



Technical  
information



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## Installation instructions for outdoor electrical installations **gesis**<sup>®</sup> IP+



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WHITE PAPER



# Electrical installation in practice

Outdoor electrical installations are particularly tricky. Constant temperature changes, high UV radiation, high ozone values and, not least, mechanical wear lead to material fatigue, then water ingress, and, finally, system failure.

Alongside the choice of suitable materials, what is also crucial for the durability of an installation is the utmost care and attention when handling system components. It is important to understand exactly what is happening and what impact an unprofessional installation has.

## Aging of materials

Many users see the designation IP68 as a guarantee of the safety of their installation – regardless of the manner in which the materials are laid. This may well be the case for new products that are tested under laboratory conditions using theoretical guidelines.

## But what happens over time?

All materials suffer some degree of aging. Connectors, too! The sensitive areas are the seals in the vicinity of the connector face and the cable gland.

High temperatures due to direct sunlight, high UV concentrations and other weather conditions, as well as chemicals, really attack the seals. And not to be overlooked are mechanical stresses and biological influences (bacteria, fungi, and

animals). The cable is also affected, particularly if there is any deviation from its specifications. And this is not that uncommon!

All materials change in structure. They tend to shrink, and minute cracks appear. The pressure in the sealed area drops as well.

On this basis, it is only a matter of time before water finds its way into the connector.





# Assessing the IP situation correctly

Let us assume that a connector needs to be used out in the open to supply power to a luminaire. By definition, a decision is made in favor of protection class IP54 (splash-proof from all sides). However, when you take a closer look at the sealing point, you soon realize that sometimes this is completely coated with water for weeks on end. This is due to the small reservoir between the cable and the seal. After a rain shower, this gap fills with water, which remains there. Over time, capillarity causes the water to penetrate the casing.

This effect is naturally exacerbated by installing the connector or device connector vertically. Water repeatedly travels along the cable to the sealing point, and during rainy periods the sealing point is often under water for weeks. Without measures to avoid this situation, the IP protection would have to be designed for IP68 (2 weeks)! The water that has penetrated also freezes in winter and helps accelerate the aging process.

Often, the user is not aware of the application conditions in extreme cases. Plug connections are laid in trays that fill up with rainwater during a heavy downpour (leaves sometimes block the drains) or are laid on the ground so they spend days under water.

A further phenomenon arises due to the capillarity of cables. If, for example, a cable is faulty in one place and water is able to penetrate, the water travels through the cable until it reaches the connector. This happens more quickly than you might think, and over great distances. But it is not just damage to the cable that can lead to this situation, poor assembly at the other end of the cable can too.

## Protection classes of system *gesis* IP+

- IP65** Jet water
- IP66** Powerful jet water
- IP67** Temporary submersion
- IP68** Lasting immersion  
(2 hours in 3 m deep water)



# Situation analysis



## Mating forces in low temperatures

In temperatures well below freezing, the mating forces increase due to hardening of the seal. This must be tested for individual applications.



## Immersion of the system

The system components have been designed for outdoor use, though with the focus on protection against spray water. The connector system is not intended for normal operation under water. Unplanned immersion is only possible as foreseen by the specification.



## Underground installation

Laying of the system components directly in the ground is not possible. According to VDE 0100-520, connectors must be protected using suitable additional facilities and must be accessible for visual inspection, testing, and maintenance. Installation pipes and bottom tanks may be the solution. Ensure that water can drain by implementing suitable measures (e.g. gravel bed)! It is not a problem if components are covered with leaves, bark mulch, or stones as long as water is allowed to drain in accordance with the point "Installation position and additional protection from the weather".

## Mechanical stresses

Avoid any bending of the cables in the area of the strain relief. The generally accepted guidelines for laying cables must be observed. Tensile forces on the contact points with solid conductors  $>2.5 \text{ mm}^2$  are avoided by first bending the cable and then processing it further.

Mechanical bending in the area of the strain relief must be controlled using suitable measures (e.g. cable clamps).

## Flexible laying of the connector system

If abrasion might occur (construction site lighting systems, event equipment, or similar temporary applications), wear of the pre-assembled cable and plug connections must be taken into consideration and must be monitored.





### Use of end caps

All unused slots must be fitted with the corresponding end cap to prevent moisture penetration. This also applies if the components are stored outside or in humid rooms.



### Torque and locking

The cable glands must be tightened to the specified torque. All connections must be locked. The end position is announced by an audible "click!". Unlocking must be done manually or using a suitable screwdriver in accordance with the assembly instructions. "Over-tightening" soon leads to wear and ineffective connections.

### Installation position and additional protection from the weather

Installations that are exposed to the weather directly age a lot more quickly. The use of suitable measures can significantly increase their service life. In the sequence of events that lead to system failure, material fatigue comes first, ahead of water ingress.

UV radiation, ozone, aggressive gases, salt spray, and high temperatures have the greatest impact on the material.

Where possible, the components, including the cables, should be protected from direct sunlight. As a general rule, the user must ensure that all the components he uses are suitable for their intended application.

If they are to be used outside for a relatively long period, choose a horizontal position to guarantee water drainage. If this is not possible, an additional cover should be used for protection. The cable arrangement is just as important. The cable must be laid in such a way that any draining water is not routed to the cable gland, but drops off beforehand.





**The Association for Electrical, Electronic & Information Technologies (VDE) makes clear reference to this situation:**

In accordance with installation regulation IEC 60364-5-52 (DIN VDE 0100-522.3), cable systems must be designed in such a way that damage caused by the ingress of water is avoided.

Cable systems must satisfy the required degree of protection. If water can accumulate or water condensation can occur, provisions for water drainage must be made!

This particularly applies to sealing points in the area of the strain relief.

The longer the maintenance intervals are to be (e.g. areas where access is difficult or requires great effort), the better the components must be protected against weather conditions and moisture from the outset.





# Selecting the appropriate cable

Selection of the appropriate cable plays a major role for continuous operation of the installation.

By default, we offer the low-cost H05VV cable, but its field of application is restricted to indoor areas. This cable is not suitable for outdoor areas and constantly humid or wet rooms! The H07RN-F cable is preferred for use indoors where, even though pollution occurs, it is not normally humid, let alone wet. Protection from foreign bodies (IP6X) is at the fore here. Temporary wetness for cleaning purposes, however, is allowed.

Outdoor installations without special demands can be implemented using H07RN-F rubber-sheathed cables. However, here too it is essential to check whether or not any additional action, such as laying inside installation pipes, is required. Often, little attention is paid to the maximum operating temperature (ambient temperature plus inherent heat generated by the current flow).

Where the demands are higher (e.g. shipbuilding or solar technology) the selection of a suitable cable or even seal must be discussed with us.

## H07RN-F rubber-sheathed cable

Use inside dry, humid, and wet rooms, as well as outdoors, though not directly in the ground. UV-resistant to a limited extent.

**Minimum bending radius:** 4 x outside diameter

**Operating temperature:** 60 °C



## H05VV-F PVC cable

Use inside dry rooms, not outdoors, not directly in the ground. Not UV-resistant.

**Minimum bending radius:** 4 x outside diameter

**Operating temperature:** 70 °C





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