

CONDUCTIVE COMPOUNDS



**CABOT**

creating what matters

## CABELEC® Compounds Processing Guide



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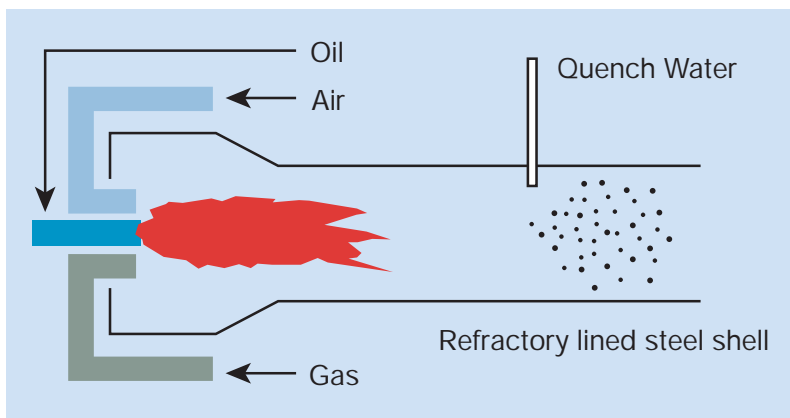
CABELEC compounds are a range of compounds that are electrically conductive thereby reducing the risk of electrostatic discharge. The conductive properties of the compounds are permanent. CABELEC compounds are based on a large variety of thermoplastic polymers and are designed to fulfil specific requirements related to electrical, rheological and mechanical properties. A range of CABELEC compounds is available for different processing techniques such as blown film extrusion, sheet and profile extrusion, injection moulding, blow moulding, etc.

## Conductive carbon black

CABELEC compounds are carefully formulated products based on conductive carbon black. The type of carbon black, the addition level and the dispersion quality are key factors for achieving good conductivity – or low electrical resistivity.

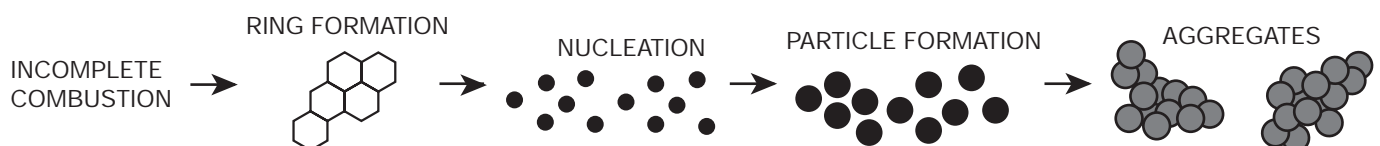
Carbon black is a particulate form of industrial carbon produced by thermal cracking or thermal decomposition of a hydrocarbon raw material. Many processes historically have been used to produce carbon black, but the most important now is the oil furnace process. It consists of atomising a heavy aromatic fraction of petroleum distillate into a preheated, closed furnace followed by cooling and collecting the formed carbon particles.

**Carbon Black Oil Furnace Process**



Electron microscopy inspection reveals that carbon black is composed of aggregates, which resemble fused clusters of spherical primary particles.

**Carbon black oil furnace process**





## Processing CABELEC compounds

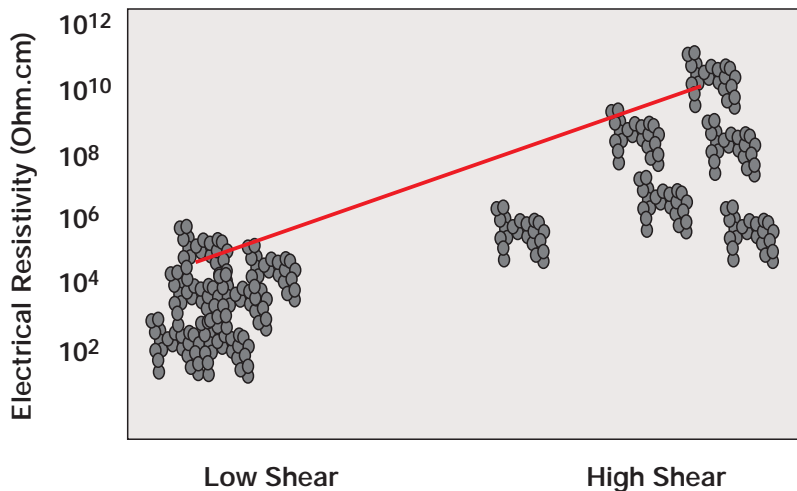
### Predrying

As the carbon black contained in the compounds is hygroscopic, CABELEC compounds should be stored in a dry place. Before processing – unless specified in the Product Data Sheet for the specific grade – the compounds need to be predried. Processing a compound having too high a moisture content will result in, for example, surface blemishes in the injection moulded part, holes in the blown film, and so on.

### Processing

CABELEC compounds can usually be processed on conventional processing equipment. To ensure good electrical and mechanical properties of the material, it is strongly recommended that the compounds be processed under low shear conditions. In fact, conductive carbon black filled compounds are highly shear sensitive. Too much shear deteriorates the carbon black structure and will result in higher electrical resistivity of the manufactured item.

**Influence of shear on carbon black structure and electrical resistivity**



Processing equipment and parameters should be carefully selected so that the shear generated is kept to a minimum. For more details please refer to the specific CABELEC processing sections.

### Dilution

CABELEC products provide optimum performance when used alone i.e. without dilution with non-conductive raw materials. For this reason we do not recommend dilution. In some processing techniques dilution is performed via addition of regrind. One should keep in mind the fact that the regrind is increasingly "diluted " resulting in progressively lower fractions of conductive material in the finished part. Appropriate blending and feeding procedures are required to maintain the desired resistivity levels. Rigorous testing of the electrical resistivity is also strongly recommended.

### Purging

After a CABELEC production run purging of the equipment is required. Due to its high carbon black content, CABELEC can be problematic when changing to a natural or light coloured material. It is generally recommended to purge with a natural, high viscosity resin and to clean the screw and barrel mechanically.

# Blown Film Extrusion

## Applications

- Film for packaging of electronic components
- Film for photographic applications
- Liners for big bags for explosive powders
- Packaging materials for explosive powders or other substances used in an explosive environment (as required by the ATEX norms)



## Equipment requirements for blown film extrusion of CABELEC compounds

CABELEC compounds can be processed on conventional blown film extruders although it is important to select the optimum processing conditions. To ensure good electrical and mechanical properties of the film, it is strongly recommended that CABELEC compounds are processed under conditions of low shear.

A general purpose screw of L/D ratio of 20-30/1 with a long feed section is recommended. The compression zone should be of low compression ratio. The die head geometry should be designed to avoid or minimise any restriction of flow.

## Optimum guidelines for processing of CABELEC compounds

Processing parameter	Settings versus natural polymer
Barrel temperatures	10-20°C higher
Melt temperatures	10-20°C higher
Die temperatures	20°C higher
Extrusion speed	Lower

Cooling of conductive films is normally more rapid than that of transparent, non-conductive films due to their high carbon black content which increases thermal conductivity. This factor should be taken into account when setting the process conditions.

The surface resistivity of the film is related to the film thickness: resistivity increases as the film thickness decreases. It is also important to avoid a large blow up ratio as this will increase separation of the carbon black structures thereby reducing the conductivity of the film.



## Coextrusion

For conductive films, coextrusion can be used provided that a high volume resistivity is acceptable. The external conductive layers can be coextruded with a non-conductive middle layer, using cheaper polymers or recycled material which will be encapsulated in the film construction ("sandwich" structure).

## Printing

Corona treatment SHOULD NOT be used on a conductive film. Nevertheless printing processes which do not require Corona treatment, for example laser printing, can be used.

## Sealing

Conductive films can be sealed using standard sealing equipment. Problems may occur due to the high thermal conductivity of the CABELEEC compound in which case increasing the sealing temperature can be beneficial.

## Troubleshooting guide

Some potential problems that can occur with CABELEEC compounds are:

Problem	Potential cause	Recommendations
Lack of conductivity	Shear too high Too much regrind Dilution too great Stretching too high Film too thin	Increase temperature, reduce speed Reduce or remove regrind Reduce or remove natural resin Reduce blow up ratio Increase film thickness
Bad sealing strength	Thermal conductivity	Increase sealing temperature and pressure
Curling of film	Inhomogeneous cooling Difference in shrinkage between the layers of a coextruded film	Reduce line speed Adapt wall thickness
Sticking of the film during winding	Film too hot during winding	Reduce speed and/or increase air cooling
Die deposit	Moisture	Dry CABELEEC compound according to guidelines in product data sheet
Voids and holes	Moisture	Dry CABELEEC compound according to guidelines in product data sheet

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