

FORENSIC INVESTIGATION OF FIRE AND EXPLOSIONS

Ioan ARON¹

Abstract: *In forensics, the investigation of intentional fires, generated by criminal violations of prevention rules, committed out of revenge, in order to hide other crimes, through vandalism, due to mental disorders or in the case of self-ignition in public in order to obtain claims. In forensics, fires and explosions are analysed according to the causes that produce them and according to the substances or devices that initiated and maintained their combustion or explosion.*

Keywords: *fires, self-ignition, combustion, explosion, substances, devices*

1. Introduction

Fires and explosions are complex technical phenomena, which can be caused in different ways and have a different evolution with a difficult problem in establishing the causes and the culprits of their production.

Primarily in the case of on-site investigation of fires and explosions is the speed of intervention, because valuable traces can be destroyed very quickly by burning and can no longer be recovered, while visual indicators of smoke and flame colour, the direction of fire spread are essential data of operational value during the investigation.

2. Fire

Fire is a physical-chemical phenomenon that causes the combustion of one or more combustible substances in the presence of oxygen in the air (Cora, 1976, p.361). Combustion is a reaction of rapid oxidation of a substance in the presence of atmospheric oxygen with the release of heat and light (Baulescu, 1971, p.21).

Explosions and fires are complex phenomena that destroy material values, sometimes incalculable, resulting in loss of life.

The importance of studying fires and explosions results from the level of danger they represent, from their frequency, and thus a special interest is the determination of the causes and the taking of prevention measures.

¹ *Transilvania* University of Braşov, aron.ioan@unitbv.ro

Any fire has a cause that, most of the time, occurs and acts as a result of human negligence. Without knowing the causes of fires and explosions, the scope and methods of response, it is not possible to implement countermeasures, especially when these acts are committed intentionally, using technical means of initiation.

The main factors specific to a fire are - the emission of heat, gas and smoke, the burning temperature and the speed of propagation of flames directed by air currents or fuel sources.

Explosion as a phenomenon is a very fast and violent burning process of explosive mixtures, which occurs in fractions of a second with the release of heat, light and generates high pressures (Stoica, 1994, p.9).

In case of explosion, there are also specific effects, additional to those of the fire, representative being the high or very high pressure that is formed during the instantaneous combustion, in the space that holds the explosive mixture (Stoica, 1994, p.10).

In forensics, fires are classified according to the causes that determine them and not according to the substances or objects affected by combustion, because the traces created in such a process have features closer to the accusations of fires than the nature of those substances or objects (Mircea, 2012, p.202-203).

Regarding the legal classification of the facts, the provisions of the Criminal Code, at art. 253 and 254, state as follows:

Destruction

- (1) The act of destroying, damaging or making unfit for use of an asset belonging to another, or hindering the taking of measures of preservation or rescue for such an asset, as well as removing the measures taken, shall be punishable by no less than 3 months and no more than 2 years of imprisonment or by a fine.
- (2) The destruction of a deed under private signature, belonging wholly or in part to another and which serves to prove a patrimonial right, if resulting in a loss, shall be punishable by no less than 6 months and no more than 3 years of imprisonment or by a fine.
- (3) If the act set out in par. (1) concerns assets forming part of the cultural heritage, it shall be punishable by no less than 1 and no more than 5 years of imprisonment.
- (4) The act of destroying, damaging or making unfit for use of an asset, perpetrated by arson, explosion or by any such means and, if it represents danger to human life or to other property, shall be punishable by no less than 2 and no more than 7 years of imprisonment.
- (5) The provisions of par. (3) and par. (4) apply even if the asset belongs to the perpetrator.
- (6) For the acts set out in par. (1) and par. (2) criminal action shall be initiated based on a prior complaint filed by the aggrieved party.
- (7) The attempted acts set out in par. (3) and par. (4) shall be punished.

Aggravated destruction

- (1) If the acts set out in Art. 253 - 235 resulted in a disaster, it shall be punishable by no less than 7 and no more than 15 years of imprisonment and a ban on the exercise of certain rights.
- (2) Disaster consists of the destruction or damaging of real estate property or of works, equipment, plant or components thereof and that resulted in the death or bodily injury of two or more individuals (Criminal Code).

Numerous categories of traces can be found in both fires and explosions, the examination and interpretation of which results in data on their onset and evolution, whether they had natural causes, whether they were caused by negligence or were intentional. All these technical data, constantly supported by an up-to-date information support, can help prevent and combat such events.

During the on-site investigation, it is necessary to establish the focus of the fire, the circumstances in which the fire started and spread and to determine its consequences. Usually, according to all probabilities, the place where the fire started is the one where the first flame appeared and from which the fire started to spread. The meaning of “place of committing the deed” includes both the concept of closed space (apartment, dwellings, industrial halls) and the concept of open space.

The fire can be determined by the thick smoke that appears before the flame (if the air in the room is insufficient, the condition of the objects on which the fire left traces, the discovery of objects that could have been instruments of fire (chips, oil bottles, substances flammable) at the crime scene.

2. Specificity of on-site research in case of explosions and fires

The on-site investigation shall be conducted only after the removal of all potentially hazardous explosions or explosive devices as well as potentially explosive materials within the potential perimeter of the fire. The priorities of the intervention are the measures to rescue the victims and to avoid them, to stop the potential dangers, and after securing the area, to enter the field of crime, in order to carry out the investigation on the spot.

The security activities are carried out strictly by qualified personnel, namely by pyrotechnicians.

The investigation team, together with the prosecutor conducting the investigation, involves judicial police officers, forensic specialists, forensic doctors, pyrotechnics specialists, firefighters, all activities being carried out under the command of the prosecutor.

It is very important for the task force to arrive during the fire, during which they can film and photograph the evolving fire, capitalizing on the direction of flame spread, their colour, smoke colour, specific odours and all those visual indicators that become important during research.

The research activity begins with the delimitation of the area burned, or affected by the explosion, and depending on the extent of the affected area, the following perimeters of action are carried out:

- the outer perimeter - is the place where the persons present at the time of the fire will be evacuated, checked and identified;
- the median perimeter - is the place where the mobile intervention and rescue crews are located, the command point, the place of collecting and inventorying the samples, the place where the personnel that will intervene are equipped;
- the inner perimeter - is the place to be investigated in order to look for traces and material means of evidence. This perimeter will only be accessed by intervention or decontamination teams, the on-site research team and medical teams as far as possible without being accompanied by cars.

Steps shall also be taken to identify and remove any secondary hazards that may occur, such as toxic or flammable gas emissions, building collapse hazards or explosion hazards, and the decoupling of the building from all sources of damage shall also be verified.

In the case of large fires affecting a large area of land or forests, it is recommended that participants in the on-site research fly over the area burned by drone or helicopter, to observe the proportions of the fire, the direction of fire, outbreaks, easy spots for intervention, close sources of water supply, dangerous targets nearby.

On this occasion, filming and photography are performed specific to the evolution of the event, or concrete aspects that may worsen or disappear during the fire.

The route and itinerary through which team members can enter the area are established, and if necessary, several research teams can be formed, each of them investigating a specific sector.

It is also sought to obtain and record data on weather conditions, meteorological manifestations during the fire that will be mentioned in the minutes.

After locating and extinguishing the fire, the fire outbreaks will be discovered, photographed and filmed, respecting the research deontology specific to the static and dynamic phase. In the activity of searching, fixing, collecting and packing the traces left by the causal factors of the fire, the following will be taken into account - matches, remains of wicks, lighters, rags, oil stains, appliances, short-circuited conductors, remains of candles, containers abandoned, which may contain flammable substances and from which papillary traces may be taken.

It is also considered to examine the switchboards and electrical circuits, installations, fuel lines, how the room was insulated (closed or open windows).

If flammable liquids have been used and spread, they are usually soaked in absorbent substrates, drained into the floor, under sills, under linoleum, and leave specific traces that can be seen visually. For laboratory examinations, samples are taken from these areas and packed according to specific deontology.

Carbonized scraps of wood, metal, fabrics, electrical conductors, ash samples from the hearth, soil and dust samples are also collected and all places where they were collected are marked with letters or numbers, photographed and their position is noted in the minutes.

Forensic scientists also look for traces of shoes and means of transport that usually exist on itter criminis, traces of burglary tools that may be present in the locking systems and papillary marks if the place is suitable.

We also examine the machines and equipment in the area, if they had the opportunity to start the fire due to their operation.

Also on this occasion, we look for and photograph watches and meters damaged by thermal causes to determine the time of fire and possibly the technical parameters. If the site has its own surveillance system, the images will be used.

In the case of explosions, from the category of samples that can be searched, collected and analysed we can mention - marking substances, triggering / initiating substances, wicks, explosive devices, containers and packaging, ammunition. Unconventional explosives and incendiary devices built by the authors, use of at least one energy source, a wick and explosives. They are unsafe to handle and can explode at any time, which is why special attention must be paid to the protection of personnel.

Unexploded ordnance or explosive devices are picked up, handled, packaged and transported by pyrotechnicians and not by forensic specialists.

Metal fragments can be collected from the explosion site, which can come from the casing or the body of the explosive device, from the detonation or timing mechanism, from batteries, safety levers, pieces of conductor, soil, ceramic materials, glass, plastic, etc.

If there are human casualties, biological evidence and associated evidence are sought - clothing, footwear, human fragments showing tattoos, private signs, jewellery, dental work, fingers - all of these items are recorded by photography and described appropriately in the report in order to be able to establish the identity of the victim especially in the situation of the existence of several victims.

The main problems that are solved by technical expertise are:

- to determine the possible causes of the fire in concrete conditions or the causes that determined the self-ignition;
- to determine the focus of the fire, the direction of propagation, the intensity and duration of the fire;
- to determine whether there has been any breach of the rules for the storage of objects, which could have been the cause of their self-ignition or which could have favoured the spread of fire triggered by other causes;
- to determine whether there has been a breach of the fire prevention rules which has made it difficult to stop the fire in time. (Stoica, V., 1994, p.41)

In a number of cases, technical expertise solves the following problems:

- if the ash, slag or carbonaceous residues contain fuel additives;
- if objects taken from the scene of the fire contain traces of flammable substances;
- what is the substance of the burned object (based on the examination of the combustion residues, picked up from the place of the fire);
- what is the content of the fire outbreak (based on the ash or slag residues presented);
- what substances have burned (based on the specific colour of the flame, the particularities of the smoke or the specific odours);
- whether self-ignition of a particular substance could occur and under what conditions;

Forensic laboratories are sent samples of soot, slag, burnt objects, ash to establish the materials that burned.

In order to identify the burned and semi-burned materials, after a first examination, in which the structural details will be established, they will be further burned, to be examined in the form of ash.

The ash of the burned materials will be examined in terms of colour, mechanical properties, structure, degree of wetting, flue gases and metal debris. The various substances in the ash composition are differentiated by spectral analysis, nuclear bombing and chemical reagents.

In the event that the fire was caused by devices intended for this purpose, the nature of the installation, its mode of operation, elements that provide clues regarding the profession or specialized training of the perpetrator, his knowledge of the crime scene, the participation of several persons are determined in establishing the cause of the fire.

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