

LOW VOLTAGE INDUSTRIAL CABLES

GENERAL CABLE, leader on the Spanish, European and world cable market, has always been committed to industrial development. The industrial sector often requires the use of cables with special characteristics that adapt to difficult environments in which cables are subject to harsher than normal working conditions. This has been the case in highly traditional industrial sectors and the trend has been further emphasised in new industrial developments, where new requirements, particularly on safety, efficiency and guaranteed useful life, have been added to traditional requisites.

Traditional sectors notably feature special applications for petrochemical plants, mining, railway rolling stock and ships (including the merchant fleet, navy, and offshore platforms).

In recent years, these have been joined by other sectors associated with the production of renewable energies, in which cables for photovoltaic facilities are particularly significant.

Brief details of the main features of each type of special cable in these sectors are described below.

Petrochemical plants

The environments of such facilities are particularly harsh for electricity cables, with regard both to safety and to resistance to external aggressions from diverse origins. The cable must therefore be protected both from possible mechanical aggressions typical of large-scale industrial environments, and from chemical aggressions caused by the presence of powerful chemical agents, particularly solvents that may attack insulation and sheathing materials.

The environment may also generate atmospheres in which there is a risk of fire or explosion, which makes it highly advisable for either the cable installation or the cable itself to be flameproof.

GENERAL CABLE has developed the ARMIGRON range of cables that cover such requirements by including the following special characteristics:

- Galvanised steel wire armour (aluminium in single-pole cables) that provides the cable with excellent mechanical resistance and also makes it intrinsically flameproof.
- Internal and external jackets with polyvinyl chloride (PVC), resistant to hydrocarbons, thus enabling the cable to continue operating even when under attack from oils or hydrocarbons. In particularly aggressive environments, an internal layer of lead is included to prevent any damage to the insulation, which is a key element in the cable.
- Non-propagation of fire, which drastically reduces the risk of a fire spreading through the cables, even in the most difficult installations. In environments with such safety hazards, this feature is essential.



ARMIGRON RVhMVh



ARMIGRON RVLVhMVh with layer of lead

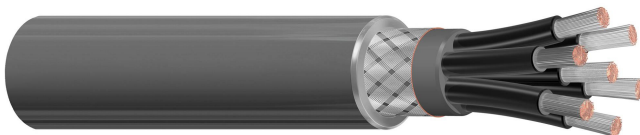
Mining

Mines are probably the most mechanically demanding environments to which cables are subject. Installation already counts as a difficulty factor because of the limitations of space and means involved. The combination of different factors such as the mobility of the installation itself (which advances with work in a mine), high intensity traffic of vehicles and different materials, limited space and a precarious infrastructure prompt very high mechanical risk.

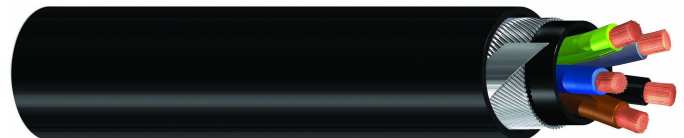
The generation of dangerous atmospheres due to the accumulation of potentially inflammable gases makes it very necessary for cables to be intrinsically flameproof. Electrical requirements may also involve special designs that ensure the evacuation of leakage currents and immediate detection of problems in the cables, in order to minimise risks.

GENERAL CABLE has developed the ARMIGRON MINAS and VULCAN MINAS ranges to respond to these strict demands. The designs of the energy, control and instrumentation cables include the following characteristics:

- Class 5 flexible conductor, particularly in cables required for mobile service or those that must be moved often.
- Armour, either braided or wire, generally in galvanised steel. In some cases, coated wires of this material are included. It provides the cable with exceptional mechanical resistance and flameproof properties.
- Jacket with exceptional mechanical properties and highly flexible to withstand difficult mechanical conditions.
- In some cases, a conductor with distributed protection to give the cable maximum electrical safety and efficiency.



CONTROL MINAS CSFt



ARMIGRON MINAS VVMV

Railway rolling stock

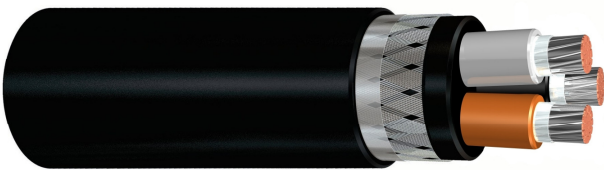
Safety in transport, and particularly of passengers, is the main requirement made of cables for railway rolling stock. Recent growing pressure to increase rolling stock

safety has prompted the European Union to develop railway sector directives that enforce improvements in equipment.

The new EN 50264 standard both includes these requisites and allows for the incorporation of the better technologies in materials developed in recent years. These improvements provide for reduced insulation thickness and therefore a decrease in outer cable diameter. Reduced diameter brings improvements in the installation of cables in very compact spaces such as those available in wagons.

All the designs in the EXZHELLENT-MR range of cables developed by GENERAL CABLE come with maximum guarantees of safety as they include the following features:

- Halogen-free
- Non-toxic with low acidity and corrosivity of the gases emitted during combustion.
- Reduced opacity of the smoke emitted during combustion.
- Non-fire propagating.
- Optionally, they may also be fire-resistant and thus used in safety circuits in order to ensure that these circuits remain in operation in the event of fire.



EXZHELLENT-MR ZC4Z 0,6/1 kV



EXZHELLENT-MR Z 0,6/1 kV

Cables for ships and oil platforms

Like cables for railway rolling stock, cables for ships must comply with exceptional anti-fire requisites. The reasons are identical: to minimise possible risks to the safety of people and equipment in the event of fire.

Cables for ships and oil platforms must also fulfil other requisites such as resistance to saline environments, the capacity to withstand mechanical and chemical forces and aggressions in a cable-aggressive environment, capacity to work in a complicated electromagnetic environment, and resistance to extreme weather conditions.

The cables in the EXZHELLENT-NAVY, EXZHELLENT-606 and EXZHELLENT 92-3 ranges have incorporated features that guarantee the proper operation and useful life of the cables even in such adverse conditions:

- Flexible conductors to facilitate installation and reduce hazards in the event of vibrations.
- Tinning of conductors, shielding and armour to prevent corrosion (optional in some ranges and standard in others).

- Braided copper or bronze wire shielding and/or armour that protect the cable mechanically and reduce its electromagnetic emissions.
- Jacket materials resistant to mechanical aggression, oils and hydrocarbons, and extreme weather, in accordance with the strictest international regulations. Resistance to mud is included as an option in cables for oil platforms.



EXZHELLENT-NAVY DHDtC4Dt 6/10 kV



EXZHELLENT 92-3 RO1O2DtZbDt-M
0.6/1 kV fire-resistant

Cables for photovoltaic installations

Photovoltaic installations have developed spectacularly in recent years and Spain is now one of the countries with the greatest installed power. These installations must fulfil very special requisites, as they can be located on very diverse sites, where the conditions for cables are sometimes extremely harsh. Such conditions include:

- Extreme operating temperatures ranging from very intense cold to extreme heat caused by the operation of the installation itself and the environmental conditions.
- Work in extreme weather conditions with high exposure to solar radiation, combined with the changes in temperature mentioned above and other extremely harsh environmental factors.

GENERAL CABLE has developed the EXZHELLENT SOLAR range of cables that incorporates high-performance and maximum safety features, thus guaranteeing the 30-year service life required in such installations. The designs therefore incorporate:

- Tinned copper flexible conductor to allow mobile service if necessary and to minimise contact resistance losses.
- Insulation and jacket materials able to withstand temperatures of up to 120 °C for 20,000 hours while working at -40 °C, with no reduction in their performance.
- Jacket resistance to extreme weather, in accordance with extremely rigorous test requirements, and incorporation of resistance to other dangerous agents such as ozone.
- Jacket with excellent mechanical resistance to abrasion and to tear, thus guaranteeing that the cable can withstand forces during installation and the accidental mechanical aggressions to which it may be subject throughout its service life. Optionally, cables with armour are available to prevent aggressions by rodents in the critical installation between the connection box and the inverter.

- Anti-fire safety features, which are essential in a clean, sustainable energy generation installation.



ExZhellent SOLAR ZZ-F (AS) 1.8 kV DC



EXZHELLENT SOLAR XZ1FA3Z1-K
0.6/1 kV reinforced

Xavier Gol
Commercial technician