Firewalls and complex partition walls

Leaflet for arrangement and design

Contains the supplement VdS 2234-S1en : 2018-01 (01)

The roof membrane is not taken across the wall

non-combustible cover

FW: $h \geq 0 \text{ cm}$
CPW: $h \geq 50 \text{ cm}$

FW: $h \geq 0,3 \text{ m}$
CPW: $h \geq 0,5 \text{ m}$

$\Delta H \geq 2 \text{ m}$
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1 Preliminary remarks

This leaflet substantiates the requirements for firewalls and complex partition walls and their design from the point of view of industrial fire insurance. It was compiled in consultation with the Bundesverband der Deutschen Industrie e.V. (BDI) (Federation of German Industry), based on building law regulations.

Fire hazard constitutes a serious threat for industrial and commercial businesses. Fire and fire consequential loss insurance may cover material damages; however, non-replaceable losses, like loss of life, health or the natural base of existence or loss of market participation or migration of experienced employees, are of greater importance.

Fire hazards in a business can effectively be countered by preventive fire protection measures. Implementation of the measures presented in this leaflet can have a favourable influence on evaluation of the premium by the insurer. If damage progression is limited through joint effort of all involved, this will in future be of advantage to all insured parties.

This leaflet is based on the current perception of fire protection. It contains recommendations which are aimed at reducing fire hazards and the consequences thereof. It is the intention to update this leaflet in mutual consultation, if basic changes in fire protection technology should arise.

In principle the leaflet applies to newly to be erected businesses, taking into consideration the specific fire protection requirements. Existing businesses should adapt their fire protection measures within the framework of options given in this leaflet.

Compared to the version of January 2008 the latest amendments of the present leaflet refer to the arrangement of photovoltaic modules to prevent as far as possible any adverse effect on the structural separation realised with firewalls and com-
plex partition walls in the building and avoid any impediment to effective firefighting.

A retrospective removal or reduction of fire protection measures can be taken as an increase of fire hazard (§§ 23 to 32 "VVG").

Fire protection measures stipulated by building authorities, industrial inspectorates and government safety organisations remain unaffected by this leaflet.

This leaflet is not regarded as agreed safety regulation according to § 7 "AFB", provided that nothing else has been agreed in individual cases.

2 Special notes

Firewalls (FW) confine fire compartments. They are intended to prevent the spreading of fire and fumes to other buildings or building sections.

Complex partition walls (CPW) meet higher requirements than firewalls. They separate buildings or building sections into complexes.

The requirements for complex partition walls are printed in blue in the brochure.

Explanatory notes on deviating building law regulations are printed in italics.

Diagrams show examples of implementation principles; firewalls and complex partition walls are presented in red, and fire-resistant components with a classified resistance of at least 90 minutes are presented in yellow.

| **F90-A:** | With a fire resistance of at least 90 minutes and from non-combustible building materials. |
| **F180-A:** | With a fire resistance of at least 180 minutes and from non-combustible building materials. |

3 Terms and definitions

3.1 Fire compartment

A fire compartment consists of one or more buildings, building sections or open storages, which have no spatial or constructional separation among themselves, however are separated from other buildings, building sections or storages.

Spatial fire compartment separation is on hand if the distance between buildings or storages of non-combustible material in the open is at least 5 m.

For storages of combustible material in the open, a minimum distance of 20 m is required.

**Constructional fire compartment separation** is on hand if buildings, building sections or storages are separated by a firewall according to this leaflet.

3.2 Building elements with a fire resistance class of 90 minutes

These are components:

- which have a fire resistance class of at least F 90-AB according to DIN 4102-4, or
- for which a fire resistance class of at least F 90-AB according to DIN 4102-2 has been proven in fire tests, and a "general building authority test certificate" has been issued.

*Note: The essential components of these building elements, such as load bearing components, are made of non-combustible materials.*

3.3 Complex

A complex consists of one or more buildings, building sections or open storages, which have no spatial or constructional separation among themselves, however are separated from other buildings, building sections or storages.

The complex is the basis for calculating the highest possible damage and a risk-related premium for fire and fire consequential loss insurance.

**Spatial separation of a complex** is on hand, if the minimum distance

- between buildings with a height of 5 m to 20 m, is equal to the height of the higher building,
- to open storages of combustible material is at least 20 m,
- between other buildings and/or storages of 5 m is maintained.

For special risk situations, e.g. high bay storage systems, explosion hazard, buildings with a height of more than 20 m, increased minimum distances may be required, which would have to be determined for each individual case.

**Minimum distances**

- to open storages of combustible material: 20 m
- otherwise: 5 m

**Constructional complex separation** is on hand if buildings, building sections or storages are se-
3.4 Explanations of spatial fire-compart-ment or complex separations with intermediate structures

If the distance between two opposite buildings is less than the height of the higher building or less than 5 m, the constructional design of the opposite external in particular walls must be taken into account when assessing the spatial separation of fire-compartments or complexes between buildings. Due to experience, external walls including their opening closures made of non-combustible building materials and/or with a classified fire resistance can help to limit the hazards of fire spread and transmission.

Note: The alternative solution described here, does however not take into account the debris shadow of a possible downfall of an external wall in the event of fire. It makes therefore sense to involve the concerned insurer in the planning and implementation of the above solution at an early stage.

Building connecting components (bridges, tunnels, etc.) do not cancel a spatial fire-compart-ment or complex separation (see Fig. 3b), if

- they are generally made of non-combustible building materials,
- combustible objects and substances aren’t placed, kept or stored in the space between the buildings or in course of the connecting component,
- a spread and transmission of fire and smoke are excluded by
  - accesses on both sides of the connecting component,
  - a horizontal and vertical angle influence in the connection area of connecting components on both external walls of the building, and
  - a static failure of the connecting components in the sense of a kinematic chain is excluded.

The accesses of the connecting component can be protected either on both sides of the connection each with a closure (door, gate) classified with a fire resistance duration of at least 30 minutes or on one side with a closure classified with a fire resistance duration of at least 90 minutes. These closures shall be permanently closed or closed timely and in complete manner in the event of fire, if necessary by means of a hold-open device.

If pipes are routed over the building connecting component, the requirements in paragraph 6.2.3 to 6.2.7 shall be followed as well.

Figure 3b: Constructions and their location that do not affect a spatial separation
4 Arrangement

Firewalls are of importance from the point of view of insurance and fire protection, e.g.

- for the division of expanded production and storage areas,
- for isolation of plants, essential for production,
- for a constructional separation between areas of differing utilisation,
- for constructional separation between areas protected by automatic fire extinguishing systems and unprotected areas,
- for constructional separation between areas protected by fire alarm systems and unprotected areas,
- as substitute for spatial distance to other buildings or storages in the open.

These statements also apply to complex partition walls. Complex partition walls are particularly well-suited for isolating different hazard areas.

4.1 Buildings of the same height

Firewalls between buildings with the same height:

- In connection with Roofs with a fire resistance less than 90 minutes, or roofs constructed with combustible building materials the firewall must extend to at least 30 cm above adjoining roof surfaces or the shed apex (see Section 6.5 for further notes).

*Notes: According to the guideline on the structural fire protection in industrial buildings (industrial building guideline – „IndBauR”), at least 50 cm are required.*

A roof overhang of 80 cm has been proven to protect fire brigade staff from radiation heat.
Firewalls and complex partition walls

- roofs with a fire resistance of at least 90 minutes must be connected directly to the adjoining Firewall. It suffices if the roof on both sides of the firewall is constructed without an opening for at least 5 m and is constructed including the bearing structure with a fire resistance of at least 90 minutes and from non-combustible material (F 90-A), see also Section 6.5: Connection to roofs and roof construction).

**Note:** The cantilever plates in the connection to the firewall allowed by some State building regulations, was proven to be insufficient for roofs with combustible building material.

A complex partition wall

- in connection with roofs with a fire resistance less than 90 minutes, or roofs constructed with combustible materials must extend to at least 50 cm (recommended 80 cm) above adjoining roof surfaces or the shed apex;
- in connection with roofs with a fire resistance of at least 90 minutes must join directly. It suffices if the roof on both sides of the firewall is constructed without an opening for at least 7 m and is constructed including the bearing structure a fire resistance of at least 90 minutes and from non-combustible building material (F 90-A), see also Section 6.5: Connection to roofs and roof construction).

**4.2 Buildings of differing height**

For a height difference of less than 2 m, a firewall in accordance with Section 4.1 must be constructed as for buildings of equal height.

These requirements also apply to complex partition walls.

For buildings with a height difference of more than 2 m, the following options are available:

- The firewall must be constructed up to the roof skin of the higher building.

**Note:** According to some State building regulations, the firewall must extend to 30 cm above roof skin height, except for buildings of low height.

- The complex partition wall must be constructed up to the roof skin of the higher building; for roofs with a fire resistance less than 90 minutes and for roofs constructed with combustible materials it must extend to at least 50 cm (recommended 80 cm) above adjoining roof surfaces or the shed apex.
The firewall must be constructed at least up to the roof skin of the lower building. The roof of the lower building, including the roof bearing structure, must be constructed with a fire resistance of at least 90 minutes and from non-combustible building material (F 90-A), which is corresponding to the height difference of the buildings and needs to be at least 5m but not more than 15m. The roof may not have any openings in this section. If combustible roof sheeting is present in this region, it must be protected by a layer of gravel, at least 5cm thick. The wall above the firewall may not have any openings and must be constructed from non-combustible building material.

The complex partition wall must be constructed at least up to the roof skin of the lower building. The roof of the lower building, including the roof bearing structure, must be constructed with a fire resistance of at least 90 minutes and from non-combustible building material (F 90-A), which is corresponding to the height difference of the buildings and needs to be at least 7m but not more than 15m. The roof may not have any openings in this section. If combustible roof sheeting is present in this region, it must be protected by a layer of gravel, at least 5cm thick. The wall above the complex partition wall may not have any openings and must be constructed from non-combustible building material.

The firewall must be erected at a distance from the higher building section, which corresponds to the difference in height between the buildings, but must be at least 5m. More than 15m is not required.

The complex partition wall must be erected at a distance from the higher building section, which corresponds to the difference in height between the buildings, but must be at least 7m. More than 15m is not required.
4.3 Effect of angle

If buildings or building sections are arranged at an angle of $<120^\circ$ to each other, increased danger arises of fire spreading across. Therefore the following applies:

- The distance of the firewall from the inner corner must be at least 5 m, or
- one of the two exterior walls must be constructed for a length of at least 5 m with a fire resistance of at least 90 minutes fire-resistant and non-combustible building material (F 90-A), or parts of both exterior walls at the inner angle must be constructed for a length of at least 5 m (measured horizontally diagonally) with a fire resistance of at least 90 minutes and non-combustible material (F 90-A). This section of the wall may not have any openings unless they are protected with a fire resistance of at least 90 minutes and no roof overhang of combustible material is allowed.

Note: Some State building regulations require firewall quality for this wall section.

It is a prerequisite for both designs, that the eaves are at more or less the same height. Else the firewall in the higher building or the exterior wall with a fire resistance of at least 90 minutes must be arranged at the higher building.

These requirements also apply to complex partition walls, however, 7 m must be taken instead of 5 m.
5 Construction, requirements and proofs

Firewalls, including bracing components, are in accordance with fire resistance class F 90-A according to DIN 4102. They prevent spreading of fire through flames, heat conduction, heat radiation and fumes for at least 90 minutes. They retain their stability under three times impact loading of 3,000 Nm and maintain spatial closure according to DIN 4102-2.

Spatial closure according to DIN 4102-2 is regarded as having been achieved, if a defined ball of cotton wool is held against the wall on the opposite side of the fire during a fire test at the worst possible positions (cracks, gaps, connections) of the building element being tested, and does not ignite. Imperviousness of the spatial closing component against cold or mildly warm smoke is monitored, but is not a criterion for passing the test.

The following building authority proofs of applicability currently apply for different types of firewalls:

- standardised construction according to DIN 4102-4 (see Table 1), or
- general building authority concession (only for walls of reinforced gas concrete), or
- general building authority test certificate of an accredited testing institute, or
- approval by the responsible highest level building authority in individual cases.

Decisive key figures for firewalls of standardised construction are raw density class, allowed slenderness ratio, minimum wall thickness and minimum pitch of reinforcement. Raw density class specifies the class upper limit of raw density in [kg/dm³].

Technical specifications of the proofs of applicability are binding.

Complex partition walls, including bracing components, correspond to fire resistance class F 180-A according to DIN 4102. They retain their stability under three times impact loading of 4,000 Nm and maintain spatial closure according to DIN 4102-2.

Testing of impact resistance must be done according to the procedure described in DIN 4102-3, whereby the required impact energy of 4,000 Nm is generated through a swinging fall motion of a test bag (weight: 200 kg) from a drop height of 2,0 m.
### Table 1
The following construction types comply with the requirements for:

<table>
<thead>
<tr>
<th>Row</th>
<th>Construction characteristics</th>
<th>Gross density class</th>
<th>Allowed minimum thickness d (cm)</th>
<th>Slenderness h/d (^{10})</th>
<th>Minimum pitch of reinforcement u (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Walls of normal concrete according to DIN 1045</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Non-reinforced concrete</td>
<td>—</td>
<td>20.0</td>
<td></td>
<td>2 x 18.0</td>
</tr>
<tr>
<td>1.2</td>
<td>Reinforced concrete</td>
<td>—</td>
<td>12.0</td>
<td></td>
<td>2 x 10.0</td>
</tr>
<tr>
<td>1.2.1</td>
<td>- non-load-bearing</td>
<td>—</td>
<td>14.0 (^{10})</td>
<td></td>
<td>2 x 12.0 (^{10})</td>
</tr>
<tr>
<td>1.2.2</td>
<td>- load-bearing</td>
<td>—</td>
<td></td>
<td></td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td>Walls of lightweight concrete with no-fines lightweight texture according to DIN 4232</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td></td>
<td>≥ 1.4</td>
<td>25.0</td>
<td></td>
<td>2 x 20.0</td>
</tr>
<tr>
<td>2.2</td>
<td></td>
<td>≥ 0.8</td>
<td>30.0</td>
<td></td>
<td>2 x 20.0</td>
</tr>
<tr>
<td>3</td>
<td>Walls of reinforced gas concrete</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1</td>
<td>Non-load-bearing wall panels of strength class 4.4</td>
<td>≥ 0.7</td>
<td>17.5</td>
<td></td>
<td>2 x 17.5</td>
</tr>
<tr>
<td>3.2</td>
<td>Non-load-bearing wall panels of strength class 3.3</td>
<td>≥ 0.6</td>
<td>20.0</td>
<td></td>
<td>2 x 20.0</td>
</tr>
<tr>
<td>3.3</td>
<td>Load-bearing, standing wall panels of strength class 4.4</td>
<td>≥ 0.7</td>
<td>20.0 (^{2})</td>
<td></td>
<td>20.0 (^{2})</td>
</tr>
<tr>
<td>4</td>
<td>Walls of reinforced prefab brick components according to DIN 1053</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.1</td>
<td>Vertically perforated panel with bricks for full plaster butt joints</td>
<td>—</td>
<td>16.5</td>
<td></td>
<td>2 x 16.5</td>
</tr>
<tr>
<td>4.2</td>
<td>Joined panels with two layers of bricks</td>
<td>—</td>
<td>24.0</td>
<td></td>
<td>2 x 16.5</td>
</tr>
<tr>
<td>5</td>
<td>Walls of masonry(^{8}) according to DIN 1053-1 und -2, utilising normal mortar of mortar group II, IIA, III or IIIa</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.1</td>
<td>Solid bricks and perforated bricks according to DIN 105-1</td>
<td>≥ 1.4 (^{3})</td>
<td>24.0</td>
<td></td>
<td>2 x 17.5</td>
</tr>
<tr>
<td></td>
<td>Lightweight perforated brick according to DIN 105-2</td>
<td>≥ 1.0</td>
<td>30.0 (24.0)</td>
<td>2 x 20.0 (2 x 17.5)</td>
<td></td>
</tr>
<tr>
<td>5.2</td>
<td>Sand lime brick according to DIN 106-1 and Part 1 A1(^{4}) (currently in design) and -2</td>
<td>≥ 1.8</td>
<td>24.0 (24.0)</td>
<td>2 x 17.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>≥ 1.4</td>
<td>24.0</td>
<td>2 x 17.5 (9)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>≥ 0.9</td>
<td>30.0 (30.0)</td>
<td>2 x 20.0 (2 x 17.5)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>≥ 0.8</td>
<td>30.0</td>
<td>2 x 24.0 (2 x 17.5)</td>
<td></td>
</tr>
<tr>
<td>5.3</td>
<td>Gas concrete bricks according to DIN 4165</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.3.1</td>
<td></td>
<td>≥ 0.6</td>
<td>30.0</td>
<td></td>
<td>2 x 24.0</td>
</tr>
<tr>
<td>5.3.2</td>
<td></td>
<td>≥ 0.6 (^{7})</td>
<td>24.0</td>
<td></td>
<td>2 x 17.5</td>
</tr>
<tr>
<td>5.3.3</td>
<td></td>
<td>≥ 0.5 (^{11})</td>
<td>30.0</td>
<td></td>
<td>2 x 24.0</td>
</tr>
<tr>
<td>5.4</td>
<td>Concrete bricks according to DIN 18151/18152/18153</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.4.1</td>
<td></td>
<td>≥ 0.8</td>
<td>24.0 (17.5)</td>
<td>2 x 17.5 (2 x 17.5)</td>
<td></td>
</tr>
<tr>
<td>5.4.2</td>
<td></td>
<td>≥ 0.6</td>
<td>30.0 (24.0)</td>
<td>2 x 24.0 (2 x 17.5)</td>
<td></td>
</tr>
</tbody>
</table>

The ( )-values apply to walls plastered according to DIN 41024, Section 4.5.2.10
1) Provided that no higher values are demanded according to DIN 41024, Table 35, due to a high load factor
2) Provided that no higher values are demanded according to DIN 41024, Table 44, due to a high load factor
3) Excentricity e ≤ d/3
4) Also for thin layer mortar
5) When using thin layer mortar and cast bricks d = 175 mm
6) When using lightweight mortar; load factor a 2 ≥ 0.6
7) When using thin layer mortar and cast bricks with mortar in butt and horizontal joints
8) For further information see e.g. [2]
9) When using thin layer mortar and cast bricks: d = 150 mm
10) There are no requirements regarding the distance between the two leaves
11) When using thin layer mortar and cast bricks with tongue and groove, only for mortar in butt and horizontal joints.
### Table 2
The following construction types comply with the requirements for complex partition walls:

<table>
<thead>
<tr>
<th>Row</th>
<th>Construction characteristics</th>
<th>Minimum thickness d (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>single-leaf construction</td>
</tr>
<tr>
<td>1</td>
<td>Walls of masonry according to DIN 1053-1, built with mortar group II, IIA, III or IILA, utilising</td>
<td>36.5</td>
</tr>
<tr>
<td>1.1</td>
<td>Masonry bricks according to DIN 105, solid or perforated bricks (excluding long hole bricks)</td>
<td>36.5</td>
</tr>
<tr>
<td>1.2</td>
<td>Lime sand bricks according to DIN 106-1 and -2</td>
<td>36.5</td>
</tr>
<tr>
<td>1.3</td>
<td>Slag bricks according to DIN 398</td>
<td>36.5</td>
</tr>
<tr>
<td>1.4</td>
<td>Gas concrete block bricks and gas concrete cast bricks according to DIN 4165</td>
<td>36.5</td>
</tr>
<tr>
<td>1.5</td>
<td>Gas concrete cast bricks of strength class P4 and P6; gross density class ≥ 0.7; mortar in butt and horizontal joints</td>
<td>36.5</td>
</tr>
<tr>
<td>1.6</td>
<td>Cavity block bricks of lightweight concrete according to DIN 18 151</td>
<td>36.5</td>
</tr>
<tr>
<td>1.7</td>
<td>Solid and solid block bricks of lightweight concrete according to DIN 18 152</td>
<td>36.5</td>
</tr>
<tr>
<td>1.8</td>
<td>Cavity block bricks of concrete according to DIN 18 153</td>
<td>36.5</td>
</tr>
<tr>
<td>2</td>
<td>Walls of normal concrete, utilising</td>
<td>24</td>
</tr>
<tr>
<td>2.1</td>
<td>non-reinforced concrete according to DIN 1045</td>
<td>30</td>
</tr>
<tr>
<td>2.2</td>
<td>reinforced concrete according to DIN 1045, non-load-bearing, bedded or standing</td>
<td>18</td>
</tr>
<tr>
<td>2.3</td>
<td>reinforced concrete according to DIN 1045, load-bearing</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30</td>
</tr>
<tr>
<td>3</td>
<td>Walls of lightweight concrete with no-fines lightweight texture according to DIN 4232</td>
<td>35</td>
</tr>
<tr>
<td>4</td>
<td>Walls of reinforced gas concrete, of at least strength class 4.4, utilising</td>
<td>24</td>
</tr>
<tr>
<td>4.1</td>
<td>non-load-bearing, bedded wall panels with gross density class ≥ 0.6</td>
<td>24</td>
</tr>
<tr>
<td>4.2</td>
<td>load-bearing, standing wall panels with gross density class ≥ 0.7</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td></td>
<td>24</td>
</tr>
<tr>
<td>5</td>
<td>Walls of prefab brick components according to DIN 1053-4</td>
<td>24</td>
</tr>
</tbody>
</table>
6 Design

Firewalls must be constructed without offset through all storeys.

Complex partition walls must be constructed without offset through all storeys.

6.1 Stability

6.1.1 General requirements

Firewalls may not be connected with components or technical constructions like props, trusses, ceiling joists or crane runways in such a way that the stability of the firewall would be compromised through expansion or collapse of these components in case of fire.

If danger exists of adjacent components exerting forces on the firewall in case of fire, provision must be made for sufficient space between the firewall and the components.

These requirements also apply to complex partition walls.
6.1.2 Connections

Statically required connections, which have to absorb the impact load according to DIN 4102-3, must be constructed in such a way that the stability and functionality of the firewalls is not compromised. Construction of connections is in accordance with DIN 4102-4 or the proofs of applicability.

These requirements also apply to complex partition walls.

6.1.3 Bracings

As an essential element of the stability, braces of firewalls must at least comply with fire resistance class F 90-A. Construction of braces is in accordance with DIN 4102-4 or the proofs of applicability.

Bracings of complex partition walls must at least comply with fire resistance class F 180-A. Their construction is in accordance with DIN 4102-4 or the proofs of applicability according to DIN 4102-2.
6.2 Openings

Openings in firewalls are not allowed in principle. If they are required for operational purposes, they must be protected with a fire resistance of at least 90 minutes.

Wall openings are regarded to be adequately protected if they are furnished with:

- Fire barriers $T_{90}$ (EI $90$ according to European fire resistance class),
- Glazing of fire resistance class $F_{90}$ (EI $90$ according to European fire resistance class),
- Locking mechanisms against spreading of fire in ventilation ducts of fire resistance class $K_{90}$ (EI $90$ according to European fire resistance class),
- Fire stop seals for cable ducts of fire resistance class $S_{90}$ (EI $90$ according to European fire resistance class),
- Installation channels for ducting electrical installations of fire resistance class $I_{90}$.

Conductors, cables, pipes, etc. may not exercise undue forces on the wall.

These requirements also apply to complex partition walls. However, per storey with a wall area

- of up to $220\,\text{m}^2$ a maximum of four openings with a total area of $22\,\text{m}^2$ (including slip doors),
- of more than $220\,\text{m}^2$ a maximum of four openings with a total area of $10\%$ (including slip doors),

may be present.

Fire stop seals for cable and pipe ducts are not taken into consideration in establishing the number of openings and total area of openings.
6.2.1 Fire protection closures

Fire protection closures are designed to protect necessary openings for operation in fire-compartment walls or complex partition walls as passageways. In the event of a fire, they must be closed timely, completely and prevent the spread of fire over the openings to be protected for a sufficiently long time.

Fire doors or shuttles must be constructed with a fire resistance of at least 90 minutes (T 90, EI 90-C) according to DIN 4102-5 and self-locking according to DIN 4102-18. They must either comply with a standardised construction type or must be approved in terms of general building authorities. If fire doors or shuttles are to be kept open for operational purposes, they must be furnished with hold-open systems approved in terms of general building authorities. All fire doors and shuttles must be closed after working hours according to the "Allgemeine Sicherheitsvorschriften der Feuerversicherer für Fabriken und gewerbliche Anlagen (ASF)", VdS 2038, even if they are furnished with hold-open systems.

Fire doors and shuttles in complex partition walls must be furnished with hold-open systems approved in terms of general building authorities.

If fixed track conveyors traverse through the firewall, fire shuttles for fixed track conveyors T 90, approved by general building authorities, are required. According to the general building authority certification, they must be certified by a VdS specialist or a specialist from another testing institute, appointed thereto by the German Institute for Construction Technology (DIBt).

These requirements also apply to complex partition walls.

Fire doors and shuttles protecting openings in firewalls to smoke-sensitive areas, must also comply with the requirements for smoke protection doors according to DIN 18095.

These requirements also apply to complex partition walls.
If a driverless transport system (DTS) is used which drives through the firewall, the respective fire protection closure and the DTS must be coordinated in such a way that the fire protection closure can close timely and completely in the event of a fire and the closing process is not hindered or impaired by the DTS. For this purpose, it is among other things necessary that in the event of a fire, DTSs do not stay in the acting area of fire protection closures, for example due to a power failure or an incorrect arrangement of the stop points for the inductive control of DTSs.

The proper functioning of this fire protection closure in conjunction with DTS shall be accepted and documented by an expert inspection body, e.g. the VdS Technical Testing Laboratory.

These requirements also apply to complex partitions.
6.2.2 Safety transition room

Safety transition room may be required in firewalls between rooms where explosions or quick spreading of fire can be expected. Safety locks must be constructed with a fire resistance of at least 90 minutes and must consist of non-combustible building materials and must be furnished with self-locking fire doors of fire resistance class T 90. The distance between fire doors must be at least 3 m. Hold-open systems are not allowed for these locks.

Safety transition room may be required in complex partition walls between rooms where explosions or quick spreading of fire can be expected.

6.2.3 Non-combustible pipelines

Essential wall lead-through of pipes and pipe bundles must be constructed according acknowledged regulations of technology and technical building regulations. They should preferably be mounted within the lower third of a firewall, so that pipes falling down cannot exert any forces on the wall.

The following constructions have proven themselves for protecting lead-through for pipes of non-combustible material – excluding aluminium – with an outer diameter up to 160 mm and for non-combustible media:

- Sand pockets below firewalls, for lines mounted near floor height;
- Y-Sand pockets in the wall for pipe lead-through (Figure 20);
- Sleeves from non-combustible building material (building material class DIN 4102-A1) for pipelines moving in the plain of the firewall, whereby the remaining space between the pipeline and the wall is to be filled with a non-combustible material with a melting point of higher than 1000°C, e.g. mineral wool;
- A compensator in front of and behind the firewall for stationary pipelines, whereby the space between the pipeline and the wall is to be completely filled with mortar or fire-resistant mortar;
- Conveyor shuttles T 90 (EI 90-C5), approved by general building authorities or mechanical pipe bulkheads R 90 (EI 90) for pneumatic extraction systems or conveyors, suitable for this application.
Firewalls and complex partition walls

Spreading of fire through heat conduction in non-combustible pipelines must be prevented. An mineral fibre insulating sleeve of building material class DIN 4102-A with a melting point higher than 1,000°C for a length of \( t \geq 500 \text{ mm} \) on both sides of the wall can be specified for this purpose. The thickness of this sleeve should be at least 60 mm.

In order to protect the lead-through of pipelines with combustible media like fuel, and for gas lines, supplementary fire protection measures, like for instance closing off the pipeline at both sides of the wall, may be necessary and must be specified for each individual case.

These requirements also apply to bulkheads for non-combustible pipelines in complex partition walls.

### 6.2.4 Combustible pipelines

Lead-through of combustible pipelines through firewalls must be avoided as a matter of principle. If this is not possible, they must be sealed off with fire barriers of fire resistance class R 90, approved by general building authorities.

These requirements also apply to bulkheads for combustible pipelines in complex partition walls.

### 6.2.5 Cables and cable trays

Cables and cable trays must be sealed off with cable fire barriers of fire resistance class S 90 (EI 90), approved by general building authorities. In case of fire, no detrimental forces are to be expected on the seal-off, if the requirements of the approval certificates are complied with.

These requirements also apply to bulkheads for cables and cable trays in complex partition walls.
6.2.6 Glazing

Parts of walls can consist of glazing of fire resistance class F 90 (EI 90), which are approved by general building authorities.

These requirements also apply to glazing of complex partition walls.

6.2.7 Ventilation and air conditioning ducts

If ventilation or air conditioning ducts pass through firewalls, the openings must be protected by locking mechanisms to prevent the spreading of fire in ventilation ducts (K 90, EI 90). These fire protection flaps must be certified by a general building authority approval (or a test mark) by the German Institute for Construction Technology (Details on ventilation and air conditioning ducts: VdS 2298).

For horizontal ventilation ducts from steel sheathing with an out insulating cover, the fixtures and suspenders must be constructed according to DIN 4102-4, Section 8.5). For such horizontal ducts with a length of more than 5m between firewalls, compensators must be fitted to prevent horizontal forces from developing as a result of duct expansion.

These requirements also apply to bulkheads for ventilation and air conditioning ducts in complex partition walls.
6.2.8 Openings of lift wells

Lift well of with a fire resistance of at least 90 minutes (F 90 or REI 90) should be not simultaneously a part of a firewall. If this is unavoidable, the walls of the lift well must be constructed like firewalls and be firmly connected with the firewall.

These requirements also apply to walls of lift wells as part of complex partition walls.

If it is possible to pass through the lift, then a safety transition room of non-combustible building material and a fire door with a fire resistance of at least 90 minutes (T 90 or EI 90) according to Section 6.2.1 must be provided, whereby the wall of lift well and the walls of the safety transition room must be constructed like a firewall. It is not allowed to use tested and approved lift doors instead of the required fire doors because of the differing degrees of protection. The distance between fire doors (T 90) and lift doors may be reduced correspondingly in this case (compare Section 6.2.2 Safety locks).

These requirements also apply to openings of lift well in of complex partition walls.
6.3 Engaging or bridging components

Firewalls may only be weakened by engaging components to the extent that the remaining wall thickness remains stable and fire-resistant (F90/REI 90 or EI 90). The same applies for conductors, conduit slots and chimneys. Horizontal or oblique cuts are not allowed.

Firewalls may not be bridged by combustible material or building elements with a fire resistance of at least 90 minutes. Steel girders and steel columns may only bridge firewalls if they are constructed with a fire resistance of at least 90 minutes, completely and at full length.

Furthermore, bridging components may not exert any force on the firewalls.

Components may not engage into complex partition walls. The other requirements also apply to complex partition walls.

6.4 Joints

Joints weaken a firewall. For this reason special construction measures are required to ensure that spreading of fire and smoke to an adjacent fire compartment is prevented in case of fire. A joint has been constructed impeccably in terms of fire protection technology if

- if it has been compactly filled with non-combustible, elastic mineral fibre material of building material class DIN 4102-A1 with a melting point of higher than 1,000°C, e.g. mineral wool, over the full depth, or
- a proof of fire resistance class F 90 according to DIN 4102-2 has been presented for using the joint construction in conjunction with the wall construction type, or
- constructive measures have been implemented, e.g. angled joints and joint covering on both wall surfaces with different steel sheets or fire protection panels.

For further details see DIN 4102-4, Section 4.

For complex partition walls, proof of fire resistance class F 180-A of joint construction in conjunction with the type of wall construction according to DIN 4102-2 must be provided.
6.5 Connection to roofs and roof construction

Firewalls must be constructed beyond the roof or the shed apex so that fires do not spread across the firewall.

For roof boards of fire resistance class F 90 and of non-combustible building materials (e.g. reinforced concrete, steel truss ceilings with underside cladding with fire protection panels), the firewall must be constructed beyond the roof if the moisture barrier, insulating layer, adhesives or roof skin are of combustible material. Spreading of fire on the roof and into the building on both sides of the firewall through light domes or exhaust openings is to be prevented thereby.

Soft roof cladding requires a construction of the firewall of at least 50 cm above roof height. For hard roof cladding, for which the applicability can be proven with a general building authority certificate, the regulations of Section 4.1 apply.

Note: Soft roof cladding does not comply with the requirements of DIN 4102-7 and is therefore not resistant to sweeping fires and radiation heat.

Complex partition walls must be constructed at least 50 cm above the roof or the shed apex of the higher building (80 cm is recommended).

Roof openings must be at a distance of at least 5 m from firewalls.

Roof openings must be at a distance of at least 7 m from complex partition walls.

For vegetated roofs, vegetation may not occur within 1 m on either side of the firewall.

These requirements also apply to complex partition walls.
6.5.1 Connection to flat roofs

Flat roofs including their bearing structures must be constructed with a fire resistance of at least 90 minutes and non-combustible material (F 90-A) within a range 5 m of either side of the firewall. In addition roof surfaces must be without an opening in this range. Combustible roof covering may only be used in this area if it is protected by a layer of gravel 16/32 of at least 5 cm thick.

Flat roofs including their bearing structures must be constructed with a fire resistance of at least 90 minutes and non-combustible material (F 90-A) within a range 7 m on either side of the firewall. In addition roof surfaces must be without an opening in this range.

For flat roofs with a fire resistance less than 90 minutes and or combustible material, the roof overhang must be constructed according to the adjacent figure.

Complex partition walls must always be constructed 50 cm beyond the roof.
6.5.2 Connection to shed, saddleback or gully roofs

For shed, saddleback or gully roofs, which are constructed with fire resistance of less than 90 minutes or from combustible building materials, the firewall must be constructed at least 30 cm (80 cm is recommended) above the apex of the higher building, or be joined to roofs with a fire resistance of at least 90 minutes.

For shed, saddleback or gully roofs, the complex partition wall must be constructed at least 50 cm (80 cm is recommended) above the apex.

If the firewall runs parallel to the shed, the shed roof, including associated structures, can be constructed with a fire resistant of at least 90 minutes and from non-combustible building materials (F 90-A), instead of a roof overhang.

For roofs with a low pitch (< 15°), constructed with a fire resistance less than 90 minutes or combustible building materials, the firewall must be constructed up to a height where the horizontal distance to the roof surface is at least 5m.

For roofs with a low pitch, constructed with a fire resistance less than 90 minutes or combustible building materials, the complex partition wall must be constructed up to a height where the horizontal distance to the roof surface is at least 7 m.
6.6 Double-leaf walls

For double-leaf firewalls both leaves must be stable, independently of each other.

The leaves must have at least so much distance between each other, that in case of a fire, thrust forces will not destroy both.

The clearance must be kept free of combustible material and may not be utilised (see Section 5.1, Table 1 for construction details).

These requirements also apply to double-leaf complex partition walls (see Section 5.2, Table 2).

Opposite exterior walls of buildings can be constructed like double-leaf firewalls.

This also applies to double-leaf complex partition walls.

Components (e.g. fire doors or gates, fire glazing, cable and pipe bulkheads, etc), protecting openings in double-leaf firewalls and complex partition walls, must be proven to be suitable regarding fire protection technology for these walls.

These requirements also apply to complex partition walls.

6.7 Exterior wall range

Combustible building materials may not bridge the firewall on exterior walls. For exterior walls with combustible building materials it is recommended

- to construct firewalls at least 50 cm above the exterior wall level, or
- to construct the exterior walls with a fire resistance of at least 90 minutes and from non-combustible building material to 5 m of the range of the firewall (see Figure 40).
Combustible building materials may not bridge the complex partition wall on exterior walls.

When connecting to exterior walls

- complex partition walls must be constructed at least 50 cm above the exterior wall level, or
- the exterior walls must be constructed to 5 m of the range with a fire resistance of at least 90 minutes and from non-combustible building material

6.8 System walls

Besides firewalls of normal construction, industry offers lightweight construction and dry-walling as firewall, complying with the test conditions for firewalls according to DIN 4102-3. The technical implementation of this type of construction, which is normally used in storey construction, is subject to stringent constructional constraints.

System walls in dry-wall and lightweight construction, are principally divided into standing and component construction types, depending on the substructures, which are covered on both sides with single or multiple fire protection panels.

The following assembly conditions need to be observed specifically:

- maximum wall height
- required connections and bracings
- installation of components as protection of openings (e.g. fire barriers, fire glazing and cable and pipe bulkheads, etc.), which is only allowed conditionally.

Before using system walls as firewalls in industry, their performance characteristics should be checked meticulously against the various aspects of risk evaluation.
7 Exterior walls

Exterior firewalls as replacement for spatial fire compartment separation must be constructed on the higher of the two opposite buildings. They must be constructed up to at least the roof skin of the higher building.

Exterior firewalls must be constructed like interior firewalls.

Exterior complex partition walls as replacement for spatial fire compartment separation must be constructed on the higher of the two opposite buildings. They must be constructed up to at least 50 cm above the roof skin of the higher building. Exterior complex partition walls must be constructed like interior complex partition walls.

8 Free-standing walls

A free-standing firewall must be constructed to a height of at least 30 cm above the top edge of stored goods.

A free-standing complex partition wall must be constructed to a height of at least 50 cm above the top edge of stored goods.

For the storage of combustible goods it is essential that the firewall be constructed sideways beyond the edge of the stored goods and to clearly mark allowable storage height (e.g. by markings on the wall and floor) in order to prevent fire from spreading around the wall.

These requirements also apply to complex partition walls.
9 Arrangement and installation of components of the photovoltaic plants (PV plants) to buildings or on their roofs

Components of PV plants, especially the photovoltaic modules or PV modules, normally contain combustible materials, e.g. synthetic materials, and their arrangement could foster fire development and/or fire spread in the case of fire.

When defining where to mount components of photovoltaic plants in or on the roof as well as to or in the façade, always see to it that existing measures designed to protect the building and their use, such as fire prevention and protection, stability, etc. will not be impaired. To provide for this, the owner and the operating party of the PV plant shall agree upon an expert planner of fire protection systems to be involved in engineering and planning.

The information in Clauses 9.1 through 9.3 apply to complex partition walls too.

9.1 PV modules on the roof

If PV modules are integrated into the roof covering (roof-integrated installation), they shall meet the same requirements as the surrounding roofing; this includes among other things their resistance to radiating heat and flying sparks (hard roofing).

For any installation of PV modules in the roof, always observe the instructions given in Clauses 6.1 and 6.5.

9.2 PV modules on roofs

For any installation of components of the PV plants on the roof, always observe the instructions given in Clause 6.5.

If PV modules are higher than the firewall mounted on top of the roof, the compulsory German Federal Building Regulations request a minimum distance of 2.5 m from the firewall to prevent the fire from spreading over the firewall (see Fig. 45). This shall also apply if the required height above roof is reduced by elevation of the PV-modules. As an alternative, the requested height above roof can be re-established by elevation of the firewall (see Fig. 46).
If components of PV plants, such as the PV modules, are installed on large-area roofs, e.g. of industrial buildings and warehouses, it is obligatory to provide for a distance of at least 5.0 m between the rows of modules and linked areas where modules are installed to delimit the fire spread in case of fire, to minimise the risk for the firefighters in action, and to make hereby effective firefighting by the fire service possible.

The required minimum distances (as shown in Fig. 45) may be reduced, if a fire spread in the case of fire from one component of the PV plant to another installed opposite to the first one has been proved to be excluded.

The aisle between the rows of modules and linked areas where modules are installed is required also to minimise the risk for firefighters emanating from live modules and plant components where modules or module strings, respectively, cannot be de-energised individually.

If cables containing combustible materials, e.g. combustible insulation of electric lines, span the aisles, those shall be protected against transmission of fire.

Note: Also see

- DIN VDE 0132 VDE 0132 Firefighting and technical assistance in or near electrical installations
- Leaflet by the German Fire Protection Association (VFDB) MB 05-02 dealing with firefighting actions on photovoltaic plants (solar plants for power generation)
- VdS 3145 being a technical guidance document for photovoltaic plants

Arrangement of PV modules above a firewall or a complex partition wall is not allowed if fire spread has not been proved to be excluded.

Guiding components made of combustible materials, e.g. PV modules and electric lines, above or through firewalls and complex partition walls should be avoided wherever possible so as to prevent any fire spread over the separation between two fire compartments.

If it cannot be avoided to install an electric line line over a firewall or a complex partition wall, the cables on the roof shall be protected against any transmission of fire. The building material used to take such protection measure shall be proved to be suitable for outside use and, therefore, shall be UV-proof and weather-resisting to provide for full protection over the intended period of use.
If guiding of lines through a firewall or a complex partition wall cannot be avoided, appropriate systems shall be used to provide for corresponding fire protection isolation (also see the Clause 6.2.5).

Components containing combustible materials, which are guided over or through a firewall or a complex partition wall, shall always be approved by the construction authority in charge.

9.3 PV modules mounted to or into the façade

If PV modules are mounted to or into the façade, not only the building regulations on how to delimit fire spread in vertical direction shall be complied with but also the information given in Clause 6.7.

10 Literature/Sources

10.1 GDV/VdS Guidelines

VdS 195 Technical Guideline of the Fire and Fire Consequential Loss Insurance; Risks, Protection Objectives and Protection Measures.

VdS 2038 General Safety Regulations of the Fire Insurers for Factories and Commercial Plant ("ASF").

VdS 2298 Ventilation systems; Leaflet for fire protection.

VdS Schadenverhütung GmbH – Verlag, Amsterdamer Str. 174, 50735 Cologne

10.2 DIN Standards

DIN 4102 Fire characteristics of building materials and components

- Part 1 Building materials; Terms, requirements and tests, Issue 05/98
- Part 2 Building materials; Terms, requirements and tests, Issue 09/77
- Part 3 Firewalls and non-load bearing exterior walls; Terms, requirements and tests, Issue 09/77
- Part 4 Composition and application of classified building materials, components and special components, Issue 03/94
- Part 11 Pipe sleeves, bulkheads, installation shafts and channels and sealing of inspection openings: Terms, requirements and tests, Issue 12/85.

- Part 17 Melting point of mineral fibre insulating materials; Terms, requirements and tests, Issue 12/90

DIN 18 090 Lifts; Swing doors and folding doors for lift well with a fire resistance of at least 90 minutes, Issue 02/69

DIN 18 091 Lifts; Horizontal and vertical sliding doors for lift well with a fire resistance of at least 90 minutes, Issue 02/69

DIN 18 092 Light load lifts; Vertical sliding doors for lift well with a fire resistance of at least 90 minutes, Issue 05/63

DIN 18 095 Smoke protection doors

- Part 1 Terms and requirements, Issue 10/88
- Part 2 Construction type tests for functional efficiency endurance, Issue 03/91

Beuth-Verlag GmbH, Burggrafenstr. 6, 10787 Berlin

10.3 Technical construction regulations

Construction supervision of industrial buildings (based on the circular issue of the Minister for City Development, Residence and Traffic of the State of North Rhine-Westphalia of October 23, 1989)

10.4 Literature


10.5 Specific amendments

DIN VDE 0132 VDE 0132 Firefighting and technical assistance in or near electrical installations

Leaflet by the German Fire Protection Association (vfdb) MB 05-02 dealing with firefighting actions on photovoltaic plants (solar plants for power generation)

VdS 3145 being a technical guidance document for photovoltaic plants