NSW GOVERNMENT

NSW Resources Regulator

FACT SHEET

Gas detector design order

April 2020

Background

The Work Health and Safety (Mines and Petroleum Sites) Regulation 2014 contains requirements relating to quality of air supplied within a mine and the maximum permissible limits for contaminants in that air. To ensure compliance with these requirements, a mine operator is required to provide gas detection equipment at strategic locations throughout the mine. In selecting the gas detection equipment, the mine operator must also have a level of confidence that a chosen gas detector will provide accurate data under varying environmental conditions.

In accordance with clause 177(1)(e) of the Regulation, the design of the following plant (referred to in this fact sheet as 'gas detectors') must be registered:

> *electrically powered hand-held plant, fixed installations and installations on mobile plant used to determine or monitor the presence of gas if they are used at an underground coal mine (but does not include tube bundle systems where the analyser is installed at the surface).*

The term gas detector is considered to relate to the complete grouping of component parts that constitutes gas detecting plant. The component parts include the gas sensor[1] and protective housing, interconnecting communications medium such as cables, optical fibre, radio links, as well as control units and transmitters that enable gas values to be displayed and output indication to be provided, so a mine operator can determine the level of a gas.

The purpose of design registration is to attest that gas detecting equipment has been designed to achieve prescribed performance outcomes. The design is tested in accordance with prescribed test conditions by an independent testing facility and results are documented. The design and the test results are reviewed and verified as achieving the prescribed performance requirements by an independent person who is competent in the designing of gas detecting equipment.

The following fact sheets contain further information about the design registration process:

---

[1] AS/NZS 60079.29.1 uses the term ***sensor,*** whereas AS/NZS 4641 uses the term ***monitor****.*

NSW Resources Regulator

- Plant design registration - for applicants
- Plant design registration - for designers
- Plant design registration - for verifiers

New gas detector design order

The Regulator has issued the *Registration of Design of plant used to determine or monitor the presence of gas (No.3) Order 2020* (design order) which was published in the NSW Government Gazette No 85 on 24 April 2020 at page 1518 and commences on 24 April 2020.

The order specifies the minimum performance requirements a gas detector design must achieve.

The minimum design and performance standards for flammable gases are contained in *AS/NZS 60079.29.1:2017 Explosive atmospheres – Gas detectors – Performance requirements of detectors for flammable gases*, with additional requirements specified for cross sensitivity to hydrogen sulphide (H_2S).

For toxic gases and oxygen, the minimum design and performance standards are contained in *AS/NZS 4641:2018 Electrical equipment for detection of oxygen and other gases and vapours at toxic levels – General requirements and test methods*, with altered requirements relating to nitrogen dioxide and nitric oxide detectors.

Performance of gas detectors

Application of a zero gas[2] and a span gas[3] while a detector is in-service will identify if changes are occurring that affect the detector accuracy. These tests provide no indication of the linear performance across the full range of the detector or how the detector will perform due to changes in environmental conditions around the sensor. These environmental conditions include changes in temperature, humidity, atmospheric pressure, air velocity, continual exposure to elevated levels of the gas, and the effects of other gases on the sensor. All are concerns in an underground mine environment.

Zero and span tests also do not give an indication of detector performance and the effects on displays and output signals, for factors such as:

- the time required following energisation until it starts to accurately detect gas
- electromagnetic emissions from electrical equipment near the sensor and other components of the detector, such as cables.

[2] Zero gas is defined in clause 1.3.44 in AS/NZS 2290.3:2018
[3] Span gas is defined in clause 1.3.36 in AS/NZS 2290.3:2018

NSW Resources Regulator

Laboratory testing also establishes a baseline figure for response times ($t(50)$ and $t(90)$) of the sensor for increasing and decreasing levels of gas.

The design order specifies that gas detectors must be tested in accordance with AS/NZS 60079.29.1:2017 (for flammable gases) and AS/NZS 4641:2018 (for toxic gases and oxygen). This ensures that sensor performance, including response times, the effect of environmental conditions and other factors, such as energisation and electromagnetic emissions, are assessed in a consistent manner.

Displays, signals and output indications

The order requires that gas detectors be designed as equipment with integral sensors, equipment with remote sensors, or equipment with a combination of integral and remote sensors. Detectors complying with this requirement provide a display indication, alarm functions, output contacts and/or alarm signal outputs that enable decisions to be made regarding management of ventilating air, the environment and equipment operation.

Gas detectors must also be designed to provide a conditioned electronic signal or output indication that may be used to enable a person to read the gas value on a display remote to the sensor or control unit, as an input into a separate alarm or tripping system, or as an input to a mine's data acquisition and control systems for display and trending of gas levels.

Gas detectors may be designed to integrate the transmission of the conditioned electronic signal or output indication within the gas detector control unit or maintain this as a separate transmitter unit.

Generally accepted industry standard signals

AS/NZS 60079.29.1 in clause 3.2.11 *gas detection transmitter* identifies that a conditioned electronic signal or output indication is something such as 4 to 20mA current loop. AS/NZS 4641:2018 in clause 1.3.8.10 *Stand-alone gas detection equipment* identifies a conditioned electronic signal or output indication as something such as 4–20 mA current loop or 3–15 psi signal.

Analogue signals

A signal, such as a 4–20 mA current loop, is an analogue signal that can be measured and displayed using electrical test equipment. It may be used to provide an input into separate gas detection control units[4] or other control and monitoring systems, using third-party componentry such as a display unit or

[4] AS/NZS 60079.29.1 uses the term ***separate gas detection control units***, whereas AS/NZS 4641:2018 uses the term ***stand-alone control units***.

an alarm and trip unit. The signal may also be an input into a programmable controller to initiate alarm and tripping functions or transfer data to the mine's data acquisition systems.

Analogue electrical signals are not limited to 4–20 mA current loops.

Digital signals

A gas detector may provide a digital output signal, rather than an analogue signal. For the digital signal to be usable by a mine operator, the structure of the digital signal must be known. Without the protocol of the digital data stream, it is not possible to interpret what the sensor is transmitting, including the gas content value the sensor has detected. A protocol converter is typically required to decode the signal and enable the gas detector data to be utilised by a mine operator. These component parts are considered to form part of the design registered plant.

Gas detector testing

To achieve design registration, a test report must be provided that confirms that a gas detector, which includes the sensor and all component parts necessary to provide a signal that a mine operator can use to determine the content of the gas in the mine atmosphere, meets the performance requirements identified in the applicable Standards. The additional component parts will include display modules, transmitter modules, a combination of the display and transmitter modules, or alarm or tripping relays. Where the sensor is remote, testing will include interconnecting cables that have been identified by the designer as suitable.

Where a gas detector incorporates the functionality of a gas detection transmitter, and the gas detection transmitter provides a digital data signal, all additional proprietary modules required to enable the mine operator to use the digital signal must be tested in conjunction with the sensor by the testing facility. The additional modules will be included as a part of the design registered gas detector.

This testing is necessary to verify that the conditioned electronic signal or output indication accurately reflects the level of gas that the sensor is being exposed to, under varying conditions.

The protocol of any software drivers used by the testing facility during the testing of a gas detector must be documented and included as a part of the design registration documentation. This enables the development of software drivers that will function with communications interfaces at that mine.

DOC20/170066