

Design & installation of 4-20mA loop powered indicators for use in Ex e enclosures

Displaying a 4-20mA process variable or control signal in a hazardous area is a well established technology using certified indicators, often loop powered, which are available from BEKA associates and other manufacturers. These instruments are usually protected by intrinsic safety or housed in a flameproof enclosure and satisfy the requirements for most panel and field mounting applications. However there is also a need to display process variables associated with hazardous area equipment housed in an increased safety Ex e panel enclosure or cubicle for which most existing panel mounting indicators are not suitable. Ex e panel enclosures may be located in Zone 1 or 2 housing Ex e certified switches, panel lamps and terminals often associated with the control of electrically operated pumps and compressors for which a digital display may be required to show variables such as pressure, flow or temperature.

The requirements for Ex e enclosures are defined in IEC 60079-0 and IEC 60079-7. Equipment containing semi-conductors, open contacts or moving coils, such as those used in measuring instruments, are not permitted within an Ex e enclosure unless they have an additional form of protection such as Ex d flameproof, Ex m encapsulation or Ex i intrinsic safety. For equipment installed in an Ex e panel enclosure located in Zone 2, type of protection Ex n is also acceptable. Ex e enclosures are required to provide 7J impact protection and IP54 ingress protection, although many industrial Ex e panel enclosures will have greater ingress protection permitting outdoor installation.

Whilst it is possible to install a conventional BEKA intrinsically

safe panel mounting instrument into an Ex e certified panel enclosure, standard instruments such as the BA307E loop powered indicator do not provide the impact protection required to maintain the Ex e panel enclosure certification. A certified Ex e external transparent cover would overcome this difficulty, but would prevent the instrument's front panel controls being operated.



Fig 1 New rugged indicator

For an Ex e panel enclosure located in Zone 2, where instrumentation is increasingly installed to avoid having operators in Zone 1, a certified Ex n instrument should maintain the Ex e panel enclosure's impact and ingress protection as the two protection techniques have similar ingress and impact requirements. Although for Zone 2 applications Ex n loop powered indicators provide an economically attractive alternative to intrinsic safe instruments, until the recent introduction of the BEKA 4 digit BA307NE and 5 digit BA327NE loop powered 4-20mA indicators, panel mounting models with third party Ex n certification were not readily available.

Following requests from users for solutions to these Ex e display requirements, BEKA have designed and obtained third party certification

for a range of new rugged display indicators tailored for these applications. This article considers their design and installation, although these are 4-20mA loop powered indicators the philosophy applies to all similar display instruments. There are two basic design requirements:

1. As Ex e enclosures do not exclude the hazardous atmosphere in which they are installed the indicators additional method of protection must be suitable for the Zone and gas in which the Ex e panel enclosure is located.
2. The installation of the indicator in the Ex e panel enclosure must not invalidate the Ex e enclosure's certification.

For Zone 2 applications Ex nA (non-sparking) protection of the 4-20mA indicator was chosen as the most economic method of achieving safety. For Ex e panel enclosures located in Zone 1 intrinsic safety Ex ia was selected, although intrinsic safety can also be used for Zone 2 applications.

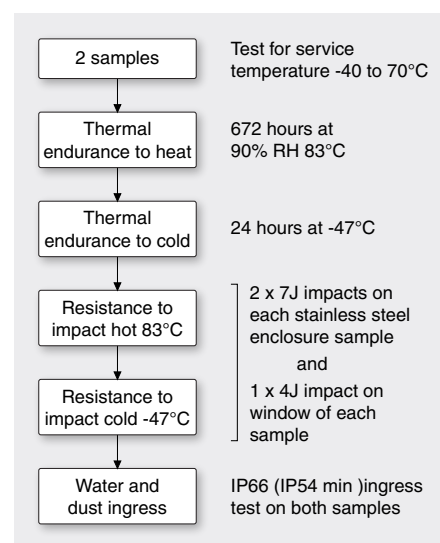


Fig 2 Instrument enclosure test sequence

To ensure that installation of the indicator does not invalidate the Ex e panel enclosure certification, the front of the 4-20mA indicator must provide 7J impact and IP66 (IP54 minimum) ingress protection.

The new BEKA 4-20mA loop powered indicators are controlled by four front panel push buttons which are protected by an elastomeric cover and the instrument is sealed to the Ex e panel enclosure in which it is mounted with a silicone gasket. Inclusion of these plastic components requires that the instrument enclosure satisfies both the metallic and non-metallic enclosure certification requirements specified in EN 60079-0.

These are summarised in Fig 2 and involve thermal endurance at 82°C, followed by impacting at high and low temperatures, after which the enclosure must still provide the required ingress protection.

To satisfy these severe requirements, BEKA have developed a cast stainless steel panel mounting instrument housing with a 10mm thick toughened glass window. This has been assessed by Notified Body Intertek Testing and Certification who have issued IECEx and ATEX Component Certificates confirming compliance with the standards. These Component Certificates have been used to support the Ex nA non-sparking certification of the BA307NE and BA327NE and the Ex ia intrinsically safe certification of the BA307E-SS and BA327E-SS. A BA307NE is shown in Fig 1.

Installation of a 4-20mA indicator in an Ex e panel enclosure located in Zone 2

Either the non-sparking Ex nA BA3x7NE or the intrinsically safe Ex ia BA307E-SS loop powered indicators may be safely installed in an Ex e panel enclosure located in Zone 2. The Ex nA certified models provide the most economic solution as an intrinsically safe interface such as Zener barrier or galvanic isolator is not required.

Fig 3 shows the circuit of a typical Zone 2 installation including a BA307NE Ex nA loop powered 4-20mA indicator. The loop may be powered from a CE marked 24V instrument power supply with acceptable isolation from the mains. If the supply is located within the Ex e panel enclosure it should have an additional form of protection such as Ex d flameproof, Ex m encapsulation or Ex nA non-sparking.

Each 4-20mA lead is protected from current overload by a fuse which, if installed in a fused terminal, is a convenient way of isolating the loop for maintenance, although an miniature circuit breaker (MCB) or electronic current limit are preferred by some users. The indicator's front panel push buttons, which are outside of the Ex nA instrument enclosure, are non-incendive and have been certified Ex ic [intrinsically safe in normal operation] resulting from the current and voltage limiting within the instrument.

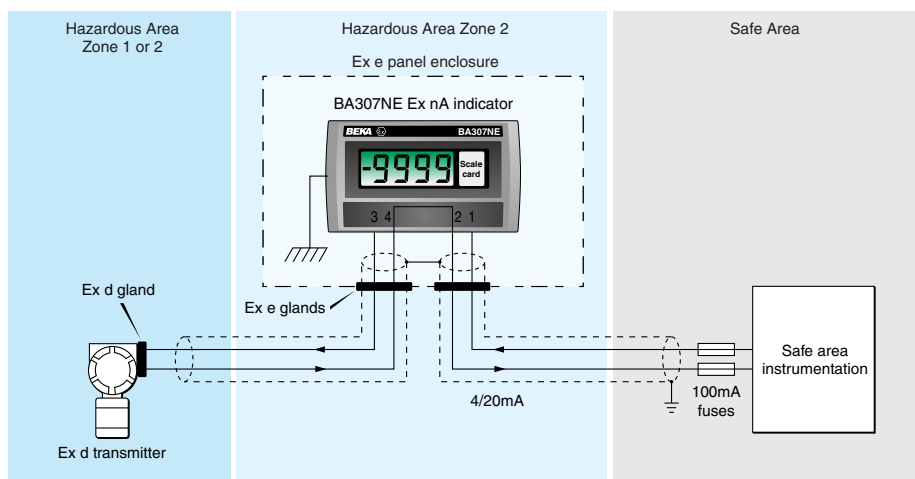


Fig 3 Installation of Ex nA Indicator in Ex e panel enclosure located in Zone 2

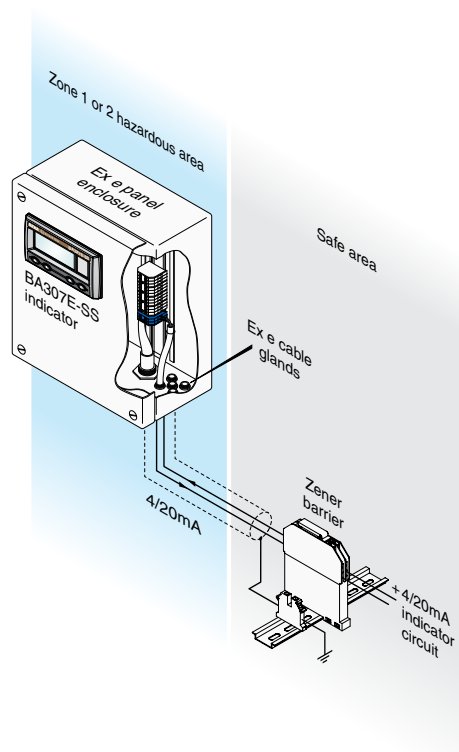


Fig 4 Installation of Ex i indicator in Ex e panel enclosure

A very useful, but frequently not appreciated feature of Ex nA equipment is that although it may only be installed in Zone 2, it may be directly connected to suitably protected non intrinsically safe apparatus located in Zone 1 as shown in Fig 3. BEKA associates application guide AG310 provides further information about the design and installation of Ex nA extra low voltage dc instrumentation.

Installation of a 4-20mA indicator in an Ex e panel enclosure located in Zone 1

Only the intrinsically safe BA3x7E-SS loop powered indicators may be installed in an Ex e panel enclosure located in Zone 1. As Zener barriers and galvanic isolators are not permitted in an Ex e enclosure located in Zone 1, these must be mounted in the safe area or in a suitable enclosure in Zone 2. Intrinsically safe apparatus, terminals and wiring should be segregated from non intrinsically safe apparatus mounted in the Ex e panel enclosure. If live maintenance is anticipated, bare intrinsically safe conductors should be protected with an IP30 cover and labelled.



Intrinsically safe BA307E-SS and BA327E-SS indicators may also be installed in an Ex e panel enclosure located in Zone 2, the installation requirements are the same as for Zone 1 except that some Zener barriers and galvanic isolators have been certified for installation in a Zone 2 enclosure and may therefore be installed in the same panel enclosure as the indicator which is useful when displaying a variable derived from within the panel enclosure.

Application Guides

BEKA associates publish two application guides which include examples of rugged loop powered indicator installations in Ex e enclosures.

AG300 describes the use of intrinsically safe systems and AG310 describes the installation of [extra low voltage dc] Ex nA instrumentation. Both may be downloaded from the BEKA website.

Accessories and other applications

These new rugged indicators which included four digit instruments and five digit models with a bargraph, can be supplied with a factory fitted display backlight and dual alarm outputs. In addition to installation within an Ex e panel enclosure they may also be installed in Ex p pressurised enclosures and their rugged construction and stainless steel housing are ideal for conventional intrinsically safe applications in harsh and marine environments.

Based on an article written by Chris Burkitt CEng, MIET which was first published in the March 2015 edition of Hazardex.

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