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PUBLICLY AVAILABLE SPECIFICATION

PRE-STANDARD

colour inside

Technical specification for flame detector system of boiler

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TECHNICAL SPECIFICATION FOR FLAME DETECTOR SYSTEM OF BOILER

FOREWORD

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IEC PAS 63312 has been processed by subcommittee 65B: Measurement and control devices, of IEC technical committee 65: Industrial-process measurement, control and automation.

The text of this PAS is based on the following document:	This PAS was approved for publication by the P-members of the committee concerned as indicated in the following document
Draft PAS	**Report on voting**
65B/1175/DPAS	65B/1180/RVDPAS

Following publication of this PAS, which is a pre-standard publication, the technical committee or subcommittee concerned may transform it into an International Standard.

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INTRODUCTION

The flame detector is the key testing equipment for the boiler furnace safety protection and burner interlock control. In the whole combustion process of the boiler (especially in the variable operating condition), it detects the change of the combustion condition, and the corresponding control measures are taken through the connected terminal devices; so its reliability is related to the safety of the combustion system and the quality of the terminal products. Due to the difference in combustion conditions in the furnace, the reliability of the flame detector itself and the quality of the installation and maintenance, many problems are exposed during the operation, such as peeping of fire detection signals, missed detection, instability, false alarm information, fiber overheating loss, etc. All of these will bring safety hazards to the industrial production.

The purpose of this PAS is to develop comprehensive technical specifications for the functions and performance of industrial boiler flame detectors, as well as the technical requirements related to design, manufacture, installation, testing, operation, maintenance, etc., so as to provide the technical basis for flame detector system users.

TECHNICAL SPECIFICATION FOR FLAME DETECTOR SYSTEM OF BOILER

1 Scope

This PAS deals with the general requirements, classification and technical requirements, installation and commissioning requirements, inspection and maintenance requirements, test methods and requirements of radiant energy sensing flame detectors (including IR, UV, visible light, and imaging-based flame detectors).

This PAS is applicable to the type selection, design, installation, commissioning, inspection, maintenance and acceptance of the radiant energy sensing flame detectors, which monitor the flame status of burners.

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.

IEC 60034-30-1, *Rotating electrical machines – Part 30-1: Efficiency classes of line operated AC motors (IE code)*

IEC 60068-2-1, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-2, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

IEC 60068-2-6, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-27, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

IEC 60068-2-78, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

IEC 60079-0, *Explosive atmospheres – Part 0: Equipment – General requirements*

IEC 60079-1, *Explosive atmospheres – Part 1: Equipment protection by flameproof enclosures "d"*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 61010-1, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements*

IEC 61326-1, *Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements*

IEC 61326-2-5, *Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 2-5: Particular requirements – Test configurations, operational conditions and performance criteria for field devices with field bus interfaces according to IEC 61784-1*

NFPA 85, *Boiler and Combustion Systems Hazards Code*

ANSI/TIA/EIA-232-F, *Interface between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange*

ANSI/TIA/EIA-422-B, *Electrical Characteristics of Balance Voltage Digital Interface Circuits*

ANSI/TIA/EIA-644-A, *Electrical Characteristics of Low Voltage Differential Signaling (LVDS) Interface Circuits*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
flame detector
device in the furnace safety supervisory system that detects the combustion status in real time according to the flame characteristics of the fuel, and which, when the flame status fails to meet the preset conditions, considers the target flame abnormal or disappeared and sends a signal in a certain manner to stop the corresponding fuel supply

3.2
infrared signal
radiant energy signals falling within the infrared spectrum, emitted from the flames of burning fuel such as coal and oil

3.3
ultraviolet signal
radiant energy signals falling within the ultraviolet spectrum, emitted from the flames of burning fuel such as natural gas and light oil

3.4
visible light signal
radiant energy signals falling within the visible light spectrum, emitted from the flames of burning fuel such as lean coal and mixed fuels

3.5
flame on
presence of flame in the furnace, as computed by the flame detector system

3.6
flame off
absence of flame in the furnace, as computed by the flame detector system

3.7
target flame
predefined flame to be detected, rather than the extended background radiation or the adjacent and opposing flames

3.8
flame intensity
value computed by flame detector according to the received radiant energy intensity of flame, representing the radiant energy intensity of the flame

3.9
flicker frequency
pulsation frequency of flame radiant energy, representing the change rate of the target flame's radiant energy intensity

3.10
AC amplitude
pulsation amplitude of radiant energy from flame, representing the peak-to-peak value of the radiant energy intensity pulsation of target flame

3.11
flame quality
extent away from the flame-off status, computed from the detected flame intensity and flicker frequency, representing the degree of flame stability

3.12
flame threshold
minimum value set for the flame detector to determine the presence of flame (i.e. flame-on threshold) or the maximum value to determine the absence of flame (i.e. flame-off threshold)

3.13
flame relay
on/off control switch that switches on when the flame logic judges that flame is present and switches off when it judges that flame is absent

3.14
fault relay
on/off control switch that switches on when no fault is detected and switches off when any fault is detected

3.15
flame detector probe
device installed locally, capable of flame information sensing, photoelectric conversion and signal amplification

3.16
analysis and processing unit
device that receives the signals transmitted from one or more flame detector probes, and, after analysing and processing by the corresponding processor, outputs the digital and analog signals of each flame signal

Note 1 to entry: The relevant parameters of each flame can be set independently.

3.17
one-to-one detection
detection mode in which each target flame has a separate, fixed flame detector

3.18
flame detector peeping
situation that exists when the flame detector cannot distinguish between a target flame and a non-target flame, and considers a non-target flame as the target flame

3.19
static commissioning
commissioning of flame detector system using simulative light sources before the boiler is started up

3.20
dynamic commissioning
commissioning of flame detector system after the boiler is started up, during which the flame detection data throughout the period from the startup to the full load operation of the boiler under typical operating conditions is analyzed and compared and the parameters setting is completed to meet the actual operating requirements of the boiler

3.21
light signal-based flame detector
flame detector that detects flames relying on the intensity, pulsation and other signals of the radiant light emitted by target flame, including infrared, visible light, ultraviolet, dual-spectrum, and full-spectrum types

3.22
imaging-based flame detector
flame detector that detects the flame by acquiring the real-time video images of the target flame

3.23
Class A unit overhaul
thorough inspection and repair on the generator unit, intended to maintain, restore or improve the performance of the unit equipment

Note 1 to entry: Class A is the highest level overhaul among regular unit overhauls.

3.24
Class B overhaul
inspection and repair on the faulty or defective equipment within the unit, which may include some targeted Class A overhaul items or rotational maintenance items depending on the evaluation outcome of the unit

3.25
Class C overhaul
targeted inspection, evaluation and repair carried out on the unit according to the wearing and aging trends of equipment, which may include the replacement of a small number of parts, the defect elimination, adjustment, preventive tests and other operations on the equipment, as well as some Class A overhaul items or rotational maintenance items

3.26
troubleshooting
activities performed on faulty equipment for the purpose of restoring it to such a status that it can execute its intended functions

Note 1 to entry: Troubleshooting includes diagnosis, repair, and replacement.

3.27
mean time between operating failures
MTBF
expectation of the duration of the operating time between failures

[SOURCE: IEC 60050-192:2015, 192-05-13]

3.28
reliability
ability to perform as required, without failure, for a given time interval, under given conditions

Note 1 to entry: The time interval duration may be expressed in units appropriate to the item concerned, e.g. calendar time, operating cycles, distance run, etc., and the units should always be clearly stated.

Note 2 to entry: Given conditions include aspects that affect reliability, such as: mode of operation, stress levels, environmental conditions, and maintenance.

[SOURCE: IEC 60050-192:2015, 192-01-24]

4 General

4.1 General requirements

The flame detector system mainly consists of flame detectors, signal transmission components and cables, junction boxes, flame detection cabinets, the analysis and processing unit, engineer tools, power supplies, installation accessories and the cooling system (if necessary). For the use purpose of each component, see Annex A.

The flame detectors should be marked with QR codes. The outer surfaces and nameplates shall be smooth, intact, scratch-free, and contamination-free. The film over the surface shall have no peeling and scratching. The characters in panels and nameplates shall be legible. There shall be no loose connections or junctions.

4.2 Power supply

The flame detector cabinet shall be provided with duplicate power supplies, which back up each other. It shall have a built-in power switching module, which balances the two power supplies via the automatic power distribution circuit.

Any failure of either power supply shall be alarmed, without affecting the normal operation of the equipment and missending signals. Switching between the two power supplies shall generate no disturbance and shall not enable the flame detector to send the "flame off" signal.

Each power supply circuit of the flame detector amplifier/flame detector shall be provided with a separate fuse or other separate protective measures.

The power supply to the fans in the flame detector cabinet shall be independent of the power supply to the flame detector system, or appropriate isolation measures shall be taken between them.

4.3 Functions and performance of flame detector

The functions and performance of flame detectors shall meet the requirements of NFPA 85 Boiler and Combustion Systems Hazards Code. Flame detectors shall be able to correctly identify the flames of fuel (coal, oil and gas) for the corresponding burners. They shall be continuously adjustable within the full frequency spectrum under monitoring (or the corresponding frequency spectrum), so that the flames can be detected throughout the whole range of working conditions.

The flame detectors should allow selection among multiple parameters, so that appropriate parameter groups can be selected for the specific fuel and combustion condition, and that the flame parameters can be switched according to the current background conditions.

The flame detectors shall correctly reflect the various flame statuses (such as flame frequency and intensity). They shall be able to mitigate the interference from the adjacent, opposite, furnace-reflected non-target flames or the interference from the adjacent main flame to the minimal level.

The flame detectors shall have the self-test function, which allows them, in a timely manner, to reflect their own conditions, make self-diagnosis of faults, and give alarms at the specified interval.

4.4 Signal output

The flame detector of each burner shall provide analog signal (4 mA to 20 mA or 0 to 10 V) outputs or communication means to indicate the intensity of flame output signal.

The flame detector of each burner shall have at least two passive dry contacts to output flame status signals (flame on/flame off) and flame detector fault signals.

For digital outputs of flame detector, single relay mode or double relay mode may be used.

a) Single relay mode: The deenergized/energized status of flame relay (contact open/closed) is used to indicate the flame on/flame off status, and the deenergized/energized status of fault relay (contact open/closed) is used to indicate the faulty/normal status.

b) Double relay mode: Two relays are used to indicate the flame on and flame off statuses respectively. When the flame-on relay is closed and the flame-off relay is open, it indicates the presence of flame. When the flame-on relay is open and the flame-off relay is closed, it indicates the absence of flame. When both relays are closed/open, it indicates a faulty status.

4.5 Interchangeability

Parts of the same type shall be interchangeable. The measurements of the same target flame indicated by different flame detection devices shall be substantially consistent and meet the overall accuracy and linearity requirements.

4.6 Installation

Flame detectors from different manufacturers may have different probe installation methods and requirements. They shall be installed in accordance with 6.1 and the manufacturer's instructions, so that the probe detection point aligns with the sensitive area for flame detection.

4.7 Commissioning

The commissioning of flame detectors consists of two stages: the static commissioning before startup of the boiler and the dynamic commissioning after startup of the boiler. The two-stage commissioning shall be so conducted that the internal parameters of each flame detector are optimized and the flame status in the boiler is correctly indicated throughout the period from boiler startup to full load operation.

4.8 Inspection and maintenance

The probe of flame detector is usually exposed to a harsh working environment. So proper inspection and maintenance is necessary for keeping stable and reliable operation of the flame detector system. In addition to the inspection and maintenance of the flame detector system during unit overhauls, the maintenance personnel shall also carry out routine maintenance and regular maintenance to identify and eliminate problems in a timely manner and improve the reliability of the flame detector system.