



# **SNS COLLEGE OF ENGINEERING**

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## **DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING**

**COURSE NAME : 19EE605 PROTECTION AND SWITCHGEAR**

III YEAR /VI SEMESTER

Unit 3- CIRCUIT BREAKER

Topic: Comparison of Various Circuit Breaker



# Molded Case Circuit Breakers

## Description

Molded case circuit breakers (MCCBs) are a common type of low-voltage circuit breaker. They feature a compact, self-contained design enclosed in a molded plastic or resin case. MCCBs are widely used in residential, commercial, and light industrial applications to protect electrical circuits and equipment from overloads and short circuits.

## Features

MCCBs offer features such as thermal-magnetic trip mechanisms, adjustable trip settings, and remote operation capabilities. They are known for their reliability, ease of installation, and cost-effectiveness, making them a popular choice for many electrical systems.

## Applications

Molded case circuit breakers are typically used to protect branch circuits, feeder circuits, and equipment in low-voltage electrical distribution systems. They are commonly found in panelboards, motor control centers, and other electrical enclosures.



# Air Circuit Breakers

## 1 High Interrupting Capacity

Air circuit breakers (ACBs) are designed to handle high fault currents, making them suitable for use in high-voltage and high-capacity electrical systems, such as industrial facilities, power plants, and large commercial buildings.

## 2 Robust Construction

ACBs feature a rugged, metal-enclosed design that can withstand the significant forces and high-energy arcs generated during circuit interruption. This ensures reliable operation and a long service life.

## 3 Advanced Features

Air circuit breakers often include features like microprocessor-based controls, remote monitoring and control capabilities, and optional accessories to enhance their functionality and integration into complex electrical systems.

## 4 Maintenance Considerations

Due to their size and complexity, air circuit breakers typically require more specialized maintenance and servicing compared to other circuit breaker types, such as scheduled inspections and contact replacement.



# Vacuum Circuit Breakers



## Compact Design

Vacuum circuit breakers (VCBs) feature a compact and modular design, allowing them to be easily integrated into various electrical equipment and systems. Their small footprint makes them well-suited for applications where space is limited.

## High Reliability

The vacuum interrupter technology used in VCBs provides a highly reliable and predictable circuit interruption performance, even in the presence of high fault currents. This makes them a popular choice for critical applications.

## Reduced Maintenance

Vacuum circuit breakers typically require less maintenance compared to other types of circuit breakers, as the vacuum interrupters are sealed and do not require frequent contact replacement or adjustments.

## Environmental Benefits

VCBs do not rely on oil or SF6 gas for their operation, making them a more environmentally friendly and sustainable option compared to some other circuit breaker technologies.



# Oil Circuit Breakers

1

## Robust Design

Oil circuit breakers (OCBs) feature a robust, heavy-duty construction that can withstand high fault currents and mechanical stresses. This makes them suitable for use in demanding industrial and utility applications.

2

## Arc Interruption

The oil medium within OCBs effectively absorbs and extinguishes the electric arc generated during circuit interruption, providing a reliable and stable means of breaking high-current circuits.

3

## Maintenance Considerations

Oil circuit breakers require periodic maintenance, such as oil filtering and replacement, to ensure their continued safe and reliable operation. This need for more specialized maintenance can be a drawback in some applications.



# Gas-Insulated Circuit Breakers



## Compact Design

Gas-insulated circuit breakers (GCBs) are designed with a compact, space-saving footprint, making them well-suited for installation in substations and other confined spaces where space is limited.



## Reliable Operation

The use of specialized insulating gases, such as sulfur hexafluoride (SF<sub>6</sub>), provides excellent dielectric properties and allows GCBs to reliably interrupt high-voltage and high-current circuits.



## Reduced Maintenance

Gas-insulated circuit breakers generally require less maintenance compared to other types, as the sealed design and use of insulating gases minimize the need for frequent inspections and component replacements.



## Environmental Considerations

The use of SF<sub>6</sub> gas in GCBs has come under scrutiny due to its high global warming potential. Newer designs are exploring alternative insulating gases or vacuum technologies to address these environmental concerns.



# Solid-State Circuit Breakers

1

## Semiconductor-Based Design

Solid-state circuit breakers (SSCBs) utilize semiconductor devices, such as power transistors or thyristors, to perform the circuit interruption function, unlike traditional electromechanical circuit breakers.

2

## Faster Response Times

The solid-state design of SSCBs allows for faster detection and interruption of faults, providing superior protection for sensitive electronic equipment and critical applications.

3

## Increased Lifespan

Solid-state circuit breakers have a longer lifespan compared to electromechanical breakers, as they do not suffer from mechanical wear and tear associated with frequent tripping and resetting operations.

4

## Advanced Functionality

Solid-state circuit breakers can offer enhanced features, such as remote monitoring, programmable trip settings, and integration with smart grid technologies, making them well-suited for modern electrical distribution systems.



# Hybrid Circuit Breakers



## Combination Design

Hybrid circuit breakers (HCBs) combine the advantages of both electromechanical and solid-state technologies, leveraging the strengths of each to provide improved performance and functionality.

## Interrupting Capability

HCBs can handle high fault currents and interrupting duties, making them suitable for use in medium and high-voltage electrical systems, such as industrial facilities and power transmission networks.

## Reliability and Efficiency

The hybrid design of HCBs allows for reliable circuit interruption while also reducing energy losses and improving overall system efficiency compared to traditional circuit breakers.

## Advanced Features

Hybrid circuit breakers can incorporate features like remote monitoring, advanced control algorithms, and integration with smart grid technologies, enhancing their versatility and adaptability to modern electrical grid requirements.





# Factors to Consider in Circuit Breaker Selection

## Application Requirements

When selecting a circuit breaker, it is crucial to consider the specific requirements of the application, such as voltage and current ratings, interrupting capacity, and environmental conditions. Choosing the right circuit breaker ensures proper protection and reliable operation.

## System Integration

Circuit breakers must be compatible with the existing electrical infrastructure and seamlessly integrate with other components, such as switchgear, control systems, and monitoring devices. This ensures efficient and coordinated operation of the overall electrical system.

## Maintenance and Lifecycle

The maintenance requirements and expected lifespan of a circuit breaker should also be evaluated. Some types may require more frequent inspections, testing, and component replacements, while others offer longer service lives with minimal maintenance.



# Conclusion: Choosing the Right Circuit Breaker

## 1 Understand Application Needs

Thoroughly assess the specific requirements of the electrical system and application to determine the most suitable circuit breaker type and features.

## 2 Consider System Integration

Ensure the selected circuit breaker seamlessly integrates with the existing electrical infrastructure and can be easily incorporated into the overall system design.

## 3 Evaluate Lifetime Costs

Factor in the long-term maintenance requirements and expected lifespan of the circuit breaker to make an informed decision that balances performance, reliability, and cost-effectiveness.

## 4 Stay Informed on Innovations

Keep up with the latest advancements in circuit breaker technologies, such as solid-state and hybrid designs, to take advantage of emerging features and benefits that may better suit your evolving needs.



# Assessment



Which type of circuit breaker offers the fastest interruption of current and requires minimal maintenance?

- a) Air circuit breaker
- b) Oil circuit breaker
- c) SF6 circuit breaker
- d) Vacuum circuit breaker.





# References



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**Thank You**