

Detection of Smoke: Full-Scale Tests With Flaming and Smouldering Fires



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ABSTRACT

Full scale fire tests are carried out to study the effectiveness of the various types of smoke detectors to provide an early warning of a fire. Both optical smoke detectors and ionization smoke detectors have been used. Alarm times are related to human tenability limits for toxic effects, visibility loss and heat stress. During smouldering fires it is only the optical detectors that provide satisfactory safety. With flaming fires the ionization detectors react before the optical ones. If a fire were started by a glowing cigarette, optical detectors are generally recommended. If not, the response time with these two types of detectors are so close that it is only in extreme cases that this difference between optical and ionization detectors would be critical in saving lives.

1 INTRODUCTION

1.1 Statement of the problem.

Many fire related deaths are caused by the fire being discovered too late. This is closely associated with detector technology, in other words, how quickly detectors react to different fire developments. This is the background to the experiments described in this paper. The main objective has been to determine the differences in how such equipment detects fire and relate these results to human safety during fires in buildings.

Four different experiments were done, two experiments with smouldering fire developments and two experiments with flaming fire developments. All experiments are carried out in a room with a floor area of about 17m². All the fires were in bedding where the fabrics are not flame retardant. There was no other furniture in the test room apart from the bed where the fire started. The time of alarm was recorded for each detector. Measurements were also made for a number of parameters that characterize early fire developments. These are pressure, temperature, carbon-monoxide and oxygen concentrations, reduction of visibility and particle distribution in smoke as a result of the fire development.

3 RESULTS

3.1 Smouldering fires.

In cases of smouldering fires, the critical limits for the accumulated CO-dose and visibility in the test room were reached about at the same time. This was typically 5000-6000 seconds after the start of the fire.

Both the optical smoke detectors and the residential types as well as the optical smoke detectors in the test room where the fire started detected the smoke sufficiently early to avoid a lethal situation during this type of fire development.

The ionization smoke detectors detected smoke from a smouldering fire much later than the optical detectors. When the particular conditions during the fire development are taken into consideration there are reasons to indicate that this detection principle would not provide adequate safety during this type of fire. This is in spite of the fact that the detectors were located in the test room.