

# Fire protection measures for roofs

Instructions for planning and construction



The present publication is non-binding. Insurance providers may also accept other safety precautions or installation and maintenance companies at conditions set at their own discretion which do not conform to these technical specifications or guidelines.

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## Instructions for planning and construction

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## 1 Preliminary remarks

These instructions concretely define the requirement for fire protection on roofs – in particular industrial and commercial buildings – from the perspective of fire insurance.

Basically, a fire hazard amounts to a serious existential threat for industrial and commercial plants.

A fire and fire business interruption insurance policy is indeed sufficient to compensate the material damages of a fire, but more serious however are the non-replaceable losses, such as loss of life, health and natural resources as well as the loss of market share or the exodus of competent employees by reason of longer business interruptions.

According to claims experience, fires which spread to large areas via the roofs of the industrial and commercial buildings and/or expand into the building interiors often lead to total loss. These and other fire hazards in the plant can however be effectively handled with preventive fire protection measures. In the following sections instructions and ideas are offered, which can be implemented for effective fire protection for roofs as an indispensable component of the total building design. The legal requirements of building authorities as well as the requirements of trade supervisory boards and professional associations remain unaffected by these instructions. Further reaching questions about fire protection measures for particular risks should in any case be coordinated with the responsible authorities and the fire insurance provider.

These instructions are based on the current knowledge of fire protection. If fundamental changes occur in construction and fire protection technology the intention is to update these instructions. It applies in principle for roofs of buildings yet to be constructed. Fire protection measures for existing roofs should be adapted to meet the recommendations of these instructions to the given possibility.

## 2 Terms

In accordance with DIN 4102-7, roof coverings and water proofing including possible insulating layers as well as dome lights or other closings for roof openings are considered as roofing. "Hard roofing" is, in accordance with DIN 4102-7, resistant against flying sparks and radiating heat and

thus conforms to a frequently stipulated building code regulation.

### **Fire protection layers**

Fire protection layers are layers in the roof construction which, when combustible thermal insulation is used, restrict the spread of fire within the roof construction (from top to bottom or from bottom to top).

### **Flaming particles (droplets)**

In the case of combustible building materials (building material class DIN 4102-B) burning droplets or particles can occur during fire or parts of the building materials can fall off. This material property is tested in accordance with DIN 4102-1 and if applicable declared in the verification of suitability (General approval from the construction supervision authorities or general test certificate).

### **Glowing, afterglow**

The burning of a solid material without the appearance of flames, however with light emission from the burning zone, is defined as glowing, a continuous glowing after the removal of the ignition source as afterglow.

### **Smouldering**

The slow oxidative reaction of a solid material without light emission, however in general with the formation of smoke and temperature increase, is defined as smouldering.

### **Singel-leaf roofs, not ventilated (warm roofs and inverted roofs)**

A non-ventilated flat roof consists of just one roof shell, whereupon warm roof and inverted roof are, in practice, differentiated.

A warm roof essentially consists of the supporting layer (e.g. concrete ceiling), the thermal insulation and the waterproofing as well as a possibly required surface protection against weather effects (e.g. gravel fill); these layers lie directly on top of one another.

With an inverted roof, its thermal insulation lies, in contrast to a warm roof, above the roof membrane. In this way, the membrane is protected against extreme thermal and mechanical effects.

### **Double-layer roofs, ventilated (cold roofs)**

A ventilated flat roof, which in practice is also defined as a cold roof, consists of

- the upper roof shell with membrane, serving as weather protection,

- the lower roof shell with thermal insulation and
- the hollow space arranged between both shells with sufficient ventilation openings for the discharge of construction and usage moisture.

### 3 Hazard zone of the roof

Roofs play particularly an important role in the design of building from the view of fire protection; in its planning and construction, technical aspects related to fire protection must be taken into account.

In contrast to saddle roofs with their roof stone coverings, flat roofs of industrial and commercial buildings are often intensely afflicted with fires by reason of their size and construction.

Lighter designs which can be structurally faster and more economical, are being increasingly used in industrial and commercial buildings. Thus buildings with roof shells are now being constructed, such as trapezoidal steel profile sheets, which do not have a proven fire resistance. This design allows for generous overall construction which in addition are currently state-of-the-art for extensive production and storage buildings as well as functional shopping centres.



**Fig. 1:** Extensive fire spread on a roof



**Fig. 2:** Flame flashover through roof penetration

However experience shows that during renovation work with the usage of open flames, roof fires often occur. Analyses of both large fires and fire experiments confirm that even relatively small resulting fires can lead to a fast, often explosive, fire outbreak for the aforementioned roof designs in just a few minutes which expand across the entire roof with fire spreading into the building interior. This lies primarily on the fire effects with in part heavy fire loads originating from the building, the roof design, and the using building materials.

Once a flame engulfs a large section of roof usually total loss of the affected building section is to be expected. If in addition, firewalls and complex separator walls in the roof area are not properly constructed, then the fire will also spread to other areas of the building.



**Fig. 3:** Flame flashover through openings in external walls on the top of the roof



**Fig. 4:** Working with open flame on a roof – Not like this!

### 3.1 Effects of fire

Roofs can be exposed to various fire effects depending on the location of the fire's origin:

- 1) in the case of a **fire inside the building** light metal roof shells as good heat conductors reach high temperatures very quickly. As a result, thermoplastic roof building materials, such as adhesives, thermal insulation or sealant can outgas and melt. If brought to their flash point or their ignition temperature, these will also ignite on the top of the roof. If roof penetration connections (drainage, exposure) are not properly designed, a fire effect on the roof can occur through these openings.
- 2) in the case of a **fire due to fire work on the roof** itself, e.g. through carelessness in the usage of open flames (propane gas burner) for the installation and repair of the water proofing sheeting, fire will take hold of the roof surface and set it in flames in a short time. Depending on physical construction flat roofs without surface protection are subject to higher repair and renovation expenditures than flat roofs with surface protection (e.g. gravel fill).
- 3) in the case of a **fire in the neighbourhood** the use of roofing resistant to flying sparks and radiating heat does not guarantee that the fire effects can be controlled. This only applies for as long as the real fire stress does not significantly exceed the testing scenario. In principle, the risk of a fire flashover by reason of the position and linking of the neighbouring building must always be critically considered.

### 3.2 Spreading of fire

For roofs, the fire can spread to the roof top and then be accelerated by unfavourable wind conditions. Ignition of the roof construction along the underside of the roof and the widely distributed decomposition gases (pyrolysis gases) above the possibly existing roof cavities can result.

In particular for roofs with roof shells of steel trapezoidal profile sheets in accordance with DIN 18807 burn-through can quickly result on the roof surface if the layers are unfavourably designed and thus the fast spread of the fire can occur on the roof surface. Pyrolysis gases from combustible adhesives can, for example, ignite in the cavities of the trapezoidal profile sheets along great lengths. Burning components of the roof construction drip on to the sheet metal joints and roof penetration sites and cause secondary fires. A fire formation of this type makes targeted extinguishing attempts impossible in many cases.

The afterglow of roof building materials in the roof cavities can also lead to flame expansion in the roof area after the main fire in the building has been extinguished, with subsequent reignition of the building fire.

## 4 Fire protection measures

The evaluation of fire protection requires consideration of the total design of the roofs. Along with this, the behaviour of fire on the individual functional layers allows a conclusion about the behaviour of fire on the total roof to be made only to a very limited extent. First and foremost the fire protection measures for roofs are determined by the selection of building material, components and their arrangement with one another.

Working with fire in the roof area is to be restricted to a minimum. If it cannot be prevented, special fire protection measures must be taken.

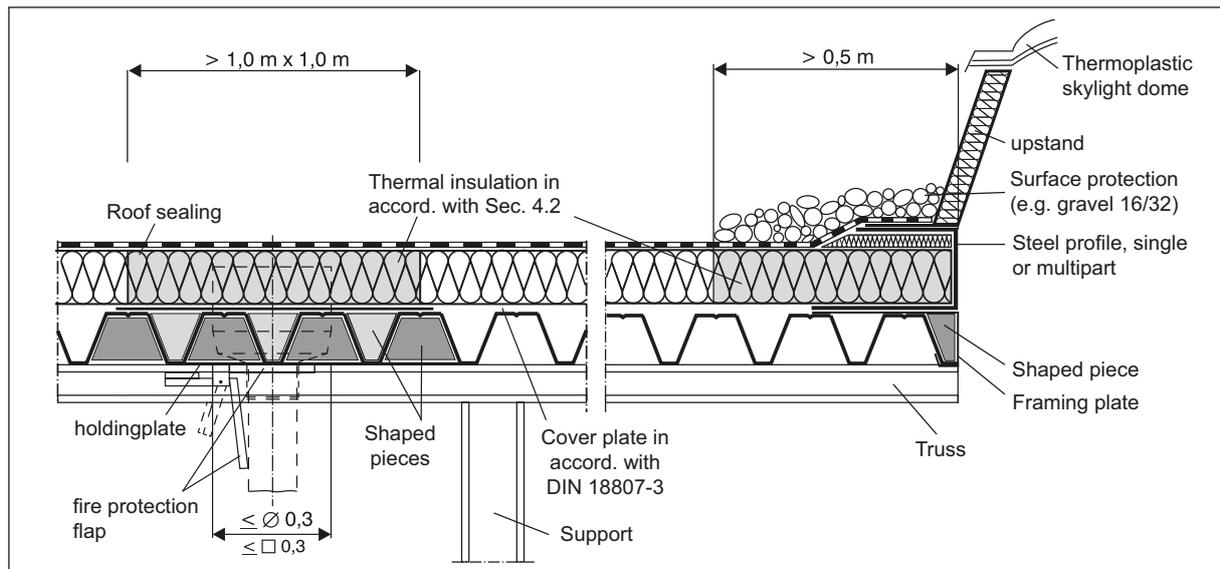
### 4.1 Roof building materials and components

In principle, the fire loads in the roof should be kept as minimal as possible. One should strive to give priority to the following materials/systems:

- Vapour barriers with low fire loads
- Non-combustible thermal insulation materials instead of combustible thermal insulation materials  
*Note: VdS 2097-2: "Structural fire protection; Products and Installations", Part 2a: non-combustible construction materials*
- High polymer water proofing sheetings (e.g. Plastic and rubber strips)
- Mechanical fasteners, the quantity of which in the surface, edges and corners is regulated by the flat roof guidelines of the roofer trade [5] instead of bituminous adhesives.

With roof shells which have a fire resistance of at least 30 minutes (e.g. ferroconcrete plates in accordance with DIN 4102-4) and roof support structures, the flash fire or the spread of flame into the buildings, however, is delayed to the extent that the usage of non-combustible building materials on the top of the roof achieves lesser importance for this.

Building materials, which tend to glow (see test certificate or permit) should not be used as building materials in roof cavities.



**Fig. 5:** Design example for smaller roof penetration sites with self-closing protection system and for larger roof penetration sites

If combustible thermal insulation materials are used within the roof structure, then these must be protected in such a way that the spread of flames within the roof structure is limited, e.g. by means of fire protection layers on the top side or in accordance with DIN 18234, enclosure 1.

When selecting water proofing, the combustion behaviour, the fire load and the possibility of flame spread and flame combat are to be considered.

If the roof is waterproofed with metal profile sheets then the underlying thermal insulation materials must be non-combustible.

If bituminous water proofing sheeting is used, then this must be protected by a gravel-fill surface protectant (grains 16/32) at least 5 cm thick. This gravel layer can also be positively assessed from a physical structural aspect and from the aspect of storm safety. However, when installing the supporting roof shell, its permissible deflection is to be observed.

## 4.2 Roof penetration

Roof penetrations such as skylight domes, smoke and heat exhaust devices, roof drainage systems or pipelines are to be designed in such a way that flame spread in the roof construction and on the top of the roof is prevented. In particular on the penetration connection points of profiled surface supports (e.g. trapezoidal profile sheet roofs) it is necessary to prevent the entry of flames and gases into the profile cavity.

Structural principals regarding fire protection on roof penetration sites are regulated in DIN 18234-3. The following measures are suitable as protection against the expansion of flames:

- Skylight domes, smoke and heat exhaust devices or other openings in the roof should have a minimal clearance of 5.0 m from firewalls which do not extend over the roof. Otherwise a minimal clearance of 2.5 m
- for small penetration sites (e.g. piping roof drainage, cable inlets) the thermal insulation around this opening is to be designed in a surface area of 1.0 x 1.0 m each with one of the following materials:
  - Non-combustible construction material in accordance with DIN 4102-1 with a melting point of at least 1000 °C
  - Phenolic resin hard foam in accordance with DIN 18164-1
  - expanded mineral construction materials with evidence of usability provided by the building authorities.

It should be particularly noted that the profile cavities to the space interior be filled with shaped pieces in the area of the retaining plate. (s.a. Fig. 5).

In the case of thermoplastic products in the penetration sites such as shaped pieces or drainage lines of PVC, PP or PE, these items melt away when fire occurs. The opening that would in this case form in a sheet metal mount must therefore be protected with a self-closing system (e.g. pipe screening R30 in accordance with DIN 4102-11 or a fire protection flap).

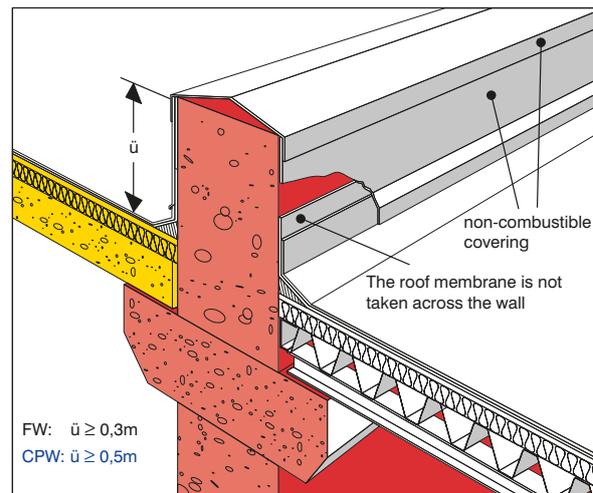
For larger penetration sites (e.g. skylight domes, smoke and heat exhaustion devices) upstands of various types are used usually. Measures must be taken for this to prevent a flame invasion in the case of fire through the upstands into the roof construction and the roof surfaces.

- DIN V 18234-3 evaluates bracings, transitions or supports for upstands as extremely critical when wood is used. Therefore, they must either be manufactured from non-combustible construction materials or protected by suitable borders.
- The roof construction must be protected up to the opening at its complete height. If the entire roof construction is surrounded by borders around the penetration points with single or multi-part steel profiles then it should be ensured that the cut profile cavities are designed around the thermal insulation as previously displayed.
- The highest possible upstands should be used.
- It should be ensured that the connection of the water proofing to the upstands is as low as possible for reasons related to fire protection.
- The heat insulators around the opening are to be formed in a strip of 0.5 m and the profile cavities to the room interior the same as with small penetration sites.
- A 0.5 m wide secure gravel strip is to be securely placed on the water proofing around the penetration site.

#### 4.3 Roof endings and connections

Roof components made of combustible building materials such as roof binders, slats, and rafters like ceilings and wooden shells, as well as water proofing and thermal insulation materials may not, in order to prevent the spread of fire across the roof, be installed through firewalls and complex separation walls (See Fig. 6). Fire walls and complex separation walls are generally to be conducted through the connecting roof surfaces or shed peaks in accordance with information sheet VdS 2234.

**Fig. 6:** Connections on the firewalls and complex partitions



Steel roof components may not be firmly connected to firewalls or complex partitions since they expand in the case of fire or fail completely and thus can threaten the stability of the walls.

If the roof guide of a firewall or complex partition is not possible, then

- flat roofs including their supporting structures must be placed in an area of at least 5 m on both sides of the firewalls or 7 m on both sides of the complex partition. They must be fire resistant and not comprised of combustible materials (F 90-A) as well as without openings. Combustible water proofing can only be used in the wall connection area if it is protected by a gravel fill at least 5 cm thick (Grain 16/32);
- Shed or saddle roofs including their supporting structures are fire-resistant and not comprised of combustible materials (F90-A),

so that flames cannot overrun the firewalls or complex partitions and cannot expand into the building to both sides of the wall.

*Note: VdS 2234 Firewalls and complex partitions – Instructions for the arrangement and design*

In the edge trims, it is particularly important that

- penetration of fire into the roof,
- expansion of combustion gas in the roof and
- expansion of fire via the roof

are prevented insofar as possible by using non-combustible construction materials and fire-stop sealing the cavities of the air-permeable structure. Wooden planks in the roof edge area must be avoided as much as possible or covered with non-combustible building materials.

In the canopy area, e.g. ramps from storehouses where high fire loads in the form of storage goods,

pallets and packages frequently exist and in addition the risk of arson exists from outside, company and organisational fire protection measures are additionally required to prevent the outbreak of fire and a fire flashover from the facade to the main roof.

*Note: VdS 2000 Fire protection in the plant, VdS 2199 Fire protection in the store room*

#### 4.4 Roof work

A fire hazard, which should not be underestimated, is, when combustible roofing materials are laid or sealed by fire-hazardous methods.

A frequently applied method in the laying and sealing work in the roof area is the so-called hot process, in which bitumen is heated. For the casting process, bitumen is heated in special bitumen cookers or tanks while the water proofing or other roof layers are bonded during the welding process with the use of open burner flames.

The most frequent causes of fire include

- Heat conduction; burning droplets including those in connection with combustible building materials such as covered thermal insulation, wood shells, complex connection areas such as cavities, facades, joints;
- Non-observance of safety rules;
- unsupervised operation of gas burners and the bitumen cooker;
- defective installation, e.g. leaky bitumen cooker;
- Ignition of the bitumen due to overheating.

The risk of fire continues to exist after the completion of a roof, since roofs must be renovated every year due to the natural aging or weather effects and stresses, which every roof is exposed to. If fire damage results from flame operations, the damages caused often exceed the liability limits of the roofer assigned to the roofing work.

From the perspective of fire protection, laying and repair techniques which are based on cold processes, i.e. no open flames or heating systems are used, are preferable. For such processes, Bitumen cold adhesive, self-adhering bitumen strips which, depending on the suitability of the sealing strips, are non-critical, or else mechanical mountings are used. If roofing work with open flames cannot be avoided, then such work may only be performed with the explicit approval of the management. In addition to this, a professional expert should be hired to carry out the work in-

volving fire hazards, who has arranged a company liability insurance policy to cover the risks. For the practical implementation, it is strongly recommended that the assigned handworker commit in writing before beginning the work to compliance with the company fire protection code in general and also the safety rules for flame operations in particular (see permit in the Appendix)

The following measures must be taken concretely and attention must be given to their consistent implementation:

- Before starting the roofing work (in particular during renovation) the respective fire hazards of the roof with consideration of the fire loads, the structural design of the layer construction etc. should be investigated. For this purpose the construction documents should be viewed and a on-site survey carried out, since these can show that additional protective precautions are necessary.
- To combat fire outbreaks, a sufficient number of suitable and operational fire extinguishers for the initial extinguishing measures must be kept at hand on the roof surface. Also well proven is the laying of stable pressurised water hoses for the duration of the roofing work (Caution: Do not use water for bitumen cookers!).
- Only those materials intended for workmanship should be kept on the roof surface (needed daily). Additional material and reserve gas tanks are also to be kept at a safe distance from the building. Only bitumen cookers which are equipped with temperature gauges, overflow guards and covers (against moisture from outside) should be used
- Bitumen cookers may only be set up in a basin and with sufficient distance from combustible materials.
- It is recommended to give preference to manual burners, which are equipped with a quick-acting control valve (ON/OFF switching of the gas flame using a valve lever).
- Gas burners and gas tanks are to be set up stably; support devices are to be provided for manual burners.
- Burners or bitumen cookers may only be kept in operation when supervised.
- Immediate alerting of the fire brigade, e.g. per mobile telephone is to be ensured.
- If a particular hazard exists e.g. as a result of covered work areas or due to high value concentration, then a firewatch must be provided during roofing work and moreover follow-up checks must be made.

The determination of and compliance with suitable protective measures must not only be clearly regulated and monitored in the interest of the companies taking the measures, but above all in the interest of the builders and operators.

#### 4.5 Additional fire protection measures

In order to spare the fire brigade the task of laying out hoses – in particular for multi-story buildings – rising ducts (wet-dry) should be provided up to the top story, into which the fire brigade can feed water in case of their mission. These protective devices must be serviced every 2 years. For reasons of frost protection, dry risers should be inspected at the start of the frost period and emptied if they contain water.

*Note: VdS 2000 Fire protection in the plant*

The risk of damage on and also in structural systems due to lightning strikes can be considerably reduced by installing a lightning protection system. As a component of the total structural design, roofs are therefore to be included in the external lightning protection and provided with appropriate lightning rods.

*Note: VdS 2000 Fire protection in the plant*

#### 4.6 Special roofs

##### Sandwich element roofs

With so-called sandwich or ISO roof elements which are industrially produced without a cavity the risk of fire spreading in the roof or via the rooftop surfaces is usually low, because experience shows that these elements are rarely involved in initial fires.

If industrially manufactured sandwich elements are used, which contain a core of combustible polyurethane hard foam as thermal insulation, then one should ensure that steel is used for the inner shell. The exterior shell can however also consist of other metallic building materials (e.g. aluminium).

If sandwich elements are produced on site with a metallic outer shell, the thermal insulation must consist of non-combustible materials due to open cavities on the sheet corrugation.

Sandwich or ISO roof elements are however not usually tested according to DIN 18234 and do not exhibit any long-term fire resistance in accordance with DIN 4102.

##### Green roofs

Planting grass on the roofs can be either

- Intensively designed (planting on thicker substratum layers with watering and care, e.g. roof gardens with groves and trees) or
- Extensively designed (usually a low level of planting on a thinner substratum layer without watering and care).

Intensively planted roofs are generally considered to be hard roofing. Should extensively planted roofs be resistant against flying sparks and radiating heat then this must be demonstrated in accordance with DIN 4102-7.

With such roofs, the following roof areas must be kept free from the planting by the arrangement of concrete plates (e.g. 4.0 cm thick concrete slabs) or Gravel (grain 16/32, surface weight > 80 kg/m<sup>2</sup>):

- a strip which is at least 1 m wide on both sides of the firewall or complex partition and
- a strip which is at least 0.50 m wide around roof openings or in front of ascending walls with windows.

##### Thatched roofs

Thatch roof coverings are not resistant against flying sparks and radiating heat in terms of DIN 4102-7. A thatched roof must therefore must be covered in the area of chimney openings to a perimeter of 0.50 m with non-combustible construction materials, such as metal covering.

For buildings with thatched roofs, the installation of lightning protection devices to restrict the risk of fire is particularly recommended.

## 5 Fire protection – related roof requirements

The fire protection requirements are rooted in both the Federal State Building Regulations and the recommendations of the fire insurance provider.

## 5.1 Requirements to comply with building regulations

Initially in the planning and construction the fire protection requirements from the Federal Building Regulations and the supplementary special building directives for roofs must be observed. An overview and summary of this is given in the table in the Appendix (see Table 1).

### 5.1.1 Roofs in accordance with DIN 4102

The following is considered as hard roofing without verification:

1. Roofing which in DIN 4102-4 is not designed to be resistant against flying sparks and radiating heat;
2. Roofing of natural and artificial stone of material class DIN 4102-A, such as concrete and bricks;
3. Steel sheet and other metal roofs without thermal insulation and covering layers on the top side of material class DIN 4102-B, with thermal insulation layers arranged underneath of at least flame-retardant construction materials (material class DIN 4102-B1);
4. professionally laid
  - Bitumen strips in accordance with DIN 52128
  - Bitumen sealing strips in accordance with DIN 52130,
  - Bitumen welding strips in accordance with DIN 52131,
  - Glass mat bitumen sheeting in accordance with DIN 52143,

in an at least two-layer design on a supporting structure of at least normally inflammable materials (material class DIN 4102-B2); whereupon one of the bitumen strips must contain a reinforcement of glass mat or fibre if the roofs are insulated with PS hard foam;

5. any kind of roofing completely covered with gravel fill (at least 5 cm thick - grain 16/32, surface weight > 80 kg/m<sup>2</sup>) or with a covering of mineral plates, e.g. concrete plates (at least 4 cm thick).

In the planning and design of hard roofing, the numerous relevant provisions such as construction material standards and also the processing guidelines of the manufacturer must be absolutely observed.

Roofings not listed here are only recognised as hard roofing if a test certificate in accordance with DIN 4102-7 is available for them. The type designations of the roof components to be installed must exactly conform to the specifications of the associated test certificate! This also applies for roof components with multiple functions such as polyurethane in-situ foams, which are placed on the roofs as the topmost layer and assume both the function of the insulating layer as well as the roof membrane. A classification of the materials used for the roofing as normally inflammable or flame retardant in accordance with DIN 4102-1 does not suffice as evidence for a hard roofing.

Roofing which does not conform to that listed above is considered to be "soft roofing".

Roof inserts (e.g. sky light domes), which are recognised as hard roofing, can be installed insofar as their surface segment is restricted in accordance with the Federal Building Regulations they can not transfer damaging fire to other building parts or sections.

### 5.1.2 Roofs in accordance with DIN 18234

For flat or flat sloped roofs, which are primarily used for industrial and commercial structures, and in addition do not have a fire resistance of at least 30 minutes, it is possible to prove an adequate fire safety according to DIN 18234.

In order to consider various fire transfer mechanisms on the roof, DIN 18234 provides for the evaluation of the effects of fire on the roofs

- in the interior space,
- on the roof and
- on openings

Evidence of protection against flame transfer from the top of the roof, for which evidence in accordance with DIN 4102-7 is not sufficient, has not been regulated up to now and can possibly be provided by an expert evaluation by a recognised test centre.

DIN 18234-3 regulates constructive measures on roof openings such as for

- skylight domes, smoke and heat exhaust devices, as well as
- pipe outlets for roof drains, continuous vents

Plants, which design a roof in accordance with DIN 18234, should demonstrate with a factory

certificate that the roof conforms to the specifications in the test certificate or to a construction type defined in the supplement to DIN 18234-1.

In the technical consideration of risk by the fire insurance provider, roofs can be positively evaluated in accordance with DIN 18234.

*Note: VdS 2035 Steel trapezoidal profile roofs – recommendations for fire protection*

## 5.2 Evaluation of the fire insurance provider

Insurance providers evaluate structural installations dependent on the usage and type of construction; roofs with

- roof supports with a fire resistance of at least 30 minutes,
- roof shells made of mineral construction materials,
- mineral construction materials as thermal insulation,
- hard roofing in accordance with DIN 4102-7

as well as roofs in accordance with DIN 18234 can be positively evaluated in terms of risk consideration.

## 6 Literature/Sources

### 6.1 Sample construction code (MBO) and Federal building regulations (LBO) as well as special building directives

Publications of the Federal law and regulation sheets or local book sellers

### 6.2 GDV- and VdS-Publications

Publisher: German Insurance Association e.V.,  
Postfach 10 37 53, 50477 Cologne

Reference: VdS Damage prevention Publisher  
Amsterdamer Strasse 174,  
50735 Cologne  
Internet: [www.vds.de](http://www.vds.de)

**VdS 2000** Fire protection in the plant

**VdS 2035** Steel trapezoidal profile roofs – Recommendations for fire protection

**VdS 2097** Structural fire protection; products and documents

- Part 2a Non-combustible building materials
- Part 3 Constructive components
- Part 6 Cable and pipe firestop seals

**VdS 2199** Fire protection in the warehouse

**VdS 2234** Firewalls and complex partitions  
– Instructions for the arrangement and design

## 6.3 DIN Standards

**DIN 4102** Fire behaviour of building materials and components

- Part 1 Building materials; terms, requirements and Test, Version 05/98
- Part 4 Composition and usage classified building materials, components and Special components, Version 03/94
- Part 7 Roofing; terms, requirements, Tests, Version 05/98
- Part 11 Pipe jackets, pipe firestop seals, installation ducts and channels as well as connections of their inspection openings; terms, requirements and Tests, Version 12/85

**DIN 18 234** Structural fire protection in industrial construction

- Part 1 Terms, requirements and tests for roofs, single-shell roofs with sealing for fire resistance from below; closed roof surfaces, Version 11/95
- Bbl. 1 Table of roofs which fulfil the requirements of DIN 18234-1 without further proof, Version 11/95
- Part 3 constructive measures for roof penetrations, connections and endings for the delay of the spread of fire, Version 12/97 (Pre-standard)

Beuth Verlag GmbH  
10772 Berlin  
Internet: [www.beuth.de](http://www.beuth.de)

## **6.4 Occupational Health and Safety Regulations of the trade associations**

**BGV D 1** "Welding, cutting and related work processes"

**BGV D 16** "Heat, flame and melting devices for building and assembly work"

**BGV D 34** "Usage of liquid gas"

Carl Heymanns Verlag KG  
Luxemburger Str. 449, 50939 Cologne  
Internet: [www.heymanns.de](http://www.heymanns.de)

## **6.5 Literature**

Structural fire protection – Industrial roofs, VdS-Fachtagung, on 13./14. October 1992, Cologne VdS Damage prevention Publisher, Cologne

Dieter Brein: Fire protection on flat roofs in the industrial sector, s + s report, 6/1996, VdS

VGH-Instruction "Fire operations"

- Form: "Repair work on flat roofs – Working with open flame"

- Form: "Roof work with open flame"– Instructions for the construction site"

Josef Mayr: Brandschutzatlas, FeuerTRUTZ GmbH, Wolfratshausen, 1996

Guidelines for planning and design of roofs with seals – flat roof guidelines – Central association of German Roofers e.V.

## 7 Appendix

### 7.1 Sample permit for installation and repair work using an open flame on roofs

1	Construction plan/ order	
2	Client	
3	Contractor	
4	responsible	Construction manager: _____ Group leader: _____
5	<b>Safety directives to be observed</b> BGV D 1 "Welding, cutting and related work processes" BGV D 16 "Heat, flame and melting devices for construction and assembly work" BGV D 34 "Usage of liquid gas"	
6	<b>Protective measures before and during the work</b> <input checked="" type="checkbox"/> remove combustible material <b>if possible</b> <input checked="" type="checkbox"/> Cover endangered areas (e.g. joints/openings) <input checked="" type="checkbox"/> Set up bitumen cookers <b>only in basins of non-combustible materials</b> <input checked="" type="checkbox"/> Do not store gas tanks and material which is not needed <b>on the roof</b> <input checked="" type="checkbox"/> Dispose a fire guide <i>on the roof</i> <input checked="" type="checkbox"/> Provide extinguishers and extinguishing agents <i>on the roof</i> Fire extinguishers with <input type="checkbox"/> water <input type="checkbox"/> powder <input type="checkbox"/> CO <sub>2</sub> <input type="checkbox"/> under pressure of standing water hose	
7	Material storage site	
8	Follow-up control (name)	- at the end of work - 1 hour and .... hours after end of work
9	Alerting in case of fire	<b>Site of the nearest reporting centre</b> - Fire detector: - Telephone: <b>Fire brigade tel. number:</b>
	Permit	The accident prevention directives of the workers associations and the safety directives of the insurance provider are to be observed. The listed safety measures are to be implemented.
	Date	Client _____ Contractor _____

## 7.2 Building regulatory requirements

		Requirements concerning fire protection	
Directives for Structural installations	Roofing	Roof, general	Roof, special
<b>Sample building directive</b>	Hard roofing – resistant against flying sparks and radiating heat Deviation allowed for: - partial roof surfaces (e.g. winter garden, sky lights) low buildings with sufficient building clearance		For row houses with gables, the roof including its supports are to be constructed with a fire resistance of at least 30 minutes (F 30-B) to resist fire spreading from inside to outside.
<b>Sample garage directive</b>		Navigatable roofs - with a fire resistance of at least 90 minutes (F 90-AB) - with a fire resistance of at least 30 minutes and of non-combustible materials for one-story mid-sized and large garages above ground and small garages of non-combustible materials for open mid-sized and large garages as well as small garages	Paneling and insulating layers beneath the roofs - non-combustible for large garages - with a fire resistance of at least 30 minutes for mid-sized garages - panelling for large garages with a fire resistance of at least 30 minutes if the building materials used for it are primarily inseparable volumetrically and their distance to the roof is no more than 0.02m.
<b>High-rise building directive – Hochhaus RL – (May, 1981 edition)</b>		Support structure, roof shell including its panelling of non-combustible building materials	Accessible flat roofs including safety fence F 90-A, which protect thermal insulation and fire-stopping against fire outbreak

		<b>Requirements concerning fire protection</b>	
<b>Directives for structural installations</b>	<b>Roofing</b>	<b>Roof, general</b>	<b>Roofing, special</b>
<b>Sample industrial construction guidelines</b>	Resistant against flying sparks and radiating heat	Resistant against fire spread within a section - roofs in accordance with DIN 18234 - roofs with roof shells of mineral building materials - roofs with other non-combustible materials Support structure: Fire-resistant according to legal evidence	Constructive measures against fire spread in the area of roof openings
<b>Hospital building code-KhBauVO (Version Dec. 1976) §8</b>		Roofs - with a fire resistance of at least 90 minutes (F90-AB) for buildings with more than one full story - with a fire resistance of at least 30 minutes (F 30-A) of non-combustible materials for one-story buildings	Roofs within a clearance of 5 m from the external walls of higher building components must have a fire resistance of at least 90 minutes and be void of openings. The roof shell must consist of non-combustible construction materials
<b>Sample gathering site directive – MVStättVO – (Draft version Aug. 1999) §5</b>		Roof with a fire resistance of at least 90 minutes and roof shell fire-resistant as well as constructed from non-combustible materials. For ground-floor gathering sites roof with a fire resistance of at least 30 minutes or of fire-retardant materials. Roof shell material must not release burning droplets	

Requirements concerning fire protection		
Directives for structural installations	Roofing	Roof, general
<p><b>Sample shopping centre code</b>  <b>– MVKVO –</b>  <b>(Version Sept. 1995)</b>  <b>§</b></p>	<ul style="list-style-type: none"> <li>- resistant against flying sparks and radiating heat</li> <li>- of non-combustible materials with the exception of the water proofing and vapour block</li> </ul>	<p><b>Roof, special</b></p> <p>Transparent roofing must not release burning droplets in the case of fire</p> <ul style="list-style-type: none"> <li>- with a fire resistance of at least 30 minutes for shopping centres with sprinkler systems</li> <li>- with a fire resistance of at least 90 minutes for shopping centres without sprinkler systems</li> </ul>
		<p><b>Roof, general</b></p> <p>Support structure</p> <ul style="list-style-type: none"> <li>- of non-combustible building materials for shopping centres with sprinkler systems, with the exception of one-story shopping centres</li> <li>- with a fire resistance of at least 30 minutes (F 30-B) in ground-floor shopping centres without sprinkler systems</li> <li>- with a fire resistance of at least 90 minutes in other shopping centres without sprinkler systems</li> </ul>





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