



27.5 kV AC SWITCHGEARS

■ RAILWAYS ■

BUILDING FUTURE **TOGETHER!**

27.5 kV AC Switchgears

27.5 kV Switchgears are designed to deliver and distribute 50 Hz alternating current (AC) for the supply of AC railway electrification systems at a nominal voltage of 27.5 kV.

«AVL Reach Limited» provides a full range of services: starting from recommendations of the optimal choice of 27.5 kV switchgear components and design, up to installation and commissioning of the delivered equipment on site.

Our range of services is listed but not limited to the following:

- Personnel training for safe operation methods and maintenance;
- Warranty maintenance;
- Post warranty maintenance;
- Spare parts supply;
- Troubleshooting and repair works.

Safety

- Maximum protection against exposure of life components to personnel.
- Fixed power contacts and busbars are protected for safe maintenance.
- Enhanced interlocking system and safeguards eliminate human error.
- Cubicles tested at the independent testing facility.
- Electrocution hazard avoided by keeping all exposed conductive components of 27.5 kV switchgear at earth potential.
- Cubicle is resistant to environmental influence.

Correspondence to International Standards

27.5 kV AC Switchgears were type tested and comply with EN 62271-200 and EN 60694 standards.

Innovation and Design

Switchgear design allows single sided maintenance. Vacuum circuit-breaker is installed on the trolley. Trolley can be positioned in any of three positions: service, control and repair.

Switchgear frame has assembled metal structure. Switchgears are equipped with single door made of solid steel sheet with right or left fixture option.

Inspection window, made of multi-layered polycarbonate, is inbuilt into circuit-breaker compartment door. Power busbars are divided by panes and mounted on insulators. Cable connections are provisioned from the bottom of the switchgear allowing direct connection to the busbars.

One of the most important advantages of the switchgear is its high level of short-circuit resistance.

Switchgear ingress protection level is IP3X.



Maintainability

- Ergonomic industrial design.
- Ease of accessibility to all functional groups.
- Remote and local equipment control options.

Control Panel



▲ Feeder Cubicle

1 Mnemonic diagram

Convenient mnemonic diagrams with LED indication of condition and position of vacuum circuit-breaker and earthing switch

2 Measuring Tools

Ampere meter for load currents indication

3 Circuit-Breaker Manual Control

Circuit-Breaker ON/OFF buttons for local mode operation

4 Inspection Window

Inspection window allows to visually define circuit-breaker position

5 Door Interlocking

Door opening interlocking when vacuum circuit-breaker is closed

6 Handlebar

For manual vacuum circuit-breaker opening/closing in service position

7 Trolley Position

Indicator of trolley drive position

8 Earthing Switch Drive

Manual opening/closing of earthing switch

9 Trolley Manual Control

For trolley manual control (with handlebar)

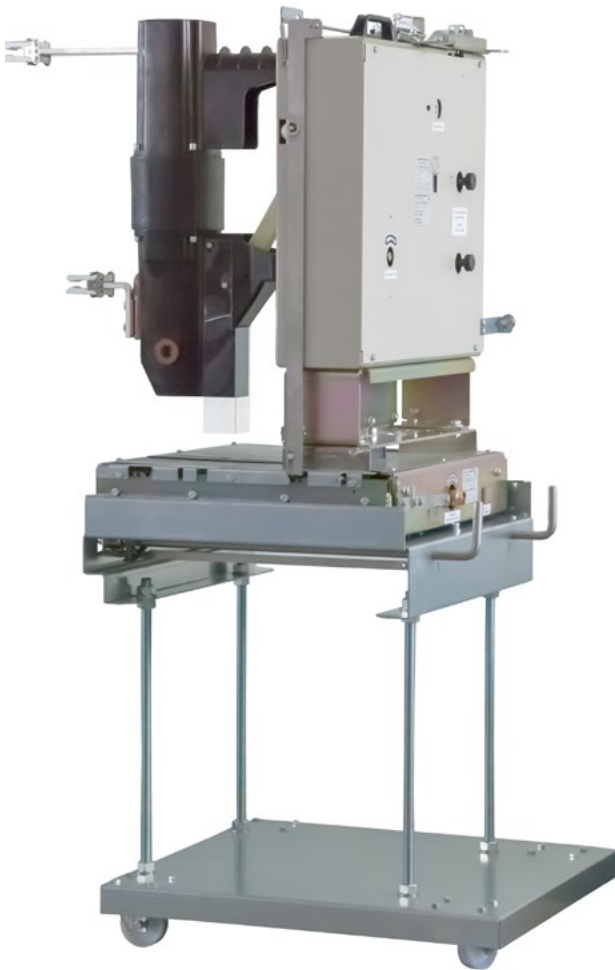
10 Manual Spring Setting

For vacuum circuit-breaker drive spring setting

11 Control Mode Selection

Control modes switching: local/ remote

Main Components of Switchgear



Vacuum Circuit-Breaker

Indoor vacuum circuit-breakers are designed for 27.5 kV rated voltage and 1250 A rated current.

Circuit-breaker is a maintenance free component. It is only recommended to make visual inspection and periodic cleaning of insulation parts and greasing of drive mechanism.

Circuit-breaker has both manual (by push button) and remote (release mechanism) control options.

In addition to release mechanisms switching module comprehensive interlocking system remain last switching operation to be always off.

High quality vacuum tube is placed into molded case made of insulating material.

Advantages:

- vacuum tube is protected against aging and damage by polymer encasement;
- circuit-breaker can be dismantled as an individual unit.

Earthing Switch

Three-pole earthing switches are optimized for zero-current switching on 27.5 kV networks and rated for 20 kA short-time current.

Control and protection units

27.5 kV switchgears control and protection functions are provided by panel type programmable logic controller (PLC) from world's leading manufacturers.

PLC driven unit provides control and protection functions in accordance with IEC61850 standard.



| No. ANSI | Control and protection functions |
|----------|---|
| 2 | Delay Time Starting or Closing Relay |
| 12 | Overspeed Device |
| 14 | Underspeed Device |
| 15 | Speed- or Frequency, Matching Device |
| 24 | Over-Excitation |
| 25 /A | Automatic Synchronizing |
| 27 | Undervoltage |
| 27B | Busbar undervoltage, set delay |
| 32 | Reverse Power |
| 37 | Undercurrent |
| 40Q | Excitation Loss Relay |
| 46 | Reverse Phase Current |
| 47 | Phase Sequence or Phase Balance |
| 49 | Thermal |
| 50BF | Breaker Failure |
| 50 | Instantaneous Overcurrent |
| 50G/N | Instantaneous Earth Fault |
| 51 | Time Overcurrent, Set Delay, IDMT (6 curves) |
| 51G/N | Earth Fault Current, Set Delay, IDMT (6 curves) |
| 51LR | Locked Rotor Protection |
| 51V | Voltage Restrained Overcurrent |
| 59 | Overvoltage |

| No. ANSI | Control and protection functions |
|----------|--|
| 59B | Busbar Maximum Voltage Relay, Set Delay |
| 59N | Neutral Overvoltage |
| 64 | Ground Detector Relay |
| 66 | Starts per Hour |
| 67 | Directional Phase Overcurrent, Set Delay, IDMT |
| 67GS/GD | Directional Earth Fault, Set Delay |
| 78 | Out-of-Step / Pole Slip |
| 78S | Out-of –Step Generator / Power Swings Relay |
| 79 | AC Reclosing Relay |
| 81 | Frequency Relay |
| 81B | Busbar Frequency Relay |
| 86 | Lockout Relay |
| 87M | Motor Differential Protection |
| 87T | Transformer Differential Protection |
| 87G | Generator Differential Protection |
| 87LD | Line Differential Protection |
| 87N | Restricted Earth Fault Protection |
| 90 | Voltage Regulating |
| 94 | Auxiliary Voltage Relay |
| 95i | Harmonics Stabiliser (2nd Harmonic) |
| FF | Measuring Circuits Fuse Fault Relay |

Technical Data of 27.5 kV AC Switchgears

| Description | | Value |
|---|------|-----------|
| Rated Voltage | kV | 27.5 |
| Rated Peak Voltage | kV | 30 |
| Rated Frequency | Hz | 50 |
| Rated Current | A | 630; 1250 |
| Busbars Rated Current | A | 1250 |
| Vacuum Circuit-Breaker Rated peak current | kA | 50 |
| Rated Short-Time Current: | | |
| • Vacuum circuit-breaker | kA/s | 20/3 |
| • Earthing Switch | | 20/1 |
| Rated Vacuum Circuit-Breaker Current | kA | 20 |
| Circuit-Breaker Opening Time, max. | s | 0.07 |
| Rated Lightning Pulse Withstand Voltage | kV | 170 |
| Poles Number | | 1/2/3 |

Vacuum Circuit Breaker Technical Data

| Description | | Value |
|---|----|-----------|
| Rated Voltage | kV | 27.5 |
| Rated Frequency | Hz | 50 |
| Rated Current | A | 630; 1250 |
| Rated Short Time Current | kA | 20 |
| Maximum Short-Circuit Current | s | 3 |
| Rated Peak Withstand Current | kA | 50 |
| Rated Impulse Withstand Voltage | kA | 170 |
| Rated Withstand Power Frequency Voltage | kV | 70 |
| Approx. Closing Time | ms | 65 |
| Arcing Time | ms | <17 |
| Approx. Opening Time | ms | 70 |
| Rated Short-Circuit Opening Current | kA | 20 |
| Rated Short-Circuit Closing Current | kA | 50 |
| Rated Cable Charge Opening Current | A | 50 |
| Operating Cycles | | |
| - vacuum tube at rated current | | 15.000 |
| - vacuum tube at rated short-circuit breaking current | | 100 |
| - circuit-breaker mechanism | - | 10.000 |

Earthing Switch Technical Data

| Description | | Value |
|---|----|--------------------------------|
| Rated Voltage | kV | 27.5 |
| Rated Frequency | Hz | 50 |
| Rated Short-Time Current | kA | 20 |
| Rated Duration of Short-Time Current | s | 1 |
| Rated Peak Withstand Current | kA | 50 |
| Rated Short-Circuit Closing Current | kA | 50 |
| Rated Impulse Withstand Voltage | kV | 170 |
| - Phase-to-Earth | | |
| Rated Power Frequency Withstand Voltage | kV | 70 |
| - Phase-to-Earth | | |
| Mechanical Life | - | M1 (2000 mechanical cycles) |
| Approx. Weight | kg | 40 |

27.5 kV AC Switchgears Overall Dimensions



Automatic and Control Equipment Compartment:

① Automatic and Control Equipment

Busbars Compartment:

② Busbars

Cable Compartment:

③ Current Transformer

④ Earthing Switch

⑤ Cable Clamp

⑥ Surge Arrester

Vacuum Circuit-Breaker Compartment:

⑦ Vacuum Circuit-Breaker

Main Types of 27.5 kV AC Switchgears

| Type | Description |
|------------------------------------|---|
| Incomer Cubicle | Transformer winding connection with 27.5 kV busbars |
| Power Line Connection Cubicle | Power lines connection to 27.5 kV switchgear busbars |
| Feeder Cubicle | Traction network feeding line connection with 27.5 kV switchgear main busbar |
| Busbar Voltage Transformer Cubicle | Includes instrument voltage transformers providing 27.5 kV switchgear busbars voltage supervision |
| Section Switch Cubicle | Busbars sections interconnection at traction substations |



Single-Line Diagrams of 27.5 kV AC Switchgears

| Description | Incomer Cubicle | Power Line Connection Cubicle | Feeder Cubicle | Busbar Voltage Transformer Cubicle | Section Switch Cubicle |
|------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|
| Single Line Diagram | | | | | |
| Load break / Switch | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| Vacuum Circuit-Breaker | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Earthing Switch | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| Current Transformer | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Voltage Transformer | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

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