

RM6 High-Voltage Fully -Insulated Gas- Insulated Switchgear

Operation Manual



MINGRI

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(1) Application and Scope of Application

This fully-insulated SF high-voltage gas-insulated switchgear (hereinafter referred to as "the equipment") is a high-voltage switchgear that uses SF gas as the arc-extinguishing and insulating medium. It is applicable to 7.2kV~40.5kV power distribution systems, and widely used in urban and rural user power transformation and distribution systems, urban central substations, underground substations and areas with harsh environments. It can meet the flexible application requirements for compact power supply scenarios.

(2) Core Features

1. Fully-sealed and fully-insulated structure: Busbars, switches and all live parts are enclosed in a stainless-steel enclosure with IP67 protection rating. It is immune to external environmental influences and can operate normally under temporary water immersion.
2. Modular design: Available in fixed and expandable units. It supports front-side and lateral cable entry/exit as well as flexible combination, suitable for limited installation space.
3. Comprehensive safety assurance: Equipped with reliable five-prevent interlocking device and safety pressure-relief channels to prevent mis-operation and safety risks under extreme conditions.
4. Convenient operation and maintenance: Adopting maintenance-free-for-life design. Electric actuation, remote control and monitoring devices can be configured to realize intelligent operation management.

2. Main Technical Parameters

Main technical parameters of fully-insulated SF high-voltage gas-insulated switchgear are shown in Table 1:

Parameters	Unit	Specifications
Rated voltage	kV	7.2 ~ 40.5 (typical 24)
Rated frequency	Hz	50
Power-frequency withstand voltage	kV	Phase-to-phase: ≥ 65
	kV	Breaking gap: ≥ 29
Lightning impulse withstand voltage	kV	To earth: ≥ 125
	kV	Breaking gap: ≥ 145
Rated current	A	630 ~ 1250
Rated short-time withstand current	kA	≥ 20 (up to 31.5 for partial modules)
	s	Withstand duration: 3
Rated short-circuit making current (peak value)	kA	≥ 50
SF6 gas rated pressure	bar	1.4 (absolute pressure, at 20°C)
Mechanical endurance	times	3000 ~ 5000
Annual gas leakage rate	%/year	≤ 0.5
Main-circuit insulation resistance (at ambient temperature)	M Ω	≥ 1000

(Table 1)

Note: Specific parameters vary slightly for different modules (C/F/V/CB). Refer to the equipment factory certificate for acceptance.

2.1 Detailed Technical Parameter Table for 24kV Rating

Detailed Technical Parameters for 24kV Rating are shown in Table 2:

Parameters	Specific Parameter Name	Specifications	Test Standard
Voltage Parameters	Rated Voltage	24kV	GB/T 11022-2020
	Power-frequency Withstand Voltage (Phase-to-Phase / To-Earth)	$\geq 65\text{kV}$ (1min)	DL/T 593-2016
	Power-frequency Withstand Voltage (Breaking Gap)	$\geq 79\text{kV}$ (1min)	DL/T 593-2016
	Lightning Impulse Withstand Voltage (Peak Value)	$\geq 125\text{kV}$ (Phase-to-Phase / To-Earth), $\geq 145\text{kV}$ (Breaking Gap)	GB/T 11022-2020
Current Parameters	Rated Current	630A/1250A (optional)	GB/T 1984-2014
	Rated Short-time Withstand Current (Thermal Stability)	20kA/3s (630A module), 31.5kA/3s (1250A module)	GB/T 1984-2014
	Rated Short-circuit Making Current (Peak Value)	$\geq 50\text{kA}$ (20kA module), $\geq 80\text{kA}$ (31.5kA module)	GB/T 1984-2014
	Rated Peak Withstand Current	$\geq 50\text{kA}/0.1\text{s}$	GB/T 11022-2020
SF6 Gas Parameters	Rated Gas-filling Pressure (20℃)	1.4bar (gauge pressure)	Manufacturer 's Technical Specification
	Annual Gas Leakage Rate	$\leq 0.5\%$ / year	IEC 60480
	Moisture Content (In-service)	$\leq 250 \mu\text{L/L}$	DL/T 596-2021
Mechanical Characteristics	Opening Time (Inherent)	$\leq 30\text{ms}$	GB/T 1984-2014
	Closing Time (Inherent)	$\leq 60\text{ms}$	GB/T 1984-2014
	Three-phase Opening-Closing Asynchronism	$\leq 3\text{ms}$	DL/T 593-2016
	Mechanical Endurance	≥ 3000 times (circuit breaker), ≥ 5000 times (disconnecter)	GB/T 11022-2020
Insulation Performance	Main-circuit Insulation Resistance (Ambient Temperature)	$\geq 1000\text{M}\Omega$ (500V megohmmeter)	DL/T 596-2021
	Auxiliary-circuit Insulation Resistance	$\geq 10\text{M}\Omega$ (500V megohmmeter)	DL/T 596-2021
Environmental Adaptability	Operating Ambient Temperature	$-25^{\circ}\text{C} \sim +40^{\circ}\text{C}$	GB/T 11022-2020
	Maximum Altitude	$\leq 2000\text{m}$ (Special design required for high-altitude application)	GB/T 11022-2020
	Pollution Class	Class ≤ 3	GB/T 11022-2020

(Table 2)

3. Installation and Operation Guidelines

(1) Pre-installation Preparation

1. Site requirements: Ambient temperature ≥ 5 , relative humidity $\leq 80\%$. No rain, snow, strong wind or sand-dust. Clean the site and close doors and windows to guarantee unobstructed access.
2. Technical preparation: Be familiar with drawings and manufacturer's documents. Confirm that the installation site altitude ≤ 2000 m and pollution class $\leq$ Class 3.
3. Tools and materials: Prepare special tools including crane, torque wrench, vacuum pump, SF6 gas detector, insulating gloves, etc. Verify completeness of equipment modules, accessories and bolts.

(2) Installation Procedure

1. Foundation verification: Check elevation and flatness of embedded parts with level instrument, tolerance $\leq \pm 2$ mm, to ensure horizontal and vertical mounting surface.
2. Equipment positioning: Lift steadily with dedicated lifting tools and avoid collision. Assemble modules in sequence per drawings. Keep flange surfaces clean and scratch-free. Apply silicone grease to sealing rings, then tighten bolts diagonally in several passes.
3. Earthing connection: Ensure reliable earthing of cabinet enclosure and metal supports with firm connection without looseness.
4. Gas treatment: Use two-stage vacuum pump to evacuate to residual pressure ≤ 133 Pa and hold for no less than 4 hours. Slowly fill with qualified SF6 gas up to rated pressure. Keep static for 24 hours, then test moisture content ($150 \sim 250 \mu\text{L/L}$) and gas tightness.
5. Secondary wiring: Connect control circuits and monitoring devices. Check that terminal block connections are firm with no damage or broken wires.

(3) Post-installation Acceptance

1. Visual inspection: No deformation or corrosion on cabinet body; cover-plate bolts are tightened; cabinet door sealing is in good condition.
2. Performance test: Complete main-circuit resistance measurement (shall not exceed 120 % of factory value), power-frequency withstand voltage test (80 % of factory value, no discharge within 1 min), and mechanical characteristic test (three-phase opening-closing asynchronism ≤ 3 ms).
3. Function verification: Test five-prevent interlock, live-display device and remote/local operation switching function to ensure accurate actions.

4. Operation Specifications

(1) Pre-operation Check

1. Environment confirmation: Detect oxygen content and SF6 gas concentration in the distribution room. Do not enter until no leakage is found. Single-person operation is prohibited.
2. Equipment status: Verify opening/closing positions of circuit breakers and disconnectors. Confirm normal reading of gas pressure gauge, no peculiar smell, abnormal noise or enclosure deformation.
3. Interlock check: The five-prevent device is intact, protection pressing plates are set correctly, and indicator lamps are consistent with operating conditions.

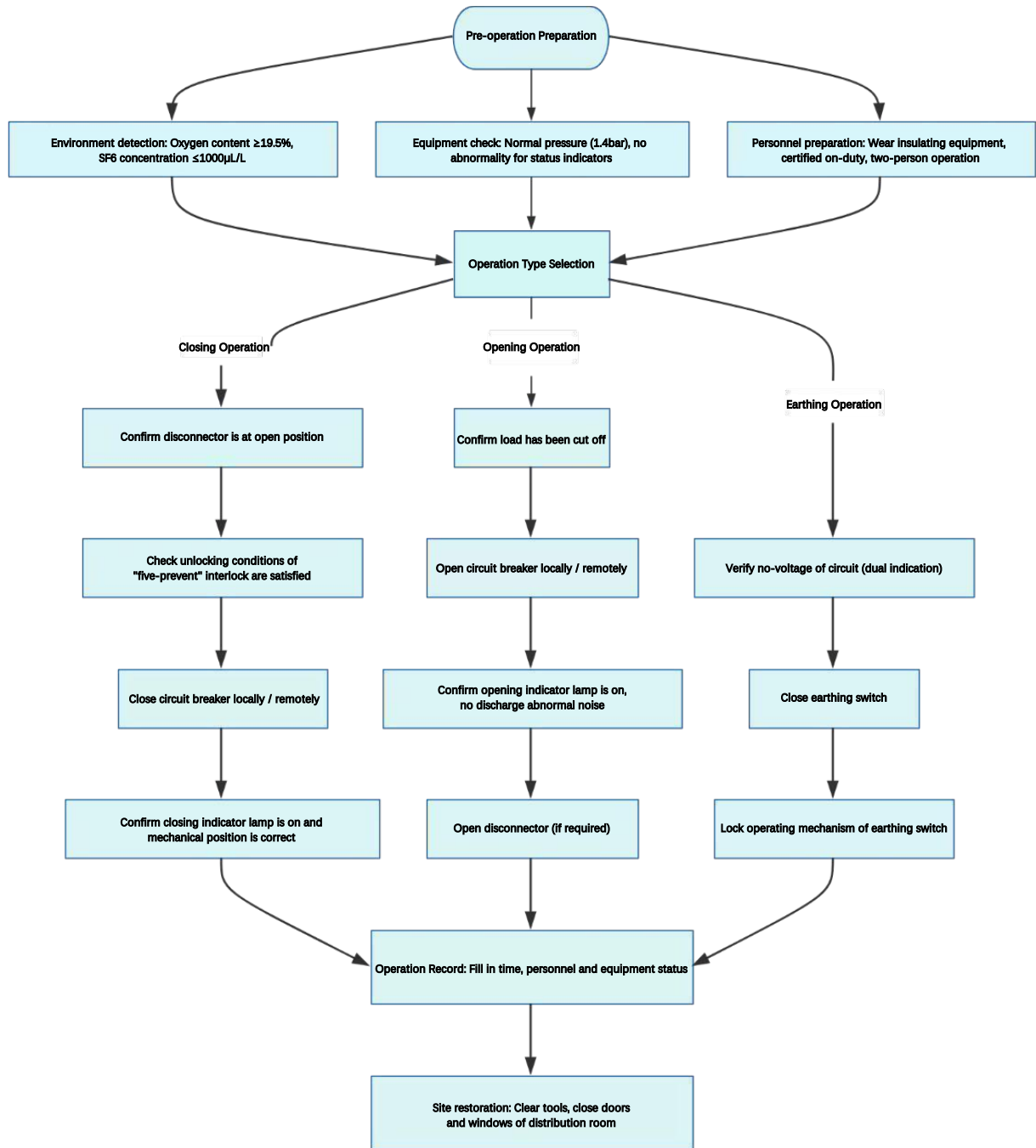
(2) Operation Procedure

1. Opening and closing operation: Wear insulating gloves for local operation. Personnel shall not enter the distribution room during remote operation. Strictly follow the sequence: "Open circuit breaker first, then open disconnector", "Close disconnector first, then close circuit breaker".
2. Earthing operation: Verify no voltage on the circuit before earthing. Voltage verification shall be confirmed by dual indicators such as current - voltage signals and live-display device.
3. Abnormality handling: In case of discharge sound, burning smell or other abnormalities during operation, stop operation immediately, evacuate from site and apply for emergency shutdown.

4. Operation Specifications

(3) Operation Flow Diagram

See Figure 1:

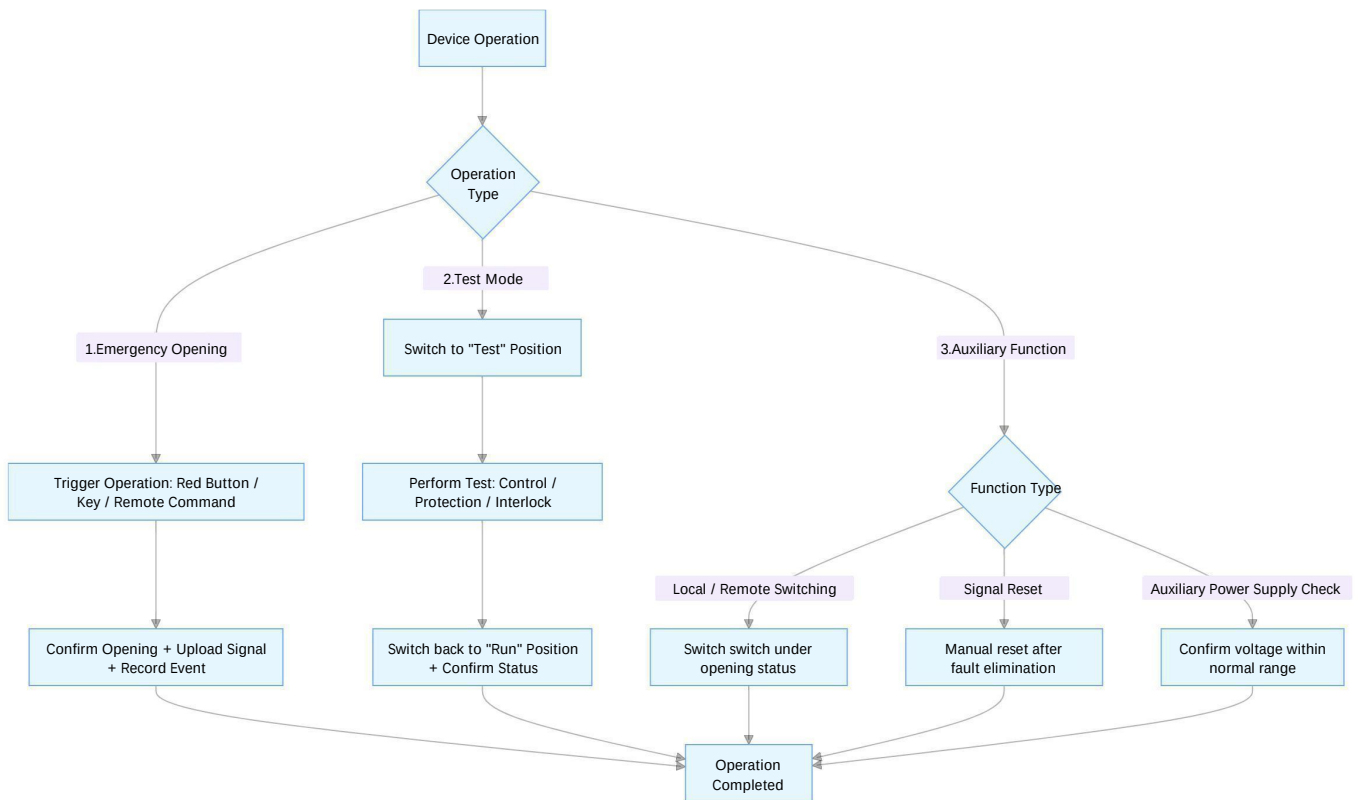


(Fig. 1)

4. Operation Specifications

(4) Special Operation Instructions

See Figure 2:



(Fig. 2)

5. Maintenance and Inspection

(1) Routine Inspection (Carried out periodically)

1. Environment check: Air-conditioner, dehumidifier and exhaust fan in distribution room operate normally. No ponding or foreign objects. Cable trench sealing is intact.
2. Equipment check: Pressure gauge reading is stable. Cabinet door sealing is in good condition. Earthing connections are free of looseness. Self-check of live-display device is normal. No abnormal leakage current of arrester.
3. Record keeping: Record inspection data in detail. Report and handle abnormal conditions in a timely manner.

(2) Special Inspection (Carried out as required)

1. After equipment modification: Add infrared temperature measurement inspection for newly-commissioned, overhaul-modified or long-term-out-of-service equipment.
2. After extreme weather: Focus on integrity of enclosure and connecting parts after thunderstorm, typhoon or earthquake.
3. During abnormal operation: Strengthen temperature measurement and pressure check after overload or fault breaking.

(3) Maintenance Prohibitions

1. It is forbidden to unlock or disable interlock devices arbitrarily. Do not stay near the explosion-proof membrane.
2. Do not disassemble gas-chamber sealing components without authorization. SF6 gas handling shall be performed by certified personnel. Waste gas shall be recycled.
3. Check anti-animal measures regularly. Ensure good lighting and unobstructed access in distribution room.

6. Safety Precautions

1. Operators must wear protective equipment including safety helmet, insulating shoes and insulating gloves. Gas mask shall be additionally equipped for SF6 gas operation.
2. In case of sharp pressure drop, abnormal noise or peculiar smell during equipment operation, evacuate the site immediately, cut off power supply and contact professional personnel for maintenance.
3. Strictly comply with national standards such as GB26860 and DL/T 617. It is forbidden to modify equipment structure or parameters in violation of regulations.
4. The distribution room shall be equipped with SF6 gas leakage detector, ventilation equipment and emergency rescue supplies. Conduct emergency drills on a regular basis.

7. Trouble shooting

Main technical parameters of fully-insulated SF6 gas-insulated switchgear are shown in Table 3:

Fault Phenomenon	Possible Causes	Treatment Measures
Gas pressure drop	1. Damaged sealing parts 2. Loose flange connection	1. Stop operation immediately
		2. Detect leakage by wrapping method or leakage detector
		3. Replace damaged sealing parts and retighten connections
		4. Fill SF6 gas up to rated pressure
Operation failure	1. Interlock device not unlocked 2. Control circuit fault (power supply, wiring, etc.)	1. Check and satisfy all interlock conditions
		2. Troubleshoot secondary wiring, control power supply and components
		3. Forcible operation is strictly prohibited
Abnormal live-display indication	1. Sensor fault 2. Loose wiring or poor contact	1. Inspection must be carried out after power-off
		2. Tighten wiring terminals and check circuits
		3. Replace damaged sensor or display unit
Local overheating	1. Excessive contact resistance of main circuit 2. Long-term overload operation of equipment	1. Locate hot spot by infrared temperature measurement
		2. Properly reduce operating load
		3. Power off when necessary, maintain main-circuit connection parts (polishing, tightening or replacing contacts)

(Table 3)

8. Storage and Transportation

1. Avoid collision and inversion during transportation. Take protective measures against rain, dust and shock. Keep the pressure of each gas chamber at 0.3~0.5bar.
2. The storage environment shall be dry and ventilated with temperature ranging from -20°C~40°C. Keep away from corrosive gas and heat sources. Check gas pressure periodically for long-term storage.
3. If the equipment is not to be installed immediately after unpacking, seal flange interfaces to prevent moisture and foreign matters from entering.

This manual is for operation guidance only. Actual operations shall be performed by certified professional personnel in combination with the factory-issued technical documents and on-site practical conditions.

The manufacturer shall not be liable for equipment damage or safety accidents caused by non-compliant operations.