



BSI Standards Publication

Plating and anodizing lines - Safety requirements

National foreword

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Plating and anodizing lines - Safety requirements

Lignes de traitement de surface et d'anodisation -
Prescriptions de sécurité

Galvanik- und Anodisieranlagen -
Sicherheitsanforderungen

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European foreword

This document (EN 17059:2018) has been prepared by 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of an identical text or by endorsement, at the latest by December 2018, and conflicting national standards shall be withdrawn at the latest by December 2018.

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

This European Standard 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 Directives, see informative Annex ZA, which is an integral part of this document.

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

Introduction

This European Standard 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.

If 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.

1 Scope

This document describes all significant hazards, hazardous situations and events relating to plating and anodizing lines, when used as intended and in compliance with the foreseeable conditions of the manufacturer. In addition, procedures for testing and measuring safety requirements, marking of equipment and minimum operation requirements are specified.

For reference to plating lines and anodizing lines the term plating line is used in this document.

This document applies to the design and construction of plating lines and anodizing lines including their transporter systems for surface treatment of industrial products by means of inorganic or organic electrolytes or by means of other process chemistries.

Plating lines and anodizing lines in terms of this standard are arrangements of process tanks for:

- electrolytic treatment of work pieces (e.g. electrocleaning, passivation, electroetching, burnishing, electrolytic polishing and brightening, drying);
- wet chemical treatment of work pieces (e.g. degreasing, passivation, chemical polishing, etching, pickling, blackening);
- electrolytic and electro-less metal deposition, even on non-metallic work pieces made electrically conductive by corresponding treatment;
- changing of substance composition on the surface of metallic work pieces e.g. burnishing, blackening, phosphatizing, chromating and;
- anodizing (anodic oxidation);

including rinsing tanks and the corresponding transporter equipment (e.g. transporter systems, handling gantry, bean, etc.), where the products are lifted in and out of tanks.

This document distinguishes between the following types of plating lines:

- Type 1: manual lines;
- Type 2: semi-automatic lines;
- Type 3: fully automatic lines.

Furthermore, it specifies equipment marking and requirements on user information.

This document does not deal with hazards resulting from plating linesparts above category 1 of PED (Pressure Equipment Directive).

This document is not applicable to:

- transporter systems of carrousel lines (see EN 618 and EN 15095);
- equipment for the preparation and treatment of water and waste water;
- machinery for dip coating and electro-deposition of organic liquid coating material (EN 12581);
- horizontal plating lines (e.g. printed circuit board, etching, reel to reel, continuous plating lines);
- machinery for surface cleaning and surface pre-treatment of industrial items using liquids or vapours (EN 12921-1, EN 12921-2, EN 12921-3, EN 12921-4).

NOTE Machinery for surface cleaning and surface pre-treatment (EN 12921 series) could be part of a plating line.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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EN 349:1993+A1:2008, *Safety of machinery — Minimum gaps to avoid crushing of parts of the human body*

EN 981:1996+A1:2008, *Safety of machinery — System of auditory and visual danger and information signals*

EN 1037:1995+A1:2008, *Safety of machinery — Prevention of unexpected start-up*

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EN 1127-1:2011, *Explosive atmospheres — Explosion prevention and protection — Part 1: Basic concepts and methodology*

EN 1677-1:2000+A1:2008, *Components for slings — Safety — Part 1: Forged steel components, Grade 8*

EN 1677-2:2000+A1:2008, *Components for slings — Safety — Part 2: Forged steel lifting hooks with latch, Grade 8*

EN 1677-3:2001+A1:2008, *Components for slings — Safety — Part 3: Forged steel self-locking hooks. Grade 8*

EN 1677-4:2000+A1:2008, *Components for slings — Safety — Part 4: Links, Grade 8*

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EN 12921-2:2005+A1:2008, *Machines for surface cleaning and pre-treatment of industrial items using liquids or vapours — Part 2: Safety of machines using water based cleaning liquids*

EN 12921-3:2005+A1:2008, *Machines for surface cleaning and pre-treatment of industrial items using liquids or vapours — Part 3: Safety of machines using flammable cleaning liquids*

EN 12921-4:2005+A1:2008, *Machines for surface cleaning and pretreatment of industrial items using liquids and vapours — Part 4: Safety of machines using halogenated solvents*

EN 13445-1:2014, *Unfired pressure vessels — Part 1: General*

EN 13445-2:2014, *Unfired pressure vessels — Part 2: Materials*

EN 13445-3:2014, *Unfired pressure vessels — Part 3: Design*

EN 13445-4:2014, *Unfired pressure vessels — Part 4: Fabrication*

EN 13445-5:2014, *Unfired pressure vessels — Part 5: Inspection and testing*

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EN 13480-1:2017, *Metallic industrial piping — Part 1: General*

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EN 13861:2011, *Safety of machinery — Guidance for the application of ergonomics standards in the design of machinery*

EN 14462:2015, *Surface treatment equipment — Noise test code for surface treatment equipment including its ancillary handling equipment — Accuracy grades 2 and 3*

EN 14597:2012, *Temperature control devices and temperature limiters for heat generating systems*

EN 50110-1:2013, *Operation of electrical installations — Part 1: General requirements*

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

EN 61000-6-1:2017, *Electromagnetic compatibility (EMC) — Part 6-1: Generic standards — Immunity for residential, commercial and light-industrial environments (IEC 61000-6-1:2016)*

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

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

EN ISO 13856-1:2013, *Safety of machinery — Pressure-sensitive protective devices — Part 1: General principles for design and testing of pressure-sensitive mats and pressure-sensitive floors (ISO 13856-1:2013)*

EN ISO 13856-2:2013, *Safety of machinery — Pressure-sensitive protective devices — Part 2: General principles for design and testing of pressure-sensitive edges and pressure-sensitive bars (ISO 13856-2:2013)*

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

EN ISO 13857:2008, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs (ISO 13857:2008)*

EN ISO 13943:2017, *Fire safety — Vocabulary (ISO 13943:2017)*

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

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

EN ISO 14122-1:2016, *Safety of machinery — Permanent means of access to machinery — Part 1: Choice of fixed means and general requirements of access (ISO 14122-1:2016)*

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

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

EN ISO 14122-4:2016, *Safety of machinery — Permanent means of access to machinery — Part 4: Fixed ladders (ISO 14122-4:2016)*

EN ISO 80079-36:2016, *Explosive atmospheres — Part 36: Non-electrical equipment for explosive atmospheres — Basic method and requirements (ISO 80079-36:2016)*

3 Terms and definitions

For the purpose of this document the terms and definitions given in EN ISO 12100 and the following apply.

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

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

3.1

draining area

area (e.g. drip tray also as part of the transporter system) where runoff excess chemistry or rinsing liquids from the work piece are collected outside treatment tanks

3.2

additive

admixture added to the coating chemistry at a specified volume ratio

Note 1 to entry: Additives influence the deposition and the coating characteristics of the deposited layers.

3.3

anode

metal in the form of plates, rods, balls (spheres), sections, pellets, billets dipping into the treatment tank and which is suspended at an anode rod or which is filled in baskets attached to an anode hook and suspended, hung or immersed in the tank

Note 1 to entry: The anodes are connected to the positive pole (electroplated coating) of the rectifiers. Anodes used in electrolytic cleaning or process tanks for anodizing are connected to the negative pole of the rectifiers.

Note 2 to entry: Non-dissolvable anodes are metals such as stainless steel, steel, titanium, etc. in form of rods, plates, expanded metal plates serving as pure power-supplying electrodes (positive electrode) or are made of graphite. They do not have the task of emitting metallic atoms to the treatment tank.

3.4

type of plating lines

are characterized by their different constructions and are distinguished by the following description:

type 1: manual plating lines;

type 2: semi-automatic lines;

type 3: fully automatic lines

3.5

operating modes

intended operation of type 3 (fully automatic line) plating lines, and, if applicable, type 2 (semi-automatic line) can include the following operating modes:

— automatic mode

automatic, programmed and continuous mode of the plating lines providing the possibility of manual and automatic loading by means of a transporter system until the program or the operator stops the machine;

— setting mode

operating mode during which settings for the next working processes are performed;

Note 1 to entry: The setting mode is also referred to as TIP mode.

— service mode

operating mode for service and maintenance works; this is an optional operating mode for manual work under restricted operating conditions

Note 2 to entry: The service mode is also referred to as MANUAL mode.

Note 3 to entry: Other operating modes are possible as long as they meet the safety objectives laid down in the European Directive 2006/42/EC (2006/42/EC, Annex I, chapter 1.2.5).

3.6

thermal load

sum of thermal energies capable of being released (EN ISO 13943) during combustion of all flammable substances associated with machinery and their production including raw and auxiliary materials

3.7

flammable substance

gas, vapour, liquid, solid, or mixtures thereof able to undergo an exothermic reaction with air when ignited

3.8

enclosure

equipment enclosed on all sides with the exception of closable access ports for loading and unloading of work pieces and having access doors and openings for fire protection reasons, e.g. roof openings

3.9

exposure limits

concentration limits of hazardous substances in air required by worker health legislation

3.10

explosive atmosphere

mixture with air, under atmospheric conditions, of flammable substances in the form of gases, vapours, mists or dusts in which, after ignition has occurred, combustion spreads to the entire unburned mixture

[SOURCE: EN 14034-1:2004+A1:2011, definition 3.4]

3.11

plating line

totality of machinery, i.e. complex installations, which together form the coating or treatment equipment

Note 1 to entry: Metal deposition or surface treatment from inorganic and/or organic liquid electrolytes on the work piece is performed here.

Note 2 to entry: Plating lines may consist of the following units:

- load and unload stations;
- transporter systems consisting of transport hoist with lifting and lowering devices;
- extraction hood at transporter system;
- flight bar including barrel, rack, jig, basket for product reception;
- control system with electrical control panels and switching devices;
- process tanks;
- rinsing baths;
- drying position;
- positions for storage of product carriers, unprocessed work-pieces and finished products;

- forced ventilation (inlet and exhaust air system);
- auxiliary equipment such as e.g.: rectifier, filters, pumps and agitators, product motions, heaters, dosing systems, treatment plants, automation systems including switching system.

Note 3 to entry: Plating lines can be installed with or without enclosure.

Note 4 to entry: Machinery for surface cleaning and surface pre-treatment (EN 12921 series) with its process tanks could be part of a plating line. These process tanks should be distinguished from process tanks from the other plating processes.

3.12

plating process

process for metal deposition or surface treatment of work piece surfaces, e.g. for deposition of inorganic or organic liquid electrolytes on the work piece or for surface treatment (cleaning, degreasing, etching)

Note 1 to entry: Treatment takes for example place in process tanks or containers, where different kinds of process chemistries are used.

3.13

danger zone

area where dangers occur when the plating line is running

Note 1 to entry: Guards or ESPEs are used to prevent, limit or supervise access.

3.14

hazardous area

area where hazards due to explosive atmosphere may exist

Note 1 to entry: The probability of occurrence of explosive atmosphere is classified in zones. Limits of hazardous zones are given in Annex A.

3.14.1

zone 0

place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is present continuously or for long periods or frequently

[SOURCE: see definition EN 60079-10-1:2015, 3.3.4]

3.14.2

zone 1

place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is likely to occur in normal operation occasionally

[SOURCE: see definition EN 60079-10-1:2015, 3.3.5]

3.14.3

zone 2

place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is likely to occur in normal operation but, if it does occur, will persist for a short period only

[SOURCE: see definition EN 60079-10-1:2015, 3.3.6]

3.15**danger points**

certain points at machines and equipment giving free access, where persons may be injured

Note 1 to entry: See Annex A for detailed list of danger points.

3.16**normal operation**

situation where the equipment, protective system, and components perform their intended function within their design and construction parameters

[SOURCE: EN ISO 12100:2010, 5.4 b)]

3.17**process tank**

tank containing an active treatment bath (e.g. an electrolyte) for performance of chemical or electrolytic surface treatment processes

3.18**material safety data sheet (MSDS)**

document, drawn up in 16 chapters in compliance with the Directive 1907/2006/EC, reporting the characteristics of a chemical product to evaluate the potential risks arising from its use

3.19**forced ventilation**

exchange of air by one or more fans across the installed inlet and exhaust system

Note 1 to entry: Air exhausted from the room (exhaust air) is replaced by fresh make-up air. Forced ventilation may be mounted on the process tanks or in the area of the transporter system.

3.19.1**air adjustment**

building ventilation to ensure the supply of sufficient quantity of fresh air to the operational space

3.19.2**make-up air**

air which needs to be replenished for air lost through forced ventilation

3.20**transporter system**

set-up for the transport of work-pieces via jigs, racks and barrels, and anodes during the processing cycle or during maintenance

Note 1 to entry: The conveying movements may be horizontal or vertical and axes may be totally or partially power-driven.

Note 2 to entry: A transporter system may consist of the following machines, components or equipment:

- hoist blank (pathway) and supports;
- transporter system frame;
- hoist drive (lift and traction drive);
- lifting equipment;

- load handling device (belts, chains, slings, hooks, loading traverses (product carrier));
- flight bar and work piece receptacles (jig, barrel, basket);
- positioning system;
- drip pan (collector);
- extraction hood;
- running board;
- safety equipment for persons.

Note 3 to entry: Transporter systems may be designed as:

- suspended hoist with crosspiece, central and lateral guiding of lifting equipment, running on lateral as well as central running rail;
- portal hoist, with crosspiece lateral guiding of lifting equipment running on rails in the container area;
- lateral hoist with supporting structure, lateral guiding of lifting equipment running on one side running rail with supporting rail;
- convertors with product carrier receptacles as dry convertors or as wet convertors, tanks with castors and product carrier receptacles, running on rails in the container area;
- continuous conveyors;
- circular conveyors.

For transporter systems see also Figures B.1 to B.9 given in Annex B.

3.21

minimum level cutout

activation point at which the heaters shall be deactivated

3.22

lower explosion limit

LEL

lower limit of the explosion range (see 3.19.1 and 3.20.1 of EN 13237:2012)

Note 1 to entry: "Explosion limit" and "ignition limit" are equivalent. In accordance with international usage, only the term "explosion limit" is used in this standard.

3.23

flight bar

used to suspend work-pieces via rack or barrels and transport to the various process tanks

Note 1 to entry: Also acts as the cathode or anode bar during the plating process or anodizing process / anodic cleaning process.

3.24

flight bar agitation

mechanical agitation of flight bar within the tank by electrical motor drive

3.25**working area**

area where the operators access during all the steps of work pieces treatment (manual or automatic), see also Figures C.1 to C.3 given in Annex C

Note 1 to entry: This includes, for example, the preparation of bath (e.g. dissolution, transfer), preparation of working piece, control of bath (pH adjustment) and operations of maintenance.

4 Requirements**4.1 General**

Plating lines shall comply with the safety requirements and protective measures of this clause. In addition, plating lines shall be designed according to the principles of EN ISO 12100 for hazards relevant but not significant which are not dealt with by this European Standard.

In addition to EN ISO 12100 plating lines shall be also designed according to the principles of ergonomics of EN 13861:2011.

All components and machinery which can be incorporated in the plating lines to achieve its intended use; e.g. heaters, rectifiers, pumps (EN 809), conveyors (EN 619) shall comply with the appropriate EN standards.

All requirements and measures mentioned in Clause 4 apply to all types and over the complete lifecycle of plating lines unless reference is made to a special type.

Machinery for surface cleaning and surface pre-treatment of industrial items using liquids or vapours shall comply with the safety requirements and protective measures according to EN 12921-1, EN 12921-2, EN 12921-3, EN 12921-4.

4.2 Mechanical safety requirements**4.2.1 General**

Danger zones on the plating line or on working area (see also Figures C.1 to C.3 given in Annex C) shall be avoided by inherently safe design measures or, if not possible, by safeguarding i.e. applying safety distances or implementing guards or protective devices.

4.2.2 Measures against shearing, crushing, cutting, drawing in and impact hazards**4.2.2.1 Safeguarding against danger points**

Danger points shall be safeguarded against access by guards or by applying the safety distances specified in EN 349 and EN ISO 13857. Examples for guards are:

- enclosing guards;
- protective devices;
- pressure sensitive mats;
- impeding guards;
- guide rails;
- belt tension sensors.

Guards shall only have openings or openings for feeding the material (for example work pieces) when safety distances are respected. The safety distances shall be established in relation to the width of the

opening in accordance with EN ISO 13857. Fixed and movable guards shall satisfy the requirements of EN ISO 14120.

Interlocking devices associated with guards shall be designed, arranged and mounted according to EN ISO 14119.

Restart of the transport device after actuation and/or cutting-off of the safety device interlocked with the drive shall only be possible, after at least one control device has been actuated (restart barrier). The requirement related to the restart inhibit does not apply to laser scanners of the transporter system, as long as the person has vacated the hazardous zone after actuation of the safety device, and, in case of intended use, there is no possibility of access behind the laser scanner.

Before restart, an auditory warning signal shall be released for equipment where the direct line of sight is obstructed.

Set-up and maintenance points shall be located outside the hazardous areas. Set-up and maintenance work such as repair and servicing operations including cleaning and rectification of faults shall be carried out during operational stop or power off of the equipment (transport devices, product motions, lifting and lowering devices, etc.). If these works cannot be carried out during operational stop or power off and if the safety devices and devices with safety function cannot be applied, or if their degree of protection is not sufficient, additional devices shall be provided. See 6.2.3 for information.

Powered covers and lids according to EN ISO 14120 shall be safeguarded by hold to run devices placed at a safe distance.

Non-powered covers and lids shall be safeguarded against gravity fall or unexpected close if this creates a risk of injury. This requirement can be achieved, by one of the following measures:

- devices for balancing the weight (counter weight),
- pneumatic springs,
- latches which automatically hold the lifted parts open,

ensuring that the centre of gravity of the guard in the open position is sufficiently far behind the axis of rotation.

4.2.2.2 Safety measures against hazardous movements

Hazardous movement shall be avoided. If hazardous movement cannot be avoided, the exposure to hazardous movement shall be prevented by:

- fixed guards and/or;
- fitting one of the following devices interlocked with the hazardous movement:
 - movable guards, see EN ISO 14120;
 - active opto-electronic protective device, see EN 61496-1 and EN 61496-2;
 - pressure sensitive protective devices; see EN ISO 13856-1 (mats and floors), EN ISO 13856-2 (edges and bars), EN ISO 13856-3 (bumpers, plates, wires and similar devices).

For safety distances from dangerous moving parts see EN ISO 13857.

NOTE 1 For conveyors see EN 619.

NOTE 2 For robots see EN ISO 10218-2.

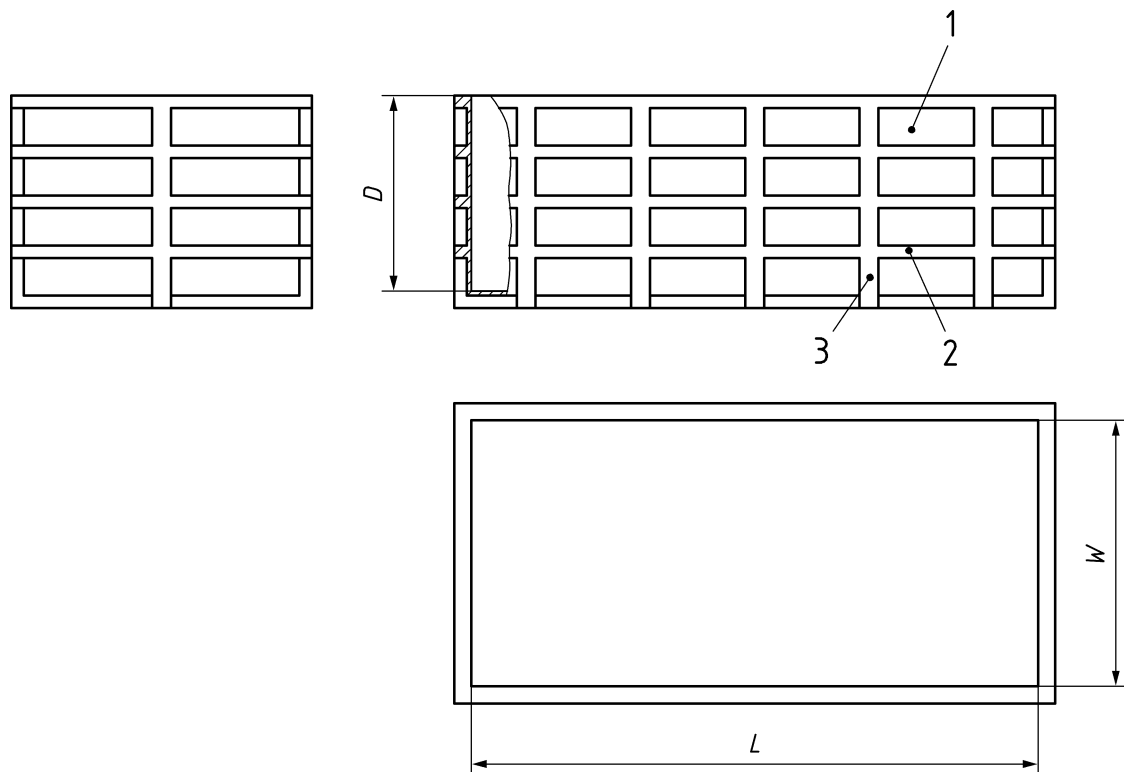
NOTE 3 For power operated doors for persons see EN 12433-1, EN 12433-2, EN 12453, EN 12635 and EN 12978.

NOTE 4 For lifting tables see EN 1570-1.

4.2.3 Safety measures against loss of stability

4.2.3.1 Safety measures against loss of stability of plating lines

Plating lines shall be designed, constructed and installed so that their stability shall be ensured and any permanent or excessive deformation shall not occur when filled with process chemistries (e.g. electrolytes). The deformation for plastic shall not exceed 1 % of the width of each field. A field is defined as the area situated between two reinforcing struts.



Key

- 1 field
- 2 horizontal centreline for reinforcing struts
- 3 vertical centreline for reinforcing struts
- D depth
- L length
- W width

Figure 1 — Reinforced plastic process tanks

The design shall take into consideration the intended use and foreseeable misuse in relation to the nature and the mass of the process chemistries to be used and the work pieces. The tank shall be constructed of material resistant against corrosion, brittleness and aging by chemical products.

Overfilling of process tanks or tanks for plating equipment shall be prevented by:

- filling limiting devices (e.g. level-control),
- warning signal during limiting device response,
- overflow outlet,

- appropriate marking and warning specifying the maximum admissible process chemistry capacity for plating equipment,
- detailed information in the instruction manual.

4.2.3.2 Safety measures against loss of stability of the transporter system

Transporter systems of plating lines shall be designed, constructed and installed so that their standing and driving stability as well as their stability during lifting and lowering of parts attached to the product carriers shall be ensured. The permissible maximum load weight shall be marked on the transporter system. This also applies when a transporter system is used during servicing or maintenance work for transporting, for example, electrode materials.

The design shall take into consideration the intended use or foreseeable misuse in relation to the nature and the mass of the work pieces or equipment parts to be moved. Dynamic forces acting on the transporter system during emergency stops shall be taken into consideration.

Hazards caused by loss of stability of the transporter system shall be prevented by:

- slings complying with the relevant safety standard (example: webbing slings made of man-made fibres: EN 1492-1),
- fittings complying with the relevant safety standards EN 1677-1, EN 1677-2, EN 1677-3 and EN 1677-4,
- drive shafts designed for fatigue fracture resistance (minimum safety factor of 2),

NOTE 1 Reference is the EU directive 2006/42/EC, section 4.1.2.3 (factor of 1.5 is the static test coefficient for lifting accessories, which was enlarged by a safety factor).

- drive motors (lifting and running drive) are designed with a minimum safety factor of 1.1, according to the type stage of the drives,

NOTE 2 Reference is the EU directive 2006/42/EG directive, section 4.1.2.3 factor of 1.1. is the dynamic test coefficient.

- control of drive motors by frequency converters,
- lifting and running drives shall be equipped with mechanical holding brake,
- marking and warning specifying the maximum admissible load capacity of the transport device at the transporter system (see Clause 6),
- detailed indications in the instruction manual.

NOTE 3 Measures against contact with hazardous liquids due to the splashing or spraying of chemical products caused by falling of work pieces are described in section 4.6.2.1.

4.2.4 Safety measures against entanglement and entrapment

4.2.4.1 Means of escape

Any enclosure or fencing accessible by operator or service personnel shall be designed so that in case of emergency an operator or member of the service personnel can exit the enclosure or fencing in a minimum time without obstacles or obstructions.

The access doors to enclosures or fencing provided for personnel shall be designed according to EN 179 and to EN 1125 and shall meet the following requirements:

- be capable of being opened and closed from inside and outside,
- always open outwards,
- be capable of being easily opened, i.e. opening by using little force.

For enclosures the following applies additionally:

- access doors should have a minimum width of 800 mm and a minimum height of 2 000 mm.

4.2.4.2 Moving or rotating elements

For safety measures against entanglement and entrapment due to moving or rotating elements, see section 4.2.2.2.

4.2.5 Safety measures against slipping, tripping and falling

Floor and all platform and gangways shall be non-skid according to EN ISO 14122-2. Floor grating joints shall not have projections or holes capable of tripping and/or hindering the operator.

Ladders, gangways and handrails that equip the plating lines shall comply with EN ISO 14122-1, EN ISO 14122-3 and EN ISO 14122-4.

Where the top side of the tank is used to prevent operators falling into the tank from an adjacent walkway, the tank top shall be at least 1,1 m above personal passage level.

If safety against falling is not given by tank top, other protective measures shall be taken such as e.g. rails having at least the same height.

For manually operated lines type 1 where falling into the tank is avoided by other means (e.g. guard rail, lip) the tank height at the loading side can be lowered to:

- 0,85 m without providing means for ergonomic assistance;
- 0,7 m with providing means for ergonomic assistance (e.g. a lifting-hook).

4.2.6 Safety measures against hazards by pressurized materials

Safety measures against hazards by pressurized materials shall comply with EN 13445-1, EN 13445-2, EN 13445-3, EN 13445-4, EN 13445-5, EN 13445-8, EN 13480-1, EN 13480-2, EN 13480-3, EN 13480-4, EN 13480-5.

NOTE 1 CR 13445-7 provides guidance on the use of the conformity procedures.

NOTE 2 CEN/TR 13480-7 provides guidance on the use of the conformity procedures.

4.3 Electrical safety requirements

4.3.1 General

Electrical equipment shall comply with EN 60204-1.

4.3.2 Safety measures against electric shock

Protection of operators against electric shock from direct or indirect contact shall be ensured by application of Clause 6 of EN 60204-1:2006. Possible access to areas with live parts of plating lines (such as bath electrodes) shall be prevented during operation. This shall be achieved by fixed guards or by interlocking the electric power supply with moving guards or ESPE (electro-sensitive protective equipment) (EN 61496-1).

If respective measures according to HD 60364-4-41 are fulfilled, no further protection against direct contact is required. Since plating lines are damp locations, this can be achieved e.g. by a SELV-circuit (Safety Extra Low Voltage circuit), not exceeding values of 30 V DC or 12 V AC voltage (see HD 60364-4-41:2007, 4.14.4.5).

NOTE For definition of AC and DC current see EN 60204-1:2006, 4.3.2 and 4.3.3. Usually, a pulsed current without reverse current fraction applies to the definition of DC current.

The insulation of electrical equipment (distribution box, intermediate distribution boxes, cables, etc.) shall be chemically resistant against potentially occurring organic/inorganic electrolytes as well as against other aggressive fluids. Electrical equipment shall be protected against external influence (e.g. mechanical, thermal, chemical stress). Electrical equipment shall be installed in such a way, that influence of process chemistries on the insulation of the electrical equipment is minimized.

In plating lines, all the metallic components connected to the process tank and in contact with the liquids (e.g. pipes, valves, pumps, sensors) shall be earthed (according to 8.2.1 and 8.2.3 of EN 60204-1:2006) as process chemistries used (e.g. electrolytes) may be electrically conductive.

As far as electrical equipment is concerned, the explosion protection outlined in 4.7.2 shall be considered.

4.3.3 Protective measures against external effects on electrical equipment

All safety-related systems and apparatus shall be constructed and installed in such a way that they cannot be influenced by interaction with electromagnetic fields (in accordance with EN 61000-6-1, EN 61000-6-3, EN 61000-6-4).

Clause 4.4.2 of EN 60204-1:2006 shall be taken into account.

4.3.4 Protective measures against electric sparks / arcs

The cross-section and their conductivity of all electrical supply cables to process tanks shall be sufficiently dimensioned. The current-carrying capacity depends, for example, on the insulation material (thickness and thermal conductivity), laying system (geometry) and environmental temperature.

Connecting points and elements shall be carefully designed. This applies to transition cross sections, surface press capacities (e.g. by tightening torques of screw joints), conductivity, environmental conditions and electrochemical compatibility of contact partners (electro corrosion). In case of need, relaxation aspects (e.g. setting properties of screw joints) are to be considered.

Clauses 12.4 and 12.5 of EN 60204-1:2006 shall be taken into account.

NOTE Detailed information and further guidance can be found, e.g. HD 60634-5-52.

4.4 Safety requirements and protective measures against thermal hazards

4.4.1 General

Plating lines shall be designed and constructed to minimize any risk of injury caused by the following hazards:

- skin contact with hot surfaces (4.4.2);
- skin contact with hot fluids (4.4.3);
- heat radiation and /or convection (4.4.4);
- overheating of process chemistries (4.4.5).