BS EN 13732:2013

BSI Standards Publication

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

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**National foreword**

This British Standard is the UK implementation of EN 13732:2013. It supersedes BS EN 13732:2002+A2:2009 which is withdrawn.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 secretary.

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

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

Nahrungsmittelmaschinen - Behältermilchkühlanlagen für Milcherzeugerbetriebe - Anforderungen an Leistung, Sicherheit und Hygiene

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CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

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**Management Centre: Avenue Marnix 17, B-1000 Brussels**



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# Foreword

This document (EN 13732:2013) 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of an identical text or by endorsement, at the latest by January 2014, and conflicting national standards shall be withdrawn at the latest by January 2014.

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

This document supersedes EN 13732:2002+A2:2009.

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

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

The main changes compared to the previous edition are the following ones:

a) specification of the scope:

   1) pre-cooled milk is taken into account;

   2) other energy than electrical energy as well as the pressure aspect of vacuum tanks are excluded;

b) updating of normative references;

c) specification of the electrical requirements (5.3 was revised and Annexes B and C were added);

d) addition of subclause 7.2 "Warning signs”;

e) specification of the noise test code;

f) editorial modifications.

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

# Introduction

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

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.

# 1 Scope

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

This standard deals with all significant hazards, hazardous situations and events relevant to bulk milk coolers on farms, when they are used as intended and under the conditions of misuse which are reasonably foreseeable by the manufacturer (see Clause 4).

It applies to refrigerated bulk milk tanks with air cooled condensing units and automatic control intended for installation on farms or at milk collecting 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.

Performance requirements in 5.5.1.2.1 and 5.5.1.2.2 do not apply to tanks in combination with instant cooling or in association with a continuous system of milking (e.g. milking with robot).

**1.2** This European Standard does not cover:

— mobile tanks;

— tanks intended to be tilted for drainage;

— equipment for delivering the milk to the tank;

— equipment for pre-cooling or instant cooling of the milk;

— the hazards due to the use of other energy than electrical energy;

— pression aspect of vacuum tanks.

**1.3** Noise is not considered to be a significant hazard, but a relevant one for bulk milk coolers. This standard therefore includes information in 7.1 and in Annex A concerning the manufacturer's declaration of the noise emission level of the cooler.

**1.4** This standard does not cover the calibration requirements for the tank to be used as a system for payment purpose.

**1.5** This standard is not applicable to bulk milk coolers on farms which are manufactured before the date of its publication as an EN.

## 2 Normative references

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

EN 378-1:2008+A2:2012, *Refrigerating systems and heat pumps — Safety and environmental requirements — Part 1: Basic requirements, definitions, classification and selection criteria*

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

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

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

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

EN 1088, *Safety of machinery — Interlocking devices associated with guards — Principles for design and selection*

EN 1672-2:2005+A1:2009, *Food processing machinery — Basic concepts — Part 2: Hygiene requirements*

EN 10088-2:2005, *Stainless steels - Part 2: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes*

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

EN 60335-1:2002, *Household and similar electrical appliances — Safety — Part 1: General requirements (IEC 60335-1:2001, modified)*

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

EN 60529:1991,[1)] *Degrees of protection provided by enclosures (IP Code) (IEC 60529:1989)*

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

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

EN ISO 3744, *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)*

EN ISO 4288, *Geometrical product specifications (GPS) — Surface texture: Profile method — Rules and procedures for the assessment of surface texture (ISO 4288)*

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

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1) EN 60529:1991 is impacted by EN 60529:1991/A1:2000, *Degrees of protection provided by enclosures (IP Code) (IEC 60529:1991/A1:2000)*.

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

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

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

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

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

ISO 2852, *Stainless steel clamp pipe couplings for the food industry*

ISO 2853, *Stainless steel threaded couplings for the food industry*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 12100:2010, EN 1672-2:2005+A1:2009 and the following apply.

**3.1**
**refrigerated bulk milk tank**
equipment for refrigeration, and bulk storage of refrigerated raw milk freshly milked

Note 1 to entry: Referred to as “Tank” throughout this document.

**3.2**
**open tank**
refrigerated bulk milk tank equipped with a lid which allows in open position manual washing of the inner vessel

**3.3**
**closed tank**
refrigerated bulk milk tank equipped with automatic washing of the inner vessel

Note 1 to entry: A manhole is only used for maintenance.

**3.4**
**freshly milked**
milk less than 2 h after being milked

**3.5**
**pre-cooled milk**
milk partially cooled 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**
**atmospheric tank**
tank of which the inner vessel is designed to operate at atmospheric pressure

**3.8**
**vacuum tank**
tank of which the inner vessel is designed to operate at a pressure below atmospheric pressure

**3.9**
**agitator**
device to mix the milk to promote heat transfer and to ensure uniform distribution of butterfat

**3.10**
**reference position**
position specified by the manufacturer for correct installation and operation of the tank

**3.11**
**maximum volume**
$V_m$
volume to which the inner vessel in its reference position and without agitation can be filled without overflowing (expressed in litres)

**3.12**
**rated volume**
$V_r$
volume of the maximum permissible filling of the tank under operating conditions as stated by the manufacturer (expressed in litres)

**3.13**
**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

**3.14**
**indirect cooling system**
cooling system in which the heat is transferred from the milk to the refrigerant through a cooling medium

**3.15**
**ice bank tank**
tank with an indirect integrated cooling system in which the cooling medium is water and ice is built on the evaporator

**3.16**
**milking**
quantity of milk (or test water) which is equivalent to 50 % of the theoretical maximum daily milk production

**3.17**
**tank for two milkings**
tank intended to be emptied for milk collection each day and designed for cooling and storing its rated volume during 24 h

**3.18**
**tank for four milkings**
tank intended to be emptied for milk collection every two days and designed for cooling and storing its rated volume during 48 h

**3.19**
**tank for six milkings**
tank intended to be emptied for milk collection every three days and designed for cooling and storing its rated volume during 72 h

**3.20**
**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

**3.21**
**ambient atmosphere**
atmosphere surrounding the tank and in front of the air-cooled condenser of the refrigerating system

**3.22**
**mean temperature**
calculated average of the different temperatures (in degrees Celsius) of a medium (air, test water, milk) measured at different measuring points, at the same time

**3.23**
**ambient temperature**
mean temperature of the ambient atmosphere (in degrees Celsius)

Note 1 to entry: See B.3.

**3.24**
**performance temperature**
**PT**
ambient temperature (in degrees Celsius) to be used when measuring the milk cooling time

**3.25**
**safe operating temperature**
**SOT**
highest limit of the range of ambient temperatures (in degrees Celsius) at which the equipment is required to function

**3.26**
**initial temperature**
**IT**
mean temperature (in degrees Celsius) of the milk to be cooled at the time of the commencement of the cooling test

**3.27**
**storage temperature**
mean temperature (in degrees Celsius) to which the milk to be cooled is reduced for storage

**3.28**
**cooling time**
time (in hours) required to cool a milking from initial temperature to + 4 °C

**3.29**
**cooling cycle**
period between two successive milk collections

Note 1 to entry: For tanks for two milkings, the cooling cycle is 24 h. For tanks for four milkings the cooling cycle is 48 h. For tanks for six milkings the cooling cycle is 72 h.

**3.30**
**specific energy consumption**
energy consumption in watt-hours per litre 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

**3.31**
**milk**
bovine mammary secretion without either addition thereto or extraction therefrom, untreated and not standardized, 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

**3.32**
**water**
water, suitable for human consumption, meeting the requirements specified in the EU Directive 80/778/EEC

**3.33**
**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.

**3.34**
**filling**
volume of the milk (or TW) in the tank

**3.35**
**temperature of the milk (or TW)**
mean temperature of the milk (or TW) at a particular moment

Note 1 to entry: See D.1.5.

**3.36**
**compact and plug in tank**
tank where the condensing unit(s) is (are) mounted on the tank which leave(s) the manufacturer in a fully working condition

# 4 List of significant hazards

This clause contains all the significant hazards, hazardous situations and events identified by risk assessment as significant for this type of machinery and which require action to eliminate or reduce the risk (see Table 1).

**Table 1**

| **Hazards (see** EN ISO 12100**)** | **Clause/subclause in this European Standard or in other standards** |
|---|---|
| **Hazards, hazardous situations and hazardous events** | |
| **Mechanical hazards** | |
| Crushing: lid | 5.2.1 |
| Entanglement | 5.2.2 |
| Drawing-in: agitator, fan of the refrigerating system | 5.2.2, 5.2.3 |
| Trapping: enter in the tank | 5.2.1 |
| High pressure fluid ejection: Refrigerating system | 5.2.3 |
| **Electrical hazards** due to: | |
| Contact of persons with live parts (direct contact) | 5.3 |
| Contact of persons with parts which have become live under faulty conditions (indirect contact) | 5.3 |
| **Thermal hazards**, resulting in: | |
| Burns, scalds and other injuries by a possible contact of persons with objects or materials with an extreme temperature:<br>- Refrigerating system, cleaning hot water | 5.2.3, 5.4, 5.8.1 |
| **Hazards generated by materials and substances** | |
| Hazards from contact with or inhalation of harmful fluids, gases mists, fumes | 5.4 |
| Fire or explosion hazard | 5.2.3 |
| Biological or microbiological (viral or bacterial) hazards | 5.5, 5.8.1, 5.8.2, 5.8.3, 5.8.4, 5.8.5, 5.8.6, 5.8.7 and 5.9 |
| **Hazards generated by neglecting ergonomic principles in machinery design** as, e.g. hazards from: | |
| Unhealthy postures or excessive effort | 5.6 |
| **Unexpected start-up, unexpected overrun/overspeed** (or any similar malfunction) from: | |
| Failure/disorder of the control system | 5.3, C.9 |
| Restoration of energy supply after an interruption | 5.7 |
| **Errors of fitting** | 7.5 |
| **Loss of stability/overturning of machinery** | 5.2.4 |
| **Slip, trip and fall of persons** (related to machinery) | 5.6 |

# 5 Safety requirements and/or protective measures — Performance

## 5.1 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 for hazards relevant but not significant, which are not dealt with by this document.

## 5.2 Mechanical hazards

### 5.2.1 Lids and covers

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 mean 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.

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 7.2 and 7.3):

— 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 reasons of hygiene, the design should avoid as much as possible the need to enter the tank.

### 5.2.2 Agitators

Access to the agitator attached to the lid of open tanks shall be safeguarded by interlocking the lid with the agitator movement according to EN 1088. When open the lid, the agitator shall stop within 2 s. The safety related parts of the control system shall comply at least with a performance level b in accordance with EN ISO 13849-1.

For agitators not attached to the lid (closed tanks), a warning sign close to the manhole(s) or inspection opening(s) shall warn for the possible automatic start of the agitator (see also Clause 7).

### 5.2.3 Refrigerating system

The refrigerating system shall comply with EN 378-1 and EN 378-2.

### 5.2.4 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 any accessible points, according to the test method given in Clause 6.

If the tank is equipped with a step or a platform, it shall not tilt when subjected to an external vertical force of 1 200 N applied on this step or platform.

## 5.3 Electrical hazards

The electrical equipment shall comply with:

— either EN 60204-1 and the specific requirements stated in Annex B;

— or EN 60335-1, with the specific requirements stated in Annex C.

NOTE In general, EN 60204–1 is more appropriate for complex equipment while EN 60335–1 is more appropriate for compact appliances and/or machines made in big series.

## 5.4 Thermal hazards and hazards generated by materials and substances used

As far as technically possible, the design of automatic cleaning equipment shall ensure that no cleaning products and hot water can 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).

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

If it is not technically possible to achieve this for specific parts, safety sign(s) shall warn about the remaining hazards and the instruction handbook shall give advice on the use of proper protective wear (see 7.3).

## 5.5 Hygiene

### 5.5.1 Adequate cooling and safe storage of milk

#### 5.5.1.1 Control and electrical equipment

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 5.5.1.2.3 and 5.5.1.2.5) with any volume of between 40 % of one milking and 100 % of the rated volume of the tank at milk temperature from 0 °C to + 35 °C and at any ambient temperature between + 5 °C and the SOT.

On a direct cooling system, the agitator and the condensing unit of the refrigerating systems shall operate together when controlled by the thermostat.

On an indirect system, the agitator and the cooling medium circulation shall operate together when controlled by the thermostat.

#### 5.5.1.2 Cooling and agitation performances

##### 5.5.1.2.1 Performance classes

###### 5.5.1.2.1.1 General

The performance of a tank shall be specified according to the classification given in Tables 2 and 3, based on batch filling.

###### 5.5.1.2.1.2 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.

#### 5.5.1.2.1.3 Classification according to ambient temperature

**Table 2**

| Classification | Performance temperature (PT) °C | Safe operating temperature (SOT) °C |
|---|---|---|
| A | 38 | 43 |
| B | 32 | 38 |
| C | 25 | 32 |

#### 5.5.1.2.1.4 Classification according to milk cooling time

**Table 3**

| Classification | Specified cooling time for all milkings from + 35 °C to + 4 °C h |
|---|---|
| 0 | 2 |
| I | 2,5 |
| II | 3 |
| III | 3,5 |

#### 5.5.1.2.1.5 Classification according to milk inlet temperature

Addition of "P" in case of pre-cooled milk at 23°C.

#### 5.5.1.2.1.6 Example of performance class marking

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

In case of pre-cooled milk: 4 B II P.

### 5.5.1.2.2 Milk cooling rate

If 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 23°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.

If 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 23°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.

If 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 23°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.

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

#### 5.5.1.2.3 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.

#### 5.5.1.2.4 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 about + 4 °C, shall not exceed + 3 °C in 12 h when the rated volume is allowed to stand undisturbed, without agitation nor refrigeration.

#### 5.5.1.2.5 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 is filled with milk to:

a) for two milking tanks: between 20 % and 100 % of its rated volume;

b) for four milking tanks: between 10 % and 100 % of its rated volume;

c) for six milking tanks: between 6,7 % and 100 % of its rated volume.

#### 5.5.1.2.6 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.

#### 5.5.1.2.7 Safe operating temperature

The tank shall be able to cool any milking as detailed in 5.5.1.2.2, under automatic control, when the equipment is operated at the specified SOT.

The cooling time of the first milking shall not exceed the specified cooling time as given in Table 3 by more than 25 %.

### 5.5.2 Prevention of milk contamination

#### 5.5.2.1 General

**5.5.2.1.1** The design and construction of tanks shall comply with the requirements of EN 1672-2 and the following.

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

— 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.

Components which are in the food area and the design of which, for technical reasons, cannot completely comply with the relevant requirements of EN 1672-2 (e.g. dipstick) shall comply as far as possible. The manufacturer shall define adequate solutions for cleaning and disinfection (see also Clause 7 and for automatic cleaning Annex E).

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

— outside parts of the equipment at the proximity of manholes, and

— other openings where splashing can occur.

The manufacturer shall define the size of this area on a basis of a risk assessment.

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

**5.5.2.1.4** 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.

NOTE Guidance on the selection of materials for food area can be found in CEN/TR 15623.

### 5.5.2.2 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.

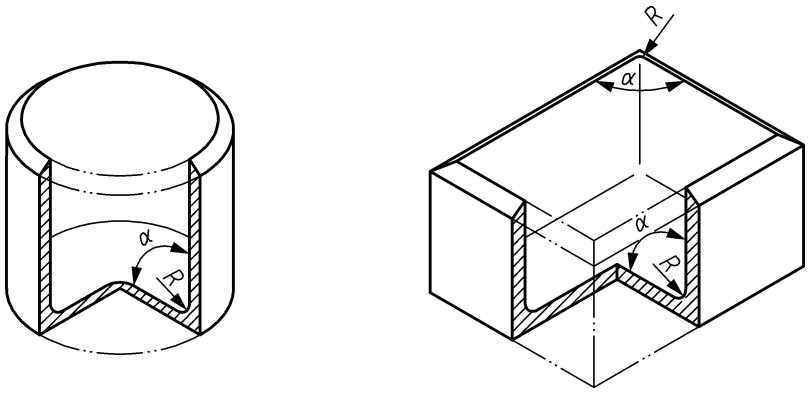
Inner vessel and all attachments which are in, or may come into contact with milk shall:

— be manufactured from austenitic stainless steel or from a material complying with relevant European specifications;

— have a surface roughness $R_a \leq 1$ µm where $R_a$ is as defined by EN ISO 4288;

— use a grade of steel the quality of which shall be at least equivalent to that of stainless steel X5CrNi18-10 (1.4301), as defined in EN 10088-2:2005, especially with regard to suitability for welding and resistance to corrosion.

All inside corners of the inner vessel which form an angle α of less than 2,36 rad (135°) shall have radii *R* not less than 20 mm (see Figure 1). All other corners in the inner vessel shall have radii not less than 3 mm.




**Key**

*R* radius

α angle

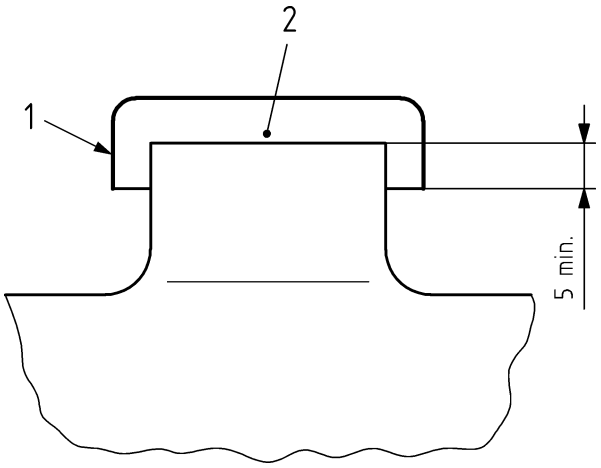
**Figure 1**

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 1,57 rad (90°). All components which are not practical to be welded to the inner vessel shall be fastened so that they can be easily removed for cleaning.

### 5.5.2.3 Openings and lids in connection with the inner vessel

a) The tank shall be provided with at least one opening for inspection having dimensions of at least equivalent to an ellipse of 350 mm × 450 mm. Each opening 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 down turned edges not less than 5 mm high to protect the milk from contamination (see Figure 2).




**Key**

1 lid

2 opening

**Figure 2**

c) Openings and lids shall permit easy and safe inspection of all internal parts of the inner vessel, the milk and also sampling of the milk.

d) On tanks to be cleaned manually, the openings and lids shall be so constructed that all internal parts of the inner vessel can be cleaned easily and safely by hand from outside the tank.

e) Openings and lids shall have all inside corners constructed to provide internal radii of not less than 3 mm.

f) 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.

g) 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 60529:1991.

#### 5.5.2.4 Thermometers

Glass thermometers and thermometers with mercury shall not be used.

#### 5.5.2.5 Agitators

The agitation device shall be so designed and constructed that:

a) shaft seals shall be provided against any contamination of the milk which can enter the inner vessel from outside;

b) material and surface roughness shall comply with 5.5.2.2;

c) corners shall have angles not less than 1,57 rad (90°), welds and corners shall have a 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.

#### 5.5.2.6 Cleaning

The inner vessel shall be designed to be cleanable as defined in 3.5 of EN 1672-2:2005+A1:2009.

If access to the inner vessel is made by manhole, equipment shall be provided for efficient cleaning without entering the vessel. See 5.5.2.7 for criteria for automatic cleaning.

#### 5.5.2.7 Automatic cleaning equipment

The automatic cleaning equipment shall comply with Annex E.

### 5.6 Ergonomics

Covers shall be so designed and constructed that during the opening and closing operations the ergonomic requirements of EN 1005-3 are fully met.

For closed tanks, if the height of the rim of the manhole from the floor is more than 1,35 m, the manufacturer shall provide appropriate means of safe access:

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 platforms height above 1,20 m, platform and step(s) shall be in accordance with EN ISO 14122-2 and EN ISO 14122-3.

If access to the rear inlet is needed by the user, the requirements above shall apply.

## 5.7 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. Then it shall be able to be safely disconnected from electrical supply (see 5.2.2).

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 7.4).

See 5.2.2. The same protective measure may be used for both requirements.

## 5.8 Other general requirements for tanks

### 5.8.1 Temperature resistance

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

### 5.8.2 Inner vessel

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

### 5.8.3 Outer casing

The design of the outer casing shall prevent the ingress of all foreign matter and shall be self-draining.

### 5.8.4 Thermal insulation

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 5.5.1.2.4.

### 5.8.5 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 presenting, under supports, a maximal lowering of 50 mm, in any direction of the lowering.

The distance between the tank and the floor (with the exception of the supports or feet) when installed on a horizontal floor shall be not less than 100 mm.

### 5.8.6 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.

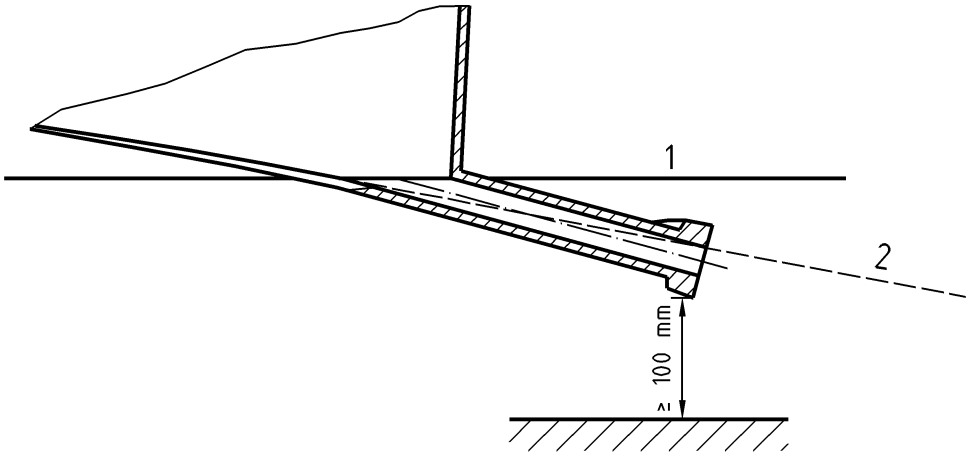
### 5.8.7 Outlet

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, including the outlet valve, shall be lower than an imaginary line continued from the line of the inner vessel (see an example in Figure 3).




**Key**

1 horizontal

2 imaginary line (continued from the line of the inner vessel)

**Figure 3**

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 fitting shall comply with ISO 2852 and ISO 2853. 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 3).

### 5.8.8 Electrical controls

#### 5.8.8.1 Duty selection

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

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 5.8.8.3);

e) cleaning-automatic (if provided): cleaning of the tank by automatic equipment.

#### 5.8.8.2 Periodic timer

To ensure permanently the homogeneity of the milk (see 5.5.1.2.6), a periodic timer shall be fitted to operate the milk agitator for pre-set periods at pre-set intervals of not more than one hour independently from other functions.

#### 5.8.8.3 Timer for sampling

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.

#### 5.8.8.4 Thermometer

Every tank shall be provided with a thermometer, to read the temperature of the milk at any volume between 10 % and 100 % of the rated volume.

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

The instrument shall be capable of withstanding, without any loss in calibration, the temperatures detailed in 5.8.1.

The thermometer shall be in operation for all functions of the duty selection switch(es), however, for function “0” (see 5.8.8.1 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.

### 5.9 Additional requirements for special tanks - Ice bank tanks

#### 5.9.1 Design

An ice bank tank shall be designed so that in the event of a failure in the ice bank control 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 can 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 can operate in compliance with the requirements of 5.9.2 and the tests given in Annex D. 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.

### 5.9.2 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 40 % of one milking and 100 % of the rated volume the ice bank tank shall comply with the requirements of Clause 5.

This control shall ensure that excessive ice cannot form in the chilled water container so as to prevent effective functioning of the equipment.

## 6 Verification and tests

This clause contains the methods of testing for the presence and adequacy of the safety requirements stated in Clause 5. All safety measures of Clause 5 contain self-evident criteria of acceptance.

Verification of the requirements can 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**

| Sub-clauses | Requirement | Verification |
|---|---|---|
| 5.2.1 | Lids and covers | Functional test and visual inspection |
| 5.2.2 | Agitators | Functional test and visual inspection |
| 5.2.3 | Refrigerating system | Check that the refrigerating equipment complies with EN 378–1 and EN 378–2. |
| 5.2.4 | Stability | a) Place the tank in its reference position. Check the overall weight.<br>b) A force of 750 N, applied by a suitable device, shall be applied to the equipment in all accessible positions;<br>c) No tilting of the equipment shall be noticed, when the tank is empty or filled at its rated volume. |
| 5.3 | Avoidance of electrical hazards | Refer to the relevant standard(s) (EN 60204–1 or EN 60335–1) and the complementary requirements in Annexes B or C. |
| 5.4 | Cleaning products and hot water | Visual inspection and functional test |

| | | |
|---|---|---|
| 5.5.1.1 | 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 D.2.1).<br>— Check the accuracy of the thermometer during the performance tests (see D.2.1).<br>— See D.2.1.<br>— Functional test. |
| 5.5.1.2.2 | Milk cooling rate | See D.2.1. |
| 5.5.1.2.3 | Storage of the milk | See D.2.1. |
| 5.5.1.2.4 | Thermal insulation | See D.2.2. |
| 5.5.1.2.5 | Freezing of the milk | See D.2.1.2. |
| 5.5.1.2.6 | Agitation of the milk | See D.2.3. |
| 5.5.1.2.7 | Safe operating temperature | See D.2.1.6 and D.2.1.7. |
| 5.5.2.1 | General | Verification according to Clause 6 of EN 1672–2:2005+A1:2009 |
| 5.5.2.2 | Welds | Examine the quality of the welds visually or by other suitable means. |
| 5.5.2.2 | Bridge or bracket | Visual inspection (drawings; on machinery) |
| 5.5.2.2 | Surface finish | The surface finish by means of a surface roughness measuring device. |
| 5.5.2.2 | Material | Verification of the materials specifications |
| 5.5.2.2 | Radii | Measurement |
| 5.5.2.3 a) to f) | Openings and lids | Check dimension<br>Visual inspection |
| 5.5.2.3 g) | Openings and lids | a) Test the compliance of the protection against the ingress of foreign solid parts inside the tank (as stated in 5.5.2.3 g) using the method indicated in Clause 13 of EN 60529:1991.<br>b) Test the compliance of the protection against the ingress of water inside the tank (as stated in 5.5.2.3 g) using the method indicated in Clause 14 of EN 60529:1991, using an empty and dry tank with lids and covers closed.<br>In order to check the second characteristic number “3”, or eventually “4” use the device described in Figure 5 of EN 60529:1991 (see 14.2.3 b) or 14.2.4 b) of EN 60529:1991).<br>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).<br>No water shall have entered the inner tank. |
| 5.5.2.4 | Thermometers | Visual inspection |

| | | |
|---|---|---|
| 5.5.2.5 | Agitators | a) Visual inspection, drawings;<br>b) Visual inspection, see EN 1672–2;<br>check the distance between the agitator coupling and the maximum milk level. |
| 5.5.2.6 | Cleaning | See Annex C. |
| 5.6 | Ergonomics | See relevant verification in EN 1005–3.<br>Check dimensions of ladder/platform. |
| 5.7 | maintenance | Functional test |
| 5.8.1 | Temperature resistance | Functional tests of the units or critical materials and components |
| 5.8.2 | Inner vessel | — The tank shall be placed in its reference position, at an ambient temperature between + 5 °C and SOT;<br>— before the test commences, the tank shall be cleaned in accordance with the manufacturer instructions;<br>— 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 D.1.1.3;<br>— calculate the ratio $V_r/V_m$ and compare to the limits stated. |
| 5.8.3 | Outer casing | Visual inspection and functional test |
| 5.8.4 | Thermal insulation | See D.2.2. |
| 5.8.5 | Supports and feet | Visual inspection, drawings;<br>Check the distance between the tank and the floor. |
| 5.8.6 | Milk inlet aperture | Visual inspection;<br>Check diameter of milk inlet aperture. |

| | | |
|---|---|---|
| 5.8.7 | Outlet | Visual inspection, drawings;<br>Check the distance between the outlet fitting and the floor;<br>Check the diameter of outlet.<br>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:<br>• ensure that the empty tank is mounted in its reference position;<br>• measure 40 l of TW with a limit deviation of ± 0,1 l and at a temperature of between + 2 °C and + 20 °C and add to the tank;<br>• open the outlet and allow to remain open for 60 s ± 1 s and then close it;<br>• measure, with a limit deviation of ± 0,005 l the volume of TW which discharges from the tank in 5 min ± 0,1 min, when the outlet is again opened. This volume should not be greater than 0,2 l. |
| 5.8.8.1 | Duty selection | Visual inspection and functional tests |
| 5.8.8.2 | Periodic timer | See D.2.1.1.5. |
| 5.8.8.3 | Timer for sampling | See D.2.1.1.5. |
| 5.8.8.4 | Thermometer | See D.2.1.1.5.<br>Check compliance. |
| 5.9.1 | Ice bank tank | See D.2.1.3, D.2.1.5, D.2.1.7 and D.2.1.8. |
| 5.9.2 | Ice bank control | See D.2.1.3, D.2.1.5 and D.2.1.7.<br>The operation of the ice bank control when stopping and starting the condensing unit shall be observed during the performance tests, D.2.1. |

# 7 Information for use

## 7.1 General

Information for use shall be provided according to 6.4 of EN ISO 12100:2010 and with additional information as required in the present clause.

## 7.2 Warning signs

At least the following specific safety signs shall be provided:

a) A waterproof label adjacent to the manhole stating the following:

“Before entering the tank:

— Isolate the tank electrically and take the complementary precautions as described in the instruction handbook!

Before closing the cover:

— It must be checked that nobody is in the tank!”

b) Where relevant, a warning sign for hot surface temperature (see 5.4 and Figure 4):

**Figure 4 — Warning sign ISO 7010 - W017: Warning; Hot surface**

c) If the risk of contact with hazardous cleaning products cannot be completely excluded by design, appropriate warning signs (depending on the specific products and the process).

The safety signals shall comply with EN 61310-1.

In general, specific warning devices are not required.

## 7.3 Instruction handbook for the user

The instruction handbook shall meet the requirements and advice of 6.4.5 of EN ISO 12100:2010. The following specific information shall be included.

a) details of general construction, including dimensions and the mass;

b) identification of the major components;

c) detailed operational guide, including an explanation of any marking using a symbol;

d) details of any user maintenance required together with frequency;

e) the limits that shall be respected and the measures to be taken for ensuring stability during use, transportation, assembly, dismantling when out of service, testing or foreseeable breakdowns;

f) The instruction handbook (and any sales literature describing the performances of the machine) shall contain the following information on airborne noise emissions, determined and declared in accordance with Annex A of this European Standard:

   1) the A-weighted emission sound pressure level at workstations, where this exceeds 70 dB(A); where this level does not exceed 70 dB(A), this fact shall be indicated;

   2) the peak C-weighted instantaneous sound pressure value at workstations, where this exceeds 63 Pa (130 dB in relation to 20 µPa);

3) the A-weighted sound power level emitted by the machinery, where the A-weighted emission sound pressure level at workstations exceeds 80 dB(A).

Whenever sound emission values are indicated, the uncertainties "*K*" surrounding these values shall be specified. The operating conditions of the machinery during measurement and the measuring methods used shall be described;

g) information on how to deal with a breakdown;

h) safety precautions concerning the significant hazards as e.g.:

1) cleaning products handling;

2) recommendation about the cleaning products to be used and not to be used;

3) unexpected start-up;

i) safety precautions for maintenance and similar interventions, and for exceptional cases when the user needs to enter the inner vessel:

1) measures for bringing the equipment to zero energy state:

i) disconnect the machine from all the energy sources;

ii) precautions against unintended reconnection;

iii) neutralisation of residual energy (e.g. capacitors);

iv) verification of the safe state;

2) information on means to get into the tank and to get out of the tank in safe and easy conditions (e.g. a ladder);

3) means for ensuring the safety of the intervention itself (including the use of protective extra low voltage (PELV) where relevant).

j) elements of training to be given to operators;

k) draw attention for arrangements to be made by the user to ensure that the cards giving instructions for daily check list for operation and milk collection are made available to the operator.

## 7.4 Instructions check list

### 7.4.1 Instructions check list for day to day operation

The manufacturer shall supply a card with simple and clear instructions, at the time the tank is installed, detailing the safe operational and effective cleaning procedures required.

The above instructions shall include at least the following:

— mode of operation, including inspection requirements prior to commencement of milking;

— the limits that shall be respected and the measures to be taken for ensuring stability during use, transportation, assembly, dismantling when out of service, testing or foreseeable breakdowns;

— method of tank cleaning, including details of chemicals and maximum/minimum cleaning water temperatures recommended by the manufacturer, together with recommended quantities.

This card shall be durable and waterproof and shall be placed either on the tank or near the tank in a prominent position.

### 7.4.2 Instructions check list for milk collection

The user at the time the tank is installed shall be supplied with a card giving simple and clear instructions detailing the correct collection procedure to be followed to ensure accurate and rapid milk collection. When the tank is equipped with an automatic cleaning system, a clear procedure to start the system shall be indicated. This card shall be durable and water proof and shall be placed either on the tank or near the tank in a prominent position.

## 7.5 Installation and maintenance instructions

A warning shall indicate that it is essential to stop and isolate the agitator before entering the inner vessel.

The installer shall be supplied with a set of instructions detailing the correct installation, handling and maintenance procedures.

The following information shall be supplied:

a) the information detailed on the main components;

b) the limits that shall be respected and the measures to be taken for ensuring stability during use, transportation, assembly, dismantling when out of service, testing or foreseeable breakdowns;

c) the information detailed on the tank data plates/labels;

d) the information detailed on the electrical equipment for protection against electric shock in accordance with Clause 6 of EN 60204-1:2006;

e) installation conditions and specifications of the supply disconnecting device in accordance with 5.3 of EN 60204-1:2006 (if not integrated into the machine). This device shall be installed near the machine at a height over 1,7 m from the floor, and marked with the indication of the protected machine. This device shall be lockable unless it is a plug/socket combination visible from the maintenance operating points;

f) information on equipotential bonding;

g) if the tank is fitted with a time clock for the control of the condensing unit(s), instruction for programming it;

h) safety precautions before entering the inner vessel:

    1) measures for bringing the equipment to zero energy state:

        i) disconnect the machine from all the energy sources;

        ii) precautions against unintended reconnection;

        iii) neutralisation of residual energy (e.g. capacitors);

        iv) verification of the safe state.

    2) information on means to get into the tank and to get out of the tank in safe and easy conditions (e.g. a ladder);

i) information on how to move the tank into the required position;

j) information on any special requirements that have to be carried out prior to the installation of the tank, i.e. floor plates, drains, doorways. This information shall also be supplied to the farmer to enable the necessary work to be carried out prior to the installation:

1) that sufficient clearance is provided around the tank to allow the outer casing to be periodically cleaned in accordance with hygiene regulations. A clearance of 500 mm is recommended;

2) that the head room above the tank or platform is sufficient to permit the user and tanker driver to carry out their duties safely and without difficulty. A head clearance of not less than 2 m above any platform is recommended;

k) details on how to level the tank to the required slope;

l) special requirements on sitting the condensing units and sitting/sizing of refrigerant pipework, if not covered by EN 378 (all parts);

m) layout schematics, including the refrigeration system;

n) electrical wiring diagrams and/or schematics;

o) details of the water supply requirements necessary to ensure correct operation of the cleaning system;

p) details of the required procedures for checking the tank cooling and cleaning systems;

q) trouble shooting charts detailing the most common faults likely to occur and the recommended correction procedures.

## 7.6 Dismantling instructions

The user and installer shall be supplied with a set of instructions, at the time the tank is installed detailing the procedures required to allow the tank and all associated components to be safely dismantled.

For refrigerating systems, see EN 378-1, EN 378-2, EN 378-3,and EN 378-4.

## 7.7 Minimum marking

**7.7.1** All individual electrical components shall be provided with data plates/labels permanently secured to the components. The data shall allow individual identification of the components.

**7.7.2** The tank shall be fitted with data plates/labels carrying at least the following information:

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

— designation of the machinery;

— designation of series or type, if any;

— serial or identification number, if any;

— tank serial number;

— tank model and type code;

— mandatory marking[2)];

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

2) For machines and their related products intended to be put on the market in the EEA, CE marking as defined in the applicable European Directive(s), e.g. Machinery.

— rated volume expressed in litres;

— relevant performance classes as specified in Clause 5;

— designation number of the refrigerant in accordance with Annex E of EN 378-1:2008+A2:2012;

— refrigerant charge in kilograms;

— maximum allowable pressure, on high and low pressure side of the refrigerating system;

— rated voltage;

— rated frequency;

— full load current (see Clause 18 of EN 60204-1:2006).

These tank data plates/labels may also carry the additional markings as specified by other standards, particularly electrical safety, and the Machinery Directive.

**7.7.3** The tank shall be permanently marked with the individual serial number as noted in 7.7.2. The marking shall be adjacent to the manhole or normal inspection position, on a permanent part of the body of the tank or inner vessel and carried out in digits not less than 4 mm high.

**7.7.4** The main controls of the tank and cooling system shall be marked so that it is obvious how the equipment is to be operated. If symbols are used their meaning shall be explained in the main instructions.

# Annex A
(normative)

# Noise test code (Grade 2 of accuracy)

## A.1 General

**A.1.1** This noise test code applies to bulk milk coolers as defined in Clause 1 and 3.1 of this European Standard.

**A.1.2** This annex provides all the information necessary to carry out efficiently and under standardized conditions the determination, declaration and verification of noise emission values of bulk milk coolers as defined in Clause 1 and 3.1 of this European Standard.

**A.1.3** The use of this Annex A ensures the reproducibility of the noise emission values determined by the grade of accuracy of the applied basic noise emission measurement standards. Methods for the determination of these noise emission values according to this normative annex are engineering methods (grade 2 of accuracy).

## A.2 Emission sound pressure level determination

**A.2.1** The A-weighted emission sound pressure level shall be measured in accordance with either:

— EN ISO 11201, grade 2, or

— EN ISO 11202 aiming at grade 2 of accuracy. Assuming that the dominant source is identifiable, 5.2 of EN ISO 11202:2010 shall be used".

NOTE In cases where the environment is close to a free field, EN ISO 11201 is the preferred method.

The measurement time shall be more than 15 s.

**A.2.2** A path around the machine shall be defined as follows: a parallelepiped surface defined according to EN ISO 3744 with a distance of 1 m from the reference box enveloping the bulk milk cooler and at a height of (1,55 ± 0,075) m above the floor lying in the relevant plane of the enveloping surface.

On this path, the noisiest position shall be identified for both operating conditions. The highest A-weighted emission sound pressure level obtained at that position shall be given in the noise emission declaration (see A.8).

In case of bulk milk coolers with remote cooling unit, measurement shall be applied on each part (cooling unit and vessel).

## A.3 Mounting conditions

The bulk milk cooler shall be installed and tested on a plane reflecting floor in a test environment following the requirements of EN ISO 11201:2010, grade 2.

If a semi-anechoic room providing an approximately free field is not available, the measurements can also be carried through outdoors at open sites which consist of a hard flat ground surface with no sound reflecting objects within a distance from the source equal to three times the greatest distance from the source centre to the measurement points.

## A.4 Operating conditions

The A-weighted emission sound pressure level shall be measured under two different operating conditions:

1) cooling duty with all the motors of the condensing unit and agitators operating during the test;

2) cleaning duty with the cleaning pump operating.

The highest of the two measured A-weighted emission sound pressure levels shall be used for the noise emission declaration (see A.8).

## A.5 Measurement uncertainties

The total measurement uncertainty of the emission sound pressure level determined according to this standard is dependent on the standard deviation $\sigma_{R0}$ given by the applied noise emission measurement method EN ISO 11201:2010, grade 2 and the uncertainty associated with the instability of the operating and mounting conditions $\sigma_{omc}$. The resulting total uncertainty is then calculated from:

$$\sigma_{tot} = \sqrt{\sigma_{RO}^2 + \sigma_{omc}^2}$$

The upper bound value of $\sigma_{R0}$ is about 1,5 dB for the grade 2 measurement method, assuming a noise source which emits sound without significant tones. This value applies for the determination of the emission sound pressure level.

NOTE 1 For machines with a rather constant noise emission, a value of 0,5 dB for $\sigma_{omc}$ can apply. In other cases, e.g. a large influence of the material flow into and out of the machine or material flow that varies in an unpredictable manner, it is possible that a value of 2 dB is more appropriate. Methods to determine $\sigma_{omc}$ are described in the basic measurement standards.

The expanded measurement uncertainty *U*, in decibels, shall be calculated from

$U = k \cdot \sigma_{tot}$,

where

*k* is the coverage factor.

NOTE 2 The expanded measurement uncertainty depends on the degree of confidence that is desired. For the purpose of comparing the result with a limit value, usually the coverage factor for a one-sided normal distribution is applied. In that case, the coverage factor $k$ = 1,6 corresponds to a 95 % confidence level. Further information is given in EN ISO 4871. Please note that the expanded measurement uncertainty U is denoted as *K* in EN ISO 4871.

NOTE 3 The expanded measurement uncertainty as described in this European Standard does not include the standard deviation of production which is used in EN ISO 4871 for the purpose of making a noise declaration for batches of machines.

## A.6 Information to be recorded

The information to be recorded covers all of the technical requirements of this noise test code and shall comply with the requirements of EN ISO 11201:2010, grade 2. Any deviations from the noise test code and/or from the basic noise emission measurement standards used are to be recorded together with the technical justification for such deviations.

## A.7 Information to be reported

The information to be included in the noise test report is that which the manufacturer requires to prepare a noise declaration or the user requires to verify the declared values.

As a minimum, the following information shall be included:

— identification of the manufacturing company, of the machine type, model, serial number and year of manufacture;

— reference to the basic noise emission measurements standard used;

— description of the operation and installation conditions during the measurement;

— location of the microphone positions;

— noise emission values obtained.

It shall be confirmed that all requirements of the noise test code have been fulfilled, or, if this is not the case, any unfulfilled requirements shall be identified. Deviations from the requirements shall be stated and technical justification for the deviations shall be given.

## A.8 Declaration and verification of the noise emission values

**A.8.1** The declaration of the noise emission value shall be made as a dual number noise emission declaration according to EN ISO 4871.

It shall declare the noise emission values $L_{pA}$ and the respective uncertainty $K_{pA}$ according to 7.3.

The noise emission value shall be rounded to the nearest decibel.

**A.8.2** The noise declaration shall state that the declared values have been obtained according to this noise test code. If this statement is not true, the noise declaration shall indicate clearly what the deviations are from this noise test code and/or from the basic standard used. Reference of the basic measurement standard used shall be given in the declaration.

If undertaken, verification shall be done according to EN ISO 4871 by using the same mounting, installation and operating conditions as those used for the initial determination of noise emission values.

NOTE 1 Additional noise emission values can be given in the declaration.

NOTE 2 The uncertainty $K_{pA}$ is expected to have a value of 2,5 dB.

The declaration should appear as in Table A.1:

**Table A.1 — Example of dual-number declaration for noise emission values**

| **Machine Model Number, operating conditions, and other identifying Information:**<br><br>Type 990, Model 11-TC, 50 Hz, 230 V, rated load |
|---|
| **DECLARED DUAL-NUMBER NOISE EMISSION VALUES**<br>in accordance with EN ISO 4871<br>— Measured A-weighted emission sound pressure level $L_{pA}$ (ref. 20 µPa) in decibels……...75 [a]<br>— Uncertainty $K_{pA}$, in decibels……2 [a]<br>— Operating conditions: cooling and cleaning duty<br>— Position of the microphone: see the instruction handbook<br>Values determined according to noise test code given in Annex A of EN 13732:2013, using the basic standard EN ISO 11201:2010, grade 2. |
| NOTE The sum of a measured noise emission value and its associated uncertainty represents an upper boundary of the range of values which is likely to occur in measurements. |
| [a] Value only given as an example. |

# Annex B
(normative)

# Electrical requirements for bulk milk coolers according to EN 60204-1:2006

## B.1 Safety requirements related to electromagnetic phenomena

The machines shall have sufficient immunity to electromagnetic disturbances to enable them to operate safely as intended and not fail to danger when exposed to the levels and types of disturbances intended by the manufacturer.

The manufacturer of the machines shall design, install and wire the equipment and sub-assemblies taking into account the recommendations of the suppliers of these sub-assemblies.

## B.2 Protection against electric shock

The electrical equipment shall comply with Clause 6 of EN 60204-1:2006.

If this electrical equipment is not integrated to the machine, the instruction handbook shall be precise and clearly state the conditions of installation (see 7.5).

For the degrees of protection see B.9.

## B.3 Ambient air temperature

Refer to the temperatures stated in 5.8.1 of this standard. See also EN 60204-1:2006, 4.4.3.

## B.4 Supply disconnecting device

A supply disconnecting device in accordance with EN 60204-1:2006, 5.3, shall be provided.

If this device is not integrated to the machine, the instruction handbook shall be precise and clearly state the conditions of installation (see 7.5).

## B.5 Power circuits

Devices for detection and interruption of over-current have to be applied to each live conductor in compliance with EN 60204-1:2006, 7.2.3. In case of single phase machines, no such device is required for the earthed neutral conductor.

## B.6 Overload protection of motors

For each motor rated at more than 0,5 kW, protection against motor overload (see EN 60204-1:2006, 7.3) shall be provided unless an analysis of the equipment design and its foreseeable operating conditions determine that such protection is not necessary.

## B.7 Control circuit supply

Transformers are not mandatory for the control circuit supply (see EN 60204-1:2006, 9.1.1) of the tanks.

## B.8 Emergency stop devices

An emergency stop device (see EN 60204-1:2006, 10.7) is not necessary. In this case particular attention shall be given to the accessibility of the normal supply disconnecting device.

## B.9 Degrees of protection

The protection classes shall comply with a minimum degree of IPX4 according to EN 60529 and EN 60204-1.

## B.10 Markings of control equipment

The markings of control equipment (see EN 60204-1:2006, 16.4) shall be in accordance with 7.7.

# Annex C
(normative)

# Electrical requirements for bulk milk coolers according to EN 60335-1:2002

## C.1 General

If EN 60335-1:2002 is chosen as reference standard, electrical equipment and tests shall comply with EN 60335-1:2002 with the following additions/modifications.

## C.2 Normal operation

See 3.1.9 of EN 60335-1:2002.

The normal operation of a bulk milk cooler shall be as follows:

a) For appliances having a direct cooling system, the tank is filled with water at (35 ± 1) °C up to:

   1) 50 % of its rated volume, for tanks for two milkings;

   2) 25 % of its rated volume, for tanks for four milkings or more.

b) For appliances having an indirect cooling system, the cooling medium container is filled with a medium having a temperature of (20 ± 1) °C up to the level indicated; the milk tank is empty and the agitator and water pump are in operation.

## C.3 General conditions for the tests

See Clause 5 of EN 60335-1:2002.

The tests of Clauses 10, 11, 13 and 19 of EN 60335-1:2002 shall be carried out at the safe operating temperature.

## C.4 Classification

See Clause 6 of EN 60335-1:2002.

In addition to the requirements of Clause 6 of EN 60335-1:2002, appliances shall be at least IPX4.

## C.5 Input and current

**C.5.1** See Clause 10 of EN 60335-1:2002.

Instead of determining the mean value, see 10.1 of EN 60335-1:2002, the maximum value of power input shall be determined, the effect of inrush currents being ignored.

**C.5.2** Instead of determining the mean value, see 10.2 of EN 60335-1:2002, the maximum value of the current is determined, the effect of inrush currents being ignored.

## C.6 Heating

**C.6.1** See Clause 11 of EN 60335-1:2002.

The appliance shall be placed in free air in the centre of the testing room.

**C.6.2** As 11.7 of EN 60335-1:2002 is not applicable to the bulk milk coolers, the following requirements apply:

— Appliances having a direct cooling system are operated for one milking cycle, any milk temperature thermostat being adjusted to the lowest setting, with a minimum milk storage temperature of approximately 3 °C.

— Appliances having an indirect cooling system are operated until the cooling system stops by its own control device.

— Appliances incorporating a cleaning system are, in addition, operated for one cycle with the controls adjusted to provide the highest cleaning temperature.

**C.6.3** In addition to the requirements of 11.8 of EN 60335-1:2002, the temperature rise limits shall be reduced by:

— 7 K, for appliances of class A;

— 3 K, for appliances of class B.

The temperature of windings and the enclosure of motor compressors, other than those complying with EN 60335-2-34, shall not exceed the values shown in Table C.1:

**Table C.1 – Temperature limits of motor compressors**

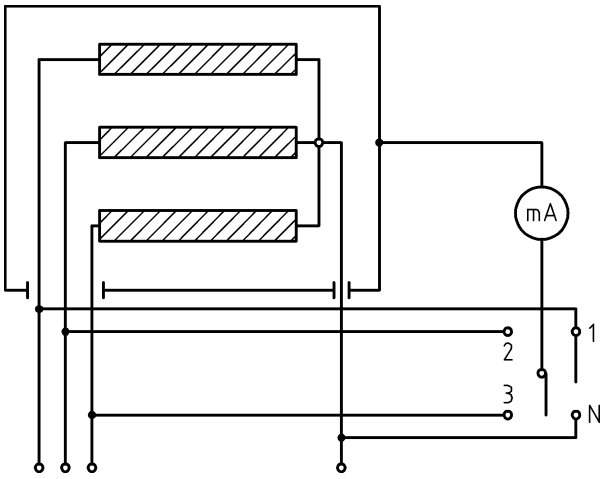
| **Part** | **Temperature** °C |
|---|---|
| Windings | 140 |
| - synthetic insulation | 130 |
| - cellulose and similar insulation | 150 |
| External enclosure | |

## C.7 Leakage current and electric strength at operating temperature

See Clause 13 of EN 60335-1:2002.

As the fourth and fifth paragraphs of 13.2 of EN 60335-1:2002 are not applicable to the bulk milk coolers, the following requirements apply.

For three-phase appliances, the measuring circuit indicated on Figure C.1 shall apply.




**Key**

| | |
|---|---|
| 1, 2, 3 and N | positions of the switch |
| mA | milliampere |

The leakage current is measured in mA between any pole of the supply and accessible metal parts connected together.

**Figure C.1**

The appliance is not earthed. The leakage current is measured between any pole of the supply and accessible metal parts connected together.

## C.8 Moisture resistance

**C.8.1** See Clause 15 of EN 60335-1:2002.

For IPX4 appliances, apply 14.2.4b of EN 60529:1991 instead of 14.2.4a (see 15.1 of EN 60335-1:2002).

**C.8.2** As 15.2 of EN 60335-1:2002 is not applicable to the bulk mil coolers, the following requirements apply. The additional quantity of liquid is equal to 1 % of the volume of the container, the minimum quantity for the milk tank being 10 l. Water pumps and fans are then operated for a period of 2 min.

NOTE The spillage test is carried out only in case of doubt.

**C.8.3** In addition to the requirements of 15.3 of EN 60335-1:2002, the following precision shall be taken into account for the bulk milk coolers.

If it is not possible to place the appliance in the humidity cabinet, electrical parts are tested separately.

## C.9 Abnormal operation

**C.9.1** See Clause 19 of EN 60335-1:2002.

Instead of the tests specified for appliances incorporating motors (see 19.1 of EN 60335-1:2002), compliance is checked as follows:

— for compressor-type appliances, by a locked-rotor test on a separate motor-compressor under the conditions specified in EN 60335-2-34, unless the motor-compressor complies with EN 60335-2-34;

— for appliances having a condenser fan motor, by the test of C.9.3;

— for appliances having other motors, by the test of 19.7 of EN 60335-1:2002.

The temperature of the motor enclosure shall not exceed 150 °C.

**C.9.2** In addition to the requirements of Clause 19 of EN 60335-1:2002, the following requirements apply to bulk milk coolers.

Appliances shall be constructed so that they shall not cause any risk of fire, mechanical hazard or electric shock even in the case of abnormal operation.

Compliance is checked by applying any defect which may be expected in normal use, while the appliance is operated under conditions of normal operation at rated voltage. Only one fault condition is reproduced at a time. The tests are made consecutively.

NOTE 1 Examples of fault conditions are:

a) disconnection and reconnection of one or more phases of the supply during:

   1) cooling operation;

   2) cleaning operation;

b) open-circuiting or short-circuiting of components as:

   1) milk thermostat;

   2) pressure switches;

   3) magnetic valve (for water or refrigerant);

c) cooling operation without milk (or TW) inside the tank;

d) cleaning operation without water (water supply taps closed).

In general, tests are limited to those cases which may be expected to give the most unfavourable results.

NOTE 2 For the purpose of these tests, thermal controls are not short-circuited.

NOTE 3 Components incorporated in the appliance complying with the relevant IEC standard are not short-circuited, provided the appropriate standard covers the conditions which occur in the appliance.

During and after the tests, compliance is checked as described in 19.13 of EN 60335-1:2002.

**C.9.3** The locked-rotor test of condenser fan motors of the bulk mill coolers shall be as follows:

The windings of a fan motor shall not reach excessive temperatures if the motor locks or fails to start.

Compliance is checked by the following test.

The fan and its motor are mounted on wood or similar material. The motor rotor is locked. Fan blades and motor brackets are not removed.

The motor is supplied at rated voltage, the supply circuit being as shown in Figure C.2. Temperatures are measured as specified in EN 60335-1:2002, 11.3.

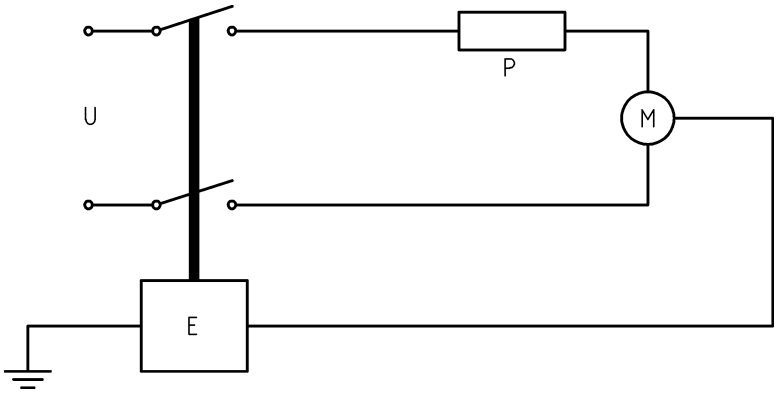
The test is carried out for 15 d (360 h) or until the motor protector has operated 2 000 times, whichever takes longest. The test is terminated if a non-self-resetting protective device operates. If the temperature of the motor windings does not attain 90 °C, the test is terminated when steady conditions are established.

During the test, enclosure and winding temperatures shall not exceed the values given in EN 60335-1:2002, Table 8.

The motor shall withstand the electric strength test of EN 60335-1:2002, 16.3 after the test has been carried out for 72 h.

At the end of the test, the leakage current is measured between the windings and the enclosure when twice the rated voltage is applied. It shall not exceed 2 mA.

NOTE A residual current device with a rated residual current of 30 mA is connected to disconnect the supply in the event of an excessive earth leakage current.




**Key**

U supply
M fan motor
P thermal motor protector (external or internal), if fitted
E residual current device

**Figure C.2 — Supply circuit for the locked-rotor test of condenser fan motors**

## C.10 Stability and mechanical hazards

Clause 20 of EN 60335-1:2002 is not applicable to bulk milk coolers.

## C.11 Mechanical strength

Clause 21 of EN 60335-1:2002 is not applicable to bulk milk coolers.

## C.12 Supply connection and external flexible cords

**C.12.1** See Clause 25 of EN 60335-1:2002.

Bulk milk coolers shall not incorporate an appliance inlet (see 25.1 of EN 60335-1:2002).

**C.12.2** Supply cords shall not be lighter than heavy polychloroprene sheathed flexible cord (code designation 60245 IEC 66) (see 25.7 of EN 60335-1:2002).

**C.12.3** In addition to the requirements of 25.23 of EN 60335-1:2002, the following requirements apply to bulk milk coolers.

The cables connecting different components on the appliance are not considered as interconnection cords. They shall not be lighter than ordinary polyvinyl chloride sheated cord (code designation 60227 IEC 53).

The cables used for connecting different split sub-assemblies are considered as interconnection cords. They shall not be lighter than heavy polychloroprene sheathed flexible cord (code designation 60245 IEC 66) (see 25.7 of EN 60335-1:2002).

## C.13 Provision for earthing

See Clause 27 of EN 60335-1:2002.

In addition to the requirements of 27.2 of EN 60335-1:2002, the following requirements apply to bulk milk coolers.

Separate parts of appliances shall incorporate a terminal for the connection of an equipotential bonding conductor. This terminal shall be in contact with all exposed metal parts of the appliance. It shall be located so that the conductor can be connected after installation of the appliance.

Small exposed metal parts, for example nameplates, are not required to be in electrical contact with the equipotential bonding terminal.

## C.14 Creepage distances, clearances and solid insulation

See Clause 29 of EN 60335-1:2002.

In addition to the requirements of 29.2.1 of EN 60335-1:2002, the following requirements apply to bulk milk coolers.

The microenvironment is pollution degree 3 unless the insulation is enclosed or located so that it is unlikely to be exposed to pollution during normal use of the appliance.

## C.15 Resistance to heat and fire

See Clause 30 of EN 60335-1:2002.

30.2.2 of EN 60335-1:2002 is not applicable to bulk milk coolers.

# Annex D
(normative)

# Test for cooling, thermal insulation, mixing tests

## D.1 General

### D.1.1 Accuracy on measurements

#### D.1.1.1 Ambient temperature

The limit deviation on ambient temperature measurements shall be ± 0,5 °C.

#### D.1.1.2 Milk or TW temperature

The limit deviation on milk or TW temperature measurements shall be ± 0,4 °C.

#### D.1.1.3 Volume

The limit deviation on the volume measurements of each milking shall be ± 0,5 %.

#### D.1.1.4 Other measurements

When no other requirement is specified in this standard, all the measurements shall be processed with a limit deviation of ± 1,5 % of the measuring amplitude.

### D.1.2 Frequency of measurements

#### D.1.2.1 Temperature measurements

One (or more) recording system(s) shall be used. The time between two measurements of the same point shall not be greater than 2 min, and the time of each measurement shall be recorded.

#### D.1.2.2 Other measurements

The measurements of any other parameter shall be processed periodically, at least once every 10 min.

At least eight measurements have to be processed during the cooling time of any milking.

### D.1.3 Ambient temperature

#### D.1.3.1 General

Temperatures shall be measured with temperature probes having a thermal mass smaller than or equivalent to the one of sensors inserted in the centre of tinned solid copper or brass cylinders having a mass of 25 g and of minimum external area (diameter = height = approximately 15 mm).

The ambient temperature is the temperature in the space surrounding the tank and is the arithmetical average of the mean value of the temperatures measured at the four measurement points.

#### D.1.3.2 Temperature in front of the condenser

The temperature at each point measured shall remain constant within ± 2 °C throughout the period of the test. The mean of the temperatures measured shall remain equal to the specified ambient temperature within ± 1 °C throughout the test.

#### D.1.3.3 Temperature around the tank

The temperatures measured shall at no point be lower than the specified temperature.

#### D.1.3.4 Location of measuring points

For the tank, halfway up the outer casing, at a distance of 100 mm ± 10 mm from the tank walls, evenly spaced out over the tank periphery.

For the air cooled condenser, at a distance 300 mm ± 10 mm, from the surface of the condenser and evenly spaced out over its intake area.

#### D.1.3.5 Number of measuring points

Tank: not less than one at each side wall of the tank with a minimum total of four.

Air cooled condenser: in front of each condenser, not less than one per square metre of the intake surface area, with a minimum of two and a maximum of six points.

### D.1.4 Air movement

The tank and condensing unit shall be sited within the test area so that the velocity of air through the condensing unit shall not be influenced by external factors.

The velocity of air touching the outer wall of the tank, the condensing unit being inoperative, shall not exceed 1 m/s.

### D.1.5 Temperature of the milk or TW

The TW temperature shall be measured with three sensors within the tank:

— one sensor is placed at less than 40 mm from the outlet of the inner tank;

— one sensor is placed so that it is immersed at the low volume first milking test (see D.2.1.2 or D.2.1.3);

— one sensor is movable so that at each milking test (including the low volume and the thermal insulation test), it is immersed between 50 mm and 100 mm.

### D.1.6 Electricity supply

The supply voltage shall be within ± 5 % of that stated in the instructions for use.

The frequency shall be the nominal frequency within ± 1 %.

## D.2 Performance tests

### D.2.1 Milk cooling tests

#### D.2.1.1 General

##### D.2.1.1.1 Location of the tank

Locate the tank in its reference position and condensing unit in a room in which the ambient temperature is maintained at the value chosen for the particular test:

— PT: Performance temperature;

— SOT: Safe Operating Temperature;

— or + 5 °C.

#### D.2.1.1.2 Temperature of the tank

The tank shall be maintained at an ambient temperature corresponding to the test temperature for at least 2 h (soak period) prior to the commencement of the particular test.

#### D.2.1.1.3 Condition of the tank

Before the tests commence the tank shall be cleaned in accordance with the manufacturer's instructions.

#### D.2.1.1.4 Procedures

The general procedures for the cooling performance tests are shown in Figures D.1 and D.2.

#### D.2.1.1.5 Checking of controls

Periodic timer: - Check the timing of this control during the tests of D.2.1.4 or D.2.1.5.

Timer for sampling: - Check the operation of this control for compliance with 5.8.8.3.

Thermostat:

— check that this control will keep the TW temperature, between cooling periods, not higher than + 4 °C, during the tests D.2.1.2 to D.2.1.5;

— check that this control will withstand the temperatures detailed in 5.8.1 during the cleaning tests as specified in Annex E;

— check that the overriding switch for manual operation of cooling and agitation operates.

Thermometer:

— check that the thermometer is capable of reading the temperature at any volume between 10 % and 100 % during the tests of D.2.3;

— check that the thermometer will withstand the temperatures detailed in 5.8.1 during the cleaning tests as specified in Annex E;

— check that the thermometer is in operation for all functions of the duty selection switch(es);

— check the accuracy of the thermometer as detailed in 5.8.8.4 during the tests of D.2.1.4 and D.2.1.5.

### D.2.1.2 Low volume - first milking test: direct cooling tanks

#### D.2.1.2.1 General

— Test ambient temperature: PT

It is necessary throughout the period of these tests, to inspect and check with the aid of wooden stick or similar device, at appropriate intervals of not more than 5 min, to ascertain if any freezing of the TW is taking place.

**D.2.1.2.2** Load into the inner vessel a quantity of TW equal to 40 % of one milking:

— two milkings tanks: $V_r \times 0,2$;

— four milkings tanks: $V_r \times 0,1$;

— six milkings tanks: $V_r \times 0,067$.

**D.2.1.2.3** When the TW has been added, and is at a temperature of + 35°C or 23°C (in case of pre-cooled milk), note the time and commence cooling under automatic thermostatic control.

**D.2.1.2.4** When the TW reaches a temperature of + 4°C note the time, but continue cooling until the thermostat switches the cooling off. Again note the time, mixed TW temperature and check if any freezing has taken place.

**D.2.1.2.5** Allow the equipment to operate under automatic control for a test period of 3 cycles of the thermostat or 6 h, whichever is the shorter. During the cycling of the tank on the thermostat, note the cut-out and cut-in temperatures. After this time period note the final mixed TW temperature.

**D.2.1.2.6** During the above test if there is ice, then the equipment fails to satisfy the requirements. Furthermore it is necessary to check that the cut-in and cut-out temperatures are consistent, if not then the tests shall be repeated.

— Test ambient temperature: + 5 °C.

**D.2.1.2.7** Repeat the tests of D.2.1.2.2 to D.2.1.2.4 at ambient temperature + 5 °C.

**D.2.1.2.8** Repeat the test of D.2.1.2.7 once more.

**D.2.1.2.9** If there is no ice for both tests D.2.1.2.7 and D.2.1.2.8, then the equipment satisfies the requirements.

If there is ice for both tests D.2.1.2.7 and D.2.1.2.8, then the equipment fails to satisfy the requirements.

If there is ice for one of these tests D.2.1.2.7 and D.2.1.2.8, carry out a third test. Should ice still form during this third test then the equipment fails to satisfy the requirement.

**D.2.1.2.10** If an automatic device is fitted in order to control the cooling duty to prevent freezing occurring on the evaporator, check that freezing is not taking place just before the device operates.

### D.2.1.3 Low milk volume/ice build test - Ice bank tanks

#### D.2.1.3.1 General

— Test ambient temperature: PT

**D.2.1.3.2** With the ice bank filled at its maximum quantity of ice monitored by the ice bank control programmed as specified by the manufacturer, load into the inner vessel a quantity of TW equal to 40 % of one milking.

**D.2.1.3.3** When the TW has been added and is at a temperature of + 35 °C or 23°C (in case of pre-cooled milk), note the time and commence cooling and ice rebuilding under automatic control.

**D.2.1.3.4** When the TW reaches a temperature of + 4 °C note the time, but continue cooling until the thermostat switches off. Note the time and mixed TW temperature again.

**D.2.1.3.5** Allow the condensing unit(s) to operate under ice-bank control until the ice-bank controller switches off. Note the time.

**D.2.1.3.6** During the above, allow the TW to be under thermostatic control.

**D.2.1.3.7** Load into the inner vessel a further quantity of TW equal to 40 % of a milking at a temperature of + 35 °C.

**D.2.1.3.8** When the TW has been added, note the time and commence cooling and ice building under automatic control.

**D.2.1.3.9** When the TW reaches a temperature of + 4 °C note the time, but continue cooling until the thermostat switches off. Note the time and mixed TW temperature again.

**D.2.1.3.10** Allow the condensing unit(s) to operate under automatic ice-bank control until the ice-bank controller switches off. Note the time and mixed TW temperature. Switch off the condensing unit(s).

**D.2.1.3.11** For a 4 milkings tank repeat the tests of D.2.1.3.7 to D.2.1.3.10 twice more. For a 6 milkings tank repeat the tests of D.2.1.3.7 to D.2.1.3.10 four times.

**D.2.1.3.12** Discharge the TW load and inspect the ice-bank for even ice building.

**D.2.1.3.13** Evaluation of results:

**D.2.1.3.13.1** Check that the ice-building times are similar for all the ice rebuilding. Any variation from the average time of more than 20 % shall be interpreted as a failure of the equipment to comply with the requirements of 5.9.2.

**D.2.1.3.13.2** Check that the ice-bank has rebuilt evenly over the evaporator. If any ice blocking appears, leading for instance to a decreased water flow, then the equipment shall have been deemed to have failed the requirements of 5.9.2.

NOTE It might be necessary to remove the inner vessel during these examinations.

### D.2.1.4 Milk cooling test - Direct cooling tanks

#### D.2.1.4.1 General

First and last milkings at performance temperature: PT.

The standard test procedure includes only the test for a first and a last milking.

If the tank includes the operation of more than one condensing unit operating in sequence, then it might be necessary to carry out additional cooling tests at volumes just before the operation of a second or subsequent condensing unit. During these tests, check the operational periods of the periodic timer for agitator. The accuracy of the thermometer should be ascertained during these tests.

#### D.2.1.4.2 Reference test: test n°1 - first milking

**D.2.1.4.2.1** After cleaning the tank and leaving for the soak period ($T_{10}$) i.e. 2 h (see Figure D.1), load into the inner vessel a quantity of test water (TW) equal to a first milking.

**D.2.1.4.2.2** When the TW has been added, and is at a temperature of + 35 °C or 23°C (in case of pre-cooled milk), note the time and kWh-metre reading ($E_0$) and commence cooling under automatic thermostatic control.

**D.2.1.4.2.3** When the TW reaches a temperature of + 4 °C note the time.

kWh-metre reading ($E_1$) may be noted, but only for information.

**D.2.1.4.2.4** Continue cooling until the thermostat switches the cooling off and mixed TW temperature ($\theta_2$).

kWh-metre reading ($E_2$) may be noted, but only for information.

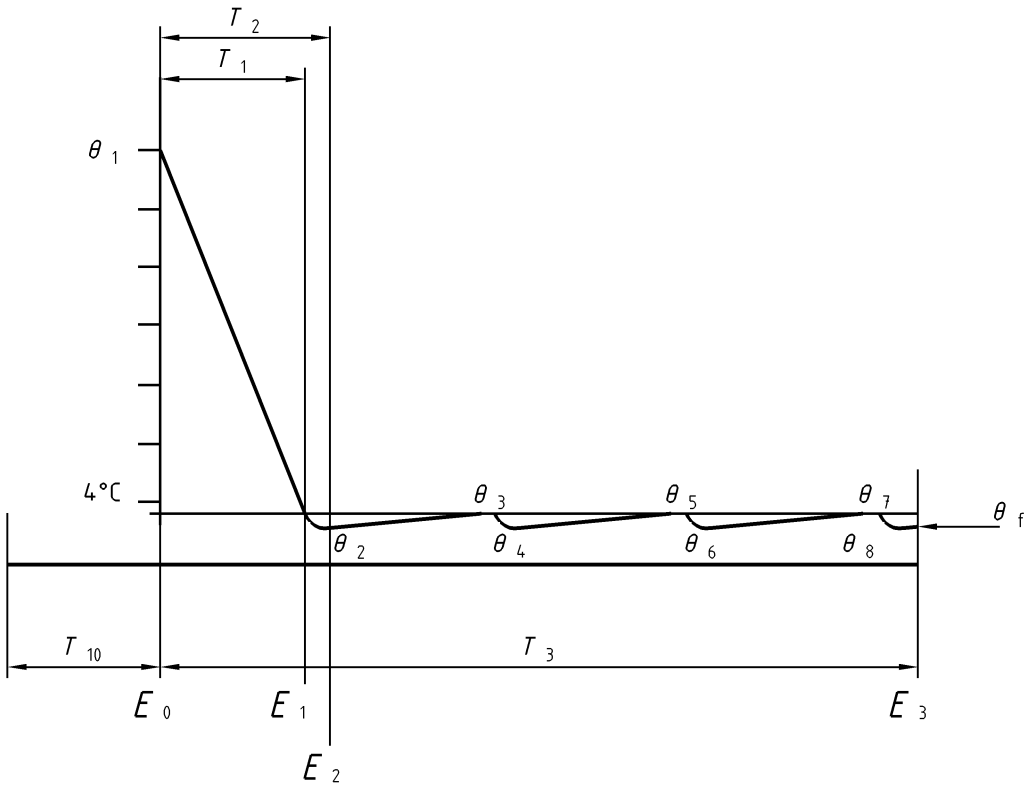
**D.2.1.4.2.5** Allow the equipment to operate for a period of $T_3$ (12 h). After this time period, note the kWh-metre reading ($E_3$) and final mixed TW temperature ($\theta_f$).

### D.2.1.4.3 Reference test: test n°2 - last milking

**D.2.1.4.3.1** Fill the inner vessel to 100 % rated volume with TW at a temperature such that the mixed temperature is as in Table D.1:

**Table D.1**

| Classification according to number of milkings (5.5.1.2.1.2) | Non pre-cooled milk | Pre-cooled milk |
|---|---|---|
| 2 milkings tank | + 19,5 °C | + 13,5 °C |
| 4 milkings tank | + 11,8 °C | + 8,8 °C |
| 6 milkings tank | + 9,2 °C | +7,2 °C |




**Key**

| | |
|---|---|
| $T_1$ | is the time to cool milking from IT to 4 °C |
| $T_2$ | is the time to cool milking from IT to cut-out of the milk cooling thermostat |
| $T_3$ | is the time of complete test |
| $T_{10}$ | is the soak period (2 h) |
| $\theta_1$ | is the initial TW temperature at the commencement of each cooling test |
| $\theta_2$, $\theta_4$, $\theta_6$, $\theta_x$ | is the TW temperature at each cut-out of the milk cooling thermostat |
| $\theta_3$, $\theta_5$, $\theta_7$, $\theta_x$ | is the TW temperature at each cut-in of the milk cooling thermostat |
| $\theta_f$ | is the TW temperature at time $T_3$ |
| $E_0$, $E_1$, $E_2$, $E_3$ | is the kWh-metre reading at times $T_0, T_1, T_2, T_3$ |

**Figure D.1 — Test procedure – direct cooling tanks**

**D.2.1.4.3.2** When the TW quantity and temperature have been adjusted as per D.2.1.4.3.1, note the time and kWh-metre reading ($E_0$) and commence cooling under automatic thermostatic control.

**D.2.1.4.3.3** Check that no TW is discharged from the inner vessel by overflowing during this test.

**D.2.1.4.3.4** When the TW reaches a temperature of + 4 °C note the time.

kWh-metre reading ($E_1$) may be noted, but only for information.

**D.2.1.4.3.5** Continue cooling until the thermostat switches the cooling off. Note the time, and mixed TW temperature ($\theta_2$).

kWh-metre reading ($E_2$) may be noted, but only for information.

**D.2.1.4.3.6** Allow the equipment to operate for a period of 12 h; $T_3$. Note the kWh-metre reading ($E_3$) and final mixed TW temperature ($\theta_f$).

#### D.2.1.4.4 Reference test: test n°1 and test n°2 - Energy consumption calculations

##### D.2.1.4.4.1 General

Calculate the energy consumption for each milking cooling test as below (expressed in Wh.).

**D.2.1.4.4.2** First milking (D.2.1.4.2.1 to D.2.1.4.2.5):

Calculate the energy consumption ($E_{ci}$) for the TW cooling and storage period $T_3$ as follows:

$$E_{ci} = E_3 - E_0$$

**D.2.1.4.4.3** Last milking (D.2.1.4.3.1 to D.2.1.4.3.6):

Calculate the energy consumption ($E_{cl}$) for the TW cooling and storage period $T_3$ as follows:

$$E_{cl} = E_3 - E_0$$

**D.2.1.4.4.4** Calculate the total specific energy consumption $E_t$ expressed in (Wh/l) for the tank as follows:

$E_t$ = $(E_{ci} + E_{cl})$ x Number of milkings/(Rated volume × 2)

#### D.2.1.4.5 Confirmation test: test n°3 - First milking and test n°4 - Last milking

Repeat stages D.2.1.4.2.1 to D.2.1.4.2.3 and D.2.1.4.3.1 to D.2.1.4.3.4.

Should the cooling times obtained from the two tests satisfy the milk cooling time classification and they are within 10 min of each other, then the equipment satisfies the requirements.

### D.2.1.5 Milk cooling test - Ice bank tanks

#### D.2.1.5.1 General

See Figure D.2.

During these tests, check the operational periods of the periodic timer for the agitator.

The accuracy of the thermometer should be ascertained during these tests.

#### D.2.1.5.2 Initial preparation work

**D.2.1.5.2.1 General**

— Test ambient temperature: PT

**D.2.1.5.2.2** After cleaning the tank, allow the tank to soak (see D.2.1.1.2).

**D.2.1.5.2.3** Starting with an ice-water compartment filled with water at PT ± 5 °C to the overflow or the manufacturers recommended level.

**D.2.1.5.2.4** Switch off the milk cooling system (all pumps and blowers associated with the milk cooling operation).

**D.2.1.5.2.5** Commence operation of the condensing unit(s) on ice-bank control. Note the time and kWh-metre reading - ($E_{10}$).

**D.2.1.5.2.6** When the condensing unit(s) switch off under ice-bank control, wait for two hours and start the test as described in D.2.1.5.3.

**D.2.1.5.3 Reference test: test n°1 - First milking**

**D.2.1.5.3.1 General**

— Test ambient temperature: PT

**D.2.1.5.3.2** With the ice-bank filled at its maximum quantity of ice monitored by the ice bank control programmed as specified by the manufacturer, wait for 2 h and load into the inner vessel a quantity of TW equal to a first milking.

**D.2.1.5.3.3** When the TW has been added, and is at a temperature of + 35 °C or 23°C (in case of pre-cooled milk), note the time and kWh-metre reading ($E_{11}$) and commence cooling and ice-building under automatic control.

**D.2.1.5.3.4** When the TW reaches a temperature of + 4 °C note the time ($T_1$).

kWh-metre reading ($E_1$) may be noted, but only for information.

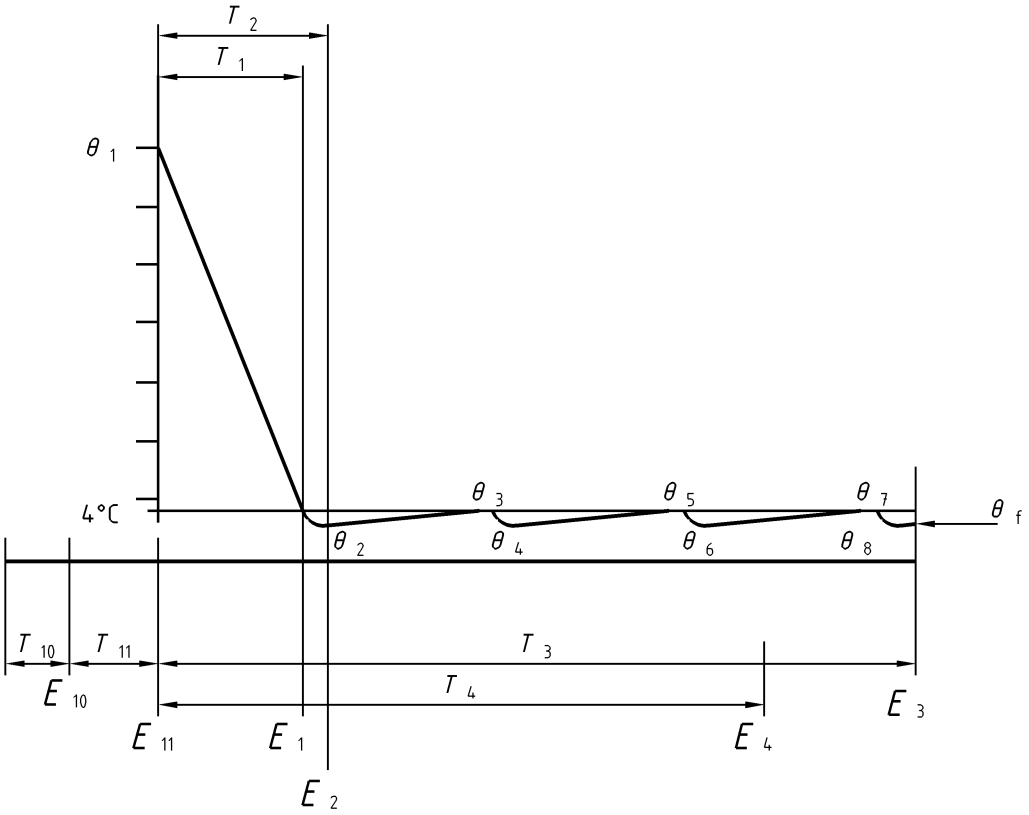
**D.2.1.5.3.5** Continue cooling of the TW until the thermostat switches off the cooling. Note the time ($T_2$), and the TW temperature ($\theta_2$).

kWh-metre reading ($E_2$) may be noted, but only for information.

**D.2.1.5.3.6** Allow the condensing units to run until the ice-bank controller switches off. Note the time ($T_4$). Allow the condensing unit(s) to continue to operate under automatic control.

kWh-metre reading ($E_4$) may be noted, but only for information.

**D.2.1.5.3.7** Allow the TW within the inner vessel to be controlled by the thermostat and the condensing unit(s) to be controlled by the ice-bank controller, for a period of 12 h ($T_3$) then switch off. Note the kWh-metre reading ($E_3$).




**Key**

$T_1$ is the time to cool milking from IT to + 4 °C

$T_2$ is the time to cool milking from IT to cut-out of the milk cooling thermostat

$T_3$ is the time of complete test

$T_4$ is the condensing unit operating time

$T_{10}$ is the soak period (2 h)

$T_{11}$ is the initial ice-build-up time

$\theta_1$ is the initial TW temperature at the commencement of each cooling test

$\theta_2$, $\theta_4$, $\theta_6$, $\theta_x$ is the TW temperature at each cut-out of the milk cooling thermostat

$\theta_3$, $\theta_5$, $\theta_7$, $\theta_x$ is the TW temperature at each cut-in of the milk cooling thermostat

$\theta_f$ is the TW temperature at time $T_3$

$E_{10}$, $E_{11}$ is the kWh-metre reading $T_{10}$, $T_{11}$

$E_1$, $E_2$, $E_3$, $E_4$ is the kWh-metre reading at time $T_1$, $T_2$, $T_3$, $T_4$

**Figure D.2 — Test procedure – ice bank tanks**

#### D.2.1.5.4 Reference test: test n°2: last milking

##### D.2.1.5.4.1 General

— Test ambient temperature PT

**D.2.1.5.4.2** With a full ice bank, fill the inner vessel to 100 % rated volume with TW such that the mixed temperature is as in Table D.2:

**Table D.2**

| Classification according to number of milkings (5.5.1.2.1.2) | Non pre-cooled milk | Pre-cooled milk |
|---|---|---|
| 2 milkings tank | + 19,5 °C | + 13,5 °C |
| 4 milkings tank | + 11,8 °C | + 8,8 °C |
| 6 milkings tank | + 9,2 °C | +7,2 °C |

**D.2.1.5.4.3** When the TW quantity and temperature have been adjusted as per D.2.1.5.4.2, note the time and kWh-metre reading ($E_{11}$) and commence cooling under automatic thermostatic control.

**D.2.1.5.4.4** When the TW reaches a temperature of + 4 °C note the time.

kWh-metre reading ($E_1$) may be noted, but only for information.

**D.2.1.5.4.5** Continue cooling the TW until the thermostat switches off. Note the time, and the final mixed TW temperature.

kWh-metre reading ($E_2$) may be noted, but only for information.

**D.2.1.5.4.6** Allow the condensing unit(s) to run until the ice-bank controller switches off. Note the time ($T_4$). Allow the condensing units to continue to operate under automatic control.

kWh-metre reading ($E_4$) may be noted, but only for information.

**D.2.1.5.4.7** Allow the TW within the inner vessel to be controlled by the thermostat and the condensing units to be controlled by the ice-bank control, for a period of 12 h ($T_3$), then switch off. Note the kWh-metre reading ($E_3$).

**D.2.1.5.5 Reference test: test n°1 and test n°2 - Energy consumption and operating time calculations**

**D.2.1.5.5.1 General**

Calculate the energy consumption for the cooling tests as follows and express in Wh/l.

**D.2.1.5.5.2** First milking: calculate the energy consumption ($E_{c1}$) for the TW storage period to $T_3$ for the first milking as follows:

$$E_{c1} = (E_3 - E_{11})$$

**D.2.1.5.5.3** Last milking calculate the energy consumption ($E_{c2}$) for the TW storage period to $T_3$ for the last milkings as follows:

$$E_{c2} = (E_3 - E_{11})$$

**D.2.1.5.5.4** Calculate the total specific energy consumption ($E_t$) expressed in Wh/l for the tank as follows:

$$E_t = (E_{c1} + E_{c2}) \times \text{Number of milkings}/(\text{Rated volume} \times 2)$$

**D.2.1.5.5.5** Condensing unit operating time:

For each milking test calculate $T_4$, which shall be less than 9 h.

**D.2.1.5.6 Confirmation test: test n°3 - First milking and test n°4 - Last milking**

Repeat stages D.2.1.5.3 to D.2.1.5.4 and D.2.1.5.5.

Should the cooling times obtained from the two tests satisfy the milk cooling time classification and they are within 10 min of each other and the ice-bank rebuilding times are less than 9 h and within 30 min of each other, then the equipment satisfies the requirements.

#### D.2.1.6 First milking test at SOT - Direct cooling tanks

##### D.2.1.6.1 General

— Test ambient temperature: SOT

**D.2.1.6.2** Load into the inner vessel a quantity of TW equal to a first milking.

**D.2.1.6.3** When the TW has been added, and is at a temperature of + 35 °C or 23°C (in case of pre-cooled milk), note the time and commence cooling under automatic thermostatic control.

**D.2.1.6.4** When the TW reaches a temperature of + 4 °C note the time.

**D.2.1.6.5** Continue cooling until the thermostat cuts the cooling off. Note the time and final mixed TW temperature.

**D.2.1.6.6** The time to cool the TW to + 4 °C in the above test shall not exceed the specified cooling time as given in Table 2 by more than + 25 %.

#### D.2.1.7 First milking test at SOT - Ice bank tanks

**D.2.1.7.1** Fill the ice-water compartment to the overflow device or manufacturers recommended level, with water at + 2 °C.

**D.2.1.7.2** Switch off the milk cooling system (all pumps and blowers associated with the milk cooling operation).

**D.2.1.7.3** Note the time and commence running the condensing unit(s) on automatic ice-bank control.

**D.2.1.7.4** When the condensing unit(s) switch off under ice-bank control note the time.

**D.2.1.7.5** Load into the inner vessel a quantity to TW equal to a first milking.

**D.2.1.7.6** When the TW has been added and is at a temperature of + 35 °C or 23°C (in case of pre-cooled milk), note the time and commence cooling under automatic thermostatic control, start the condensing unit(s) under automatic ice-bank control.

**D.2.1.7.7** When the TW reaches a temperature of + 4 °C note the time.

**D.2.1.7.8** Continue cooling until the thermostat cuts the cooling off. Note the time and final mixed TW temperature.

**D.2.1.7.9** Allow the condensing unit(s) to run until the ice-bank control cuts the unit(s) off. Note the time.

**D.2.1.7.10** The time to cool the TW to 4 °C in the above test shall not exceed the specified cooling time as given in Table 2 by more than + 25 %.

In addition the operating time of the condensing unit(s) shall not exceed 11 h.

#### D.2.1.8 Failure of the ice-bank control

##### D.2.1.8.1 General

— Test ambient temperature: + 5 °C

**D.2.1.8.2** Ensure that the inner vessel is empty.

**D.2.1.8.3** Fill the ice-water compartment with water at + 2 °C.

**D.2.1.8.4** Connect the contacts of the ice-bank controller together to ensure that only this control is put out of action.

**D.2.1.8.5** Start the condensing unit(s) operating and allow to remain in operation for not less than 2 days or until ice-water is frozen or until the operation of the condensing unit(s) is stopped by the operation of an ancillary safety device, whichever is the sooner.

**D.2.1.8.6** Check if the inner vessel or outer casing has suffered any damage, if so, then the equipment shall have been deemed to have failed the requirements of 5.8.2.

**D.2.1.8.7** Melt the ice and check the condition of the tank construction.

**D.2.1.8.8** Operate the condensing unit(s) and check that it (they) is (are) still capable of operating satisfactory and that the duty has not deteriorate.

### D.2.2 Thermal insulation test

#### D.2.2.1 Location of the tank

Locate the tank in a room in which the ambient temperature is maintained at the PT.

The tank shall be placed in its reference position.

**D.2.2.2** The tank and all ancillary equipment, including the condensing unit(s), shall be maintained at the PT for at least 12 h prior to the commencement of the test.

**D.2.2.3** Fill the inner vessel to 100 % rated volume with TW at a temperature of + 4 °C ± 0,5 °C.

**D.2.2.4** With an ice bank tank also fill the ice-water compartment with water at + 4 °C.

**D.2.2.5** Just prior to the commencement of the test, agitate the contents of the inner vessel, and in the case of an ice bank tank, the ice-water compartment. Note the time and mixed water temperatures. Should the mixed temperatures be greater than + 4,5 °C, then reduce them to + 4 °C ± 0,5 °C before commencing the test period.

**D.2.2.6** For the next 12 h the tank and all ancillary equipment shall be isolated from the electricity supply.

**D.2.2.7** After 12 h, agitate the TW, and in the case of an ice bank tank, the ice-water compartment, for 2 min. Note the final mixed temperatures.

**D.2.2.8** The temperature rise of the TW in the inner vessel and the water in the ice water compartment shall not exceed + 3 °C over the test period of 12 h.

### D.2.3 Milk mixing tests

**D.2.3.1** The milk shall be sampled in accordance with the guidelines set out in Annex F.

**D.2.3.2** Fill the tank to 100 % rated volume with milk as defined in 5.5.1.2.6.

**D.2.3.3** Agitate the milk for a period of 2 min.

**D.2.3.4** Take samples of the milk, in accordance with the guidelines set out in Annex F.

**D.2.3.5** Store the milk for a period of 60 min, without any agitation or cooling.

**D.2.3.6** Agitate the milk for a period of 2 min, for tanks designed for continuous agitation for a period of 10 min.

**D.2.3.7** Take samples of the milk in accordance with the guidelines set out in Annex F.

**D.2.3.8** Repeat the test with the inner vessel filled to 10 % rated volume.

**D.2.3.9** If there is an indication that there may be incomplete agitation at an inner vessel volume different to 100 % and 10 %, then carry out a test at this volume.

**D.2.3.10** During these milk mixing tests check that there is no formation of froth or butter.

**D.2.3.11** If a tank is fitted with a continuous agitation system, the samples shall be taken 10 min after the 60 min standing period.

In addition the tank shall be left to operate in a normal manner for a period of 6 h to ensure that froth or butter are not formed.

# Annex E
(normative)

# Test for cleanability and cleaning performance

## E.1 Introduction

This normative annex describes a standard test for the assessment of the cleanability and cleaning performance of a tank with automatic cleaning equipment.

## E.2 Definitions and steps for the test

**E.2.1** Standardized soiling procedure: soiling with naturally coagulated raw milk.

**E.2.2** Cleaning: cleaning by automatic cycle according to the manufacturer's instructions in the instruction handbook.

**E.2.3** Evaluation of cleaning results: evaluation for the cleaning of the inner surfaces of the refrigerated milk tank and other specified parts of the tank e.g. outlet, agitator and dipstick which includes:

a) an examination of chemical residues (see E.12);

b) a visual inspection using a bright light (see E.8 and E.10);

c) a measurement of the residual bacterial pollution:

   1) for the tank outlet:

      i) by rinse procedure (see E.9.2);

   2) for internal surfaces and equipment two methods are used:

      i) by rinsing procedure (see E.9.3.1);

   and

      ii) by swabbing procedure (see E.9.3.2).

**E.2.4** The criteria for acceptable cleanability when assessed by this annex are as follows:

a) chemical residues: less than acceptable concentration;

b) milk residues: not detectable;

c) bacterial contamination:

   1) tank outlet: 100 000 colony forming units per millilitre (cfu/ml) of rinse water;

   2) tank surfaces: 100 000 colony forming units per square metre (cfu/$m^2$).

## E.3 Installation of the tank to be tested

### E.3.1 Connection and installation of the tank in its reference position

**E.3.1.1** Install the tank in its reference position according to the instruction handbook (see 7.4).

**E.3.1.2** Connect the tank to the water(s) supply according to the instruction handbook (see 7.4). Install a device in order to allow samples of the water(s) feeding the tank.

**E.3.1.3** Check the real dimension of the internal surface of the tank.

**E.3.1.4** Measure the exact volume of the cooler outlet drainage pipe, as follows:

— install the measuring equipment as described in G.1.1;

— ensure that the pinchcock is closed and that the outlet valve of the tank is opened;

— fill the volume of the outlet with water (as far as the upper edges of the outlet inside the tank);

— close and open the outlet valve, if any, to make this measurement very precise;

— open the pinchcock and collect the water;

— record this volume ($V_1$).

### E.3.2 First automatic cleaning cycle

**E.3.2.1** Carry out the automatic cleaning cycle according to the instruction handbook (see 7.2 and 7.4.2) once.

**E.3.2.2** When the automatic cleaning cycle is running, make a full check to see that it operates in accordance with the manufacturer's instructions/operating manual with respect to the following details:

— initial rinses: number and volume of rinses;

— wash stage: detergent concentration, volume of wash solution, wash temperature (initial and final) and time and duration of wash cycle;

— intermediate rinses: number and volume;

— disinfection stage: volume, concentration and contact time;

— final rinses: number and volume of rinses.

**E.3.2.3** Measure the volumes of water(s) with a limit deviation of ± 5 %.

### E.3.3 After a complete automatic cleaning cycle

After the complete automatic cleaning cycle, leave the tank at rest with all the covers and outlets opened until the beginning of the soiling procedure as described in E.5, at least 12 h.

## E.4 Preparation of soiling milk (solution A)

**E.4.1** Use bulk raw whole milk of the following composition:

Fat with a mass fraction of ≥ 3,2 %;

Protein with a mass fraction of ≥ 3,0 %.

NOTE The mass fraction is the number of grams of solute (solid) in 100 g of product.

**E.4.2** Add to the milk with a volume fraction of 1,5 % of a volume fraction of 0,1 % of bromocresol purple.

NOTE 1 The volume fraction is the number of millilitres of solute in 100 ml of product.

NOTE 2 The volume fraction is the number of grams of solute (solid) in 100 ml of product.

**E.4.3** Incubate at 30 °C until its colour changes to clear yellow (pH 4,6).

**E.4.4** Prepare a quantity of the solution A of at least 0,5 l/m$^2$ of the internal surfaces of the tank to be tested, with a minimum of 4 l in any case, increased by the necessary quantity to feed the spraying pump.

**E.4.5** Take a sample for bacteria counting (cfu/ml) of the solution A (see E.11.1).

**E.4.6** Store the solution A at + $4^{\,0}_{-2}$ °C until required time for soiling to the internal tank surfaces (maximum storage time: 24 h).

## E.5 Soiling of the tank

**E.5.1** Use one of the sterilised spraying equipment as described in G.2.1.

**E.5.2** Close the outlet and switch on the agitator.

**E.5.3** Spray the solution A continuously on all the parts of the internal surfaces with the peristaltic pump. If complete and even coverage is not obtained, collect the solution A through the outlet and re-spray the tank areas which are still not soiled. Spray the solution A three times maximum.

**E.5.4** Stop the agitator. Open the outlet to allow the remaining of the solution A to drain from the tank. Collect this drained solution (solution B).

**E.5.5** Take a sample for bacteria counting (cfu/ml) of the solution B (see E.11.1), in order to make sure that bacteria are still alive.

**E.5.6** Close all the covers/openings except the outlet which remains opened.

**E.5.7** Leave the solution A in contact with the tank internal surfaces for 4 h $^{+0,5}_{\;\;0}$ h.

## E.6 Automatic cleaning of the tank

**E.6.1** Carry out the automatic cleaning cycle according to the instruction handbook (see 7.3) using one of the manufacturer's recommended products or product combinations (see E.3.2.2).

**E.6.2** In the case when the instruction handbook sets out a postponed disinfection, this disinfection will be done according to the instruction handbook just after the end of the automatic cleaning cycle.

**E.6.3** Prepare a reference solution(s), as follows:

**E.6.4** To prepare a reference solution for the automatic cleaning cycle, solution $L_1$, mix products or product combinations used for the automatic cleaning cycle with the water(s) used for the automatic cleaning cycle in the same proportion as automatically done during the cleaning cycle (to obtain the "wash solution", see E.3.2.2). For the volume of solution $L_1$ to prepare, see E.12.3.1.

**E.6.5** To prepare a reference solution for the postponed disinfection, if any, solution $L_2$, mix products or product combinations used for the postponed disinfection with the water(s) used for the postponed disinfection in the same

proportion as automatically done during the postponed disinfection. For the preparation of the volume of solution $L_2$, see E.12.3.2.

## E.7 Tank rest phase

Leave the tank at rest during 16 h ± 1 h after the cleaning cycle.

## E.8 Visual assessment of internal tank surfaces and equipment

**E.8.1** Carry out a visual assessment carefully, avoiding any contact or contamination which can affect subsequent microbiological evaluation.

**E.8.2** Inspect all internal tank surfaces using a bright light source, noting the presence of any areas having visible residues of soil deposits.

**E.8.3** Note in the test report the location of trace(s), if any.

**E.8.4** Complete this examination after the swabbing procedure, see E.10.

## E.9 Taking method for bacteriological examinations

### E.9.1 Solutions and equipment used for bacteriological examinations

#### E.9.1.1 Solutions and equipment used for the rinsing method

**E.9.1.1.1** Use the required equipment which is described in Annex E. Sterilise all the laboratory equipment used to sample and to prepare the solutions, for 15 min at 121 °C.

**E.9.1.1.2** Prepare the following solution $S_1$, as follows:

**E.9.1.1.2.1** Prepare a volume $V_2$ of distilled or de-ionised water which shall be the addition of:

— the volume $V_1$ required to fill the outlet (see E.3.1.4);

— the volume required to be sprayed on each part of the internal surfaces of the tank (calculated with the rate of 0,5 l/m$^2$);

— the volume provided to prime and rinse the pump;

— the volume to prepare the dilution of solutions $L_1$ and $L_2$ (see E.12.3);

— the volume used for the swabs (see E.9.3.2.1).

**E.9.1.1.2.2** Mix with $V_2$ a neutralising buffer solution in the following proportions (quantities are given in grams per litre):

| | |
|---|---|
| Monopotassium phosphate: | 0,042 5 |
| Sodium thiosulphate: | 0,16 |
| Polyoxyethylene sorbitan monooleate ($C_{12}H_{10}ClNO_3$): | 5 |
| Sodium hydroxide: | 0,008 |

Suitable commercial preparation allowing the preparation of this solution by dissolving the preparation in distilled or de-ionised water should be used.

**E.9.1.1.2.3** Mix also $V_2$ with the necessary number of Ringer tablets in order to get a Ringer solution diluted at one quarter which is equivalent to the following ingredients (quantities are given in grams per litre):

| | |
|---|---|
| sodium chloride: | 2,250 |
| potassium chloride: | 0,106 |
| anhydrite calcium chloride: | 0,120 |
| sodium hydrogen-carbonate: | 0,050 |

**E.9.1.1.2.4** Sterilise the solution $S_1$ for 15 min at 121 °C.

### E.9.1.2 Equipment used for the swabbing method

Use the required equipment which is described in G.2.2. Sterilise all the laboratory equipment used to swab and to prepare solutions, for 15 min at 121 °C.

### E.9.2 Assessment of the tank outlet

**E.9.2.1** Separate the tank outlet pipe from the cleaning system and fit the equipment as described in G.1, ensuring the pinchcock is closed and the outlet is opened.

**E.9.2.2** Pour the volume $V_1$ (see E.3.1.4) of sterile solution $S_1$ into the outlet. Allow the solution $S_1$ to stand inside the outlet for 30 min and during this time if there is an outlet valve in this part of the system, close it and open it once.

**E.9.2.3** Open the pinchcock and collect the rinse (solution $F_1$) in a suitable sterile container. Mix it.

**E.9.2.4** Take a sample for bacteria counting (cfu/ml) of the solution $F_1$ (see E.11.1).

### E.9.3 Assessment of the internal tank surfaces and equipment

#### E.9.3.1 General

This assessment shall be done by two different methods: by rinsing method and by swabbing method.

#### E.9.3.2 Rinsing method

**E.9.3.2.1** Remove the equipment used for the assessment of the tank outlet. Leave the outlet open. Install a suitable container in order to collect all sprayed water (see E.9.3.2.3) via the outlet.

**E.9.3.2.2** Use the second sterilised spraying equipment as described in G.2.1.

**E.9.3.2.3** Run the peristaltic pump to spray solution $S_1$. Leave at least 2 l ± 0,5 l of the solution $S_1$ flowing as far as its required rate. Take a sample of this sprayed solution for bacteria counting (solution $S_2$), in order to be sure that the solution $S_1$ is not polluted by the spraying equipment (see E.11.1 for the storage of the solution $S_2$).

**E.9.3.2.4** Open the manhole and spray the solution $S_1$ continuously on all parts of the internal tank surfaces and equipment with the peristaltic pump.

**E.9.3.2.5** Note the total volume of solution $S_1$ sprayed into the tank (named $V_3$).

**E.9.3.2.6** Leave the tank at rest 5 min time.

**E.9.3.2.7** Note the volume (named $V_4$) of the collected rinse solution (solution $F_2$). Mix it.

**E.9.3.2.8** Take a sample for bacteria counting (cfu/ml) of the solution $F_2$ (see E.11.1).

**E.9.3.2.9** Take a sample of at least 50 ml of solution $F_2$ for chemical examination.

**E.9.3.3 Swabbing method**

**E.9.3.3.1** Put inside each test tube with swab, as specified in G.2.2.1, 5 ml of solution $S_1$. Apply the plastic mask on provided location (see G.2.2.2).

**E.9.3.3.2** Extract the swab from the test tube containing the solution $S_1$, eliminate the excessive solution $S_1$ by pushing the swab against the internal wall of the test tube and by twisting the swab in the air, to obtain a wet swab.

**E.9.3.3.3** Press the swab on the surface to be tested, in the free area of the plastic mask. Move the swab from one side to the opposite forming parallel lines, on the whole surface to be tested. Avoid rotation with the swab. More than one way on the same line is not necessary.

**E.9.3.3.4** Use the opposite face of the swab and press it on the same surface. Move the swab from one side to the opposite forming parallel lines angled 90° to the lines formed in E.9.3.3.4.

**E.9.3.3.5** Put the swab back to its test tube and shake it by hand in order to mix the potential bacterial pollution with the neutral solution $S_1$.

**E.9.3.3.6** Repeat the same procedure on the seven provided locations, as defined in G.2.2.2.

**E.9.3.3.7** Take a sample for bacteria counting (cfu/ml) of each of the solution in the test tubes, designated solution $G_1$ to $G_7$ (see E.11.1 for the storage of these solutions).

## E.10 Visual assessment of internal tank surfaces and equipment

**E.10.1** Enter into the tank after the rinsing and swabbing operations. Inspect all internal tank surfaces using bright light source noting the presence of any areas having visible residues of soil deposits.

**E.10.2** Record the place of the traces, if any. Take swabs on these areas.

## E.11 Bacteriological examination

**E.11.1** Store each sample for bacteria counting (samples of solution $A$, $B$, $F_1$, $F_2$, $G_1$ to $G_7$ and $S_2$) in ice water until tested inside a period of maximum 24 h after the sample.

**E.11.2** Shake 20 times each sample.

**E.11.3** Prepare a diluent containing peptone 1 g and sodium chloride 8,5 g for 1 000 ml of water. Sterilise the diluent at 121 °C for 15 min.

**E.11.4** Prepare for each sample dilution to 1/10 and a dilution to 1/100 using the diluent prepared in E.11.3.

**E.11.5** Plate in triplicate 1 ml of each sample and 1 ml of each dilution of each sample in milk plate count agar. Use only sterile equipment to transfer solutions.

**E.11.6** Add a suitable quantity of the following nutritional environment, mixed at 45 °C, inside each plate:

| | |
|---|---|
| Yeast: | 2,5 g |
| Truptone: | 5,0 g |

Glucose: 1,0 g

Skimmed milk powder: 1,0 g

Agar-agar: 15,0 g

Water for 1 000 ml of solution.

**E.11.7** Leave the plates incubated at (30 ± 1) °C for (72 ± 2) h.

**E.11.8** Count colonies inside each plate. If less than the quarter of the surface of the plate is covered by intrusive colonies, count colonies on the part with non-intrusive colonies and calculate the corresponding number for the whole plate. If more than the quarter of the plate is covered by intrusive colonies, do not take this plate into account.

**E.11.9** Use the result of plates containing between 10 colonies and 300 colonies. Calculate the number of microorganisms per millilitre as follows:

$$\frac{\sum C}{1 \cdot n_1 + 0{,}1 \cdot n_2 + 0{,}01 \cdot n_3 \cdot d}$$

where

*C* is the number of intrusive colonies counted on the plate

$n_1$ is the number of counted plate for the original solution;

$n_2$ is the number of counted plate for solution with dilution 1/10;

$n_3$ is the number of counted plate for solution with dilution 1/100;

*D* is the dilution from the first obtained counting.

**E.11.10 Rinsing method**

Determine the final result per square metre of internal surface of the tank by determining the ratio between the number of microorganisms inside the total volume of the sprayed solution and the whole internal surface of the tank which has been sprayed.

**E.11.11 Swabbing procedure**

Determine the final result per square metre of internal surface of the tank by determining the ratio between the number of microorganisms inside the solutions $G_1$ to $G_7$ and the surface under test.

## E.12 Chemical examination

**E.12.1** Use a pH metre of 1/100 reading.

**E.12.2** Measure the pH of the solution $F_2$.

**E.12.3** Prepare reference solutions, as follows:

**E.12.3.1** Mix solutions $S_1$ and $L_1$ in order to obtain the following concentration of solution $L_1$:

— a volume fraction of 1 % of the solution $L_1$;

— a volume fraction of 0,5 % of the solution $L_1$;

— a volume fraction of 0,3 % of the solution $L_1$;

— a volume fraction of 0,2 % of the solution $L_1$;

— a volume fraction of 0,1 % of the solution $L_1$.

**E.12.3.2** Measure the pH for each of these different concentrations in order to obtain a curve to read the concentration of $L_1$ (volume fraction) according to the pH.

**E.12.3.3** Do the same operation for the solution $L_2$.

## E.13 Interpretation of results

### E.13.1 Chemical evaluation

The maximum concentration of chemical product in the solution $F_2$ shall be a volume fraction of 0,5 %.

### E.13.2 Bacteriological evaluation

The bacteria contamination of the tank outlet and of the tank surfaces shall be less than the acceptable criteria given in E.2.4.

The solution $S_2$ shall contain less than 10 cfu/ml.

### E.13.3 Visual evaluation

No visible traces shall appear.

# Annex F
(normative)

# Sampling methods for milk mixing tests

At least six samples of milk shall be taken at each of the two sampling times.

At least three of these shall be taken from the top layer of the milk surface. Not less than 90 % of each sample shall be taken from the top 20 mm layer of the milk.

These three samples shall be taken from:

— close to the agitator;

— as far as possible from the agitator;

— at a place where the agitation of the milk seems to be least.

At least another three samples shall be taken from the bottom of the inner vessel. Not less than 90 % of each sample shall be taken from milk within 50 mm of the bottom of the inner vessel. One of these samples shall be from the area adjacent to the outlet.

Samples shall be taken with a ladle or large glass pipette.

Samples shall be checked in accordance with the requirements of EN ISO 1211.

# Annex G
(normative)

# Equipment and installation for the tests for cleanability and cleaning performance required in Annex E

## G.1 Equipment and installation for the examination dealing with the tank outlet

### G.1.1 Equipment

See E.3.1.4 and E.9.2.

Collect the following equipment for the exact volume measurement of the tank outlet drainage pipe (see E.3.1.4):

— one sterile drain sealing bung or disc with a rigid tube, see Figure G.1 (diameter *D* is adapted to the inner diameter of the tank outlet pipe);

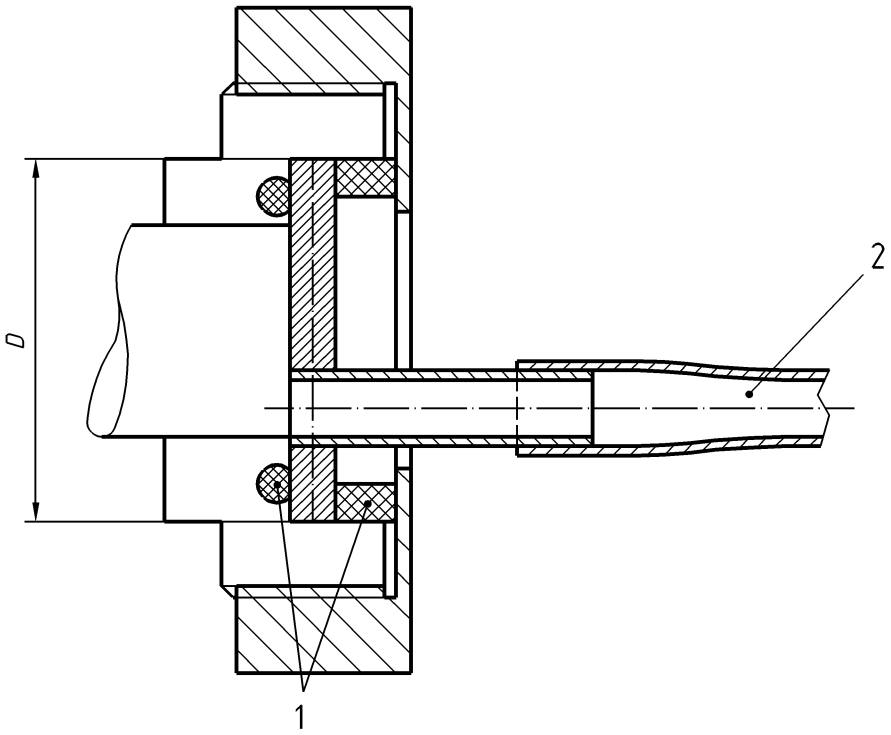
— a rubber hose (2) (which can be used in contact with food);

— a Mohr pinchcock for closing the rubber hose;

— a nut.

### G.1.2 Installation

Separate the tank outlet pipe from the cleaning system and install this equipment as shown in Figure G.1.




**Key**

1 gasket

2 rubber hose

**Figure G.1**

## G.2 Equipment and installation for the examination dealing with the internal tank surfaces and equipment

### G.2.1 For spraying method (see E.5.3 and E.9.3.1)

#### G.2.1.1 Equipment

The following equipment shall be collected for spraying:

**G.2.1.1.1** One peristaltic pump

The peristaltic pump shall fulfil the following requirements:

— at least three rollers;

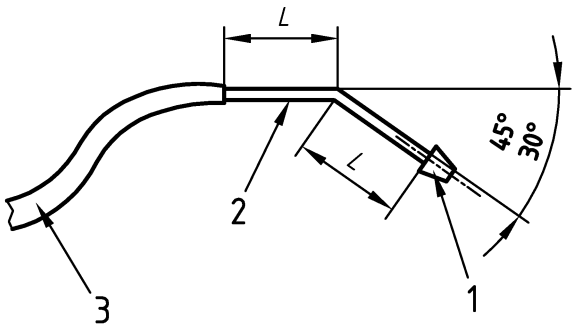
— only one pipe accepted;

— rotation speed variable in order to adjust the flow rate. The flow rate shall be adjusted, with water, at 300 l/h (5 l/min) for the operational use.

**G.2.1.1.2** Two complete sets of equipment for spraying:

**G.2.1.1.2.1** One of these sets of equipment shall be used to spray the soiling milk (solution A, see E.5.3) and the other shall be used to spray the sterilised solution (solution $S_1$, see E.9.3.2.5). Each set of equipment shall be identified.

Each equipment set shall include the following items, as shown in Figure G.2:




**Key**

1 nozzle

2 pipe

3 rubber hose

With 0,20 m ≤ *L* ≤ 0,50 m

**Figure G.2**

**G.2.1.1.2.2** One rubber hose (3), which can be used in contact with food and be sterilisable.

The length of the rubber tube should be selected according to the dimensions of the tank to be tested.

**G.2.1.1.2.3** One pipe in austenitic stainless steel (2) (see dimensions and shape in Figure G.2).

**G.2.1.1.2.4** One nozzle (1) which shall allow the following requirement: when the nozzle is installed horizontally, at a height *h* = 1,2 m and at a flow rate of 300 l/h, the water jet, shall spray at a distance *d* between 3 m ≤ *d* ≤ 4 m.

The shape of the wet part shall have a length L ≥ 1,5 m and a width *l* between 0,5 m ≤ *l* ≤ 1,5 m (see Figure G.3).

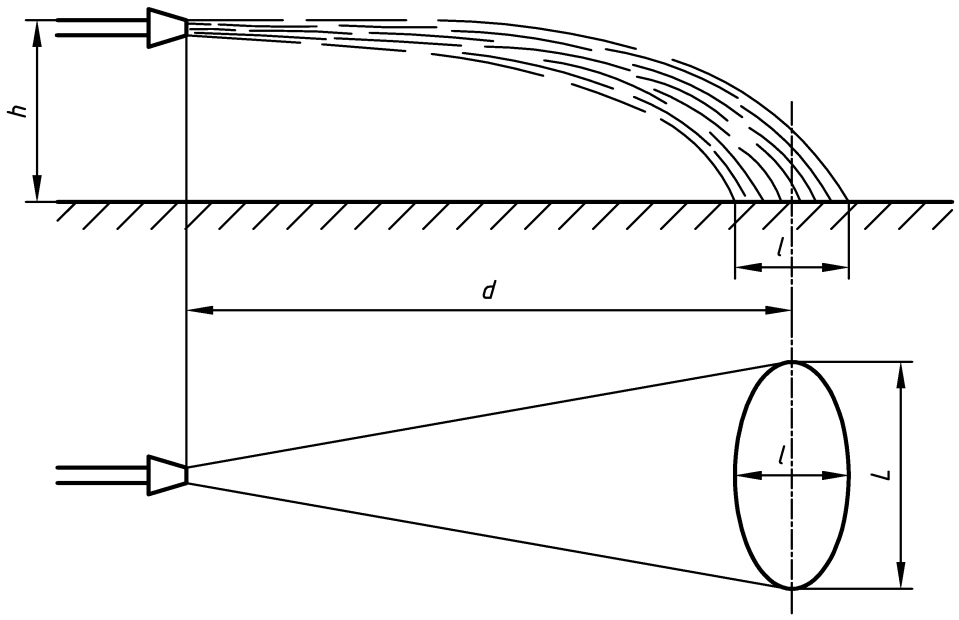



**Figure G.3**

This nozzle may be made easily using a blind nut (ø = 14 mm), in austenitic stainless steel, opened on the top as shown in Figure G.4 (the height *H* would be adapted to obtain the right performances).

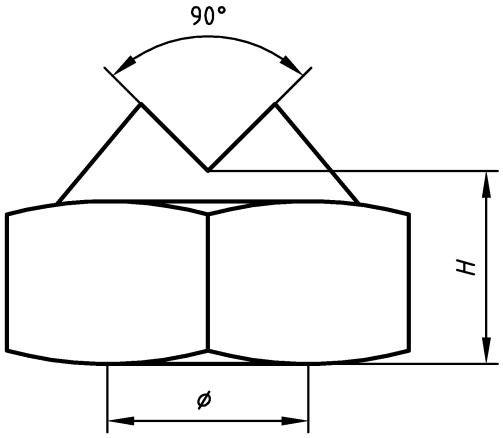



**Figure G.4**

**G.2.1.1.3** Equipment for the collection of solution.

All the equipment used to collect or store solutions (collecting tube or tank, rubber tube for samples) but also the above mentioned hoses, nozzle shall be sterilised for 15 min at 121 °C.

### G.2.2 For swabbing method (see E.9.3.2)

#### G.2.2.1 Equipment

Collect the following equipment for the swabbing method:

— Seven commercial swabs inside a test tube: the head of the swab shall be in compacted cellulose cotton wool with a bigger volume than 1 $cm^3$, the shaft of the swab which is normally fixed to the cock of the test tube may be in wood, plastic or stainless.

— Seven floppy plastic masks to limit the test surface. The dimensions of each mask shall be in accordance with those given in Figure G.5.

Dimensions in millimetres

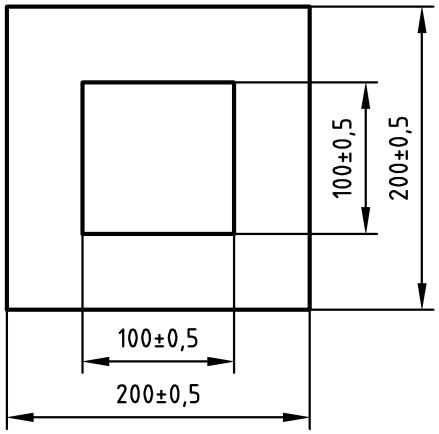



**Figure G.5**

Each mask shall be able to be applicable on surfaces having a radius ≥ 50 mm and to be sterilised.

When the same mask is used several times, it shall be cleaned with denatured ethanol.

#### G.2.2.2 Installation

Each plastic mask shall be applied by hand on the surface where the swab is to be taken. It shall be maintained by hand during the test.

For each tank, seven swabs shall be done at the following places:

— one on each rear side (see positions no. 1 and 2, Figure G.6);

— one on the upper side (see position no. 3, Figure G.6);

— one on the farthest agitator part from the internal nozzle of the cleaning system of the tank (see position no. 4, Figure G.6);

— one at the lowest point around the internal hole of the outlet (see position no. 5, Figure G.6);

— two located by the operator.

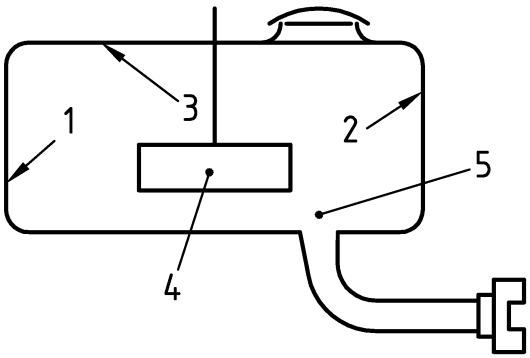



**Figure G.6**

The location of the swabs shall be noted in the test report.

# Annex ZA
(informative)

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

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

Once this standard is cited in the Official Journal of the European Communities under that Directive and has been implemented as a national standard in at least one Member State, compliance with the normative clauses of this standard confers, within the limits of the scope of this standard, a presumption of conformity with the relevant Essential Requirements of that Directive and associated EFTA regulations.

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

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[2] ISO 7010, *Graphical symbols — Safety colours and safety signs — Registered safety signs*

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[6] Directive 2004/108/EC of the European Parliament and of the Council of 15 December 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility and repealing Directive 89/336/EEC

[7] European Directive 80/778/EEC of 15 July 1980 relating to the quality of water dedicated to human consumption as amended by Council Directives 81/858/EEC and 91/692/EEC

[8] Directive 89/109/EEC of 21 December 1988 on the approximation of the laws of the Member States relating to materials and articles intended to come into contact wit foodstuffs

[9] Directive 90/128/EEC of 23 February 1990 relating to plastic materials and articles intended to come into contact with foodstuff, modified by Directive 92/39/EEC

[10] Commission Directive 92/39/EEC of 14 May 1992 amending Directive 90/128/EEC relating to plastics materials and articles intended to come into contact with foodstuffs

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