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Industrial furnaces and associated processing equipment — Safety —

Part 3: Generation and use of protective and reactive atmosphere gases

Fours industriels et équipements associés — Sécurité —

Partie 3: Génération et utilisation des gaz d'atmosphère protectrice et réactive

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 244, *Industrial furnaces and associated processing equipment.*

ISO 13577 consists of the following parts, under the general title *Industrial furnaces and associated processing equipment — Safety*:

— *Part 1: General requirements*

— *Part 2: Combustion and fuel handling systems*

— *Part 3: Generation and use of protective and reactive atmosphere gases*

— *Part 4: Protective systems*

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Introduction

This part of ISO 13577 is a Type C-Standard as defined in ISO 12100.

The machinery concerned and the extent, to which hazards, hazardous situations and events are covered, is indicated in the scope of this part of ISO 13577.

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

Compliance with product standards, e.g. ISO 22967 or ISO 22968 is not sufficient to ensure the minimum safety requirement for TPE. This part of ISO 13577 shall always have priority for TPE.

Industrial furnaces and associated thermo-processing equipment (TPE) generally consists of the following components:

— processing chamber (e.g. steel construction with lining and/or refractory);

— heating systems;

— protective system;

— control and instrumentation system/operator-control level.

ISO 13577-1 provides the general safety requirements common to TPE. This part of ISO 13577 details in addition specific safety requirements for generation and use of protective and reactive atmosphere gases that are part of TPE as listed in the scope. These requirements establish the minimum acceptable requirements for safety functions required for various processes. Where a process is not part of the TPE, the requirements do not apply.

For example, the minimum requirements for the opening and closing of doors on a TPE does not apply to TPE that do not have doors in their design.

NOTE As stated in its scope, ISO 13577-1 does not cover blast furnaces, converters (in steel plants), boilers and equipment not covered under ISO 12100.

The requirements of protective system are specified in ISO 13577-4.

If a general provision of ISO 13577-1 counters provisions in this part of ISO 13577, the provisions of this part of ISO 13577 take precedence.

It is assumed that TPE will only be operated and maintained by trained personnel.

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Industrial furnaces and associated processing equipment — Safety —

Part 3: Generation and use of protective and reactive atmosphere gases

1 Scope

This part of ISO 13577 specifies safety requirements for generation and use of protective and reactive atmosphere gases that are part of industrial thermo-processing equipment (TPE).

NOTE The general safety requirements common to TPE are provided in ISO 13577-1 (see Introduction).

This part of ISO 13577 deals with significant hazards, hazardous situations and events relevant to the generation and use of protective and reactive atmosphere gases created by thermochemical reactions and their use in TPE that are part of TPE as listed in Clause 4 and Clause 5, when used as intended and under the conditions foreseen by the manufacturer.

This part of ISO 13577 covers

— pipework downstream of and including the manual isolating valve,

— equipment for the generation of atmosphere gases,

— additional equipment for the use of atmosphere gases in TPE,

— safety devices, and

— functional requirements for safety related control system

for the generation and use of protective and reactive atmosphere gases.

It applies to the supply of atmosphere gas, source gas, inert gas and process liquids to TPE and their removal from TPE, confined to equipment integrated in the TPE.

This part of ISO 13577 also details the anticipated significant hazards associated with atmosphere gas systems and their use in TPE and specifies the appropriate preventative measures for the reduction or elimination of these hazards.

The pressure hazard of the piping and components covered by this standard is within the maximum pressure/size relationship of group I as described in Annex C.

This part of ISO 13577

— specifies the requirements to be met to ensure the safety of persons and property during installation, commissioning, start up, operation, shutdown and maintenance,

— does not cover the relevant risks involved in the flue gas ducting system when it is not considered a part of TPE,

— is not applicable to utility supply upstream of the TPE main disconnects,

— does not apply to TPE for semi-conductor devices,

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— does not apply to TPE with atmosphere, such as air and flue gas from an over stoichiometric combustion,

— does not cover the decommissioning of the TPE,

— does not cover vacuum furnaces,

— does not deal with the hazard of noise which is covered in ISO 13577-1,

— is not applicable to generation and use of atmosphere gas in TPE and associated plant which is manufactured before the date of its publication, and

— gives the necessary requirements for the information for use.

A TPE designed according to this part of ISO 13577 does not create any potentially explosive atmosphere in the area around the TPE and is not designed to be located in an area with a potentially explosive or hazardous atmosphere.

A table of typical protective and reactive gases is given in Annex B.

2 Normative references

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

ISO 7-1, *Pipe threads where pressure-tight joints are made on the threads — Part 1: Dimensions, tolerances and designation*

ISO 228-1, *Pipe threads where pressure-tight joints are not made on the threads — Part 1: Dimensions, tolerances and designation*

ISO 5817, *Welding — Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) — Quality levels for imperfections*

ISO 7005-1, *Metallic flanges — Part 1: Steel flanges*

ISO 7005-2, *Metallic flanges — Part 2: Cast iron flanges*

ISO 8434-1, *Metallic tube connections for fluid power and general use — Part 1: 24 degree cone connectors*

ISO 8434-2, *Metallic tube connections for fluid power and general use — Part 2: 37 degree flared connectors*

ISO 8434-3, *Metallic tube connections for fluid power and general use — Part 3: O-ring face seal connectors*

ISO 12100, *Safety of machinery — General principles for design — Risk assessment and risk reduction*

ISO 13574:2015, *Industrial furnaces and associated processing equipment — Vocabulary*

ISO 13577-1:2012, *Industrial furnaces and associated processing equipment — Safety — Part 1: General requirements*

ISO 13577-2:2014, *Industrial furnaces and associated processing equipment — Safety — Part 2: Combustion and fuel handling systems*

ISO 13577-4, *Industrial furnace and associated processing equipment — Safety — Part 4: Protective systems*

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

ISO 19879, *Metallic tube connections for fluid power and general use — Test methods for hydraulic fluid power connections*

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ISO 23551-1, *Safety and control devices for gas burners and gas-burning appliances — Particular requirements — Part 1: Automatic and semi-automatic valves*

ISO 23551-2, *Safety and control devices for gas burners and gas-burning appliances — Particular requirements — Part 2: Pressure regulators*

IEC 60730-2-5:2011, *Automatic electrical controls for household and similar use—Part 2-5: Particular requirements for automatic electrical burner control systems*

IEC 60730-2-6:2007, *Automatic electrical controls for household and similar use—Part 2-6: Particular requirements for automatic electrical pressure sensing controls including mechanical requirements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 13574 and the following apply.

NOTE See Annex J for the list of terms specified in ISO 13574.

3.1
safety shutdown
function that takes the TPE out of operation and brings it in a defined safe state

Note 1 to entry: The definition is different from safety shutdown according ISO 13574:2015, 2.166 which is applicable to ISO 13577-2.

3.2
flame failure
loss of flame from the normally detected position by any cause other than the action of de-energising the automatic shut-off valves system

Note 1 to entry: The term is used in ISO 13577-2.

3.3
gas generator
equipment that converts or modifies a fluid or a mixture of fluids (gaseous or liquid) into a gas which can be utilized as the controlled atmosphere within the thermo-processing equipment

3.4
endothermic generator
gas generator that produces atmosphere gas by an endothermic reaction

3.5
exothermic generator
gas generator that produces atmosphere gas by an exothermic reaction

3.6
combustible atmosphere gas
any gas mixture that is capable of forming ignitable mixtures with air or oxygen under the conditions of temperature and pressure used in the process, according to the lower explosion level (LEL) of the actual gas mixture

3.7
inert gas
non-combustible gas which will not support combustion and does not react at all

Note 1 to entry: Nitrogen, helium and argon are typical inert gases.

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3.8
purge gas
gas which can be used to purge a TPE

Note 1 to entry: A purge gas can safely be used for pre- and post-purging of cold and hot enclosures of TPE.

Note 2 to entry: Typically, purge gases are nitrogen, argon, helium and lean exothermic gas.

3.9
safety purge volume
volume of purge gas needed to displace either air or a combustible gas from a furnace chamber/enclosure to achieve a volume fraction of 1 % or less oxygen and/or a non-combustible atmosphere gas and/or 25 % of the lower flammability limit

Note 1 to entry: Typically, this will be a volume equal to five times the volume of the thermo-processing equipment chamber to be purged, if the purging gas is an inert gas.

Note 2 to entry: Non-combustible atmosphere gas as defined in 3.6.

3.10
multi-turn valve
valve which, in order to operate from the fully closed to the fully open position, requires a number of revolutions of the operating key or handwheel to be completed

3.11
safe ignition temperature
<MAC> minimum temperature at which spontaneous, safe auto-ignition of combustible gases occurs

Note 1 to entry: The safe ignition temperature has been established at 750 °C.

3.12
toxic atmosphere gas
gas which, in addition to having asphyxiating properties, also acts as a poison

3.13
internal gas generator
gas generator integrated into or directly connected to a TPE

3.14
gas control equipment
centralized mounting of components such as: pipework, safety components, pressure and flow accessories, assembled in a functional unit

3.15
atmosphere gas
gas that is supplied into or formed in TPE in accordance with a defined specification for thermo-processes

Note 1 to entry: Atmosphere gas is used to react with the material processed or to avoid a reaction with the material processed.

3.16
process liquids
liquids that are supplied to TPE to create an atmosphere gas

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