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## J INDUSTRY

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## **J** INDUSTRY

JA	ELECTRONICS AND OPTOELECTRONICS
JB	SENSORS, DETECTING ELEMENTS, MEASUREMENT AND REGULATION
JC	COMPUTER HARDWARE AND SOFTWARE
JD	USE OF COMPUTERS, ROBOTICS AND ITS APPLICATION
JE	NON-NUCLEAR POWER ENGINEERING, ENERGY CONSUMPTION AND UTILIZATION
JF	NUCLEAR ENERGY
JG	METALLURGY, METAL MATERIALS
JH	CERAMICS, FIRE-PROOF MATERIALS AND GLASS
JI	COMPOSITE MATERIALS
JJ	OTHER MATERIALS
JK	CORROSION AND MATERIAL SURFACES
JL	FATIGUE AND FRACTURE MECHANICS
JM	STRUCTURAL ENGINEERING
JN	CIVIL ENGINEERING
JO	LAND TRANSPORT SYSTEMS AND EQUIPMENT
JP	INDUSTRIAL PROCESSES AND PROCESSING
JQ	MACHINERY AND TOOLS
JR	OTHER MACHINERY INDUSTRY
JS	RELIABILITY AND QUALITY MANAGEMENT, INDUSTRIAL TESTING
JT	PROPULSION, ENGINES AND FUELS
JU	AERONAUTICS, AERODYNAMICS, AEROPLANES
JV	COSMIC TECHNOLOGIES
JW	NAVIGATION, CONNECTION, DETECTION AND COUNTERMEASURE
JY	FIREARMS, AMMUNITION, EXPLOSIVES, COMBAT VEHICLES

## CURRENT STATE OF RESEARCH AND NORMATIVE FRAMEWORK REGARDING ASSESSMENT OF FIRE ALARM SYSTEMS SUITABILITY FOR OPERATION

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**Abstract:** Regardless of how reliable modern fire alarm systems are against false alarms, a significant number of fire alarms cannot be relied upon due to the undesirable sensitivity of fire detectors. One of the most important characteristics of the reliable operation of the fire alarm system is the accuracy and reproducibility of the activation of fire detectors under the influence of dangerous fire factors. Namely the achievement of the accuracy of measuring the magnitude of the signal at which the fire alarm is triggered during external testing we have taken as the basis, as a working hypothesis, for solving the main task - increasing the operability of the fire alarm system. The above implies the need to implement a set of measures aimed at maintaining these systems in good technical condition, which ensures their use for their intended purpose. The work reveals the innovative approaches of domestic Ukrainian and foreign researchers in maintaining fire alarm systems in a suitable operating condition and rationalizing the methodology for diagnosing the sensitivity of fire detectors to the controlled parameters of the service area. The research makes it possible to build a solid foundation for identifying gaps in the methods of diagnosing fire alarm systems, deriving ideas that contribute to the development of new conceptual foundations of the subject area.

**Keywords:** fire alarm system; fire detector; tester; operability; reliability; diagnostics.

### 1 Introduction

According to statistical data, more than 390,000 economic facilities in Ukraine are equipped with fire alarm systems, which is 93.7% of their required number. It is known that 14.4% of object fire alarm systems have exhausted their resource, are morally obsolete and need to be replaced. Generalized statistical data also indicate that over the past five years in Ukraine, fires have occurred at more than 1,600 facilities where a fire alarm system was installed. In 62.5% of cases, fire alarm systems provided timely notification of the occurrence of a fire. In the rest of the cases, its failure contributed to an increase in the risk to people's lives and an increase in the probability of material damage caused by fire at these facilities [11].

Scientist M. Ahrens [1] provides information on the death rate of people due to fires in residential buildings with a working fire alarm system using smoke fire detectors, which is 54% lower than in those where it is in a non-working state or is absent (Figure 1). There is evidence that every percentage point of installation of fire alarm systems reduces the number of registered fires by more than 2.6%.



Figure 1. The rate of deaths per 1,000 registered fires in residential buildings equipped with fire alarms using smoke detectors [1]

At the same time, a significant number of fire alarm signals from fire alarm systems are not reliable. Scientists confirm that the level of false signals generated by the fire alarm system without existing fire-related signs is 22% of the total number of all its

activations [17]. Researchers from Poland provide data that 35% of false alarms in fire alarm systems are associated with malfunctioning fire detectors [24]. Scientist A. Hangauer claims that the number of false alarms can reach 50% of all fire alarms due to the unwanted cross-sensitivity of fire detectors to particles of substances that are not necessarily formed as a result of a fire (water vapor, dust, insects or even hairspray, etc.) [16]. And this is despite the fact that modern fire detectors are highly reliable and resistant to false alarms.

False fire alarms represent a serious problem for both facility managers (who must analyze the causes of occurrence and take measures to reduce them) and emergency services (who must deploy certain resources to respond). Experts from the Hochiki company (Japan), which has been a leader in the development and production of innovative products in the field of fire safety for more than a hundred years, found that the costs of false fire alarms, for example in the UK, constitute approximately 700 million pounds every year. They explain that nine out of ten false alarms of the fire alarm system led to the complete evacuation of people from buildings or other structures with a loss of labor productivity. But the problem appears to be deeper, as 56% of business owners surveyed said that too many of these triggers mean employees do not take real anxiety seriously. They develop fatigue and complacency, which can lead to unpredictable consequences [10].

The rapid development of technology, market requirements and wear and tear during the operation of the fire alarm system lead to the need for frequent maintenance, repair or replacement of individual components. Countries such as the USA, Canada, Australia, Singapore, Germany, Sweden, Norway, Denmark are known for their high quality of service and timely updating of fire alarm systems, and have strict standards requirements for their compliance. It is believed that the level of maintenance of fire alarm systems depends on the qualifications and professional training of personnel, the presence of regulatory requirements for the regulation of maintenance issues, the general approach to safety, etc. Service companies in these countries, which are distinguished by the professionalism of their specialists, usually meet the specified requirements.

Properly designed and installed fire alarm systems must ensure that a fire is quickly detected and an alarm signal is issued for the necessary measures to be taken. The requirements determined by the norms of the national standard provide for the need to maintain fire alarm systems in working condition, taking into account the average working time of the fire alarm upon failure [7, 8].

The purpose of this work is to conduct an analysis of the current state of research and the regulatory framework for assessing the operability of fire alarm systems.

The object of research is the processes of maintaining the operational suitability of fire protection systems.

The subject of the study is literary sources and the regulatory framework for assessing the operability of fire alarm systems.

### 2 Materials and Methods

The research uses theoretical analysis and synthesis to study existing and form new approaches to solving the problem of maintaining the fire alarm system in a serviceable condition and rationalizing the methods of diagnosing the sensitivity indicators of fire detectors. The work also used other scientific research methods (logical analysis, statistical, etc.).

### 3 Results and Discussion

Taking into account the fire risk and the efficiency of fire alarm systems, the one that provides detection and notification of dangerous fire factors with the expected high sensitivity is



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