



BSI Standards Publication

# Industrial furnaces and associated processing equipment — Safety

---

Part 2: Combustion and fuel handling systems

This is a preview of BS EN ISO 13577-2:2023. [Click here to purchase the full version from the ANSI store.](#)

## National foreword

This British Standard is the UK implementation of EN ISO 13577-2:2023. It is identical to ISO 13577-2:2023. It supersedes BS ISO 13577-2:2014 and BS EN 746-2:2010, which are withdrawn.

The UK participation in its preparation was entrusted to Technical Committee RHE/13, Liquid fuel firing.

A list of organizations represented on this committee can be obtained on request to its committee manager.

### Contractual and legal considerations

This publication has been prepared in good faith, however no representation, warranty, assurance or undertaking (express or implied) is or will be made, and no responsibility or liability is or will be accepted by BSI in relation to the adequacy, accuracy, completeness or reasonableness of this publication. All and any such responsibility and liability is expressly disclaimed to the full extent permitted by the law.

This publication is provided as is, and is to be used at the recipient's own risk.

The recipient is advised to consider seeking professional guidance with respect to its use of this publication.

This publication is not intended to constitute a contract. Users are responsible for its correct application.

© The British Standards Institution 2024  
Published by BSI Standards Limited 2024

ISBN 978 0 539 17755 8

ICS 13.100; 25.180.01

### Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 January 2024.

### Amendments/corrigenda issued since publication

Date	Text affected
------	---------------

---

This is a preview of BS EN ISO 13577-2:2023. [Click here to purchase the full version from the ANSI store.](#)

## EUROPÄISCHE NORM

December 2023

ICS 13.100; 25.180.01

Supersedes EN 746-2:2010

English Version

## Industrial furnaces and associated processing equipment - Safety - Part 2: Combustion and fuel handling systems (ISO 13577-2:2023)

Fours industriels et équipements associés - Sécurité -  
Partie 2: Équipement de combustion et de manutention  
des combustibles (ISO 13577-2:2023)

Industrielle Thermoprozessanlagen und dazugehörige  
Prozesskomponenten - Sicherheitsanforderungen - Teil  
2: Feuerungen und Brennstoffführungssysteme (ISO  
13577-2:2023)

This European Standard was approved by CEN on 10 June 2023.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and United Kingdom.



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

**CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels**

This is a preview of BS EN ISO 13577-2:2023. [Click here to purchase the full version from the ANSI store.](#)

## European foreword

This document (EN ISO 13577-2:2023) has been prepared by Technical Committee ISO/TC 244 "Industrial furnaces and associated processing equipment" in collaboration with Technical Committee CEN/TC 186 "Industrial thermoprocessing - 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 June 2024, and conflicting national standards shall be withdrawn at the latest by June 2024.

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 document supersedes EN 746-2:2010.

Any feedback and questions on this document should be directed to the users' national standards body/national committee. A complete listing of these bodies can be found on the CEN website.

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

## Endorsement notice

The text of ISO 13577-2:2023 has been approved by CEN as EN ISO 13577-2:2023 without any modification.

This is a preview of BS EN ISO 13577-2:2023. [Click here to purchase the full version from the ANSI store.](#)

## Contents

	Page
<b>Foreword</b> .....	<b>vi</b>
<b>Introduction</b> .....	<b>vii</b>
<b>1 Scope</b> .....	<b>1</b>
<b>2 Normative references</b> .....	<b>2</b>
<b>3 Terms and definitions</b> .....	<b>4</b>
<b>4 Safety requirements, measures and verification means</b> .....	<b>4</b>
4.1 General.....	4
4.1.1 Safety objectives and basic requirements.....	4
4.1.2 Over-temperature protection.....	5
4.1.3 Accumulation of hazardous fluids.....	6
4.1.4 Seismic protection.....	6
4.1.5 Regional requirements.....	6
4.2 Fuel pipework.....	6
4.2.1 General.....	6
4.2.2 Connections.....	6
4.2.3 Unconnected pipework.....	8
4.2.4 Galvanic cells.....	8
4.2.5 Flexible tubing and couplings.....	8
4.2.6 Marking.....	8
4.2.7 Soundness/tightness.....	8
4.2.8 Condensate drains on gas pipework.....	10
4.2.9 Fuel pipe heating.....	10
4.2.10 Purge points.....	10
4.2.11 Pressure relief devices.....	10
4.2.12 Blow-off and breather pipes or conduits.....	10
4.2.13 Equipment supplied with different fuels.....	11
4.2.14 Bypass.....	11
4.2.15 Isolation of required safety devices.....	11
4.3 Required safety devices for gaseous fuels.....	11
4.3.1 Manual isolating valve.....	11
4.3.2 Filter/strainer.....	11
4.3.3 Gas pressure regulator.....	12
4.3.4 Low gas pressure protection.....	12
4.3.5 High gas pressure protection.....	13
4.3.6 Automatic shut-off valves.....	13
4.3.7 Valve proving.....	14
4.3.8 Individual manual shut-off valves for burners.....	15
4.3.9 Flame arrestor.....	15
4.4 Gas pressure boosters.....	15
4.5 Required safety devices for liquid fuels.....	16
4.5.1 Manual isolating valve.....	16
4.5.2 Filter/strainer.....	16
4.5.3 Pressure relief valve.....	16
4.5.4 Liquid fuel pressure regulator.....	16
4.5.5 Pressure regulation of auxiliary fluids.....	16
4.5.6 Liquid fuel and auxiliary fluid pressure protection.....	16
4.5.7 Liquid fuel temperature protection.....	16
4.5.8 Automatic shut-off valves.....	17
4.5.9 Automatic shut-off valves for multiple burners.....	17
4.5.10 Individual manual shut-off valves for multiple burners.....	17
4.6 Combustion air and fuel/air ratio.....	18
4.6.1 Combustion air system.....	18
4.6.2 Air flow and pressure sensing devices.....	18

This is a preview of BS EN ISO 13577-2:2023. [Click here](#) to purchase the full version from the ANSI store.

4.6.3	Air/fuel ratio .....	19
4.7	Supply of pre-mixed fuel gas/air .....	19
4.7.1	Mixture pipework.....	19
4.7.2	Air and gas supply to the mixture circuit.....	19
4.8	Liquid fuel atomisation .....	20
4.9	Burners.....	20
4.9.1	Main burners.....	20
4.9.2	Radiant tube burner systems.....	20
4.9.3	Ignition device/pilot burner .....	20
4.9.4	Permanent pilots .....	21
4.9.5	Burner capacity control .....	21
4.9.6	Flue gas venting.....	21
4.9.7	Purge of residual fuel .....	21
4.10	Automatic burner control systems.....	21
4.10.1	General.....	21
4.10.2	Low-temperature equipment.....	22
4.10.3	High-temperature equipment.....	22
4.10.4	Automatic burner control systems for burners operating in the open air .....	23
4.10.5	Flame supervision for line-burners.....	23
4.11	Start-up of the heating system and burner ignition.....	23
4.11.1	Pre-purging of the combustion chamber.....	23
4.11.2	Start-up of the fuel supply.....	25
4.11.3	Start fuel flow rate.....	25
4.11.4	Ignition.....	25
4.11.5	Maximum safety times for gas-fired natural draught burners .....	25
4.11.6	Maximum safety times for forced and induced draught gas-fired burners .....	26
4.11.7	Maximum safety times for liquid fuel fired burners .....	27
4.11.8	Flame failure on start-up.....	28
4.11.9	Flame failure during operation.....	28
4.12	Multiple fuels.....	29
4.12.1	General.....	29
4.12.2	Fuel circuit.....	29
4.12.3	Combustion air supplies.....	29
4.12.4	Operation of the safety devices.....	29
4.12.5	Air/fuel ratio .....	29
4.13	Oxygen or oxygen-enriched combustion air (OOECA) .....	29
4.13.1	General.....	29
4.13.2	Suitability for oxygen service .....	30
4.13.3	Pipework.....	30
4.13.4	Flow velocities.....	30
4.13.5	Connection for oxygen pipework.....	31
4.13.6	Sealing materials for oxygen pipework.....	31
4.13.7	Fittings.....	31
4.13.8	Blow off and venting lines.....	31
4.13.9	Flexible tubing and couplings.....	31
4.13.10	Safety devices against backflow .....	31
4.13.11	Material requirements.....	31
<b>5</b>	<b>Verification of the safety requirements and/or measures .....</b>	<b>32</b>
<b>6</b>	<b>Information for use .....</b>	<b>36</b>
6.1	General.....	36
6.2	Marking.....	36
6.3	Instruction handbook.....	36
6.3.1	General.....	36
6.3.2	Description of equipment.....	36
6.3.3	Inspection procedures .....	37
6.3.4	Commissioning, start-up and operating procedures .....	37

This is a preview of BS EN ISO 13577-2:2023. [Click here to purchase the full version from the ANSI store.](#)

6.3.5	Shutdown procedures .....	37
6.3.6	Maintenance procedures.....	38
6.3.7	Documentation.....	38
<b>Annex A</b>	<b>(informative) List of significant hazards.....</b>	<b>39</b>
<b>Annex B</b>	<b>(informative) Examples of fuels.....</b>	<b>41</b>
<b>Annex C</b>	<b>(normative) Maximum allowed pressure.....</b>	<b>42</b>
<b>Annex D</b>	<b>(informative) Examples for the determination of safety integrity level (SIL) or performance level (PL) using the risk graph method .....</b>	<b>47</b>
<b>Annex E</b>	<b>(normative) Regional product standards.....</b>	<b>58</b>
<b>Annex F</b>	<b>(informative) Example for manual leak check of automatic shut-off valves.....</b>	<b>63</b>
<b>Annex G</b>	<b>(informative) Example of piping and components.....</b>	<b>65</b>
<b>Annex H</b>	<b>(informative) Methods for burner start-up .....</b>	<b>76</b>
<b>Annex I</b>	<b>(informative) Requirements specific to Japan .....</b>	<b>91</b>
<b>Annex J</b>	<b>(informative) Requirements specific to the USA.....</b>	<b>95</b>
<b>Annex K</b>	<b>(informative) Requirements for Europe and associated countries .....</b>	<b>99</b>
<b>Bibliography</b>	<b>.....</b>	<b>102</b>

This is a preview of BS EN ISO 13577-2:2023. [Click here to purchase the full version from the ANSI store.](#)

## 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 document 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](http://www.iso.org/directives)).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at [www.iso.org/patents](http://www.iso.org/patents). ISO shall not be held responsible for identifying any or all such patent rights.

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

For an explanation of the voluntary nature of standards, 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 [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 244, *Industrial furnaces and associated processing equipment*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 186, *Industrial thermoprocessing - Safety*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 13577-2:2014), which has been technically revised.

The main changes are as follows:

- revised document structure with requirements consolidated for the different fuels;
- improvement and specification of the requirements for testing the fuel pipework after construction;
- addition of requirements for gas pressure boosting systems;
- integration of selected requirements from the regional annexes into the global standard text;
- requirements for solid fuels removed;
- additional informative annex listing relevant product standards for components in the different regions.

A list of all parts in the ISO 13577 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

This is a preview of BS EN ISO 13577-2:2023. [Click here to purchase the full version from the ANSI store.](#)

## Introduction

This document is a type-C standard as defined in ISO 12100:2010.

This document is of relevance, in particular, for the following stakeholder groups representing the market players with regard to machinery safety:

- machine manufacturers (small, medium and large enterprises);
- health and safety bodies (regulators, accident prevention organisations, market surveillance etc.)

Others can be affected by the level of machinery safety achieved with the means of the document by the above-mentioned stakeholder groups:

- machine users/employers (small, medium and large enterprises);
- machine users/employees (e.g. trade unions, organizations for people with special needs);
- service providers, e.g. for maintenance (small, medium and large enterprises);
- consumers (in case of machinery intended for use by consumers).

The above-mentioned stakeholder groups have been given the possibility to participate at the drafting process of this document.

The machinery/equipment concerned and the extent to which hazards, hazardous situations or hazardous events are covered, is indicated in the Scope of this document.

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

This document assumes that the equipment is installed in a ventilated area and does not create any potentially explosive atmosphere. The installation of a TPE in accordance with the requirements of this document will not by itself require a change to the classification of the TPE location according to IEC 60079-10-1:2020.

Conformance with product standards, e.g. ISO 22967:2010 or ISO 22968:2010 is not sufficient to ensure the minimum safety requirements for industrial furnaces and associated processing equipment (TPE). This document always has priority for TPE.

Industrial furnaces and associated processing equipment (TPE) generally consist 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 13577-1:2016 provides the general safety requirements common to TPE. This document details in addition specific safety requirements for combustion and fuel handling systems that are part of TPE as listed in the Scope.

The requirements for protective systems are specified in ISO 13577-4:2022.

The requirements for reducing hazards from noise are given in ISO 13577-1:2016.

It is assumed that TPE are operated and maintained by trained personnel.

This is a preview of BS EN ISO 13577-2:2023. [Click here to purchase the full version from the ANSI store.](#)

This is a preview of BS EN ISO 13577-2:2023. Click here to purchase the full version from the ANSI store.

# Industrial furnaces and associated processing equipment — Safety —

## Part 2: Combustion and fuel handling systems

### 1 Scope

This document specifies the safety requirements for combustion and fuel handling systems that are part of industrial furnaces and associated processing equipment (TPE), including single and multiple burner systems in thermoprocessing equipment and machines.

**NOTE** The general safety requirements common to TPE are provided in ISO 13577-1:2016. ISO 13577-1:2016, Annex B also includes a list of processes for which industrial furnaces and heating systems covered by the ISO 13577 series are used.

This document deals with significant hazards, hazardous situations and events relevant to combustion and fuel handling systems as listed in [Annex A](#), when used as intended and under the conditions for use as described in the instruction handbook.

This document covers:

- fuel pipework downstream of and including the manual isolating valve;
- combustion air supply (including oxygen and oxygen enriched combustion air) and flue gas system;
- burner(s), burner system and ignition device;
- functional requirements for safety related control system.

This document applies to any oxidation of gaseous and liquid fuels with air or other gases containing free oxygen to release thermal energy in TPE. [Annex B](#) includes examples of gaseous and liquid fuels.

For thermal or catalytic post combustion and waste incineration, this document applies only to auxiliary burners designed to start-up and/or support the process.

The pressure hazard of the piping and components covered by this document is within the maximum pressure/size relationship of category I as specified in [Annex C](#).

This document also gives the necessary requirements regarding information for use.

This document does not cover hazards from heating generated by electricity.

This document does not deal with the hazards created by the release of flammable substances from the products processed in the TPE.

This document is not applicable to combustion and fuel handling systems:

- of gas welding and allied processes;
- up-stream of the TPE manual isolating valve.

This document is not applicable to industrial furnaces and associated processing equipment (TPE), including single and multiple burner systems in thermoprocessing equipment and machines manufactured before the date of its publication.