Common Failures with Offshore Cable Glands

- Failed Thread Sealing Gaskets
- Missing Armour Clamp Components
- Cold Flow
- Split Seals
- Corrosion




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Four things you should know about **offshore marine cable glands**

Cable glands are often considered as simple electrical ancillaries, but in fact they are vital components which must maintain the protection levels of the equipment to which they are attached. Failure to specify the correct type or quality of cable gland could lead to expensive failures or refits later. In this article, Geof Mood of CCG Cable Terminations identifies four things that you ought to know (but probably don't) if you are installing cable glands in hazardous areas - particularly if the application is an offshore or marine one.

1. Changes to IEC 60079-0 – The importance of thread sealing gaskets

Edition 7 of this standard was published at the end of 2017 and introduced a major technical change relating to cable glands. The cable gland manufacturer now has to supply the installer with some extra information including how to seal the interface between the cable gland and the equipment it is installed on.

That doesn't sound too serious, but prior to this edition of the standard the cable gland and the equipment would both be separately tested and certified to verify that they would provide Ex protection for the extent of their working life.

Many well-known cable gland manufacturers treated critical thread sealing gaskets as accessories and thus the sealing of the critical interface between the gland and the equipment, the thread sealing gasket, was not tested (unless the cable gland was supplied with a sealing gasket fitted as standard) and was left entirely up to the installer. Some certificates even clearly stated in their 'Specific Conditions of Use' (a.k.a. 'Special Conditions for Safe Use') that the installer was responsible for sealing the interface. Without the thread sealing gasket first being thermally conditioned and then IP tested as part of the gland testing procedure, there is no guarantee that the sealing method would survive for the life of the installation (and don't get me started about how fibre washers degrade and break up over time!).

This was obviously a crazy situation so IEC 60079-0 Ed. 7 addressed this and the sealing method specified by the cable gland manufacturer must now go through thermal conditioning tests and then the IP tests, etc., before the product can be certified. (Cable gland manufacturers that always supplied their cable glands with sealing gaskets as standard had already been doing this.)

This change has been classed as a major technical change (i.e. "changes to technical requirements made in a way that a product in conformity with the preceding edition will not always be able to fulfil the requirements given in the later edition.") It is so significant that any cable gland that has been certified previously without a sealing gasket fitted as standard (which is most cable glands, certainly in the UK) must undergo retesting and be recertified. Despite the fact that IEC 60079-0 Ed. 7 has been in existence since December 2017, most cable gland manufacturers have not yet reacted to this major technical change. Failure to fit cable glands certified to IEC 60079-0 Ed. 7 could be a reason for an installation to fail its initial inspection.

(At the time of writing, the new edition of BS EN 60079-0 had still not been published, but IEC 60079-0 Ed.7 can still be used in an ATEX certification as it represents the latest technical knowledge.)

Before we leave this topic, it should be noted that the material of the sealing gasket is often what determines the maximum temperature that a cable gland can be used at, so some of the claimed temperature ranges for cable glands will have to be reduced once they are tested with sealing gaskets in place.

2. Coldflow in cables - Myths debunked

Coldflow in cables is mentioned in the installation standard IEC 60079-14 (and the EN equivalents) in the very unhelpful instruction 'Cable glands and/or cables shall be selected to reduce the effects of "coldflow characteristics" of the cable'. Although there is a note to explain what coldflow in cables is, the note gives a description which could equally well describe 'compression set', which is a completely different phenomenon. (Indentations made in cables by over-tightened cable gland seals are almost always the result of compression set.) Coldflow is best described as 'the movement of a material when under pressure with no recovery of shape when the pressure is removed'. A simple example of a material that is subject to significant coldflow is modelling clay or putty. When it is pressed into shape it doesn't spring back again. Note that coldflow can happen with quite small forces, and may happen over an extended period.

The result of the poor wording in 60079-14 has been confusion and a proliferation of myths regarding coldflow in cables, including the canard that 'all cables suffer from coldflow'. In the world of the pedantic they do, but only in the same way that steel and glass suffer from coldflow. Coldflow in cables only becomes important when it is 'significant', so when is that?

To cut a very long story short, it is only when the cable being used is a BFOU or RFOU type cable made to comply with the NEK 606 specification and even then, the only part of the cable that is affected is the inner bedding and not the outer sheath. The bedding of these cables is a thermoplastic, in common with a lot of cables, but in this case the bedding material is relatively soft. Softer in fact than a cable gland seal so that when the two of them are pressed together, it is the cable bedding and not the cable gland seal that is displaced (this is after all what we mean by one thing being harder than the other). Coldflow can be tested using a simple hardness tester (a Durometer). If the bedding of the cable is less hard than the cable gland seal then there is a risk that the cable is at risk of significant coldflow. If the durometer is left in contact with the cable bedding and the durometer reading continues to fall then the cable bedding is definitely at risk of significant coldflow. It gets worse…

Durometer

The effect of coldflow in cables can vary dramatically with temperature. In tests a BFOU cable bedding at 16°C had an initial durometer reading of 60 Shore A, falling to under 50 Shore A within a few seconds. When the temperature was raised to around 60°C the reading was 25 Shore A, dropping to under 20 Shore A after a few seconds. To put things in perspective, 20 Shore A is about the hardness of a rubber band and 65 Shore A is about the hardness of a car tyre tread or a cable gland seal. No wonder then that cable glands with rubber inner seals pressing on the bedding of BFOU and RFOU cables will cause significant displacement of the bedding. The dramatic change in hardness with temperature also explains why an installation may initially look fine, but later be found to have badly affected cables when the equipment is moved to a hotter climate or when the equipment has been operated and the cable has been warmed by passing a current through it.

The recommendation given by a manufacturer of BFOU and RFOU cables is that if the type of protection used in the installation is Ex d, or if you need an inner seal on the cable gland, then a barrier gland should be used. The reason for this is that the barrier material acts on the cable cores and not on the bedding material. I would go further and recommend the use of a cartridge injection liquid resin barrier gland.

The damage caused by coldflow can be seen in the pictures below.

Coldflow damage

3. Ex d glands offshore – IEC 61892-7

On the topic of barrier glands, it is not a well-known fact but for offshore installations carried out to IEC 61892-7 (Mobile and fixed offshore units – Electrical installations – Hazardous Areas), the only type of Ex d cable gland allowed is a barrier gland. (Did I mention that the best type of barrier gland is a cartridge injection liquid resin barrier gland where the resin is mixed automatically during installation?). Prior to 2014, IEC 61892-7 was an exact copy of IEC 60079-14 in the area of cable gland selection and allowed non-barrier Ex d glands, but this all changed with Edition 3 in 2014 and only barrier glands are now permitted.

4. Nickel plating will not always stop corrosion offshore

A very high proportion of the Ex cable glands in the world are made from brass, for a number of very good reasons. However brass has a major problem in that if it comes into contact with salty water (which can be spray in the air) or stagnant water or water that is slightly acid (acid rain?) or alkaline, then the brass will degrade. This happens through a process called dezincification where the zinc is leeched out of the brass alloy leaving a porous, weakened, copper-rich material behind. The way to avoid this problem is to nickel plate the brass cable glands. What is not obvious at the time of purchase is whether the nickel plating will stand the test of time or not. As a rule of thumb if there is only a few microns of nickel plating then the plating can only be considered as 'decorative'. If the plating is 10 microns thick or more then it is 'protective'.

Readers who have been in the industry for some time will immediately think that this is bad advice as 'common knowledge' is that you are only allowed to put 8 microns of plating on a flamepath, and the entry threads of a cable gland are usually a flamepath. In this case 'common knowledge' is out of date because the limitation on plating thickness that used to be in 60079-1 Clause 5.1 was removed in 60079-1:2014 Ed.7.

Plating thickness is important, but plating quality is also critical, and for offshore applications the nickel plating should be marine grade electroless nickel plating. The photos below show the results of a 500 hour salt spray test carried out according to ASTM B117:2011 followed by a sulphur dioxide test to ISO 6988. Both of the cable glands looked bright and shiny before the test. The example with a claimed 4 microns of plating lost some of its plating during the test and what was left was severely discoloured and degraded. The sample with 12 microns of marine grade electroless nickel plating was essentially unaffected by the test.

Image 1: 4 microns of nickel plating,
Image 2: 12 microns of nickel plating

IEC 60079-14 requires that documentation is supplied to describe the protection from corrosion employed on an installation and the inspection tables detailed in the standard require that equipment, including cable glands, is inspected to check that the corrosion protection is adequate. (There are similar requirements in IEC 61892-7.) This covers only the initial installation and inspection. Further regular checks to make sure that corrosion has not taken place are specified in the inspection tables in IEC 60079-17. The simple way to make sure that cable glands will pass all of the inspections for corrosion for the life of the installation is to install cable glands that have at least 10 microns of marine grade electroless nickel plating on them.■

About the author

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