SWA cables

Cable glands connected to SWA cables must be able to provide earth continuity from the termination point of the armour in the cable gland body through to the equipment, if the enclosure is metallic, or via a metallic gland plate that is bonded to an external earth point, and / or directly to an external earth point via an earth tag. In the interests of safety most earthing systems associated with armoured cables will utilise a number of directly grounded external earth link cables connected to the earth tag which is in contact with the cable gland. Usually the cable would be earthed at one of its two ends as a minimum, and this approach ensures that in the event of a short circuit or earth fault in the cable, the quickest and most direct route to ground will be achieved as a result of the design philosophy adopted. When multiple cable entries are required in non-metallic enclosures (e.g. GRP terminal box) that do not have an external earth point, the user may prefer to engage an external earth cable between each metallic cable gland via an earth tag. At least one of the earth tags would also be used to connect an earth cable directly to ground. This method of providing earth continuity is sometimes referred to as a "daisy-chain" arrangement.

The earth tag described above must also be tested to ensure that it can withstand the equivalent short circuit earth fault current test rating of the cable and cable gland, otherwise the system will not have adequate (safety) earth protection.

LC / SWA or LC / PVC / SWA cables

In addition to the standard requirements for SWA cables, there is a set of special guidelines for lead covered cables intended for direct burial in the ground of hydrocarbons processing and refinery sites. These guidelines were introduced in the UK by the Oil Companies Material Association (OCMA) and responsibility for these was subsequently transferred to EEMUA, the Engineering Equipment and Material Users Association. The EEMUA Publication 133 "Specification for Underground Armoured Cable Protected Against Solvent Penetration and Corrosive Attack" defines the requirements of the petroleum industry for underground lead-sheathed cables for use where protection against solvent penetration or corrosive attack is required.
When the cable is LC / PVC / SWA the addition of the lead sheath introduces another metallic part of the cable that could effectively become live in the event of an earth fault or induced voltage and this must also be earthed. Any metallic parts used to terminate the lead sheath as part of the earth path must also be tested and documented to demonstrate that adequate levels of protection are maintained. In the case of LC / SWA cables the earth fault short circuit levels will be increased due to the parallel earth path existing between the armour wires and the lead sheath. It is important therefore that the whole cable gland and earth tag arrangement is tested on lead sheathed cable to ensure that the arrangement can withstand the overall affects resulting from short circuit in the cable armour / lead sheath.

If the cable glands and accessories chosen have not been tested, and are incorrect the connection of the earth circuit via the cable armour will become the weakest link in the system, and could result in potential fatality, lost time incident (LTI) or other accident.

SAFE EARTHING SYSTEMS

The need for safe earthing systems has been around for many years since the early development of the electrical power industry, but the much wider spread use of electrical energy for every imaginable application merely increases the need for an increase in the safety associated with earthing. In the United Kingdom the BS 7430:1998 code of practice for earthing should be observed.

Before we can discuss the problem of how to provide adequate and safe earthing systems, we should first consider the causes of earth faults. These can be caused by Lightning, Earth Leakage Current & Voltage, Differential Voltage Faults, Cable Capacitance Discharge, Circulating Currents, Fault Conditions from Loose or Inadequate Connections, or Human (Installation) errors, including the absence of the correct electrical protection devices, the installation of incorrect protection devices, incorrect installation, or failure to observe regulations. Good quality and reliable earthing systems are therefore essential to protect against the situations arising as previously mentioned.

Both cable manufacturers and cable gland manufacturers must cater in their design for the eventuality of an earth fault being carried via the cable armour, which is primarily intended for mechanical protection, but which may also be able to double up as the safe means to carry the earth fault conditions to ground. This may be the case with some Low Voltage cables as well as Medium & High Voltage cables, but in the latter two cases a higher fault current may be expected to occur in these cables.

Each cable that is expected to be able to carry an earth fault via its integral armour would have a rated current carrying capacity.

When a metallic cable gland is connected to an equipment enclosure which may also be metallic, or alternatively non-metallic, an Earth Tag may be required to ground the earth circuit via an Earth Link Cable or connect to another piece of equipment. These are intended to provide an earth bond connection as specified in BS 6121 : Part 5 : 1993, and subsequently EN 50262.

Here are the Short Circuit Fault Current Rating values for CMP slip on Earth Tags, when installed between the cable gland and equipment :-

CMP Brass Earth Tags

CMP Earth Tag Size	Short Circuit Ratings Symmetrical Fault Current (kA) for 1 second
20	3.06
25	4.00
32	5.40
40	7.20
50	10.40
63	10.40
75	10.40

CMP CIEL Cable Glands

In the event that MV and HV cables have a High Fault Current Carrying Capacity, via their Single Wire Armour configurations, the fault rating of the cable may be higher than those of the standard CMP Earth Tags. In this case it would not be advisable to use standard earth tags as it is important to match the rated fault current of the earth tag to the corresponding fault current rating of the cable armour. If the rating of the earth tag is greater than the fault current rating of the mating cable armour then using the earth tag would be acceptable, but the situation may be unsafe if the rating of the cable armour fault current carrying capacity is greater than that of the standard earth tag.

In such cases the perfect solution to overcome potential over heating and possible flash over, would be to use the CMP CIEL solution which involves the inclusion of an integral Cast Integral Earth Lug arrangement, in the cable gland assembly. The CMP CIEL range uses the same principal design concept as a standard CW, E1W, or E2W cable gland product in terms of sealing and / or hazardous area protection, but with additional facility for extra heavy duty earth connection.

This product design is available in Brass, Nickel Plated Brass, and Aluminium, and can be supplied in the Cable Gland Types CW CIEL, CWe CIEL, E1W CIEL, E1FW CIEL, E2W CIEL & E2FW CIEL.

The following fault current ratings apply to the CMP CIEL design type cable glands.

CMP CIEL Gland Size	Short Circuit Ratings Symmetrical Fault Current (kA) for 1 second
20S to 40	26.0
50S to 90	43.0

In addition to the recognised causes of earth faults described above, other environmental factors would also have an impact upon the overall electrical performance, and require reliable safe earthing systems in order to protect against them. These environmental considerations would include the possibility of Electromagnetic Interference (EMI / RFI), cross talk and induced voltages stemming from the positioning of cables

It has been a known fact for many years in the UK power generation industry that unless special measures are taken to both segregate the cables in accordance with wiring regulations, and also isolate the metallic cable armour from running in continuous contact throughout the whole of the earthing system, interference or electrical noise was likely to spread around the extent of the plant.

To combat the sometimes intense levels of interference that had been experienced in practice, users were able to use the CMP ZEN range of Insulated Cable Glands, which would allow the cables to be earthed at one end only, for example the supply end, and insulated at the field end. ZEN is available with an insulating arrangement to ensure that no contact is made between the earth circuit carried through the cable armour and the electrical enclosure which the cable enters. This isolation of the cable armour at one end of the cable is sometimes referred to as single point earthing.

The ZEN range of products from CMP however goes much further than merely single point earthing, and allows great flexibility in the earth system, delivering optimum safety into the bargain. The CMP ZEN cable gland is available with or without the integral extra heavy duty earth lug featured in the CMP CIEL cable gland range, and this allows a whole range of options to be considered in terms of engineering solutions being adopted. Either in conjunction with other cable glands from the CMP CIEL family or not, the CMP ZEN product enables engineers to design safe earthing systems that can effectively deal with :-

- Cross Talk Noise Reduction
- The Electrical Separation of Main Earths
- Earth Fault Segregation
- Fault Current Reduction with Series Cable Resistance
- Electrical Noise Reduction in Instrument Cables
- Circulating Current Protection in Single Core Cables or Three Core Cables with unbalanced Load Conditions

It may also be of interest to note that versions of the ZEN cable gland range are available from CMP Products which have been tested approved and used in containment areas of the Nuclear Power Generation industry.