SLOVENSKI STANDARD

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Vitreous and porcelain enamels - Glass-lined apparatus for process plants - Part 3: Thermal shock resistance

Emails und Emaillierungen - Emaillierte Apparate für verfahrenstechnische Anlagen - Teil 3: Temperaturschockbeständigkeit

Emaux vitrifiés - Appareils émaillés pour les installations industrielles - Partie 3 : Résistance au choc thermique

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Foreword

This document (EN 15159-3:2006) has been prepared by Technical Committee CEN/TC 262 “Metallic and other inorganic coatings”, the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by January 2007, and conflicting national standards shall be withdrawn at the latest by January 2007.

EN 15159 is comprised of the following parts, under the general heading *Vitreous and porcelain enamels — Glass-lined apparatus for process plants*

Part 1: *Quality requirements for apparatus, components, appliances and accessories*

Part 2: *Designation and specification of resistance to chemical attack and thermal shock*

Part 3: *Thermal shock resistance*

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, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

1 Scope

This European Standard specifies requirements on thermal shock resistance as well as heating and cooling procedures of standardised glass-lined apparatus, components, accessories, and glass-lined pipes primarily used for process equipment in chemical plants.

It specifies the limits of thermal shock resistance using diagrams (see Figure 1 and Figure 2). For glass-lined steel, a difference is made between a thermal shock on the glass-lined side (by charging an apparatus) versus a thermal shock on the steel side (by heating and cooling an apparatus).

This European Standard applies to operating temperatures from – 25 °C to + 230 °C.

This European Standard is only applicable to enamelled unalloyed and low-alloy carbon steels.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1
glass-lined steel
composite material produced by smelting a vitreous and porcelain enamel coat onto a steel substrate

2.2
shock medium
substance (e.g. steam, aqueous liquids or solids) having a higher or lower temperature than that of the enamel and thus causing a sudden temperature change when brought into contact with the glass-lined surface

2.3
thermal shock
sudden change of temperature either on the glass-lined side or the steel side of the enamel resulting from contact with a shock medium

2.4
wall temperature, T_W
average steel temperature in degrees Celsius, of the enamel

NOTE The wall temperature is often equivalent to the temperature of the heating or cooling medium entering the jacket of the apparatus.

2.5
product temperature, T_P
temperature, in degrees Celsius, of the product which is inside the apparatus in contact with the glass-lined surface or is to be charged into the apparatus

2.6
temperature of heating or cooling medium, T_{HC}
temperature, in degrees Celsius, of the medium (e.g. water, steam, heat transfer oil), which is charged into the jacket of the apparatus for heating or cooling

NOTE Where steam is the heating medium, the temperature of the heating or cooling medium is the condensation temperature at the particular actual pressure in the jacket of the apparatus.

EXAMPLE For saturated steam excess pressure of 0,6 MPa, T_{HC} = 165 °C.

3 Thermal shock diagram

The thermal shock diagram (see Figure 1) defines the limits of thermal shock for a shock medium brought into contact with the glass-lined surface (e.g. when a product is charged into the apparatus and the heating or cooling medium is in the jacket or half pipe coil jacket). These limits of thermal shock depend on the wall temperature, T_W, and the product temperature, T_P.

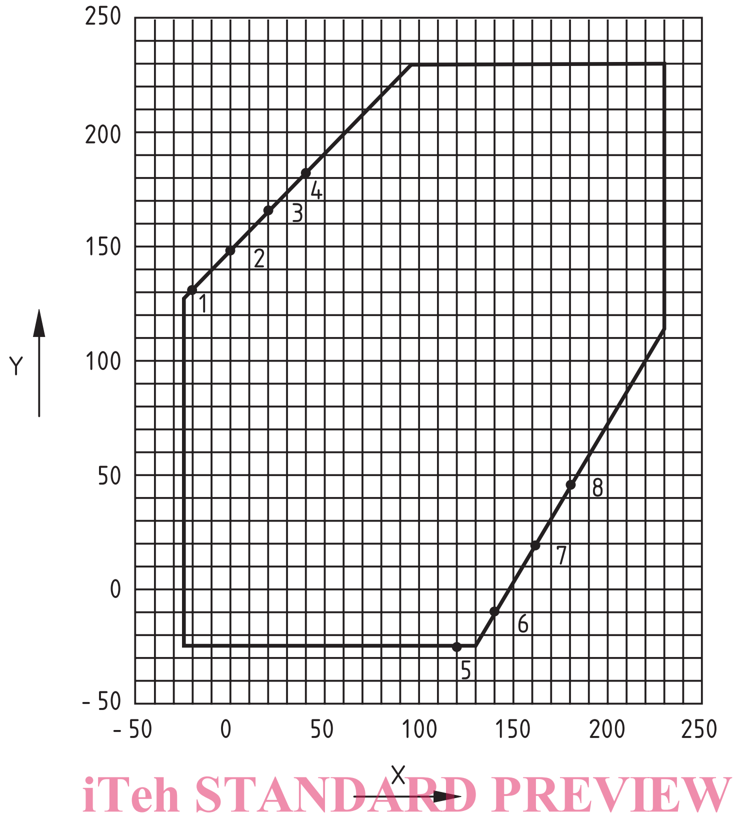
NOTE The values defined in the diagram were calculated on the basis of nearly infinitely high heat transfer coefficients approximately found with aqueous shock media.

Tables 1 and 2 give examples showing the corresponding wall temperature and maximum product temperature.

If the products (e.g. gases, solids, highly viscous fluids) have a relatively low heat transfer coefficient, higher thermal shock limits may be permitted in accordance with the manufacturer (see Annex A).

Table 1 — Charging hot product into a cold apparatus

Example	Wall temperature T_W	Maximum product temperature T_P (rounded)
	°C	°C
1	- 20	130
2	0	150
3	20	165
4	40	180



Key

X Wall temperature, T_W, °C

Y Product temperature, T_P, °C

Figure 1 — Thermal shock diagram for examples 1 to 8 (see Tables 1 and 2) (thermal shock on the glass-lined side of the steel)

Table 2 — Charging cold product into a hot apparatus

Example	Wall temperature T_W	Minimal product temperature T_P (rounded)
	°C	°C
5	120	-25
6	140	-5
7	160	20
8	180	50

4 Diagram for heating and cooling

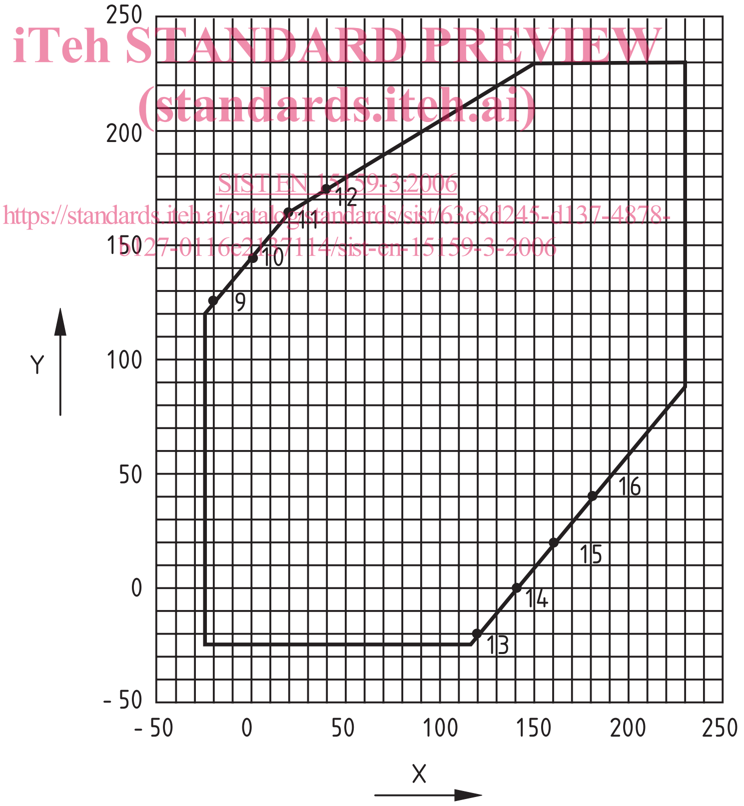
The diagram for heating and cooling (see Figure 2) defines the limits of thermal shock for a shock medium of the enamel brought into contact with the steel wall of the enamel (e.g. when a heating or cooling medium is charged into the jacket or the half pipe coil jacket of an apparatus filled with product). These limits of thermal shock depend on the temperature of the heating or cooling medium, T_{HC}, and of the product, T_P.

NOTE The values defined in the diagram were calculated on the basis of nearly infinitely high temperature transfer coefficients for both the product and the heating or cooling medium. Such coefficients are approximately found with aqueous product, steam as a heating medium or water as a cooling medium.

If the products (e.g. gases, solids, highly viscous fluids) have a relatively low heat transfer coefficient, higher thermal shock limits for heating may be permitted in accordance with the manufacturer.

If relatively low heat transfer coefficients prevail in the jacket (e.g. if heat transfer oil is used as shock medium instead of condensing steam or water), extended thermal shock limits than those shown in Figure 2 may be permitted in accordance with the manufacturer (see Annex A).

Tables 3 and 4 give examples showing the corresponding maximum product temperature and heating and cooling temperature.



Key

X Product temperature, T_P, °C

Y Temperature of heating/cooling medium, T_{HC}, °C

Figure 2 — Diagram for heating and cooling for examples 9 to 16 (see Tables 3 and 4) (thermal shock on the steel-side of the enamel)