Rail industry
Connection technology and electronic components
In dialog with customers and partners worldwide

Phoenix Contact is a global market leader in the field of electrical engineering, electronics, and automation. Founded in 1923, the family-owned company now employs around 14,500 people worldwide. A sales network with over 50 sales subsidiaries and more than 30 additional global sales partners guarantees customer proximity directly on site, anywhere in the world.

Our range of services consists of products associated with various electrotechnical applications. This includes numerous connection technologies for device manufacturers and machine building, components for modern control cabinets, and tailor-made solutions for many applications and industries, such as the automotive industry, wind energy, solar energy, the process industry or applications in the field of water management, power transmission/distribution, and transportation infrastructure.

Company independence is an integral part of our corporate policy. Phoenix Contact therefore relies on in-house competence and expertise in a range of contexts: the design and development departments constantly come up with innovative product ideas, developing special solutions to meet customer requirements. Numerous patents emphasize the fact that many of Phoenix Contact’s products have been developed in-house.
“For years, Phoenix Contact has been a reliable partner of the rail industry and offers products for use in rail vehicles and signal technology. Our high level of innovative expertise, combined with extensive industry know-how, is the basis for reliable and economic components and solutions. Select your tailor-made connection and system solution from our extensive product range. Our team of experts will gladly provide you with the necessary support.”

*Oliver Kirsch, Head of Business Development Railway*

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Products for rail vehicles

Highest quality, reliability, and zero maintenance are three essential requirements that must be met by products used in rail vehicles. Besides shock and vibration resistance of the components, the behavior of the materials used in case of a fire plays a particularly important role.

Needless to say, railroad-specific products from Phoenix Contact meet relevant standards such as EN 50155, EN 50121, and EN 45545.
Products for rail vehicles

Wherever systems and products in rail vehicles have to be supplied with energy and signals and data have to be distributed, products from Phoenix Contact are being used. Terminal blocks with an overall width of only 3.5 mm are perfectly suited for the smallest installation spaces. High-current terminal blocks with Power-Turn spring connection technology are quick, safe, and easy to install. Highly compact relay modules feature an extended input voltage and temperature range up to class TX. Connectors with railroad-approved cables provide the necessary connections to the train communication network.

Perfect for the smallest installation spaces
The space-optimized Push-in terminal blocks are ideal for use in space-sensitive applications. With an overall width of only 3.5 mm, conductors with rated cross sections from 0.14 – 1.5 mm² can be installed.

Clearly marked
More than 2,000 halogen-free marking solutions optimized for fire protection, eleven different printing systems, and three marking technologies: MARKING system offers the right marking solution for any application in the rail industry.

Switch signals reliably
The highly compact and bridgeable PLC... RW relay modules feature an extended input voltage and temperature range up to class TX. The plug-in, sealed relays are insensitive to dust, noxious gases, and humidity. With the electrical isolation, interference signals in the signal path are reliably filtered out and interference-free operation is ensured.

You can find further information on our website at phoenixcontact.com
**Reliable PCB connections**

Reliable connections for signal, data, and power transmission directly on the PCB are a must in the rail industry. Phoenix Contact offers the biggest range of PCB terminal blocks and PCB connectors. A range of connection methods, assembly techniques, and locking systems ensure maximum reliability and flexibility.

**Potential distribution made easy**

PTPOWER high-current terminal blocks are ideal for use as feed-in terminals. With the aid of reducing bridges, extremely compact and simple potential distribution can be established with little wiring required.

**Comprehensive portfolio**

In addition to crimp and spring connectors suitable for the rail industry, the product range includes assembled sensor/actuator cables with A-coding and data cables with D and X-coding for communication networks and passenger information systems.
Driver's compartment

The driver’s compartment is the command center and therefore the heart of every rail vehicle. All the key measurement and control instruments are found here, where they are operated and monitored by the train driver. Components from Phoenix Contact ensure that the technical systems work together perfectly. Plug-in terminal blocks provide greater modularity. An extensive marking product portfolio is available for clear, durable marking of all components, thereby providing the necessary overview in the technical cabinet.

Your advantages:
• Terminal blocks with Push-in connection fulfill EN 50155 and EN 45545-2, for example
• Push-in connection technology saves time during installation thanks to tool-free conductor assembly
• Double-level and multi-level terminal blocks are ideal for use where space is limited
Ideal for limited space

Space is a precious commodity in the driver’s compartment and must be used wisely. Double-level terminal blocks with console design are therefore perfect for this purpose. On a pitch width of 5.2 mm, the Push-in or combi connection with 30° offset offers the ultimate in wiring convenience while providing an excellent overview.

Clearly and permanently marked

Shrink sleeves provide permanent and captive wire and cable marking. The WMS-2 HF... material type has a shrink ratio of 2:1 and fulfills the high requirements of EN 45545-2 (R22/R23/R24: HL3). What is more, the shrink sleeves are halogen-free and fulfill DIN 5510-2 with an oxygen index of 34.9%.

Cable management including marking

The halogen-free CD-HF... cable ducts enable the individual bars to be broken out without using any tools or resulting in any burr through defined breaking points. They meet the requirements of EN 45545-2 (R22/R23: HL3). The KMK HP... cable marker carriers, together with the WT-HP HF... cable binders are ideal for cable bundling and marking at the same time.

High contact density in a compact space

The PTRV series multi-level terminal blocks are particularly suitable for applications where a large number of contact points need to be wired but there is not much installation space. With four or eight levels per terminal block, currents of up to 10 A can be transmitted at a voltage of 250 V.

The multi-level terminal blocks are also optionally available with color coding. This provides an excellent overview. Push-in connection technology makes wiring quick and easy.

Space-optimized wiring in the switchboard
Products for rail vehicles

Data transmission and infotainment

Travelers on short and long-distance transport expect quick access to travel information and a reliable Internet connection on board. From the train control system, the passenger information and infotainment systems to “Internet on board”, the components in the various systems must communicate with each other without any malfunctions. To meet the needs of this essential data exchange, Phoenix Contact offers connectors and cables which ensure a reliable communication connection and meet the high environmental and material requirements of the rail industry.

Your advantages:

• M12 connectors, for assembly and molded, which comply with EN 45545-2
• Tested for an extended temperature range and for resistance to temperature shocks
• Securely locked, thanks to a special vibration brake
• FL ISOLATOR tested according to EN 50155 and EN 50121
Reliable data communication
When it comes to rolling stock, connectors must meet stringent requirements. The M12 network connectors impress with their mechanically robust design. Together with high-quality cables, which were designed for use in rail vehicles, they form the basis for reliable data communication on the train.

Fixed number of positions or modular
Heavy-duty connectors are used for connecting devices as well as in the area of the carriage connections. Data, signals, and power can be transmitted using contact inserts which meet all railroad requirements. Modular contact inserts can be used to establish flexible connections to suit requirements.

Fault-free network
When transmitting data over copper wires, it is important to equalize shield potentials, particularly on rail vehicles. The Ethernet network filter from the FL ISOLATOR series reliably protects network components by means of electrical isolation for potential differences of up to 4 kV.

Cabling systems for the communication network
An Ethernet-based Train Communication Network (TCN) consists of two communication levels: the Ethernet Train Bus (ETB) forms the control level and provides continuous data exchange across all train components. Communication takes place via CAT5 Ethernet. The ECN (Ethernet Consists Network) vehicle bus is subordinate to the train bus and communicates via PROFINET CAT5.

System communication increasingly takes place via CAT6, 10 Gigabit Ethernet. Auxiliary systems take on tasks such as language and information (on-board radio), monitoring (cameras) or on-board media (Internet). Phoenix Contact offers the right cabling system for all these control levels.

Structure of a train communication network (TCN)
Your advantages:

- Phoenix Contact connection technology is suited for the modular installation of components in systems
- Plug and Play for signals, data, and power with connectors suitable for railroad use
- Continuous availability of the Push-in connection technology
- Protection against mismatching thanks to the individual coding options of the COMBi plug zone

Door control

In addition to their main purpose, door controllers are increasingly taking on monitoring, diagnostic, and communication tasks. To ensure that these varied tasks work in harmony, products and solutions from Phoenix Contact are used.

Plug-in connection solutions offer a great deal of flexibility, while M12 connectors provide the communication interface to data networks. Pre-wired terminal strips ensure quick and smooth installation on site.
**Easy handling**

The molded M12 rail connectors are fully electrically tested, equipped with SPEEDCON fast connection technology, and meet the requirements of EN 45545-2 (R22/R23/R24: HL3). The easy Plug and Turn principle saves the installer the time-consuming process of screwing in the connectors.

**Space-saving connections**

With the space-saving Push-in spring connection, solid and stranded conductors can be connected quickly and conveniently. Together with the flat headers, the COMBICON connectors offer an optimum solution for installation in housing and front plates.

**Clear marking**

The halogen-free and railroad-approved PATG HF marker carriers are equipped with reinforcing ribs, which ensure central fixing of the conductor or cable. The matching UCT-WMT... or UC-WMT... insert labels can be marked on the go or from a fixed location with the THERMOMARK PRIME or BLUEMARK CLED.

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**Plug and Play system modules – quick and easy to install**

Installation, and also replacement of individual modules, must be quick, safe, and error-free, both during mounting and when carrying out maintenance. This also applies to many applications in rail vehicles.

Connection technology from Phoenix Contact makes it easier to install and wire modular system components. Whether it is a terminal block, PCB connector with Push-in connection technology or a plug-in terminal block from the COMBI series: we have the perfect solution for any application. Alongside the extensive range of accessories, we can provide the right marking material for all your applications. What is more, the Push-in connection technology considerably reduces the wiring effort.

Modern connection technology provides modularity for system components
Products for rail vehicles

Carriage connection

The carriage connection area is particularly exposed to extreme environmental influences. In order to protect the electrical supply for devices and systems as well as data transmission across the entire trainset, the connection elements at the carriage connections are subject to special requirements.

Phoenix Contact has developed heavy-duty connectors for this purpose: HEAVYCON HPR and HEAVYCON ADVANCE meet the stringent requirements and ensure permanent and safe connection of the electrical cables and data transmission at the carriage connections.

Your advantages:
• High level of safety: extremely resistant materials and high protection classes
• For the harshest requirements: housings fulfill IP66, IP68, IP69K protection
• Shock and vibration-resistant transmission of signals, data, and power
Safe and reliable
HEAVYCON HPR is specified for use in transport and transportation technology. The sleeve housings, panel mounting bases, and box mounting bases conform to the standards for the safe transmission of signal and power circuits on rail vehicles. They also ensure comprehensive protection in the event of electromagnetic interference fields.

Robust without compromise
HEAVYCON ADVANCE housings eliminate the need for the panel mounting base that is normally used. The sleeve housings with screw locking are robust without compromise and remain sealed up to IP69K protection. They are mounted directly on the mounting plate or control cabinet panel and are designed for use under the most extreme outdoor conditions.

Subsequent marking
The WMTB HF... cable markers made of self-extinguishing PUR material are suitable for subsequent cable marking. These can be used both indoors and outdoors. Matching cable binders are also available for these requirements.

Carriage connection
As soon as control and data cables leave the protected railcar body, e.g., in the carriage connection areas, increased protection is required against extreme environmental influences. Data signals which are transmitted inside the carriage via M12 connectors, can be reliably protected with EMC inserts and module carriers in heavy-duty connectors. This ensure that all vehicle buses are consistently connected to the train bus.

The FL-ISOLATOR isolates the relevant shield potentials of the carriage by galvanically isolating two network connections.

Schematic representation: connector and network filter for the carriage connection
Products for signal technology

Components used in signal technology are subject to more stringent requirements with regard to EMI resistance and environmental influences. It does not matter whether the components are exposed to extreme heat or cold, humid or dry air.

For use in signal technology, Phoenix Contact provides products that meet increased requirements and excel through quality, reliability, and robustness.
Products for signal technology

Supplying signaling systems with energy, protecting them against surge voltages and lightning strikes, and establishing a reliable connection to the signal: these are the tasks which Phoenix Contact products take on in signal technology. Terminal blocks with different connection technologies safely and reliably maintain the electrical connection. Surge protection devices satisfy all the required proofs of safety. FO media converters ensure that data is transported without interference.

Integrating signal wiring in 19” racks
Due to the high signal density, the classic 19 inch rack is widely used in signal technology. The interface can now be directly integrated into the rack by using the modular PTMC marshalling terminals: either as pre-assembled blocks or in color-customizable units.

Durably marked
Whether you need standard labels for IP20 applications or stainless steel signs for IP6x applications, we have the optimum combination of marking technology and materials for all your durability requirements.

Convenient testing
From the quick contacting using the QUICKON fast connection technology, easy and safe handling to convenient testing of the cable paths: knife disconnect terminal blocks from Phoenix Contact are the ideal tool for control and signal technology.

You can find further information on our website at phoenixcontact.com
Interference-free data communication via fiber optics

In signal technology, data have to be transmitted over large distances, quickly and reliably. Our FO media converters meet these requirements. Extensive measures for shielding and equipotential bonding can be omitted.

Perfect surge protection

In control and protection technology, MCR-PLUGTRAB protective devices are used to protect signal towers and other signaling systems against lightning and surge voltage. All required proofs of safety are achieved by a system-specific circuit technology.

High availability

With their robust design, the QUINT POWER power supplies provide up to 200% of the output power for 5 seconds and now offer advanced preventative function monitoring for safe energy supply in signal stations and signal towers. Needless to say, the power supplies meet the various increased EMC requirements of the rail industry with regard to noise emissions and noise immunity.
Products for signal technology

Control and protection technology

In highly complex rail systems, control and protection technology forms the basis for safe and efficient rail operation. Phoenix Contact supplies electronic and electromechanical components and solutions, which are used in signal towers, train control systems or in controllers for railroad crossings, for example. In the event of surge voltages, surge protective devices ensure smooth rail operation, knife disconnect terminal blocks provide convenient, safe system testing, and the CHECKMASTER test device is used to quickly and safely check that the surge protective devices are functioning correctly.

Your advantages:
Across-the-board lightning and surge protection solutions:
• Reduce damage to control and signal system technology
• Increase the availability of signal technology
• Enable trains to run around the clock
Portable test laboratory
According to IEC 62305-3, surge protective devices must be tested regularly. In addition, the standard requires the traceable documentation of test values. This is how the CHECKMASTER 2 operates: all test results are stored in an internal memory. The test values can be output immediately or at a later time.

All connections – one system
With the CLIPLINE complete terminal block system, the choice is yours. Whether you opt for Push-in, spring, fast, screw or bolt connection: all of these connection technologies are suitable for the rail industry and can be freely combined with each other, thanks to the double function shaft.

Multifunctional base element
The VAL-MS-AR surge protective device was specially developed for the US railroad industry and meets AREMA standards. Independent terminal points for input and output cables ensure error-free operation. The base element provides a secure hold in the event of vibrations, impacts, and magnetic influences.

Safely receive, forward, test, and protect signals
At the cable end rack, the cables for the external systems are reliably and durably connected to knife disconnect terminal blocks and fed to the internal systems. Their disconnection and testing options allow work to be carried out in line with standards and directives at all times. By using test plugs, system-compatible surge protective devices can be connected cable by cable via branch line – with no need to interfere with the wiring. The surge protective devices work impact-free for all signal lines. They protect the system technology insulation and fulfill the system-specific requirements for functional safety. Maintenance can be carried out on the protective plugs without affecting the signal circuits.
Products for signal technology

Switch heaters

Switches are subjected to extreme weather conditions and must be able to function reliably even in winter, despite ice and snow. This is why they are equipped with heaters. Phoenix Contact offers suitable components for controlling these switch heaters. The Axiocontrol controller is resistant to vibrations and EMI, plus it is suitable for use in an extended temperature range. QUINT POWER power supplies safeguard the supply of all components. FO media converters or wireless systems are designed for large transmission distances in which a high level of EMI resistance is required.

Your advantages:

• Easy to integrate the controller into existing networks
• License-free wireless technology for I/O signals and serial data
• Power supply ensures high availability of the entire system thanks to SFB and POWER BOOST
• Lightning and surge protection with low voltage protection level
Fast and robust
The modular AXC high-performance controller from the Axiocontrol family boasts a robust design. It is shock-resistant, resistant to EMI, and responds immediately to voltage failures. The XC version can be used in particularly demanding environments with an extended temperature range from -40°C to +70°C.

Reliable wireless technology
The Radioline modules with transmission based on the robust Trusted Wireless 2.0 technology have been developed for forwarding I/O signals and serial data over long distances of up to several kilometers. From a simple point-to-point connection to self-healing mesh networks with up to 250 devices all types of network structure can be configured.

It must never fail
A redundant system made up of two QUINT POWER power supplies and a QUINT ORING also ensures smooth operation if an error occurs. SFB and POWER BOOST guarantee high system availability. With permanent monitoring of the input voltage, output current, and decoupling section, the loss of redundancy is reported early on.

Controlling a switch heater
Switch heaters are designed to safeguard line operation in icy and snowy weather. This calls for a controller which can control many interlinked components. Phoenix Contact has exactly the right products for this job, which meet the high requirements for use in the rail industry. Redundant power supplies reliably supply the system with power. Intelligent controllers can be integrated into existing networks. Integrated logs permit extensive diagnostics and maintenance via remote access. Both the wireless modules and the FO media converters enable secure and reliable communication with the control room. Surge protective devices protect the entire system against faulty switching operations and lightning strikes.

Control cabinet for a switch heater controller

- Power supply
- Wireless modules
- Surge protection
- Device circuit breakers
- Controller
- Omni-directional antenna
- FO media converters
- Terminal blocks with Push-in connection
- High-current terminal blocks
- Surge protection
Tunnel operation

Safety and availability are decisive factors in tunnel infrastructure – along with economical operation. Phoenix Contact products provide you with a high-quality electrotechnical infrastructure from a single source, which is tailored to suit your individual requirements.

In addition to FO communication and surge protection, safety controllers are also available. These can be set up redundantly to maintain system availability in the event of a failure. Industrial switches connect the local control units to the central controller.

Your advantages:

- All your control components from a single source, perfectly matched to each other
- Connect small-scale and safety controllers to one another via Gigabit ring structure
- Maximum availability of the safety controller thanks to controller redundancy based on PROFINET
- Two independent network interfaces
- PROFINET controller with PROFIsafe function
**For the highest safety requirements**

The compact safety PLC from the RFC series meets the highest safety categories SIL 3, SIL CL 3, and PLe/Cat 4. As a PROFINET I/O controller/device, the controller either works as a higher-level PROFi safe PLC in a PROFINET network or it can be operated by a higher-level PROFINET-capable controller as a PROFINET I/O device. The RFC 460R controllers set up a redundant system automatically using AutoSync Technology.

**Data transmission for real time applications**

Thanks to integrated ERTEC technology, FL SWITCH IRT switches offer optimum realtime properties for PROFINET applications. The IRT switches detect PROFINET data packets due to their PROFINET ID and relay these data packets with the highest priority. The polymer fiber ports can form interference-free fiber optic rings that can be diagnosed – optionally with an additional fiber optic branch.

**Modular small-scale controllers – simply versatile**

Programmable modular controllers from Phoenix Contact excel thanks to their high functional density and support all current standards such as Ethernet, mobile communication or fixed-line network. Thanks to integrated Modbus/TCP, the controllers communicate with numerous fieldbus devices without any additional programming, both passively as a Modbus server as well as actively as a Modbus client. In addition, the parameterization memory can be expanded with an SD card.

**Redundant control system for failsafe performance**

A redundant control system consists of various levels. The most important level is the control level, which has access to the process. Here, two high-performance controllers are synchronized in such a way that one of them always controls the process.

The OPC server ensures that the control level is always provided with data from the controller which is executing the process.

The FL switches connect the modular small-scale controllers to the central controller so that data and signals can be forwarded in real time.

The I/O components are connected via PROFINET, so network redundancy protocols can be used in a standardized manner. In almost all cases, these require a ring topology.
Quality from the start

Rail vehicles are subjected to vibrations and shock due to operational reasons and therefore require extremely high standards of reliability for the electrical connections and failsafe performance of electronic components. Constant product quality that corresponds to the highest requirements of the rail industry is ensured through ongoing tests during the development and production cycle of the products. This is also documented by the IRIS certification required by the rail industry.

Norms and standards

DIN EN 50155

EMC
DIN EN 50121-3, DIN EN 50121-4, DIN EN 50121-5, IEC 62236-4, IEC 62236-5, IEC 60571

Shock and vibration test
IEC 60068-2-27, IEC 60068-2-6, IEC 61373

Material test
DIN ISO 4589-2, UL 94/EN 60695-11-10

Fire protection
DIN EN 45545-2, ASTM E 162 (NFPA 130), ASTM E 662 (NFPA 130), SMP 800 C, BS 6853, DIN 5510-2, NF F 16-101, NF F 16-102

Others
AREMA MP 11.5.1 Class C, AREMA MP 11.5.1 Class D, AREMA MP 14.1.2

For additional information, visit phoenixcontact.com
Shock testing IEC 60068-2-27 – Shocks (intensity according to DIN EN 50155)

This is used to test and document the resistance of a terminal connection to irregular occurring shocks with varying energy content. Intensities from IEC 61373 (European standard for railroad applications) are used to simulate the load in rail traffic.

For the definition of the shock, acceleration and duration are specified. IEC 60068-2-27 prescribes three positive and negative shocks on each of the three spatial axes (x, y, z). The simulated accelerations reach 50 m/s$^2$ with a shock duration of 30 ms. No damage may occur at the terminal connection that would impair further use.

Vibration test IEC 61373 – Broadband noise (intensity according to DIN EN 50155)

In transportation technology, terminal blocks are always exposed to vibrations and shocks.

For a practical simulation of the vibration stress, the test objects are subjected to broadband noise-induced vibrations. This means that realistic accelerations are generated at the terminal block and the connected conductor.

During the category 1b test, the objects are exposed to a frequency range of 5 Hz to 150 Hz. The r.m.s. value of the acceleration is up to 5.72 m/s$^2$. The test objects are tested for five hours in each of the three axes (x, y, z). In addition to the vibrations, the electrical contact is monitored during the test to make it more difficult.

No damage may occur to the terminal blocks that would impair their further use. In addition, no contact interruptions $> 1 \mu$s are permitted during the test.

Phoenix Contact terminal blocks with all connection methods fulfill this high vibration requirement.

Vibration test IEC 60068-2-6

This test demonstrates the vibration resistance of a terminal connection subjected to permanent vibrations. Harmonic, sinusoidal vibrations are applied to the test object to simulate rotating, pulsating or oscillating forces. The test is performed on each of the three spatial axes (x, y, z).

In the test, the object runs through a frequency range of 5 Hz to 150 Hz at a speed of one octave per minute. The r.m.s. value of the acceleration is up to 50 m/s$^2$. The test objects are tested for two hours on each of the three axes (x, y, z). In addition, the electrical contact is monitored during the test. No damage may occur at the terminal blocks that would impair their further use. In addition, no contact interruptions $> 1 \mu$s are permitted during the test.

All connection technologies meet the requirements of the standard without the electrical contact being interrupted. They are therefore particularly suitable for challenging applications in which the reliable function of the terminal connection must be ensured, even when subjected to the most extreme vibrations.
Determining the oxygen index according to DIN ISO 4589-2

Determining the oxygen index is the most important fire protection test for electro-mechanical and electronic components besides the smoke toxicity and smoke density test. This test method determines the lowest oxygen concentration of an ambient atmosphere that is required for a material to continue burning independently under specified conditions. The burn duration (< 180 s) and burn path (< 80 mm) are monitored.

The unreinforced polyamides used for Phoenix Contact terminal blocks with flammability rating UL 94 V0 achieve an oxygen index > 32%. These excellent results are responsible for achieving outstanding ratings and classifications, for the expiring national standards as well as the European standard EN 45545-2.

Inflammability classification UL 94/EN 60695-11-10

UL 94 describes inflammability tests that have gained particular importance in the field of electrical engineering. Behavior in fire is the main focus. Items are classified according to either UL 94 HB (Horizontal Burn) or UL 94 V (Vertical Burn). The test setup is such that the UL 94 V0/1/2 classifications are stricter than the UL 94 HB classifications.

After conditioning, the test bar is vertically clamped and flame-treated several times for ten seconds at a time. Between the flame treatments, the time it takes for the test bar to extinguish is measured. Afterwards, the afterburning times and the drip behavior are evaluated.

The plastics used for the Phoenix Contact terminal blocks meet the stricter criteria for classification as V0 materials.

<table>
<thead>
<tr>
<th></th>
<th>UL 94 V0</th>
<th>UL 94 V1</th>
<th>UL 94 V2</th>
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<tbody>
<tr>
<td>Burning time after each flame treatment</td>
<td>≤ 10 s</td>
<td>≤ 30 s</td>
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<td>Total burning time after 10 flame treatments</td>
<td>≤ 50 s</td>
<td>≤ 250 s</td>
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<td>Glowing time after the 2nd flame treatment</td>
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<td>≤ 60 s</td>
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<tr>
<td>Complete burn-off</td>
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<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Ignition of the absorbent cotton under the sample</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Fire protection DIN EN 45545-2:2013-08

DIN EN 45545-2:2013-08, which emerged from the technical specification DIN CEN/TS 45545-2:2009-07 and has been ratified since March 2013 and converted to national law, specifies the “Requirements for fire behavior of materials and components”.

To qualify plastics for certain operating and design classes of rail vehicles, the standard describes testing methods for determining hazard levels (HL) based on different requirement sets (R). In this case, HL 3 corresponds to the highest requirements.

The following tests are performed in order to qualify the plastics for electrotechnical applications:

- Oxygen index according to DIN EN ISO 4589-2
- Development of smoke gas in accordance with EN ISO 5659-2 (25 kW/m²)
- Toxicity of smoke gas NF X70-100-2 (600°C)
- Glow-wire test according to EN 60695-2-11
- Vertical small flames test according to EN 60695-11-10

The unreinforced polyamides used for Phoenix Contact terminal blocks with flammability rating UL 94 V0 meet the most stringent requirement of HL3 in accordance with the tests described in the requirement sets R22, R23, R24, R25, and R26.
Surface inflammability ASTM E 162 (NFPA 130)

In order to evaluate the surface inflammability and the flame spread for plastics, the flame spread index is determined according to ASTM E 162. To do so, a sample is irradiated with a heat source and also ignited with a naked flame. During the test, the time in which the flame front reaches two separate measuring points is determined. The product of this flame propagation time and a calculated heat development factor yields the flame spread index. Furthermore, the drip behavior of the plastic is also observed and evaluated during the test.

In America, the flame spread index must not exceed 35. Terminal blocks from Phoenix Contact achieve a value of 5 and produce non-burning droplets. Therefore, the value lies far below the permissible maximum values of the Federal Railroad Administration of the U.S. Departments of Transportation (FRA).

Smoke gas development ASTM E 662 (NFPA 130)

Standard ASTM E 662 specifies the method for evaluating the specific optic density of the smoke during an open fire or a smoldering fire. For this purpose, the percentage of light transmitted in relation to the burning chamber volume is observed. To do so, a sample is placed in a precisely defined smoke density chamber. The test object is irradiated with a heat of 2.5 W/cm². The following processes are then simulated for 20 minutes: first, burning with a naked flame followed by smoldering fire, i.e., avoidance of a naked flame. The limit values for the optical smoke density of both processes are recorded after 1.5 and 4 minutes.

- Specific optical smoke density (Ds 1.5), limit value 100
- Specific optical smoke density (Ds 4), limit value 200
- Maximum smoke density (Dm) during the 20 minutes

The polyamides used for Phoenix Contact terminal blocks fulfill all the requirements of the "Federal Railroad Administration (FRA) of the US Department of Transportation" in accordance with ASTM E 662.

Smoke gas toxicity SMP 800 C

SMP 800 C describes the maximum permissible values of poisonous smoke gases when a plastic is burned. In comparison with BSS 7239 (Boeing standard), this standard specifies more precise measuring methods for the qualitative and quantitative determination of toxic smoke gases that result when a test object is completely burned. For this purpose, 6 liters of smoke gas is removed from the NBS chamber during the ASTM E 662 test between the 4th and 19th minute and sent for analysis.

SMP-800-C limit values of toxic smoke gases in ppm:
- Carbon monoxide (CO) ............ 3500
- Carbon dioxide (CO₂) ............ 90,000
- Nitrogen oxides (NOX) ............ 100
- Sulfur dioxide (SO₂) ............ 100
- Hydrochloric acid (HCl) .......... 500
- Hydrobromic acid (HBr) .......... 100
- Hydrofluoric acid (HF) .......... 100
- Hydrocyanic acid (HCN) .......... 100

The polyamides used by Phoenix Contact are many times below the critical concentrations.
Halogen-free flame protection

Halogens include the chemical elements fluorine, chlorine, bromine, and iodine. One property of halogen compounds, particularly those containing bromine, relates to the reduction in the degree of inflammability when used in plastics. However, in the event of fire, poisonous corrosive smoke gases are formed, which can also lead to secondary damage. For this reason, Phoenix Contact does not use any flame protection systems which contain halogens or other additives. Polyamide, polycarbonate, polycarbonate/ acrylonitrile butadiene styrene (PC/ABS) and polyolefines feature halogen-free flame protection systems. Terminal blocks from the CLIPLINE complete system are made of polyamide 6.6 (PA 6.6) with fire protection classification UL 94 V0. According to state-of-the-art technology, these polyamides are used halogen-free, with melamine cyanurate as the flame protection agent. Phoenix Contact terminal blocks are thus, without exception, entirely free of halogens.

MARKING system – quality features

Marking materials and their markings must withstand extreme environmental conditions, according to their area of application. This means that the material properties must not change significantly and the marking must also remain easily readable. This is the only way to ensure clear and durable marking. This is why Phoenix Contact carries out comprehensive checks on all marking materials with regard to their durability.

• Weather resistance
  Artificial weathering according to DIN EN ISO 4892-2
• Corrosion resistance
  Salt spray: IEC 60068-2-11/52
  Alternating condensation climate with SO₂: DIN 50018
• Oil and chemical resistance
  Immersion: DIN EN ISO 175

In addition to environmental influences in the form of physical and chemical effects, marking materials and their markings, in particular, are subjected to a range of mechanical strains. It must not be possible to scratch the marking off, and abrasion caused by industrial cleaning agents must not render it illegible. Furthermore, the marking materials must be able to reliably withstand vibrations. The marking solutions used by Phoenix Contact fulfill these high expectations.

• Wipe resistance
  DIN EN ISO 61010-1 and DIN EN 62208
• Scratch resistance
  DIN EN ISO 1518
• Adhesion
  FINAT 1, 2, and 9
• Adhesive strength
  DIN EN ISO 2409
• IP protection
  DIN EN 60529 / ISO 20653
• Vibration resistance
  DIN EN 50155
We are there for you

With more than 50 subsidiaries and over 30 agencies around the world, we are always close by. Specialists for the rail industry and a globally positioned sales network are available to advise you on site, competently and in person.

With a wide range of railroad-approved components and extensive industry expertise, we develop special solutions, individually tailored to your requirements, for rail vehicles and control and protection technology.
**Worldwide service and support**

We assemble and wire terminal strips in accordance with your specifications, and these are consistently marked and delivered to you. You can install pre-assembled terminal strips directly in your control cabinet, thereby reducing your installation time to a minimum. Molded M12 connectors are electrically tested by us prior to shipping and can therefore be integrated into your wiring concept without any problems.

With our worldwide production facilities, we guarantee quick availability of our products and solutions and, on top of that, we fulfill “Local content” requirements.
Customized cable assembly
Optimize your production processes with tailor-made cabling solutions from Phoenix Contact. We supply 100% pre-tested cables worldwide for reliable data, signal, and power transmission. The railroad cables used meet the requirements of EN 45545-2.

Individual set solutions
To reduce the effort of materials and stock management, you can order pre-picked material sets under a single order number. These sets are as individual as your requirements and can also contain individual terminal strips or DIN rails as well as individual products from the Phoenix Contact portfolio, for example.

Pre-assembled terminal strips
Reduce your assembly time with pre-assembled terminal strips. These are individually constructed according to your electrical design. You can choose from the entire Phoenix Contact product portfolio. Needless to say, your terminal strips also come with the configured accessories, such as covers, bridges, marking or plugs.

CLIP PROJECT: one software tool for configuration and marking
Use CLIP PROJECT to configure terminal strips and create your markings.
- One system for consistent configuration and marking
- CLIP PROJECT creates comprehensive documentation for your projects
- Data exchange with all common CAE programs
- Auto-correct feature for error-free projects
- Access to all marking materials and control of all Phoenix Contact printing systems
- Order individually-marked marking solutions directly from the software

Configuring, marking, and documenting
Always up-to-date, always available to you. Here you’ll find everything on our products, solutions and service:

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Product range

- Cables and wires
- Connectors
- Controllers
- Electronics housings
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- Fieldbus components and systems
- Functional safety
- HMIs and industrial PCs
- I/O systems
- Industrial communication technology
- Industrial Ethernet
- Installation and mounting material
- Lighting and signaling
- Marking and labeling
- Measurement and control technology
- Monitoring
- PCB terminal blocks and PCB connectors
- Power supply units and UPS
- Protective devices
- Relay modules
- Sensor/actuator cabling
- Software
- Surge protection and interference filters
- System cabling for controllers
- Terminal blocks
- Tools
- Wireless data communication