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Industrial furnace 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

ICS: 13.100;25.180.01

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 13577-3 was prepared by Technical Committee ISO/TC 244, *Industrial furnaces and associated processing equipment*, Subcommittee SC , .

This second/third/... edition cancels and replaces the first/second/... edition (), [clause(s) / subclause(s) / table(s) / figure(s) / annex(es)] of which [has / have] been technically revised.

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

Introduction

This document 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 document.

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

This DIS 13577-3 assumes that the equipment is not creating any potentially explosive atmosphere and is located in a normally ventilated area.

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

Industrial Furnaces and Associated 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

TPE cover e.g. gas generators, vaporizer, dissociators, pre- and post treatment equipment.

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 fluids 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.

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 takes precedence.

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

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 atmosphere gas 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 or reactive fluids created by thermochemical reactions, and their use in TPE that are part of TPE as listed in Clause 4 and 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

— Functional requirements for safety related control system

for the generation and use of protective or reactive fluids.

It applies to the supply of fluids 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 normative 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.

This part of ISO 13577 does not cover the relevant risks involved in the flue gas ducting system when it is not considered a part of TPE.

This part of ISO 13577 is not applicable to utility supply upstream of the TPE main disconnects.

This part of ISO 13577 does not apply to TPE for semi-conductor devices.

32 This standard does not apply to TPE with atmosphere:

33 — As air

34 — As a flue gas from an over stoichiometric combustion

35 This part of ISO 13577 not covers the decommissioning of the TPE.

36 This part of ISO 13577 not covers vacuum furnaces.

37 This International Standard also gives the necessary requirements for the information for use.

38 This Part of ISO 13577 assumes that the equipment is not creating any potentially explosive atmosphere and
39 is not designed to be located in an area with a potentially explosive atmosphere. .

40 This Part of ISO 13577 assumes that the equipment is not designed to be located in an area with hazardous
41 atmosphere.

42 This standard is not applicable to generation and use of atmosphere gas in TPE and associated plant which is
43 manufactured before the date of its publication as International Standard.

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

45 This part of ISO 13577 does not deal with the hazard of noise. It's covered in ISO 13577-1.

46 **2 Normative References**

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

50 ISO 7-1:1994, *Pipe threads where pressure-tight joints are made on the threads — Part 1: Dimensions,*
51 *tolerances and designation*

52 ISO 49:1994, *Malleable cast iron fittings threaded to ISO 7-1*

53 ISO 228-1:2000, *Pipe threads where pressure-tight joints are not made on the threads — Part 1: Dimensions,*
54 *tolerances and designation*

55 ISO 5817:2003, *Welding - Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding*
56 *excluded) - Quality levels for imperfections*

57 ISO 7005-1:1992, *Metallic flanges —Part 1: Steel flanges*

58 ISO 7005-2:1988, *Metallic flanges — Part 2: Cast iron flanges*

59 ISO 7005-3:1988, *Metallic flanges — Part 3: Copper alloy and composite flanges*

60 ISO 8434-1:1997, *Metallic tube connections for fluid power and general use — Part 1: 24° compression*
61 *fittings*

62 ISO 8434-2:1994, *Metallic tube fittings for fluid power and general use — Part 2: 37° flared fittings*

63 ISO 8434-3:2005, *Metallic tube connections for fluid power and general use — Part 3: O-ring face seal*
64 *connectors*

65 ISO 12100:2010, *Safety of machinery - General principles for design - Risk assessment and risk reduction*

- 66 ISO 13574, *Industrial furnaces and associated thermal processing equipment - Vocabulary*
- 67 ISO 13577-1, *Industrial furnaces and associated processing equipment - Safety – Part 1: General*
68 *requirements*
- 69 ISO 13577-2, *Industrial furnaces and associated processing equipment – Safety – Part 2: Combustion and fuel*
70 *handling systems*
- 71 ISO 13777-4, *Industrial furnaces and associated processing equipment – Safety – Part 4: Protective Systems*
- 72 ISO 13849-1:2006, *Safety of machinery - Safety-related parts of control systems - Part 1: General principles*
73 *for design*
- 74 ISO 19879:2005, *Metallic tube connections for fluid power and general use — Test methods for hydraulic fluid*
75 *power connections*
- 76 ISO 22967:2010, *Forced draught gas burners*
- 77 ISO 22968:2010, *Forced draught oil burners*
- 78 ISO 23551-1:2012, *Safety and control devices for gas burners and gas-burning appliances - Particular*
79 *requirements - Part 1: Automatic valves*
- 80 ISO 23551-2: 2006, *Safety and control devices for gas burners and gas-burning appliances – Particular*
81 *requirements - Part 2: Pressure regulators*
- 82 ISO 23551-3:2005, *Safety and control devices for gas burners and gas-burning appliances – Particular*
83 *requirements - Part 3: Gas/air ratio controls, pneumatic type*
- 84 ISO 23551-4:2005, *Safety and control devices for gas burners and gas-burning appliances – Particular*
85 *requirements - Part 4: Valve-proving systems for automatic shut-off valves*
- 86 ISO 23553-1:2007, *Safety and control devices for oil burners and oil-burning appliances – Particular*
87 *requirements – Part 1: shut off devices for oil burners*
- 88 IEC 61511-1:2003, *Functional safety - Safety instrumented systems for the process industry sector - Part 1:*
89 *Framework, definitions, system, hardware and software requirements*
- 90 IEC 62061:2005, *Safety of machinery - Functional safety of safety-related electrical, electronic and*
91 *programmable electronic control systems*

92 **3 Terms and definitions**

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

94 **3.1**

95 **protective or reactive atmosphere**

96 atmosphere that is used to prevent the oxidization or decarburization of a products surface, or to change
97 property of steel such as carburizing or nitriding

98 [SOURCE: ISO 13574:—, 2.137]

99 **3.2**

100 **flame detector device**

101 shutdown device by which the presence of a flame is detected and signalled; it can consist of a flame sensor,
102 an amplifier and a relay for signal transmission

103 [SOURCE: ISO 13574:—, 2.65]

104 **3.3**
 105 **flame trap**
 106 **flame arrestor**
 107 device fitted to the opening of an enclosure, or to the connecting pipe work of a system of enclosures, and
 108 whose intended function is to allow flow but prevent the transmission of flame

109 [SOURCE: ISO 13574:—, 2.68]

110 **3.4**
 111 **automatic shut-off valve**
 112 valve that opens when energised and closes automatically when de-energized

113 [SOURCE: ISO 13574:—, 2.194]

114 **3.5**
 115 **safety shutdown**
 116 A function that takes the TPE out of operation and brings it in a defined safe state

117 NOTE The definition is different from safety shutdown according ISO 13574:—, 2.166 which is applicable to
 118 ISO 13577-2.

119 **3.6**
 120 **flame failure**
 121 loss of flame from the normally detected position by any cause other than the action of de-energising the
 122 automatic shut-off valves system

123 NOTE The term is used in ISO 13577-2.

124 **3.7**
 125 **atmosphere gas generating system (e.g. gas generator)**
 126 equipment that converts or modifies a fluid or a mixture of fluids (gaseous or liquid) into a gas which can be
 127 utilised as the controlled atmosphere within the thermo-processing equipment

128 **3.8**
 129 **automatic re-start**
 130 automatic repetition of the starting up sequence without manual intervention.

131 **3.9**
 132 **endothermic generator**
 133 gas generator that produces atmosphere gas by an endothermic reaction

134 **3.10**
 135 **exothermic generator**
 136 gas generator that produces atmosphere gas by an exothermic reaction

137 **3.11**
 138 **gas, combustible atmosphere**
 139 any gas mixture that is capable of forming ignitable mixtures with air or oxygen under the conditions of
 140 temperature and pressure used in the process, according to the lower explosion level (LEL) of the actual gas
 141 mixture.

142 NOTE 1 Typically any gas mixture containing more than 5% (V/V) combustibles ($H_2+CO+CH_4$) of which CH_4 is not
 143 more than 1% (V/V), where the remainder of the mixture is non-combustible, is considered to be combustible. Any gas
 144 mixture which contains more than 1% (V/V) C_nH_m or 2,5% (V/V) NH_3 where the remainder of the mixture is non-
 145 combustible is also considered to be combustible (see Annexes B)

146 NOTE 2 A combustible gas which contains 1 % (V/V) or less oxygen cannot in itself form an explosive or combustible
 147 mixture.

148 **3.12**149 **gas, inert**

150 a non-combustible gas which will not support combustion and does not react at all

151 NOTE Nitrogen, helium and argon are typical inert gases. 3.15

152 **3.13**153 **purge gas**

154 a gas which can be used to purge a TPE

155 NOTE 1 A purge gas can safely be used for pre- and post-purging of cold and hot enclosures of TPE.

156 NOTE 2 Typically purge gases are nitrogen, argon, helium and lean exothermic gas.

157 **3.14**158 **purge**

159 forced introduction of a fluid into a pre-determined area, in order to cleanse, by displacement, the existing fluid

160 [SOURCE: ISO 13574:—, 2.141]

161 **3.15**162 **safety purge**163 forced introduction of a defined gas (usually Nitrogen) into the work chamber in order to provide a safe
164 atmosphere for the process

165 [SOURCE: ISO 13574:—, 2.143]

166 **3.16**167 **emergency safety purge**168 *safety purge* (3.15) conducted automatically during an upset or abnormal condition

169 [SOURCE: ISO 13574:—, 2.145]

170 **3.17**171 **safety purge volume**172 the volume of purge gas needed to displace either air or a combustible gas from a furnace
173 chamber/enclosure to achieve 1% (V/V) or less oxygen and/or a non-combustible atmosphere gas (as defined
174 in 3.5) and/or 25% of the lower flammability limit.175 NOTE Typically this will be a volume equal to five times the volume of the thermo-processing equipment chamber to
176 be purged, if the purging gas is an inert gas177 **3.18**178 **valve, multiturn**179 a valve which, in order to operate from the fully closed to the fully open position, requires a number of
180 revolutions of the operating key or handwheel to be completed181 **3.19**182 **temperature, safe ignition (MAC)**

183 the minimum temperature at which spontaneous, safe auto-ignition of combustible gases occurs

184 NOTE The safe ignition temperature has been established at 750 °C.

185 **3.20**186 **toxic atmosphere gas**

187 a gas which, in addition to having asphyxiating properties, also acts as a poison

188 **3.21**189 **gas generator, internal**

190 Gas generator integrated into or directly connected to a TPE