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Machines voor oppervlaktereiniging en voorbehandeling van industriële producten met vloeistoffen of dampen - Deel 4: Veiligheid van machines die gebruik maken van gehalogeneerde oplosmiddelen

Machines de nettoyage et de prétraitement de pièces industrielles utilisant des liquides ou des vapeurs - Partie 4: Sécurité des machines utilisant des solvants halogénés

Machines for surface cleaning and pretreatment of industrial items using liquids and vapours - Part 4: Safety of machines using halogenated solvents

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Machines for surface cleaning and pretreatment of industrial items using liquids or vapours - Part 4: Safety of machines using halogenated solvents

Machines de nettoyage et de prétraitement de pièces industrielles utilisant des liquides ou des vapeurs - Partie 4: Sécurité des machines utilisant des solvants halogénés

Maschinen zur Oberflächenreinigung und -vorbehandlung von industriellen Produkten mittels Flüssigkeiten oder Dampfphasen - Teil 4: Sicherheit von Maschinen, in denen halogenierte Lösemittel verwendet werden

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This European Standard (EN 12921-4:2005) has been prepared by the Technical Committee CEN/TC 271 "Surface treatment equipment — Safety", the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 2005, and conflicting national standards shall be withdrawn at the latest by December 2005.

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

For relationship with EC Directives, see informative Annex ZA, which is an integral part of this European Standard.

This European Standard is part of a series of standards in the area of safety for development and construction of machines for surface cleaning and pre-treatment of industrial items using liquids or vapours.

The EN 12921 series includes the following parts:

— Part 1: Common safety requirements;

— Part 2: Safety of machines using water based cleaning liquids;

— Part 3: Safety of machines using flammable cleaning liquids;

— Part 4: Safety of machines using halogenated solvents.

NOTE Although a machine for surface cleaning and pre-treatment of industrial items, as an integral whole, formally does not fall under the scope of the ATEX Directive 94/9/EC, the standard is based upon a fundamental risk analysis according to this directive.

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

Introduction

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

This European Standard contains additional safety requirements to and/or deviations from EN 12921-1:2005.

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

When provisions of this type C standard are different from those which are stated in type A or B standards, the provisions of this type C standard take precedence over the provisions of the other standards, for cleaning machines that have been designed and built according to the provisions of this type C standard.

1 Scope

This European Standard specifies the significant hazards of machines for surface cleaning and pre-treatment – in the following called "cleaning machines" – of industrial items using halogenated solvents, either pure or as a mixture.

This European Standard applies together with EN 12921-1:2005. Both parts together cover all significant hazards relevant for cleaning machines of industrial items using liquids or vapours, when they are used as intended and under the conditions foreseen by the manufacturer (see Clause 4). The specific requirements specified in Part 4 take precedence over the respective requirements in EN 12921-1:2005.

This European Standard applies together with EN 12921-3 in case of release of flammable vapours from the cleaning liquids.

This European Standard does not apply to machinery and related equipment excluded from the scope of EN 12921-1:2005.

This European Standard is not applicable to cleaning machines which are manufactured before the publication of this European Standard by CEN.

2 Normative references

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

EN 1093-3, *Safety of machinery — Evaluation of the emission of airborne hazardous substances — Part 3: Emission rate of a specified pollutant — Bench test method using the real pollutant*

EN 12921-1:2005, *Machines for surface cleaning and pretreatment of industrial items using liquids or vapours — Part 1: Common safety requirements*

EN 12921-3, *Machines for surface cleaning and pretreatment of industrial items using liquids or vapours — Part 3: Safety of machines using flammable cleaning liquids*

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

EN ISO 12100-2:2003, *Safety of machinery — Basic concepts, general principles for design — Part 2: Technical principle (ISO 12100-2:2003)*

3 Terms and definitions

For the purpose of this European Standard, the terms and definitions given in EN ISO 12100-1:2003, EN 12921-1:2005 and the following apply.

3.1
halogenated solvent
organic solvent containing at least one halogen atom per molecule and not having a flash point as obtained by standard methods

NOTE Examples for halogenated solvents are:

- dichloromethane (methylene chloride);
- HCFC 123, HCFC 141B and HCFC 225;

— trichloroethylene;

— tetrachloroethylene (perchloroethylene).

These halogenated solvents used in industry can contain a small quantity of stabilising agents (anti-acid, anti-oxidant, etc).

3.2
vapour zone
space within the cleaning machine filled with saturated solvent vapour when the cleaning machine is on stand-by

3.3
freeboard zone
space within type II-cleaning machines above the vapour zone and up to the rim of the tanks. The freeboard zone can be further divided into cooling zone, safety zone, refrigerated zone (see Annex A)

3.4
cooling zone
space within the freeboard zone of a cleaning machine above the vapour zone and up to the upper part of the condensing cooling coil

3.5
safety zone
space within the freeboard zone of a cleaning machine above the cooling zone up to the rim of the tank

3.6
refrigerated zone
space within the freeboard zone of a cleaning machine where its temperature is below 0 °C measured at a distance of 150 mm or more from the refrigeration cooling coils

3.7
types of cleaning machines using halogenated solvents
types of halogenated solvent cleaning machines used in this European Standard are defined below and examples shown in Annex A

3.7.1
type I - sealed system
system in which there is no direct connection between any volume containing halogenated solvent and the outside environment during normal operation

3.7.1.1
type Ia - collection chamber system
collection chamber system consists of a collection chamber and one or more process chambers with doors, one door sealing the collection chamber from the process chamber(s), the other from the outside environment (see Figure A.1)

3.7.1.2
type Ib - single chamber system
single chamber system consists of a chamber which is used for both processing items and collecting halogenated solvent vapours for recovery (see Figure A.2)

3.7.2
type II - enclosed open system
system in which there is no connection between halogenated solvent and the outside environment during normal operation including loading and unloading. This cleaning machine consists of one or more open tank(s) within an enclosure. The items are processed through the cleaning machine by means of mechanical handling device and solvent fumes are collected at the inlet and outlet points of the enclosure (see Figure A.3)

3.8
piston effect
rising or escaping of vapours caused by excessive speed in relation to the volume of the item by which it is introduced into or extracted from the vapour zone

3.9
open tank
tank in which there is communication between solvent and the outside environment during normal operation, including loading and unloading

4 List of significant hazards

Table 1 — List of significant hazards associated with machines for surface cleaning and pre-treatment using halogenated solvents

Clause/sub-clause of this European Standard	Hazard	Clause/sub-clause of EN 12921-1:2005
4.1	**General** This clause contains significant hazards, hazardous situations and events, as far as they are dealt with in this European Standard, identified by risk assessment as significant for this type of machinery using halogenated cleaning liquids and which requires action to eliminate or reduce the risk. NOTE Information on the method of risk analysis is given in EN 1050.	4.1
4.2	**Mechanical hazards**	4.2
4.2.1	**Crushing, shearing, cutting, entanglement, drawing-in, impact**	4.2.1
4.2.2	**High pressure fluid ejection**	4.2.2
4.2.3	**Ejection of parts of the cleaning machine and/or items**	4.2.3
4.2.4	**Mass and stability and inadequacy of mechanical strength**	4.2.4
4.2.5	**Slip, trip and fall hazards**	4.2.5
4.3.	**Electrical hazards**	4.3
4.4	**Thermal hazards**	4.4
4.5	**Hazards generated by noise**	4.5

Table 1 (*continued*)

Clause/sub-clause of this European Standard	Hazard	Clause/sub-clause of EN 12921-1:2005
4.6	**Hazards generated by materials and substances processed, used or emitted by the cleaning machine**	4.6
4.6.1	**General**	4.6.1
4.6.2	**Hazards resulting from contact with/or inhalation of dangerous liquids, gases, aerosol, fumes and dusts**	4.6.2
4.6.2.1	**Inhalation of dangerous vapours** These hazards are related to: — drag-out and idling by the cleaning machine while in operation; — filling, emptying and/or cleaning the cleaning machine; — damaged sealing around door leading to halogenated solvent vapour leaks; — opening of doors, vent valves and automatic closures before halogenated solvent purged to a safe concentration on type I-cleaning machines; — failure of vapour limiting device.	
4.6.2.2	**Substances generated by chemical decomposition** These hazards are related to: — solvent overheating due to the increased concentration of contaminants (high boiling oils, hydrocarbons, tar, etc.); — over temperature by the heating system; — chemical reactions between halogenated solvent and water (present on the items to be cleaned due to humidity condensation or other sources); — halogenated solvent breakdown due to radiation, e.g. UV light; — halogenated solvent breakdown due to high temperature from external sources (e.g. flames); — halogenated solvent breakdown due to reaction caused by reactive metal fines and swarf acting as a catalyst (e.g. zinc, magnesium, aluminium).	
4.6.3	**Fire and explosion hazard** See 4.6.3.1 and 4.6.3.2 of EN 12921-1:2005. Fire or explosion hazards are caused by presence of flammable vapours (in hazardous explosion mixtures) together with a potential ignition source. Flammable vapours can be originated from total loss of halogenated solvent and overheating of combustible contaminants. Vapours produced within the flammable region and a high energy source being present. NOTE The risk of fire or explosion is extremely low with halogenated solvents during normal operation.	4.6.3
4.7	**Hazards combinations**	4.7
4.8	**Hazards caused by failure of energy supply**	4.8
4.9	**Hazards related to failure of control system**	4.9

5 Safety requirements and/or measures

5.1 General

Machinery shall comply with the safety requirements and/or protective measures of this clause. In addition, the cleaning machine shall be designed according to the principles of EN ISO 12100-2 for hazards relevant but not significant which are not dealt with by this European Standard (e.g. sharp edges).

The common safety requirements or measures for cleaning machines using liquids or vapours in 5.1 of EN 12921-1:2005 shall be considered.

The intended use shall be determined and explained/defined in the instruction handbook and, when necessary, by other additional means (plate, sign, labelling, etc.) in accordance with and/or limited by the properties of halogenated solvents either pure or as a mixture indicated in the safety data sheet.

5.2 Mechanical hazards

5.2.1 Safeguarding of danger points

5.2.1.1 General

Shall be according to 5.2.1.1 of EN 12921-1:2005.

5.2.1.2 Safety measures against crushing, shearing, cutting, entanglement, drawing-in, impact

Shall be according to 5.2.1.2 of EN 12921-1:2005.

5.2.1.3 Guards and interlocks

Shall be according to 5.2.1.3 of EN 12921-1:2005.

5.2.1.4 Moving parts of the cleaning machine

Shall be according to 5.2.1.4 of EN 12921-1:2005.

5.2.1.5 Location of controls

Shall be according to 5.2.1.5 of EN 12921-1:2005.

5.2.1.6 Prevention against the hazard from close or fall of covers, lids and doors

Shall be according to 5.2.1.6 of EN 12921-1:2005.

5.2.1.7 Devices for setting-up, make-ready, cleaning and trouble-shooting during the work process

Shall be according to 5.2.1.7 of EN 12921-1:2005.

5.2.2 Safety measures against high pressure fluid ejection

5.2.2.1 General

Shall be according to 5.2.2.1 of EN 12921-1:2005.

5.2.2.2 Safety measures against overpressure

Shall be according to 5.2.2.2 of EN 12921-1:2005.

5.2.2.3 Safety measures against rupture and corrosion of piping or joints

Shall be according to 5.2.2.3 of EN 12921-1:2005.

5.2.3 Safety measures against ejection of parts of the cleaning machine and/or items

Shall be according to 5.2.3 of EN 12921-1:2005.

5.2.4 Safety measures regarding mass and stability and inadequacy of mechanical strength

Shall be according to 5.2.4 of EN 12921-1:2005.

5.2.4.1 Positioning of the cleaning machine

Shall be according to 5.2.4.2 of EN 12921-1:2005.

5.2.4.2 Safety measures against overload

Shall be according to 5.2.4.3 of EN 12921-1:2005.

5.2.4.3 Safety measures against spillage

Shall be according to 5.2.4.4 of EN 12921-1:2005.

5.2.5 Safety measures against slip, trip and fall

Shall be according to 5.2.5 of EN 12921-1:2005.

5.3 Safety requirements and measures against electrical hazards

5.3.1 General

Shall be according to 5.3.1 of EN 12921-1:2005.

5.3.2 Safety measures against electric shock

Shall be according to 5.3.2 of EN 12921-1:2005.

5.3.3 Safety measures against electromagnetic influences on electrical equipment

Shall be according to 5.3.3 of EN 12921-1:2005.

5.4 Safety requirements and measures against thermal hazards

5.4.1 General

Shall be according to 5.4.1 of EN 12921-1:2005.

5.4.2 Heating systems

Shall be according to 5.4.2 of EN 12921-1:2005.

5.4.3 Measures against contact of the skin with hot surfaces

Shall be according to 5.4.3 of EN 12921-1:2005.

5.4.4 Measures against radiation and/or convection of heat

Shall be according to 5.4.4 of EN 12921-1:2005.

5.4.5 Measures against overheating of cleaning liquid

Shall be according to 5.4.5 of EN 12921-1:2005.

5.5 Safety requirements and measures against noise

5.5.1 General

Shall be according to 5.5.1 of EN 12921-1:2005.

5.5.2 Noise reduction at source at the design stage

Shall be according to 5.5.2 of EN 12921-1:2005.

5.5.3 Noise reduction by protective measures

Shall be according to 5.5.3 of EN 12921-1:2005.

5.5.4 Noise reduction by information on personal protective equipment (PPE)

Shall be according to 5.5.4 of EN 12921-1:2005.

5.6 Safety requirements and measures against hazards generated by materials and substances processed, used or emitted by the cleaning machine

5.6.1 General

Shall be according to 5.6.1 of EN 12921-1:2005.

5.6.2 Safety measures against contact with/or inhalation of dangerous liquids, gases, vapours, aerosols, fumes

Shall be according to 5.6.2 of EN 12921-1:2005.

5.6.2.1 Prevention of inhalation of dangerous vapours

5.6.2.1.1 General

In order to avoid inhalation of dangerous vapours by use of cleaning machines the following measures shall be adopted:

— Devices shall be fitted and/or working methods adopted to control vapour emissions (see 5.6.2.1.2 to 5.6.2.1.7);

— national exposure limit values shall be observed (see Annex A of EN 12921-1:2005).

5.6.2.1.2 Condenser

Type Ia and Type II machine shall be fitted with a condenser able to ensure that saturated vapour level calculated by design shall be maintained below the upper limit of the cooling zone.

In designing the condenser there is a relationship between the cleaning machine heat input, surface area of the condenser, the initial temperature of the cooling fluid and the cooling fluid flow rate. The cleaning machine heat input may be variable and therefore change through the operating cycle.

The appropriate heat input for the design of the condenser shall consider all the conditions, that is including distillation during regeneration of the contaminated halogenated solvent by distillation.

For type II-cleaning machines the condenser shall be interlocked such that the coolant flow rate is maintained, after the cleaning machine heating has been shut off, for a specified period or until the halogenated solvent has cooled to a specified temperature.

5.6.2.1.3 High vapour level cut off

A device (for example one or more high temperature sensors), only manually resetable shall shut the heating system off if there is a fault in the condensing system. For type II-cleaning machines the device shall be so designed as to avoid solvent vapours escaping from the top of the system. For type I-cleaning machines the device shall be designed to avoid overpressure within the system.

The sensor shall be positioned as close as possible to the vapour zone or in the most suitable position for short reaction time.

Additional devices may be required depending on the characteristics of the liquid to be used (e.g.: low boiling point liquid).

5.6.2.1.4 Halogenated solvent emission control

5.6.2.1.4.1 Forced ventilation

A forced ventilation system which collects exhausted vapours shall be fitted into all types of cleaning machines using halogenated solvents. This requirement even applies if the halogenated solvent is used at ambient temperature.

For type I machines forced ventilation system may be omitted provided that a vapour monitoring system prevents the external door or cover opening when solvent vapour concentration in the collection chamber, or in the process chamber is above the safe level according to health and safety regulations in force.

Forced ventilation system shall be fitted with a flow or pressure sensing device switching off the heating system and any other devices creating vapours or mists if the design rate is not achieved.

For type Ia-cleaning machines the forced ventilation system shall be de-activated by means of interlocks, when the door between the solvent process chamber(s) and the collection chamber is open (see Figure A.1).

For type II-cleaning machines, the forced ventilation system shall be interlocked with the doors at the entry and exit points, or the covers over the halogenated solvent cleaning chamber. The extract system may be switched off when the door(s) or cover(s) are closed provided that halogenated solvent emissions are prevented.

NOTE Forced ventilation according to the definition (EN 12921-1:2005, 3.9) can be achieved by vacuum systems providing the function is met.

5.6.2.1.4.2 Covers, doors and enclosures

A cover or door shall be fitted to all openings of the cleaning machine. The doors on type I-cleaning machines shall comply with the requirements for a sealed system.

The enclosure on type II cleaning machines shall be fitted with doors at all entry and exit openings, or fitted with covers over the open area of the halogenated solvent chambers. Doors or covers can be omitted provided that a handling system is fitted which prevents the installation of cover or doors. In such cases considerations shall be given to the installation of exit and entry tunnels to minimise emissions.

When present, the covers shall be permanently fastened to the machine (preferably automatic type) and easy to close. Covers shall be designed such that they do not pull excessive quantity of solvent out of the machine during opening.

Typical examples of suitable methods are sliding covers, rollers shutter covers, etc.

5.6.2.1.4.3 Freeboard zone

A freeboard zone shall be fitted to the open tank of Type II machines and as a minimum, the height of the zone shall be equal to or greater than 0,75 times the minor side of the tank measured at the vapour top level.

NOTE The freeboard zone of a cleaning machine has two functions: The first is to act as a barrier to reduce halogenated solvent emissions while the cleaning machine is idling. The second is to act as a drying zone for the items being cleaned.

The freeboard required above, is the minimum to reduce halogenated solvent emissions. Where the items being cleaned have a height greater than the minimum freeboard height, then the freeboard zone height shall be increased to equal the work height.

Alternatively the items being cleaned shall be moved up through the freeboard zone in steps. Each step shall move the items a portion of its height equal to the freeboard zone height. The number of steps will equal the items height divided by the freeboard zone height. Each step shall be of sufficient duration to ensure all the halogenated solvent is removed from that part of items before it exists the freeboard.

This operations shall be carried out by suitably controlled mechanical handling.

A third option for drying items which have a height greater than the freeboard zone height, is to move the items through the freeboard zone at a sufficiently slow speed to ensure all the halogenated solvent is removed before that part of the items exits the freeboard.

This operations shall be carried out by suitably controlled mechanical handling.

5.6.2.1.4.4 Items transfer speed

The transfer speed inside the cleaning machine, shall be controlled at a maximum speed of 3 meters per minute in the vertical direction and a maximum of 6 m/min in the horizontal direction for type II-cleaning machines. In all cases during vertical movements the ”piston effect” shall be avoided.

NOTE The above requirement can best be achieved by means of programmable mechanical handling.

5.6.2.1.4.5 Items process dwell time

In type Ia- and type II-cleaning machines, the items shall be held in the cleaning tanks for the necessary period of time to ensure the items leave the cleaning liquid at a temperature equal to the final cleaning tank fluid temperature, to avoid excessive drag-out.

Exceptions can be allowed if other suitable means or any other systems resulting in the same level of safety.

NOTE For type Ia-cleaning machines the above can be achieved e.g. by fitting a vapour sensor at the vapour zone height, for type II-cleaning machines this can be achieved e.g. by means of adequate programming of mechanical handling.

5.6.2.1.4.6 Items drying

Before an item is removed from the cleaning machine it shall be free from all residual halogenated solvent.

NOTE For type I-cleaning machines this can be achieved e.g. by fitting a halogenated solvent concentration monitoring device in the collection chamber. For type II-cleaning machine this is can be achieved by programmable mechanical handling system.

Hot air drying or vacuum drying or any alternative method can be used for drying.

Assistance in achieving the above can be obtained if during operation the items are oriented within the cleaning machine in such a way that all residual halogenated solvent can freely drain from them.

'Cuppy' or 'trappy' items can be rotated totally or partially.

Where rotation is required this shall always be carried out automatically and be timer controlled. Where 'cuppy' or 'trappy' parts cannot be rotated due to the sensitive properties of the items alternative drying methods shall be used.

5.6.2.1.4.7 Work baskets/jigs

Work baskets or jigs, when included with the cleaning machine, shall be designed in a form as open possible to allow free draining, taking into account due regard to the strength of the basket for the work load intended.

The plan area of the basket for type II-cleaning machines shall not exceed 50 % of the plan area of the cleaning tank(s) of the cleaning machine to avoid excessive halogenated solvent emissions due to the piston effect.

5.6.2.1.5 Filling point

A filling point equipped with a valve and plug or cap shall be fitted. This point should be capable of being connected to a mechanical pump system for transferring the halogenated solvent. This applies to all types of cleaning machines using halogenated solvents.

The bottom of the cleaning chamber(s) shall slope in order to facilitate draining and cleaning of the cleaning machine. Drain points shall be fitted to each chamber of the cleaning machine at the lowest point in the chamber and shall be equipped with a drain valve, with a plug or cap. This point shall be capable of being connected to a mechanical pump for transfer of the halogenated solvent. This applies to all types of cleaning machines using halogenated solvents. In type Ib machines the sump shall be fitted to a chamber where the contamination collects.

Provision shall be made for the venting of any halogenated vapours formed during the filling operation. For type I-cleaning machines this shall be by means of a vent pipe, which shall exhaust into a location where the halogenated vapours will not cause a hazard. For type II-cleaning machines a forced ventilation system shall be fitted which will collect any vapours produced.

NOTE for type I machines a vapour return from the machine to the filling tank is the best method of collecting the vapours.

5.6.2.1.6 Doors of sealed system

The sealing on the doors of type I-cleaning machines shall be leak proof.

5.6.2.1.7 Halogenated solvent purging system

The manufacturer of the cleaning machine shall develop a method ensuring that the concentration in the collection chamber of type Ia-cleaning machines and the collection/process chamber of type Ib-cleaning machines is below 1g/m^3 before any vent valves, automatic closures or the door between the working environment and the collection chamber on type Ia-cleaning machines and the single chamber door on type Ib-cleaning machines can be open. Vent valves, automatic closures, and doors shall be interlocked in such a way that they cannot be opened until the required halogenated solvent concentration level is achieved in the chamber.

NOTE The requirement can be achieved by

— purging with a forced ventilation system and measuring the halogenated solvent concentration in the chamber by means of a monitoring device,

— purging with a forced ventilation system for a specified period fixed by an automatic timing device.

If forced ventilation is used for purging, then a pressure or flow monitoring device shall be fitted and interlocked with the door. The door shall not be allowed to open, if there is a failure of the forced ventilation system.

5.6.2.2 Prevention of hazards due to substances generated by chemical decomposition

5.6.2.2.1 Sump cleaning liquid temperature

5.6.2.2.1.1 High temperature cut off

Machines with a heating system shall be fitted with a safety device to switch-off the heating system if the sump liquid temperature rises to the pre-set point of the cut-off.

The value of the pre-set point shall be established according to the characteristic of the solvent(s) to be used, see Annex A for typical values.

5.6.2.2.1.2 Temperature monitoring

A temperature indicator shall be fitted in the sump liquid to enable its temperature to be monitored and clean-out of the machine undertaken before the contamination builds up to an unacceptable level. See Annex A for clean out temperatures of typical solvents.

NOTE Sump temperature monitoring can be combined with the high temperature cut-off, see 5.6.2.2.1.1.

5.6.2.2.2 Heating system over-temperature control

The heating system shall be designed such that the maximum temperature of the heater surface in contact with the halogenated solvent does not exceed the limit temperature for the halogenated solvent(s) for which the cleaning machine is designed.

Machine shall be equipped with a low level sensing device.

Direct electrically heated machines shall be designed so that the heater flux density is limited according the characteristics of the solvent(s) for which the machine is designed.

To avoid over temperature at the surface of electric heaters the flux density should be limited to a value of 4 W/cm² for the common solvents Methylene Chloride, Trichloroethylene, Perchloreothylene.

Steam heated cleaning machines shall be designed so that the steam pressure is limited according the characteristics of the halogenated solvent(s) for which the cleaning machine is designed (see A.2).

Heating systems using intermediate thermal liquids shall be equipped with temperature controls according the characteristics of the thermal liquid and the characteristic of the halogenated solvent(s) for which the cleaning machine is designed.

5.6.2.2.3 Water separator

A water separator shall be fitted to remove water from the halogenated solvent distillate stream. This applies to all types of cleaning machines.

NOTE Types of water separator are gravity separators and adsorbent separators. In order to increase the efficiency of the gravity separator, a cooled water separator can be used.

5.6.2.2.4 Halogenated solvent breakdown due to radiation

Radiation sources shall not be directed at the vapour or liquid halogenated solvent surfaces of cleaning machines using halogenated solvents.

NOTE Cleaning machines should not be positioned in direct sunlight or ultraviolet radiation, it is important that this information is passed onto the user in the instruction handbook (see 7.2.2).

5.6.2.2.5 Halogenated solvent breakdown due to high temperature external sources

See 7.2.1.

5.6.2.2.6 Halogenated solvent breakdown due to light metal fines

In order to prevent the solvent breakdown due to light metal fines the following measures shall be adopted:

— use of systems to remove fines or swarf from halogenated solvent(s) low capacity removable:

  — filters;

  — design feature to facilitate cleaning of tanks from accumulated fines and swarf (e.g. clean out large doors, transfer system(s) to intermediate storage tanks);

— use of selected halogenated solvent(s) (see 7.2.1);

— control of solvents characteristic through water separator

5.6.2.3 Safety measures against dripping of cleaning liquid

Shall be according to 5.6.2.4 of EN 12921-1:2005.

5.6.2.4 Safety measures against inhalation of emissions and/or contact with cleaning liquids generated by chemical reaction

Shall be according to 5.6.2.5 of EN 12921-1:2005.

5.6.2.5 Safety measures against inhalation of emissions generated by chemical decomposition

Shall be according to 5.6.2.6 of EN 12921-1:2005.

5.6.3 Safety requirements and measures against fire and explosion

Shall be according to 5.6.3 of EN 12921-1:2005.

To prevent the possibility of fire or explosion due to high temperature of the halogenated solvent, cleaning machines shall be fitted with a sump liquid high temperature cut-off according to 5.6.2.2.1.1.

5.7 Safety requirements and measures against hazard combinations

Shall be according to 5.7 of EN 12921-1:2005.

5.8 Safety requirements and measures against failure of energy supply

5.8.1 General

Shall be according to 5.8.1 of EN 12921-1:2005.

5.8.2 Failure of forced ventilation

Shall be according to 5.8.2 of EN 12921-1:2005.

5.8.3 Safety measures against unexpected ejection of cleaning machine part or cleaning liquid

Shall be according to 5.8.3 of EN 12921-1:2005.

5.8.4 Safety measures against hazards of items being stuck in the cleaning machine

Shall be according to 5.8.4 of EN 12921-1:2005.

5.9 Safety requirements and measures against failure of control systems

Shall be according to 5.9 of EN 12921-1:2005.

6 Verification of the safety requirements and/or measures

6.1 General

Shall be according to 6.1 of EN 12921-1:2005.

Safety requirements and/or measures detailed in Clause 5 shall be checked by inspection, functional test, measuring or examination of drawings/calculations.

6.2 Mechanical

Shall be according to 6.2 of EN 12921-1:2005.

6.3 Electrical

Shall be according to 6.3 of EN 12921-1:2005.

6.4 Thermal

6.4.1 General

Shall be according to 6.4.1 of EN 12921-1:2005.

6.4.2 Heating systems

Shall be according to 6.4.2 of EN 12921-1:2005.

6.4.3 Temperature of touchable surfaces

Shall be according to 6.4.3 of EN 12921-1:2005.

6.5 Noise

Shall be according to 6.5 of EN 12921-1:2005.

6.6 Material and substances processed, used or emitted by the cleaning machines

6.6.1 Contact with/or inhalation of dangerous liquids, gases, vapours, mists, fumes

6.6.1.1 General

Shall be according to 6.6.1.1 of EN 12921-1:2005.

6.6.1.2 Prevention of inhalation of dangerous vapours

6.6.1.2.1 General

Verification of the compliance with National Occupational exposure limits (see Annex B of EN 12921-1:2005) can be made by measurement of the concentration at the operators working place. The measurements shall be taken with the machine in the condition of maximum potential emissions.

NOTE In open tanks of type II machines the condition of maximum emissions is in stand-by conditions i.e. heating system ON, condensing ON and ventilation system operating with no items present in the machine.

6.6.1.2.2 Condenser and safety back-up systems

6.6.1.2.2.1 Condenser

For cleaning machines where the condenser is visible the following procedure shall be used:

With the cleaning machine operating under the design heat load and the condenser coolant system operating under the design conditions the vapour/air interface shall be observed to be controlled by the condenser.

For cleaning machines in which the condenser is not visible other test methods shall be used such as temperature measurement or concentration measurement to ensure the condenser is controlling the vapour.

6.6.1.2.2.2 High vapour level control

With the machine operating under the design heat load and the condensing system operating under design conditions, the condensing system coolant flow shall be stopped, to simulate a total coolant failure. The cooling fluid monitoring device shall be made inoperative for the duration of this test. The high vapour level control sensor shall be allowed to come into contact with the rising vapour. The machine shall be monitored and verification approved when the heating system switches off and the vapour/air interface rises to its maximum level within the confines of the machine.

6.6.1.2.3 Halogenated solvent emission control

6.6.1.2.3.1 General

The solvent concentration measurements shall be carried out in accordance with EN 1093-3 for each machine or type of machine i.e. same size, model and construction. In addition to the above the following verification methods shall be adopted.

6.6.1.2.3.2 Forced ventilation

With the forced ventilation system operating under design conditions the inlet duct to the fan shall be obstructed by means of a damper, or covering the ventilation inlet. The heating shall be observed to have been switched off.

6.6.1.2.3.3 Covers, doors and enclosures

Visual check of all covers, doors and enclosures on type II-cleaning machines to ensure they reduce halogenated solvent emissions to a minimum.

6.6.1.2.3.4 Freeboard zone

The freeboard zone height for type II-cleaning machines shall be measured to ensure the minimum requirements.

6.6.1.2.3.5 Work load transfer speeds

If a mechanical handling system is fitted to type II-cleaning machines the vertical and horizontal speed within the cleaning machine shall be measured to ensure that they do not exceed the maximum requirements.

6.6.1.2.3.6 Work load process dwell time

If a mechanical handling system is fitted to type II-cleaning machines the process dwell time shall be measured and shall not be below the minimum required for the typical intended work load.

6.6.1.2.3.7 Work load drying time

If a mechanical handling system is fitted to type II-cleaning machines, and on all type I-cleaning machines, the drying time shall be measured and shall not be below the minimum required for the typical intended work load.

6.6.1.2.3.8 Work load orientation

The work baskets and jigs, when included with the machine, shall be visually checked to ensure they comply with the requirements concerning form and dimension.

The orientation of the items on baskets or jigs within the machine shall be checked in order to verify that the piston effect shall be prevented.

6.6.1.2.3.9 Filling point

Visual check of the filling point fitted. Solvent concentration measurements shall be carried out in accordance with EN 1093-3 for each machine or type of machine i.e. same size, model and construction at the nearest position to the machine where the operator works when filling the machine. The highest measurements achieved shall be recorded in the Instruction Manual.

6.6.1.2.3.10 Emptying system

Solvent concentration measurements shall be carried out when emptying the machine in accordance with EN 1093-3 for each machine or type of machine i.e. same size, model and construction at the nearest position to the machine where the operator works when emptying the machine. The highest measurements achieved shall be recorded in the Instruction Manual.

6.6.1.2.3.11 Shape of chamber

Visually check that the machine sump after the system has been emptied and after all the solvent has drained away. There shall be no residual pools of solvent, observed in the machine sump.

6.6.1.2.3.12 Drain point

Visually check that the drain point and cap or plug are fitted.

6.6.1.2.3.13 Door seals

The sealing of doors on type I machines shall be checked by taking solvent concentration measurements around the vicinity of the door and this shall be 5×10^{-6} or less.

6.6.1.2.4 Chamber purging system

The halogenated solvent concentration in the collection chamber of type Ia-cleaning machines and the single chamber of type Ib-cleaning machines shall be checked with a monitoring device before opening the door. The concentration shall be below 1 g/m^3.

6.6.1.3 Fumes and emissions generated by the cleaning process

Shall be according to 6.6.1.2 of EN 12921-1:2005.

6.6.1.4 Dripping of cleaning liquid

Shall be according to 6.6.1.3 of EN 12921-1:2005.

6.6.1.5 Fumes and emissions generated by chemical reaction

Shall be according to 6.6.1.4 of EN 12921-1:2005.

6.6.1.6 Fumes and emissions generated by chemical decomposition

6.6.1.6.1 General

Shall be according to 6.6.1.5 of EN 12921-1:2005.

6.6.1.6.2 Sump temperature

6.6.1.6.2.1 High temperature cut off

With the machine operating under idling conditions i.e. heating and condensing switched on, with solvent boiling under steady state conditions and with clean solvent in the tank(s). The thermal cut off set point shall be turned to the solvent boiling point and the machine heating shall be switched off.

NOTE The solvent boiling point shall be acquired from the safety data sheet of the solvent given by the supplier of the solvent. The solvent boiling point shall meet the design temperature of the machine.

6.6.1.6.2.2 Sump temperature monitoring

With the cleaning machine operating under idling conditions i.e. heating system and condenser switched on, with halogenated solvent boiling under steady state conditions, and with clean halogenated solvent in the tank(s). The indicated temperature shall be observed to be at the boiling point of the halogenated solvent given by the solvent supplier.

6.6.1.6.3 High system over-temperature

The conformity of the heating system to the design specification at the assembly stage shall be checked. Also checking at the testing stage that all values for pressure and temperature of the heating system conform to the design specification shall be carried out.

Test of the low level control and cut-off, and the thermal cut-off shall be carried out by simulation.

6.6.1.6.4 Water separator

Visual check to ensure that no residual free phase water collects in the halogenated solvent tanks of a cleaning machine.

6.6.1.6.5 Halogenated solvent breakdown due to radiation

Visual check to ensure that radiation sources are not directed at the surface of halogenated solvent vapour or liquid in the cleaning machine.

6.6.1.6.6 Halogenated solvent breakdown due to high temperature external sources

Visual check of the requirements of 5.6.2.2.5 in compliance with 7.2.1.

6.6.1.6.7 Halogenated solvent breakdown due to light metal fines

Visual check of the requirements of 5.5.2.2.6 in compliance with 7.2.1.

6.6.2 Fire and explosion

Shall be according to 6.6.2 of EN 12921-1:2005.

Verification of the high temperature cut-off according to 6.6.1.5.2.1.

6.7 Hazard combinations

Shall be according to 6.7 of EN 12921-1:2005.

6.8 Failure of energy supply

Shall be according to 6.8 of EN 12921-1:2005.

6.9 Control systems

Shall be according to 6.9 of EN 12921-1:2005.

7 Information for use

7.1 General

In addition to the requirements described in 7.1, 7.2 and 7.3 of EN 12921-1:2005, the following information for use shall be given:

7.2 Instruction handbook

7.2.1 General

The instruction handbook shall contain at least:

— cleaning machine classification (type I, type Ia, type Ib or type II) according to this European Standard;

— prescriptions to be considered relating to safe use of the halogenated solvent either pure or in mixture indicated in the safety data sheet;

— information on the halogenated solvent(s) to be used, depending on the work to be carried out and in particular when metal fines are present;

— procedure for setting the cut-off point of the high vapour level control by a competent person;

— flow temperature and flow rate of the coolant (if set by the user) together with appropriate test method;

— maximum sump temperature. Standard values for common halogenated solvent are given in A.2;

— procedures for the adjustment of all devices on the cleaning machine;

— limitations associated with the use of solvents, such as:

  — unless permitted by the intended use, the use of solvents or mixtures with different physical and chemical characteristics is prohibited;

  — emphasise that the contamination collected in these solvents during cleaning operations may generate other hazards e.g.: be flammable, corrosive;

  — prohibit the heating of solvents using open flames;

— prohibit the use of ancillary equipment e.g.: filling and emptying pumps made from reactive metals (e.g. Zn, Mg);

— intervals of calibration of the vapour monitoring system.

7.2.2 Installation

The halogenated solvents shall not be exposed to light sources emitting UV radiation.

The surface of the ground on which the machine is installed shall be perfectly sealed, constructed as a retention tank and not be capable of being attacked by the solvent and be capable of being washed using a copious supply of water unless a retention system is integrated in the machine.

In the case of cleaning machines installed in a pit, their installation shall comply with the following:

— Installation of a forced ventilation system, which is switched on when opening the pit, or which is operated permanently.

7.2.3 Operation of the cleaning machine using halogenated solvents

The halogenated solvents shall be suitable for use with the cleaning machine, including the temperature settings for the various thermostats, in accordance with the solvent(s) used. This applies to all cleaning machines except for cold type cleaning machines.

The maximum input temperature of the cooling fluid in the condenser, as recommended in accordance with the halogenated solvent used. This applies to all cleaning machines except for cold type cleaning machines.

The requirement to ensure that products which are not compatible with the halogenated solvent (acids, bases, halogenated hydrocarbons different to those used) shall not be accidentally introduced into the cleaning machine.

Limitation of the residue concentration of contamination in the cleaning liquid.

The conditions for monitoring the quality of the halogenated solvent(s) during use, together with details of the principal products which are incompatible with the halogenated solvent.

The maximum linear speed for introducing and removing the load, (vertical and horizontal).

The time required for one cleaning cycle, when the load to be processed is identical or similar to the typical load.

The requirements for positioning and arranging the parts to be processed, relative to their support, in order to avoid any area of solvent retention.

The method used to adjust the time delay device and the minimum time between shutting down the heating system and shutting down the condenser system, when the heating system is fitted with an automatic time delay shut down device. This applies to all cleaning machines except for cold type cleaning machines.

7.2.4 Determination of vapour emission

The results of and the method used to measure the solvent vapour concentration, during the static operations stage according to 6.2 shall be given in the operating instructions of the machine.

7.2.5 Maintenance

The following information shall be given to be observed when entering a cleaning machine (e.g. cooling down, cleaning out and washing the tank, two operators working together):

— how to completely drain and clean the cleaning machine;

— how to purge the machine in order to reach safe solvent concentration;

— personal protective equipment (PPE).

The instruction shall specify all safety precautions necessary for the safe cleaning and maintenance of the machine, e.g.:

— installation of a local exhaust system outside the cleaning machine;

— use of personal protective equipment (PPE);

— all operations shall be carried out outside the cleaning machine.

In exceptional circumstances, when entering into the machine is necessary, the instruction manual shall specify additional information about e.g.:

— authorisation for entering the cleaning machine;

— use of qualified personnel to supervise the operation (trained personnel);

— use of personal protective equipment (PPE) - breathing protective devices;

— measures in case of emergency.

7.2.6 Emptying the used cleaning liquid (halogenated solvent)

Emptying of the used cleaning liquid from the machine shall normally be performed at ambient temperature.

When a higher temperature has to be used due to removing difficult contaminants (e.g. waxes, dielectric lubricant and other or similar contaminants), specific information shall be given to enable the operation to be performed safely with respect to the nature of the cleaning liquid and the properties of the expected contaminants.

7.2.7 Halogenated solvent recovery

The halogenated solvents from the cleaning machine could be recovered either by an in-built still or by using an external still.

The safety precautions to be taken when recovering the halogenated solvent shall be described, in especially those for in-built stills.

7.3 Minimum marking

In addition to marking required in 7.3 of EN 12921-1:2005 cleaning machines using halogenated solvents shall be marked with:

— machine classification (type I, type Ia, type Ib or type II) according to the requirements of this European Standard;

Annex A
(informative)

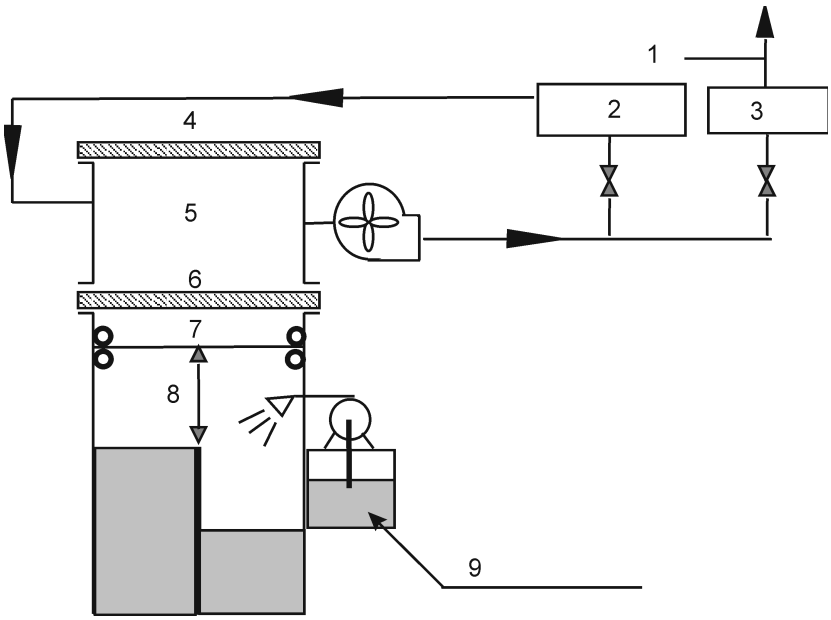
Examples and description of types of cleaning machines using halogenated solvents and design parameters

A.1 Examples and description of types of cleaning machines using halogenated solvents

A.1.1 Type I – Sealed cleaning machines

Type Ia – Collection chamber systems

The collection chamber cleaning machine consists of a collection chamber and a process chamber with two doors, one door sealing the collection chamber from the process chamber and the other door sealing the collection chamber from the outside environment (see Figure A.1).



Key

1	monitoring point	6	door 1
2	refrigeration	7	process chamber
3	activated carbon recovery unit (ACRU)	8	internal lift
4	door 2	9	spray liquid tank
5	collection chamber		

Figure A.1 — Collection chamber cleaning machine using halogenated solvents – type Ia

At the beginning of a cleaning cycle, door 1 between the collection chamber and process chamber is closed.

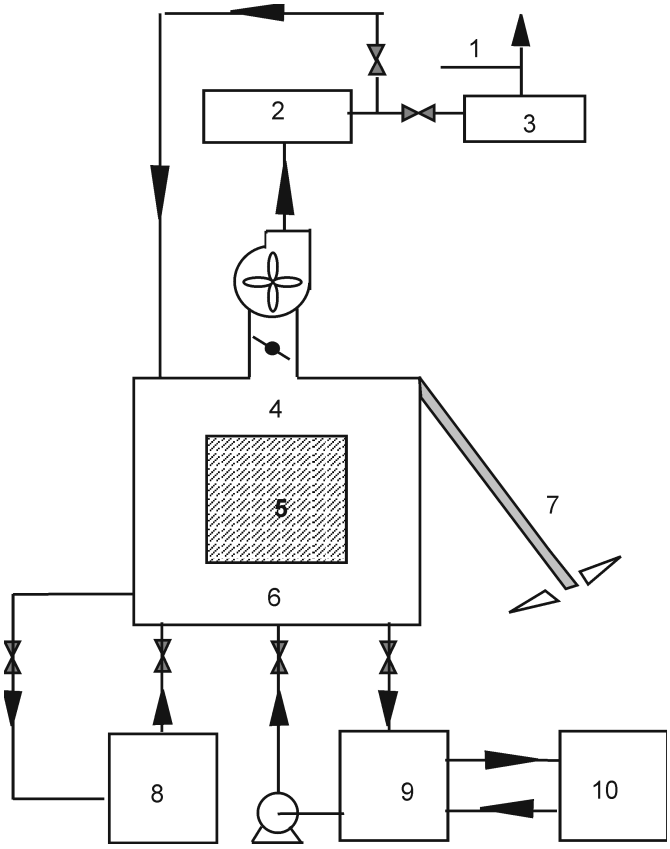
Items to be cleaned are placed into the collection chamber and door 2 between the collection chamber and the outside environment is closed and sealed. Door 1 between the collection chamber and the process chamber is opened and the items to be cleaned are transported through the cleaning process. After cleaning, the items are returned to the collection chamber and door 1 between the collection chamber and the process chamber is closed and sealed.

Residual halogenated solvent remaining on the items and in the collection chamber can be removed by circulating the air through a recovery system. On completion of the drying cycle and at a concentration of < 1 g/m³ within the collection chamber, door 2 between the collection chamber and outside environment is opened and the items are removed.

Type Ib – Single chamber cleaning machine

The single chamber cleaning machine consists of a chamber which is used both for processing items and collecting halogenated solvent vapours for recovery (see Figure A.2).

In this cleaning machine items to be cleaned are placed into the chamber and the door is sealed. Halogenated solvent vapour and liquid are supplied to the chamber from external auxiliary tanks and the items are cleaned. At the end of the cleaning cycle as much halogenated solvent as possible is drained from the chamber and the residual halogenated solvents are extracted and passed through a recovery system before the chamber door is opened.



Key

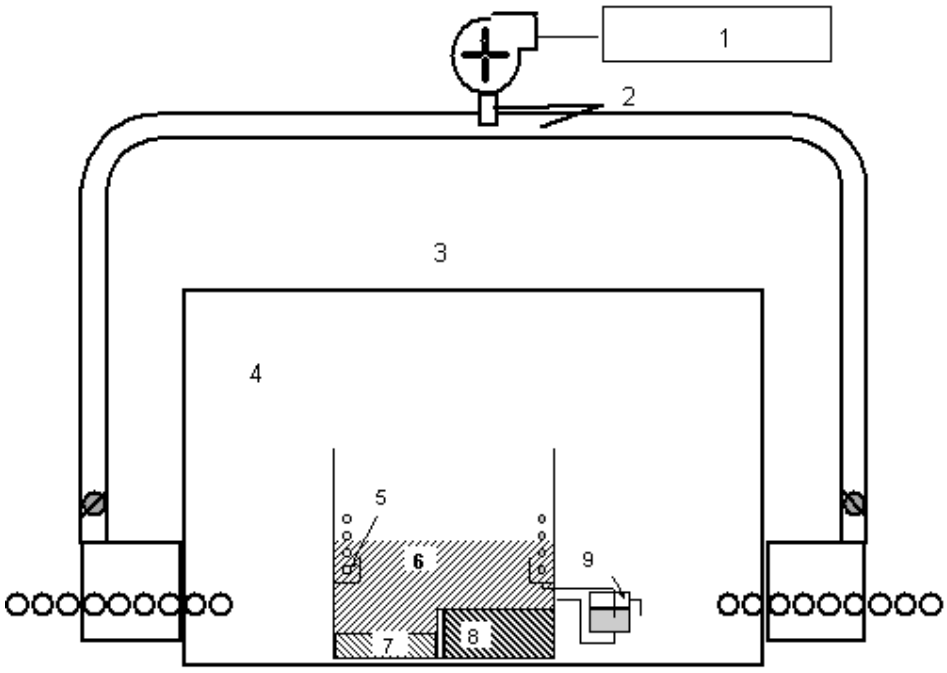
1	monitoring point	6	process and collection
2	refrigeration	7	door
3	activated carbon recovery unit (ACRU)	8	vapour generation
4	chamber	9	liquid rinse
5	work load	10	still

Figure A.2 — Single chamber cleaning machine using halogenated solvents – type Ib

A.1.2 Type II – enclosed open cleaning machine

A.1.2.1 General

The enclosed cleaning machine consists of on open top tank or tanks within an enclosure (see Figure A.3). Items to be cleaned are processed through the cleaning machine by means of mechanical handling (transport) and halogenated solvent fumes are collected at the exit and entry points of the enclosure.



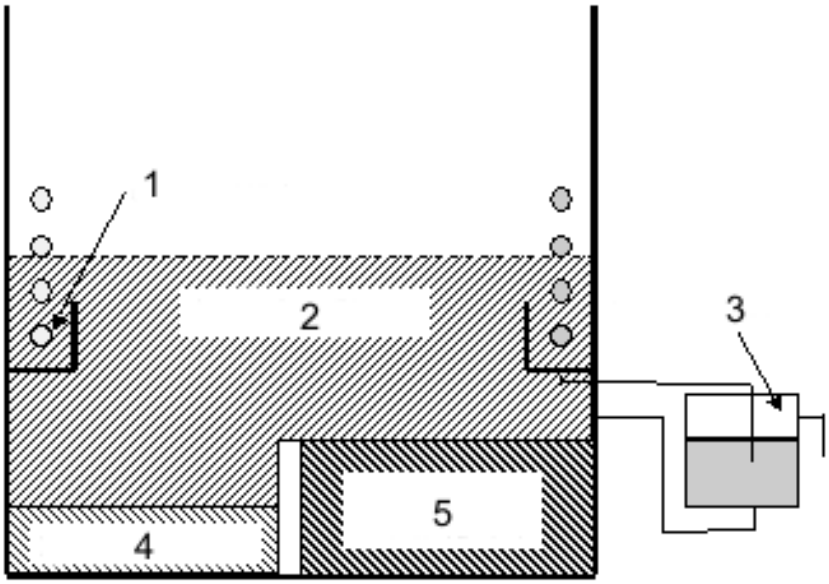
Key

1	activated carbon recovering unit	6	vapour zone
2	air exhaust ducts	7	boiling sump
3	enclosure	8	liquid immersion
4	vent box	9	water separator
5	condensate trough		

Figure A.3 — Enclosed open cleaning machine using halogenated solvents – type II-a

A.1.2.2 Design parameters

The open tank generating vapours to be contained in an enclosed system consists of a tank or tanks (see Figure A.4) designed with the proper parameters to meet all the safety requirements and equipped with manual or motorised covers which closes the opening when not in use.



Key

1 condensate trough
2 vapour zone
3 water separator
4 boiling sump
5 liquid immersion

Figure A.4 — Open top tank

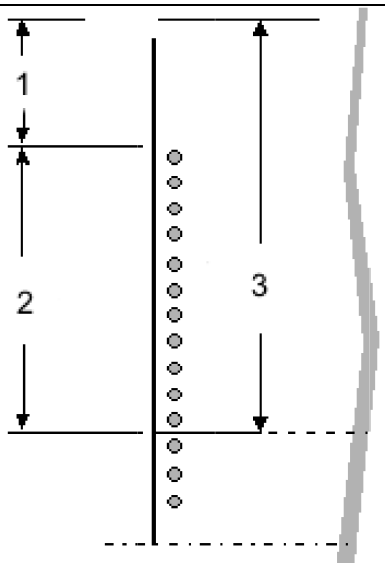
Figures A.5a to 5c shows the typical construction of a freeboard zone (Figure A.5a), the optional cooling zone and safety zone (Figure A.5b), and optional refrigerated zone (Figure A.5c)

$$Freeboard\ ratio = \frac{Freeboard\ zone\ heigt}{Maximum\ vapour\ width} \quad (1)$$

Key

1 vapour level
2 freeboard zone
3 freeboard zone height
4 vapour width

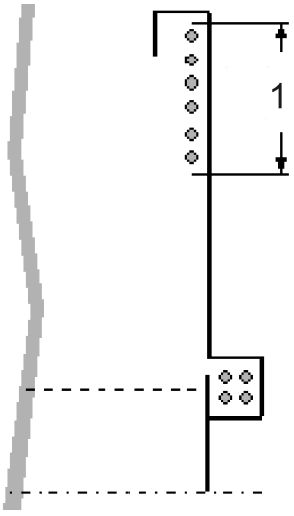
Figure A.5a — Freeboard zones



Key

1 safety zone
2 cooling zone
3 freeboard zone

Figure A.5b — Cooling zone and safety zone



Key

1 refrigerated zone

Figure A.5c — Refrigerated zone

A.2 Characteristics for halogenated solvents

A.2.1 Common halogenated solvents

The most commonly used halogenated solvents are:

— methylene chloride;

— trichloroethylene;

— tetrachloroethylene (perchloroethylene).

A.2.2 Sump temperature monitoring

As oil and/or grease is dragged into the distillation sump of the cleaning machine, the sump liquid temperature rises.

Typical sump liquid working temperatures for common halogenated solvents and light oils, found by experiment are shown below in degrees Celsius.

	Working temperature (°C)
methylene chloride	45
trichloroethylene	95
tetrachloroethylene (perchloroethylene)	130

A.2.3 High temperature cut-off device for the sump temperature

Typical set points of the high temperature cut-off device for the sump temperature, found by experiment, are shown below for the common halogenated solvents in degrees Celsius.

	Set Point (°C)
methylene chloride	55
trichloroethylene	110
tetrachloroethylene (perchloroethylene)	140

Annex B
(informative)

A-deviations

A-deviation: National deviation due to regulations, the alteration of which is for the time being outside the competence of the CEN/CENELEC national member.

This European Standard falls under Directive 98/37/EC.

NOTE (from CEN/CENELEC IR Part 2:2002, 2.17) Where standards fall under EC Directives, it is the view of the Commission of the European Communities (OJ No C 59; 1982-03-09) that the effect of the decision of the Court of Justice in case 815/79 Cremonini/Vrankovich (European Court Reports 1980, p. 3583) is that compliance with Adeviations is no longer mandatory and that the free movement of products complying with such a standard should not be restricted except under the safeguard procedure provided for in the relevant Directive.

Austria

According to Gazette No. 865/1994 “CWK-Anlagen-Verordnung” the use of halogenated solvents in Austria is only allowed in enclosed machines.

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 98/37/EC

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to Essential Requirements of the New Approach Directive Machinery 98/37/EC, amended by 98/79/EC.

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

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

Bibliography

[1] EN 1050, *Safety of machinery — Principles for risk assessment*