Vacuum

inNOVAtions

from Cooper Power Systems

THE ULTIMATE GAS-FREE, OIL-FREE AND MAINTENANCE-FREE SOLUTION FOR

AUTOMATION, PROTECTION AND SWITCHING APPLICATIONS

NOVA Technology

COOPER Power Systems

Kyle Distribution Switchgear

Kyle Leads Vacuum Technology

Cooper Power Systems' Kyle Distribution Switchgear NOVA products incorporate vacuum technologies which have advanced the durability and extended the application base for vacuum products. Kyle's constant development effort represents a detailed understanding of arc control, thermal loads, and contact erosion. Each is pivotal to the successful application of vacuum to solid dielectric systems.

The patented axial-magnetic field vacuum interrupter, designed and manufactured by Kyle Distribution Switchgear, is the most advanced vacuum interrupter in the world. Rely on Kyle vacuum interrupters to provide dependable operation for the lifetime of the switchgear.

Innovative Design

Many vacuum interrupters employ radial magnetic field contacts. Slots are machined into the contact structure to affect the direction of current flow during arc interruption in such a way as to induce a radial magnetic field. This radial magnetic field rotates the arc around the circumference of the contact, minimizing wear in any one spot. Though this method is sufficient for low and medium current density applications, higher current levels can cause significant contact erosion or shield burn-out.

Kyle vacuum interrupters employ axial-magnetic field contacts. Slots are machined into the contact support structure producing a coil that induces a magnetic field along the axis of the interrupter. This axial-magnetic field keeps the arc in an easier-to-interrupt diffuse mode, resulting in less power in the arc that needs to be dissipated. Furthermore, Kyle's patented design uses the entire contact surface, resulting in far less contact erosion.

Axial-Magnetic Field Vacuum Interrupter Design

- Maintains high fault-interrupting capability.
- Provides fast, low-energy arc interruption.
- Minimizes heat dissipation.
- Ensures long contact and interrupter life.
- Eliminates the production of toxic byproducts.
- Maximizes operating safety.

World-Class Manufacturing Process

The heart of the interrupter is the contact material and structure. During the interruption of high current, the surface of the contacts can reach melting temperature, liberating any residual gases or contaminants into the vacuum. The key is to provide contact material that is highly conductive, yet resistant to erosion.

High purity chromium powder is analyzed, filtered, pressed into a porous disk, infiltrated with copper, and fired into solid material. After electro-polishing, parts are assembled in a Class 1000 clean room, then loaded into a vacuum brazing furnace for final production. All processes are certified to ISO 9001 quality standards.

Contact Infiltration

Vacuum interrupter contacts are manufactured with chromium and copper to obtain mechanical and electrical characteristics needed for the contacts. Chromium powder is pressed into disks of appropriate size and density. Oxygen Free High Conductivity (OFHC) copper is then infiltrated into the chromium at over 1100°C within a vacuum furnace to obtain a homogeneous chrome/copper matrix.

Copper placed onto chromium disks prior to contact infiltration.

Contact Machining

The infiltrated disks are then machined into contacts using a dry machining process. To prevent contamination on the surface of the contacts, liquid lubricants are not used. The contacts are cooled by an air vortex.

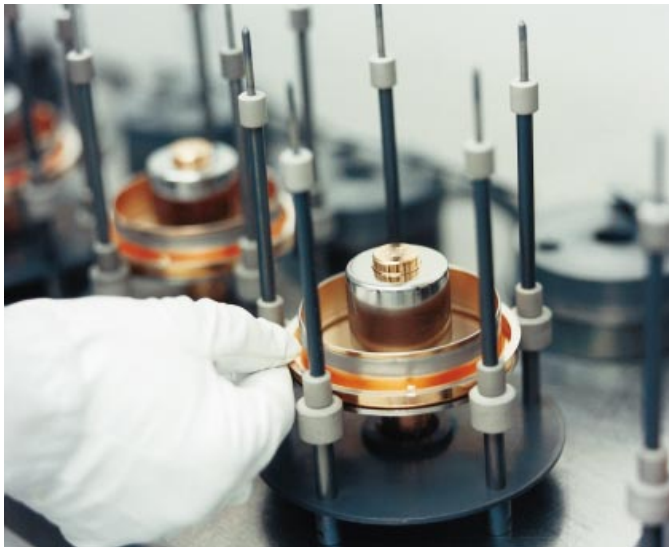
Contacts are machined to specific tolerances.

Electropolishing

Electropolishing is a method of polishing metal surfaces by applying an electric current through an electrolytic bath in a process that is the reverse of plating. Kyle utilizes electropolishing as a process to prepare vacuum interrupter parts for brazing. The surfaces of the vacuum interrupter must be clean and free of contaminants to obtain a permanent braze joint.

Electropolishing removes all contaminants from the interrupter contacts.

The first step is to remove all contaminants from the part, introduced during machining, using an industrial degreasing solution and an ultrasonic cleaner. The parts are then processed through an electropolishing bath. Finally, the parts are rinsed thoroughly using warm deionized water to ensure that residual electrolytic solution does not remain on the surface.



Vacuum interrupters are assembled in precision stainless steel fixtures.

Interrupter Assembly

Interrupters are assembled in a contaminant-free Class 1000 clean room, similar to surgical or semiconductor assembling environments, to ensure the highest quality product. Brazing alloy is applied at all joints. The interrupters are then placed in precision stainless steel fixtures to ensure consistent dimensional assembly.

Brazing

Sealing the interrupter is accomplished within a microprocessor-controlled, high-temperature, high-vacuum brazing furnace. The assembled interrupters are set on a rack and placed in the furnace. Brazing occurs within a vacuum measuring approximately $1x10^{-6}$ torr at a temperature between 800°C and 900°C.

Vacuum interrupters are placed in high-vacuum brazing furnace.

Testing

Each completed interrupter must pass a series of electrical and pressure tests. After production testing, as a final quality check, all interrupters are stored for 30 days and then retested to catch any failures. After final acceptance, the new interrupters are released for installation in Kyle Distribution Switchgear products.

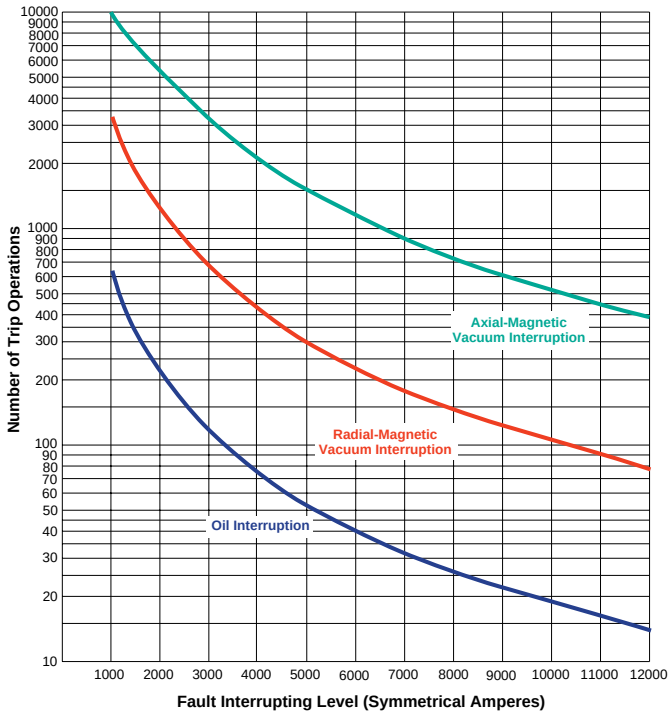
A Kyle vacuum interrupter is pressure tested.

Kyle NOVA three-phase recloser.

Kyle Vacuum Technology Leads Industry

Cooper Power Systems' Kyle axial-magnetic field vacuum interrupters are used in Kyle NOVA switchgear products (reclosers, distribution switches, sectionalizers). Congruent with utilities' maintenance-free philosophy, Kyle axial-magnetic field vacuum interrupters provide extended life and are an integral part of the NOVA technology.

Cooper Power Systems, Kyle Distribution Switchgear, manufactures the most advanced vacuum interrupter in the world. Superior to oil interruption and radial-magnetic field vacuum interruption (see duty cycle comparison), the patented axial-magnetic field Kyle vacuum interrupters provide the longest life of any vacuum interrupter in the industry.



Duty cycle comparison of oil, radial-magnetic field, and axial-magnetic field fault interruption.

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