WHITEPAPER

NEW STANDARD
FOR CABLING IN **BUSES**

LAPP

NEW STANDARD FOR CABLING IN BUSES

On 9.12.2015 a new standard for cabling in buses came into force in the EU: ECE-R 118.01. It significantly raises the requirements for fire protection in buses used for passenger transportation.

It affects cables that are installed in the passenger compartment, the engine compartment or any separate heating compartment. According to the stipulations of the Economic Commission for Europe (ECE), which announced the standard three years ago, cables need to have exceptional flame-retardant properties. This new EU regulation relates to very specific classes and categories of buses. The relevant vehicles are set out in an ECE regulation “Consolidated Resolution on the Construction of Vehicles (R.E:3)”. The specified vehicles for use of the ECE-R118 directive are buses in vehicle class M3, class II and class III.

Bus classes under ECE/TRANS/WP.29/78/Rev.3
Consolidated Resolution on the Construction of Vehicles from UNECE

ECE R 118
Valid from 15 December for buses and coaches with more than 22 passenger seats plus a driver’s seat

Category M

Category M3
Motor vehicles for passenger transportation with
– more than 8 seats
– weight of more than 5 tons

Class II
Motor vehicles for transportation of seated and some standing passengers, e. g. urban buses

Class III
Motor vehicles designed exclusively for transportation of seated passengers, e. g. coaches

Not valid for buses at airports, for example

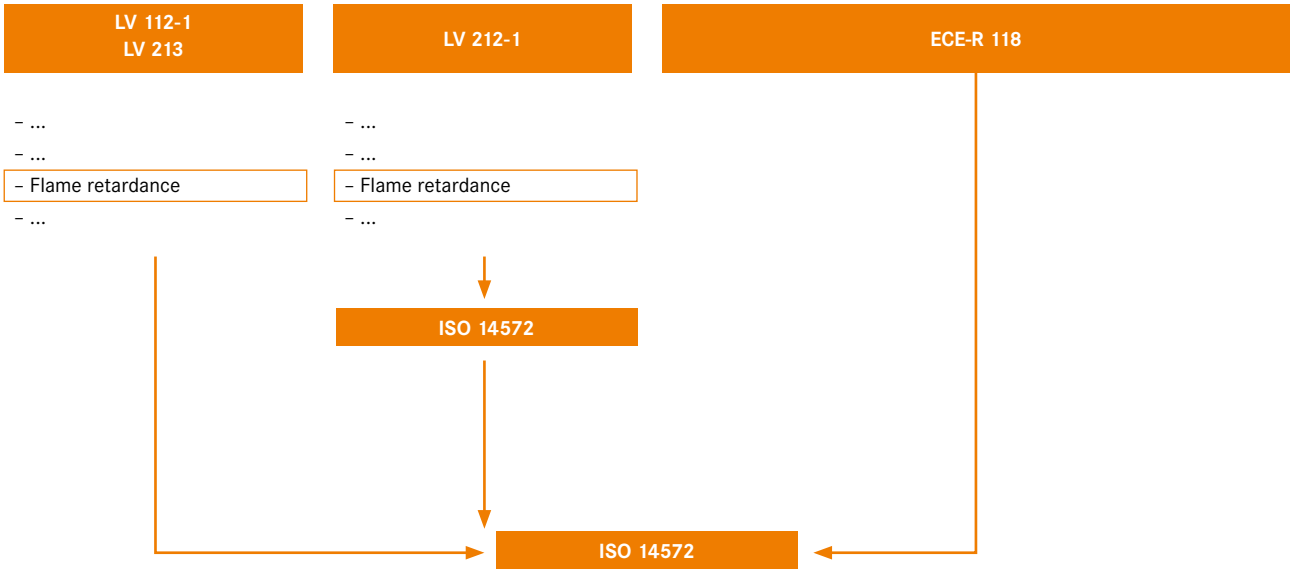
FLAME TEST

One of the requirements of ECE-R 118.01 is the new stricter flame test. In the laboratory, a flame is held on a 50 centimetre long section of cable and removed again after 15 to 30 seconds. The fire on the cable insulation must extinguish itself within 70 seconds and the propagation of the flame must stop at least five centimetres before each of the two ends of the cable section. This is intended to ensure that a flame that sets fire to the sheath will not spread as on a fuse and set on fire other cables and the interior fittings of the bus while passengers may still be inside the vehicle. In addition, fire-fighters have the assurance that the flame on the cable insulation will not continue burning or even re-ignite once the source of the fire has been extinguished.

INFO

LV 112-1, 212-1 and 213 are complete test indexes (mechanical, electrical and chemical tests). Only one of these tests is a flame test.
- LV 112-1 and 213 refer directly to ISO 6722
- LV 212-1 refers initially to ISO 14572, with ISO 14572 in turn referring to ISO 6722.

ECE-R 118 is a new regulation that deals exclusively with the fire behaviour of materials used in vehicles.
- The relevant paragraph for cables refers to ISO 6722.



Flame test

INFO

The scope and nature of the automotive manufacturers' delivery specifications – LV 112-1, 212-1 and 213 – are in absolutely no way to be equated with the legally stipulated ECE-R 118 regulation.

Other requirements for Ethernet cables are also specified, in addition to ECE-R 118 [described below – PVC vs. PUR]

PREVENTION OF TOXIC GASES IN FIRES

The new cables aim to protect passengers in the event of a fire. A total of 60 percent of all victims in fire incidents are not killed by burns but by inhaling toxic gases, particularly carbon monoxide, or corrosive vapours. Cables that have to meet special fire protection requirements are often made of polyvinyl chloride (PVC). In addition to chlorine, these cables contain other halogens as flame retardants, i.e. chemical elements from the seventh main group of the periodic table, which in addition to chlorine include fluorine and bromine. These additives prevent the cable sheath from getting quickly burnt away and make it easier to extinguish the fire on the cable once the exterior cause of the fire has been eliminated, for instance when the fire-fighters have extinguished it. PVC cables are therefore the number one choice in car engine compartments.

However, this fire protection has disadvantages: Although PVC cables burn slowly in a fire, they produce a high volume of smoke. They also emit halogens, including chlorine, which are found in the PVC. If fire-fighters use water to extinguish the blaze, it combines with them to form hydrochloric acid. The other halogens that act as flame-retardant additives, combine with water to form hydrofluoric acid and hydrogen bromide, while highly toxic dioxin is also produced. The acids chemically burn airways and in the worst case scenario can result in death. Therefore, PVC cables are only suitable for use where there are no people in the vicinity. This is the reason why PVC flooring is no longer used in public buildings. In cars and buses, PVC cables should only be used in the engine compartment but are to be avoided in the passenger compartment.

NO ETHERNET CABLES WITH PVC MATERIALS IN PASSENGER COMPARTMENT

Where cables are installed more or less visibly in buses – for example for the ticket machine, destination display or CCTV cameras – they may not contain any halogens but must still have optimum fire protection properties. Cables with a PVC sheath do not meet this requirement due to their halogen content. In industry, a common alternative to PVC is polyurethane (PUR). The material has outstanding mechanical properties – it is extremely resistant to oil and many chemicals and is also highly resistant to abrasion and movements which are repeated millions of times, for instance in machinery. However, PUR also has several disadvantages: It is prone to hydrolysis, meaning that it it slowly dissolves in water, although this is not of any consequence when used in the interior of a bus. However, the main issue is that PUR burns away quickly and is not self-extinguishing. Therefore, a cable with a pure PUR sheath would not pass the fire test stipulated in ECE-R 118.01.

In practical terms, the overall requirements for cables in the automotive sector mean that cable manufacturers are faced with the task of bringing the fire behaviour of PUR up to the level of PVC. This is done using a PUR formulation containing various additives. These substances do not represent any health risk even if they escape into the air during a fire. The additives do not contain any halogens, which is also the case for PUR cables in general.

Additional standard for bus cabling

The Federal Office for Motor Vehicles monitors compliance with this standard

ECE-R118.01
European standard

Fire behaviour of interior fittings and insulation materials, as well as electrical cables and components for public passenger transportation

MBN LV 112, LV 212 and LV 213
Valid for entire German automotive industry

Requirements:
- Resistant to oil
- Resistant to petrol
- Resistant to salt spray
- Temperature range
- etc.

ECE-R 118.01 is not the only relevant standard for cables in buses. Cables must also comply with DIN ISO 6722, the most important standard for cables in motor vehicles. The delivery specifications issued by the German automotive industry are also applicable, and are similar in nature to a standard. The standards require cables to demonstrate other properties such as media resistance in compliance with ISO 6722 to engine coolant, salt water, diesel, petrol and also battery acid, for example. In addition, the cable's bending fatigue strength and its ozone resistance are tested. This is just a small selection of the tests that the cables have to pass. For example, for Class B the cable has to withstand a temperature range of -40 to +100 °C for a sustained period (the industrial standard is -20 to +80 °C) and meet the increased requirement for up to +105 °C in continuous use and even up to +130 °C for a short time. A "short time" here means 240 hours. The safety buffer for applications in buses and cars is calculated very generously. However, these properties could also be very useful for other applications, such as photovoltaic systems in the desert.

The new ECE-R 118.01 applies to all cables installed in the passenger compartment of buses. There are new requirements such as ECE-R and ISO6722 for Ethernet cables, which are increasingly being used in buses. The amount of data traffic in vehicles has risen considerably. Screens mounted below the ceiling use navigation data to indicate the next stop, the ticket machine uses contactless technology to debit the fare from the passenger's chip card according to the distance travelled, while CCTV cameras are intended to deter vandalism. And on long-distance buses, passengers can surf the net using Wi-Fi. To handle this amount of data, high-speed Ethernet cables are increasingly being used in buses.

ETHERNET: COMPREHENSIVE STANDARD

In terms of their internal structure, Ethernet cables complying with the new standard do not differ from those that are familiar from an office environment. They are used for networking computers – in fact the entire Internet is based on Ethernet communication. The current Ethernet standard includes not only conventional network cables featuring copper conductors but also fibre optic cables and even wireless Ethernet with no cables at all. Ethernet is now well-established in industrial production, where it is increasingly replacing traditional field bus systems for data exchange between sensors, actuating elements and production control. However, Ethernet cables and connectors used in offices are not suitable for use in a factory. They must be resistant to oil, chemicals and heat, and need to withstand millions of movement cycles in drag chains.

Up to 140 metres of Ethernet cable are installed in modern buses, or considerably more if the bus is equipped with an entertainment system like those used in long-distance aircraft. A luxury feature such as this also dramatically further increases the amount of data. A changeover to Ethernet cables with fibre optic cables for even higher data rates is not currently necessary, as the distances to be bridged in buses are not as great as those in aeroplanes. Buses that are currently being ordered use only Ethernet cables with copper cores. In principle, other cables could be fitted with an optimised PUR sheath, as cable types other than Ethernet cables will be installed in buses in the future. As long as they are installed in the passenger compartment they must also comply with ECE-R 118.01.

Other LAPP products complying with ECE-R 118.01

At the LAPP, we offer a wide range of items that have successfully passed the tests required by ECE-R 118.01 at an accredited laboratory. They include the network cables from the ETHERLINE® HEAT 6722 series. These are available in three performance classes as Cat.5e, Cat.6_A and Cat.7 versions. If you have any questions or require further information, our team will be happy to help.

CONTACT

Call **+49 (0)711 783801** to quickly and easily speak to our friendly and knowledgeable sales team at our headquarters in Stuttgart

Our service hours:
Monday – Thursday from 7:00 – 18:00 h
Friday from 7:00 – 17:00 h

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