



# White Paper

General instructions on lightning safety for shelters



## Contents

Lightning protection

Prevention of touch voltages

Prevention of step voltages

Installation of a lightning rod on shelters with thin wood walls/installation on the beams

Use of an isolated lightning rod (CUI conductor): a) in case of an insufficient wall thickness; b) up to the air-termination rod in case of a low shelter height

# White Paper

## General instructions on lightning safety for shelters

About 2 million lightning strikes are registered in Germany each year. Lightning is fascinating to watch, but also extremely dangerous. Annually, thunderstorms result in property damage and even death of people and animals. Especially people exposed in the open such as golfers and hikers are at risk. Severe lightning injuries and fatalities are reported each year from all over the world, especially on golf courses. For this reason, shelters are vital to protect golfers from the effects of lightning. In the following, general instructions on lightning safety for shelters are provided.

Shelters, for example on golf courses, must not only protect from storm and rain, but also from the effects of a lightning strike. Thus, there is no question that shelters must be equipped with a lightning protection system. Golf course operators have a high duty of care towards their members / golfers. The liability of, for example golf course operators, is based on the so-called duty to implement safety precautions which is specified on page 7 of the 6/2010 edition of the German "Golfmanager" magazine authored by Daniel Witaschek:

*"Golf course operators have a duty towards each golf course user to avoid all impending or existing hazards unless this is impossible or unreasonable for the golf course operator. This duty includes both organisational and construction measures. The number, equipment, size and position of the lightning-proof shelters heavily depend on the size, location and design of the relevant golf course. Lightning-proof shelters must*

*comply with all applicable technical requirements. Limitation of liability due to a lack or insufficient number of lightning-proof-shelters or their insufficient equipment, for example by a relevant notice or a written agreement on limitation of liability, shall be excluded."* (translation)

### Shelters

Shelters should not be located in exposed locations (on hill-tops, at the edge of the forest, under single trees).

Shelters are only lightning-proof if

- ➔ they are equipped with an adequate lightning protection system with potential control
- ➔ conductive systems (e.g. electrical cables) are included in the equipotential bonding
- ➔ suitable measures for preventing touch voltages have been taken.

### Lightning protection

Frequently, a lightning protection system is simply called a lightning rod. As shown in **Figure 1**, the lightning protection system of a shelter consists of a rooftop air-termination system (air-termination conductor and/or rod), wall-mounted down conductor (down-conductor wire) and earth-termination system (commonly earth rods). The function of a lightning rod is to intercept lightning and to safely conduct it to the ground to prevent dangerous sparking, thus protecting the structure

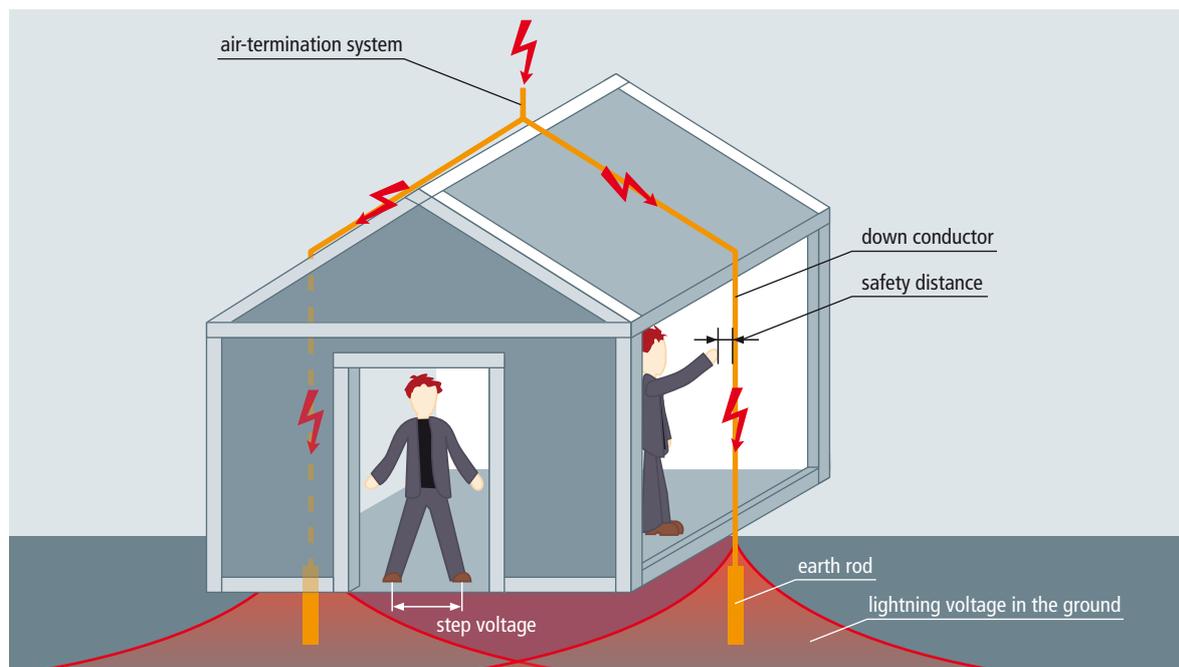


Figure 1 Shelter with lightning rod/persons at risk due to touch and step voltage



from fire and mechanical destruction. The formation of a high "lightning voltage" in the ground, also referred to as potential gradient area, presents a risk to persons in the shelter. This voltage may be applied to the feet of a person standing on the ground. It is therefore also called step voltage. Moreover, persons must maintain an adequate safety distance to the lightning rod to prevent dangerous touch voltages (Figure 1).

Effective lightning protection measures that protect golfers, hikers, etc. from the effects of a lightning strike can be implemented in shelters with a relatively low effort. Apart from technical measures, it is equally important to know what to do during thunderstorms. In an upcoming thunderstorm, you should seek shelter immediately and stay there until the last thunder or lightning has ended. Further considerations are based on commonly used wood shelters.

#### Prevention of touch voltages

To prevent dangerous high touch voltages, an adequate safety distance must be maintained between the lightning rod and the persons in the shelter. In a shelter of about 3 m x 3 m with an eaves height of 3 m and the lightning rod shown in Figure 2, a safety distance of at least 15 cm is required.

If the shelter has a minimum height of approximately 3 m, the safety distance to the rooftop lightning rod (air-termination conductor or rod) is already maintained. However, it is more difficult to keep an adequate distance to the outer walls. Therefore the wall / wall construction where the lightning rod (down-conductor wire) is conducted to the ground must have an adequate wall thickness (Figure 2). To connect the lightning rod with the ground, earth rods (metal rods of a defined length, material appropriate to the local conditions) are commonly used for this purpose. On each down conductor, the earth rods are vertically buried in the ground at a depth of about 6 m to 9 m depending on the type of ground (Figure 2 to 5).

Log-structured shelters usually have this wall thickness. The situation is quite different when it comes to sheds with thin wood walls. In this case, the down conductors must be installed directly at the outer edges near the wall construction to ensure the maximum wall thickness (Figure 2). As an alternative, an isolated lightning protection system\* can be used. (\* Extensive expert knowledge is required. For this reason, please contact a certified lightning protection expert (for example, VDE-certified (Verband der Elektrotechnik Elektronik

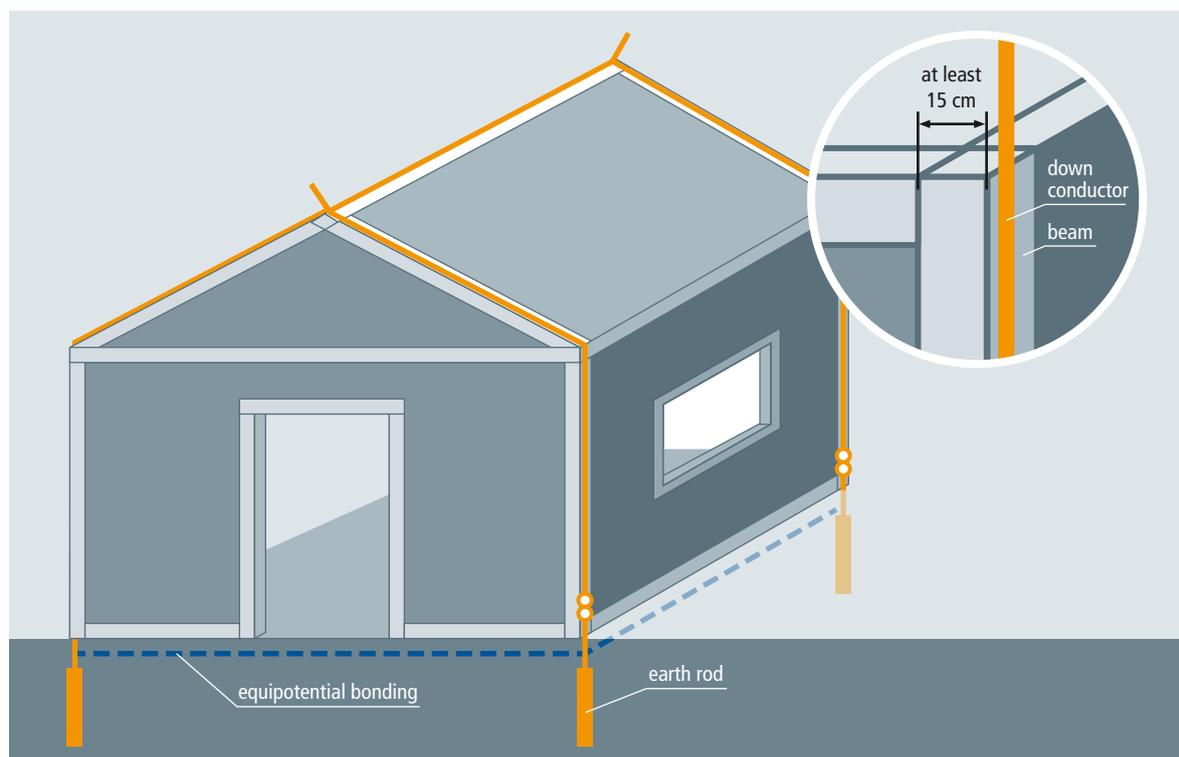


Figure 2 Installation of a lightning rod on shelters with thin wood walls/installation on the beams

# White Paper

## General instructions on lightning safety for shelters

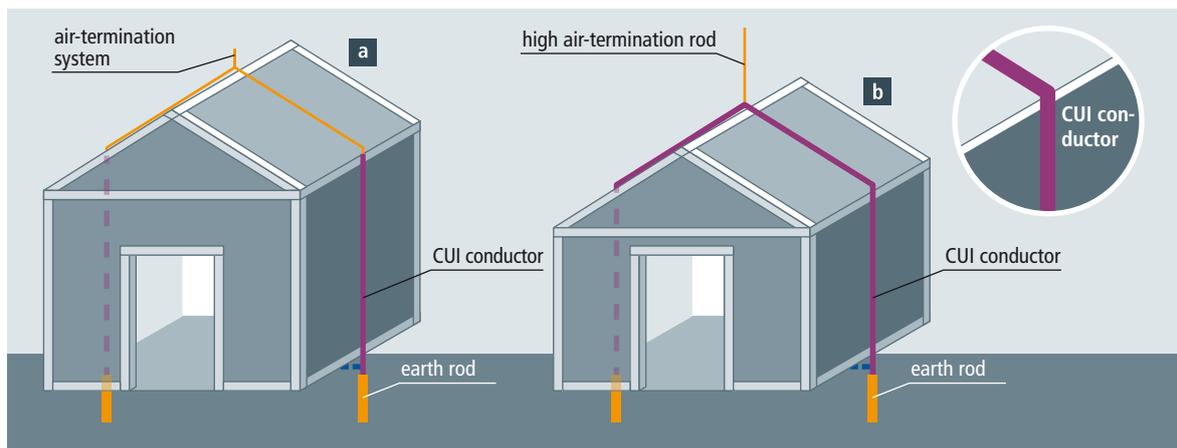


Figure 3 Use of an isolated lightning rod (CUI conductor): a) in case of an insufficient wall thickness; b) up to the air-termination rod in case of a low shelter height

Informationstechnik) or VDB-certified (Verband Deutscher Blitzschutzfirmen e.V.) lightning protection experts)

Another possibility to maintain the safety distance required to protect shelters in case of a lightning strike is to use highly insulating lightning rods, for example CUI conductors from DEHN + SÖHNE (Figures 3 and 7). This is essential especially for shelters that are even smaller than those described above.

### Prevention of step voltages

Dangerous high step voltages as a result of lightning strikes into the lightning rod of a shelter or nearby lightning strikes must not occur in shelters. To this end, there are two options:

a) Prevention of dangerous step voltages by "insulating" the ground

This means that the floor must be made of e.g. a 5 cm asphalt layer (Figure 4). As an alternative, a wood floor can be used that maintains a sufficient distance from the ground to ensure adequate ventilation and that the wood floor remains dry in any circumstance.

b) Prevention of step voltages by means of potential control  
Another protection measure to "insulate" the floor involves the integration of a finely meshed metal grid (e.g. reinforcement steel mat laid in concrete or a mesh earth electrode directly in the ground below the shelter floor). To ensure a long service life of this metal grid, it is advisable to use 10 mm round conductors made of V4A stainless steel (material number 1.4571). These round conductors are installed max. 0.1 m below the ground surface at intervals of 1 m x 1 m

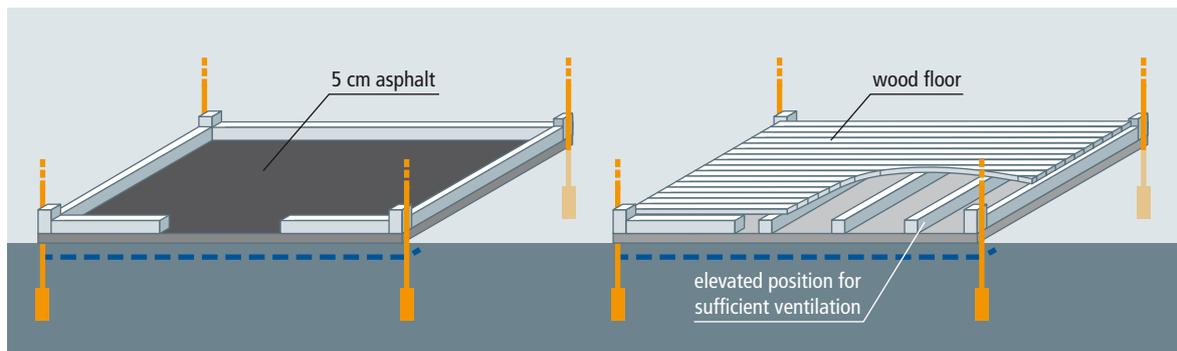


Figure 4 Shelter with a 5 cm asphalt floor or ventilated wood floor ensures protection against step voltages

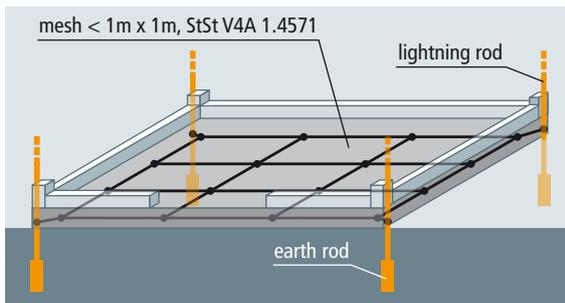


Figure 5 Floor of a shelter with potential control made of V4A stainless steel with a diameter of 10 mm installed at intervals of  $< 1\text{ m} \times 1\text{ m}$  to ensure protection against step voltages



Figure 6 Potential control of a shelter



Figure 7 Practical application of an isolated lightning rod (CUI conductor)

and must be connected with adequate clamps on all cross points and down conductors (see Figures 5 and 6).

### Summary

In general, persons must stay in shelters for about 30 minutes after they hear the last rumble of thunder. Only then, the thunder cell is far enough away.

Shelters on golf courses or hiking trails require both a lightning rod and adequate measures to reduce the risk of impermissibly high touch and step voltages. As described above, these measures can be implemented by simple means.

The IEC 62305 series includes the basis of standardisation and an overall lightning protection concept. For further information on lightning protection, please visit [www.dehn.de](http://www.dehn.de).

**Surge Protection  
Lightning Protection  
Safety Equipment  
DEHN protects.**

**DEHN + SÖHNE  
GmbH + Co.KG.**

**Hans-Dehn-Str. 1  
Postfach 1640  
92306 Neumarkt  
Germany**

**Tel. +49 9181 906-0  
Fax +49 9181 906-1100  
info@dehn.de  
www.dehn.de**

Type designations of products mentioned in the white paper being at the same time registered trademarks are not especially marked. So if there is no marking of <sup>TM</sup> or © this does not mean that the type designation is a free trade name. Neither it can be seen whether patents or utility models and other intellectual and industrial property rights are available. We reserve the right to introduce changes in performance, configuration and technology, dimensions, weights and materials in the course of technical progress. The figures are shown without obligation. Misprints, errors and modifications excepted. Reproduction in any form whatsoever is forbidden without our authorisation.

actiVsense, BLITZDUCTOR, BLITZPLANER, DEHN, DEHN Logo, DEHNbloc, DEHNfix, DEHNgrip, DEHNguard, DEHNport, DEHNQUICK, DEHNrapid, DEHNshield, DEHNsnap, DEHNventil, HVI, LifeCheck, Red/Line, Yellow/Line are protected by German Trade Mark, by Community Trade Mark (EU) and/or in other countries.

Figure 6 and 7: Fritz Mauermann GmbH + Co. KG, Paderborn