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## Intrinsically safe electrical equipment for use with diesel powered plant

This safety bulletin provides safety advice for the NSW mining industry.

This safety bulletin must be read **in conjunction with Safety Alert SA17-06**.

### Issue

Safety alert [SA17-06 Flameproof alternators supplying intrinsically safe equipment](#) was issued on 9 June 2017 to warn of potential safety concerns regarding the use of some intrinsically safe equipment installed on mobile diesel machines intended for use in hazardous zones of underground coal mines. The alert related to intrinsically safe equipment supplied from flameproof alternators fitted to diesel machines.

This bulletin is intended to provide clarification of these concerns.

### Investigation

SA17-06 considers the connection of intrinsically safe equipment to alternators used on the diesel-powered equipment. When considering 'intrinsically safe apparatus', SA17-06 included 'associated apparatus' as part of the intrinsically safe apparatus.

Australian Standard AS/NZS 60079 part 11 and international Standard IEC 60079 part 11 identify the requirements for the design and certification of both 'associated apparatus' and 'intrinsically safe apparatus' and the standards have separate definitions for 'associated apparatus' and 'intrinsically safe apparatus'.

Intrinsically safe apparatus must only be connected to other compatible intrinsically safe apparatus or to the intrinsically safe outputs of compatible associated apparatus. In both cases, the electrical characteristics of the intrinsically safe connection terminals are defined. Intrinsically safe apparatus must never be connected directly to a non-intrinsically safe electrical power supply, whether mains supplied or a stand-alone. The connection to a non-intrinsically safe power supply source must always be through associated apparatus.

Associated apparatus designed in accordance with AS/NZS and IEC 60079.11 will have a maximum voltage  $U_m$  specified to which the apparatus is permitted to be connected. These standards identify creepage and clearance distances for varying values of  $U_m$ , that allow for over-voltages caused by transients and surges that are normally found within a supply network, such as switching transients. These distances apply for printed circuit board track layout, and for component positioning and for the mounting of completed assemblies.

If the supply voltage exceeds the specified value of  $U_m$  for extended periods of time or the excursions occur frequently, protection devices may be damaged. The damage may result from thermal effects caused by repeated or extended exposure to voltages exceeding the rated  $U_m$ , or may result from repeated exposure to voltage spikes with extremely rapid rates of rise. The circuit design and the rating of protection devices is such that if a protective circuit suffers damage it should result in the loss of

output from the associated apparatus stage. This loss of output will result in a loss of functionality of the intrinsically safe apparatus, but not a loss of the explosion protection properties of the apparatus.

AS/NZS and IEC 60079.11 allow for reduction of some creepage and clearance distances, however this will be assessed by the certifying body as part of the certification assessment process. Special conditions of use should be detailed in the certificate of conformity by the certifying body. If no special conditions of use are imposed the associated apparatus will handle normal supply transients and surges without damage or loss of explosion protection properties.

The explosion protection certification of flameproof alternators only covers the flameproof properties of the alternator and does not assess the magnitude or duration of voltage transients associated with operation of the alternator. The alternator output has not been assessed against the intrinsic safety standards. The quality of the output voltage is a function of the connected load, the regulator design and the alternator design. The alternator electrical specifications do not consider transient over-voltages or situations such as a 'load dump' conditions that are a function of the connected loads. They also do not assess the electrical protection systems that are provided to outgoing circuits, i.e. short circuit or earth leakage, or the performance of the alternator under a fault condition.

The ISO 16750 series of standards is also referenced by SA17-06. This series of standards, particularly part 2, identify electrical voltage fluctuations, both increases and decreases, that may occur in automotive electrical systems. Voltage fluctuations have potential to affect the performance of connected equipment, both explosion-protected equipment and non-explosion protected electronic systems that are supplied from the alternator.

Internal alternator earth (chassis) leakage protection devices that comply with AS/NZS 4871 normally use a 'leakage-to-frame' detection technique that uses a centre-tapped connection to create a chassis reference to the frame of the mobile diesel machine. Electrical equipment intended to be connected to an alternator fed supply should be designed to operate across the potential range of voltages that the equipment may be exposed. Associated apparatus that is designed and certified in accordance with the intrinsic safety standards should manage voltage transients and surges when connected to the output of an alternator.

## Recommendations

1. Mine operators of underground coal mines that use mobile diesel machines that are fitted with intrinsically safe apparatus should ensure that the intrinsically safe equipment fitted to the machine is installed in accordance with all conditions of use as detailed in the relevant certificates of conformity, and that the associated apparatus and intrinsically safe equipment are compatible with the electrical output and the protection systems of the alternator.
2. Plant designers must consider the compatibility of interconnected explosion protected electrical apparatus during component selection to ensure that installations are fit for purpose. Where intrinsically safe equipment is used, the installation should be assessed in accordance with AS/NZS 60079.25 *Explosive atmospheres*.

**NOTE:** Please ensure all relevant people in your organisation receive a copy of this safety bulletin, and are informed of its content and recommendations. This safety bulletin should be processed in a systematic manner through the mine's information and communication process. It should also be placed on the mine's notice board.

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