



# ELECTRICAL SAFETY – NO COMPROMISE



## SEALING CABLES IN EXPLOSIVE ATMOSPHERES

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- 1) Main Function of Cable Glands
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- 12) IEC 62444:2010

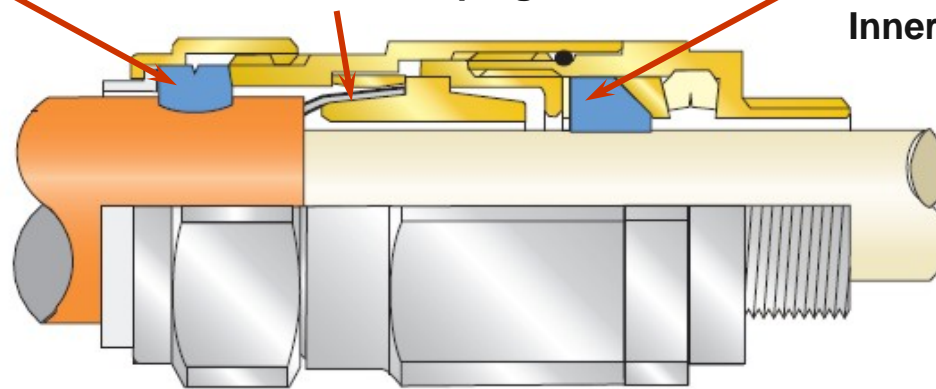


# CABLE GLAND MAIN FUNCTIONS

Environmental & Load  
Retention Seal on  
Cable Outer Sheath

Earth Continuity by Means  
of Armour Clamping

Explosion Protection  
Via Seal on Cable  
Inner Bedding



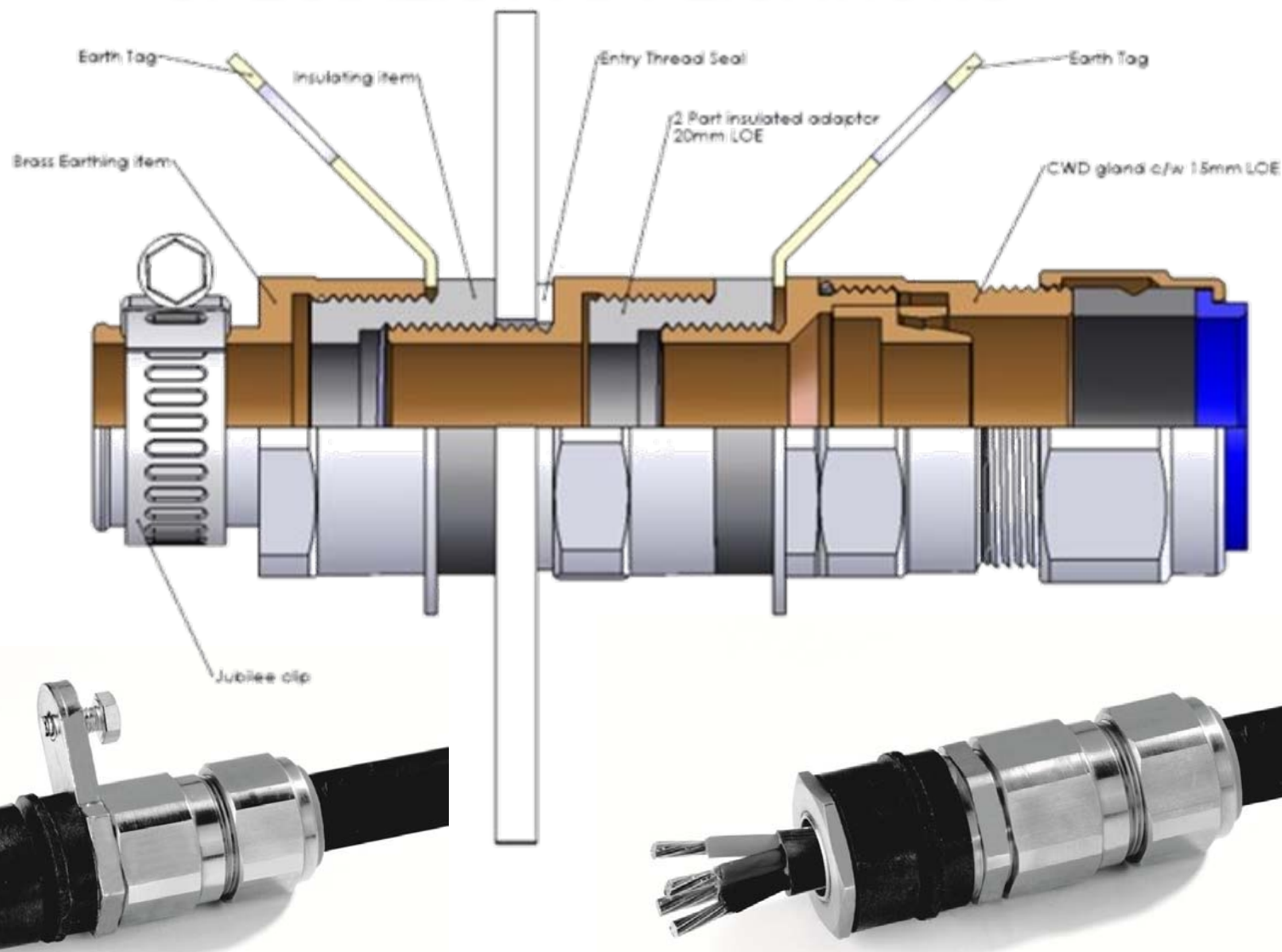
**Typical (SWA)  
Single Wire  
Armour Cable**



- ▣ Ingress Protection
- ▣ Earth Continuity
- ▣ Cable Anchorage & Retention
- ▣ Protection technique / sealing cables in explosive atmospheres



# SPECIALIST APPLICATIONS





# SELECTION AND INSTALLATION



**When things go wrong  
Who is responsible ?  
Who takes the blame?**





# COMMON CABLE GLAND ISSUES

Issue	Selection	Product Design	Installation
Doesn't maintain equipment integrity	<input checked="" type="checkbox"/>		
Incompatible with cable	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Doesn't meet required standards	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Over tightening		<input checked="" type="checkbox"/>	?
Lack of earth continuity		<input checked="" type="checkbox"/>	?
Cable not secured effectively		<input checked="" type="checkbox"/>	?
Water Ingress / Corrosion		<input checked="" type="checkbox"/>	?
<b>Stakeholder</b>	<b>Client Engineer</b>	<b>ISO 9001 Manufacturer</b>	<b>Contractor</b>



# COMPLIANCE / STANDARDS

Standards & Other Requirements to Consider	
MDA / QMD	No longer issued or current
AS/NZS 2380 series	Withdrawn 2005
IEC 60079 series	Fully endorsed by Australia
AS/NZS 4871	Last updated in 2010
AS/NZS 1972	Last updated 2006
AS/NZS 60079.14	First published September 2009. Defines design, selection, and erection - Applies to Group I Mining situations along with Groups II & III
AS/NZS 2381 series	Was to be withdrawn September 2011.
Certification Scheme	AUS Ex, ANZ Ex, IEC Ex
Risk Assessment	Equipment Protection Levels (EPL)
Dust Hazards (Zones 20, 21 & 22)	DIP or Ex t IIIC A21 IP6X EPL Db to IEC or AS/NZS 61241?
AS/NZS 60079.0 – Annex A	Clause A.2.5 (Release by a tool), Once installed cable glands should not be able to be opened by hand
AS/NZS 60079.1	Flame transmission tests of cables and cable glands - per AS/NZS 60079.14
AS/NZS 60079.17	Section 4.7 (Environmental Conditions) All bolts and cable entries remain tight Section 4.12.5 (Cable Glands) Inspectors check for tightness by hand

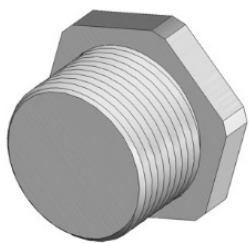


# STANDARD AS/NZS 4871:2010

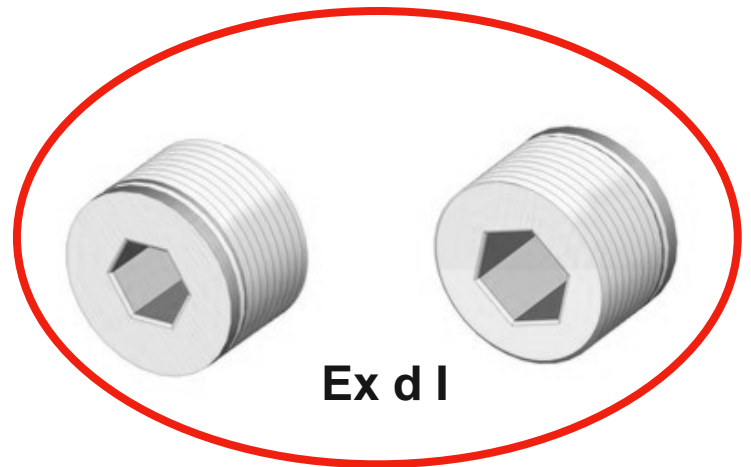
## 2.2.4 Unused openings and threaded entries

Unused openings and threaded entries shall be closed or plugged so the degree of protection (see Clause 2.2.1) or the explosion-protection integrity of the enclosure or both is maintained.

Precautions shall be taken to prevent release during normal service conditions.



Ex d I



Ex d I





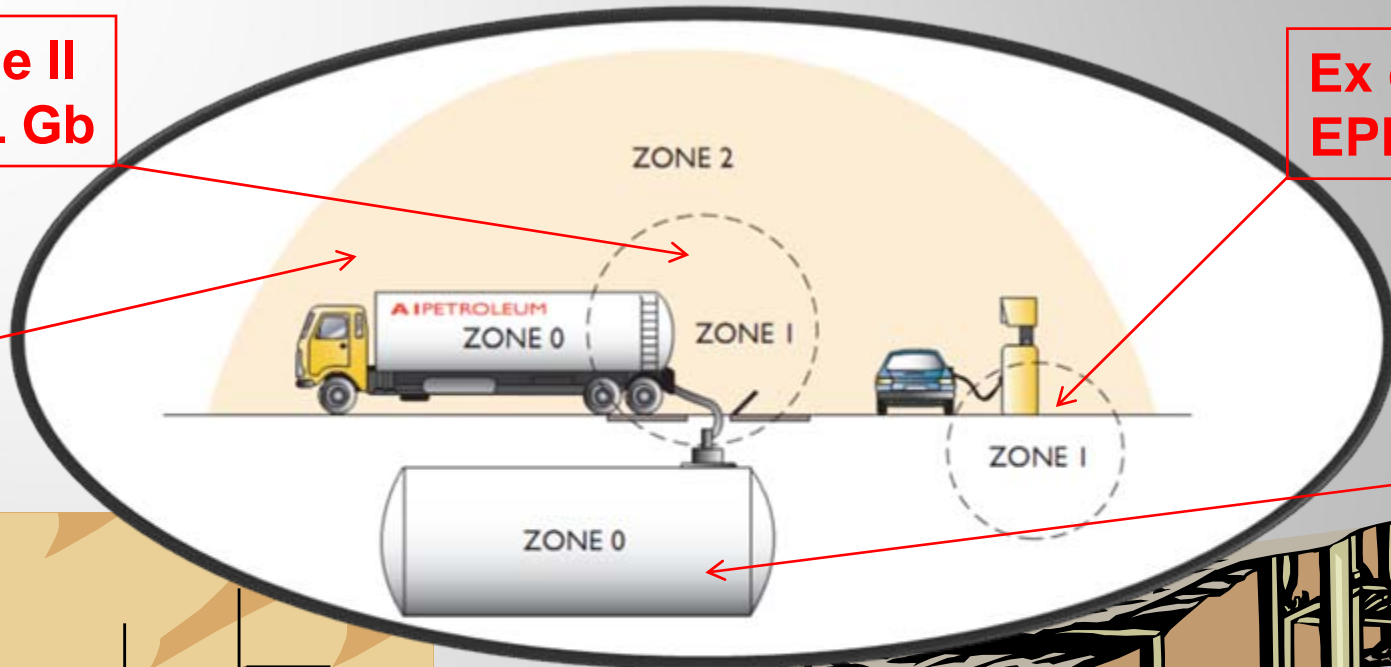
# EXPLOSIVE ATMOSPHERES

**Ex e II  
EPL Gb**

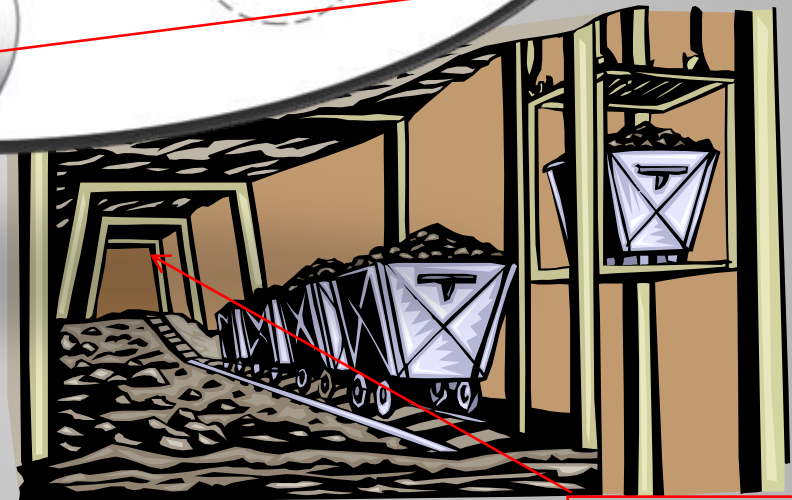
**Ex d IIC  
EPL Gb**

**Ex nR II  
EPL Gc**

**Ex ia II  
EPL Ga**



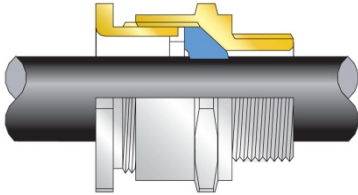
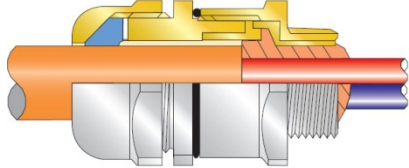
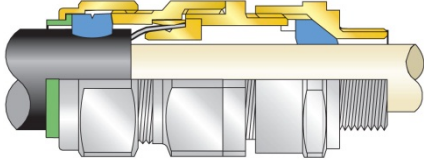
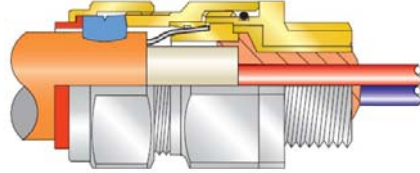
**Ex ta IIIC (DIP)  
EPL Da IP6X**



**Ex d I  
EPL Mb**



# FLP SEALING RING OR BARRIER SEAL ?

Generic Cable Type	Method of Protection / Sealing	
	Sealing Ring	Barrier Seal
Unarmoured Cable		
Armoured Cable		

Ex d I / IIC EPL Mb / Gb

Ex d I / IIC EPL Mb / Gb

- IEC Ex certification is the same for all types
- How do we select ?
- When is a barrier seal required ?

Ex d I EPL Mb, Ex d IIC EPL Gb,  
Ex e II EPL Gb, Ex nR II EPL Gc,  
Ex ta IIIC EPL Da



# STANDARD AS/NZS 4871:2010

## 3.5.2 Explosion protected enclosures

(c) Sealing - Where conductors are extended through a common wall between two flameproof enclosures or from a flameproof enclosure to external atmosphere, they shall be sealed in accordance with the enclosure certification.

Where multicore or data cables, including fibre optic, are used they shall be sealed with a certified barrier gland or be verified by test for non-transmission of flame.



# CABLE STANDARD AS/NZS 1972:2006

## 1.2 Application

Cables shall comply with the relevant requirements of the following Standards, as appropriate for the types of cables specified.

Section 2 AS/NZS 5000.1

Section 3 AS/NZS 1026 or AS/NZS 1429.1

Section 5 AS/NZS 5000.1

Type 1, 2, **2S**, 3, 3S, 7, 7S, 8

Section 5 AS/NZS 5000.1 **and AS/NZS 60079.1**

Type 9



# CABLE STANDARD AS/NZS 1972:2006

## 5.9.9 Tests (Type 9 Cable)

The cable shall be tested in accordance with AS/NZS 5000.1 except that the high voltage test shall be carried out at a voltage of 1.5 kV.

The cable construction shall comply with the requirements of the test for non-transmission of an internal ignition in AS/NZS 60079.1 when terminated through an Ex d gland to an Ex d enclosure except that the cable shall extend no more than 100 mm from the rear of the compression point and be flush with the point of entry.





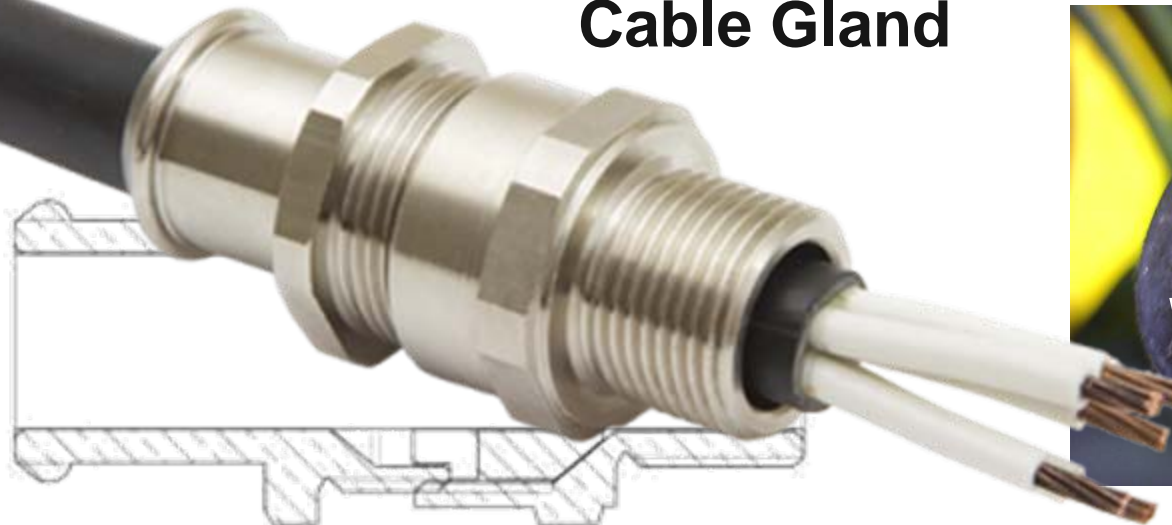
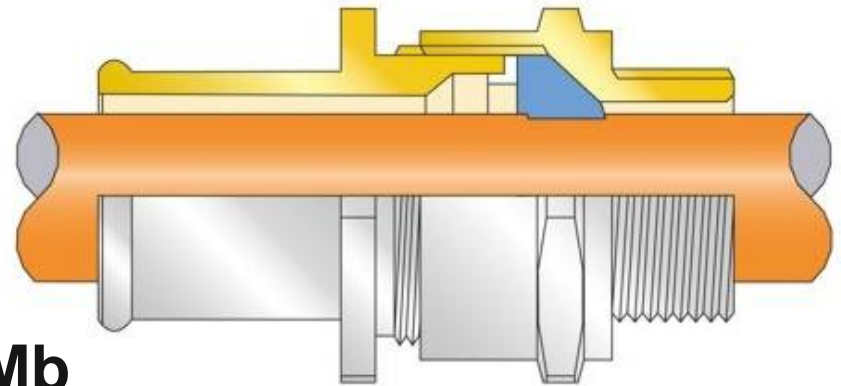
# AS/NZS 1972 - TYPE 2S CABLES

## 5.5.6 Fillers

Where used, fillers shall be non-hygroscopic



Ex d I EPL Mb  
Cable Gland



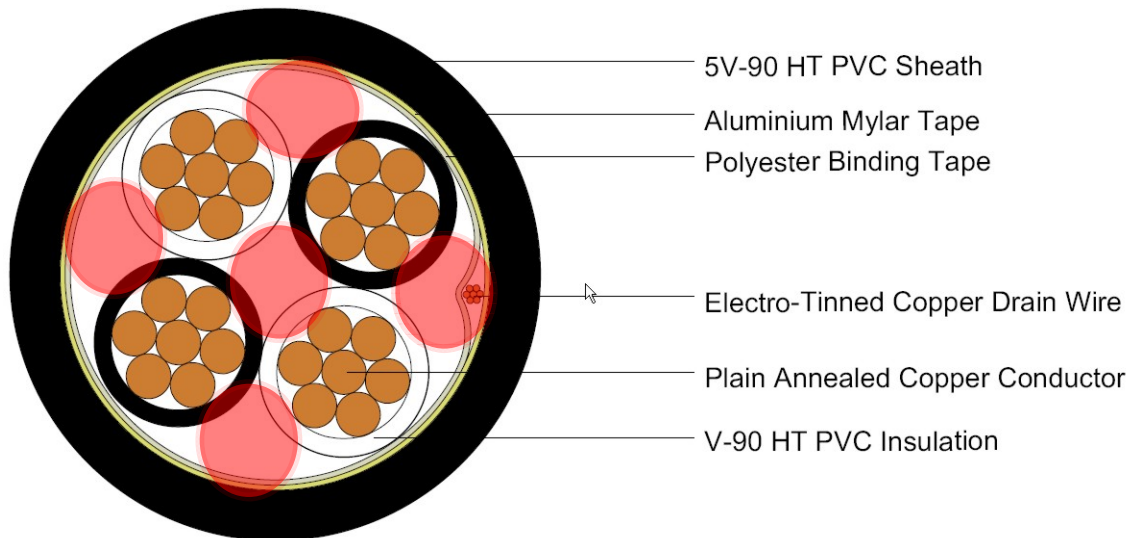
When is a Barrier  
Gland required ?



## AS/NZS 60079-14:2009 – (10.4.2.)

For Group II Flameproof Type d enclosures, the cable should :-

- I. Substantially compact and circular (i.e. specifically the part of the cable entering the enclosure)
- II. Have an extruded bedding (penetrating around the conductors – no gaps)
- III. Have fillers, if any are used, which are Non-Hygroscopic  
*(Not have the ability to absorb or transport water molecules)*





# CABLE DIVERSITY

AS/NZS, IEC, BS, other

- ▣ Power, Control, Lighting, Instrument, Data, Fibre
- ▣ LV, MV, HV, EHV
- ▣ Shielded (IS or OAS), Unshielded
- ▣ Paper Insulated Lead Covered
- ▣ Unarmoured
- ▣ Armoured
  - Single Wire Armour (SWA)
  - Steel Tape Armour (STA, DSTA)
  - Braided (GSWB, BWB, CWB)
  - Pliable Wire Armour (PWA)
  - Strip Armour (ASA)
  - Corrugated Metal Clad or Steel Tape



**Must be selected, installed & sealed correctly**



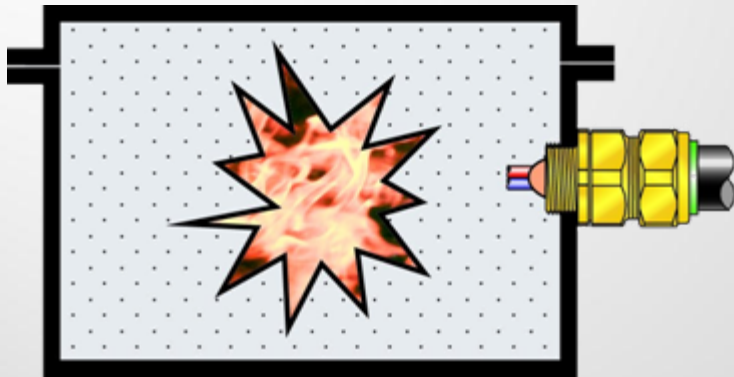
# AS/NZS 60079.14:2009 – TABLE 6

Type of wiring system (Group II Gas)		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
Zone 2 (EPL Gc)	Thermoplastic, thermosetting or elastomeric sheathed unarmoured.			P
				P
				P
Zone 1 & Zone 2 (EPL Gb, Gc)	Thermoplastic, thermosetting or elastomeric sheathed with armouring or braiding designed for mechanical protection.			P
				P
				P
				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.				

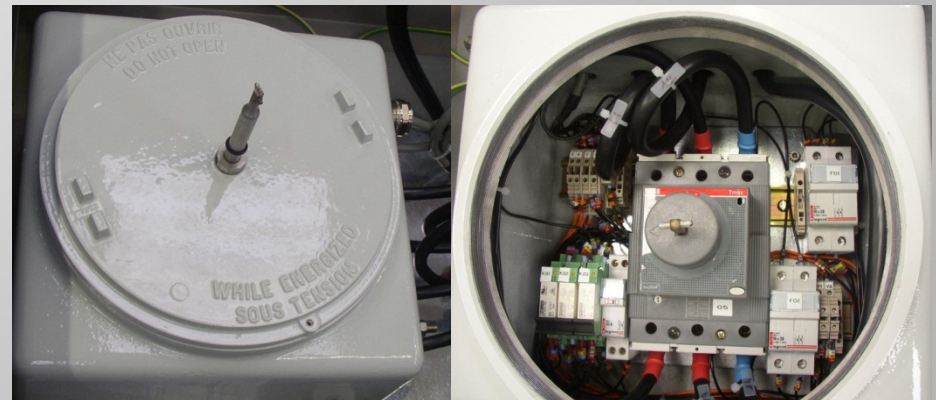


# FLAMEPROOF 'D' CABLE ENTRIES

## Flameproof Type d Cable Entry (AS/NZS 60079.1)



- Direct Entry – Ex d







## AS/NZS 60079-14:2009 – (10.4.2)

Group II Certified to AS/NZS 60079.1. Five options exist.

- a) Cable gland certified as part of the equipment along with specified cable.
- b) Cable gland with a sealing ring following Figure 2, provided cable selected suits defined criterion. ☒
- c) M.I.M.S. cable with matching certified cable gland.
- d) Flameproof sealing device (e.g. sealing chamber with compound) plus certified cable gland.
- e) Flameproof cable gland with compound or elastomeric seal around the individual cores. ☒

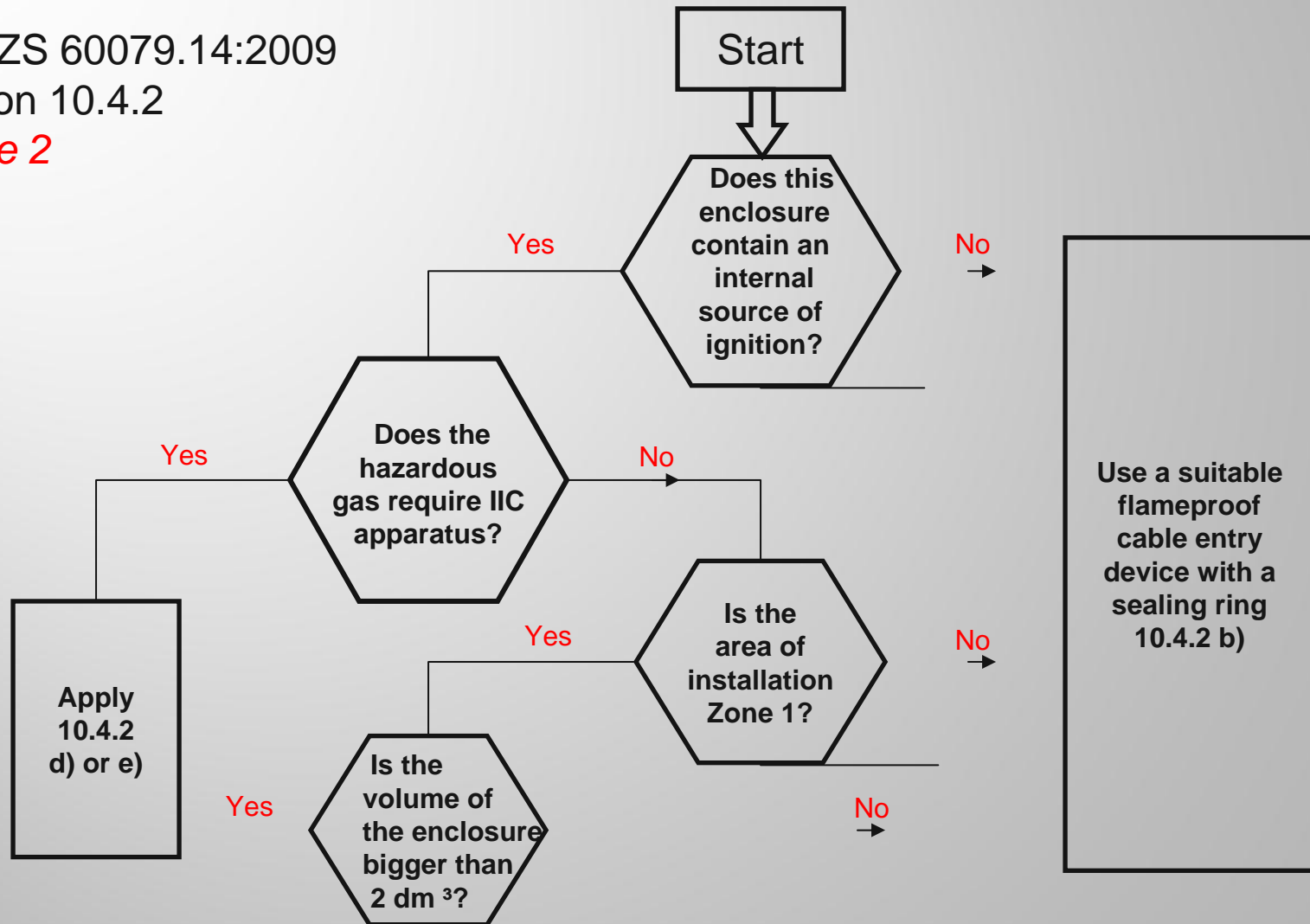


# AS/NZS 60079-14:2009 – (10.4.2)

AS/NZS 60079.14:2009

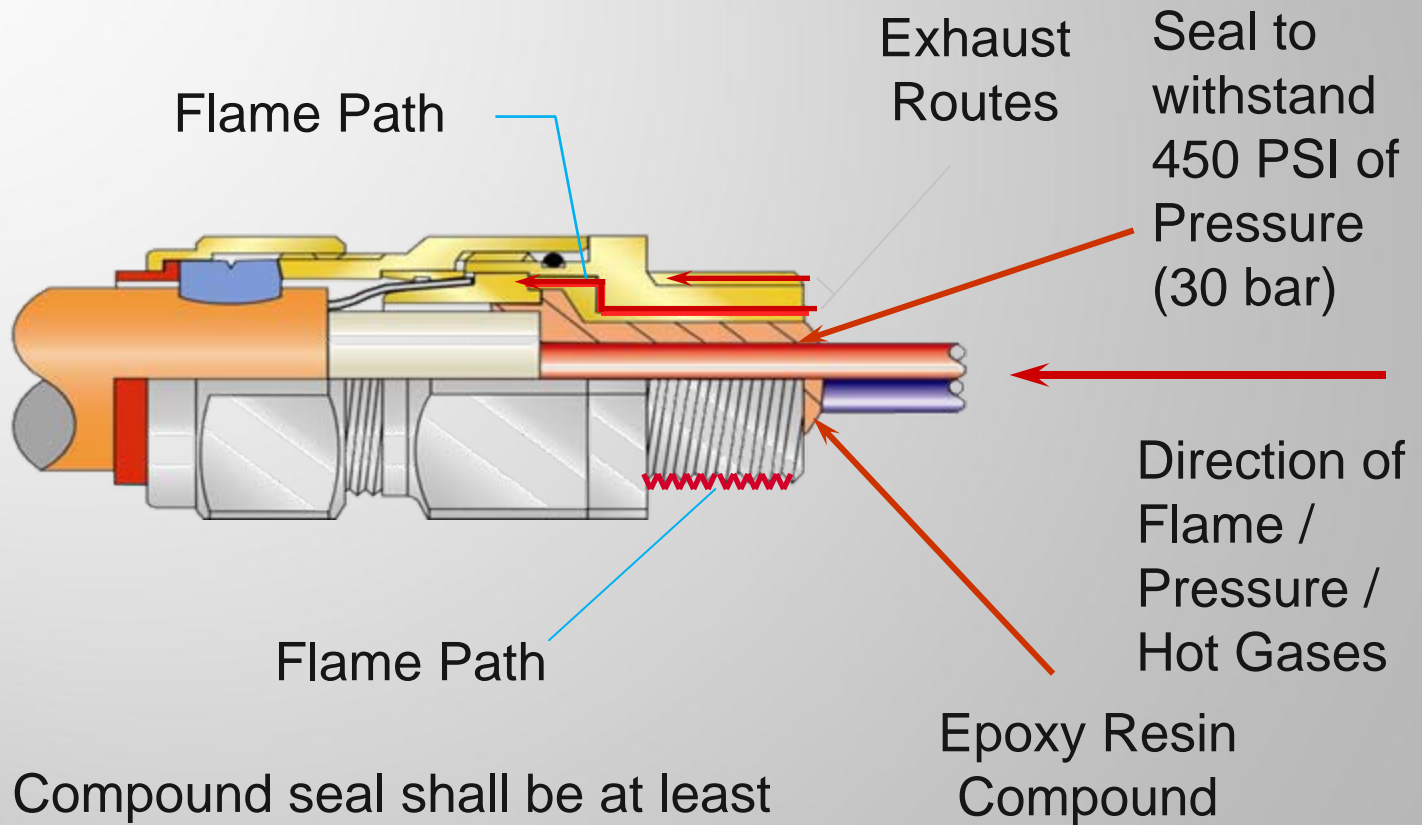
Section 10.4.2

*Figure 2*





# COMPOUND BARRIER SEAL



Compound seal shall be at least 20% of the cross sectional area

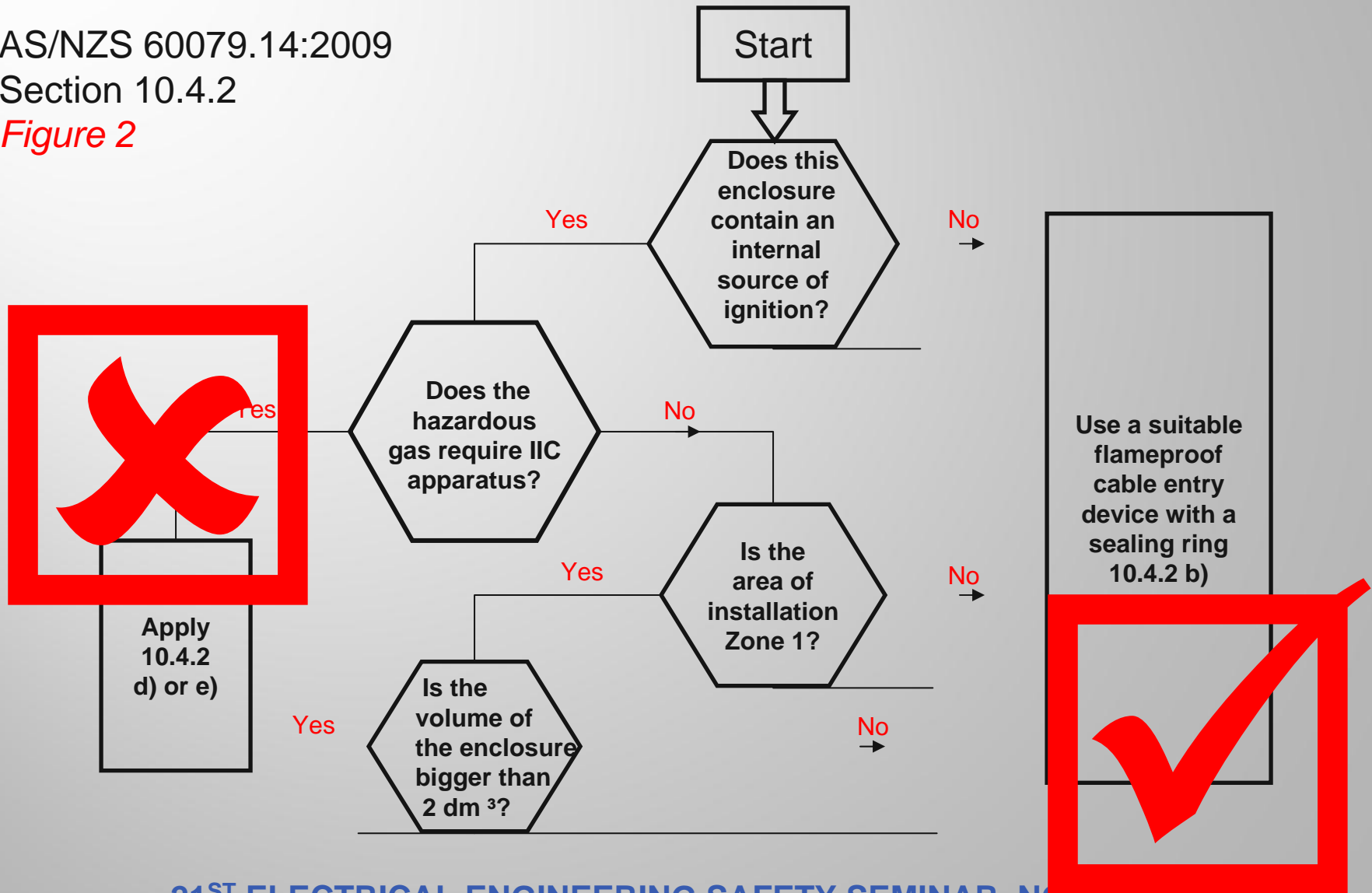


# AS/NZS 60079-14:2009 – (10.4.2)

AS/NZS 60079.14:2009

Section 10.4.2

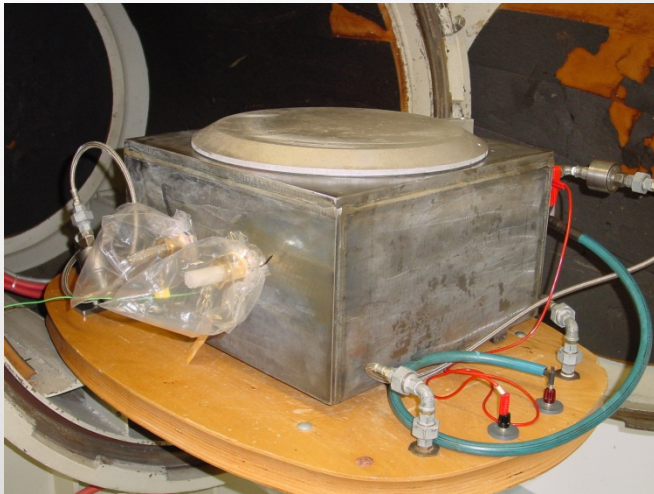
*Figure 2*





# IGNITION TEST SET UP

Flameproof Type 'd' enclosure mounted in test chamber



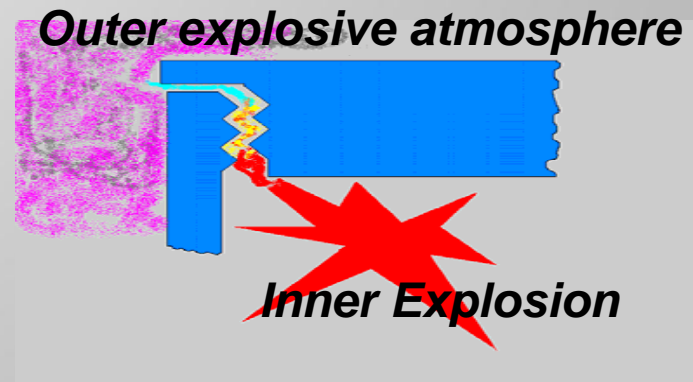
Test Condition:

5 tests with pre-pressure of 0.5 bar

Mixture:  $\text{H}_2$ -Air (28 +/- 1)%  $\text{H}_2$

$\text{C}_2\text{H}_2$ -Air (7.5 +/- 1)%  $\text{C}_2\text{H}_2$

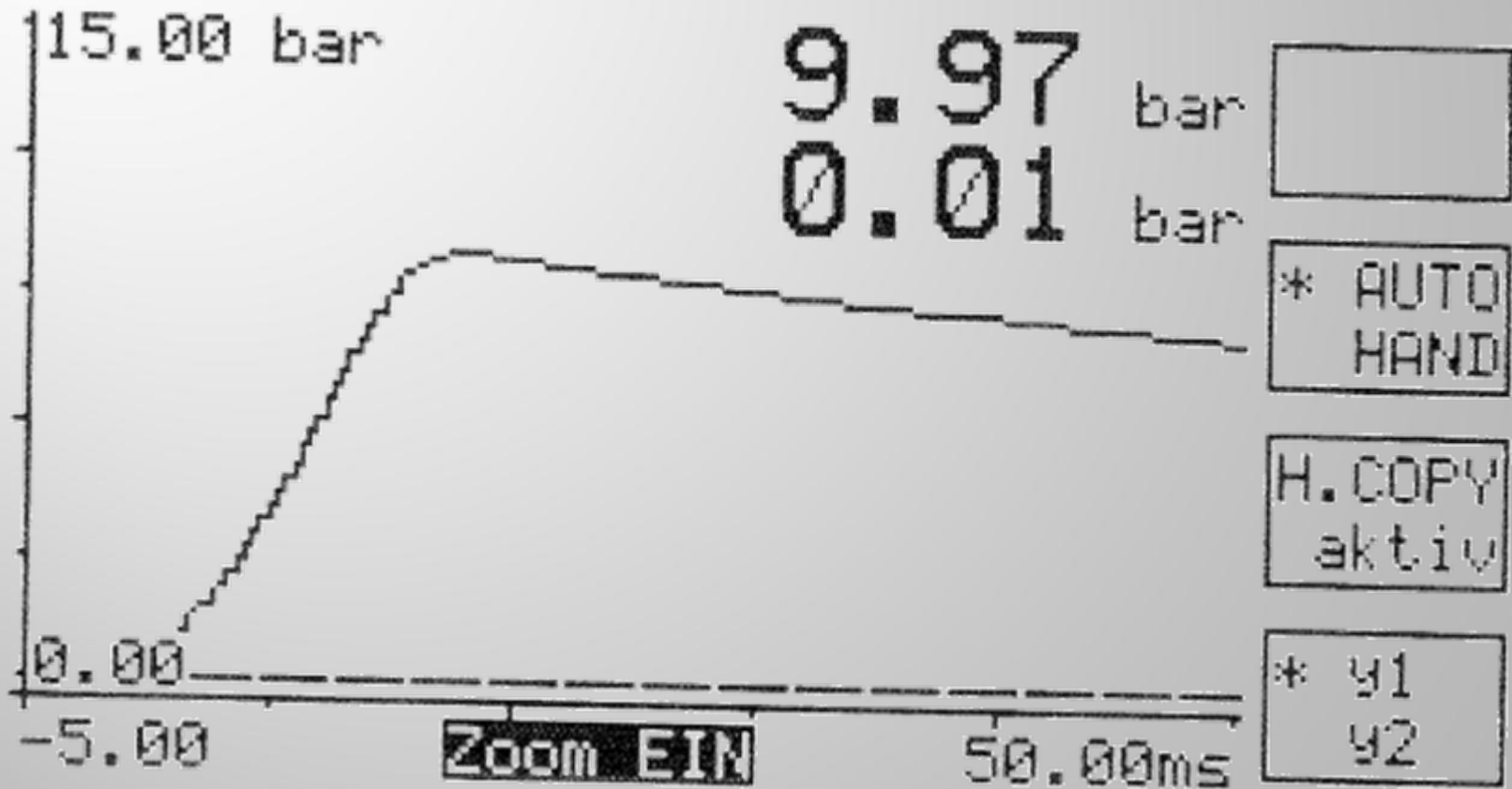
Cable Length: 145 mm





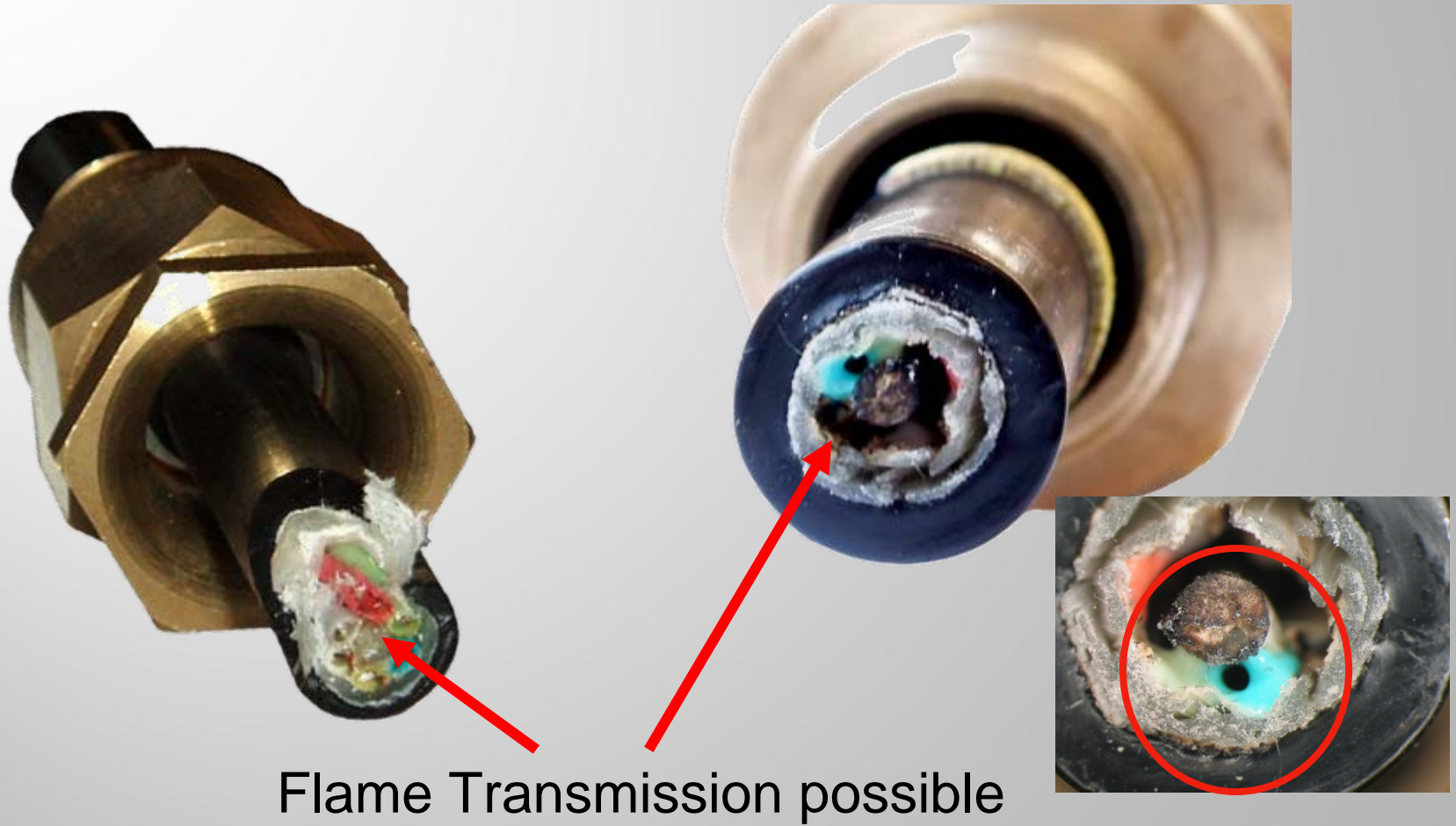


# EXPLOSION PRESSURE / TIME





# FAILED CABLE SAMPLES



Flame Transmission possible



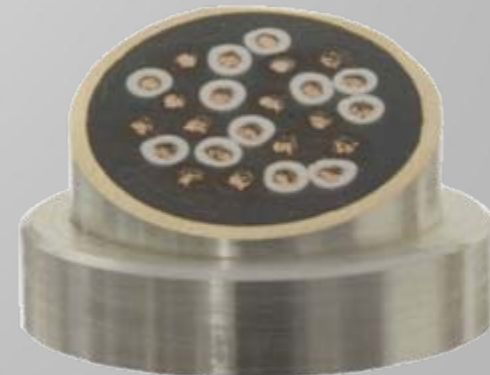
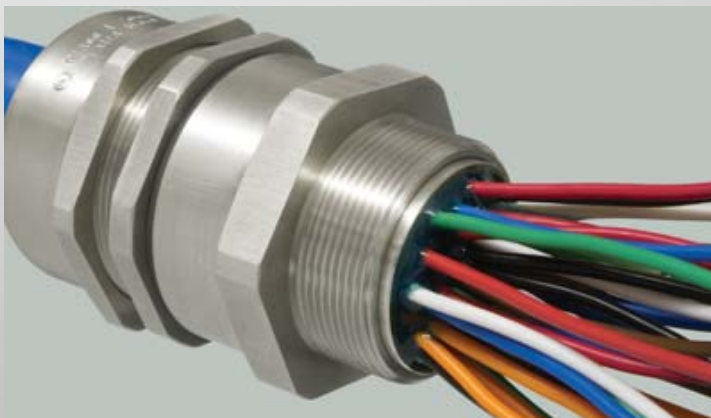
# IGNITION TEST FACTS

- ▣ Growing number of fibre optic cables and other special cables for communication applications.
- ▣ 4 year period a series of 72 different ignition test series were carried out at the request of customers.
- ▣ Different cable glands from different manufacturers
- ▣ Pull tests according AS/NZS 60079.0 Appendix A, and ignition tests according to AS/NZS 60079.1 applied.
- ▣ 72 samples tested, 59 passed, **13 failed (18%)**



# LIQUID POUR BARRIER SOLUTION

Considering multicore, data, fibre optic and instrument cables, a liquid pour resin barrier gland would be ideal.





# PRODUCT CERTIFICATION STANDARDS

Equipment Form of Protection		Product Certification Standards		EPL Category	Equivalent Zone
		Australian Standards	Latest AS / NZS Standards		
General Requirements		AS 2380.1	AS/NZS 60079.0:2008	-	-
Ex d	Flameproof	AS 2380.2	AS/NZS 60079.1:2007	EPL Gb	1
Ex e	Increased Safety	AS 2380.6	AS/NZS 60079.7:2006	EPL Gb	1
Ex ia	Intrinsic Safety	AS 2380.7	AS/NZS 60079.11:2011	EPL Gb	0
Ex ib	Intrinsic Safety	AS 2380.7	AS/NZS 60079.11:2011	EPL Gb	1
Ex ic	Intrinsic Safety	AS 2380.7	AS/NZS 60079.11:2011	EPL Ga	2
Ex nA	Non-Sparking	AS 2380.9	AS/NZS 60079.15:2011	EPL Gc	2
Ex nW	Enclosed Break				
Ex nL	Energy Limitation				
Ex nR	Restricted Breathing				
Ex o	Oil Immersion	No Standard	AS/NZS 60079.6:2007	EPL Gb	1
Ex m	Encapsulation	AS 2431	AS/NZS 60079.18:2011	EPL Gc	2
Ex p	Pressurisation	AS 2380.4	AS/NZS 60079.2:2007	EPL Gb	1
Ex q	Sand / Quartz Filled	No Standard	AS/NZS 60079.5:2007	EPL Gb	1

**AS 2380.2, AS 2380.6 & AS 2380.7 withdrawn 28.2.2005**





## AS/NZS 60079.14:2009

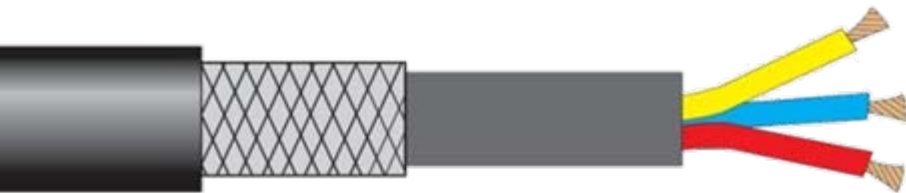
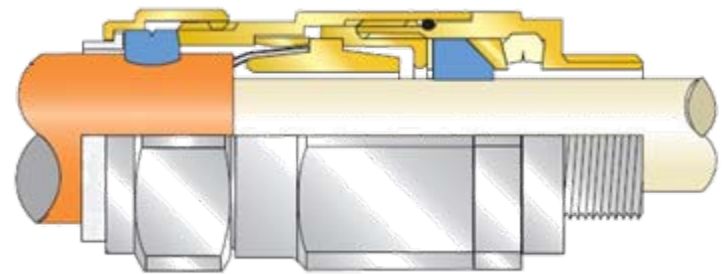
- *“The following referenced documents are indispensable for the application of this document.*
- AS/NZS 60079 Parts 0, 1, 7, 15 etc.
- Also refers to AS/NZS 4871, “Electrical equipment for underground coal mines”.

Products certified under AUS Ex or ANZ Ex schemes to AS 2380 series of standards do not fit in the spirit of the latest installation requirements



# CABLE GLAND PULL TEST

AS/NZS 60079.0 : 2005 (or later) Annex A





# ARMoured CABLE TERMINATIONS

## Cable Glands for Armoured Cables

- 1) Armour is for Mechanical Protection.
- 2) Mechanism for Earth Continuity

The armour should be clamped, or crimped, “securely” to prevent loss of earth continuity.

AS/NZS 60079.0 Clause A.2.5 (Release by a tool), states that “Cable glands shall be designed so that after installation they are only capable of being released or dismantled by means of a tool”.



AS/NZS 60079.17 Section 4.7 (Environmental Conditions) states that “If the equipment is subject to vibration, special care shall be taken to ensure that bolts and cable entries remain tight”.



# CURRENCY OF CERTIFICATION

*Certification of*

## EXPLOSION PROTECTED ELECTRICAL EQUIPMENT

Administered by: Standards Australia Quality Assurance Services

### Certificate of Conformity

<b>Certificate No:</b>	AUS Ex 764	<b>Issue 0:</b>	Original Issue 1/1/1986
		<b>Issue 3:</b>	12/8/1998
<b>Date of Expiry:</b>	12/8/2008		
<b>Certificate Holder:</b>	CMP Products Glasshouse Street ST PETERS Newcastle upon Tyne NE6 1BE UK		
<b>Electrical Equipment:</b>	CMP Cable Glands Types A2F, E1FW, E2FW and E1FX		



# AUS EX CERTIFICATION

## *Certification of*

# EXPLOSION PROTECTED ELECTRICAL EQUIPMENT

Administered by: Standards Australia Quality Assurance Services

Ex 764-3

*This certificate is granted subject to the conditions as set out in Standards Australia Miscellaneous Publication MP 69 and the Procedures (Doc Q7134) of the scheme.*

*The electrical equipment and any acceptable variation to it specified in the schedule to this certificate and the identified documents, was found to comply with the following standards:*

- AS 1828-1985 Electrical equipment for explosive atmospheres – Cable glands  
(incorporating Amendment 1)
- AS 2380.1-1989 Electrical equipment for explosive atmospheres – Explosion-protection techniques - General requirements
- AS 2380.2-1991 Electrical equipment for explosive atmospheres – Explosion-protection techniques – Flameproof enclosure 'd'  
(incorporating Amendment 1)
- AS 2236-1994 Electrical equipment for explosive atmospheres – Dust-excluding Ignition-proof (DIP) enclosures
- AS 1939-1990 Degrees of protection provided by enclosures of electrical equipment (IP Code)



# ANZ EX CERTIFICATION

**Australian/New Zealand  
Certification Scheme for**

**EXPLOSION-PROTECTED ELECTRICAL EQUIPMENT**

**ANZEx Scheme**

Certificate No.: **ANZEx 03.3000**

Issue No.: **Original**

Date of Issue: **11/08/2003**

*This certificate is granted subject to the conditions as set out in Standards Australia/Standards New Zealand P-008Ex Mark Management Committee Publication MP87 Int.:2001.*

## **STANDARDS:**

*The electrical apparatus and any acceptable variations to it specified in the schedule of this certificate and the identified documents, was found to comply with the following standards:*

**IEC 60079-0:1998** (Third Edition)

Electrical apparatus for explosive gas atmospheres  
Part 0: General requirements (incorporating amendment 1)

**IEC 60079-1:2001** (Fourth Edition)

Electrical apparatus for explosive gas atmospheres  
Part 1: Flameproof enclosures 'd' (incorporating Corrigendum 1)





# IEC EX CERTIFICATION

## STANDARDS:

The electrical apparatus and any acceptable variations to it specified in the schedule of this certificate and the identified documents, was found to comply with the following standards:

**IEC 60079-0 : 2007-10**

Edition: 5

Explosive atmospheres - Part 0: Equipment - General requirements

**IEC 60079-1 : 2007-04**

Edition: 6

Explosive atmospheres - Part 1: Equipment protection by flameproof enclosures "d"

**IEC 60079-7 : 2006-07**

Edition: 4

Explosive atmospheres - Part 7: Equipment protection by increased safety "e"

**IEC 61241-1 : 2004**

Edition: 1

Electrical apparatus for use in the presence of combustible dust - Part 1: Protection by enclosures "tD"

*This Certificate does not indicate compliance with electrical safety and performance requirements other than those expressly included in the Standards listed above.*

## TEST & ASSESSMENT REPORTS:

*A sample(s) of the equipment listed has successfully met the examination and test requirements as recorded in*

### Test Report:

GB/SIR/ExTR09.0054/00

GB/SIR/ExTR10.0299/00

### Quality Assessment Report:

GB/SIR/QAR06.0011/00

GB/SIR/QAR07.0009/02



# IEC 62444 INDUSTRIAL CABLE GLANDS

E

EARTHING

## CABLE GLAND STANDARDS

Cable glands are mechanical fittings that form part of the electrical installation material. The purpose of a cable gland is to seal the cable and retain it in the electrical equipment that it is attached to. It should maintain the ingress protection rating of the enclosures, keeping out dust and moisture but it should also prevent the cable from being pulled out of the equipment and from being twisted whilst connected to equipment. If it is intended for use with armoured cable, the cable gland also provides an earth continuity function.

By David O'Brien, CMP Products Pty Ltd

**W**hen selecting cable glands, is there a standard that needs to be considered to which the cable gland conforms? Here are just a few of the features that ought to be considered.

### Ingress Protection rating:

Will the product perform in service as on the day of the original ingress protection test?

### Material:

What grade of material is the cable gland made from? Taking a material strength, electrical conductance, and corrosion resistance point of view, metallic cable glands are made in brass (with or without stainless steel), stainless steel,

aluminium, and plastic. Each material has its own set of characteristics that determine the construction and performance requirements for cable glands. How many times have you heard users or installation contractors saying that a product is no good if it doesn't meet "Australian standards"? Well it may surprise you to know that for industrial cable glands there are no Australian standards for manufacturers to comply with, which begs the question what, if any, standard do the various cable glands circulated in the Australian standard comply with?

### NEED FOR A COMMON STANDARD

In some other overseas territories comprehensive cable gland standards have been developed. This has enabled products to be manufactured to a common standard.





# CONCLUSIONS

Main Issue	Qualification
Latest Explosive Atmospheres standards	AS/NZS 60079 Series
IEC 62444:2010 industrial cable gland standard	Should be considered
MDA / QMD / AS/NZS 2380 Series	Cannot be developed
IEC Ex Certification	The Leading Scheme
More careful evaluation of cable	Of great importance
Selection of Group I & Group II barrier glands	Needs some review
Tightness of cable glands to AS/NZS 60079.17	Do they pass inspection
Long term performance meeting expectations ?	Reliability Measurement



# THANK YOU