Voltage Troubles

Australia is at the intersection of North American, Japanese and European vehicle technologies. Maybe soon we will add China and India to the list. But one of the consequences of this is voltage troubles!

North American trucks have always had a 12V electrical system. Prior to the introduction of electronic fuel control technology, the starter on a US truck operated at 24V using a series-parallel switch, whilst the rest of the electrical system was at 12V. Electronic engine control brought more reliable engine starting so the series-parallel switch was eventually dropped in favour of 12V starter motors.

Despite a mixture of 12V and 24V trucks in the Australian market, 12V became dominant in the 1960s.

Most Australian trailers now have 12V lighting circuits. That's okay for single trailers but 24V lighting makes better sense for multiple trailers. The problem with 12V is that it gets wasted on a long combination vehicle.

Current flow through wires and connectors causes voltage loss. Because 12V systems need to provide higher current than a 24V system, they experience greater voltage losses. It is not uncommon to measure 10V or less at the tail lamps of a B-double truck and lower voltage on a road train. Lighting intensity suffers.

Light-gauge wiring and multiple poor quality connections are important contributors. A good rule is to halve the published rating of electrical components when they are used on a truck. This allows for dust, vibration and heating from continuous operation. So a relay or a trailer connector with a published rating of 30A should only be used for about 15A continuous current.

A further problem of our own making is that the Australian Design Rules (ADRs) specified a seven-pin trailer connector that was designed for use on passenger cars. The ISO standard (1724) that was specified used the term '12V' in its title. It seemed like a good idea at the time! Europe, Japan and North America specified the Australian plug's big brother (ISO 1185), which has bigger pins and smaller voltage drops. The light duty plugs are still a problem, although the ADRs now allow the heavy-duty connectors to be used. I would love to see the medium-duty connectors disappear!

In 1990, Federal Interstate registration of B-double trucks became possible. One requirement was for prime-movers and trailers to have antilock brakes. Regulators decided that a consistent voltage level was necessary for the reliable ABS interconnection of trucks and trailers. 12V was specified because most trailers had 12V lighting circuits. Unfortunately, this was the wrong choice.

European and Japanese truck manufacturers had to fit a voltage reducer to provide 12V power at the ABS trailer connector. At the time 12V ABS systems for trailers were available and it was a workable solution. However, the Europeans and not the Americans were developing these advanced electronic systems.

A decade later trailer Electronically Controlled Brake Systems (EBS), which incorporated an antilock brake function, started to appear. They were then all 24V!

24V trailer EBS could not be supplied at 12V so the design rule requirement made no sense. It had to change. The 12V supply requirement for antilock brake systems was dropped, but the industry was by now used to 12V trailer supply.

Some European manufacturers of electronically controlled braking systems have developed multivolt systems for the Australian market. They

work with either a 12V or 24V supply. But there remains a subtle problem… EBS and ESC (stability control) systems have a communication circuit called a CAN bus. Whilst the system will work without the CAN communication, it is highly desirable. CAN communication speeds up the braking response and provides co-ordination.

The problem is that the CAN bus voltage must be the same as the supply voltage; otherwise the communication doesn't work. The CAN is either 12V or 24V, separately from the supply level of the controller and valves.

If a voltage reducer is used on a European or Japanese truck to provide a 12V EBS connection, then the CAN bus must also be reduced to 12V using a separate converter. Converters are commercially available that do this.

Of course, the alternative is to supply the trailer EBS at 24V without voltage conversion.

North American and Australian trucks can work with a multivolt trailer EBS system electrical system without a voltage converter. The voltage level and the CAN signal need to be at 12V. A communication module is commercially available that converts the trailer brake air pressure level into a CAN signal. The CAN voltage level is the same as the voltage that the module is supplied at.

Some truck manufacturers are supplying different voltage levels for power and CAN in the seven-pin EBS trailer connector. This doesn't comply with the ADR 35 & 38 requirement that the EBS connector be configured according to ISO standards 7638-1 (24V) or –2 (12V).

Operators of a fleet that has both 24V and 12V trucks and EBS or ESC trailers, need to decide what voltage level to supply. The best option is 24V because it is a stronger voltage and all trailer EBS controllers can use it. 24V trucks do not need any voltage converters.

12V trucks in the fleet can be fitted with a voltage converter that supplies the trailer EBS/ESC with 24V and also supplies the CAN module with 24V.

It is a pity that the rules did not specify a 24V ABS connection way back in 1990! Australia needs to sort voltage level out before trailer EBS and ESC become standard equipment. ARTSA makes some sensible recommendations in Part 1 of its Combination Vehicle Brake Code of Practice that will hopefully help.

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ISO 1185 heavy duty seven-pin trailer connector pair. Used for lighting circuits. These connectors will mate with SAE 560 connectors that are used in North America.

ISO 1185 heavy-duty seven-pin connector pair with mirrored earth pin. This is used for auxiliary circuits.

ISO 1724 medium-duty seven-pin trailer connector pair. Used for lighting circuits (single-trailer).

ISO 7638-1 (24V) or ISO 7638-2 (12V) seven-pin EBS braking connector. Power, return and CAN bus for electronic braking systems.