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**General safety code for industrial
combustion furnaces—Part 1:
General requirements**

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Foreword

This Japanese Industrial Standard has been established by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee according to the proposal for establishment of Japanese Industrial Standard submitted by Japan Industrial Furnace Manufacturers Association (JIFMA)/Japanese Standards Association (JSA) with a draft being attached, based on the provision of Article 12, paragraph (1) of the Industrial Standardization Act. This Standard partially replaces **JIS B 8415**:2008, which has been withdrawn.

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JIS B 8415 series consists of the following 3 parts under the general title *General safety code for industrial combustion furnaces*—:

Part 1: General requirements

Part 2: Combustion and fuel handling systems

Part 3: Protective systems

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General safety code for industrial combustion furnaces—Part 1: General requirements

Introduction

This Japanese Industrial Standard has been prepared based on **ISO 13577-1:2016**, Edition 2, with some modifications of the technical contents.

The vertical lines on both sides and dotted underlines indicate changes from the corresponding International Standard. A list of modifications with the explanations is given in Annex JB.

This Standard is a type-C standard as defined in **JIS B 9700**.

The machinery concerned and the extent to which hazards, hazardous situations or hazardous events are covered are indicated in the scope of this Standard.

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 Standard shall always be used and take precedence for industrial combustion furnaces and associated devices.

Industrial combustion furnaces and associated devices generally consists of the following components:

- processing chambers (e.g. steel construction with lining and/or refractory-lined);
- combustion and fuel handling systems;
- protective system;
- control and instrumentation system.

This Standard specifies the general safety requirements common to industrial combustion furnaces and associated devices. If the provisions of this Standard conflict with those specified in **JIS B 8415-2**, the provisions of **JIS B 8415-2** shall take precedence.

Industrial combustion furnaces and associated devices are assumed to be operated by trained furnace operators.

1 Scope

This Standard specifies the general safety requirements for the industrial combustion furnaces and associated devices (hereafter referred to as the combustion furnaces) heated by gaseous fuel and liquid fuel in the industrial field as shown in the following a) to d).

Further, this Standard specifies the requirements to secure the safety of persons and devices against serious hazards such as predictable mistakes and malfunctions which can occur in the course of commissioning, operation and maintenance.

- a) equipment of metallurgic/metallic processing plant
- b) equipment of glass manufacturing plant
- c) equipment in ceramics manufacturing plant
- d) equipment in cement/quicklime/gypsum manufacturing plant

The details of industrial combustion furnaces to be applied are shown in Annex B.

This Standard is not applicable to the following:

- equipment in chemical plant and petroleum plant;
- waste incineration equipment;
- blast furnace and converter furnace in ironmaking plant;
- ambient gas generating device generating flammable gas, and ambient gas;
- equipment for burning in open space;
- equipment supplying flammable gas generated from heated materials (e.g. coke oven)

NOTE 1 An example of list of significant hazards is shown in Annex A.

NOTE 2 The International Standard corresponding to this Standard and the symbol of degree of correspondence are as follows.

ISO 13577-1:2016 *Industrial furnaces and associated processing equipment—Safety—Part 1: General requirements* (MOD)

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS B 8415-2 *General safety code for industrial combustion furnaces—Part 2: Combustion and fuel handling systems*

NOTE Corresponding International Standard: ISO 13577-2 *Industrial furnaces and associated processing equipment—Safety—Part 2: Combustion and fuel handling systems*

JIS B 8415-3 *General safety code for industrial combustion furnaces—Part 3: Protective systems*

NOTE Corresponding International Standard: ISO 13577-4 *Industrial furnace and associated processing equipment—Safety—Part 4: Protective systems*

JIS B 9700 *Safety of machinery—General principles for design—Risk assessment and risk reduction*

NOTE Corresponding International Standard: ISO 12100:2010 *Safety of machinery—General principles for design—Risk assessment and risk reduction*

- JIS B 9703 *Safety of machinery—Emergency stop function—Principles for design*
NOTE Corresponding International Standard: ISO 13850 *Safety of machinery—Emergency stop function—Principles for design* (IDT)
- JIS B 9710 *Safety of machinery—Interlocking devices associated with guards—Principles for design and selection*
NOTE Corresponding International Standard: ISO 14119 *Safety of machinery—Interlocking devices associated with guards—Principles for design and selection*
- JIS B 9711 *Safety of machinery—Minimum gaps to avoid crushing of parts of the human body*
NOTE Corresponding International Standard: ISO 13854 *Safety of machinery—Minimum gaps to avoid crushing of parts of the human body*
- JIS B 9713-2 *Safety of machinery—Permanent means of access to machinery—Part 2: Working platforms and walkways*
NOTE Corresponding International Standard: ISO 14122-2 *Safety of machinery—Permanent means of access to machinery—Part 2: Working platforms and walkway*
- JIS B 9713-3 *Safety of machinery—Permanent means of access to machinery—Part 3: Stairs, stepladders and guard-rails*
NOTE Corresponding International Standard: ISO 14122-3 *Safety of machinery—Permanent means of access to machinery—Part 3: Stairs, stepladders and guard-rails*
- JIS B 9716 *Safety of machinery—Guards—General requirements for the design and construction of fixed and movable guards*
NOTE Corresponding International Standard: ISO 14120 *Safety of machinery—Guards—General requirements for the design and construction of fixed and movable guards*
- JIS B 9718 *Safety of machinery—Safety distances to prevent hazard zone being reached by upper and lower limbs*
NOTE Corresponding International Standard: ISO 13857 *Safety of machinery—Safety distances to prevent hazard zones being reached by upper and lower limbs*
- JIS B 9960-1 *Safety of machinery—Electrical equipment of machines—Part 1: General requirements*
NOTE 1 Corresponding International Standard: IEC 60204-1 *Safety of machinery—Electrical equipment of machines—Part 1: General requirements*
NOTE 2 The corresponding International Standard refers to **IEC 60204-1:2009**.
- JIS C 60079-0 *Explosive atmospheres—Part 0: Equipment—General requirements*
NOTE Corresponding International Standard: IEC 60079-0 *Explosive atmospheres—Part 0: Equipment—General requirements*
- JIS C 6802 *Safety of laser products*

NOTE Corresponding International Standard: IEC 60825-1 *Safety of laser products—Part 1: Equipment classification and requirements*

ISO 13732-1 *Ergonomics of the thermal environment—Methods for the assessment of human responses to contact with surfaces—Part 1: Hot surfaces*

ISO 15534-1 *Ergonomic design for the safety of machinery—Part 1: Principles for determining the dimensions required for openings for whole-body access into machinery*

ISO 15534-2 *Ergonomic design for the safety of machinery—Part 2: Principles for determining the dimensions required for access openings*

IEC 62598 *Nuclear instrumentation—Constructional requirements and classification of radiometric gauges*

3 Terms and definitions

For the purpose of this Standard, the terms and definitions given in **JIS B 9700**, and the following apply.

3.1

protective system

instrumented system used to implement one or more safety related instrumented functions

A protective system is composed of any combination of sensor(s), logic solver(s) and final elements.

NOTE 1 This can include either safety related instrumented control functions or safety related instrumented protection functions, or both.

NOTE 2 See **2.138** of **ISO 13574**.

3.2

guard

physical barrier, designed as part of the machine to provide protection

NOTE 1 A guard acts as follows.

- alone: only effective when “closed” (for a movable guard) or “securely held in place” (for a fixed guard)
- in conjunction with an interlocking device with or without guard locking: protection is ensured whatever the position of the guard

NOTE 2 Depending on its construction, a guard may be described as, for example, casing, shield, cover, screen, door, enclosing guard.

NOTE 3 The definition of this term is partially quoted from **3.27** of **JIS B 9700**.

3.3

safety device

device used for implementation of protective functions, either by alone or as a part of protective system

NOTE Sensors, limiters, flame monitors, burner control systems, logic systems, operation terminals and automatic shut-off valves are included.

4 Safety requirements and protective measures

4.1 General

4.1.1 General requirements

The combustion furnaces shall comply with the safety requirements and protective measures described in this clause, and shall be verified in accordance with Clause 5. In addition, the combustion furnaces shall be designed in accordance with the principles of **JIS B 9700** for relevant hazards (but not significant hazards) which are dealt with by this Standard.

Anticipated significant hazards are listed in Table A.1.

For ease of reference, Table A.1 also indicates the corresponding preventive measures, and should be used in conjunction with Clauses 4, 5 and 6.

Where particular requirements of Part 2 and Part 3 of **JIS B 8415** apply, they shall supplement or modify these general safety requirements.

4.1.2 Design and construction requirements

4.1.2.0A General

The manufacturer shall maintain evidence that all safety requirements of the design have been satisfied.

The structural assembly, steel sections, auxiliaries and utilities that form part of equipment shall be stable and suitable for function and the intended use.

In particular, the design shall include solutions and constructional details relating to the following:

- static stability of equipment, including structures intended for containing the processed materials and the materials entering and leaving the combustion furnaces;
- accessibility;
- maintenance and cleaning clearances;
- movement of material and machinery;
- safety in operation;
- health and safety at the workplace;
- protection against fire and prevention of explosion;
- emissions from the process;
- protection against earthquakes.

Cut-off, regulating and measuring devices, and pipework and tanks carrying or containing fluids, which are likely to solidify and/or have high viscosity, shall be protected against the effects of solidification and subsequent blockage.

If internal parts of equipment require frequent inspection, they shall be provided with lighting appropriate to the structure and the nature of the process, or the user shall be advised in the instruction handbook to install suitable lighting.

The design of combustion furnace and the action of the regulating and safety devices shall prevent

- a) unintended release of flammable or hazardous fluids to the outside of the equipment,
- b) a backflow of flammable or hazardous fluids to pipework not intended for such fluids, and
- c) flashback in the pipework.

The safety devices shall

- be suitable for the range of adjustment required for the regulation of equipment, and
- not cause one device inadvertently to over-ride another.

Safety devices shall be fitted in such a manner that they are accessible and protected against harmful effects. In particular, they shall withstand continuous operation in the area in which they are to be used. Auxiliary fluids (e.g. lubricants, dielectrics, diathermic and dynamic fluids) shall be selected to minimize the hazard of their products of combustion resulting from a fire.

Drains that form part of equipment shall discharge into a suitably isolated sump. Means shall be provided for the collection and removal of such discharges.

Pipework distribution systems forming part of equipment shall be designed to withstand corrosion.

Pipework distribution systems of the device that can become dangerous if subjected to wide variations in temperature or pressures, or extreme fluctuation in voltage, the hazard shall be marked.

4.1.2.1 Stability

The equipment structures shall be designed to withstand their static and dynamic loads. The equipment shall be designed for normal and foreseeable accidental thermal static and dynamic working stresses (including those resulting from overpressurization or operation below atmospheric pressure).

The design should also take account of vibration, wind pressure, impact, earthquakes and other foreseeable external forces.

4.1.2.2 Accessibility

All parts of equipment that need to be accessed by personnel for operation and maintenance shall be served by adequate means of access, preferably fixed. Stairways, platforms and service floors shall be safe and shall be equipped with adequate safeguards (see **4.2.10**). Inspection and service floors shall be safe, well lit/ventilated, protected against heat radiation and be fire-resistant (see **4.4.3.1**).

The design should take account of the need for emergency escape routes to avoid the trapping of personnel in the event of hazardous situations (such as fire or buildup of toxic gases).

4.1.2.3 Roofs and covers

Where the roofs or covers of equipment have been designed to be walked on, they shall be accessible by a safe means.

Roofs or covers to which access is not intended shall be marked and designated as “not accessible” and shall be adequately guarded to prevent access.

Roofs or covers that have to be walked on for operating, maintenance and inspection purposes and that are more than 1 m above floor level shall be accessible through safe ascents and shall be fitted with railings to prevent falls. Where the heat source is located in the roof (e.g. in the ceramics or glass industry), one escape route shall be available in front of, and one behind, the firing zone, one of which shall be a stairway. For design requirements, see **4.1.2.4**.

4.1.2.4 Access channels and stairs

In general, the design of access channels and stairs shall be in accordance with **JIS B 9713-2** and **JIS B 9713-3**. For channels intended for repair purposes below tunnel furnaces or kilns, the unobstructed passage way shall be at least 1.8 m high by 0.7 m wide, and shall be accessible through two stairways.

4.2 Mechanical safety

4.2.1 General

The design shall be such as to avoid injury by movement of the machinery parts of equipment, by crushing, shearing, entanglement, drawing-in or impact. It shall also prevent hazardous situations arising where high-pressure fluids are used or where parts of equipment and materials to be processed are liable to be ejected. The stability of combustion furnace during operation and the safety of the access areas around the equipment shall also be considered.

Where the construction of equipment includes the following, they shall be protected and marked in such a way as to minimize the hazard:

- corners and projections;
- passages of reduced height, and
- manhole covers, drains, etc.

The principles for design of emergency stop shall be in accordance with **JIS B 9703**.

4.2.2 Crushing

The design shall incorporate means to minimize hazard to personnel arising from

- movement of material and machinery;
- automation,
- suspended loads,
- falling materials, and
- moving parts.

All moving machinery that can present a hazard shall be guarded wherever practicable. Where guarding is not practicable, audible and/or visual signals shall be provided. Strategically positioned emergency stop mechanisms shall be provided to stop potentially hazardous moving machinery.

A fixed guard or a guard with interlocking, where provided, shall be in accordance with **JIS B 9710** and **JIS B 9716**.

Any traversing part of the equipment or material carried by it shall not be closer to any fixed structure than the safety distance requirements given in **JIS B 9711**.

In designing the equipment, a minimum distance (e.g. a gap) for avoiding a hazard of crushing any part of a human body should be taken into consideration. The design of the equipment should take account of the minimum distance requirement specified in **JIS B 9711**, **JIS B 9718**, **ISO 15534-1** and/or **ISO 15534-2**.

4.2.3 Shearing

Where possible, shear traps shall be eliminated by

- a) filling the gaps or reducing the maximum clearance between the moving parts, such that parts of the body cannot enter the gap, and
- b) increasing the minimum clearance between the moving parts to eliminate shear hazard.

Where it is not possible to avoid the creation of a shear trap, adequate guarding shall be used (see **JIS B 9710** and **JIS B 9716**).

Means shall be provided to prevent unintentional closure/opening of moving parts (e.g. doors, conveyors, elevators) during operation and maintenance.

4.2.4 Entanglement

Design measures shall be taken, or suitable guards shall be provided, to prevent entanglement by rotating shafts, conveyors and transmission machinery (see **JIS B 9710** and **JIS B 9716**).

4.2.5 Drawing-in

Design measures shall be taken, or suitable guards shall be provided, to avoid drawing-in (see **JIS B 9710** and **JIS B 9716**).

4.2.6 Impact

The speed, force or torque, and inertia of the moving parts shall be kept to a minimum by the design, in order to reduce the possibility of injury. Where this is not practicable, adequate guarding or safety devices shall be provided (see **JIS B 9710** and **JIS B 9716**). Where guarding or safety devices cannot be provided, a perimeter fence shall be provided.

NOTE Impact hazards are caused by objects that act against the inertia of the body but do not penetrate.

4.2.7 High-pressure fluid ejection

In order to minimize the risk of injury caused by the ejection of fluids, such as compressed air, steam and high-pressure hydraulic oil or water,

- all components within the system shall be operated within their manufacturer's specifications and all parts of the system shall be protected against overpressure,
- verification of leak tightness shall be achieved by pressure testing to at least the intended operating pressure, and
- any pressure relief device shall be verified by testing in accordance with the manufacturer's instruction handbook.

Pipework should be permanent. Where the use of flexible pipework is unavoidable, a device suitable for the most arduous duty and operating conditions likely to be experienced shall be used. If flexible pipework is used for hydraulic oil pressure part, it shall be shielded from ignition sources (e.g. hot surfaces). The replacement interval shall be described in the instruction handbook.

NOTE For gas and liquid fuels, **JIS B 8415-2** specifies requirements for pipework including flexible hoses.

4.2.8 Ejection of parts

In order to minimize the risk that a body can be crushed or penetrated by material or parts of the equipment that have been ejected unexpectedly or accidentally, adequate guarding shall be provided (see **JIS B 9710** and **JIS B 9716**).

4.2.9 Slip/trip

Working platforms shall be designed so as to provide a level standing space of adequate size, with a firm foothold. Walkways shall be made from materials that are as slip resistant as practicable under working conditions, and suitable guard rails, posts and toe boards shall be provided.

Where necessary, a fixed access ladder with handholds or a stairway with handrails or some other suitable means shall be provided to give safe and convenient access to all equipment needing adjustment, lubrication or maintenance.

4.2.10 Falls

Where the design of equipment or the movement of equipment requires floor openings that can constitute a hazard, automatic guards, safety warning devices (see **6.3**) or barriers shall be provided.

4.2.11 Transport

Where applicable, the equipment shall be designed for transport. Instructions for transport shall be provided.

4.3 Electrical safety

4.3.1 Electrical device of equipment

4.3.1.1 General

An electrical device located up to the defined equipment limits shall be suitable for their function and intended use. A risk assessment shall be done for each emergency condition and the results shall determine the action to take on the power supply to the equipment.

An electrical device of equipment shall be in accordance with **JIS B 9960-1**. However, the requirements to meet **JIS B 9961** and/or **JIS B 9705-1** described in **9.4.1** of **JIS B 9960-1** are not applicable where the requirements of the protective system specified in **JIS B 8415-3** apply.

The functional requirements to which the protective systems according to **JIS B 8415-3** apply are specified in the other parts of this Standard.

Pipework that conveys flammable fluids shall not be installed in ducts, pipes or trenches carrying electrical conductors, unless an explosion-proof method is provided in accordance with **JIS C 60079-0** suitable for the applicable hazardous area.

Where it is necessary during commissioning, re-commissioning, maintenance or fault-finding operations to gain access to live parts, appropriate interlocks, protection systems or guarding shall be incorporated (see **JIS B 9710** and **JIS B 9716**).

Adequate grounding or other means should be taken to minimize the risk due to static electricity.

Electrical conductors and electrical devices shall not be located in areas affected by hot parts, openings of furnace or hot gas discharge, etc.

4.3.1.2 External influences

The equipment shall be designed to minimize hazards resulting from foreseeable external influences on the power supply, controls and systems.

Disconnection and/or restoration of the power supply shall not cancel the safety and interlock conditions.

The electrical control system shall be suitably protected or guarded against mechanical damage from operations within the equipment environment.

NOTE Such influences can be beyond the boundaries of combustion furnace defined within the scope of this Standard and are intended to be dealt with in contract with/among the supplier, agent importers and/or users of the equipment.

4.4 Thermal and cryogenic safety

4.4.1 General

The manufacturer shall design the combustion furnace to prevent unintended contact with workpieces, flames, surfaces or devices, which can be at elevated temperatures or below ambient temperatures.

NOTE Such influences can be beyond the boundaries of combustion furnace defined within the scope of this Standard and are intended to be dealt with in contract with/among the supplier, agent importers and/or users of the equipment.

4.4.2 Contact with hot or cold surfaces

Precautions shall be taken to prevent contact with operating controls at elevated or below ambient temperature either accidentally or while operating them.

Where it is not possible, for process reasons or other constraints, to maintain surface temperature at an appropriate level, means should be taken to prevent hot operating controls from being touched. Wherever possible, this shall be made by means of guards in accordance with **JIS B 9716**.

If these means are not practicable, areas of elevated temperatures shall be indicated by means of suitable marking, warning signs, etc. (see **6.3.4**). In addition, the presence of such hazards shall be described in the instruction handbook.