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Second edition
2023-05

Safety and control devices for gas burners and gas-burning appliances — Particular requirements —

Part 8: Multifunctional controls

Dispositifs de commande et de sécurité pour les brûleurs et les appareils à gaz — Exigences particulières —

Partie 8: Equipements multifonctionnels

Reference number
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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 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).

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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.

This document was prepared by Technical Committee ISO/TC 161, *Controls and protective devices for gaseous and liquid fuels*.

This second edition cancels and replaces the first edition (ISO 23551-8:2016), which has been technically revised. It also incorporates the Amendment ISO 23551-8:2016/Amd. 1:2019.

The main changes are as follows:

— the document has been updated to align technically and with the revised format of ISO 23550:2018;

— the document has been updated to align technically and with the relevant latest editions of ISO 23551 series, referenced herein;

— specific regional requirements have been moved from annexes into the main body of the document.

A list of all parts in the ISO 23551 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.

Introduction

This document is designed to be used in combination with ISO 23550 and relevant parts of the ISO 23551 series. Together with both ISO 23550 and the ISO 23551 series, this document establishes the full requirements as they apply to the product covered by this document.

Where needed, this document adapts ISO 23550 by stating the corresponding clause number and adding:

— “with the following modification”;

— “with the following addition”;

— “is replaced by the following”; or

— “is not applicable”.

In order to identify specific requirements that are particular to this document, that are not already covered by ISO 23550, this document contains certain clauses or subclauses that are additional to the structure of ISO 23550. These subclauses are indicated by the introductory sentence: “Subclause (or Annex) specific to this document."

To ensure global relevance of this document, the differing requirements resulting from practical experience and installation practices in various regions of the world have been taken into account. The variations in basic infrastructure associated with gas controls and appliances have also been recognized, some of which are addressed in Annexes F, G and H. This document intends to provide a basic framework of requirements that recognize these differences.

Safety and control devices for gas burners and gas-burning appliances — Particular requirements —

Part 8: Multifunctional controls

1 Scope

This document specifies safety, construction, performance and testing requirements of multifunctional controls (MFC) intended for use with gas burners, gas appliances and appliances of similar use.

This document applies to an MFC with declared maximum inlet pressures up to and including 50 kPa (500 mbar) of nominal connection sizes up to and including DN 150 for use on burners or in appliances using gases such as natural gas, manufactured gas or liquefied petroleum gas (LPG). It is not applicable to corrosive and waste gases.

An MFC consists of two or more functions, at least one of which is a mechanical control, as specified in the relevant control standards.

This document is also applicable to construction and performance requirements for components of burner ignition systems as specified in Annex K. The requirements and test methods in Annex K include optional type testing and evaluation of these components.

This document is applicable to:

— water-operated gas valves (see Annex I);

— overheating safety devices (OSDs) (see Annex J); and

— optional requirements for components of burner control systems (see Annex K).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 23550:2018, *Safety and control devices for gas and/or oil burners and appliances — General requirements*

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

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

ISO 23551-4, *Safety and control devices for gas burners and gas-burning appliances — Particular requirements — Part 4: Valve-proving systems for automatic shut-off valves*

ISO 23551-5, *Safety and control devices for gas burners and gas-burning appliances — Particular requirements — Part 5: Manual gas valves*

ISO 23551-6, *Safety and control devices for gas burners and gas-burning appliances — Particular requirements — Part 6: Thermoelectric flame supervision controls*

ISO 23551-9, *Safety and control devices for gas burners and gas-burning appliances — Particular requirements — Part 9: Mechanical gas thermostats*

ISO 23551-10, *Safety and control devices for gas burners and gas-burning appliances — Particular requirements — Part 10: Vent valves*

IEC 60730-1:2020, *Automatic electrical controls — Part 1: General requirements*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 23550 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1 General terms

3.1.1
multifunctional control
MFC
combination of two or more controls, at least one of which is a mechanical control, whereby the functional parts cannot operate if separated

3.1.2
closing mechanism
part of the actuating mechanism that operates the closure member to the closed position guaranteeing the gas shut-off function with the required tightness

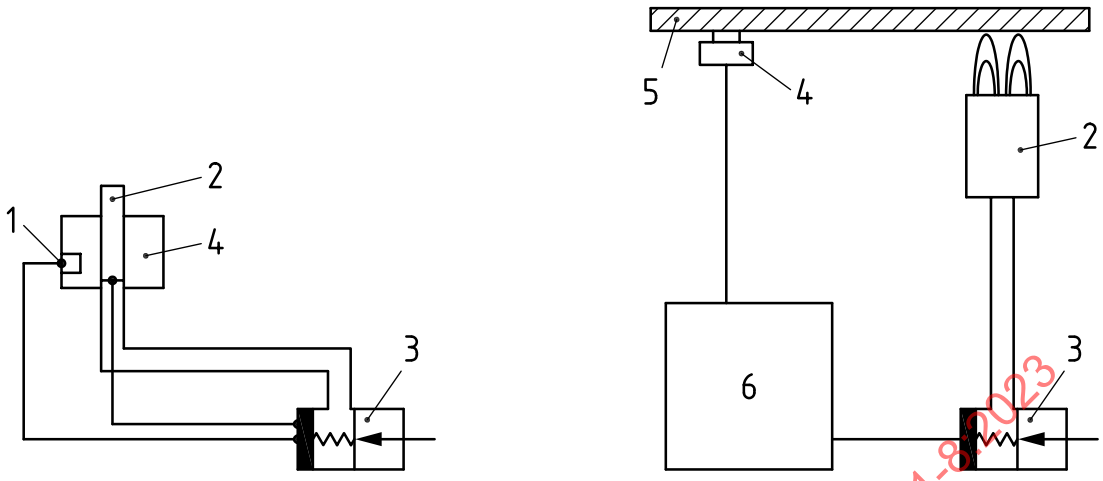
3.1.3
water operated gas valve
device that uses flow of water to control the flow of gas

3.1.4
overheating safety device
OSD
temperature-sensing device which is intended to keep temperature below one particular value during abnormal operating conditions of the appliance and which has no provision for setting by the end user

Note 1 to entry: These devices usually use a thermistor or a bimetal sensing part (element).

3.1.5
OSD sensor
part of the overheating safety device control which is intended to be exposed to the influences of the activating quantity to which the automatic action of a sensing control responds

Note 1 to entry: Examples of OSDs are shown in Figure 1.



a) Example a) **b) Example b)**

Key

1	thermo-electric flame supervision control	4	OSD sensor
2	burner	5	object to be measured (heated by burner)
3	gas shut-off valve	6	burner control unit

Figure 1 — Examples of OSDs

3.1.6
overheating temperature
temperature at which the OSD functions to turn off the gas supply to the burner during abnormal operating conditions of the appliance

3.1.7
thermistor
thermally sensitive semiconductor resistor, which shows over at least part of its resistance/temperature (R/T) characteristic a significant non-linear change in its electrical resistance with a change in temperature

[SOURCE: IEC 60730-1:2020, J.2.15.1]

3.1.8
bimetal
object that is composed of two separate metals joined together

3.2 Definitions pertaining to component parts of burner control systems

3.2.1
pilot burner
burner which provides a flame to ignite a main burner(s)

Note 1 to entry: Herein after referred to as a pilot.

3.2.2
sensing element temperature limit
temperature below which the sensing element will act to shut off the fuel supply

3.2.3
intermittent/continuous ignition
type of ignition which is ignited or energized upon equipment user initiation of the operational cycle and which remains continuously ignited or energized during the operational cycle then extinguished or de-energized when the operational cycle is completed

Note 1 to entry: In this type of system, the main burner can cycle on and off multiple times during the complete equipment use cycle, but the intermittent pilot remains continuously ignited throughout the full cycle even when the main burner is extinguished.

EXAMPLE A clothes dryer.

3.2.4
intermittent/interrupted ignition
type of ignition which is ignited or energized upon equipment user initiation of the operational cycle and which is extinguished or de-energized after the equipment use cycle has been initiated

EXAMPLE An example a gas range top or oven burner ignition operation.

3.2.5
oxygen depletion safety shutoff system
ODS
system designed to shut off the main burner and pilot gas to the equipment when the oxygen content of the room in which the equipment is installed is reduced below a predetermined level

3.2.6
thermocouple
flame sensing device consisting of two dissimilar metal wires joined at one end so that when heat is applied to the joined end, an electrical junction is formed that generates electrical energy and when the heat is removed the voltage will decay over time

3.27
fast-acting thermocouple
flame-sensing thermoelectric generating device whose voltage output decays more rapidly than a common thermocouple

Note 1 to entry: In applications where these devices are used the decay rate does not exceed 30 s.

4 Classes of control

4.1 Classes of controls

Shall be according to ISO 23550:2018, 4.1, and the relevant specific part of the ISO 23551 series as defined in 6.2.1.

4.2 Groups of controls

Shall be according to ISO 23550:2018, 4.2, and the relevant specific part of the ISO 23551 series as defined in 6.2.1.

5 Test conditions

Shall be according to ISO 23550:2018, Clause 5.

6 Construction

6.1 General

ISO 23550:2018, Clause 6, is replaced by the following.

Subclauses specific to this document.

An MFC shall consist of a combination of controls according to 6.2.

Requirements for construction of the controls incorporated in the MFC are covered in the relevant control standards. Where no control standard is available, the requirements of ISO 23550 are applicable.

In addition, this document covers requirements for the safety-related interactions between the different functions of the MFC (see 6.2.2).

Where there are no requirements for these interactions between two or more controls, a risk assessment shall be performed. MFCs shall be designed such that access to internal parts requires the use of tools.

6.2 MFC based on combination of controls

6.2.1 General

MFCs are based on a combination of the functionality provided by the controls as given by the following list:

— automatic shut-off valves according to ISO 23551-1;

— pressure regulators according to ISO 23551-2;

— valve proving systems according to ISO 23551-4;

— manual gas valves according to ISO 23551-5;

— thermo electric flame supervision devices according to ISO 23551-6;

— mechanical gas thermostats according to ISO 23551-9;

— vent valves according to ISO 23551-10;

— electronic fuel/air ratio controls according to ISO 23552-1;

— automatic electrical burner control system according to IEC 60730-2-5;

— water-operated gas valves according to Annex I.

— OSDs (see Annex J).

6.2.2 Interaction between controls

6.2.2.1 Closing mechanism for closure member

Each automatic shut-off valve shall consist of a separate, independent closing mechanism controlling only one closure member. A check of internal leak-tightness shall be possible on each of the automatic shut-off valves. If two or more closure members are controlled by one closing mechanism, the valve is considered as one automatic shut-off valve.

6.2.2.2 Interactions between functions

The interactions between the functions of the MFC shall not interfere with the safety of the individual functions. Mechanical functions shall not affect the safety of electronic functions and vice versa.

6.3 Components of burner control systems

When specified by the manufacturer, components of burner control systems shall meet the construction requirements specified in Annex K.

7 Performance

7.1 Overview

ISO 23550:2018, Clause 7, is replaced by the following subclauses.

Subclauses specific to this document.

7.2 General

Requirements for performance of MFCs are covered in the relevant control standards (see list in 6.2.1). Where no control standard is available, the requirements of ISO 23550 are applicable.

7.3 External leak-tightness of MFC

An MFC shall be leak-tight in accordance with the leakage rate given in Table 1. The test is performed according to ISO 23550:2018, 7.2.2.1 and 7.2.2.2.

Table 1 — External leakage rate

Nominal inlet size DN	External leakage rates cm^3/h of air
DN < 10	60
10 ≤ DN	120

7.4 Mechanical thermostat function

If the MFC incorporates an independent mechanical thermostat function and a pressure regulator, the pressure regulator shall be put out of action for the tests of the thermostat function.

7.5 Internal leak-tightness of MFC

The leak-tightness of the closure member(s) of each function shall be tested independently.

7.6 Endurance test for combined functions

For an MFC which uses a single closure member to perform more than one function, the test conditions and number of cycles for endurance testing shall be applied by the function having the most severe combination.

7.7 Components of burner control systems

When specified by the manufacturer, components of burner control systems shall meet the performance requirements specified in Annex K.

8 Electrical equipment

Shall be according to ISO 23550:2018, Clause 8.

9 Electromagnetic compatibility (EMC)

Shall be according to ISO 23550:2018, Clause 9.

10 Marking, installation and operating instructions

10.1 Marking

ISO 23550:2018, 10.1, is replaced by the following.

The marking of MFCs are covered in the relevant control standards as listed under 6.1 and 6.2.1.

10.2 Installation and operating instructions

Shall be according to ISO 23550:2018, 10.2, with the following addition.

Instructions for MFC are covered in the relevant control standards as listed under 6.2.1.

They shall include all of the information of the relevant control standard concerning use, installation, operation and servicing. They shall also include information on the following points:

a) gas, and if applicable, water connection(s);

b) a statement to the effect that the functions of the MFC have to be verified as being suitable for their application;

c) if applicable, maximum water pressure (see I.2);

d) if applicable, water flow to open and to close the water operated gas valve.

10.3 Warning notice

Shall be according to ISO 23550:2018, 10.3.

Annex A
(informative)

Leak-tightness test — Volumetric method

Shall be according to ISO 23550:2018, Annex A.

Annex B
(informative)

Leak-tightness test — pressure-loss method

Shall be according to ISO 23550:2018, Annex B.

Annex C
(informative)

Conversion of pressure loss into leakage rate

Shall be according to ISO 23550:2018, Annex C.

Annex D
(normative)

Gas quick connector (GQC)

Shall be according to ISO 23550:2018, Annex D.

Annex E
(normative)

Elastomers/requirements resistance to lubricants and gas

Shall be according to ISO 23550:2018, Annex E.

Annex F
(normative)

Specific regional requirements in European countries

Shall be according to ISO 23550:2018, Annex F.

Annex G
(normative)

Specific regional requirements in Canada and the USA

Shall be according to ISO 23550:2018, Annex G.

Annex H
(normative)

Specific regional requirements in Japan

Shall be according to ISO 23550:2018, Annex H.

Annex I
(normative)

Water-operated gas valves

I.1 General

Annex specific to this document. This annex is applicable to the specific requirements of an MFC that incorporates a water-operated gas valve function. An MFC that incorporates a water-operated gas valve shall conform to the additional requirements given under I.2.

I.2 Additional requirements

I.2.1 Construction

In addition to the provisions of 6.1, the following applies.

The water-operated gas valve shall subordinate the admission of gas to the gas outlet to the water flow through it.

In the event of leakage at the joint sealing of the water circuit, it shall not be possible for water to penetrate into the gas circuit. To this end, there shall be a space between the gas-carrying and water-carrying parts of the water-operated gas valve. This space shall provide drainage with an opening having an area of at least 19 mm^2. It may consist of one or more orifices of which the smallest transverse dimension shall not be less than 3,5 mm.

I.2.2 Tightness of the gas circuit

The gas circuit shall be checked for internal leak-tightness. If, due to the design of the water-operated gas valve, the water pressure can have an influence on the leak-tightness, the following tests are carried out without water in the control and at the maximum water pressure.

Internal leak-tightness is ensured if the leakage of air does not exceed the values of ISO 23550:2018, 7.2.1 to 7.2.3 and with the test method of ISO 23550:2018, 7.2.3.3.

I.2.3 Low temperature test

The water inlet is connected to a water supply at the maximum pressure as described by the installation and operating instructions without water flow.

The ambient temperature of air around the water-flow-sensing device is lowered at approximately 1 °C/min down to a temperature of –10 °C during a time sufficient to obtain the freezing of the device.

If, after thaw, the water circuit does not have any visible damage, internal and external leakage tests are carried out (see ISO 23550:2018, 7.2).

This test does not need to be performed if the water-supply compartment is separate from the gas-carrying compartment.

I.2.4 Performance requirements

I.2.4.1 General

In addition to the provisions of Clause 7, the following subclauses apply.

I.2.4.2 Water pressure pulse test

I.2.4.2.1 Requirement

The following is intended to prevent unexpected opening of the gas passage due to water pressure impulses. The air leakage shall not exceed 40 cm^3/h when the closing mechanism of the water-operated gas valve is subjected to a pressure of 15 kPa.

I.2.4.2.2 Test

The closing mechanisms are first operated twice. In the de-energized position, the valves are supplied with air in such a way that the air pressure opposes the closing direction of the closure member. The air pressure is increased at a rate not exceeding 100 Pa/s.

As soon as a pressure of 15 kPa is obtained, the leakage rate is measured.

I.2.4.3 Opening and closing function

When tested according to the manufacturer instructions, the water flow to open the gas valve and to close it shall be according to the values specified by the manufacturer.

I.2.4.4 Endurance

I.2.4.4.1 Requirement

The water operated gas valve shall be subjected to an endurance test of 50 000 cycles.

At the end of the test, the water operated gas valve shall remain satisfactory and shall conform to the conditions stated in I.2.2 and in I.2.4.2.

I.2.4.4.2 Test

The gas circuit is supplied with air at ambient temperature.

The water circuit is supplied with water at ambient temperature in the direction of flow at a pressure and rate such that the water-operated gas valve is fully opened.

Annex J
(normative)

Overheating safety devices

J.1 General

Annex specific to this document. This annex is applicable to the specific requirements of an MFC that incorporates an overheating safety device, hereafter referred to as "OSD". An MFC which incorporates an OSD shall conform to the additional requirements given in this annex.

If the OSD includes electrical and/or electronic components, it shall be tested and evaluated using the relevant clauses in ISO 23550 and IEC 60730-1 and/or other relevant standards, as applicable.

J.2 Additional requirements

J.2.1 Moving parts

If the OSD has moving sensing elements (e.g. with springs), the operation shall not be impaired by other parts.

The OSD can be an integral part of the MFC or non-integral, remotely mounted from the MFC.

J.2.2 Performance requirements

J.2.2.1 General

The performance of an MFC incorporating an OSD shall take into consideration the safety and endurance.

J.2.2.2 Overheating temperature test

J.2.2.2.1 Requirement

Gas flow shall be shut off when the overheating temperature is reached, as specified by the manufacturer.

J.2.2.2.2 Test

An MFC that incorporates an OSD shall be tested according to related standards or according to manufacturer instructions.

The sensing part shall be placed in an oven or mounted to a test apparatus that simulates the application, as specified in the manufacturers' documentation. The temperature of the sensing surface or medium shall be increased until the gas flow is shut off.

Measure the temperature when the gas is shut off. The OSD shall conform to the requirements of J.2.2.2.1.

If the sensing part is of the automatic reset type, the temperature shall be reduced until the OSD resets. The test shall be repeated five times on the same sample.

If the device is a single use device, the test shall be repeated on five separate samples and all five shall meet the requirement.

J.2.3 Endurance

J.2.3.1 General

An OSD shall withstand the mechanical, chemical and thermal stresses to which it can be subjected during normal use.

J.2.3.2 Mechanical

J.2.3.2.1 Requirement

If OSD has moving parts, it shall withstand 50 000 cycles at ambient temperature.

If the moving parts are exposed to elevated temperatures during normal use, then half of the total cycles shall be conducted at 80 % of the manufacturer's specified overheating temperature.

After the endurance test, the OSD shall conform to J.2.2.2.1.

J.2.3.2.2 Test

An MFC that incorporates an OSD shall be tested according to manufacturer instructions or specifications.

For testing purposes, one cycle consists of the full range of movement of the mechanical moving part in both directions. The rate of cycling shall be specified by the manufacturer.

J.2.3.3 Thermal cycling of the sensing element

J.2.3.3.1 Requirement

The sensing part of an automatic reset type OSD shall withstand 1 000 cycles of operation.

The OSD shall conform to J.2.2.2.2, but only on the one sample used for this test.

J.2.3.3.2 Test

The sensing part shall be placed in an oven or mounted to a test apparatus that simulates the application, as specified in the manufacturers' documentation. An OSD that senses surface temperature shall be mounted accordingly so that it is in contact with the surface.

One cycle shall consist of the following temperature cycle. The temperature of the sensing surface or medium shall be maintained at the manufacturer's declared overheating temperature ±5 K for 5 min, and then the temperature reduced or removed to allow the OSD to cool for 5 min. When the OSD reaches the declared overheating temperature, the shut-off function shall activate to shut off the gas flow according to the manufacturer's documentation.

J.2.3.4 Thermal stress

J.2.3.4.1 Requirement

The sensing part of an automatic reset type OSD shall withstand 10 000 cycles of thermal stress conditions. Four samples shall be used for this test.

J.2.3.4.2 Test

Expose four OSD samples to 10 000 cycles. A cycle shall consist of raising the temperature of the sensing surface or medium to not less than 10 °C below the specified overheating temperature then reducing the temperature to 50 °C below the specified overheating temperature. Acclimation time at temperature

extremes shall be not less than 5 min. Following the test, the devices shall meet the requirements of J.2.2.2.1. Activation of the shut-off function during the temperature cycles shall be considered a failure.

Annex K
(normative)

Requirements for components of burner control systems

K.1 Scope

Annex specific to this document. This annex is applicable to components of burner control systems such as pilot burners, oxygen depletion systems (ODS), thermocouples, fast-acting thermocouples, on-demand pilot, ignition and flame sensing electrodes and other components.

For the purposes of this document, the specific requirements given in this annex modify the provisions of this document when it is applied to components of burner control systems.

Conformance of a component with to this annex does not imply that such a component is acceptable for use on gas appliances without supplemental testing with the component applied to the particular appliance design.

K.2 Additional requirements and tests conditions

K.2.1 Data to be provided by the manufacturer

K.2.1.1 General

The manufacturer shall provide the relevant data for the devices under test.

K.2.1.2 Requirement

Operating temperature limits of components, and points of measurement thereof shall be provided, including but not limited to the following:

— pilot burner tip;

— pilot burner orifice fitting;

— flame sensor;

— thermoelectric type components, the surface temperature in the area of the hot and cold junction;

— component housing(s) (electrical or mechanical);

— sensing element temperature limit(s);

— any means that determine time(s) of operation;

— maximum and minimum oxygen cut-off points for ODS systems;

— thermoelectric type flame sensor or generator:

  — available lead length(s) (nominal),

  — minimum and maximum electrical resistance for each nominal lead length,

  — test burner nominal inlet test pressure and input rate,

  — electrical resistance load with which the device is to be tested, and

— nominal closed circuit millivoltage output of the device.

K.2.1.3 Test

Conformance shall be determined by documentation and manufacturer's specification.

K.3 Construction

K.3.1 Connections

Shall be according to ISO 23550:2018, 6.4, with the following addition.

When component parts are intended for connection to pipe, the inlet, outlet or other connections shall be provided with cleanly cut threads in accordance with the applicable requirements for pipe threads.

When component parts are intended for connection to semi-rigid tubing, the connection and the fittings used thereon shall be in accordance with the applicable requirements for fittings.

K.3.2 Additional construction requirements

K.3.2.1 Construction requirements for pilot burners

K.3.2.1.1 General

The construction of pilot burners shall be according to the following subclauses.

K.3.2.1.2 Requirement

The following requirements shall be met.

— Electrode tips shall be constructed of high-temperature alloy steel or equivalent material and shall be of such design that extreme burning will not result during the conduct of the tests specified herein.

— ODS pilot burners:

  — shall be provided with a non-removable fixed orifice;

  — shall not have means for field adjustment of the oxygen safety cut-off point of the ODS pilot;

  — shall incorporate features which will prevent the interchange of components which could negate or change the “action to shut off” function.

K.3.2.1.3 Test

Subject to verification and review of technical documentation.

K.4 Performance

K.4.1 Thermal stress

K.4.1.1 General

Components shall be tested in accordance with the following applicable test conditions when cycled the number of times specified in Table K.1 consistent with the specified type of ignition.

K.4.1.2 Requirement

Test conditions below shall be applied as follows.

a) All systems and components shall be tested as specified in Test Condition 1 (see K.4.1.3).

b) All components not exposed to combustion chamber atmosphere shall be tested as specified in Test Condition 2 (see K.4.1.3).

c) All components intended to be exposed to combustion chamber atmosphere shall be tested as specified in Test Condition 3 and Test Condition 4 (see K.4.1.3) except that spark electrodes and flame sensors which are not thermally actuated shall not be tested under Test Condition 4 (see K.5.2.2).

One device used for the test in K.4.2 or K.4.3, as applicable, shall be subjected to each of the applicable test conditions. At the manufacturer's disgression, these tests may be conducted concurrently using a different device for each applicable test, provided each device used has been first subjected to the test specified in K.4.2 or K.4.3. Test Conditions 2 and 3 may be conducted simultaneously on a device having one portion exposed to combustion chamber atmosphere and another portion not exposed to combustion chamber atmosphere.

K.4.1.3 Test

Test Condition 1

Components shall be operated for a total of 720 h in a test chamber(s) maintained at a temperature equal to the manufacturer's specified maximum operating temperature, within +5 %.

Test Condition 2

a) Component parts not for exposure to combustion chamber atmosphere shall be placed in a test chamber(s) and cycled to permit and interrupt (alternately) gas flow to the test burner. The component parts shall be maintained at a temperature equal to the manufacturer's specified maximum operating temperature within +5 % and cycled one-half of the total number of cycles specified in Table K.1.

b) Component parts shall then be maintained at a temperature equal to the manufacturer's specified minimum operating temperature within −5 % for the remainder of the total number of cycles specified in Table K.1.

Test Condition 3

a) With the exception of thermocouples, the component parts of one burner control system which is intended for exposure to combustion chamber atmosphere and, if necessary, their respective test burners shall be placed in a test chamber(s) and cycled to permit and interrupt (alternately) gas flow to the test burner. During the portion of the cycle permitting gas flow, the temperature of the component parts shall be raised to the manufacturer's specified maximum operating temperature within +5 %. During the portion of the cycle with the gas flow interrupted, the test chamber heat source shall be interrupted and the component parts cooled either naturally or by passing room temperature air over the parts as specified by the manufacturer until the flame-responsive element temperature has been reduced to 121 °C (250 °F) or less. The component parts shall be cycled one-quarter of the total number of cycles specified in Table K.1 under this test condition.

b) With the exception of thermocouples, the component parts shall be cycled for the remainder of the total number of cycles specified in Table K.1 in the manner described in "a)" above except that the flame-responsive element shall be reduced to a temperature just sufficient to cause the system to cycle during the portion of the cycle with the gas flow interrupted.

Depending on the manufacturer's installation instructions, these tests shall be conducted with or without the flame-responsive element directly exposed to flame envelopment.

During these tests, the ignition coils of devices intended for use only with the pilot of a continuous, intermittent/continuous, or intermittent/interrupted ignition source may be replaced after each 2 000 cycles, 7 500 cycles or 7 500 cycles respectively.

Test Condition 4

Spark electrodes and flame sensors, which are not thermally actuated, shall not be subjected to this test. Component parts of one device which is intended for exposure to combustion chamber atmosphere and, if necessary, its respective test burners, shall be placed in a test chamber and cycled 100 times to permit and interrupt (alternately) gas flow to the test burner. During the portion of the cycle with the gas flow interrupted, the temperature of the component under test shall be reduced to the manufacturer's specified minimum operating temperature within −5 %. The portion of the cycle permitting gas flow shall be as short as possible to permit the component to perform its intended function.

Table K.1 — Duration of thermal stress test

Specified ignition source[a]	Duration of test								
	Hours	Number of cycles							
	Test cond.	Test condition 2			Test condition 3			Test cond.	Test cond.
	1	a	b	Total	a	b	Total	4	5
Continuous	720	3 000	3 000	6 000	1 500	4 500	6 000	100	6 000
Intermittent/ continuous	720	12 500	12 500	25 000	6 250	18 750	25 000	100	6 000
On-demand pilot	720	12 500	12 500	25 000	6 250	18 750	25 000	100	6 000
Intermittent	720	50 000	50 000	100 000	25 000	75 000	100 000	100	6 000
Intermittent/ interrupted	720	12 500	12 500	25 000	6 250	18 750	25 000	100	6 000
Interrupted	720	50 000	50 000	100 000	25 000	75 000	100 000	100	6 000

[a] For definitions of continuous, intermittent/continuous, intermittent, intermittent/interrupted and interrupted ignition source, see Clause 3.

After completion of each applicable continued performance Test Condition, each burner control system shall be retested for electric strength and K.4.2 or K.4.6, as applicable, and shall conform.

A component which is constructed so it will hold the gas supply open solely as a result of a uniform high ambient temperature shall also be retested as described in K.4.8.3 and shall conform.

At the conclusion of this test, each component shall be carefully checked to determine that field replaceable parts such as orifice(s), flame sensors and thermocouples are capable of being removed and replaced.

K.4.2 Operation of thermoelectric devices

K.4.2.1 General

The operation of thermoelectric devices shall conform to the following subclauses.

K.4.2.2 Requirement

For a thermoelectric device, the pull-in current, as applicable, and the dropout current shall be within the manufacturer's specified values.

These tests shall be conducted prior to the conduct of K.4.1.