Sealed enclosures

An overview of **Connections**

Glands

Glands are an inexpensive way of taking a cable through the wall of an enclosure. The normal method of sealing is to compress a rubber seal onto the outer jacket of the cable and this is adequate for sealing against the spray from a hosepipe, some products rate glands to 1m immersion and very occasionally 10m. Pressure at this depth tends to try and push the cable inside the enclosure.

Another level of sealing is achieved in explosion proof glands where it is possible to fill a compartment in the gland with a compound that sets hard around the individual wires. However for underwater use there are a few issues to consider. Firstly the housing can not be vacuum tested with glands fitted because the vacuum will continually draw air through the voids between individual wires, secondly if the cable becomes damaged water will enter the enclosure via capillary action through the spaces between the individual wires.

Penetrators

Penetrators are different from glands in that the individual wire bundles are intercepted via a solid pin, these pins are set in a non conductive material providing a solid barrier that the water will not pass through even if the cable is damaged. Hence the terms ‘water block’ and ‘pressure blocks’ are used. Pressure ratings for penetrators may vary but can be produced to achieve full ocean depth. Due to their robustness and reliability they are used where the protection of equipment is paramount.

A disadvantage of penetrators is that they have to be factory moulded to the cable before they can be fitted to the housing, although there are some penetrators that are designed as field installable (utilising an oil filled boot in place of a moulding). Handling the cable/enclosure assemblies can be cumbersome in both these cases. Unlike when using glands, the use of penetrators allows the enclosure to be vacuum tested without drawing air through the cable.

Underwater Connector

Underwater Connectors have a similar water blocking system as for penetrators except a solid pin is replaced with a pin and socket arrangement where the water block insert is split into two halves known as the 'plug' and 'receptacle'. The housing for these mating pairs can be a metal shell, a rubber moulding or a combination of both. Connector specifications vary enormously and choice is based on performance and cost. The main types to consider are:

(a) 'Open face pressure' rated where if a leak occurred between the two halves no damage would occur to the connector. These are the most robust and expensive type connector.
(b) 'Mated pressure' rated, where the connector halves must be mated to protect the cable. There is no water block insert on the cable so if there is a leak in the connector the cable will be damaged.
(c) 'Pressure balanced' connectors, these are usually the rubber moulded type where the pins or sockets are encapsulated forming a flexible water block. This flexibility can often allow them to be wet mateable and can be used at full ocean depth. However being flexible, it can affect electrical reliability if mishandled.

The main advantage connectors have over penetrators is that one half of the mating pair can be fitted and tested with the enclosure whilst the remaining half is moulded to the cable.

Summary Table

	Gland	Penetrators	Connectors
Cost effective	Inexpensive Field Installable	Varies according to pressure requirement	Can be expensive and pressure limited
Watertight Integrity	Shallow water – with caution	Very good	Varies with type and manufacturer
Pressure resistance	Low Pressure pushes cable into enclosure	Good Check pressure rating	Metal shell has an ultimate limit Pressure balanced has no limit
Ease of repair	Medium - requires removal of cable from housing but can be achieved on site	Poor – Housing opened and the connector will have to be returned for refurbishment.	Good – allows replacement of cable or housing independently
Testing	Vacuum/Pressure test possible if blanks are made	Vacuum test possible Pressure test possible if the cable is short	Vacuum test possible Pressure test may require blanking plugs
Electrical performance	Very good – no discontinuity of the conductors or screen	Good – Solder joints at insert pins. Cable screen discontinuity in most cases	Dependant on quality of the Pin and Socket connection. Cable screen discontinuity in most cases

Pressure Compensation

Pressure Compensation allows a rectangular housing to be used at a limitless depth. To visualize how this works imagine a plastic bag full of liquid and sealed at the neck, whatever depth the bag went to the pressure on the inside would be the same as that on the outside. At depth everything including liquids, compresses and this volume change has to be accommodated within the design. In practice the housing is filled with oil and a bladder or rolling diaphragm is used to provide the flexible barrier to compensate for the change in volume.

Pressure Relief

Pressure relief valves would normally only be fitted to a housing that contains a battery and there is a risk that the battery may under some circumstances give off a gas. The relief valve can let the gas out without letting water in. Without this valve the housing would be trying to explode, if the housing did not leak or break the stored energy would present a real danger for anyone opening the housing.

How we can help

Sealed Enclosures are able to provide Cable Glands if required. Examples of these can be seen at www.cableglands.com. Underwater Connectors can be seen at www.subconn.com and for tailor made solutions 'ready to go' we can arrange this through Link Subsea Ltd, their e-mail address is sales@linksubsea.com

In all cases a detailed specification is required for each cable, this will include:

- The pressure rating?
- The number of conductors required?
- The maximum amount of power to be transmitted in amps?
- The length of cable required?
- If the connector needs to be pluggable to separate off pieces of equipment?
- Will the cable have to be flexible?
- Does the cable need to be screened?

Sealed Enclosures will machine penetrations to suit all types of connections and it is much preferred that the Connectors etc are available at the time of machining to ensure the correct fit. They will also be required for the pressure test, alternatively a blank would have to be provided or made. At test, the nearer the housing is to its final state, the more conclusive the test can be.

Pressure Compensation and Pressure Relief are options that we can provide with our housing and if necessary tailored to the individual application.