Introducing Malaysian Standards

- ***DMS 2694 : 2025***
  Equipment for use in Explosive Atmospheres in Tropical Service

- ***DMS 2821 : 2025***
  Guidelines for application of multiple standards for fixed Installation in Explosive Atmospheres

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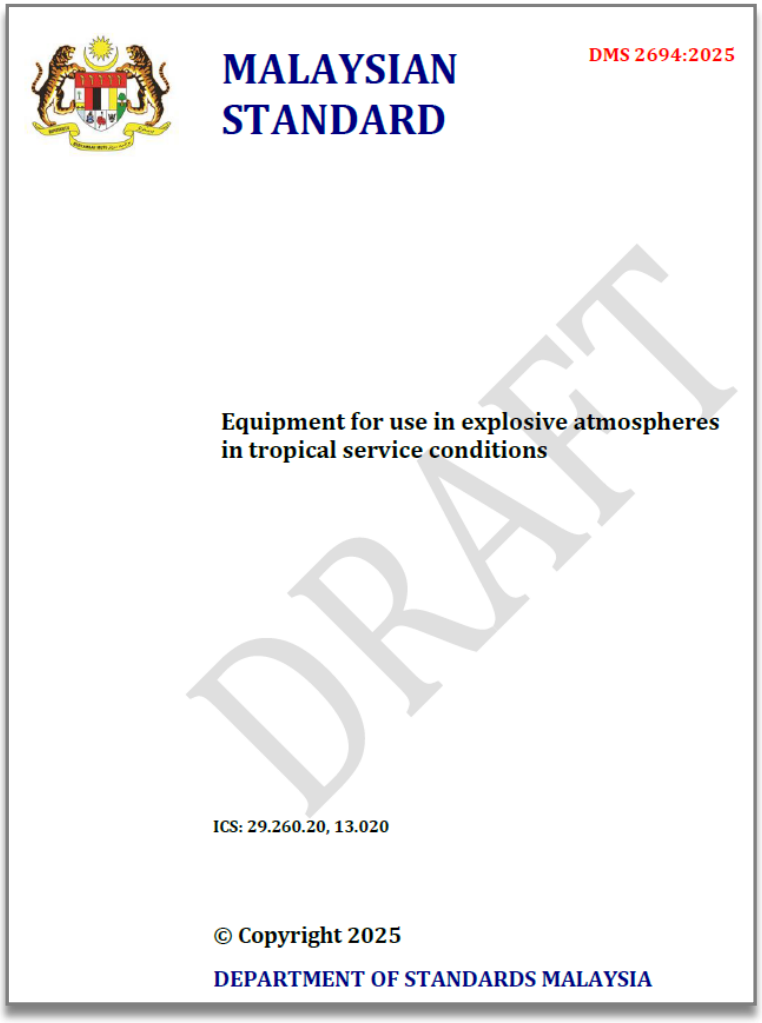
Why we need DMS 2694?

1. IEC stds are for international users and do not addressed specific localised service conditions

2. IEC allow individual member country to register National Exceptions to the IEC stds

3. Lack of participations from tropical countries on Explosive Atmospheres stds lead to tropical climate requirements not adequate addressed in the IEC 60079 series standards.


MALAYSIAN STANDARD

DMS 2694:2025

Equipment for use in explosive atmospheres in tropical service conditions

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ICS: 29.260.20, 13.020

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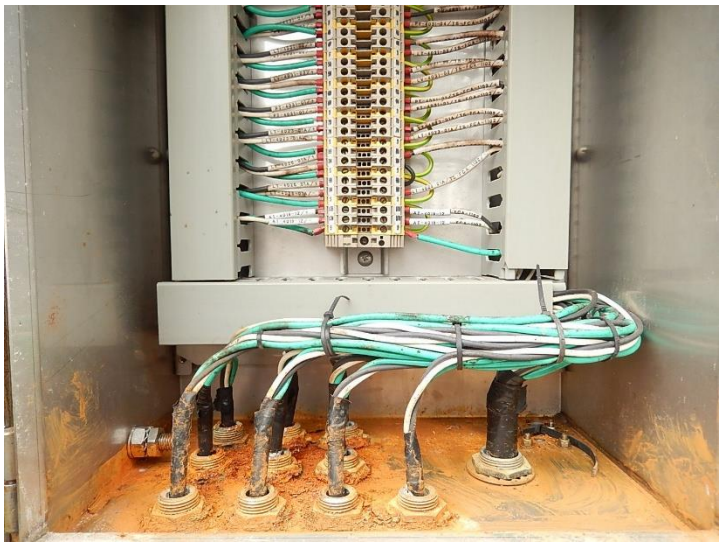
DEPARTMENT OF STANDARDS MALAYSIA

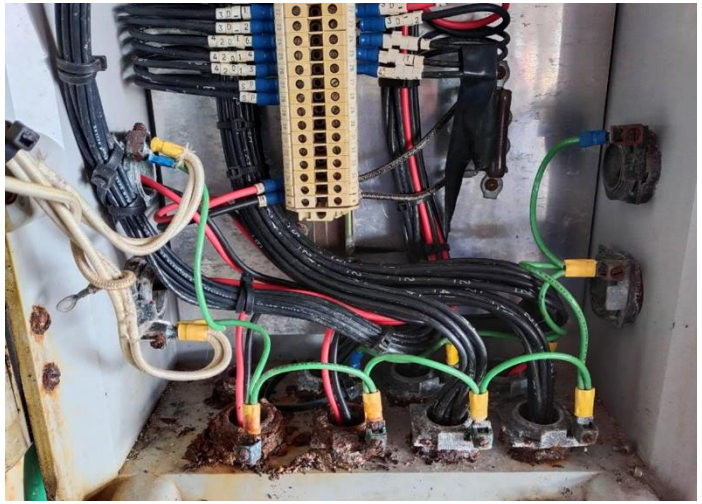
Tropical Service Conditions Issues - Corrosion

Tropical Service Conditions Issues – High UV

Tropical Service Conditions Issues – Water Ingress

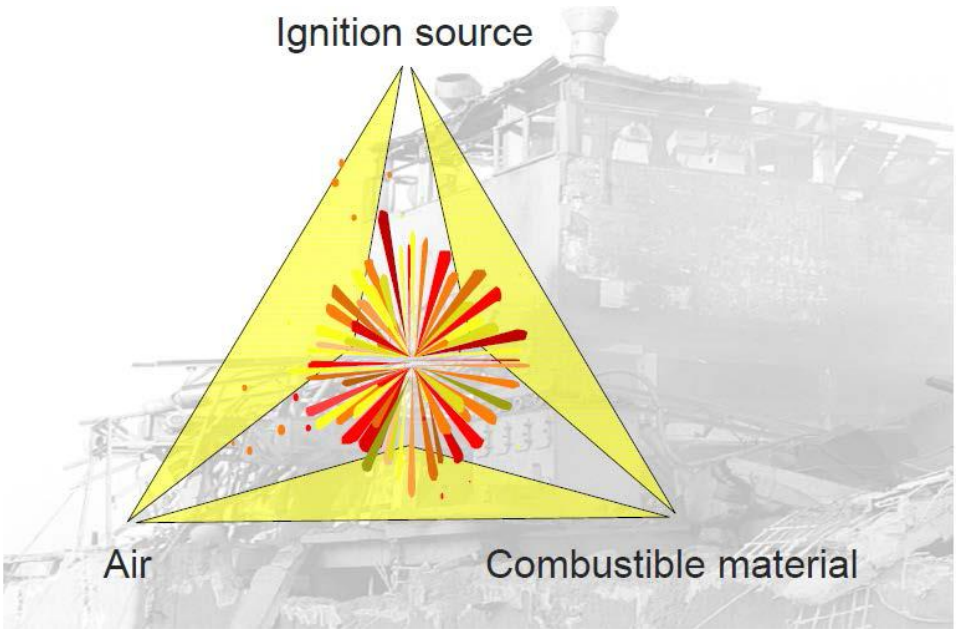
Tropical Service Conditions Issues – Water Ingress





Dangerous Solution to Water Ingress

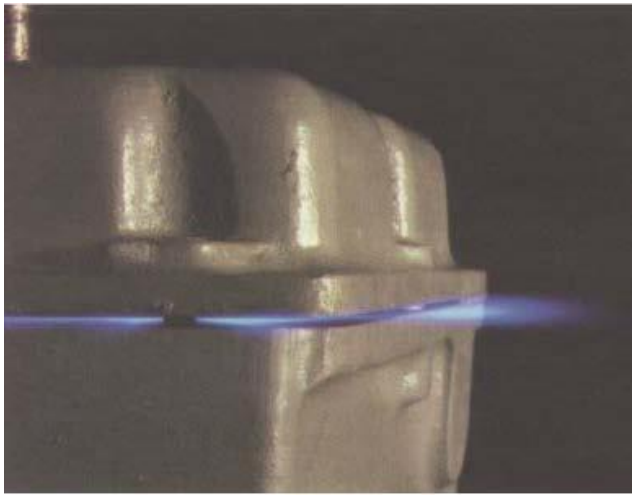
Basic Principle of Explosion - Fire Triangle



1. Explosion occurs only when air + flammable Item is ignited
2. Explosion will not occur in absent of any one of the 3 components
3. Air & flammable mixture must be within the upper and lower flammable limits (not to rich & not too lean) for explosion to occur
4. Ignition source must have adequate ignition energy
5. Explosion-proof equipment are designed using above concepts
6. Ex d equipment allow explosion but contain the explosion and release product of explosion at safe temperature.

Explosion-proof Enclosure, Ex d – Flame path

Flame path release gases at safe temp below ignition temp of outside flammable gas



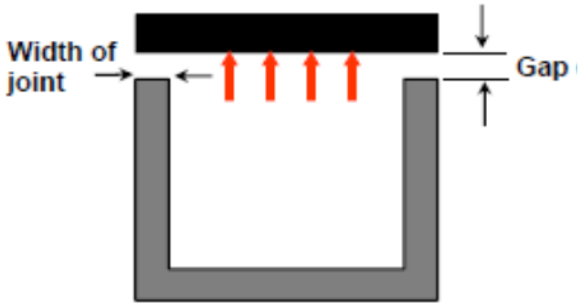
This SHOULD NOT happen

Explosion-proof Enclosure, Ex d – Flame path

- Flame path width and gap are controlled dimensions to extinguish flame and enable escaping gasses to cool below the fire temperature and will not ignite flammable gas outside, if presence.

- Flame path must be to correct smoothness. Corrosion will damage flame path and the Ex d enclosure no longer safe.

- Rain & moisture ingress are issues



Gas group IIA and IIB

Flat Joint

Gas group IIA, IIB and IIC

Threaded Joint

Issues addressed by DMS 2694

1. Dictate additional requirements/exceptions for design, manufacture, testing, installation and maintenance of electrical equipment in explosive atmospheres for Malaysian type climate, in addition IEC 60079 & ISO/IEC 80079 series standards

2. Impact of convectional, monsoon thunderstorms, Lightning to electrical equipment

3. Water ingress, corrosion, high ambient temperature & humidity and UV

4. Issue cover in DMS 2694 also applicable for electrical equipment in non-explosive atmospheres

What DMS 2694 specify

Clause 4.2 : RH range 70% to 95%

Clause 4.3c : Ambient temp range generally 15° - 60° C
(User to specify range if beyond these)

Clause 4.5 :
Equipment shall be selected and installed with suitable protection against highest lightning strikes to be expected by having suitable SPD and earthing. SPD shall have failure indication feature.

DMS 2694 Cl. 6.1-Water Ingress Due To Equipment Breathing

1. Air inside equipment enclosure heats up and expand during noon temperatures. Pressure increase expanding enclosure
2. Late evening, heavy shower cools air inside enclosure, decreasing pressure, and creating suction effect.
3. During convectional storm & rain, there is a spike in ambient pressure due to the down draft cold air air rain water with humidity 100%.
4. Air with water vapour is sucked into the enclosure, condensing into water and stays there.
5. Above cyclic process repeats many times in tropical & monsoon climate
6. The water ingress cause corrosion, rust and early failure of the electrical equipment
7. IEC 60529 on Ingress Protection test (Table 8) for IPX5 or X6 is only for 3 min. duration, not relevant to tropical rain which can >60min

Water Ingress In Outdoor Equipment

1. Breathing effect also take place in electrical equipment operating ON and OFF cycles. Air inside equipment enclosure heats up when equipment is ON. Pressure increase inside enclosure
2. When equipment if OFF, air inside enclosure, cools decreasing pressure, and creating suction effect.
3. Air with water vapour is sucked into the enclosure, condensing into water and stays there.
4. Good example are all the lighting fixtures, where they are switched off daily at dawn when humidity is hight!

Misconception of IP Rating – Not for Tropical Rain

1. Misconception that IP Rating per IEC-60529 covers protection from weather, water ingress esp. from rain

2. IEC 60529 water jet test (Table 8) for IP65, IP66 is only for 3 min. whereas Tropical storm/rain can last > 60min.

3. IP rating per IEC 60529 does not cover water ingress due equipment breathing

4. Ex d equipment by design must have flame path gap

IEC 60529 Ed. A2-2013 IP Not Applicable

Table 8 – Test means and main test conditions for the tests for protection against water

Second characteristic numeral	Test means	Water flow rate	Duration of test	Test conditions, see
0	No test required	–	–	–
1	Drip box Figure 3 Enclosure on turntable	$1^{+0,5}_{0}$ mm/min	10 min	14.2.1
2	Drip box Figure 3 Enclosure in 4 fixed positions of 15° tilt	$3^{+0,5}_{0}$ mm/min	2,5 min for each position of tilt	14.2.2
3	Oscillating tube Figure 4 Spray ± 60° from vertical, distance max. 200 mm or Spray nozzle Figure 5 Spray ± 60° from vertical	0,07 l/min ± 5 % per hole, multiplied by number of holes 10 l/min ± 5 %	10 min 1 min/m² at least 5 min	14.2.3 a) 14.2.3 b)
4	As for numeral 3 Spray ± 180° from vertical	As for numeral 3		14.2.4
5	Water jet hose nozzle Figure 6 Nozzle 6,3 mm diameter, distance 2,5 m to 3 m	12,5 l/min ± 5 %	1 min/m² at least 3 min	14.2.5
6	Water jet hose nozzle Figure 6 Nozzle 12,5 mm diameter, distance 2,5 m to 3 m	100 l/min ± 5 %	1 min/m² at least 3 min	14.2.6

DMS 2694 Cl. 6.2 & 8.3 – IP Specification & Test

The test means and the main test conditions are given in Table 2.

Table 2 –Test means and the main test conditions for tropical outdoor use

IP	Test means	Water flow rate	Duration of test
IPX5CW (Tropical)	Water jet hose nozzle Nozzle 6.3 mm diameter, distance 2.5 m to 3 m For moderate rain	2.5 L/min ± 5 % at 30 kPa (0.3 bar)	at least- 30 min
IPX6CW (Tropical)	Water jet hose nozzle Nozzle 12.5 mm diameter, distance 2.5 m to 3 m For violent shower	100 L/min ± 5 % at 1000 kPa (1 bar)	at least 60 min
NOTE. For more information, refer to MS IEC 60529 Ed 2,2 and 60068-2-18 method RB2, for details on the test means and test conditions.			

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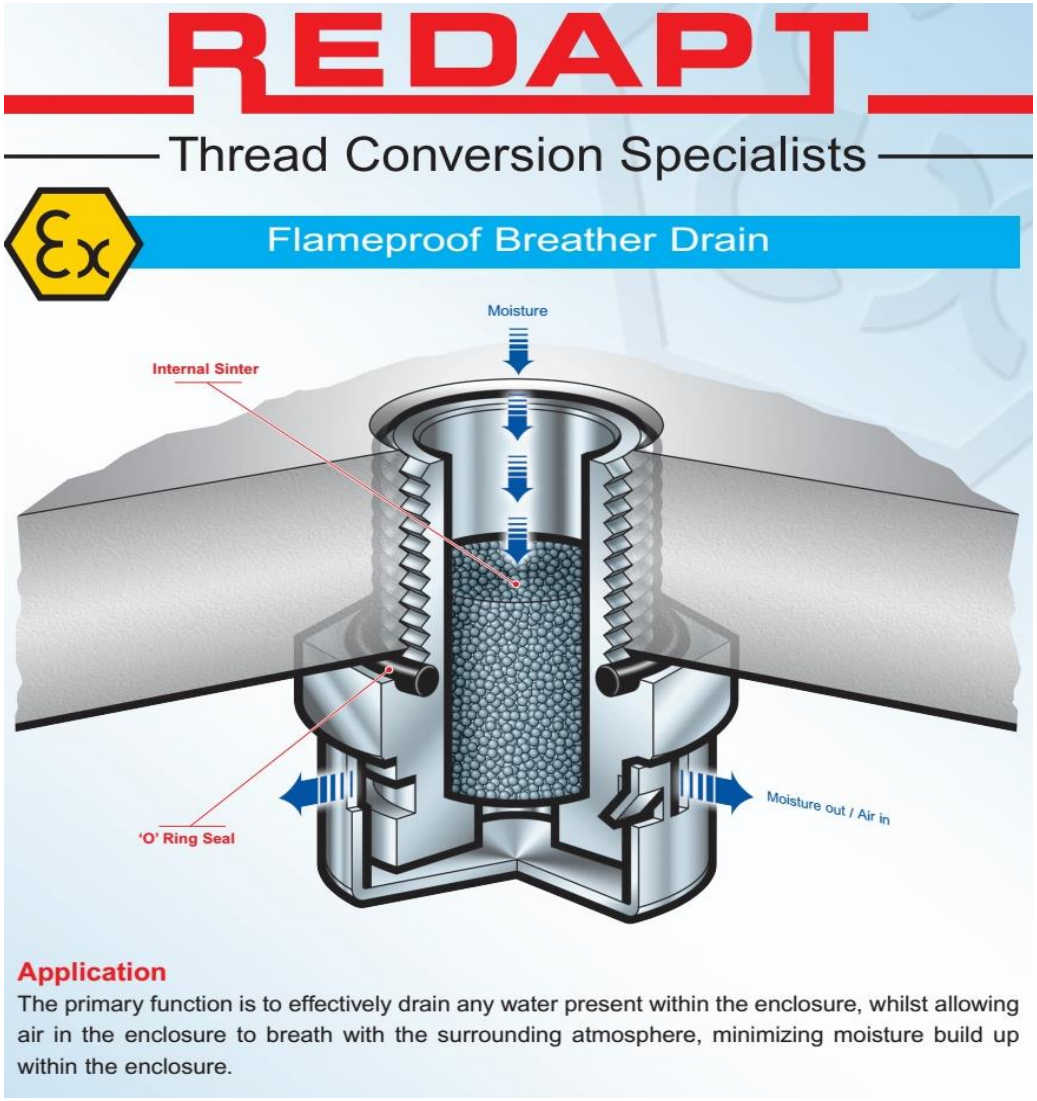
DMS 2694 Table 1 - Suitably Sized Ex Breather is the solution

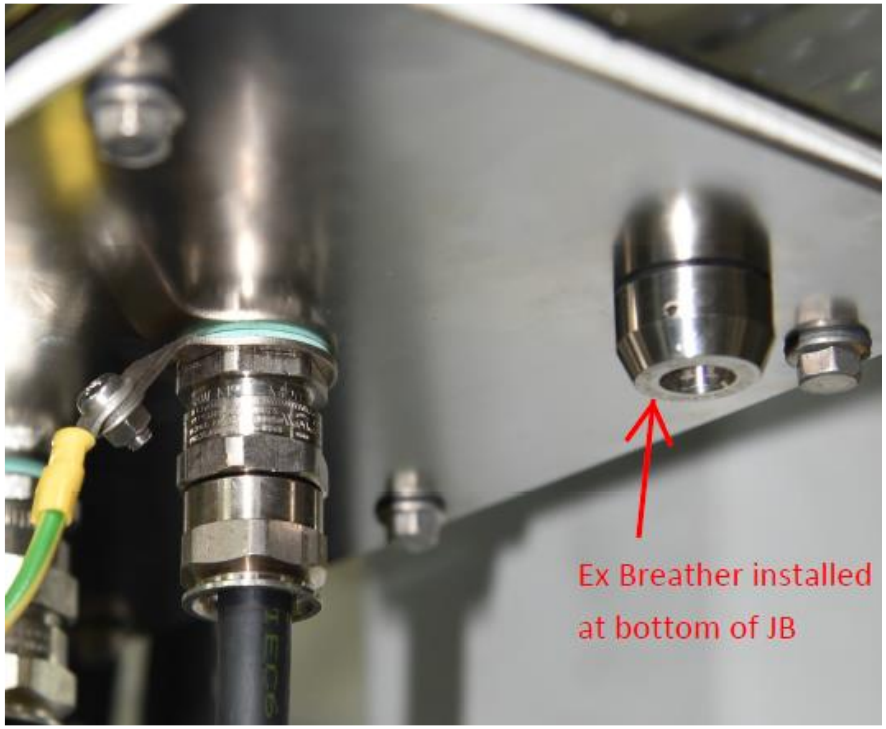
- A suitable breather to equalize the pressure between the inside and outside of the enclose wall shall be installed to mitigate the breathing effect.
- The mitigation by IP rating alone is not sufficient to prevent water ingress due to breathing effect.
- This will prevent water ingress and gasket failure.
- The breather shall be sized with appropriate air flow rate according to the breather's manufacturer recommendation.

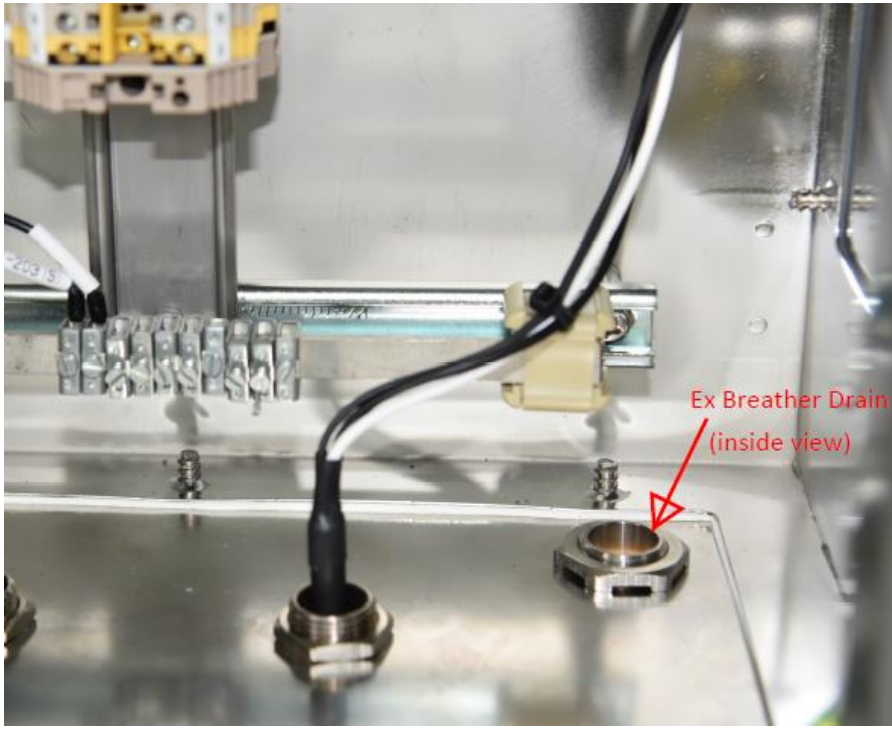
Breather Example



Nickel Plated Brass
Ex Breather Drain

Ex Breather Installation





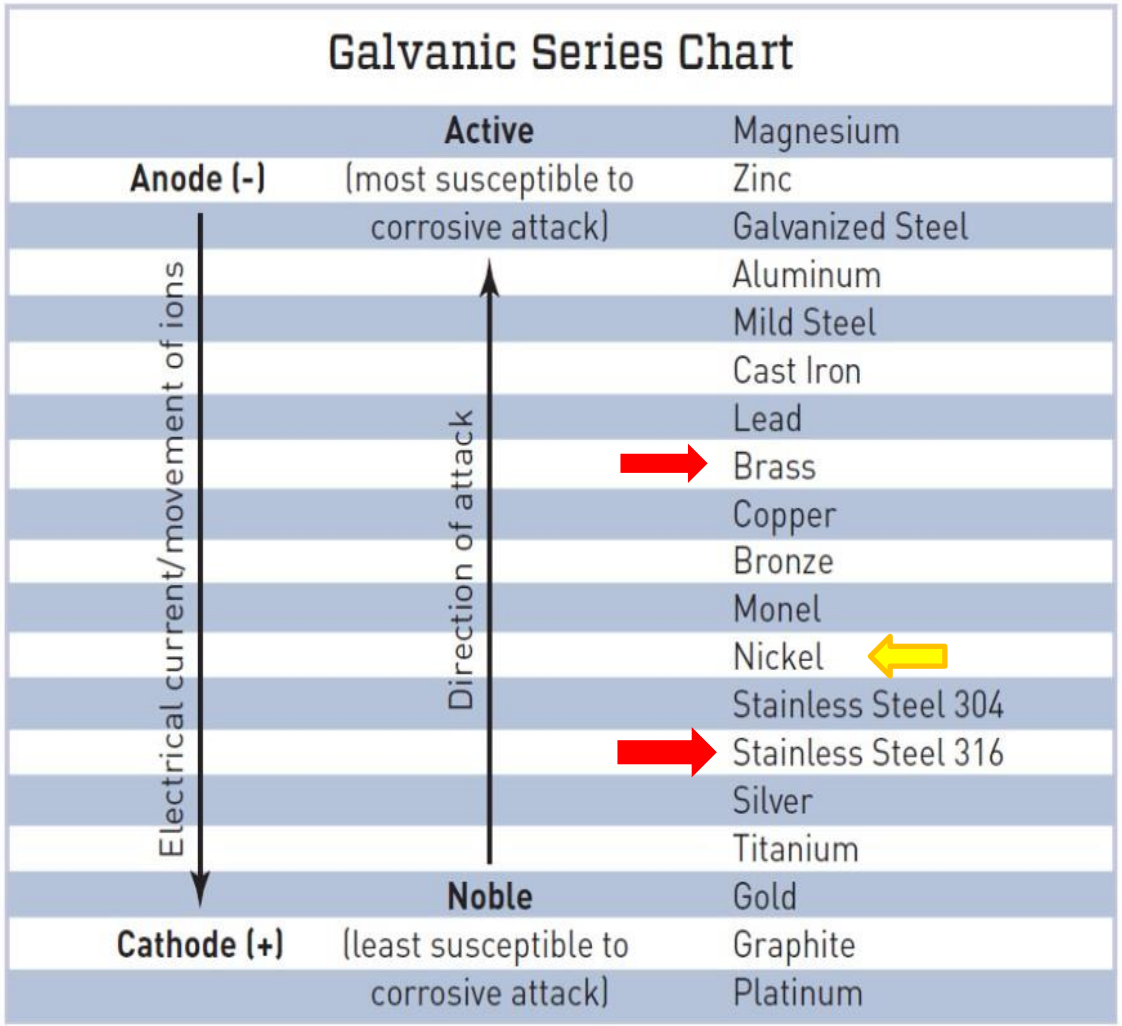
DM 2694 Cl. 6.2 – Rain Hood for outdoor equipment

For protection against strong sunlight/UV, recommend outdoor to have roof, weather shade or rain hood.

DMS 2694 Cl. 7 –Cable Gland

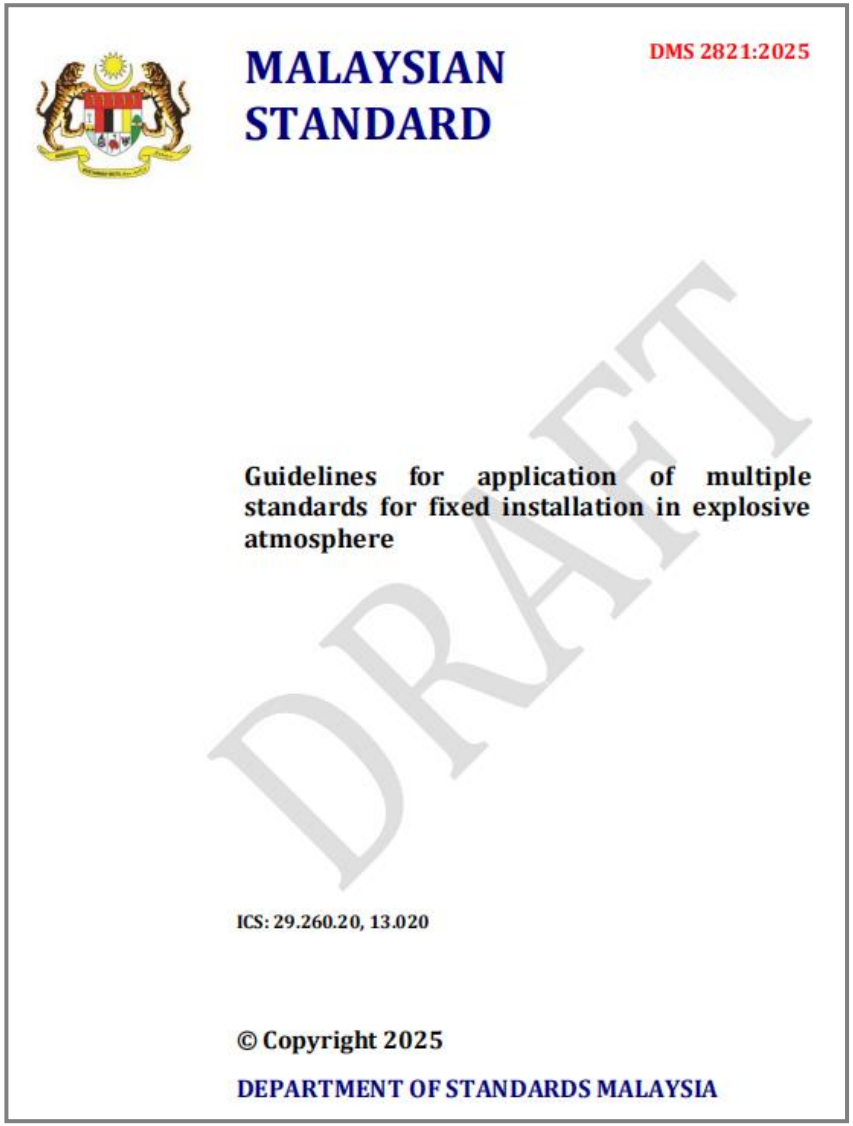
1. Nickel plated brass cable gland shall be used as the base line option.
2. Shroud of any material shall not be used to cover the cable gland. The shroud will trap rainwater leading to corrosion. Shroud obstruct inspection.
3. Brass with Stainless steel will lead to galvanic corrosion.
4. Bare brass cable gland may be used if it will not be exposed to adverse environment. Other types of cable gland materials (e.g. stainless steel, plastic) may be used to suit intended application and meeting the performance requirements.
5. Where metal type cable gland is used, the material of the cable gland body should preferably be made of the same material as the equipment to prevent galvanic corrosion. Where armoured, braided or metal clad cable is used, the armour, braid, or metal cladding have to be preferably of the same material as the gland body material in contact for the same reason.
6. Where the gland material cannot be the same as the equipment or armour, braid or metal cladding, the cable gland shall be nickel plated

DMS 2694 Cl. 7 – Nickel Plated Cable Gland to be used with SS 316 Panel



Why we need DMS 2821?

1. Main international standards for Explosive Atmospheres are IEC & NEC.
2. Test standards of IEC & NEC are different and difficult to compare apple to apple.
3. Keeping to one standard only will not give the best economical benefit as each standard has their competitive advantages on specific equipment
4. Harmonisation provide more options.



DMS 2821 Cl. 6 – IEC Area Classification

Table 1 – Area classification for explosive gas and dust atmosphere as per IEC 60079

Hazardous Gas Atmosphere as per IEC 60079-10-1		Hazardous Dust Atmosphere as per IEC 60079-10-2	
Zone 0	Area in which an explosive gas atmosphere is present continuously, or for long periods, or frequently.	Zone 20	A place in which an explosive dust atmosphere, in the form of a cloud of dust in air, is present continuously, or for long periods or frequently.
Zone 1	Area in which an explosive gas atmosphere is likely to occur occasionally in normal operation.	Zone 21	A place in which an explosive dust atmosphere, in the form of a cloud of dust in air, is likely to occur in normal operation occasionally.
Zone 2	Area in which an explosive gas atmosphere is not likely to occur in normal operation, but, if it does occur, will exist for a short period only.	Zone 22	Area in which an explosive dust 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.

Table 2 – Area classification for explosive gas and dust atmosphere as per ANSI/NFPA NEC Article 500

Class (Nature of the Material)	
Class I	Hazardous because flammable gases or vapors are present in the air in quantities sufficient to produce explosive or ignitable mixtures
Class II	Hazardous because combustible or conductive dusts are present
Class III	Hazardous because ignitable fibers or flyings are present, but not likely to be in suspension in sufficient quantities to produce ignitable mixtures
Division (Probability of Material Being Present)	
Division 1	Area where there is or may be an explosive atmosphere of gases or vapors mixed with air present during normal operation, for any reason.
Division 2	Area where there is an explosive atmosphere of gases or vapors mixed with air when an abnormal condition exists, such as failure of a containment wall or ventilation system

DMS 2821 Cl. 6.1:
NEC & IEC Area Classification Comparison

6.1 Comparison of standards – Hazardous Area Classification

Hazardous material	IEC	NEC 500/CEC J19
Gas and vapours	Zone 0 Zone 1 Zone 2	Class I, Division 1 Class I, Division 2
Dusts	Zone 20 Zone 21 Zone 22	Class II, Division 1 Class II, Division 2
NOTE Equipment for Class I, Division 1 may be used in Zone 1 and Zone 2. Equipment for Class I, Division 2 may be used in Zone 2 only. Similarly for dusts.		

Important Note : NEC Class 1 Division 1 cannot be used in IEC Zone 0 area.
NEC Class II Division 1 cannot be used in IEC Zone 20 area.

DMS 2821 Cl. 7, Table 3 – Gas Group Comparison

The classification of gases or vapours is made in accordance with their maximum experimental safe gaps (MESG) or minimum ignition currents (MIC). The Table 3 shows the equivalent groups between the standards shown.

Table 3 – Equipment grouping for explosive gas atmosphere

Typical Gas	IEC, CENELEC, NEC 505, CEC 18	NEC 500, CEC Annex J19
Acetylene	Group IIC	Class I, Group A
Hydrogen	Group IIB + H2	Class I, Group B
Ethylene	Group IIB	Class I, Group C
Propane	Group IIA	Class I, Group D
Methane	Group I[1]	Mining[2]

[1]Not within scope of NEC. Under jurisdiction of MSHA
[2]Not within scope of CE code

DMS 2821 Cl. 8:
NEC & IEC Temperature Class Comparison

Table 5 – Temperature class for explosive gas atmosphere

Max. Surface Temperature (°C)	IEC, CENELEC, NEC 505, CEC 18	NEC 500, CEC Annex J18
450	T1	T1
300	T2	T2
280		T2A
260		T2B
230		T2C
215		T2D
200	T3	T3
180		T3A
165		T3B
160		T3C
135	T4	T4
120		T4A
100	T5	T5
85	T6	T6

DMS 2821 Cl. 12:
NEC & IEC IP Comparison

Type	Area	Description	IP Code
1	Indoor	General purpose	10
2	Indoor	Drip proof protection against falling water and dirt	11
3	Indoor, Outdoor	Dust and rain tight protection against windblown dust, rain, sleet and damage from formation of ice	54
3R	Outdoor	Rain proof and ice/sleet proof protection against falling rain and damage from formation of ice	14
3S	Outdoor	Dust tight, rain tight and ice/sleet proof protection against and damage from formation of ice	55
4	Indoor, Outdoor	Water tight and dust tight	66
4X	Indoor, Outdoor	Water tight and drip tight protection against dust, fibers, falling dirt and dripping non-corrosive liquids	66
5	Indoor	Dust tight and drip tight protection against dust, fibers, falling dirt and dripping non-corrosive liquid	52
6	Indoor, Outdoor	Temporary submersion protection against falling dirt, dust, fibers, hose directed water and temporary submersion in water	67
6P	Indoor, Outdoor	Prolonged submersion protection against falling dirt, dust, fibers, hose directed water and prolonged submersion in water	67
7	Indoor	Class I, Division I, Groups A, B, C and D hazardous locations, air-break equipment	
8	Indoor, Outdoor	Class I, Division I, Groups A, B, C and D hazardous locations, oil-immersed equipment	
9	Indoor	Class II, Division I, Groups E, F and G hazardous locations, air-break equipment	
10	Mining	Mining Applications	
12	Indoor	Dust tight and drip tight protection against dust, fibers, falling dirt and dripping non-corrosive liquids (enclosure without knockouts)	52
12K	Indoor	Dust tight and drip tight protection against dust, fibers, falling dirt and dripping non-corrosive liquids (enclosure with knockouts)	52
13	Indoor	Dust tight and oil tight protection against dust, spraying of water, oil and non-corrosive coolant	54

DMS 2821 – Cl 15 Installation

Equipment certified under one standard when installed in an area classified with a standard not of its own certification, shall be installed according to its own certification classification standard. E.g. an NEC certified equipment (that can be classified as equivalent to a IEC Zone) when installed in in an equivalent IEC Zone, shall be installed in accordance to NEC requirement and vice-versa.

Interconnection between equipment of same certification standard in an area classified with a standard not of their own certification standard, shall be done according to their own certification standard. As an example, the interconnection between NEC equipments in IEC Zone (that can be classified as equivalent to the NEC equipment classification) shall be done according to NEC standard. Likewise, Interconnection between IEC certified equipment in equivalent NEC classified area shall comply with IEC standard. .

DMS 2821 – Cl 15.1 Interconnection by wiring

Interconnection between equipment certified to different but harmonised standards but which can be classified as equivalent, shall comply to following requirements.

15.1 Interconnection wiring by direct cable entry (recommended).

a) . Only IEC cables shall be used. The cable shall be in compliance to MS IEC 60079-14 Ed 5, clause 9.

b) Cable glands, adapters, plugs, breathers used at each equipment shall comply to the certification standards of that equipment i.e. for IEC equipment, all cable gland, adapters, accessories, plugs, breathers installed on that IEC equipment shall be IEC certified also. Likewise, for NEC equipment, the cable glands, accessories, adapters, breathers & plugs shall be of the correct NEC certification.

c) For NEC Class I or II, Division 1 or 2 equipment with explosionproof enclosure, sealing at cable entry is required. NPT barrier cable gland certified to NEC standards shall be used. For IEC equipment, selection of cable gland shall follow IEC 60079-14 Ed 5.0 Clause 10. If IEC Ex equipment is involved, correct cable gland to be use, whether with barrier around all conductors or only with elastomer seal is given in IEC 60079-14 Ed5.0, Clause 10.6

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15.2 Interconnection wiring by conduit

a) In the absence of IEC standards for conduits, IEC equipment shall follow 15.1. If conduit system is required, NEC standard 501.10 shall be adopted.

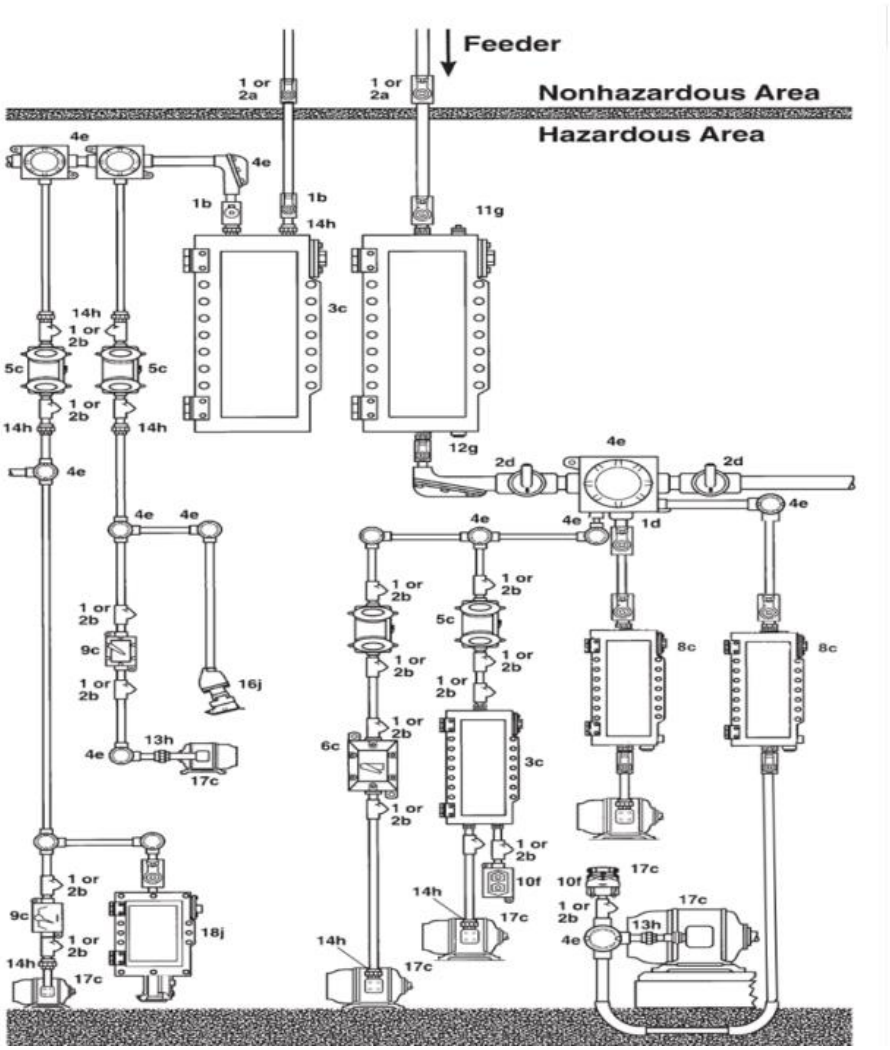
b) Figure A.1 to Figure A.6 provide typical NEC conduit system installation for reference for NEC Class I Division I or 2 equipment.

c) In Class I, Division 1 or 2 locations, all conduit must be rigid metal or steel IMC with at least five full tapered threads tightly engaged in the enclosure. When field drilling and tapping is performed it may be required to drill and tap deeper than standard NPT to insure engagement of five full threads. Drilling and tapping of NPT thread shall be done by competent person.

d) NEC 501.15 requires requires that sealing fittings filled with approved compound be installed in conduits entering explosionproof enclosures. Seals are necessary to limit volume, to prevent an explosion from traveling throughout the conduit system, to minimize gases or vapours from moving from a hazardous to a non-hazardous area through connecting raceways or from enclosure to enclosure, and to stop pressure piling — the buildup of pressure inside conduit lines caused by precompression as the explosion travels through the conduit.

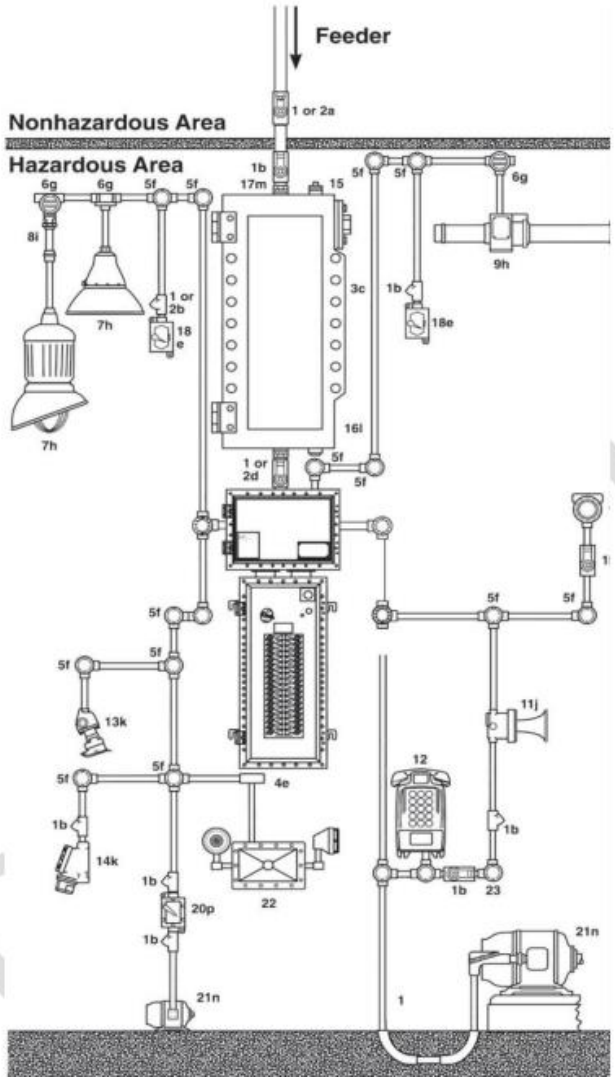
DMS 2821 – Appendix A

A.1 Typical NEC Class 1 Division 1 Conduit Set-up for Power



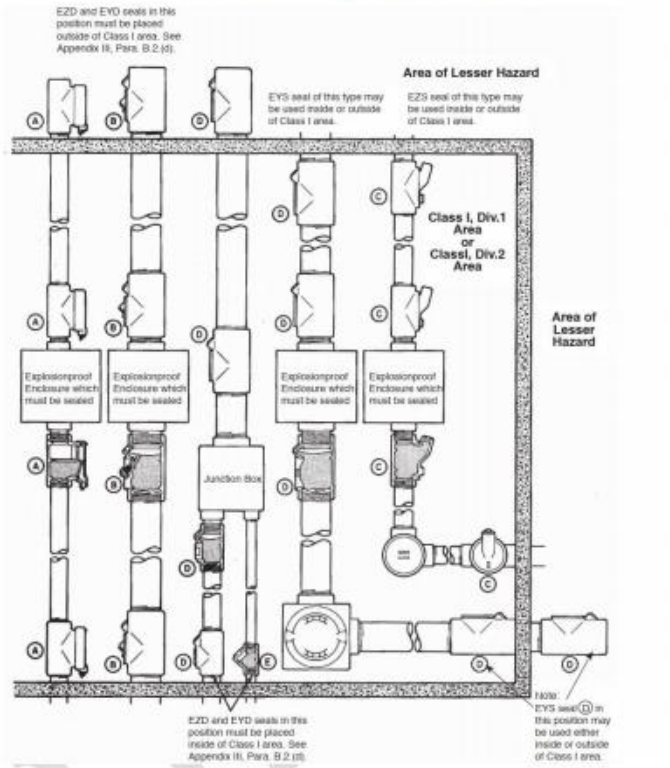
DMS 2821 – Appendix A

A.2 Typical NEC Class 1 Division 1 Conduit Installation set-up for Lighting



DMS 2821 – Appendix A

A.4 Typical NEC Hazardous Area Sealing Installation Set-up



Key

(A) EZD drain seals are available in 1/2 – 2 inch conduit sizes for vertical conduits only.

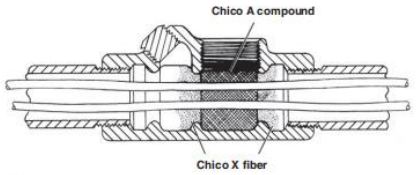
(B) EYD drain seals are available in 1/2 – 4 inch conduit sizes for vertical conduits only

(C) EZS seals of this form are available in 1/2 – 3 inch conduit sizes for vertical or horizontal conduits.

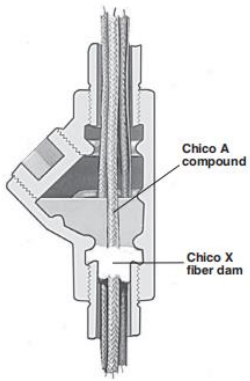
(D) EYS seals of this form are available in 1/2 – 6 inch conduit sizes for vertical or horizontal conduits

(E) EYS seals of this form are available in 1/2 – 1 inch conduit sizes for vertical conduits.

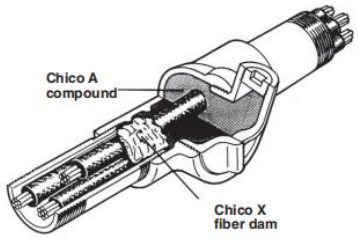
Figure A.4 – Installation Diagram for Sealing



EYS – horizontal seal



EYS – vertical sealing



EZS – horizontal seal

Status of these 2 DMS Documents

- DMS 2694 & DMS 2821 have been published for public comments from May 1- Jun 30, 2025. No comments received.

- Both documents endorsed by JSM NSC19 committee on Sep 2, 2025

- Target to be published as MS 2694:2025 & MS 2821:2025 in Nov 2025.

To Set the Rules or Follow the Rules?

- **Its important that Malaysia WRITES the rules suitable for our climatic conditions, environmental requirements instead of following standards originating & more suitable for temperate locations**

- **Standards need regular updating to keep up with new technologies, knowledges, and experiences. We welcome comments and suggestions for additional issues to be included and for further improvements in future edition of these standards.**

- **Thank you for your attention!**