IR-Camera Devices for Fire Protection in Challenging Environments – Field Experiences and Test Methods

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Abstract

Traditional fire detectors qualified according to European standard series EN 54 are reliable and well-known products, which have long since become established in the application. However, those detectors often reach their limits in applications with extremely challenging environmental conditions. Recycling plants, waste bunkers and industrial plants, are some examples of applications, where self-ignition of stored materials or external entry of hot substances can lead to fire incidents which may not only cause high economic damage, but also entail high risks for people and the environment. Thus, reliable equipment for detecting and fighting unwanted fires is particularly important in this area.

In Germany, insurers increasingly recommend the use of infrared cameras to monitor these risks. Increased temperatures should be detected at an early stage in order to be able to take countermeasures as soon as possible - both through organisational and technical measures.

But especially because of the use in polluted areas, at varying temperature conditions the reliability of the device itself is crucial for such a protection concept.

Since the VdS Inspection Services received more and more requests for the evaluation of such installations it became clear that an evaluation of those devices in the VdS fire protection laboratory was necessary. Test methods and test equipment was developed and the first products were tested.

This paper discusses the development of a feasible test procedure and the challenges and questions that arose during this process.

Keywords: Fire detection, IR-cameras, product testing

Introduction

During the last decades, fire detection technology has steadily evolved and improved. There is a wide range of detectors available so that it is possible to select the best option adapted to the application and the existing environmental conditions. Despite this advancing development there are still special applications, where the use of FDAS according to the EN 54 standard series is not feasible, cannot provide sufficient protection against a damaging event or cases in which there are requirements that go beyond the primary protection goal of FDAS. One example of such applications is the recycling industry, where fire incidents can quickly get out of control and the fire brigade often has no choice but to allow the affected area to burn down in a controlled manner and to focus on preventing the fire from spreading to other parts of the plant. The damage caused by such an event not rarely amounts to several millions of euros.

In order to avoid such fire incidents, it is therefore important to detect irregularities as early as possible and to take countermeasures as soon as possible. IR camera devices are used for this purpose, which monitor the temperatures of surfaces and objects. In the event of temperature developments that indicate, for example, thermal development in the bulk material, an alarm can be generated at an early stage. The hotspot can then be displayed to the operating personnel supported by a visual representation so that a targeted reaction is possible. These systems are becoming more and more common in the recycling industry and are also increasingly recommended by insurers as an additional fire protection measure alongside the requirements of building regulations.

Inspection of the IR-camera devices by experts of the Inspection Services

To ensure the effectiveness of the installed IR camera devices our colleagues from the VdS Inspection Services were tasked with inspecting these systems in the application. With each individual application situation and each individual camera system more characteristics and challenges became apparent which needed to be addressed during the evaluation of the effectiveness and reliability of IR camera devices. As is always the case in fire detection the challenge is to tread a fine line between a detection at the earliest possible time and reducing the number of false alarms as much as possible. This is even more difficult here, since even relatively low temperatures can and should lead to an alarm, but the application situation also involves interfering factors such as vehicles. In cases where the IR camera device is combined with an extinguishing monitor it is possible that vehicles bringing bulk material into the plant are detected as an event and are extinguished.

An important experience of our colleagues from the application was therefore to always keep the windows of these vehicles closed - or at least to close them after the first attempt of the extinguishing monitor to extinguish the supposed fire.

Another challenge is the environment in these applications. The environment is dusty, there may be sprinkling systems, and some halls are mostly open to the outside. IR-camera devices, often using pan and tilt units in order to monitor a larger area, can be affected by these conditions. Due to this a regular automatic check of the IR camera equipment at least every 24 hours, is required by the planning and installation guidelines, with the aim to reduce the likelihood of the system not functioning fully for too long without it being noticed.

Product testing of IR camera devices at the laboratory

Witnessing the challenging conditions in the application it became clear that in order to confirm the (lasting) effectiveness of a system, the devices themselves must also be put through their paces. So, with these experiences and impressions the VdS laboratory was tasked with developing a test procedure for IR camera devices. At first glance, this project looked rather straightforward, after all we already know flame detectors which respond to IR radiation and we know a wide range of defined environmental tests from which the adequate ones could be selected.

However, at second glance, especially with regard to the performance expected from IR camera devices in the application, it became clear that it is just not that simple after all, as the intended purpose of the IR-camera devices is quite different from that of flame detectors. And as our colleagues from the Inspection Services developed and adapted their planning and installation guidelines, we also had to rethink and adapt our approach and our tests.

When we test fire protection devices at our laboratory, we look at two aspects:

1. The function of the devices: does the device really work as intended?
2. The reliability of the devices: does it still work while and after being exposed to the expected environmental conditions?

As mentioned before, there already is a range of standardized environmental tests, and depending on the installation site, the applicable combination of tests can be chosen. The major challenge was the first of these aspects: to develop suitable test methods and test scenarios for verifying the correct performance of the IR camera devices.

At the first stage, we focused mostly on the correct detection of temperatures and whether alarms and faults are detected and forwarded.

- Does the device reliably detect a set alarm threshold temperature everywhere in the declared field of view?
- Can the device detect a defined event at the declared maximum distance?
- Does the device react even when there is small rate of rise in temperature?
- Does the detection of a threshold value work reliably within the entire alarm threshold range?

While we developed test procedures for these scenarios, our colleagues gained more and more experience with installed IR camera devices in the application. After sharing experiences and concerns the planning and installation guidelines for IR camera devices were revised. In particular the section on project planning of IR camera devices was adapted. Therefore, in the next step, we focused on developing tests that validate the information required for project planning. Depending on the focus, in which areas is detection reliable? Is the required automatic self-test after 24 performed correctly? Are all critical faults registered and forwarded?

Product guideline for IR camera devices

Finally, all this work and experience should naturally result in a product guideline which transparently defines the requirements and test methods for the different variants of such devices. With the objective of developing test methods that are neutral to the device and, in doing so, evaluate all critical properties and, if necessary, relevant additional features with reproducible, feasible tests without unnecessarily inflating the procedure, we took another look at each of the developed tests and questioned them when writing the guidelines. Does the test work with all likely possible variants of IR camera equipment? Does this test really provide us with a reliable and also a relevant statement? Do we illuminate all aspects of the device that could be critical in the application?

In some cases, experience showed us that a test is actually not meaningful for these devices. In other cases, we found that we had to perform a test differently in order to be able to evaluate all (expected) device variants. Due to the revision of the Planning and Installation guideline, new requirements were added, so that new tests had to be developed. And last but not least, there are tests that are difficult to perform due to the circumstances. In particular, the long ranges of the IR camera devices play a role here, which currently make it necessary for us to carry out the tests outdoors.

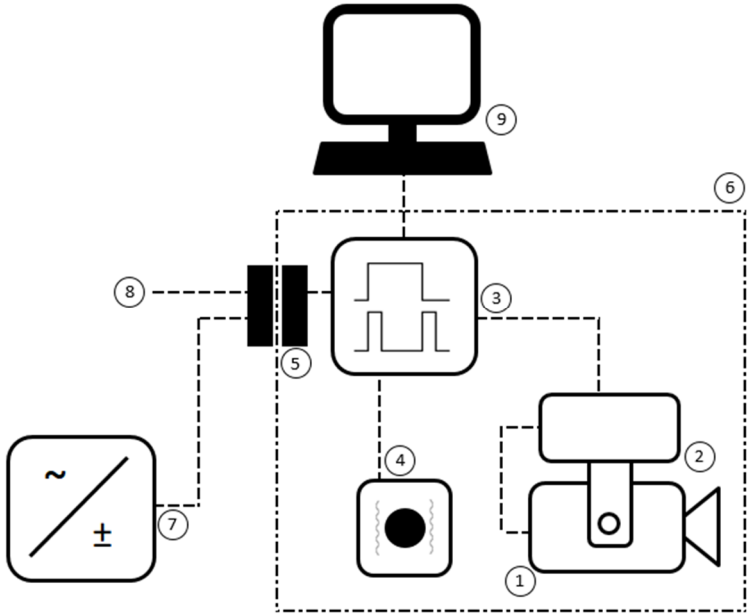

Fig. 1. General Structure of an IR camera device

1. IR-camera
2. Pan and tilt unit
3. Evaluation unit
4. Reference radiator
5. Interface
6. IR-camera device
7. Power supply
8. BMS or CIE
9. Enhanced visualization and control unit

Conclusion and outlook

By the time this paper is published, we will hopefully have already achieved the publication of the guidelines. Nevertheless, there is still work to be done in the future. The systems will continue to evolve, as will the applications in which they are used. We will continue to follow this development and also adapt and optimize our test methods.

At the same time, our colleagues from the inspection services are focusing on developing quality requirements for the specialized companies that install these systems. A lot depends on the professional installation and the choice of the appropriate settings on site - depending on this, a system can either lead to false triggers too often, so that the alarms are no longer taken seriously, or react too late to events and thus no longer meet the requirement of a very early detection of irregularities.

And with regard to the application in combination with extinguishing monitors, we are still faced with the task of testing not only the individual devices on the detection and extinguishing side, but also the effective, successful interaction of these two sides. A precise localization and the transmission of this location information to an automatically controlled extinguishing monitor are the next step to ensure a reliable, effective protection for these special applications. We are looking forward to accompany this development further and to work on ensuring a high- quality standard for these systems.

References

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