

# EPLs: Not as optional as you think!

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## Abstract

This paper introduces the new concept of Equipment Protection Levels (EPLs) for hazardous area electrical equipment as introduced in the 2009 editions of AS/NZS60070.10.0, AS/NZS60079.14 and AS/NZS60079.17. It covers the impact that EPLs will have upon:

- hazardous area classification
- electrical equipment markings
- the selection and installation of electrical equipment and wiring systems for hazardous areas

Practitioners will need a good working understanding of this new 'alternative' approach, even if they chose not to apply it, because although the 'new' approach is optional, it impacts the use of the 'historical' method.

## Introduction

The current versions of the IEC Standards for electrical equipment in hazardous areas have introduced the new concept of Equipment Protection Levels (EPLs). EPLs were introduced to enable an alternative approach to historical method of selecting electrical equipment for use in a hazardous area. As the AS/NZS standards are now based upon the IEC standards, EPLs are included in the Australian Standards for hazardous area classification, and equipment selection, installation, maintenance and inspection, that were issued in September 2009.

The new alternative approach breaks the rigid link between zone and explosion protection technique. For example, when using EPLs the user might be able to use Ex n equipment (historically restricted to Zone 2) in areas classified as Zone 1.

By assigning an EPL requirement to each hazardous area zone based upon a detailed risk assessment, the user can determine the equipment EPL required for the area.

The new approach requires that the EPL be marked on electrical equipment and that the hazardous area classification drawings also state the EPLs for each zone. In addition, the selection, installation, maintenance and inspection standards define the requirements for each EPL.

## Historical Method of Ex-Equipment Selection

It has always been acknowledged that not all explosion-protection techniques provide the same level of assurance against the possibility of an incendive condition occurring. For example, Ex n equipment is safe in normal operation, whereas Ex ia is safe with up to two faults. Therefore, Ex ia equipment is far less likely to create an incendive condition than Ex n equipment.

Hazardous areas are divided into zones, according to the probability of the occurrence of an explosive atmosphere. The previous installation standards, AS/NZS2381 (gases) and AS/NZS61241.14 (dusts), allocated specific explosion-protection techniques to specific zones, on the statistical basis that the more frequent the possible occurrence of an explosive atmosphere, the greater the level of security required against the possibility of an ignition source being present. In this historical approach, no account was taken of the potential consequences of an explosion. Thus, AS/NZS2381 provided a solid link between the explosion-protection techniques for the equipment and the zone in which the equipment could be used.

As AS/NZS2381 (gases) and AS/NZS61241.14 (dusts) only set minimum requirements, a plant owner perceiving a high level of risk, could choose to specify the use of equipment with a higher level of ignition safety than that required for the zone. For example, if the plant owner deemed the consequence of ignition of a flammable atmosphere in Zone 2 to be unacceptable, they could prohibit the use of typical Zone 2 equipment (eg. Ex n) and specify superior protection techniques such as Ex e or Ex d. However, the opposite was not true. The owner of a remote, un-manned, well secured, small pumping station could not drive a pump in Zone 1 with a 'zone 2 type' motor, even if the total amount of gas available to explode was small and the risk to life and property from such an explosion can be discounted.

## The New Approach to Ex-Equipment Selection

The new approach introduced in the recent AS/NZS60079 series standards, provides the user the flexibility to select explosion-protected electrical equipment based upon a complete risk analysis. The new approach affects the following aspects:

- hazardous area classification
- Ex-protected equipment marking
- the installation standards

The impact upon each of these aspects is covered in more detail below.

### ***Hazardous Area Classification and EPLs***

Regardless of whether or not EPLs are to be assigned based on a risk assessment by the plant owner, a hazardous area classification of the facility is required to zone the plant based upon the probability of a flammable atmosphere existing. For flammable gases and liquids the zones will be as follows:

- **Zone 0** place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is present continuously or for long periods or frequently
- **Zone 1** place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is likely to occur in normal operation occasionally
- **Zone 2** place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is not likely to occur in normal operation but, if it does occur, will persist for a short period only

For combustible dusts the zones will be:

- **Zone 20** area in which an explosive atmosphere in the form of a cloud of combustible dust in air is present continuously, or for long periods or frequently
- **Zone 21** area in which an explosive atmosphere in the form of a cloud of combustible dust in air is likely to occur, occasionally, in normal operation
- **Zone 22** area in which an explosive atmosphere in the form of a cloud of combustible dust in air is not likely to occur in normal operation but, if it does occur, will persist for a short period only

If the plant owner decides that EPLs are **not** to be assigned based upon a risk assessment the default values stated in Table 1 below shall be applied when selecting electrical equipment. When the default values are used, effectively the same explosion-protection techniques as permitted by AS/NZS2381 can be used. For example, using the historical method Ex d is permitted in Zone 1. The default EPL for Zone 1 is 'Gb', and Ex d has been deemed by the equipment standard to offer protection level 'Gb'. Therefore, Ex d is still allowed in Zone 1 when the default values are used from Table 1.

**Table 1**

Zone	Default EPL	Permitted Equipment EPLs
0	'Ga'	'Ga'
1	'Gb'	'Ga' or 'Gb'
2	'Gc'	'Ga', 'Gb' or 'Gc'
20	'Da'	'Da'
21	'Db'	'Da' or 'Db'
22	'Dc'	'Da', 'Db' or 'Dc'

NOTE: The definitions for the EPLs will be given later in the section covering equipment marking.

The default values are required because the new installation standard is written in terms of EPLs rather than Zones. For example, if the user wants to know which type of cabling system is allowed in Zone 1, the relevant table in AS/NZS60079.14 only shows the cables allowed based upon the EPL required for the location. There is no mention of zone.

If the plant owner decides to conduct a risk assessment, the correlation between zone and EPL shown above in Table 1 can be varied. Risk based adjustments for EPL are intended only to be applied by organisations where a formal risk management and operational frameworks has previously been established e.g. the organisation already operates under a safety case management regime or has national or international management framework covering standards and processes to be applied.

After the completion of the hazardous area classification, a risk assessment is carried out to assess whether the consequences of ignition of an explosive atmosphere requires the use of equipment of a higher equipment protection level (EPL) than the default values in Table 1. Alternatively, the assessment may justify the use of equipment with a lower equipment protection level than the default values.

Assigning EPLs to hazardous areas is not intended to be carried out without thorough and careful consideration. Accordingly, for risk based EPL assessments the following shall be apply:

- Hazardous area classification shall be included in the assessment.
- The assessment shall be made with input from person(s) with the relevant competencies and experience in the areas of:
  - Hazardous area classification;
  - Risk assessment;
  - Process and plant design; and
  - Plant operations.

NOTE: It is desirable that these persons are from multi-discipline teams. Other members may also need to be considered e.g. legal, OH&S and general management.

- The risk assessment shall be conducted via a formal process (e.g. risk assessment workshop using a facilitator or leader), and the results and rationale shall be formally documented and retained.
- The EPLs assigned shall be recorded as part of the hazardous area classification drawings and charts. References to assessments and any corporate guides for EPLs shall be included in this documentation.

Where a risk assessment is carried out to assess consequence of ignition, the acceptable range of adjustments to the default EPLs in Table 1 is given in Table 2 below.

**Table 2**

<b>Zone</b>	<b>Acceptable EPL range</b>
0, 20	a, b
1, 21	a, b, c
2, 22	a, b, c
Non Hazardous	a, b, c or none

The key points are:

- When the risk is deemed to be low, the EPL can only be reduced by 1 level. For example, EPL 'Gc' cannot be assigned to Zone 0.
- For Zone 2 or Zone 22, even if the risk is deemed to be low, the EPL cannot be deemed to be none (which would allow non-certified equipment), it must remain at 'Gc' or 'Dc' respectively.
- When the risk is high, there is no limit as to the increase in the EPL level.

It should be noted that EPLs may be assigned on factors other than risk assessment. Such factors may include:

- Standardization of equipment for installation and maintenance issues.
- Preference or requirement for an IP rating or impact rating afforded by the protection technique of a particular EPL.

NOTE – An example where enhanced IP or impact ratings may be required is a coal handling plant where EPL b equipment offers improvements in both ratings, over what might otherwise be accepted for a Zone 22 classification.

However, where other than risk based EPL assessment is applied, the EPL assigned shall be not less than the default assignment shown in Table 1.

Where factors other than risk are considered, the decisions may be accepted by the relevant responsible person(s) in the owner or operators organization. Such decisions shall be recorded in relevant documentation and noted on hazardous area/EPL drawings.

### ***Explosion-protected Equipment Markings and EPLs***

Historically, although explosion-protected electrical equipment carried markings identifying the applicable technique(s), the markings on the equipment did not indicate the allowable zone(s) of use. The installation standards AS/NZS2381 (gases) and AS/NZS61241.14 (dusts) define the acceptable zones of use based upon the perceived safety of the technique.

The latest explosion-protected electrical equipment standards require that the EPL afforded by the technique(s) used by the equipment be marked on the equipment. Therefore, there is now a direct link between

the EPL for the hazardous area and the marking of the equipment. If the user knows that a specific area requires equipment providing EPL 'Gb', then he can look at the equipment and determine if it is suitable.

For above ground industries the EPLs are as follows:

- **EPL Ga** Equipment for explosive gas atmospheres, having a 'very high' level of protection, which is not a source of ignition in normal operation, expected faults or when subject to rare faults.
- **EPL Gb** Equipment for explosive gas atmospheres, having a 'high' level of protection, which is not a source of ignition in normal operation or when subject to faults that may be expected, though not necessarily on a regular basis.  
NOTE: The majority of the standard Ex-protection concepts bring equipment within this equipment protection level.
- **EPL Gc** Equipment for explosive gas atmospheres, having a 'enhanced' level of protection, which is not a source of ignition in normal operation and which may have some additional protection to ensure that it remains inactive as an ignition source in the case of regular expected occurrences (for example failure of a lamp).  
NOTE Typically this will be Ex n equipment.
- **EPL Da** Equipment for combustible dust atmospheres, having a 'very high' level of protection, which is not a source of ignition in normal operation or when subject to rare faults.
- **EPL Db** Equipment for combustible dust atmospheres, having a 'high' level of protection, which is not a source of ignition in normal operation or when subject to faults that may be expected, though not necessarily on a regular basis.
- **EPL Dc** Equipment for combustible dust atmospheres, having an 'enhanced' level of protection, which is not a source of ignition in normal operation and which may have some additional protection to ensure that it remains inactive as an ignition source in the case of regular expected occurrences.

The marking of the EPL can take one of two forms. The EPL can be marked as a suffix to the usual protection marking, or as an integral part of the historical marking. Following are two possible markings for an Ex d IIB T3 motor. Ex d has been deemed to offer protection at a level 'Gb'.

- Ex d IIB T3 Gb - suffix
- Ex db IIB T3 - integral

Some readers will have noticed that the concept of the integral marking is not completely new. Intrinsic safety has been doing this for years to differentiate between Ex ia (Zone 0) and Ex ib (Zone 1). Under the new

marking requirements, Ex ia (which offers protection at level 'Ga') can be marked in one of the following two ways:

- Ex ia IIC T6 Ga
- Ex ia IIC T6 (ie no change to the previous standard as the 'a' was already stated after the 'i')

The marking can get more complicated for mixed techniques. An Ex edqm IIC T4 light fitting (which offers protection at level 'Gb') could be marked in one of the following two ways:

- Ex edqm IIC T4 Gb
- Ex ebdbqmb IIC T4

These new markings are determined by the equipment standards. Therefore even if the user will not be using EPLs, the user needs to understand that the equipment will have extra markings. These extra letters could be integral to the markings that the user is familiar with.

The potential for confusion is magnified by the emerging trend for mechanical equipment to be marked for hazardous area duty. The European ATEX Directives require marking on mechanical potential ignition sources such as pumps and fans. This will eventually migrate to IEC and hence AS/NZS. The main problem is that the mechanical standards already use the letters 'b' and 'c' to indicate protection methods. This use of the same letter for a technique and an EPL is bound to cause issues. The author has already been confused by an Ex dc IIC T4 motor/pump set, that he initially thought was incorrectly deemed to be suitable for EPL 'Gc' rather than the correct 'Gb', only to find the motor was certified to the older AS/NZS60079.0 and had no EPL markings. The 'c' was for the pump protection!!

### ***Selection and Installation Standards and EPLs***

AS/NZS60079.14 (which will replace AS/NZS2381 and AS/NZS61241.14) does not mention zones. All of the clauses in the standard refer to EPLs rather than zones. Therefore the user must convert the zones in the plant to EPLs to use the standard. For example, AS/NZS60079.14 clause 9.3.6 states:

#### ***9.3.6 Additional requirements for locations requiring EPL 'Gb'***

*Flexible cabling shall be one of the types specified in Table 7, as appropriate, except for flexible cords or cables that are an integral part of electrical equipment, provided such equipment, including the cable, complies with the appropriate Standard for the type of explosion-protection concerned.*

If the default EPL assignment is being used, the above clause applies to Zone 1, but not Zone 2. However, the clause could apply to Zone 2 if an assessment had deemed that for a specific plant Zone 2 required an installation providing EPL Gb.

Similarly, for non-IS circuits in Group II, AS/NZS60079.14 clause 9.3.2.2 states in part:

*Wiring systems for non intrinsically safe and non energy limited circuits shall be selected in accordance with Table 6.*

As can be seen below, Table 6 is based on EPLs, not zones.

Table 6 - Non-intrinsically safe and non energy limited wiring systems in hazardous areas			
Type of wiring system	EPL Ga	EPL Gb	EPL Gc
Cables in metallic conduit and fittings complying with AS/NZS 2053.1 and AS/NZS 2053.7 and the appropriate protection technique for the area in which they are to be installed.	P	P	P
Served MIMS.	*	P	P
Thermoplastic, thermosetting or elastomeric sheathed unarmoured.			P
Thermoplastic, thermosetting or elastomeric sheathed with armouring or braiding designed for mechanical protection.	*	P	P
Cables in rigid and corrugated, non-metallic conduit, minimum light duty, complying with AS/NZS 2053.1, AS/NZS 2053.2 and AS/NZS 2053.5.			P
Metal sheathed, served and armoured.	*	P	P
Flexible cords and cables in accordance with 9.3.5.	*	P	P
Metal sheathed, served and unarmoured.			P
Flexible steel conduit with non-metallic serving to AS/NZS 2053.1 and AS/NZS 2053.8.			P
Trunking, ducts, pipes or trenches installed to meet the requirements of 9.6.8.		P	P
Flexible conduit assemblies complying with the relevant requirements of AS/NZS 60079.1		P	P
P denotes permitted use.			
* This wiring system may be installed in a location requiring EPL Ga, if provided with additional protection to counter the harmful environmental effects detailed in 9.5.1.			
For additional requirements for conduit refer to 9.4.			

Based on the above, AS/NZS60079.14 cannot be applied unless the user has assigned EPLs to the hazardous area classification, or the default EPL assignment in Table 1 is applied by the user of the standard.

## Conclusions

EPLs provide users with the ability to select electrical equipment for hazardous areas based upon a risk assessment, rather than a rigid "one-size-fits-all" approach.

Assigning EPLs on a risk basis is optional. Users can decide to simply apply the default EPL assignment which results in the same techniques being used as per AS/NZS2381 and AS/NZS61241.14. However, the user must still understand EPLs as they will affect equipment markings and the new installation standard is written in terms of EPLs rather than zones.

***There is NO escaping EPLs!!!!***