.5.2.2;
- c) corners in the food area shall have angles not less than 1,57 rad (90°), welds and corners shall have radii not less than 3 mm;
- d) the lowest point of any coupling of an agitator at which milk could enter unintentionally shall be at least 30 mm above the level of milk which corresponds to maximum volume.

4.5.2.6 Cleaning

The inner vessel shall be designed to be cleanable as defined in EN 1672-2:2020, 3.6.1.

If the tank is a closed tank, it shall be possible to clean without entering the tank (e.g. with automatic cleaning equipment complying with Annex F).

4.6 Energy consumption

If the energy consumption is provided by the manufacturer, values shall be either measured or estimated according to the informative Annex K.

The performance data for the condensing unit may be available in accordance with EN 13215:2016+A1:2020.

4.7 Ergonomics

Lids shall be so designed and constructed that during the opening and closing operations the relevant ergonomic requirements of EN 1005-3:2002+A1:2008 are fully met.

The tank shall be provided with at least one manhole having dimensions of at least equivalent to an ellipse of 400 mm × 480 mm or a circular of 480 mm diameter.

If a point for maintenance or access is more than 1,35 m above the floor, the manufacturer shall provide appropriate means of safe access and rescue (see example in informative Annex L):

- a) a platform shall be fixed to the tank and shall comply with the following requirements:
 - 1) the height from the platform to the rim of the tank shall be not less than 1 m and not more than 1,35 m;
 - 2) the platform dimensions shall be at least 300 mm wide and 250 mm deep;
- b) if the distance from the floor to the platform is more than 450 mm, step(s) shall be provided;
- c) for platform height above 1,20 m, platform and step(s) shall be in accordance with EN ISO 14122-2:2016 and EN ISO 14122-3:2016.

4.8 Provisions for maintenance

As the tank is provided to operate under automatic control, the hazard due to unexpected start-up exists only during maintenance operations. The control system shall be able to be safely disconnected from the electrical supply (see 4.3).

If the electrical disconnecting device is not visible from the maintenance operating points, it shall be lockable.

If the lockable disconnecting device is not a part of the tank, information shall be given in the instruction handbook (see 6.5 e)).

See 4.3. The same protective measure may be used for both requirements.

4.9 Other general requirements for tanks

4.9.1 Temperature tolerance

The tank and associated equipment shall be designed and constructed to withstand the following temperatures:

- operation: from +5 °C to SOT
- storage and transport: from -25 °C to +55 °C
- cleaning water: up to +90 °C for 2 min
up to +70 °C continuously

4.9.2 Inner vessel

The inner vessel shall be so designed that the rated volume (V_r) is between 90 % and 98 % of the maximum volume (V_m).

4.9.3 Outer shell

The design of the outer shell shall provide the inner vessel with a degree of protection against the ingress of foreign solid parts and water not less than IP 43 as detailed in EN 60529:1991²⁾ and shall be self-draining.

4.9.4 Thermal insulation of cooling tank

The insulating material shall be non-settling and shall not be liable to displacement during storage, transportation or operation.

Adequate provision shall be taken to ensure that the thermal insulation will comply permanently with the requirements of 4.5.1.2.4.

4.9.5 Supports and feet

A tank shall be fitted with adjustable supports or feet to permit it to be placed in its reference position, on a floor where the maximum height difference between the lowest and highest part of the floor does not exceed 50 mm.

This requirement does not apply to silo tanks.

4.9.6 Milk inlet aperture

The tank shall be provided with at least one milk inlet aperture.

All milk inlet apertures shall have a diameter of not less than 40 mm, and not more than 210 mm.

Milk should enter the tank without turbulence and without forming froth.

The milk tank outlet (4.9.7) may also be used as the milk inlet aperture.

4.9.7 Outlet

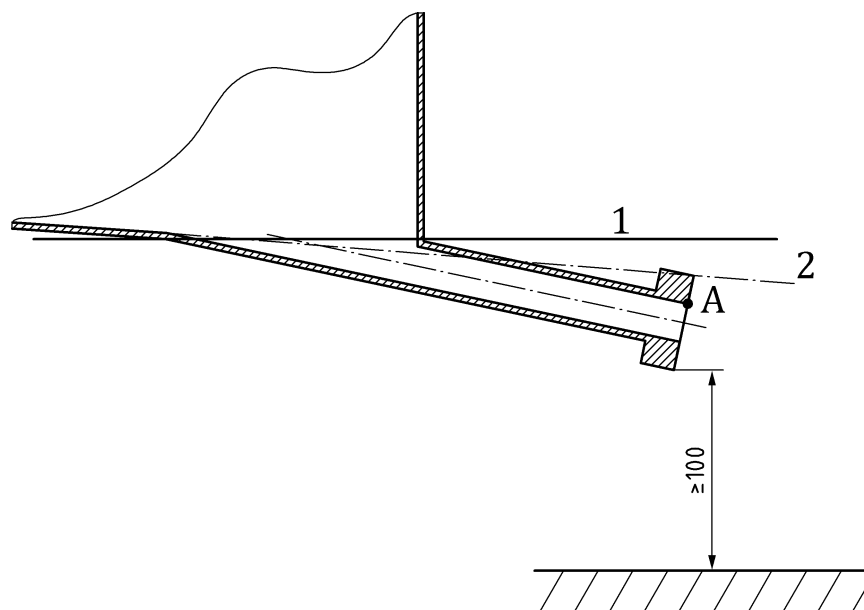
The tank shall be provided with an outlet.

The outlet orifice and the bottom of the inner vessel shall be designed so that all the contents drain to the outlet.

With the tank in its reference position and containing 40 l of test water, at least 39,8 l shall run out in 1 min by gravity.

The highest point of the inside of the outer end of the outlet pipe (A), including the outlet valve, shall be lower than an imaginary line (2) continued from the line of the base of the inner vessel (see an example in Figure 6).

Dimensions in millimetres



Key

- 1 horizontal
- 2 imaginary line (continued from the line of the inner vessel)

Figure 6 — Outlet of the tank

The outlet pipe shall be constructed from stainless steel and shall have an inner diameter of at least 48 mm. The outlet pipe shall have not more than one bend and one detachable hygienic joint, or if an outlet valve is fitted two detachable hygienic joints. The outlet valve or, if there is no valve, the outlet pipe, shall terminate with a male thread fitting which shall be provided with a cap. The total length of the outlet shall be as short as practicable.

The ground clearance under the outlet fitting shall not be less than 100 mm (see Figure 6).

4.9.8 Electrical controls

4.9.8.1 Duty selection

Besides the controls required for completely stopping and disconnecting the machine from energy, at least the following control functions shall be implemented:

- a) “standby”: cooling, agitation and cleaning “OFF”;
- b) cooling-automatic: automatic operation for cooling and agitation;
- c) cooling-manual: cooling and agitation by manual control;
- d) agitation-manual: agitation by manual control (see 4.9.8.3);
- e) cleaning-automatic (if provided): cleaning of the tank by automatic equipment.

4.9.8.2 Periodic timer

To ensure the homogeneity of the milk (see 4.5.1.2.6) a periodic timer shall be fitted to operate the milk agitator for pre-set periods at pre-set intervals of not more than 1 h independently from other functions.

4.9.8.3 Agitation timer

A time switch shall be provided to operate only the milk agitator for not less than 2 min. This does not apply to tanks designed for continuous agitation.

4.9.8.4 Thermometer

Every tank shall be provided with a thermometer, to read the temperature of the milk at any volume between 6,7 % and 100 % of the rated volume.

The instrument shall be suitably protected to ensure that neither dust nor liquid may enter any part of it.

The instrument shall be capable of withstanding, without any loss in calibration, the temperatures detailed in 4.9.1.

The thermometer shall be in operation for all functions of the duty selection switch(es), however, for function “OFF” (see 4.9.8.1 a)) the temperature may not be displayed.

In any ambient temperature from +5 °C to the PT, the error of the thermometer shall not be greater than ±1 °C between +2 °C and +12 °C, when the milk temperature is changing at a rate of not more than 15 °C/h.

If the thermometer is fitted with a graduated scale it shall be easily legible and preferably fitted on the side from which the tank is emptied. The temperature scale shall be graduated in degrees Celsius with one division per degree Celsius up to +12 °C and shall be marked from at least 0 °C to +80 °C. In the range from +2 °C to +12 °C the scale length shall be not less than 20 mm. On instruments fitted with circular scales, the scale length is read along a circle described by the tip of the pointer or along a circle through the outer ends of the strokes of one division per degree Celsius whichever is the least.

In the case of digital indication, the temperature scale shall be displayed in degrees Celsius at least from 0 °C to 80 °C. The height of the figures shall be not less than 10 mm.

4.10 Additional requirements for ice bank tanks

4.10.1 Design

An ice bank tank shall be designed so that in the event of a failure in the ice bank control (4.10.2) no part of the structure shall suffer any permanent damage.

The equipment shall be designed to ensure that ice re-forms regularly over the whole evaporator surface.

A removable cover shall be provided to permit inspection of the ice bank.

The container for chilled water shall be designed so that the water may be changed without difficulty, e.g. by the use of a draining pipe with valve or cap.

The container for chilled water shall be of a size to ensure that the ice bank control and circulation system may operate in compliance with the requirements of 4.10.2 and the tests given in Annex E. The running time of the condensing unit shall not exceed 9 h to build up the ice necessary to cool one milking when working at PT and shall not exceed 11 h when working at SOT.

4.10.2 Ice bank control

An ice bank tank shall be fitted with an independent control for each condensing unit which will automatically control the amount of ice and will operate in ambient temperatures from +5 °C to SOT, so that for any volume of milk between the minimum cooling volume and 100 % of the rated volume the ice bank tank shall comply with the requirements of Clause 4.

This control shall ensure that excessive ice may not form in the chilled water container thus preventing effective functioning of the equipment.

4.11 Noise

Machinery shall be designed and constructed in such a way that the risk resulting from the emission of airborne noise is reduced to the lowest level, taking account of technical progress and the availability of means of reducing noise, in particular at the source. The success of the applied noise reduction measures is assessed on the basis of the actual noise emission values.

When designing machinery, the information and technical measures to control noise at the source given in EN ISO 11688-1:2009 shall be taken into account.

NOTE EN ISO 11688-2:2000 provides useful information on the physics of noise generation mechanisms in machinery.

The most relevant noise sources and measures to achieve the reduction of noise may be the following (see Table 3).

Table 3 — Noise sources and design options to minimize them

Potential noise sources	Design options for minimising noise emission
Wash pump	Lower speed / lower power Encased with noise shielding / guarding
Agitator motors	Optimize balance Lower speed / lower power Encased with noise shielding / guarding
Condensing units fans	Lower speeds Modified fan blade trailing edge design Smooth flow of air in condensor (minimize turbulences)
Compressor	Lower speeds Encased with noise shielding / guarding Vibration dampening mountings
Rigid mounting of vibration sources on a radiating surface	Vibration dampening mountings, mounting on high impedance structures

5 Verification and tests

This clause contains the methods of testing for the presence and adequacy of the safety requirements stated in Clause 4. All safety measures of Clause 4 contain self-evident criteria of acceptance.

Verification of the requirements may be made by means of inspection, calculation, or testing. These shall be applied to a machine in a fully commissioned condition, but partial dismantling may be necessary for the purpose of some checks. Such partial dismantling shall not invalidate the result of the verification.

Methods of verification of safety requirements are given in Table 4.

Table 4 — List of verification

Sub-clauses	Verification
4.2.1 Lids and covers	By operation and visual inspection.
4.2.2 Agitators	By operation and visual inspection. Check that the agitator stops within 2 s, when opening the lid.
4.2.3 Refrigerating system	Check that the refrigerating equipment complies with EN 378-1:2016+A1:2020 and EN 378-2:2016.
4.2.4 Stability	a) Place the tank in its reference position. Check the overall weight. a) A force of 750 N, applied by a suitable device, shall be applied to the equipment in all accessible positions; b) No tilting of the equipment shall be noticed, when the tank is empty or filled at its rated volume.
4.3 Avoidance of electrical hazards	Refer to the relevant standard(s) (EN 60204-1:2018 or EN 60335-1:2012 ¹⁾) and the complementary requirements in Annexes C or D.

Sub-clauses	Verification
4.4 Cleaning products and hot water	By operation and visual inspection.
4.5.1.1 Control and electrical equipment	— Check the correct operation of the thermostat, for example the temperature differential and the consistency of cut-out and cut-in temperatures. This shall be carried out during the performance tests (see E.2.1). — Check the accuracy of the thermometer during the performance tests (see E.2.1). — See E.2.1. — By operation.
4.5.1.2.2 Milk cooling rate	See E.2.1.
4.5.1.2.3 Storage of the milk	See E.2.1.
4.5.1.2.4 Thermal insulation	See E.2.2.
4.5.1.2.5 Freezing of the milk	See E.2.1.2.
4.5.1.2.6 Agitation of the milk	See E.2.3.
4.5.1.2.7 Safe operating temperature	See E.2.1.6 and E.2.1.7.
4.5.2.2 Welds	Examine the quality of the welds visually or by other suitable means.
4.5.2.2 Bridge or bracket	Visual inspection (drawings; on machinery)
4.5.2.2 Surface finish	The surface finish by means of a surface roughness measuring device.
4.5.2.2 Material	Verification of the materials specifications
4.5.2.2 Radii	Measurement
4.5.2.3 a) to g) Openings and lids	Check dimension Visual inspection
4.5.2.3 h) Openings and lids and 4.9.3 Outer shell	a) Test the compliance of the protection against the ingress of foreign solid parts inside the tank (as stated in 4.5.2.3 g)), using the method indicated in EN 60529:1991²⁾, Clause 13. b) Test the compliance of the protection against the ingress of water inside the tank (as stated in 4.5.2.3 g)), using the method indicated in EN 60529:1991²⁾, Clause 14, using an empty and dry tank with lids and covers closed. In order to check the second characteristic number “3”, or potentially “4” use the device described in EN 60529:1991²⁾, Figure 5 (see EN 60529:1991²⁾, 14.2.3 b) or 14.2.4 b)). Then open and close the different lids and covers of the tank (except those of the electric parts, which are not concerned by this sub-clause). No water shall have entered the inner tank.
4.5.2.4 Thermometers	Visual inspection

Sub-clauses	Verification
4.5.2.5 Agitators	Visual inspection, drawings; Check the distance between the agitator coupling and the maximum milk level.
4.5.2.6 Cleaning	According to Annex F.
4.7 Ergonomics	According to relevant verification in EN 1005-3:2002+A1:2008. Check dimensions of ladder/platform.
4.8 Provisions for maintenance	Visual inspection.
4.9.1 Temperature tolerance	Operation: Annex E Storage and transport: material data sheet Cleaning: Annex F
4.9.2 Inner vessel	— the tank shall be placed in its reference position, at an ambient temperature between +5 °C and SOT; — before the test commences, the tank shall be cleaned in accordance with the manufacturer instructions; — fill the tank up to the maximum volume (V_m) with TW at a temperature between +4 °C and +20 °C, measuring this volume by an appropriate method in order to fulfil the accuracy stated in E.1.1.3; — calculate the ratio V_r/V_m and compare to the limits stated.
4.9.4 Thermal insulation	See E.2.2.
4.9.5 Supports and feet	Visual inspection, drawings; Check the distance between the tank and the floor.
4.9.6 Milk inlet aperture	Visual inspection; Check diameter of milk inlet aperture.
4.9.7 Outlet	Visual inspection, drawings; Check the distance between the outlet fitting and the floor; Check the diameter of outlet. Measure indirectly the volume of test water which drains in 1 min by determining the balance of TW remaining in the tank. Proceed as follows in triplicate: • ensure that the empty tank is mounted in its reference position; • measure 40 l of TW with a limit deviation of $\pm 0,1$ l and at a temperature of between +2 °C and +20 °C and add to the tank; • open the outlet and allow to remain open for $60 \text{ s} \pm 1 \text{ s}$ and then close it; • measure, with a limit deviation of $\pm 0,005$ l the volume of TW which discharges from the tank in $5 \text{ min} \pm 0,1 \text{ min}$, when the outlet is again opened. This volume should not be greater than 0,2 l.