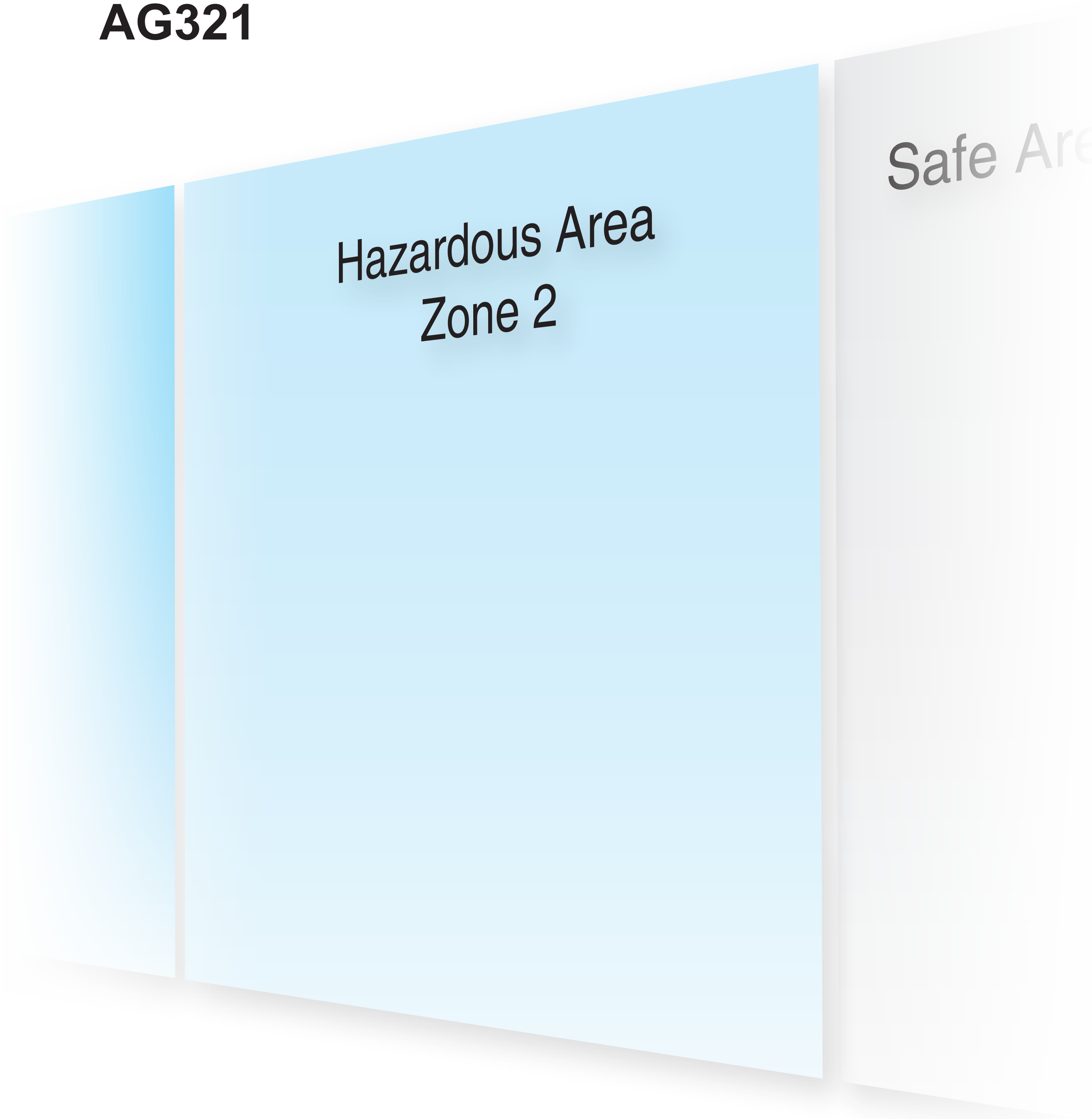
Application Guide

AG321



Installation of
[extra low voltage dc]
Ex ec instrumentation

BEKA associates

About BEKA

BEKA associates is an independent privately owned company specialising in the design, manufacture and sale of process display instrumentation, predominantly for use in potentially flammable areas although general purpose instrumentation is also manufactured. All design and manufacture is conducted within the UK and our products are purchased by end users, major instrument companies and contractors worldwide.

Since the installation of the first BEKA intrinsically safe loop powered indicator in 1984, BEKA associates have been at the forefront of indicator development culminating in the launch of the fourth generation 'E' and 'G' models. These new instruments are based on the accumulated experience gained from thousands of installations coupled with the latest electronic, production and certification technology, resulting in larger digits, improved visibility and more standard features than the previous generation. In addition to Ex i intrinsically safe models, the new generation includes internationally certified Ex ec panel mounting indicators for installation in Zone 2 without the need for Zener barriers or galvanic isolators.

We hope that you find this guide helpful.

This document which is written from a European perspective, contains a review of North American Zone 2 practice in section 14. It is under regular review, if you are reading a printed version, please check the current edition which may be downloaded from http://www.beka.co.uk/application_guides.html

Comments and suggested additions for future editions are always welcome. Please contact chrisb@beka.co.uk

We would like to acknowledge the assistance of Chris Towle BSc, CEng, MIMech.E, MIET, FInstMC in preparing this document.

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1. FOREWORD

This document discusses the requirements of extra low voltage d.c. Ex ec apparatus and its possible applications. The interaction with other methods of protection is also explored. The BEKA 4-20mA indicators BA307SE (4 digit) and BA327SE (5 digit) are used to illustrate the construction and marking requirements. Their application in various ways is used to illustrate the more usual applications of Ex ec instruments in hazardous areas. The basic principles of 4-20mA loop powered indicators are illustrated in Figure 1.

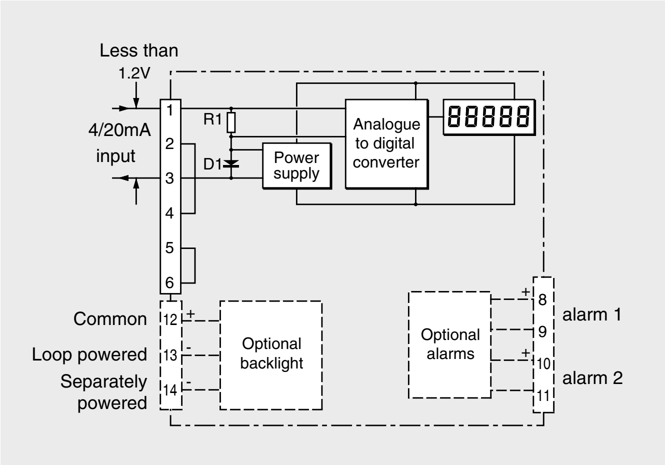


Figure 1 Indicator block diagram

The operation of the indicator can be simply explained as follows: the 4/20mA input current flows through the resistor R1 and forward biased diode D1. The voltage developed across D1 is multiplied by a switch mode power supply and used to power the instrument. The voltage developed across R1 provides the input signal to the analogue to digital converter which drives the display.

The backlight and alarm functions are factory fitted options.

2. INTRODUCTION

Ex n (Type N) explosion protection has been the predominant technique used for the protection of Zone 2 instrumentation for many years. The requirement of Type n apparatus was that in normal operation it was not capable of igniting a surrounding explosive atmosphere.

The IEC and CENELEC are replacing Zone 2 protection techniques with variations of the other methods of protection. Energy limiting Ex nL protection has already been replaced by Ex ic intrinsic safety without the consideration of countable faults. Following the publication of EN IEC 60079-7:2015 *Equipment protection by increased safety "e"*, non-sparking protection Ex nA is gradually being replaced with Ex ec increased safety.

Increased safety is defined as:

> *'A type of protection in which additional measures are applied to electrical equipment or Ex components to give increased security against the possibility of excessive temperature and against the occurrence of arcs and sparks'.*

Ex ec apparatus complies with the basic principle of being safe in 'normal operation' which is what differentiates it from the more onerous requirements for Ex e operation in Zone 1.

This latest edition of the Ex e standard, which compliments the General Requirements EN IEC 60079-0, is intended to ensure that a malfunction capable of causing ignition is not likely to occur.

It is important to recognise that this document discusses the design and application of extra-low d.c. voltage instrumentation [usually 24V] utilising low power [less than 10W]. The majority of Ex ec equipment utilises higher voltages and power, and the techniques described in this document are not applicable to this type of equipment

This document brings together some current thinking on the use of instrumentation in Zone 2, in particular the use of loop powered Ex ec indicators with instrumentation using different types of protection.

2.1 Other types of Zone 2 protection

Any apparatus which is suitable for use in Zones 0 or 1 can be used in Zone 2. It is also possible to use an 'Ex ec' indicator mounted in Zone 2 to monitor flameproof Ex d, increased safety Ex e or pressurised Ex p equipment which is mounted in Zone 1. The possible combinations are almost infinite and this document concentrates on combinations which are known to have occurred in practical situations. The use of Ex ic systems is covered adequately elsewhere and hence this document concentrates on Ex ec.

2.2 Field wiring requirement

The requirements for field wiring for Ex ec circuits are identical with those for all other electrical systems in explosive atmospheres with the exception of intrinsic safety. The fundamental requirement is to have secure and protected cabling so that the probability of a dangerous fault is minimised. The Code of Practice IEC 60079-14 part 9 permits the use of a number of types of cable but the majority of installations [other than in the US] use steel wire armoured cable or cable with a toughened outer sheath on cable trays. The vulnerable section is always the short length of cable making the final connection to the field instrument and additional protection in the form of flexible conduit is frequently used. For operational reasons it is usual to use screened cables for instrument systems. Armoured cable does provide some protection against low frequency magnetically induced interference but is not very effective against high frequencies.

The glands used are required to be compatible with the cable and to maintain the integrity of the ingress protection [IP rating] of the enclosure. The usual solution is to use an Ex e certified gland. The exception is where flameproof apparatus is used flameproof glands must be used [barrier glands are not essential in Zone 2]. Similarly appropriate stoppers must be used to seal unused entries.

The cable armour is bonded to the plant structure by the terminating glands. Screens are bonded to the point in the plant system which is most effective in reducing the effect of interference usually the plant reference potential point. Screens do make a contribution to safety by providing a fault return path and this is ensured by the interconnection of this reference point with the plant bonding network.

3. EDITORIAL NOTES

This document uses the term ‘safe area’ as the designation for a location where there is no significant risk of a flammable, ignitable or hazardous mixture of gas and air being present. It is recognized that the relevant standards use the term ‘non-hazardous area’ but ‘safe area’ is simple and clear. For the pedantic neither term is precise since the location is not safe against all hazards nor is it a two dimensional area.

This document refers to mounting equipment in Zones rather than using the ‘Equipment Protection Level [EPL] preferred by the IEC standards or the Categories of the ATEX Directive. The subtle implications of the use of these designations are fully explained elsewhere and touched upon in section 4.5. Usually EPL Gb and Cat 2 apparatus is intended for use in Zone 1 and EPL Gc and Cat 3 in Zone 2. Both Categories and EPLs were devised to encourage a risk analysis approach to the use of equipment in hazardous areas [although they are not quantitatively defined] but their correlation with Zones predominates.

Where readers prefer this format then these simple substitutions can be made but this document avoids the use of these terms so as to avoid the complexities and repetitions which their use introduces. Figure 4 illustrates some aspects of the use of categories and levels of protection.

This document refers to the ingress protection [IP] code of IEC 60529 when considering the environmental protection offered by an enclosure. This is summarised in the following table.

FIRST NUMBER Protection against solid objects		SECOND NUMBER Protection against liquids	
0	No protection	0	No protection
1	Objects greater than 50mm	1	Vertical (90º) dripping water
2	Objects greater than 12mm	2	70º to 90º dripping water
3	Objects greater than 2.5mm	3	Sprayed water
4	Objects greater than 1mm	4	Splashed water
5	Dust-protected	5	Water jets
6	Dust-tight	6	Heavy seas
7		7	Effects of immersion
8		8	Indefinite immersion

Figure 1 Ingress protection [IP] codes [IEC 60529]

4. INSTALLATION PRACTICE FOR Ex ec CIRCUITS

4.1 Safe area apparatus

The choice of equipment for use in an Ex ec circuit in the safe area is quite simple. It must be reasonably reliable and considered adequately safe for maintenance personnel to touch. In European terms if the equipment is CE or UKCA marked it is almost certainly acceptable.

The power supply for this type of instrumentation is usually a 24V power supply with some form of voltage and current regulation. It must meet the requirements for personnel safety so that 'live maintenance' can safely be carried out. The implicit requirement for galvanic isolation from the mains supply ensures that the possible difficulties from circulating earth currents caused by mains faults is minimised. The need for operational reliability ensures that the probability of failure to a dangerous condition is acceptably low.

The requirements of other apparatus connected into an Ex ec circuit within the safe area such as controllers are similar to that of the power supply. In normal operation this type of equipment absorbs energy but if it does have a significant voltage or current output in normal operation then these must be taken into account when assessing the voltage and current applied to the hazardous area.

Since power supplies are usually common to a number of circuits the maximum value of the current is usually determined by a fuse and the value of the permitted current is determined by the lowest permissible current of the equipment in the hazardous area. Similarly the permitted voltage is the lowest permitted voltage of the equipment in the hazardous area and the value determined by the regulation of the power supply

Sometimes the circuit is 'earthed' in the safe area. Unlike intrinsically safe circuits there is no requirement for Ex ec circuits only to be earthed at one point. However, operationally it is usually desirable to earth instrument circuits at one point so as to avoid interference from circulating earth fault currents. Avoiding these circulating currents is desirable from a safety viewpoint but not a requirement for this type of circuit.

4.2 Use of multi-cores

There is no guidance on the use of multicore cables for Ex ec circuits in IEC 60079-14, although a multi-core is frequently the neatest solution to an installation which has several Ex ec instrument loops in a small area. It might be considered excessive for a method of protection, which only considers normal operation but if the criteria used to select multi-cores for intrinsically safe circuits which may enter a Zone 0 are used they will prove more than adequate for Ex ec circuits. The basic requirements are that 'the radial thickness of the conductor insulation shall be appropriate to the conductor diameter and the nature of the insulation. The minimum radial thickness shall be 0.2mm. Also the conductor insulation shall be such that it will be capable of withstanding an r,m,s, a,c. test voltage of twice the nominal voltage of the circuit with a minimum of 500V.

There are two forms of multicore which are not considered to develop faults between circuits. The multicore which can be used in all circumstances [including flexible cables] is where the individual circuits are segregated from one another by being contained within individual screens.

The other multicore which is more frequently used does not use individual screens but requires a voltage test of 500V rms or 750V dc between the cores and the outer screen and/or armour and also a 1000V rms or 1500V dc test between two bundles of the cores connected together. In addition this type of multicore must be in a fixed installation effectively protected from damage, for example on a cable tray and only carry circuits with voltages less than 60V. It might be argued that higher voltages could be permitted for 'ec' circuits but this could be considered a step too far and consequently is not proposed in this document. In practice the instrument circuits contained in a multi-core are normally restricted by the necessity to avoid interference between circuits causing operational malfunctions.

4.3 Isolation and over current protection

Since only restricted live maintenance of Ex ec circuits is allowed, a means of isolation becomes a requirement and this requirement is embodied in IEC 60079-14. Live maintenance is usually permissible under the protection of a *'gas clearance'* certificate or on the basis of a risk analysis. Isolation must be provided in all leads so as to avoid the possibility of a common mode voltage creating an incendive spark by a short to earth.

There is also a requirement to ensure that each lead is protected against a current overload which is usually done by a fuse. The two requirements are frequently satisfied by using fuse holders with easily removable fuses and removing the fuses to achieve isolation. This is a satisfactory method at the low voltages and currents common in instrumentation systems. Clear identification of, and easy access to the means of isolation is essential for their effective use. It is also necessary to ensure that the maintenance procedure makes sure that unauthorised reclosure of the switches does not occur. It is not considered necessary to have a means of isolation or electrical protection for the screen. Figure 2 illustrates an example of the type of switch fuse terminal block frequently used.

The switch-fuse can be a convenient point to monitor circuit currents since they are in the safe area and breaking circuits in the hazardous area may create and incendive possibility.

This type of switch fuse terminal block is not favoured by everyone and the use of an appropriately rated m.c.b. or any other reliable form of current limitation combined with a means of isolation is equally acceptable.

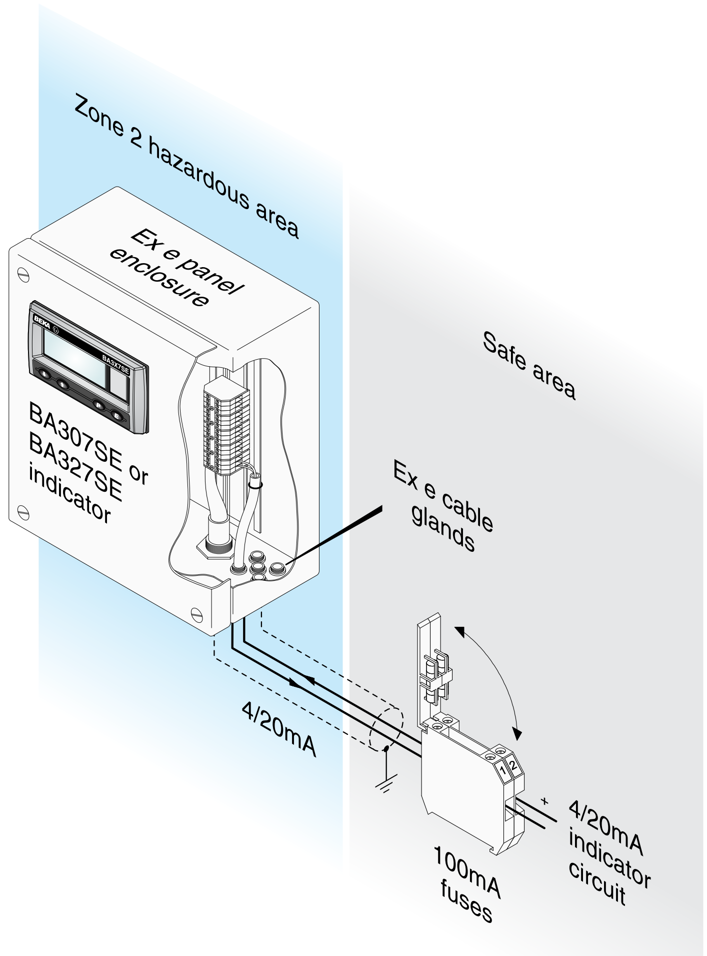


Figure 2. Typical Zone 2 installation in Ex e panel enclosure

These requirements are created with higher voltage and currents in mind and some instrument installations achieve the intentions by using electronic limiting of the current and turning off the source of power to achieve isolation. This is considered acceptable by some end users and is adequately safe but is not strictly in accordance with IEC 60079-14. In practice electronic current limiting is frequently used to prevent a single loop fault pulling down a common power supply. However isolation of individual systems is still often required because it is not considered desirable to turn off a supply to several loops just to service one loop.

4.4 Junction boxes

Junction boxes for use in Zone 2 are required to provide adequate protection against the environment. The minimum ingress protection requirement is IP54, however the majority of certified enclosures achieve IP65. The usual solution is to use Ex e component certified enclosures, terminals and glands, because this is convenient, economic and safe. There is no need to be concerned with the temperature classification of the junction box provided that the terminals are used within their normal rating and a T4 classification is acceptable.

A common error is to choose a small box, which makes the tidy routing of the wiring difficult and the fitting of the glands in the gland plate extremely difficult. It is always worthwhile considering fitting spare terminals and drilling spare gland holes in the gland plate, since this is difficult to do retrospectively.

The unused entries do need to be sealed with an appropriate plug, a reasonable 'rule of thumb' is always use a box at least one size bigger than you think is necessary.

The choice of material of the box is usually decided by local preference but it should ensure adequate resistance to corrosion, for example by the use of stainless steel. If plastic enclosures are preferred then it is usual to use an Ex e component certified enclosure to ensure that the possibility of a hazardous build-up of static electricity does not occur. Plastic enclosures are like Marmite, in that they are loved or hated by end users.

The usual practice is to use Ex e certified terminals since this ensures an adequate level of safety and is an economic readily available solution. Additional terminals should be included so that spare cores of multi-cores can be correctly terminated and can be readily brought into service at a later date if necessary. Similarly, provision should be made for terminating screens and for their cross connections if they are to be carried through. Where armoured cable is to be used then the gland plate should ensure that the armours are interconnected. Whether the junction box is 'earthed' by bonding to a local structure or not is a matter of local practice and frequently much debate.

Usually the box is adequately bonded by its method of mounting, but making provision for the connection of a bonding strap is recommended since then any local preference can be satisfied. Provision should be made within the enclosure so that the wiring is secure and tidy. In addition the box should be mounted so that the cables entering the enclosure are supported so as to ensure that the stress on the glands is minimized.

There are many widely differing opinions on the most secure way of making off individual wires. A satisfactory method of terminating stranded cables is to use crimped-on ferrules. Where it is unavoidable that two wires have to use the same terminal the preferred technique is to use a ferrule which joins the two wires together and presents a single prong to the terminal. Using two ferrules in one terminal is not permitted in Ex e certified terminals.

Some installations in high humidity situations suffer from condensation problems, and in these locations it is advisable to fit drain plugs. These plugs must maintain the ingress protection rating [at least IP54] of the enclosure.

It is not good practice to mix high and extra low voltage circuits in a junction box [and in some countries it may be illegal to do so] because of the possibility of problems being created during 'live maintenance'. It is permitted to mix all methods of protection within the same Zone 2 mounted junction box provided that they are all using an extra low voltage. If intrinsically safe circuits are included then the terminals associated with those circuits must be segregated from those of other circuits by at least 50mm. It is important that the enclosure and all the circuits should be clearly identified to ensure that during maintenance procedures the chances of making a mistake are minimised.

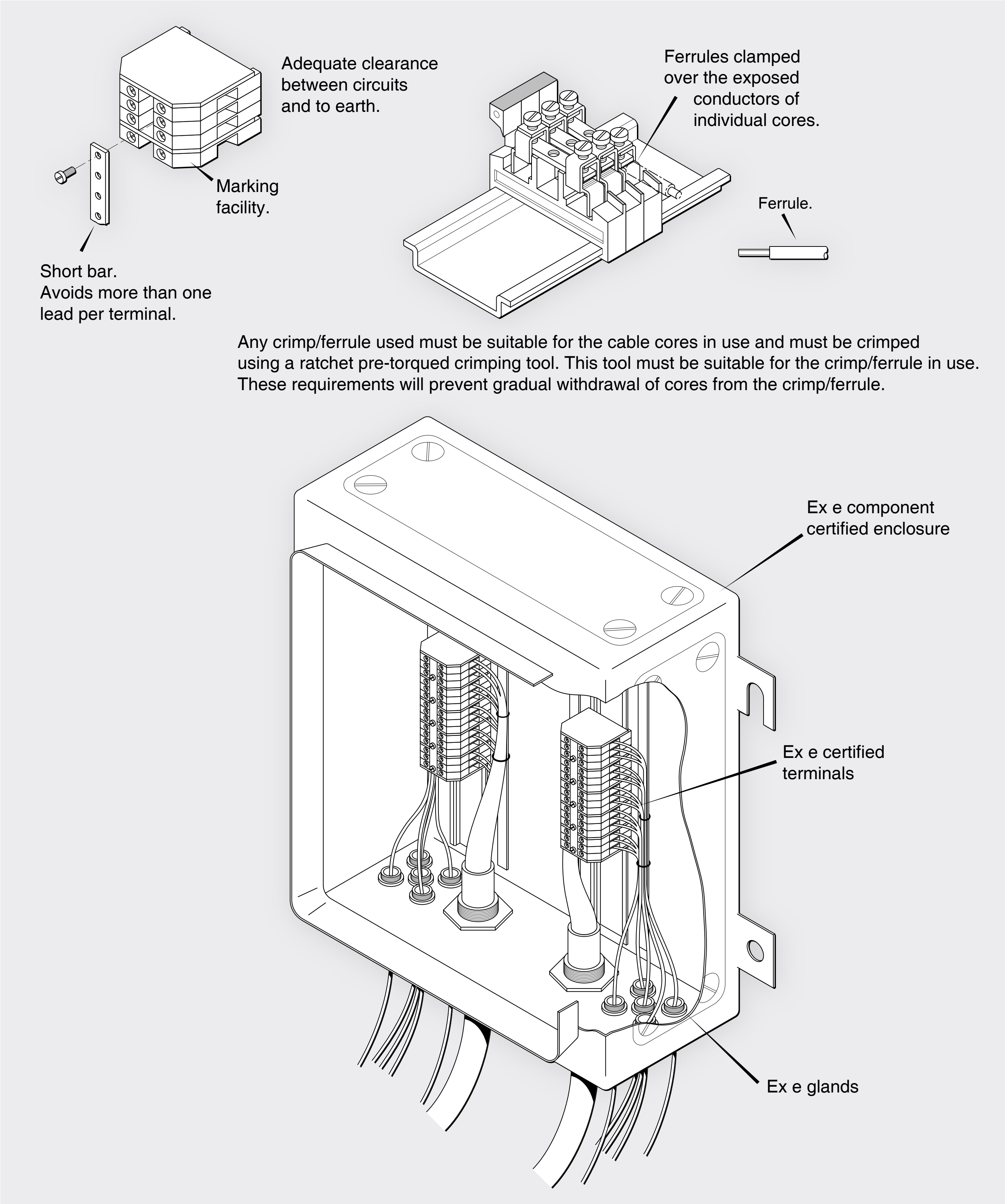


Figure 3 Typical Zone 2 Junction Box

There is a need to clearly mark junction boxes and terminals so that they can be readily identified for inspection and installation purposes. The location of junction boxes always requires careful consideration. Since the junction box is frequently the most useful point for fault finding it is important that it should be readily accessible, preferably without the need to use additional access equipment such as ladders.

A location where the light is adequate and there is somewhere to rest test equipment is also desirable.

A well designed junction box can save a considerable amount of time and provide facilities which make maintenance easier.

Figure 3 illustrates some of the desirable features.

4.5 Area classification (Zones)

The object of area classification is to evaluate the probability of a hazardous mixture of gas and air being present on a plant.

Hazardous areas are classified into Zones based on an assessment of the frequency of the occurrence and duration of an explosive gas atmosphere, as follows:

- Zone 0: An area in which an explosive gas atmosphere is present continuously or for long periods;
- Zone 1: An area in which an explosive gas atmosphere is likely to occur in normal operation;
- Zone 2: An area in which an explosive gas atmosphere is not likely to occur in normal operation and, if it occurs, will only exist for a short time.

Various sources have tried to place time limits on to these Zones, but none have been officially adopted. The most common values used are:

- Zone 0: Explosive atmosphere for more than 1000h/yr
- Zone 1: Explosive atmosphere for more than 10, but less than 1000 h/yr
- Zone 2: Explosive atmosphere for less than 10h/yr, but still sufficiently likely as to require controls over ignition sources.

Where people wish to quantify the Zone definitions, these values are the most appropriate, but for the majority of situations a purely qualitative approach is adequate.

Area classification is not an exact science and there is often a divergence of opinion. The relevant IEC standard is IEC 60079-10-1 and there are a significant number of industry codes which suggest acceptable interpretations for commonly occurring situations such as road tanker loading bays. Almost all well ventilated areas not in the immediate vicinity of a source of release are Zone 2. Figure 4 summarizes some aspects of area classification.

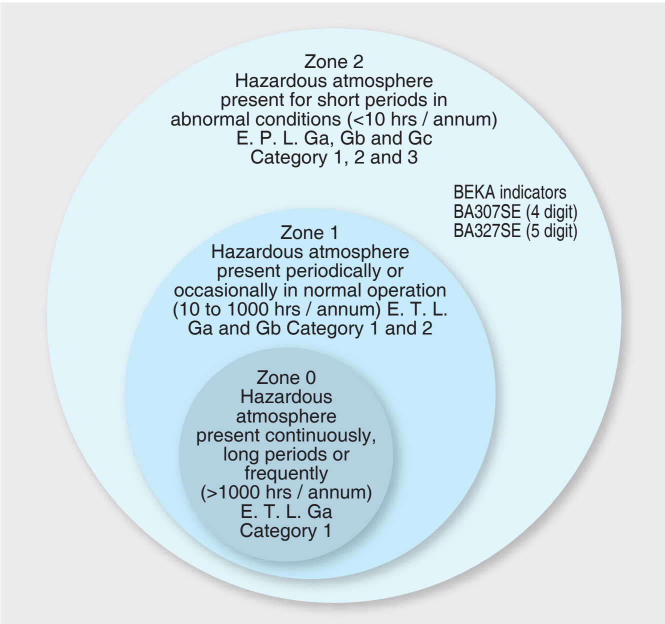


Figure 4 Summary of area classification concepts

European user directive requires a risk analysis of plants, which almost always uses area classification as a basis for the analysis. In the past it was quite common to classify large areas as Zone 1 in order to play safe. However the more logical approach of risk analysis is one factor leading to the major part of most plants being classified as Zone 2, since human beings are not compatible with most hazardous gases. The desire to minimize product loss, environmental concerns and the improvements in glands, flanges and other possible sources of release have also reduced the size and numbers of Zone 1's. In practice most plants with large areas of Zone 1 are almost impossible to justify because of the possible risk to personnel and the environment.

In the particular case of indicators they should where possible be mounted in Zone 2 so that they are readily accessible without exposing any user to unnecessary risk whatever the certification. It is difficult to generalize about area classification because so many factors influence the decisions on a particular installation. Figure 5 shows a typical diagram of a storage tank of liquid whose vapour is heavier than air and flash point below atmospheric temperature.

This illustrates that Zone 0's are usually inside process vessels. [Arguably the vapour space has a mixture above the flammable level but it is usual to make it Zone 0. This covers the conditions of filling and emptying the tank when air may be introduced and the location of the hazardous atmosphere is unpredictable] The Zone 1 is small, in the immediate vicinity of the vent and the Zone 2 is much the larger volume. The probable position of an indicator on this location is inside the bund in a Zone 2.

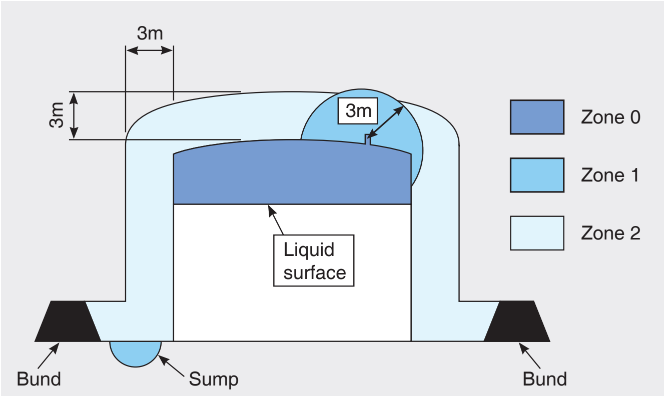


Figure 5 Typical area classification of storage tank

5. CONSTRUCTIONAL REQUIREMENTS

Increased safety protection applies additional measures to electrical equipment or Ex e components to give increased security against the possibility of excessive temperature and against the occurrence of arcs and sparks. It relies heavily on the apparatus enclosure protecting the equipment, the requirements for which are contained in IEC 60079-0 and set a very high standard. There is always a problem in writing standards in that the standard must allow for the possibility of the equipment being used in almost all circumstances. This inevitably means that the equipment is over designed for most locations but it does achieve a high level of reliability for both operational and safety reasons. However the cost is increased.

Non-metallic enclosures, and those containing non-metallic components or seals, are subjected to thermal endurance to heat for 28 days at 10°C above the maximum service temperature at a relative humidity of 90%, followed by a day of endurance to cold. Metallic and non-metallic enclosures are then subjected to an impact test at high and low temperatures.

The sadistic skill of the certifying engineer is the choice of the point of impact which is most destructive. For some completely illogical reason light transmitting parts are subject to a lower impact test of dropping the 1 kilogram from 40cm. Life is made more difficult for enclosures intended for use at lower ambient temperatures since the impact tests are done at a temperature some 5 to 10ºC below the minimum service temperature. The most surprising materials become brittle at -45ºC.

Finally, the ingress protection against the ingress of water and dust is tested. The requirement is to test in accordance with IEC 60529 and to achieve a minimum level of IP54, which is a modest requirement. In practice many manufacturers including BEKA achieve a higher level of protection of IP66 which affords complete protection against both methods of contamination. This test is done after all the other tests, The difficult part is to maintain the level of protection over a long time and when installing the necessary cables and glands.

There is no requirement for vibration testing in the relevant standards but many manufacturers carry out tests to ensure equipment reliability. For example BEKA test to an in-house standard which has been found to ensure adequate performance in the conditions normally experienced.

This description is not complete in detail but does indicate how comprehensive the testing required is. A fortunate by-product is a very reliable industrial product. Nevertheless when locating any equipment, choosing a location which avoids extremes of environment and risk of impact is a common sense precaution, which increases reliability. In the particular case of indicators an acceptable viewing position is also a requirement.

6. CERTIFICATION

6.1 General

There is no ATEX or UKEX requirement to have Category 3 equipment, such as Ex ec, certified by a third party as self-certification is acceptable. Understandably most end users prefer the reassurance of independent certification and consequently the majority of Category 3 apparatus, such as Ex ec instrumentation is third party certified. In their role as Accredited Certification Bodies, Notified Bodies in Europe and Approved Bodies in the UK continue to issue Type Examination Certificates for Category 3 equipment. BEKA have IECEx, ATEX and UKEX Ex ec certification for their BA307SE and BA327SE indicators on which are based their EU and UK Declarations of Conformance. Both indicators also have North American Ex ec certification, see section 14.

6.2 Ex ec certification

BEKA BA307SE and BA327SE indicators are used in this guide as an example of Ex ec certification and marking. These loop powered 4/20mA panel instruments are intended to be mounted in the front of an Ex e panel or cubicle located in Zone 2. Only the front of the indicators have Ex e impact and ingress protection, the rear of the instruments and their Ex e terminals rely on the panel or cubicle in which they are mounted to provide impact and ingress protection. The BA307SE is a 4 digit indicator and the BA327SE a 5 digit indicator incorporating a bargraph display.

Both indicators have four front panel push buttons for selection of functions and calibration. The push buttons have non-incendive contacts which have been certified intrinsically safe Ex ic for use in Zone 2. Intrinsic safety voltage and current limiting for these contacts is contained within the indicators and no external Zener barrier or galvanic isolator is required.

There are 5 documents relevant to the use of Ex ec BEKA indicators in hazardous areas.

a) **The IECEx Ex ec certificate**
This type of certificate is issued by a certification body accredited by an organisation approved by the IEC, using IEC standards as a basis of the certificate. Increasingly this certification, directly or indirectly, is acceptable in large parts of the world.

b) **The ATEX Ex ec certificate**
This Type Examination Certificate for Category 3 equipment is issued by a Notified Body appointed by an EEA country in their role as an Accredited Certification Body. ATEX certificates use CENELEC standards as a basis for certification. Fortunately IEC and CENELEC standards are identical allowing ATEX certificates to be based on product safety analysis performed for an IECEx test report. Following Brexit, when the United Kingdom departed from the EU, BEKA ATEX apparatus certificates are issued by Intertek in Italy.

c) **The UKEX Ex ec certificate**
Following Brexit when the UK left the EU, a UK Type Examination Certificate for Category 3 equipment is now issued by an Approved Body appointed by the UK government. UKEX Type Examination Certificates are similar to ATEX certificates. BEKA UKEX certificates are issued by Intertek in the UK.

d) **EU Declaration of Conformity**
This document is created by the apparatus manufacturer (BEKA). It is a declaration that apparatus complies with all the relevant EU directives. The ATEX certificate is used to confirm compliance with the *European Explosive Atmospheres Directive 2014/34/EU.*

e) **UK Declaration of Conformity**
This document is created by the apparatus manufacturer (BEKA). It is a declaration that apparatus complies with all the relevant UK Statutory Instruments. The BEKA UKEX certificate is used to confirm compliance with UK Statutory Instrument, *Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations UKSI 2016:1107 (as amended).*

6.3 Analysis of marking requirements

For completeness an analysis of the IECEx, ATEX and UKEX marking is included which involves some repetition. BEKA BA307SE & BA327SE indicators are used as an example. The required IECEx markings for a BEKA BA307SE & BA327SE indicator are:

IECEx ITS 22.0023X
Ex ec ic IIC T5 Gc
Ex tc IIIC T 80ºC Dc [Dust certification]
-40ºC ≤ Ta ≤ +70ºC

IECEx certificate

IECEx	This confirms that the certificate is issued by the international certifying authority.
ITS	Intertek Testing and Certification Ltd., an approved certification body by IECEx.
22.0023X	Certificate number. 22 is the year of issue and the 'X' suffix indicates that Specific Conditions of Use are specified on the certificate.
Ex ec	Increased safety protection - provides increased security against the possibility of excessive temperatures and the occurrence of arcs and sparks.
ic	Intrinsically safe method of protection suitable for Zone 2 and 22. In BA307SE and BA327SE only applies to front panel push button contacts.
IIC	Surface industry gas group. Representative gas hydrogen
T5	Temperature classification
Gc	Equipment protection level [EPL] indicating suitability for use in a Zone 2 gas hazard.
-40ºC ≤ Ta ≤ +70ºC	Ambient temperature range including the effect of adjacent equipment

The ATEX and UKEX marking requirements for a gas hazard are

ATEX certificate

ITS-I INTERTEK ITALIA S.p.A. Notified Body in EU that issued the certificate.

22ATEX34494X Certificate number 22 is the year of issue and the 'X' suffix indicates that Specific Conditions of use are specified on the certificate.

UKEX certificate

ITS Intertek Testing and Certification Ltd Approved Body in UK that issued the certificate.

22UKEX0609X Certificate number 22 is the year of issue and the 'X' suffix indicates that Specific Conditions of use are specified on the certificate.

Common ATEX and UKEX marking

Ex Indicates compliance with EU Flammable Atmosphere Directive and UK Statutory Requirements.

3 GD Category 3 for use in Zones 2 and 22

Ex ec Increased safety protection - provides increased security against the possibility of excessive temperatures and the occurrence of arcs and sparks.

ic Intrinsically safe method of protection suitable for Zone 2 and 22. In BA307SE and BA327SE only applies to front panel push button contacts.

IIC Surface industry gas group. Representative gas hydrogen

T5 Temperature classification

Gc Equipment protection level [EPL] inducating suitability for use in a Zone 2 gas hazard.

-40ºC ≤ Ta ≤ +70ºC Ambient temperature range including the effect of adjacent equipment

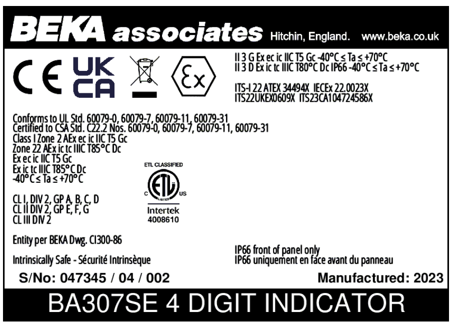


Fig 6 BA307SE Certification information label

The BEKA BA307SE indicator label is shown in Figure 6. The label includes dust and North American certifications. The CE and UKCA logos, which are justified by the indicator's Declaration of Conformities, are required to allow the indicator to be placed on the EU and UK markets. The instrument serial number and the year of manufacture are shown on a separate label adjacent to the terminals.

Although not part of the marking requirements, all certificates or test reports specify the same maximum input current and voltage and the same Specific Conditions of Use for the BA307SE and BA327SE indicators.

7. DOCUMENTATION

7.1 General

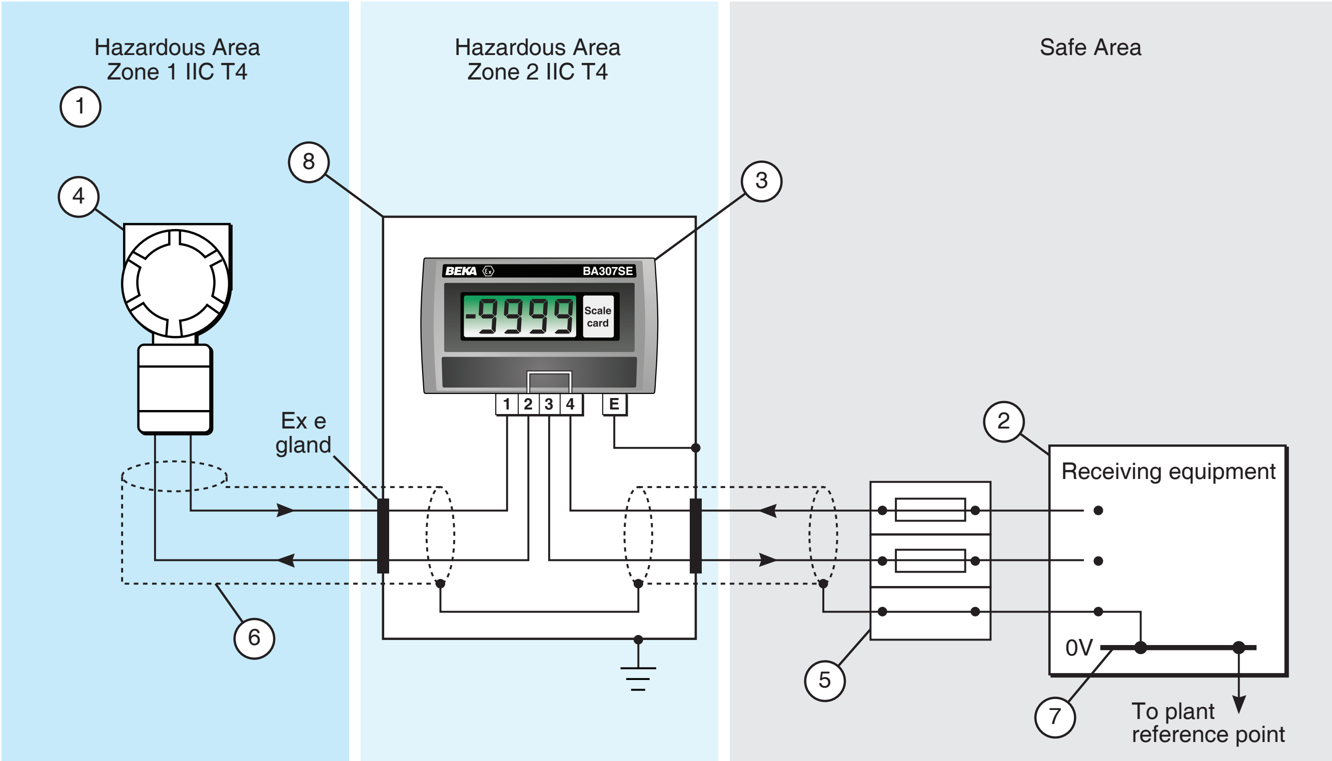
The documentation for any installation should provide a source of information on two aspects. One, it should provide a reference as to why the system is adequately safe. Secondly, it should provide the information to ensure that a technician can safely install the intended system. In general it may be easier to separate the two requirements and produce two drawings. It must be recognized that creating adequate safety documentation is time consuming and expensive but is a legal requirement in the majority of countries.

Some installers prefer to file copies of certificates relating to equipment used. However the majority of certificates are available on the internet. IECEx certificates are listed on the IECEx website and ATEX certificates are usually listed on the manufacturers websites. Clear instructions on how to find certificates are preferable to copies since then a current copy of the certificate can be used. The BEKA instruction manuals carry a QR barcode ,which when scanned by an appropriate device such as a mobile telephone leads directly to the website and copies of the certificates, instruction manuals and other relevant literature.

7.2 Example of system documentation

The safety documentation can be just a series of notes but is possibly better presented as a drawing and a series of notes as illustrated by the drawing for the imaginary installation of Figure 7.

The format of the installation drawing is usually determined by the preference of the end-user. It must ensure that the installing technician has clear instructions on what equipment to install and where and what cables and accessories to use. The drawing should contain a reference to the safety documentation, but should not repeat the safety arguments. The installing technician should have access to the safety documentation so that he can more readily understand the safety arguments and reassure himself if something causes any misgivings.



NOTE 1: The hazardous area contains a Zone 1 adjacent to process vessel No 3 and a Zone 2 comprising the nearby well-ventilated area, [area classification drawing No ABC 123]. The gas hazard is caused by a combination of hydrogen [IIC T1] and ethyl methyl ether [IIB T4] requiring IIC T4 equipment.

NOTE 2: The Alpha interface is CE and UKCA marked to confirm compliance with the Low Voltage Directive. It has an isolated 24V dc output to power the transmitter and accepts the 4/20mA loop current.

NOTE 3: The BEKA loop powered indicator Type BA307SE is certified Ex ec ic IIC T5 Gc certificate number IECEx ITS 22.0023X. It is suitable for mounting in a 90mm +0.5/-0.0 x 43.5mm +0.5/-0.0 aperture in an Ex e component certified enclosure. The BA307SE when mounted as recommended by the manufacturer BEKA does not invalidate the Ex e enclosure certification. The total power dissipation of the indicator plus other equipment installed in the enclosure does not not exceed the maximum permitted by the enclosure Ex e component certificate.

The ambient temperature range within the Ex e enclosure, including temperature rise caused by installed equipment is -30°C to + 60°C which is within the permitted temperature range of the BA307SE indicator which is -40°C to +70°C.

NOTE 4: The ALPHA pressure transmitter Type YYYY is certified ‘Ex d IIC T4’ certificate number yyyy and is suitable for mounting in the Zone 1 IIC T4 location. The adjacent process equipment creates a service temperature range of -20ºC to +60ºC, which is within the permitted temperature range of -40ºC to +70ºC.

NOTE 5: The 100 mA fuses are mounted in terminal blocks within the cable termination cabinet. They provide over-current protection for the cables and hazardous area equipment. They also provide a means of isolation and they are clearly identified and easily accessible to ensure safe use.

NOTE 6: The cables are screened twisted pairs 22 AWG with a toughened outer sheath installed in cable trays. The glands used on the transmitter have Ex de certification and those used on the Ex e enclosure have Ex e certification.

NOTE 7: The screens are carefully terminated to ensure inter-connection and avoid unintended earth connections. The safe area end is directly connected to the receiving equipment ‘0’ volt rail and subsequently to the plant reference point. The transmitter end of the screen is carefully finished but isolated from earth.

NOTE 8: Ex e component certified enclosure certificate number IECEx ABC YY.nnnnU.

Figure 7. Descriptive System Document for pressure transmitter 02 process vessel No. 3

8. TYPICAL CIRCUITS USING AN Ex ec INDICATOR IN ZONE 2

8.1 Common factors

All the diagrams use a power supply and receiving equipment block to illustrate the equipment used in the safe area. All the Ex ex certificates for the BA307SE and BA327SE indicators used in these examples specify input parameters of I_{max} 200mA and U_{max} 30V and require that the indicators are powered from a limited energy circuit.

A limited energy circuit is not exactly defined in any IEC or CENELEC document. A reasonable interpretation is a SELV or PELV supply as suggested in clause 16.2.1 of IEC 60079-14:2014. A 24V regulated dc CE or UKCA marked supply confirming transformer isolation from the mains and compliance with the Low Voltage Directive can be considered adequate.

The 100mA fuses used in all examples provide current limitation and enables the loop to be easily isolated for maintenance. The voltage that appears across the input terminals is determined by the input protection components within the indicator which prevents U_{max} being exceeded.

The fuses shown are 100 mA rated and mounted in terminal blocks. The 200 mA input current rating of the indicator I_{max} is the rating in normal operation and in practice the current in this type of circuit is usually limited to less than 30 mA. A 100mA fuse can allow a current greater than 100 mA to flow for a short time but this is a transient situation. A 100mA fuse which effectively limits the transferred power is considered to provide the required level of protection. Fuses must be included in both leads so as to ensure complete isolation when required. It is important that the fuses are clearly identified so that correct isolation is readily accomplished. Where other equipment in the circuit has an input current limitation it should be not less than 100mA or the fuse rating must be changed to an appropriate value.

The circuit can be fully floating but is more usually ‘earthed’ at one point in the safe area by the common power supply and/or the receiving equipment. This earth [usually combined with the screen earth] and the plant reference potential should be bonded together. Earthing at more than one point should be avoided since the possible circulating currents cause both safety and operational problems. In those rare cases where multiple earths cannot be avoided, the use of bonding conductors as reluctantly permitted in intrinsically safe circuits, provide a possible solution.

The Ex e enclosure in which the BA307SE or BA327SE is mounted should be bonded to a local earthing point or the plant’s equipotential conductor. The earth stud on the rear of the indicator should be connected to the Ex e enclosure bonding terminal.

The electrical continuity of all the cable screens entering and leaving the Ex e enclosure should be maintained, but they should be isolated from the local earth. Ideally, screens should only be earthed at one point to the plant’s equipotential conductor in the safe area.

With the exception of the flameproof equipment the glands used are Ex e glands. In practice some end-users prefer to use Ex de glands so as to avoid possible misuse. The cables are normally 22 AWG or 0.5mm² with a screen and with a toughened outer sheath supported on cable trays, but other types of cable installation can be used if there is a local preference.

When installed in a pressurised enclosure in Zone 2 Type pzc equipment is required.

Figures 8 to 12 illustrate situations where the field equipment is loop-powered by the 4-20 mA signal. Figure 13 illustrates the situation where the 4-20 mA signal is derived from hazardous area equipment containing a separate source of power. In these circumstances the field wiring and indicator is shown protected by an additional set of fuses within the hazardous area equipment. A similar arrangement is required whenever the hazardous area equipment contains a separate source of power. It may not be necessary to use fuses but some reliable form of current limitation of the 4-20 mA circuit is essential. The procedure for using the isolating switches within the pressurised enclosure [or any other similar hazardous area equipment] needs to be carefully documented, since opening the enclosure should only be done under carefully controlled conditions.

The following figures illustrate the use of the indicator in Zone 2 with equipment using other methods of protection. The examples shown are the combinations most frequently occurring, but other combinations do occur.

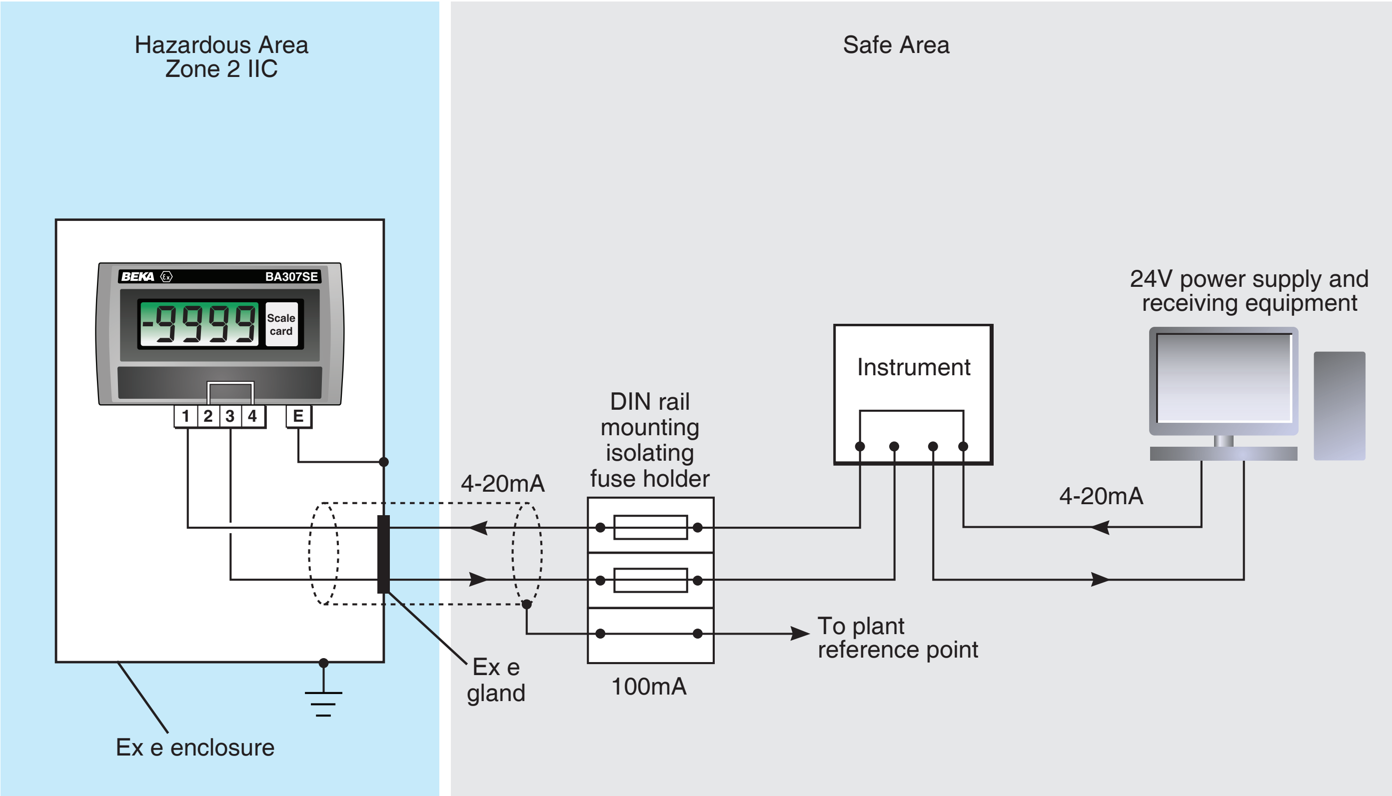


Figure 8. Indicator in Zone 2 monitoring safe area instrument

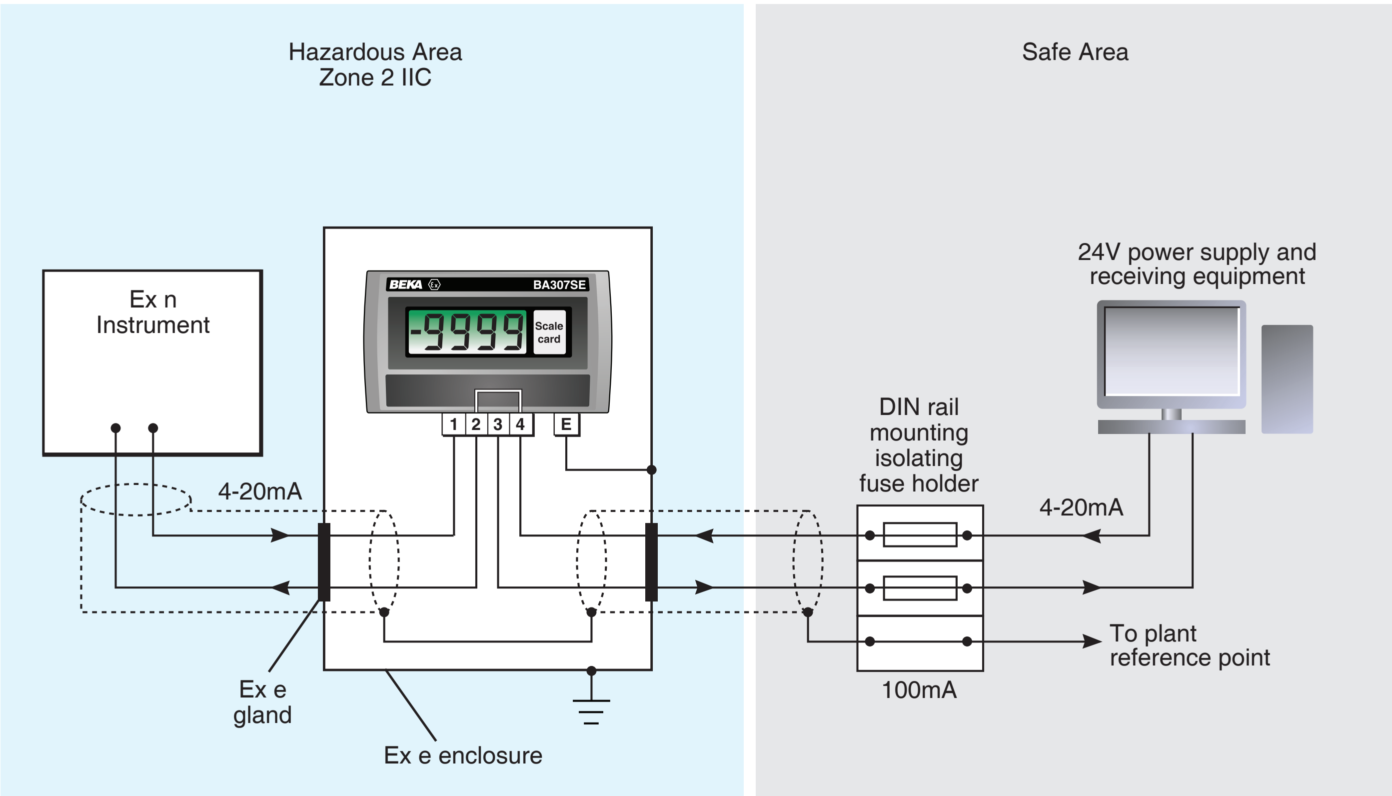


Figure 9. Indicator in Zone 2 monitoring non-arcing instrument in Zone 2

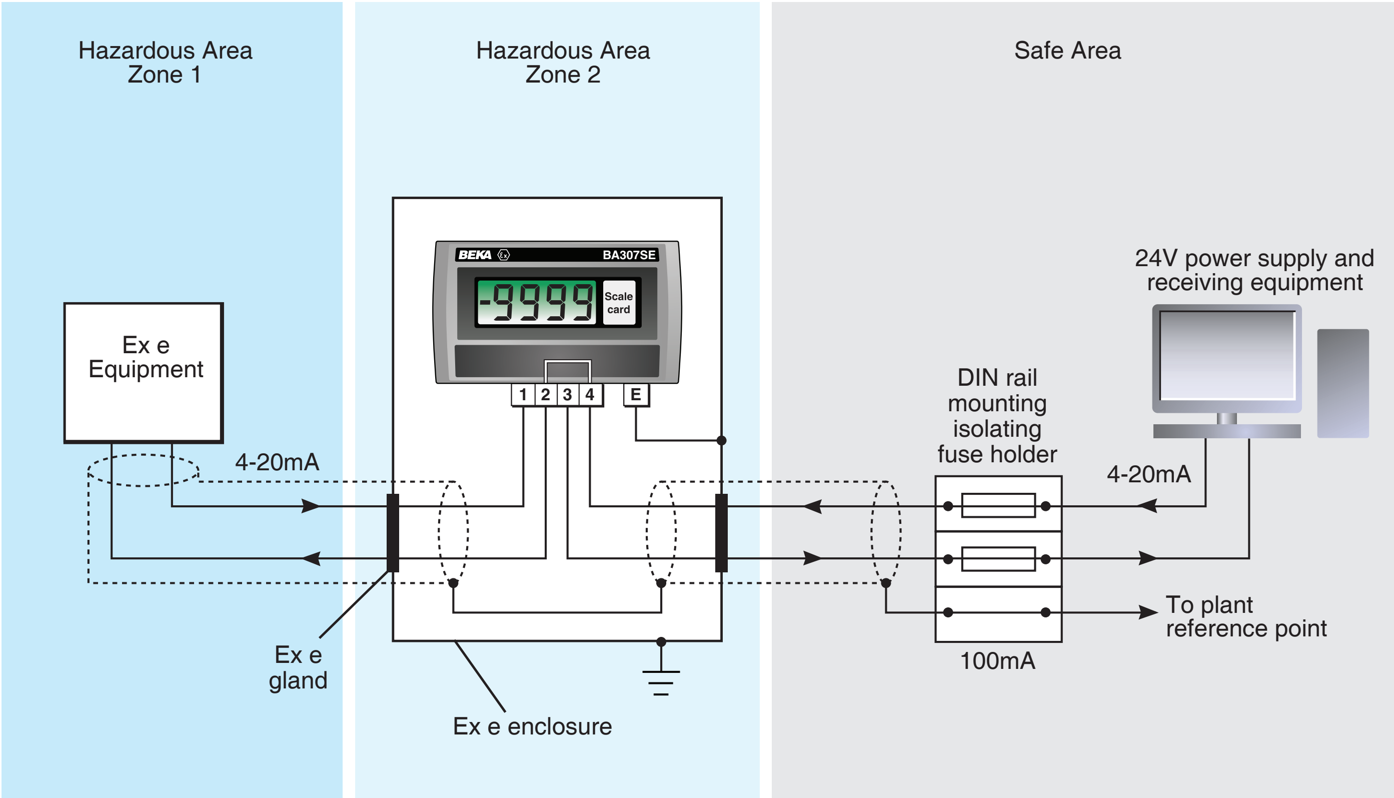


Figure 10. Indicator in Zone 2 monitoring Ex e equipment in Zone 1

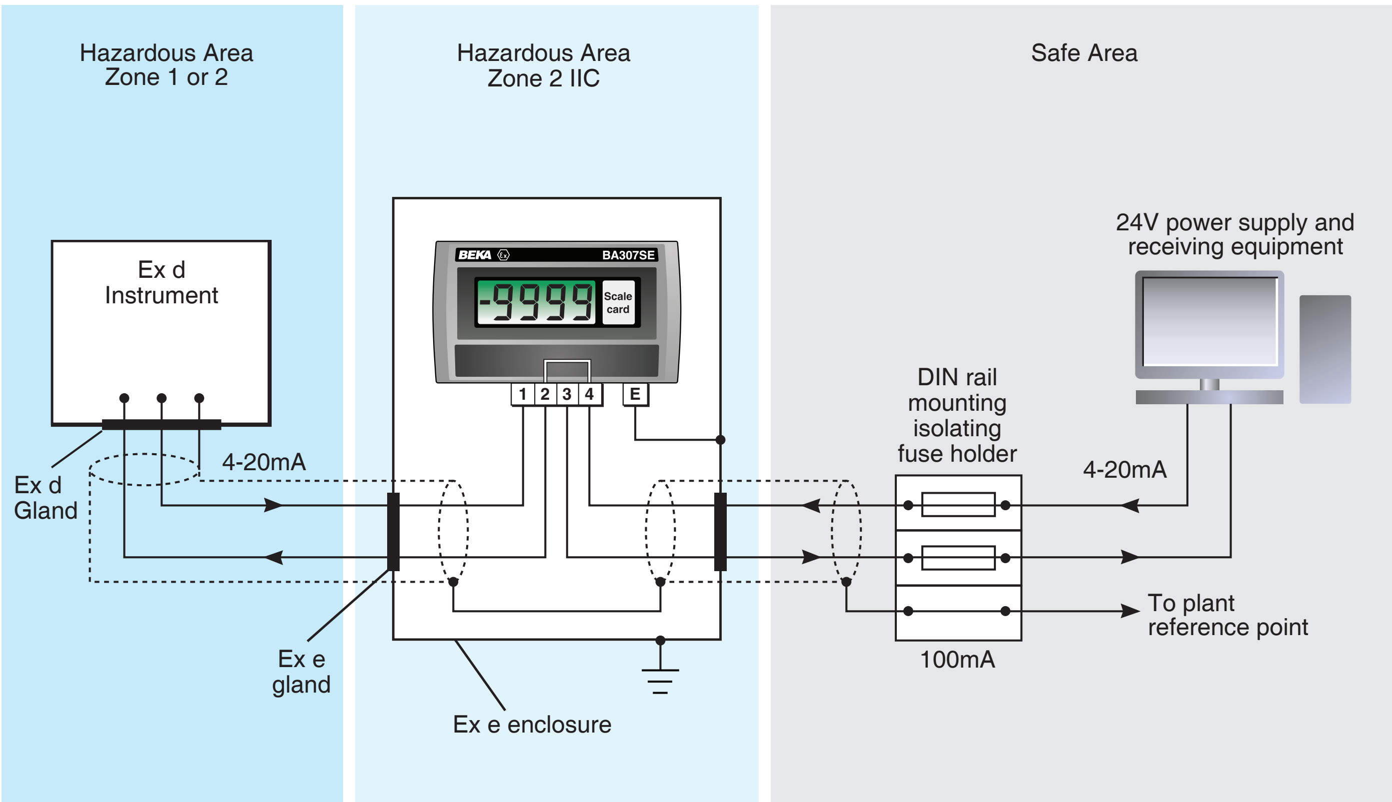


Figure 11. Indicator in Zone 2 monitoring Flameproof instrument in Zone 1 or 2

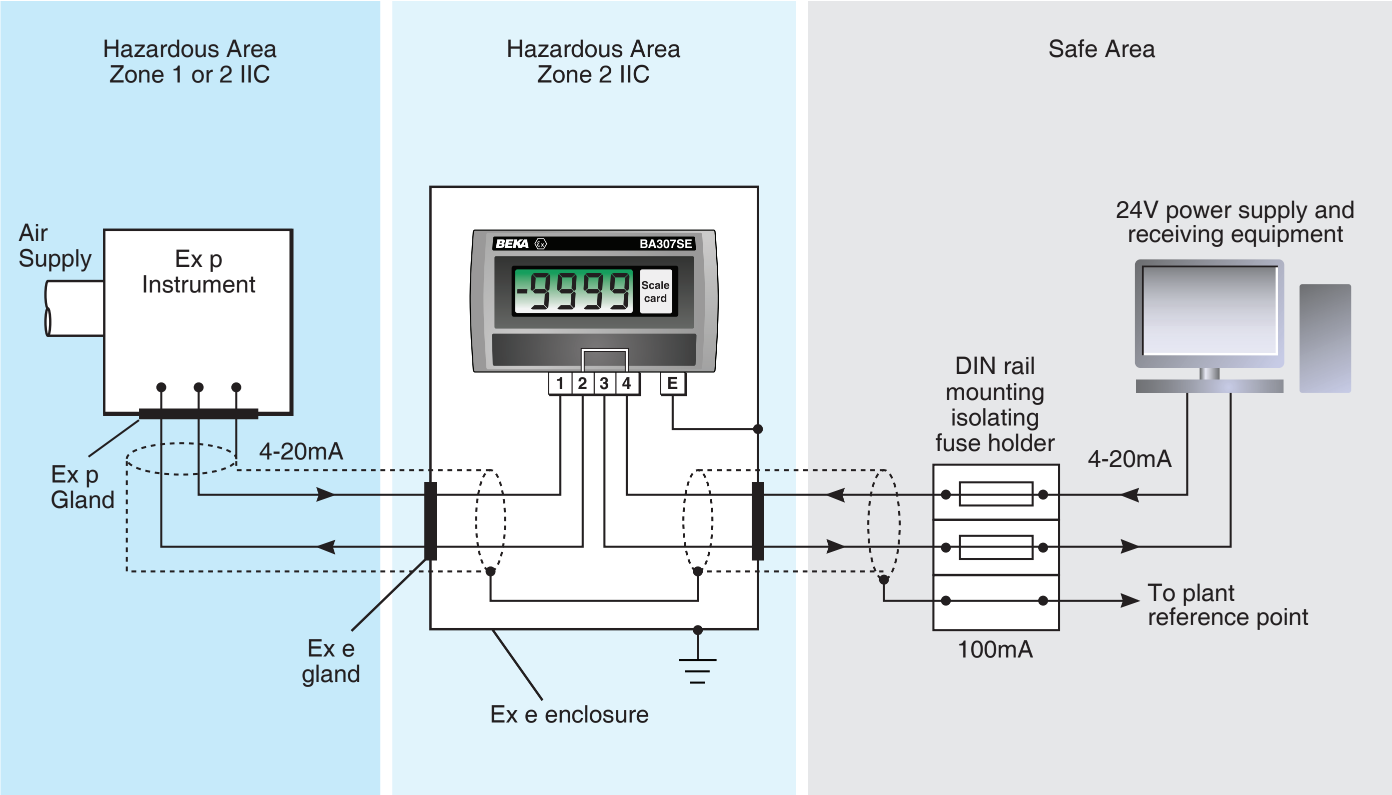


Figure 12. Indicator in Zone 2 monitoring signal powered pressurized equipment

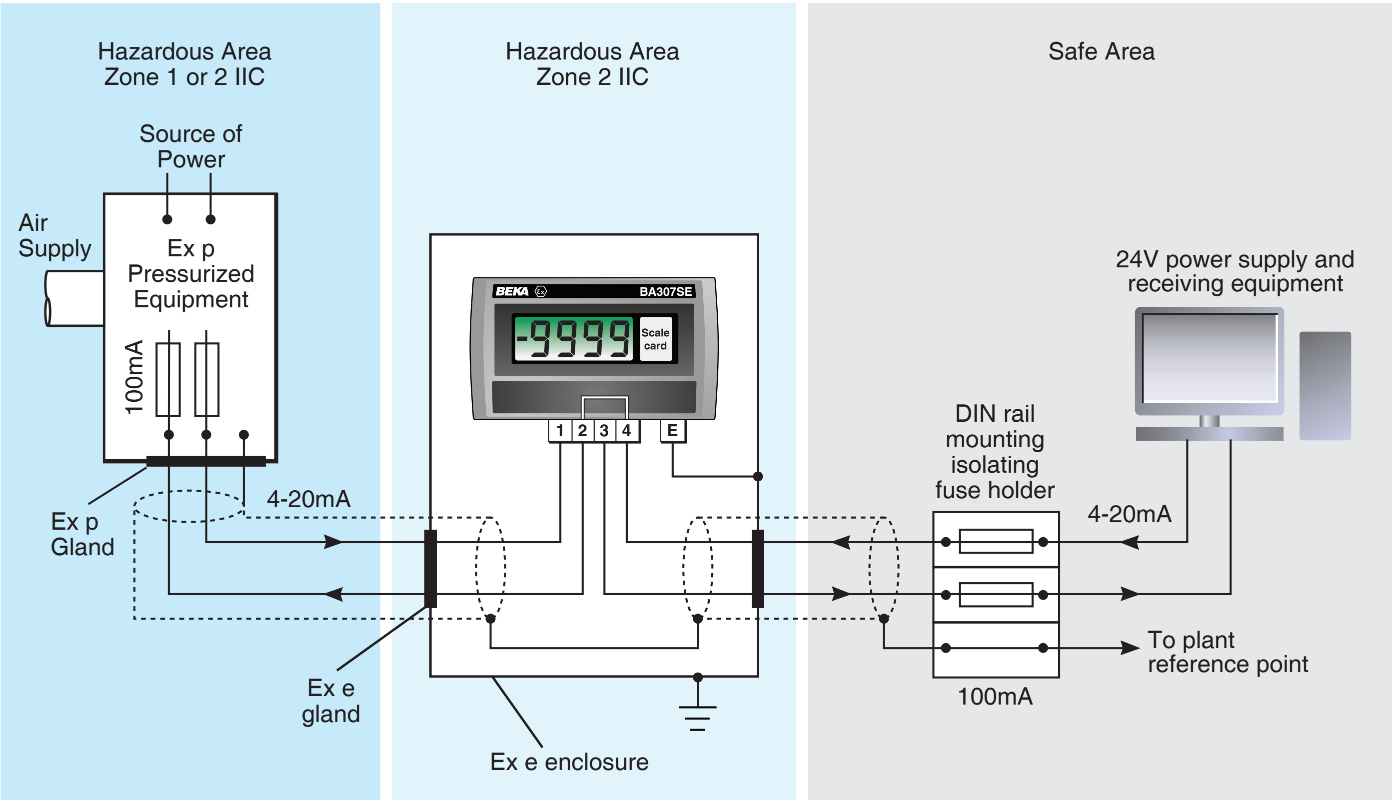


Figure 13. Indicator in Zone 2 monitoring signal from powered pressurized equipment with a source of power

NOTE: The additional set of fuses within the pressurized equipment is to protect the field wiring and indicator from faults within the equipment. The type of pressurized equipment must be appropriate to the Zone of use.

9. INSPECTION

The recommended inspection procedures for this type of installation are contained in IEC 60079-17. Some of the systems discussed contain more than one method of protection and the inspection procedures have to be adapted to this multiplicity. This note concentrates on the requirements of the indicator.

Three grades of inspection are proposed, detailed, close and visual. A detailed inspection is usually carried out if there is some reason to suspect that there is a significant problem. It would involve removing the indicator to a safe area and checking the gaskets, removing any pollution and looking for any damage or obvious deterioration in condition. A functional check would confirm that there was not significant electrical damage. Suspect and faulty instruments should be returned to BEKA associates or to the local BEKA agent. No attempt should be made to repair suspect or faulty instruments. This type of inspection should only be necessary on very rare occasions. For example it is not necessary on initial installation since the indicator will have been subjected to a detailed final factory inspection.

The initial detailed inspection should confirm that the indicator is being installed in accordance with the installation drawing or instructions. The questions of where to install it and choice of cables glands should all have been decided by the compiler of the installation drawing. The installing technician should be encouraged to question any aspect which he has cause to doubt and should have access to the safety documentation and the relevant certificates if he wishes.

Close inspections are not relevant to indicators. If the indicator is of the required type and is working then a visual inspection is all that needs to be done. Removing covers and attempting to check the status of the electronics except when absolutely necessary is to be discouraged.

Visual inspections are inspections looking for obvious faults and do not require the use of tools or the removal of covers. In the case of the indicator a check that the indicator is the intended model, is reasonably clean and undamaged and the glands and immediately adjacent cable are in good condition is all that is necessary.

10. MAINTENANCE

Any maintenance should only be attempted in accordance with the permitted work practice of the particular site, which should ensure personnel and plant safety but may not permit ‘live working’. All maintenance work should be carried out subject to the precautions which would be applied in a safe area.

There is no requirement for routine maintenance of the indicator. If the indicated value becomes obscured, cleaning the window with a damp cloth is the recommended solution.

If the indicator appears not to be functioning then this should be confirmed by measuring the current in the safe area. Live maintenance of type Ex e apparatus is not permitted except when a risk analysis demonstrates that it is acceptably safe to do so.

The principles to be followed are that the maintenance procedure shall not cause incendive sparks or expose or create hot surfaces. However, if the indicator malfunctions the only universally acceptable recourse is to remove it for examination in the safe area and this is frequently the most practical solution. It is necessary to isolate the hazardous area circuit before disconnecting the indicator. Isolation can be achieved by opening the switches in the switch-fuse terminal blocks and unauthorised re-energising prevented by removing and retaining the fuses. It is always worthwhile to check that the circuit is isolated before working on it. This can be done by using an intrinsically safe multimeter such as the Fluke 28 II Ex. While it is safe to make voltage measurements, an energized circuit should not be broken in the hazardous area to make current measurements since there is a slight possibility of an incendive spark being created. It is usually possible to conveniently monitor circuit currents at the fuse–switch isolator in the safe area.

If the indicator is removed and not replaced by a spare indicator the continuity of the circuit can be restored by using a terminal block to make the appropriate interconnections. Using such a terminal block ensures that the circuit leads do not stray and enables the circuit to be energized and used without the indicator. If the indicator is removed and the loop is to be reenergised without a replacement indicator being installed, the integrity of the Ex e enclosure must first be restored.

Fault finding on a live circuit in Zone 2 can be done safely using an intrinsically safe multimeter on the voltage range. The voltage measurements listed in the indicator manual can be safely used. Each circuit is slightly different but most faults can be diagnosed by measuring the voltages on the indicator terminals. Care must be taken to avoid contaminating the interior during the temporary relaxation of the ingress protection and the gaskets of the Ex e enclosure checked as the cover is replaced. It is possibly hazardous to disconnect any of the wiring and hence the circuit should be isolated or a gas clearance certificate obtained before loosening terminals.

If it is necessary to reconfigure the indicator this can be done safely in situ as the push button contacts are intrinsically safe. If recalibration of the indicator is considered necessary this can be done in the hazardous area using the indicators internal calibrator.

11. THE USE OF BACKLIGHTING

Indicator display backlighting is a factory fitted indicator option which can be loop or separately powered, both of which are included in the Ex ec certification. The choice of method can be made or changed on-site, but any disconnection should only be made with the circuit isolated.

The more common use is to connect the backlight in series with the indicator 4-20mA input as shown in Figure 14. This increases the voltage drop across the indicator from 1.2 to 5.0V and provides almost constant backlight brightness which is sufficient for most applications. The increased voltage drop is rarely a problem, particularly with a 24V supply. I_{max} and U_{max} specified by the Ex ec certification for the combined indicator and backlight connected in series remains unchanged at 200mA and 30V. Figure 14 shows the indicator backlight being used with flameproof equipment, but it can be used with all the possible applications of the indicator provided that the combined voltage drop of 5V does not cause a problem.

For applications where this increased voltage drop is not acceptable, or the backlight brilliance needs to be adjusted such as in some marine environments where night vision has to be maintained, the backlight can be separately powered. I_{max} and U_{max} specified by the Ex ec certification for the backlight circuit are 200mA and 30V. At voltages above 9V the consumptions is 22mA and the brilliance is constant, below 9V the backlight brilliance gradually reduces.

There are two possible circuits as illustrated in Figures 15 and 16.

Where the power supply is common to the signal and backlight then a three wire connection as shown in Figure 15 can be used. All three leads should be fused and capable of being isolated as shown. The common lead can carry currents up to 42mA but the voltage drop in the field wiring is not likely to cause a problem for lead lengths less than 1km if 18 AWG or 0.75 sq mm cable is used.

Where separate power supplies are used, or it is thought desirable to keep the signal and backlighting circuits isolated from each other, a four lead interconnection as illustrated in Figure 16 can be used. The wiring can be two separately screened pairs as illustrated or combined in a multi-core.

The backlighting does not create a maintenance or inspection problem. When connected in series with the display there is a voltage drop of 4V which can be safely measured between terminals 12 and 13. When separately powered the indicator draws a constant current of about 22mA if the available voltage is greater than 9V. The backlight functions but with reduced brilliance at lower voltages. The current is most conveniently and safely monitored at the fuse-isolator.

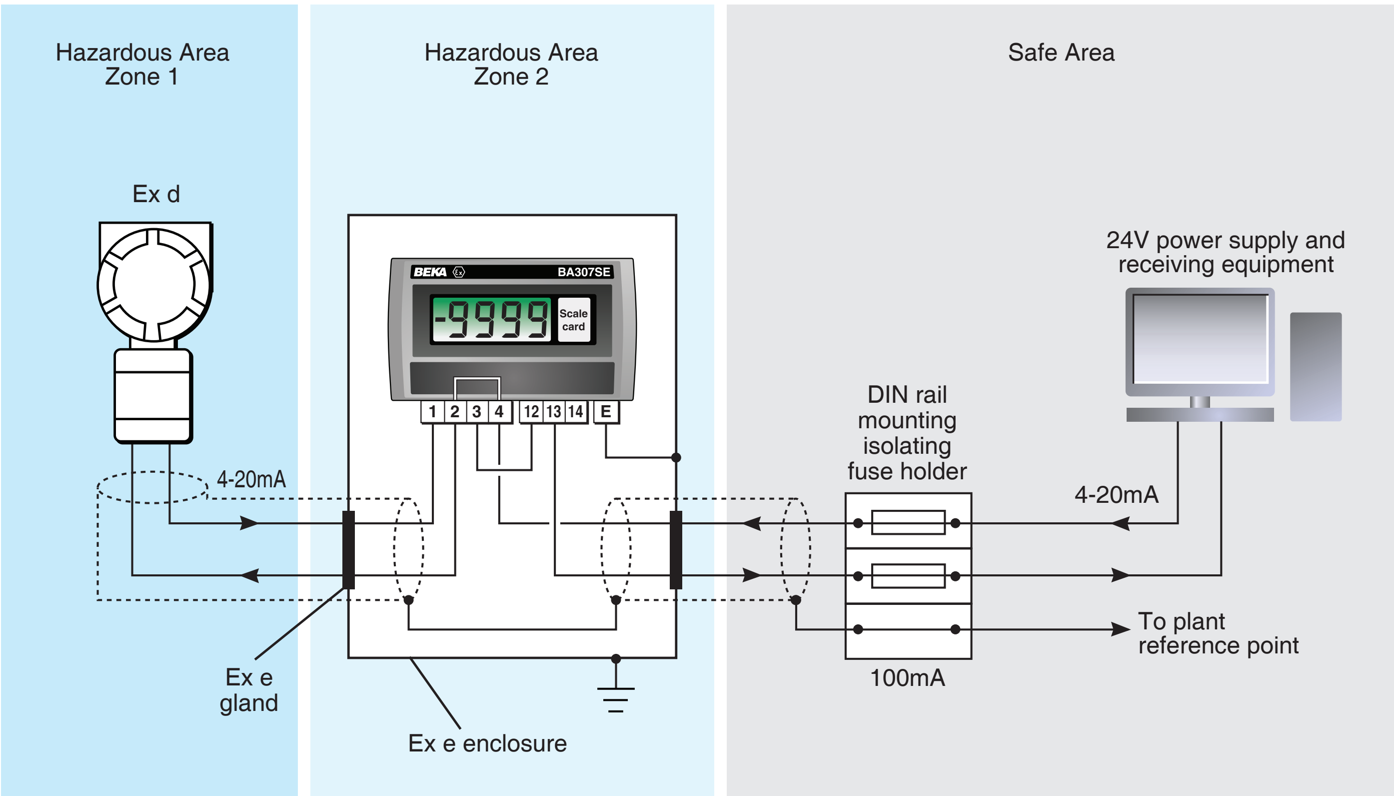


Figure 14. 4-20mA circuit including indicator with loop powered backlight

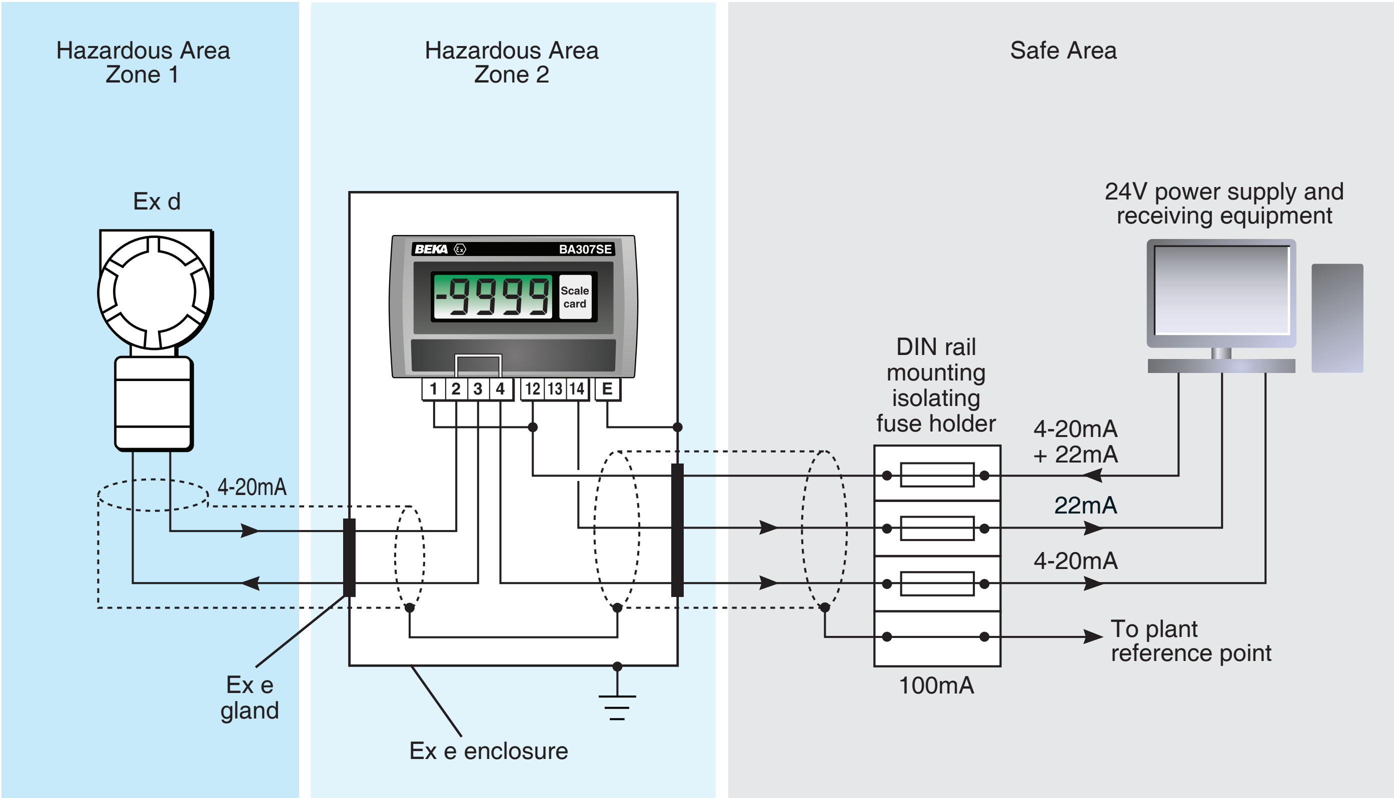


Figure 15. 4-20mA circuit and backlight separately powered from a common power supply

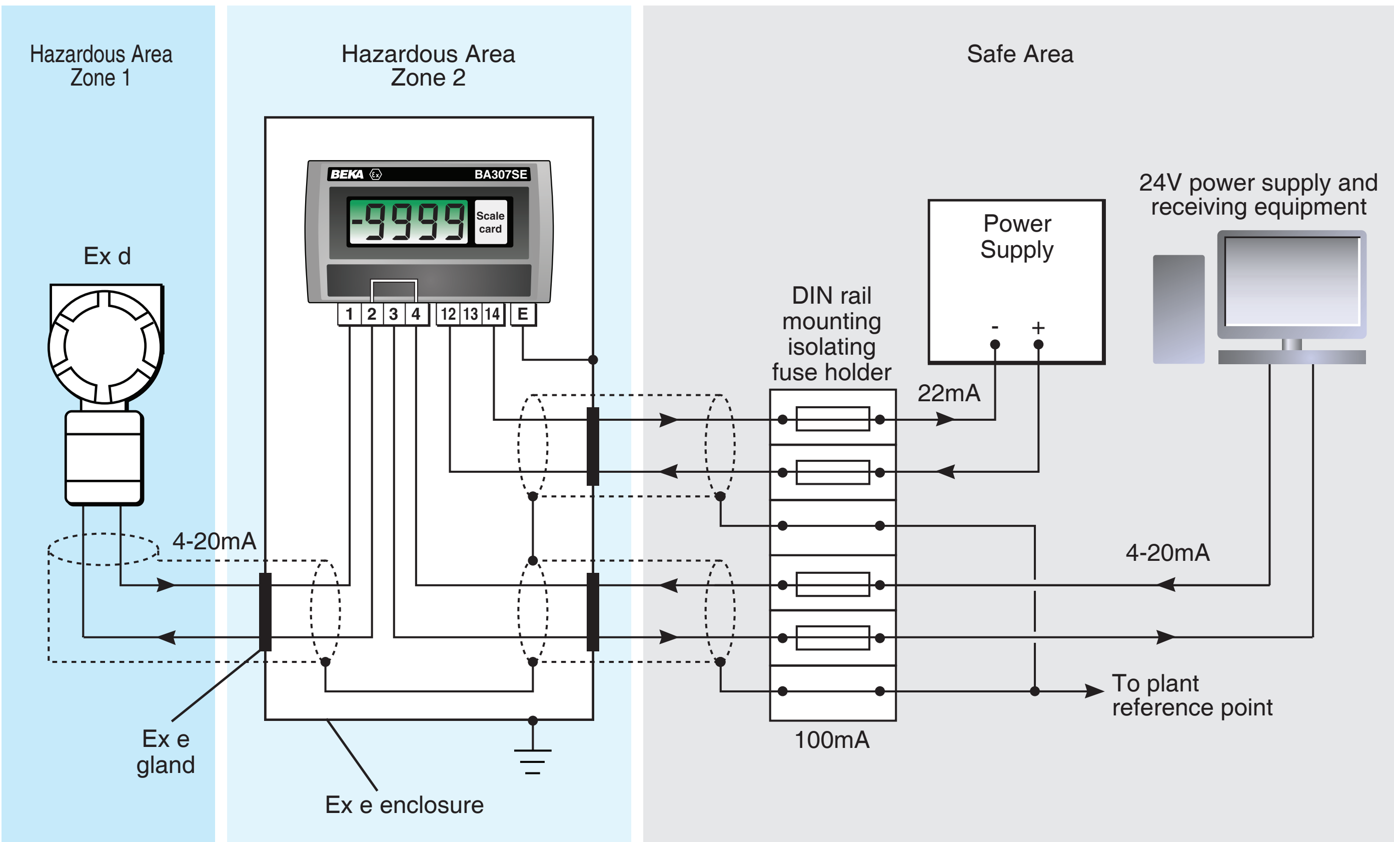


Figure 16. 4-20mA circuit and backlight separately powered and isolated from each other

12. THE USE OF ALARMS

12.1 General

There are a large number of ways that alarm circuits are configured. Figure 17 shows the most commonly used circuit with the switch configured to be in the closed state in normal operation and opening on alarm. It is positioned in the 'live' side of the circuit so that any open circuit or fault to the screen or earth in the field wiring and a failure of the power supply will have the same effect as an open circuit switch and produce an alarm. This configuration is usually described as 'fail safe'.

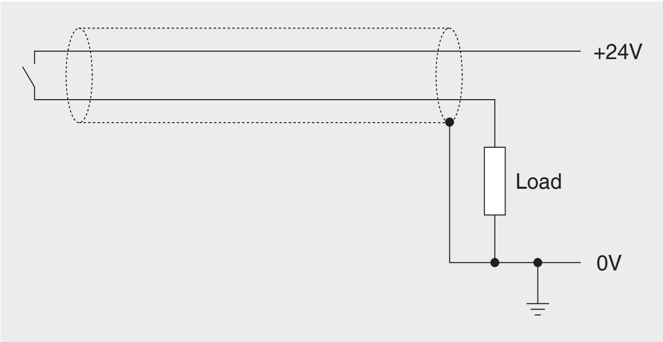


Figure 17. Basic alarm circuit

The fault that is not 'fail safe' is a short circuit of the cable which does not at the same time produce a fault to the screen, but this is not very probable. This problem can be removed by mounting two resistors near the switch as indicated in Figure 18 which simulates a proximity detector. This circuit requires the use of more complex receiving equipment and a means of mounting the resistors and consequently is not commonly used.

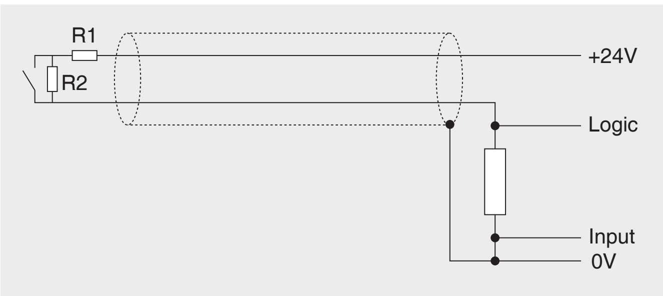


Figure 18. Higher integrity circuit

12.2 Indicator alarms

The BA307SE and BA327SE indicators can be supplied with a factory fitted dual alarm module, each alarm having a single pole solid state switch output. Each output can be independently configured to act as a high or low alarm with a normally open or closed position in the alarm condition. When the power is removed by the 4-20mA signal failing, both alarm outputs fail to open circuit. This is a further reason for choosing to use the open circuit switch as the alarm condition as illustrated in Figures 17 and 18. When an alarm occurs an annunciator on the front panel of the indicator is activated. If preferred the numerical display can be configured to alternate between the measured value and the alarm channel identification 'ALr1' or 'ALr2'. The other configurable functions for each alarm are adjustable setpoint, hysteresis, alarm delay and alarm accept.

The switch is a galvanically isolated semi-conductor which provides complete isolation from other circuits and hence can be used in almost any location within an alarm circuit. The equivalent circuit of the switch is as illustrated in Figure 19 and its rating is decided by the Ex ec certificate as 200mA, 30V. The switches only control a d.c. supply of the correct polarity, the positive being connected to terminal 8 or 10.The switches have a high voltage rating but they should not be used to switch highly inductive loads which are not adequately suppressed.

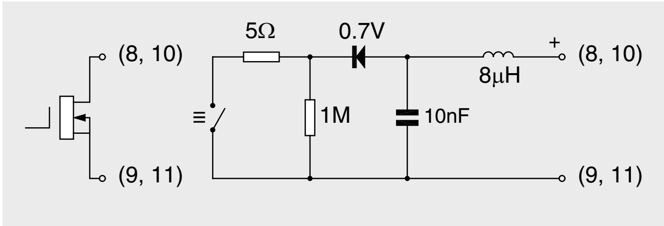


Figure 19. Equivalent circuit of each alarm output

12.3 Alarm circuits

The isolation of the switches is such that they can readily be used in many different ways and this document illustrates some of the more commonly occurring applications. The alarms are not usually suitable for use in the highest integrity shut-down circuits because circuits using the indicator alarms inevitably would have a large number of components in series and all the possible failures are very difficult to anticipate. However the alarms when used to monitor the status of an instrument or measured value provide a useful method of improving the detected failure rate in a SIL rated system. The examples which follow indicate typical applications of reasonable use of the alarms

It is important to recognise that provided that the indicator is mounted in a Zone 2 the switches can control equipment mounted in the safe area or in any of the hazardous area Zones. This concept is illustrated by the examples showing the use of 4-20mA indicators with various forms of explosion proof equipment. However the alarm switches cannot be used in an intrinsically safe circuit because the segregation provided by the galvanic isolator is not certified as being adequate for that purpose. Theoretically it is possible to devise techniques which would allow their use in intrinsically safe circuits but these are complex and not generally practicable and usually a better solution is to use an intrinsically safe indicator.

Figure 20 illustrates the alarm circuits being separately powered and wired so as to isolate the circuits from each other. The loads being driven illustrate the fact that these can be located in both the safe and hazardous area. The load in the hazardous area is shown as a valve in the Zone 2 but this load can be in any type of hazardous area provided that it is suitably protected. The hazardous area equipment and wiring is protected by 100mA fuses positioned at the safe to hazardous area interface so as to satisfy the certification requirements of the indicator. The value of the fuse is determined by the lowest permissible input current [Ii] of any of the equipment in the hazardous area.

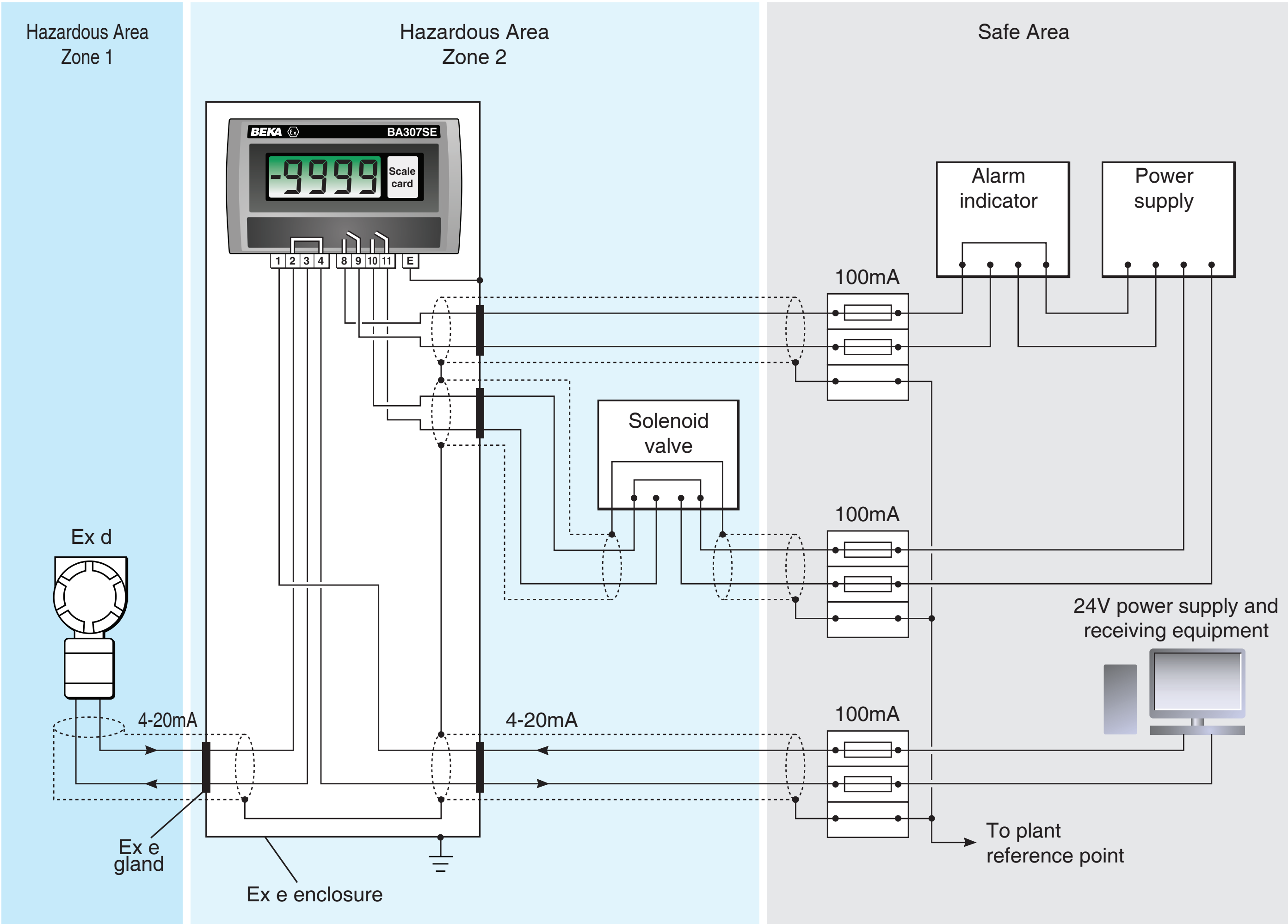


Figure 20. Possible application of indicator alarms

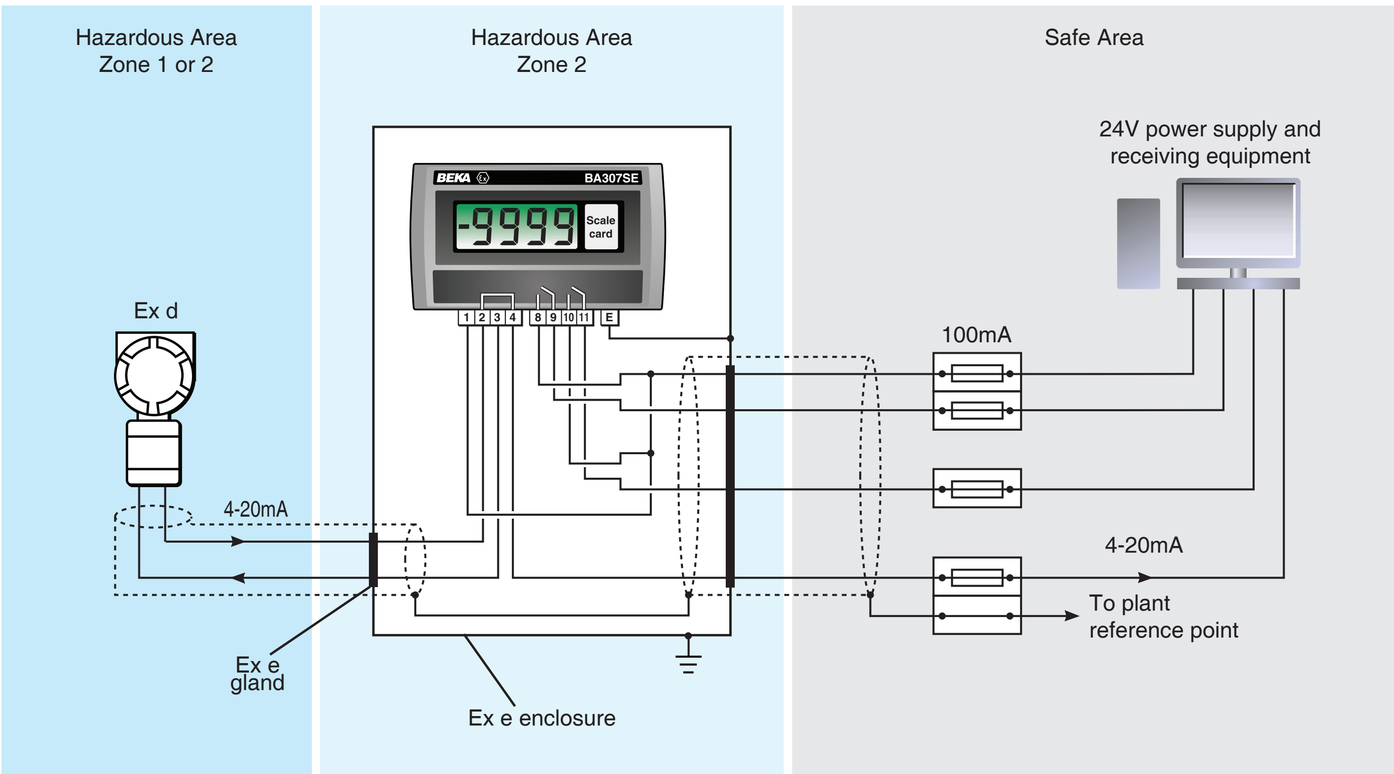


Figure 21. Alarms used with common supply

Figure 21 shows a commonly used configuration which transmits the alarm status back to the safe area. This circuit is frequently used to monitor deviations of the monitored value and if both alarms are open to show failure of the transmitter circuit. This example illustrates the use of a common lead to provide power to all three circuits so as to use fewer wires and fuses than if all the circuits where separately connected.

13 Use in a Pressurised Enclosure

Some panel mounting Ex ec instruments may be used in pressurised cabinets and cubicles located in Zone 2 if the front of the instruments maintain the impact and ingress protection of the enclosure. The BA307SE and BA327SE Ex ec indicators, which are used as examples in this document, have front of panel protection and their Ex ec certificates specify that the indicators may be installed in an Ex pzc panel enclosure located in Zone 2.

An additional Specific Conditions of Use is specified when a BA307SE or BA327SE indicator is mounted in an Ex pzc enclosure. The prospective short circuit current of the supply must be less than 10kA which is unlikely to cause difficulties.

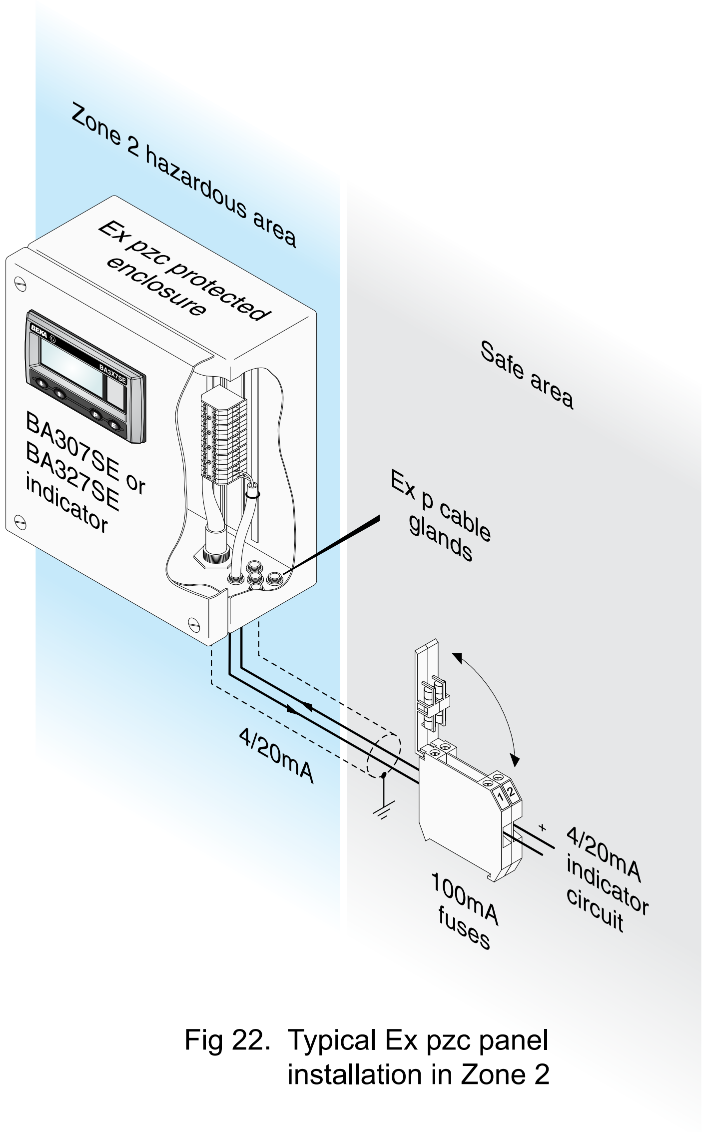


Fig 22. Typical Ex pzc panel installation in Zone 2

14. Ex ec in the USA and Canada

In North America IEC standards for flammable atmospheres, including IEC 60079-0 general requirements, IEC 60079-7 Increased safety and IEC 60079-11 Intrinsic safety have been published locally as UL 60079-0, UL 60079-7 and UL 60079-11 in the USA, and as CSA C22.2#60079-0, CSA C22.2#60079-7 and CSA C22.2#60079-11 in Canada. This allows apparatus with increased safety protection to be certified in North America and to be used within Zones in much the same way as in Europe, although installation requirements may differ.

The BEKA BA307SE and BA327SE indicators used to illustrate Ex ec installations in this guide, have the following US ETL and Canadian cETL Ex ec approvals.

ETL codes for USA
Class I Zone 2 AEx ec ic IIC T5 Gc
Zone 22 AEx ic tc IIIC T85ºC Dc [Dust certification]
Class I Division 2 Groups A, B, C, D
Class II Division 2 Groups E, F, G

Class III Division 2

-40ºC ≤ Ta ≤ +70ºC

cETL codes for Canada
Ex ec ic IIC T5 Gc
Ex ic tc IIIC T85ºC Dc [Dust certification]
Class I Division 2 Groups A, B, C, D
Class II Division 2 Groups E, F, G

Class III Division 2

-40ºC ≤ Ta ≤ +70ºC

The ETL Ex ec increased safety parameters are the same as the IECEx, ATEX & UKEX parameters, therefore the Ex ec application diagrams contained in this guide are applicable for US and Canadian installations, subject to compliance with the local codes of practice and the BEKA Control Drawing CI300-86 which is shown on the next page.

The Indicator's front panel push button contacts are non incendive and they have been certified intrinsically safe AEx ic in the USA and Ex ic in Canada, without the need for an external Zener barrier or galvanic isolator. This is the 'ic' code shown on the ETL Authorisation to Mark. This allows the loop powered indicator to be adjusted and configured live when installed in a Zone 2 or Division 2 hazardous area. These loop powered indicators are not intrinsically safe and therefore they should not be connected to an intrinsically safe loop.

14.1 Installation in Division 2

Both the USA and Canadian versions of the IEC General Requirement standard contain *national deviations* permitting the following additional product markings.

In the USA UL 60079-0:

29.19.1 DV.4 Class I, Division 2, Group A
Electrical equipment complying with all applicable Class I, Zone 0, Zone 1, or Zone 2, Group IIC requirements for any of the Class I, Zone 0, Zone 1, or Zone 2 types of protection are permitted to additionally be marked Class I, Division 2, Group A - along with the appropriate temperature class. Equipment marked Group A may also be marked Group A, B , C, D, or any combination thereof.

29.21.1 DV.2 Class II, Division 2, Group F
Electrical equipment complying with all applicable Zone 20, Zone 21, or Zone 22, Group IIIB requirements for any of the Zone 20, Zone 21, or Zone 22 types of protection are permitted to additionally be marked Class II, Division 2, Group F - along with the appropriate temperature class. Equipment marked Group F may also be marked Group F, G or any combination thereof.

29.23.1 DV Class III, Division 2, Equivalency Marking
Electrical equipment complying with all applicable Zone 20, Zone 21, or Zone 22, Group IIIA requirements for any of the types of protection, and with a temperature class of not greater than 120°C (for equipment that may be overloaded) or not greater than 165°C (for equipment not subject to overloading), are permitted to additionally be marked Class III, Division 2.

In Canada CSA:

29.1A Optional additional marking
Optional additional marking may include the appropriate Class, Division, Group, and temperature class marking based on the permitted installation of that type of protection according to the CE Code, Part I. If this optional Class, Division, Group, and temperature class marking is applied, the ambient temperature range shall be marked on the product.

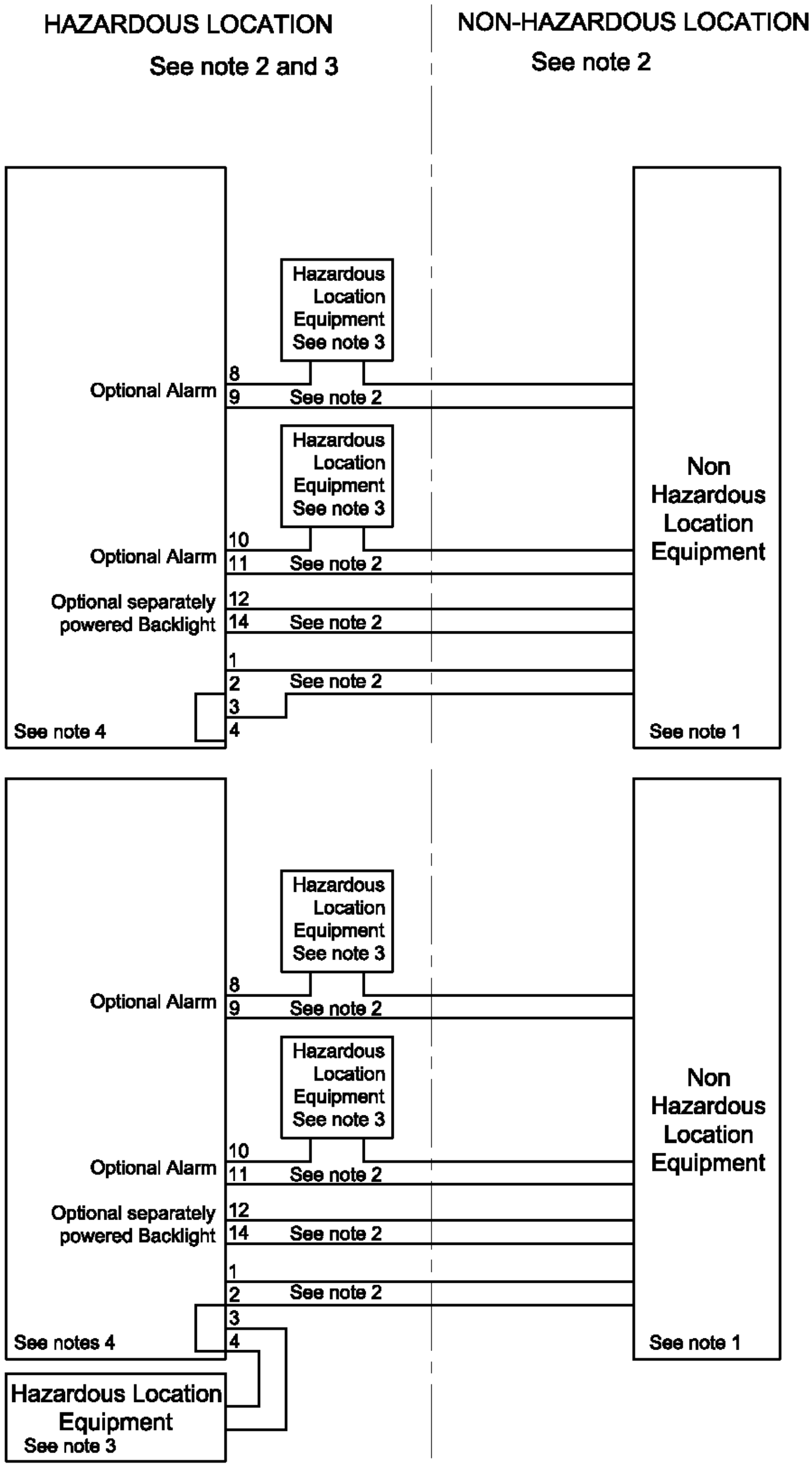
***Note:** As the default ambient temperature range in this Standard is different from that of Division-based products, the ambient temperature range is required to reduce the likelihood of misapplication.*

This allows AEx ec and Ex ec apparatus certified in the USA and Canada, such as the BA307SE and BA327SE to also be marked and to be installed in Division 2.

Class I	Division 2	Groups A, B, C and D
Class II	Division 2	Groups F and G
Class III	Division 2	

Division 2 installations in the USA and Canada should comply with BEKA Control Drawing CI300-86 and the local Code of Practice for non-incendive apparatus.

LOOP POWERED INDICATORS WITH SEPARATELY POWERED BACKLIGHT



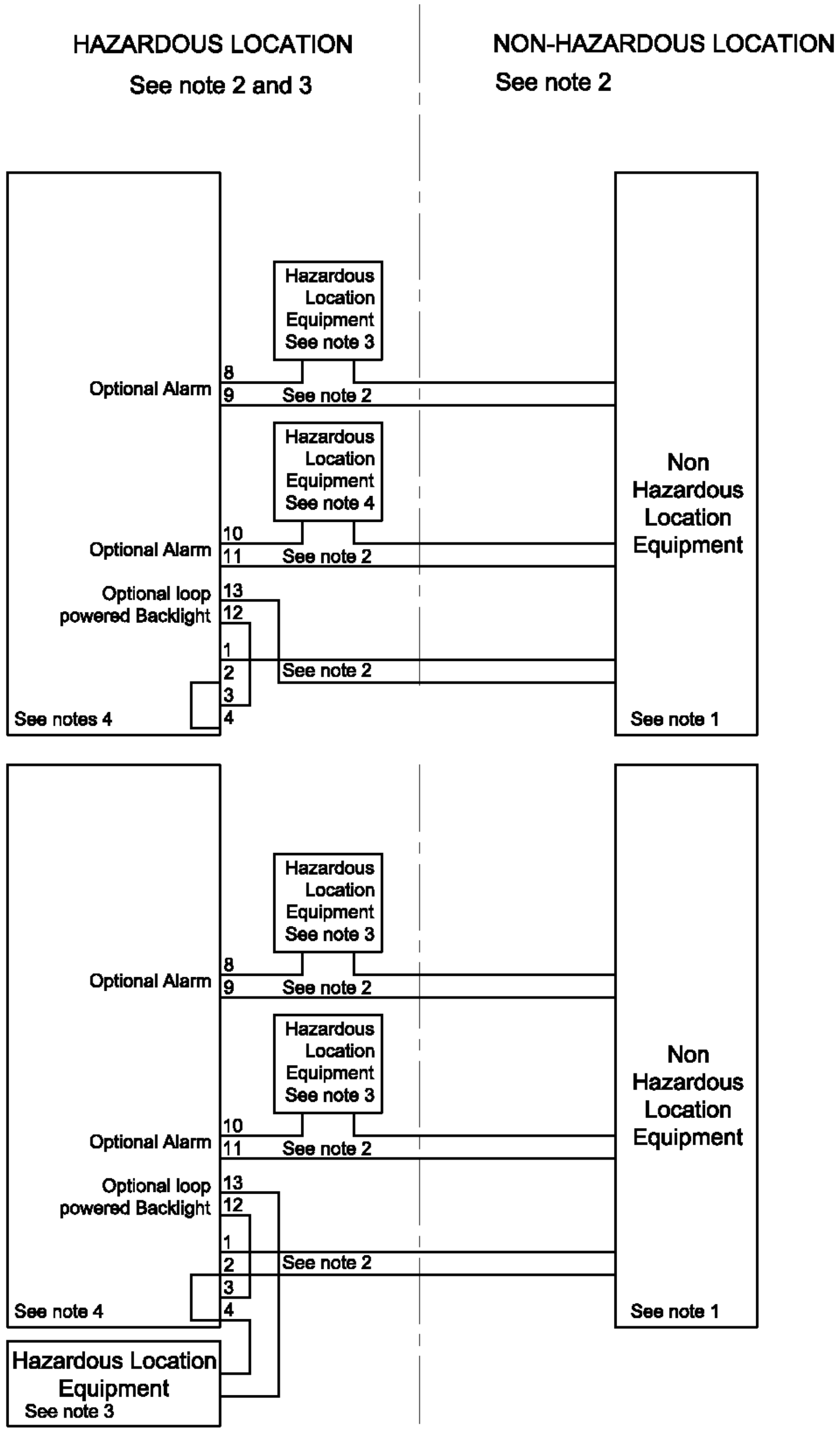
Iss.	Date	Modification	Ckd.	Appd.
1	30.06 2023	New drawing.		

BEKA associates
Hitchin England

Title: ETL Control Drawing for BA307SE and BA327SE LOOP POWERED INDICATORS	Drawn: KB	Checked:	Scale: –
	Drawing No. CI300–86	Sheet 1 of 3	

File No 300–86s01.dwg 30.06.23

LOOP POWERED INDICATORS WITH LOOP POWERED BACKLIGHT



Iss.	Date	Modification	Ckd.	Appd.
1	30.06 2023	New drawing.		

BEKA associates
Hitchin England

Title	Drawn	Checked	Scale
ETL Control Drawing for BA307SE and BA327SE LOOP POWERED INDICATORS	KB		–
	Drawing No. CI300–86	Sheet 2	

File No 300–86s02.dwg 30.06.23

Notes

1. The non-hazardous location equipment shall not use or generate more than 250V rms or 250V dc.

2. Field wiring installations shall be in accordance with the National Electrical Code ANSI/NFPA 70. Installations in Canada shall be in accordance with the Canadian Electrical Code C22.2.

3. Hazardous location equipment shall be NRTL Approved Ex e or Ex d Apparatus. For Canadian installations hazardous location equipment shall be NRTL or CSA Approved Apparatus.

4. Loop powered indicators with model numbers and coding as shown in the table below.

Models	Zones	Divisions	Ambient Temperature
BA307SE BA327SE	Class I Zone 2 AEx ec ic IIC T5 Gc Zone 22 AEx ic tc IIIC T85°C Dc Ex ec ic IIC T5 Gc Ex ic tc IIIC T85°C Dc	Class I Div 2 Groups A–D Class II Div 2 Groups E–G Class III Div 2	–40°C ≤ Ta ≤ +70°C

5. Ratings

TB1 4/20mA Loop Input – Terminals 1 & 3
Umax = 30V
Imax = 200mA

TB2 Backlight – Terminals 12 & 13 (4/20mA loop powered)
Umax = 30V
Imax = 200mA
(connected in series with TB1 terminals 1 & 3)

TB2 Backlight – Terminals 12 & 14 (separately powered)
Umax = 30V
Imax = 200mA

TB4 Alarms – each channel – Terminals 8 & 9; 10 & 11
Umax = 30V
Imax = 200mA

6. For Ex ec, the instrument must be installed within an Ex e or Ex pzc panel enclosure.

   For Ex tc, the instrument must be installed in Ex tc panel enclosure.

   For all installations, the instrument must be powered from a limited energy circuit and the vents located on the back of the instrument must not be obstructed.

   For instruments designated for type of protection pressurized equipment the supply circuit shall be rated for a prospective short circuit current of not more than 10kA.·

   The equipment must be installed in a panel that maintains at least one of the following types of protection:
   Ex e IIC Gc -40°C ≤ Ta ≤ +70°C·
   Ex pzc IIC Gc -40°C ≤ Ta ≤ +70°C·
   Ex tc IIIC Dc -40°C ≤ Ta ≤ +70°C with an enclosure meeting the requirements of either:
   IP5X for Groups IIIB & IIIA
   or IP6X for Group IIIC applications

Iss.	Date	Modification	Ckd.	Appd.
1	30.06 2023	New drawing.		
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Hitchin England

Title	Drawn	Checked	Scale
ETL Control Drawing for BA307SE and BA327SE LOOP POWERED INDICATORS	KB		–
	Drawing No. Sheet 3	CI300–86	

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