

Technical article

Robust, reliable and safe

CIRCUTOR Heavy Duty Capacitor



One of the common solutions for improving energy efficiency is power factor correction, with the capacitor being the key element.

Consolidated strength

► Rising costs of electrical energy and greater environmental awareness have led us to improve energy efficiency. One common solution for improving energy efficiency is power factor correction, with the capacitor being the key element.

For twenty years **CIRCUTOR** has been using gas impregnation technology, which together with other advances, provides capacitors with what are known in the market as **Heavy Duty**

features. The capacitors permanently support **1.8 times the rated current (RC)**, reaching **2.5 times RC** for short time and can reach an **inrush current** of up to **400 times RC**. Class D of the IEC-60831, the low voltage capacitor manufacturing standard, sets a maximum working value of 55°C, but the strength of the CIRCUTOR Heavy Duty capacitor enables capacitors to work in extreme temperature conditions, occasionally supporting up to 65°C, with this being another key feature ensuring 150,000 h of useful life. All



**Higher
temperature
strength
65 °C
short time**

these features make CIRCUTOR Heavy Duty capacitors highly strength and long lasting.

European raw materials for greater durability

On this was these **Heavy Duty** capacitors can support more demanding work conditions, with extreme temperatures, and fluctuations in working voltage and current due to CIRCUTOR applies a policy of choosing high quality raw materials. In the case of CIRCUTOR Heavy Duty capacitors, the key material is metallized polypropylene, which always has European origin with the very highest performance features.

CIRCUTOR Heavy Duty capacitors impregnated by inert gas (DRY technology) are very **safe against fire and toxic leakage, and are also biodegradable**, in contrast to oil saturated foil, or solid or semi-solid resins which are flammable. Other advantages of inert gas impregnation are:

- **Lighter in weight** compared to other capacitors of equal power, thus improving both transport costs and the cost of the batteries it is equipped with, and achieving **greater cost efficiency and advantages** for both the end user and for the whole supply chain.
- **Increased safety**, due to the greater efficiency of the internal pressure relief valve protection system. In the absence of a liquid impregnant (oil) or solid impregnant (thermosetting resin), the gases of the capacitive elements emitted in the event of a fault act directly on this internal pressure relief safety valve.



With CIRCUTOR Heavy Duty, the key material is metallized polypropylene, which is always of European origin with the very highest performance features.

- The absence of leakages also enables different assembly options, adaptable to the various types of cabinets available, achieving **optimal adaptation** of the final solution to each user.

- **Environmentally friendly**, since they are **capacitors impregnated with harmless and inert gas**, they are also free of oils or other impregnants with risk of leakage.

The optimised design of the **CIRCUTOR Heavy Duty** capacitor permits the achievement of this high level of performance, maintaining the necessary degree of cooling to achieve up to 150,000 hours of lifetime.

Durability and safety as a key factor

Another advantage, besides the inert gas impregnant of these Heavy Duty capacitors, is the metallised **self-healing** capacity (figure 1), which prevents leakages after a dielectric breakdown. This allows better withstand any network overvoltages, high working temperatures and the presence of harmonic currents in the network to be compensated, or even a high number of connection operations.



CIRCUTOR Heavy Duty capacitors saturated with inert gas (DRY technology) are very safe against:



Fire



**Longer lifetime
150,000 h**



**Environmentally
friendly**

Self-healing process of the metalized polypropylene

Self-healing of the metalized polypropylene prevents the development of leakages after a dielectric incident.

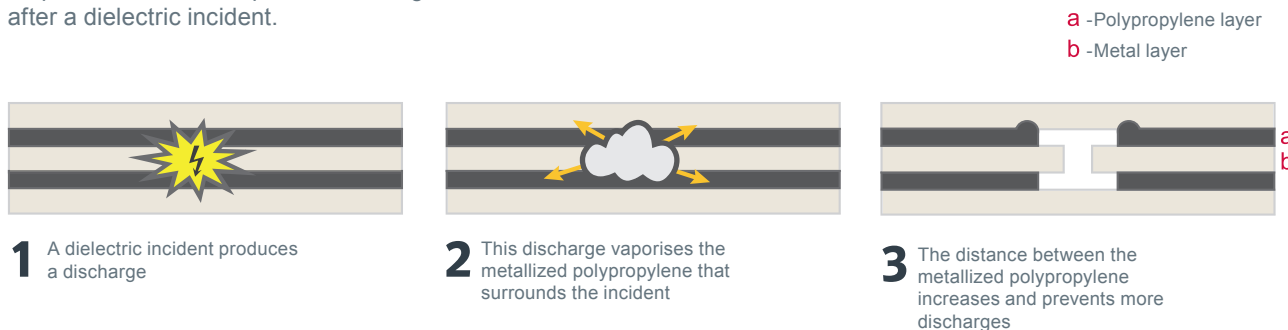


Figure 1

Like with any other material, polypropylene chemically degrades over time, which here is coupled with the electrical stress factors of the capacitor. For this reasons, capacitors should be equipped with appropriate protection systems, so if necessary they can be disconnected without causing any damage to the neighboring elements (other capacitors, switching equipment, regulator etc.). In this regard, **CIRCUTOR Heavy Duty** capacitors are equipped with a pressure relief protection system, which acts in the event of an increase in its internal pressure simply a higher value than 506 hPa approximately (0.5 bar), disconnecting the capacitor from the mains as shown in the figure 2.

Manufacturing: a vital step for quality

The figure 3 at the next page shows the main components of the capacitors filled with **CIRCUTOR Heavy Duty** gas.

Its manufacturing process includes the basic premise of any product manufactured by CIRCUTOR: maximum guarantees of quality and reliability. This means that the capacitor production process includes some aspects that are worthy of mention:

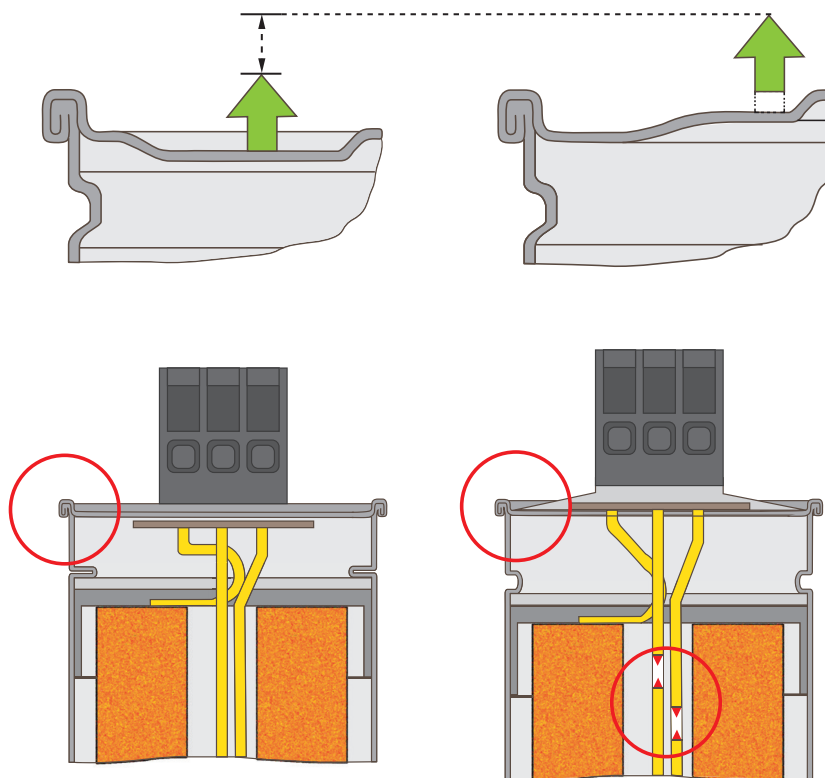


Figure 2

The **CIRCUTOR Heavy Duty** capacitors have an overpressure protection system which is activated in case of any increase in internal pressure, disconnecting the capacitor from the network.

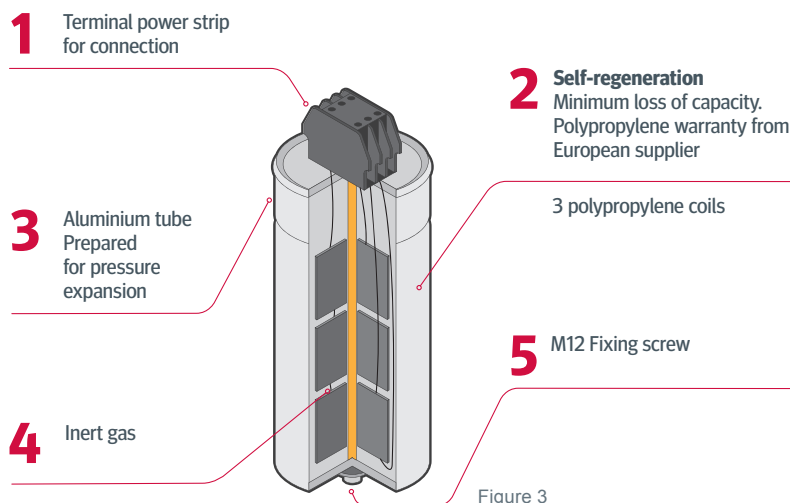


Figure 3

1. Once the coils are mounted inside the aluminium tube, it is vital to ensure the total elimination of any possible humidity from their components, so each capacitor undergoes a long and exhaustive vacuum process in auto-claves. It is essential to ensure that there is no trace of humidity or oxygen left inside the capacitor to prevent oxidation of the metallic part of the polypropylene film. Preventing this oxidation also avoids rapid deterioration of the capacitor and therefore reduces its dielectric losses, lowering internal discharges and improving its capacity throughout its lifetime.

2. After the vacuum process, the capacitors are filled with a mix of N₂ (nitrogen) and He⁴ (helium gas isotope with an atomic mass of 4, a natural element which has a very low density and is colourless, odourless and flavourless) gases, once again under vacuum conditions, until achieving an internal pressure in the capacitor of slightly more than 1013 hPa (1atm). The figure shows this filling process.

3. As can be seen in the figure, during the filling and sealing process of the capacitors, the cover is already equipped with the set of terminals for connection to the mains. These terminals already include the discharge resistors required to discharge the capacitor to a value of less than 75 V

three minutes after it is disconnected from the mains (figure), as specified in the applicable standard **IEC 60831-1**.

4. The production process ends with the performance of a basic test to guarantee the quality and reliability of each capacitor: checking the sealing process to ensure that there are no leakages of the internal gas. If any leakage is detected, that capacitor is removed from the production process.

Conclusions

In summary, we can highlight the strength of the Heavy Duty capacitors, a reliable unit that permanently supports **1.8 times the rated current** and up to **2.5 times RC for short time**, reaching an inrush current of up to 400 times RC, and guaranteeing a long lifetime of up to **150,000 hours**. All these features make CIRCUTOR Heavy Duty capacitors highly resistant and long lasting.

Aware also of market needs, CIRCUTOR has more than 6,000 **Heavy Duty** capacitors in **stock**, ready to be delivered upon customer request. CIRCUTOR is the ideal partner for power factor correction solutions, thanks to its Heavy Duty capacitors and its regulators. ▀

Figure 4
Capacitor filling and sealing process.

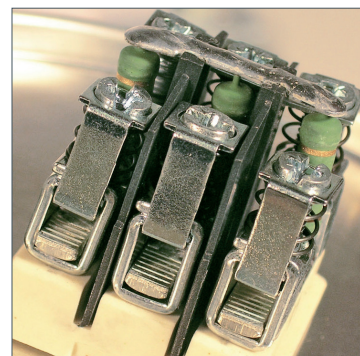


Figure 5
Terminals for connection to the network