



Trailer Connectors for Commercial Vehicles
Is State-Of-The-Art sufficient for the new GSR?

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ERICH JAEGER



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Whitepaper

Connectors for Commercial Vehicles – Connections for Trailers Is State-Of-The-Art sufficient for the new GSR?

In the commercial vehicle industry, connectors between towing vehicles and trailers must perform flawlessly under demanding circumstances: In the tough daily use, they have to reliably transfer electrical signals and data streams from truck to trailer and back to enable safety-related functionalities like lighting and braking throughout all involved vehicles.

Within this application, the requirements for the connector components keep increasing: On 5 January, 2020, the new General Safety Regulation came into effect. This EU Regulation intends to introduce new vehicle safety systems for heavy-duty vehicles thus significantly improving the safety for all participants in road traffic. Of course, these new systems make new demands on the interface between tractor and trailer.

This white paper explores, to what extent the existing trailer connectors are suitable to meet the demands of the vehicle safety systems and what it takes to comply with the requirements.



Trailer connectors for commercial vehicles – State-of-the-art

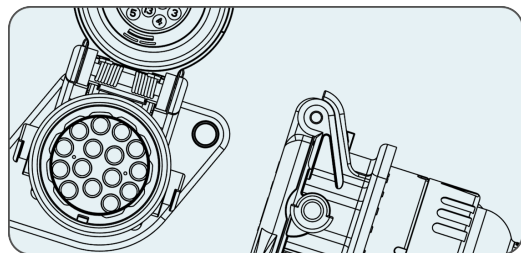
Driving on motorways, you can see that a huge amount of goods and food is transported on a daily basis - most of which can only be coped with by the use of large heavy-duty vehicles. Having then a look between the tractor and the goods container or semi-trailer, you will recognize hose-like spirals, which are always in motion.

These components perform the heaviest work in transferring functionalities and signals between the truck and the goods to be transported in the trailer.

The requirements for these spiral cables – or coils – and the attached connectors have steadily increased in recent years, along with the requirements for the entire logistics industry.

Trailer connectors according to ISO 12098 and 7638-1

State-of-the-art are two separate plug-in systems according to the standards ISO 12098 and ISO 7638-1.



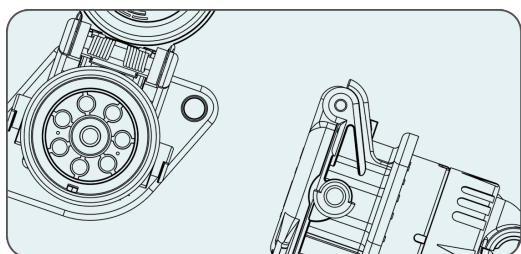
The 15-pin 24V trailer connector according to the ISO standard 12098 is the modern system for the transmission of light and additional functions in 24V on-board networks and is mandatory for the transport of hazardous goods according to ADR guidelines. ERICH JAEGER offers sockets of the „JAEGER Expert“ product line, which are 100% waterproof.





Exploded view of a socket according to ISO 12098

Further infos on the standard ISO 12098



The second connector is a 7-pin 24V ABS/EBS connector according to ISO 7638-1, which is used in almost any type of commercial vehicle with an ABS/EBS system.

This connector is used for the transmission of the electronic pulses and the power supply of the trailer anti-lock braking system or the electronic brake. The plug-in device is equipped with 5 poles as ABS version (contact 1 to 5) and with 7 poles as EBS version.



Exploded view of a socket according to ISO 7638-1

Further infos on the standard ISO 7638-1

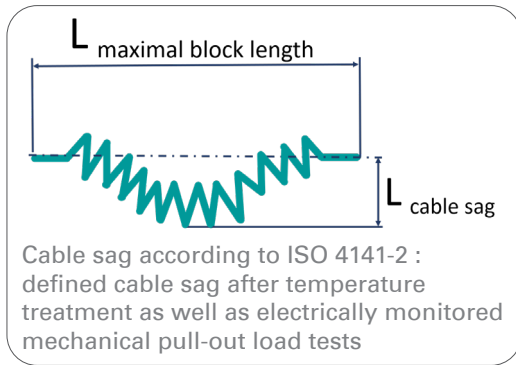


For both connectors, manufacturers of trucks, trailers and truck bodies rely on ERICH JAEGER's quality connectors. Since 2016, these latest connector generation is available in an „EXPERT“ version featuring the highest water protection class IPX9K and durability over more than 10,000 plug-in cycles.

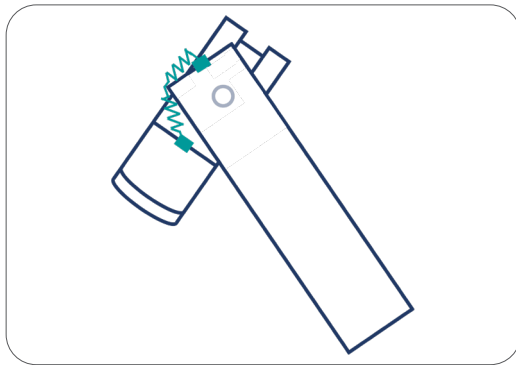
The sockets installed on the towing vehicle and trailer are each connected to a spiral coiled cable, which is assembled with plugs according to the specific standards according to ISO 12098 (15P/24V) and ISO 7638-1 (7P/24V).



Spiral cables for the use in EURO 6 vehicles



The spiral cables, which were developed according to the requirements of the EURO 6 standard, work reliably in a temperature range from -40°C to +125°C. The coils return to their original shape even after 200,000 complete pull-outs. This is the only way to prevent a large cable sag and a failure of the electrical connection.

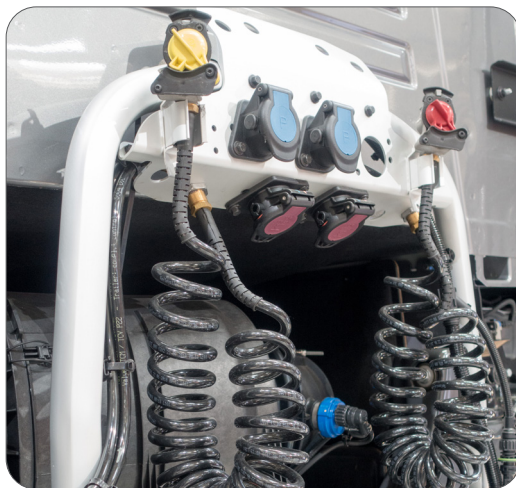


The highly flexible electric spiral cables perform with maximum flexibility and durability in extremely tight turning maneuvers.

In u-turn maneuvering, the lines are bent by 90° to the right or left. At the ERICH JAEGER test station, OEM products are tested on 20,000 or more bending cycles to reproduce full functionality over lifetime for such extreme situations as tight truck-trailer u-turns.

In order to increase road safety continuously, ERICH JAEGER is an active member of the National and International Standards Committee, which reviews, specifies and updates the connector and associated testing standards. In 2019, the Committee updated the test standards based on ISO 4141-1, -2, -3.

For freight forwarders, fleets and for aftermarket requirements, we recommend the latest generation of „EURO 6“ spiral lines, which offers the best possible cost-benefit ratio due to their longevity and which guarantees lowest downtimes.



Current rack on the cabin back of a typical tractor with all necessary electrical and pneumatic connections.

The electrical connection of the 15-pin connector ensures the lighting and power functions on the trailer and the separate 7-pin connector is for trailer brake control purposes only.



New GSR (General Safety Regulation) for commercial vehicles

On 5 January 2020, the first articles of the Regulation (EU) 2019/2144 took effect. It includes type-approval requirements for motor vehicles and their trailers and systems, components and separate technical units intended for such vehicles, as regards their general safety and the protection of vehicle occupants and vulnerable road users (General Safety Regulation - GSR). On 6 July 2022, the complete Regulation will become mandatory in all EU Member States.

One of the major objectives of this Regulation is to further reduce the number of persons killed and injured in traffic by making high-standard vehicle safety systems. This Regulation includes the obligatory introduction of a range of new technologies and safety measures following a fixed timetable.

Further information on the EU regulation on the BMVI website



Roadmap for the introduction of new vehicle safety systems for heavy goods vehicles

	07/2022	07/2024	01/2026	01/2029
Intelligent speed assistance	▲	●		
Driver drowsiness and attention warning system	▲	●		
Reversing detection system	▲	●		
Turn assist systems and collision warning system	▲	●		
Event data recorder			▲	●
Emergency stop signal	▲	●		
Tire pressure monitoring system	▲	●		
Improving direct vision for drivers			▲	●

▲ All new vehicle types

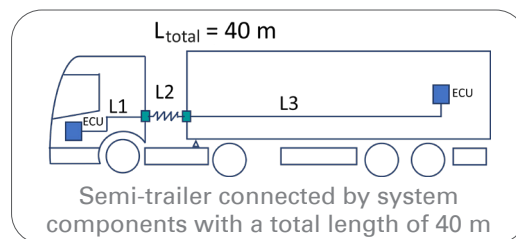
● All initial registrations

In addition to the existing security measures, the detailed technical requirements have already been developed at EU and UNECE level or are in some cases already in force.

The international association OICA (International Organization of Motor Vehicle Manufacturers), has already made proposals for the integration of the new technologies into new or updated standards.



One of the most important findings in the implementation of the new requirements is the fact that it cannot be the towing vehicle alone which bears all technological innovations. The new safety requirements apply to the entire unit of tractor and trailer. This becomes even clearer if we want to implement partially and fully autonomous driving functions in near future.



Focus on the connection between tractor and trailer



For the rapid implementation of the new vehicle systems, the current connector systems have been examined regarding extensibility. Both the 7-pin connector according to ISO 7638-1 and the 15P connector according to ISO 12098 have independently integrated a data channel for the transmission of CAN messages at a data rate of 125 kbps. This data channel is described in detail in ISO standard 11992 Part 1 with the title *Road vehicles – Interchange of digital information on electrical connections between towing and towed vehicles. Part 1: Physical and data-link layers*. The standard was updated in May 2019.

In the 7-pin EBS connector, the data channel for the EBS function quickly became the standard and the brake manufacturers agreed on

the data formats of the braking functions in order to be able to freely exchange all combinations of tractor and trailer. The communication of the brake signals is recorded in the standard according to ISO 11992 Part 2.

In the 15-pin connector, the data channel has not been used for special applications since its introduction; or has at least rarely been used. The application was then mostly limited to combinations of tractor and trailer which mostly remained within a fleet and were never or rarely changed. The main application was solely the transmission of the light functions on the trailer. Very often, the two old 7-pin socket systems according to ISO 1185 and ISO 3731 are still used on semi-trailers. These do not offer a data option.



A trailer socket 15-pin 24V according to ISO 12098 with rear occupancy arrangement and CAN-BUS. The CAN-BUS data lines are located in chambers 14 and 15.

Pin	Funktion	Pin	Funktion
1	Left-hand direction indicator light	9	Continuous power supply (steady, constant)
2	Right-hand direction indicator light	10	Reverse lock release for inertia brake and locking of steering axle
3	Rear fog light	11	Starting-traction control system
4	Common return	12	Axle lifting device
5	Left-hand rear, position, and marker lights, and license plate lamp	13	Common return for data lines
6	Right-hand rear, position, and marker lights, and license plate lamp	14	CAN-H
7	Brake lights	15	CAN-L
8	Reversing light		



CAN-BUS data transfer of the 15-pin plug-in connection

All application protocols that do not belong to braking functions are transmitted via the CAN-BUS data channels of the 15-pin plug-in connection. These are standardized in ISO 11992 part 3. The working title is: *Road vehicles – Interchange of digital information on electrical connections between towing and towed vehicles – Part 3; Application layer for equipment other than brakes and running gear.*

This standard has now been updated and contains communication protocols for the implementation of the new General Safety Regulation. It applies to commercial vehicles over 3500 kg. Presently (30.03.2021) the standard has been published as ISO/DIS 11992-3 for its final approval.

The very comprehensive document includes information for different application areas:

Security

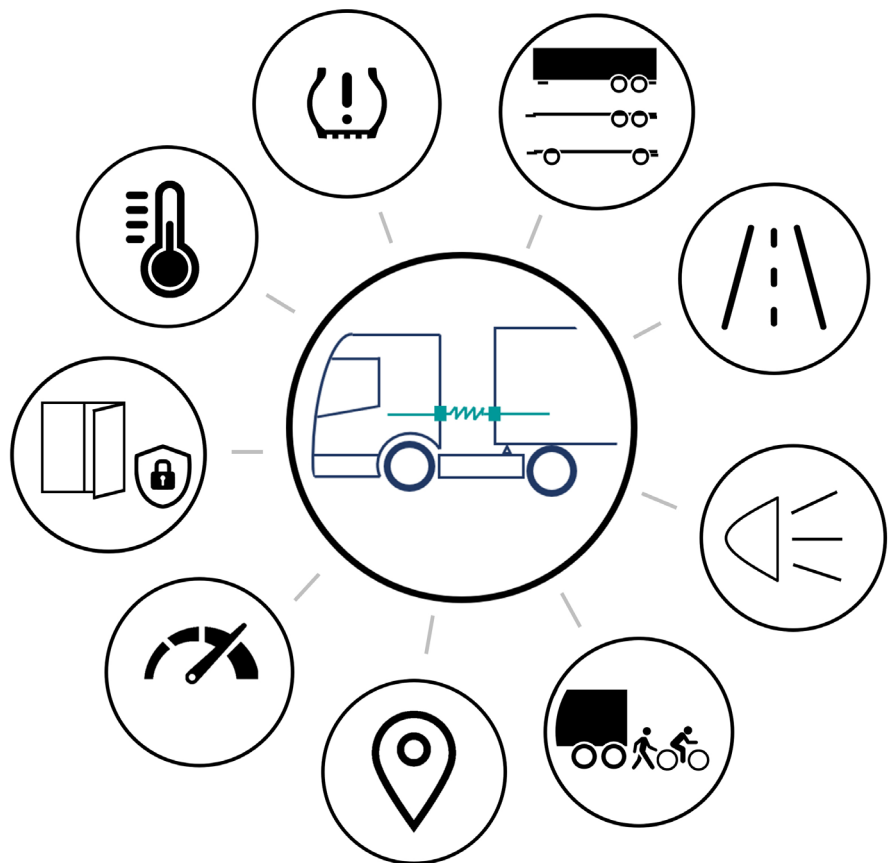
- Object detection (pedestrian, cyclist detection)
- Distance measurement to obstacles behind the trailer - reverse warning system
- Activation and status of anti-theft protections
- Ambient temperature
- Lighting status of all standard lighting equipment on the trailer including possible additional lighting (all-round lighting, emergency lighting...) and replacement lighting
- Lane assistant

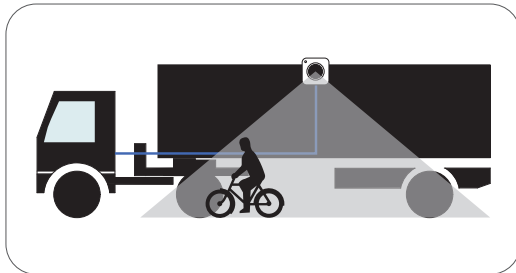
Functions for the transport of goods

- Temperature in refrigerated transport trailers
- Signals for trailer bodies for storage, loading and unloading

Control parameters for other applications

- Geometry data of the trailer and coupling point information
- Longitudinal and transverse velocity around the coupling point
- Articulated angle between towing vehicle and towed vehicle
- Identifications of different trailer types
- Drive information from the engine (speed, speed, torque...)
- Special functions for superstructures (level indicators, loading board...)
- Track ID for individual object identifier





For all the listed functions, object recognition is probably one of the most important innovations in order to significantly reduce the number of accidents involving cyclists and pedestrians in urban traffic. Lane-assist and rear-space monitoring will also provide significantly greater safety in long-distance traffic when passing other vehicles.

In addition, the new features via the data channel offer a broad range of new possibilities to turn the current trailer into a smart trailer.

New products and services

The **truck manufacturers** can offer new USP's with new innovative additional products including new added value for their customers.

The **trailer manufacturers** are given the opportunity to equip the trailers with new features using new sensors and actuators which only make sense within the combination of the tractor and trailer and which can now be connected via a defined interface.

Concerning **fleet management**, new perspectives are opened up for cost-optimized goods management and forward-looking maintenance.

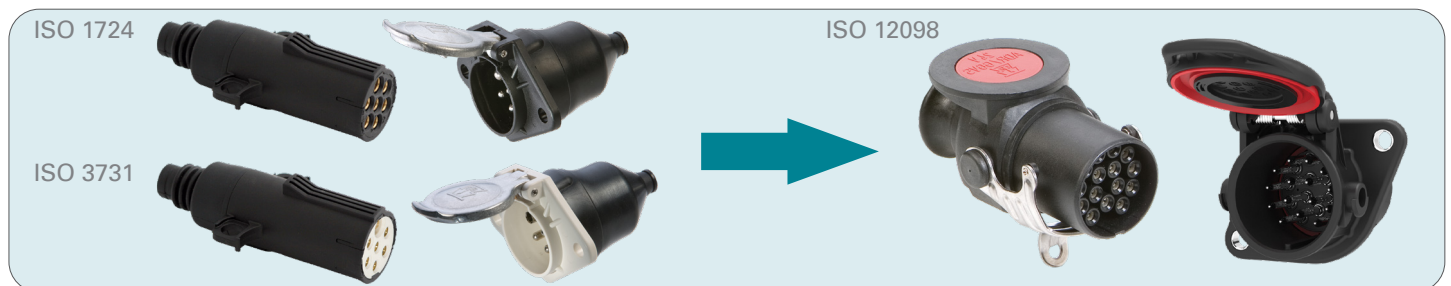
Impact on current connectors

Today, the following connectors are used for the electrical connection between the tractor and the trailer:

- 7P/24V EBS connector according to ISO 7638-1 for all braking functions
- 7P/24V Type N according to ISO 1185 for lighting functions
- 7P/24V TYP S according to ISO 3731 for current transmission and special functions
- 7P/12-24V according to ISO 25981 for electronic charging systems (charge battery on trailer)
- 15P/24V according to ISO 12098 for lighting, power transmission and data transmission

All OEM truck manufacturers have already replaced the old 7-pin connectors according to ISO 1185 and ISO 3731 by the 15-pin connector in accordance with ISO. Still, the 7-pin connectors can often be found in trailers and truck bodies, partly because the trailers are often used longer in the market than trucks. However, a clear trend is visible towards 15-pin plug-in connections also among the trailer manufacturers – especially after the ADR regulation for hazardous-cargo vehicles no longer allowed the old 7-pin sockets. Yet, the main reasons in favor of the 15-pin connector are the superior locking system over the 7-pin system and the fact that no watertightness (IP protection class) is specified for the old connectors.

Due to the new functionalities of the CAN data bus within the 15-pin connector according to ISO 12098, there will be an increasing demand concerning this system.

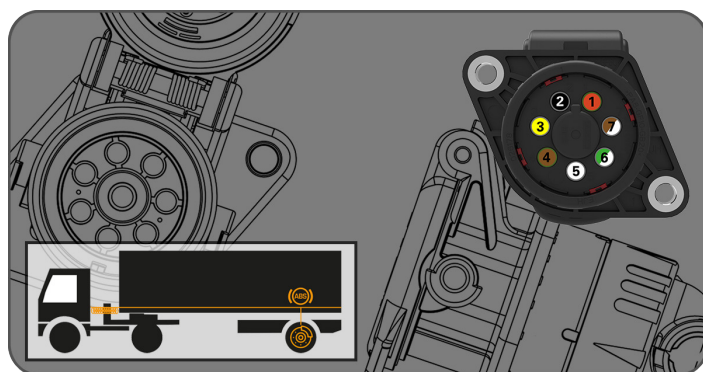
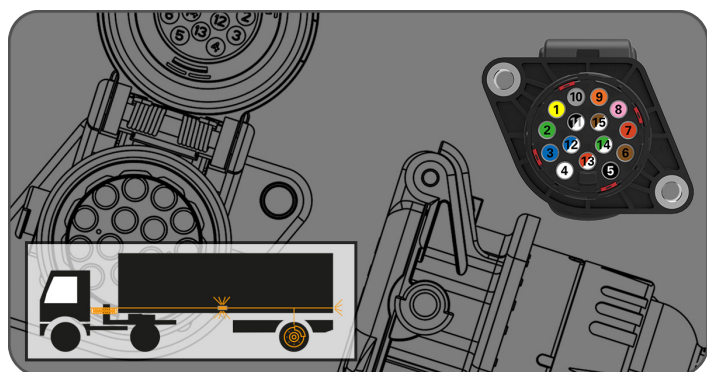




Solutions by ERICH JAEGER

5 years ago, ERICH JAEGER launched the latest generation of EBS and 15P/24V connectors and can provide many references in the different market sectors.

For OEM tractor manufacturers and trailer manufacturers and their cable harness makers, the system offers a simple, economical and modular design. Optimized contact and sealing systems provide 100% water protection and prevent water entry into the wiring harnesses thus avoiding consequential damage in vehicle electronics due to the capillary effect of the wires.



Conclusion – New challenges for manufacturers of trucks and trailers

State-of-the-art is the 15P/24V plug-in system according to ISO 12098, which receives a significant upgrade by extending the data protocols on the CAN data bus system and incorporates new security features. For the implementation of the new safety guidelines and other comfort functions, a tight cooperation between OEM tractor manufacturers and trailer manufacturers is necessary. OEMs will be the first companies to provide the new data protocols for trailer signals according to the roadmap. It is up to the trailer manufacturers to integrate the new sensors and actuators in the new generations of the „smart-trailers“

What's next?



As a future outlook, further technology steps have to be implemented for fully automatic driving functions (LEVEL 5) in heavy-duty traffic. A high-speed data connection, which is currently being introduced in the passenger car sector for data exchange in the vehicle, will also become a standard for communication between truck and trailer in a few years. Here, ERICH JAEGER is working on the plug-in connection of the future



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