

How Does a Vacuum Breaker Work?

Published on May 7, 2025 at 06:47:27 · Last reviewed on May 7, 2025

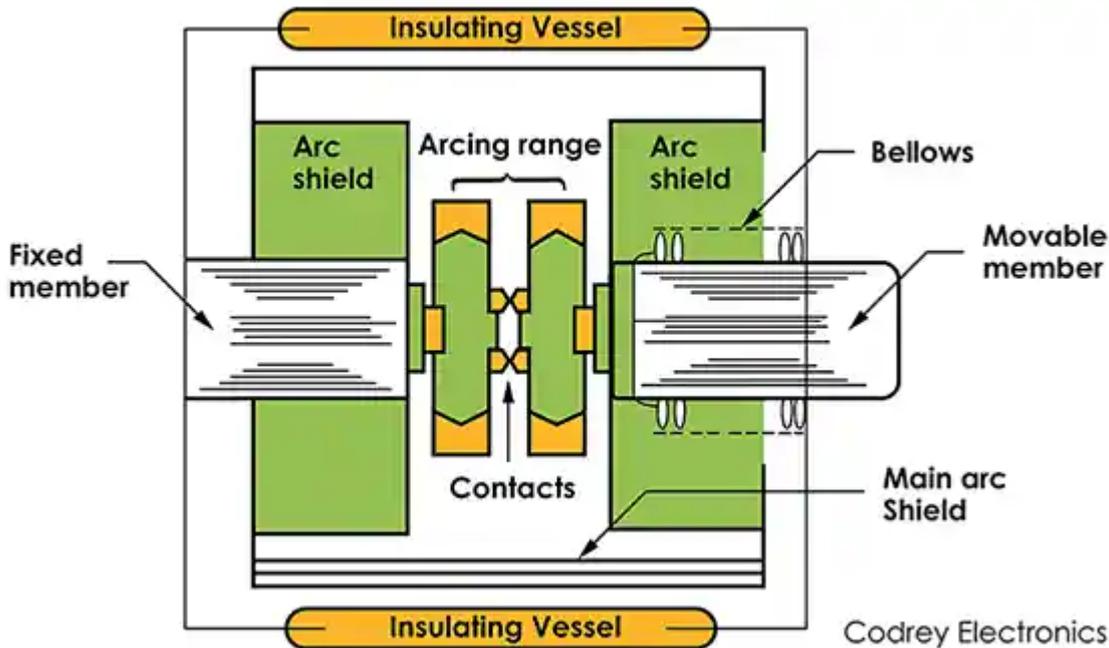
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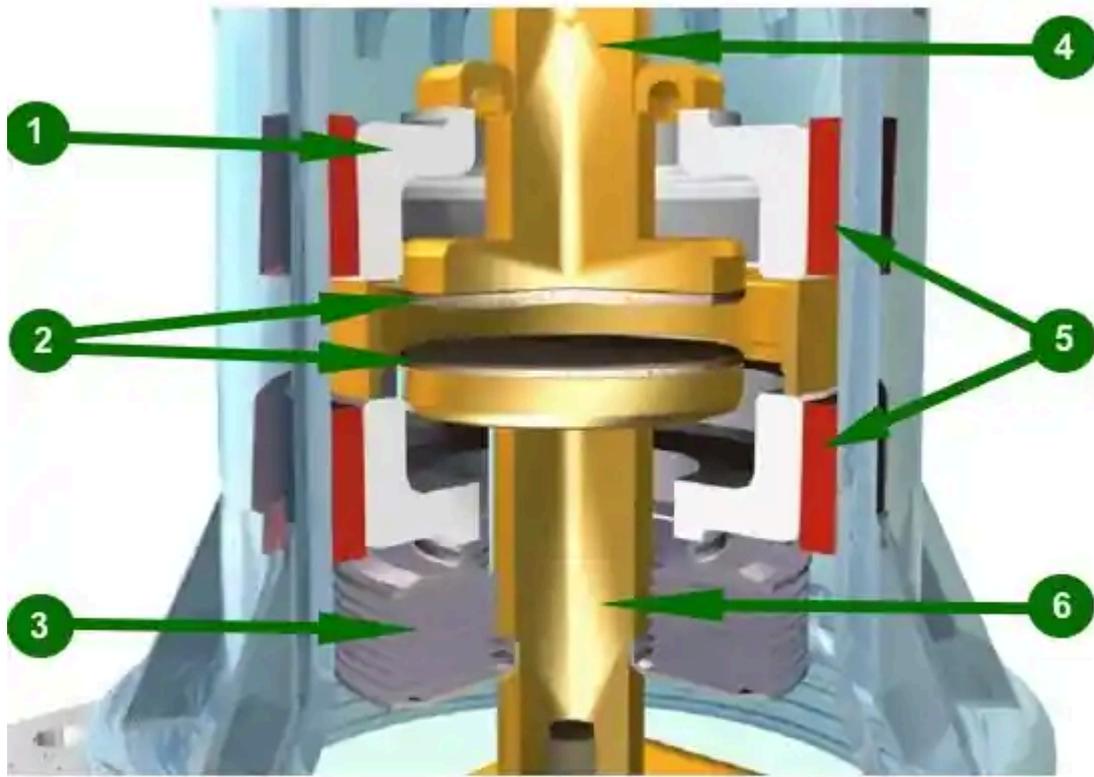
Introduction to Vacuum Breakers A vacuum breaker is an essential type of circuit breaker that interrupts current flow in high-voltage electrical systems using vacuum as the arc-extinguishing medium. Unlike air or gas-insulated alternatives, a vacuum interrupter extinguishes the arc in a near-perfect vacuum environment, making it highly efficient, reliable, and safe for medium-voltage applications.



How Vacuum Breakers Work The core mechanism of a vacuum breaker lies in its **vacuum interrupter chamber**. Here's how it functions:

- **Contact Separation:** When a fault is detected, the breaker mechanism forces the contacts apart inside a sealed vacuum chamber.
- **Information:** As the contacts separate, an arc forms due to ionization of metal vapors.
- **Exinction:** In the vacuum, there are no gas molecules to sustain the arc. The arc is rapidly extinguished, usually within half a cycle of the AC waveform.

- **Dielectric Recovery:** The vacuum allows for very fast dielectric recovery, making the system ready for operation quickly.



- 1. Insulators
- 2. Contacts
- 3. Bellows

- 4. Fixed insulator contact
- 5. Sealing ring
- 6. Movable contact

Applications of Vacuum Breakers Vacuum circuit breakers are typically used in:

- Medium-voltage switchgear (1 kV to 38 kV)
- Power distribution systems in industrial plants
- Substations in utility grids
- Mining and marine applications
- Renewable energy systems

Their compact size, minimal maintenance, and long life make them ideal for mission-critical operations.





breaker guide installed in industrial switchgear panel" class="wp-image-1284"/>

Market Trends and Industry Adoption According to **IEEE** and **IEEMA**, vacuum breaker technology has become the dominant standard for medium-voltage systems worldwide. The market is seeing:

- Increased demand from smart grid expansion
- Rising installation in renewable energy plants
- Replacement of aging SF6-based breakers for environmental compliance

Manufacturers like **ABB**, **Schneider Electric**, and **Siemens** have continued to innovate in contact material, actuator design, and digital integration.

 **Parameters and Comparison**

Feature	Vacuum Breaker	SF6 Breaker
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Arc Quenching Medium	Vacuum	Sulfur Hexafluoride (SF6)
Dielectric Recovery Time	Very Fast	Moderate
Environmental Impact	None	High (greenhouse gas)
Maintenance Requirements	Low	Moderate to High
Typical Application Voltage	1 kV to 38 kV	72.5 kV and above

Advantages Over Traditional Breakers

- **No gas refilling required**
- **Long mechanical life** (~10,000 operations or more)
- **Fast arc extinction and low energy loss**
- **Compact and modular design**

These benefits have made vacuum breakers increasingly preferred in urban and industrial electrical networks.

Buying Guide and Selection Tips When selecting a vacuum breaker:

- **Match voltage and current rating** to your system
- Choose between **fixed or withdrawable types** depending on maintenance needs
- Prefer models with **digital diagnostics** for smart grid compatibility
- Ensure **compliance with IEC 62271 or ANSI/IEEE C37.04 standards**





FAQ Section

Q1: Why is vacuum used instead of air or gas in these breakers?

A vacuum provides excellent insulation and arc-extinction capability without introducing harmful gases, making the breaker more eco-friendly and efficient.

Q2: Can vacuum breakers be used in high-voltage (above 72.5 kV) systems?

Generally, vacuum breakers are used in medium-voltage systems. For higher voltages, SF6 or air-insulated breakers are more common.

Q3: How often do vacuum breakers need maintenance?

They require minimal maintenance, often after 10,000 operations or more, making them ideal for demanding environments.



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