

Phase Segregated Type

SF₆ Gas Insulated Switchgear

Type SDA524 for 245 kV

GIS

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SDA524

For 245 kV

The number of application for SF₆ gas insulated switchgear has been tremendously growing all over the world, because it has many advantageous features as below:

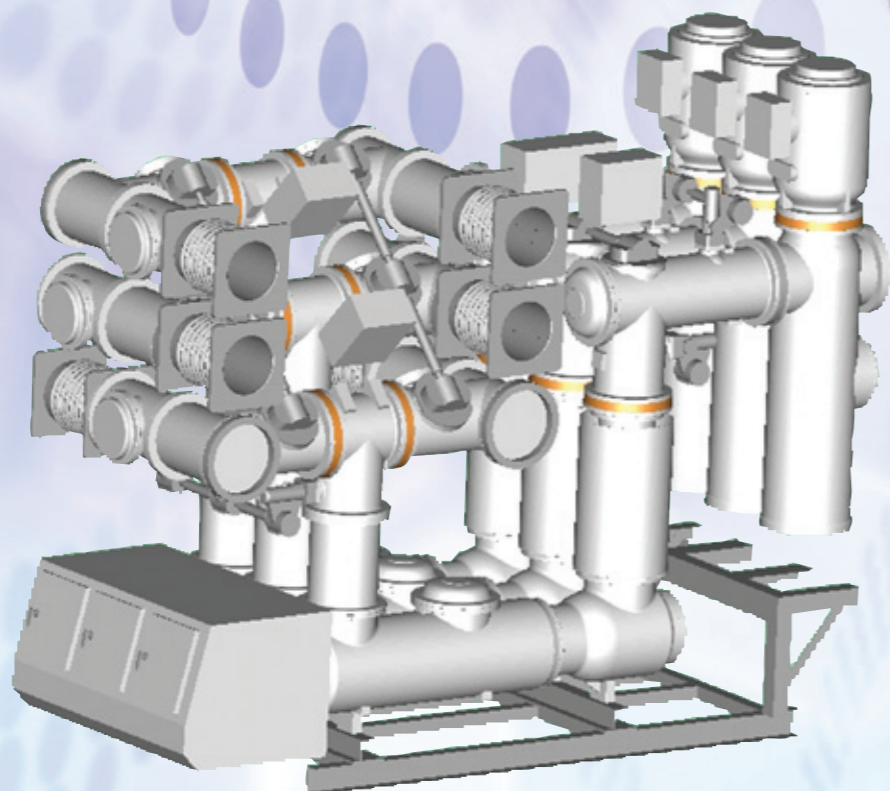
- **Small space requirement**
- **High reliability**
- **Safety**
- **Good harmony with environment**
- **Long maintenance interval**
- **Short erection period at site**

Fuji started the development of SF₆ gas insulated switchgear (GIS) in the 1960's.

The first 72.5 kV GIS, which was of the phase segregated type, was put into operation in 1970. Since then Fuji has also developed three phase encapsulated type GIS in addition to phase segregated one as our standard series of GIS. Based on these experiences with high and long term technology, Fuji has successfully developed as a standard series of phase segregated type GIS which realizes a quite compact and very reliable construction.

The 72.5 kV and above GIS is being manufactured in our substation equipment factory located in Chiba prefecture, Japan. The substation equipment factory has been recognized to be in accordance with the requirements of the quality standards ISO 9001.

SDA524 245 kV 4,000 A 40 kA



Small overall dimensions make for minimum space requirements. Therefore, the costs of foundations and buildings can be minimized.

Phase isolated and individually encased in earthed metal housing construction realizes no possibility of phase-to-phase short-circuit fault completely.

The modular design principle applied realized the standardization of components and parts. This makes possible the large quantity production way which increases the reliability of components and parts with their easy stock control.

Unified SF₆ gas pressure throughout the switchgear makes simplified gas maintenance work.

Technical data

Rated voltage	[kV]	245
Rated power frequency withstand voltage	[kV]	Phase-to-earth 395/460
		Across open switching device 395/460
		Across isolating distance 460/530
Rated lightning impulse withstand voltage	[kV]	Phase-to-earth 950/1050
		Across open switching device 950/1050
		Across isolating distance 1050/1200
Rated normal current	[A]	Busbar 2000, 3150/4000
		Others 1250/1600/2000, 3150/4000
Rated short-circuit breaking current of circuit breaker	[kA]	31.5/40
Rated short-time withstand current (3 s)	[kA]	31.5/40
Rated peak withstand current	[kA]	80/100(50 Hz), 82/104(60 Hz)
Rated SF ₆ gas pressure, gauge (at 20 °C)	[MPa]	Switchgear 0.6
		Circuit breaker 0.6
Rated break time of circuit breaker	[cycles]	3
Rated operating sequence of circuit breaker		O-0.3 s-CO-3 min.-CO, O-3 min.-CO-3 min.-CO, CO-15 s-CO

Applicable standards : IEC



Fig.1 Section of cable feeder bay with double busbar

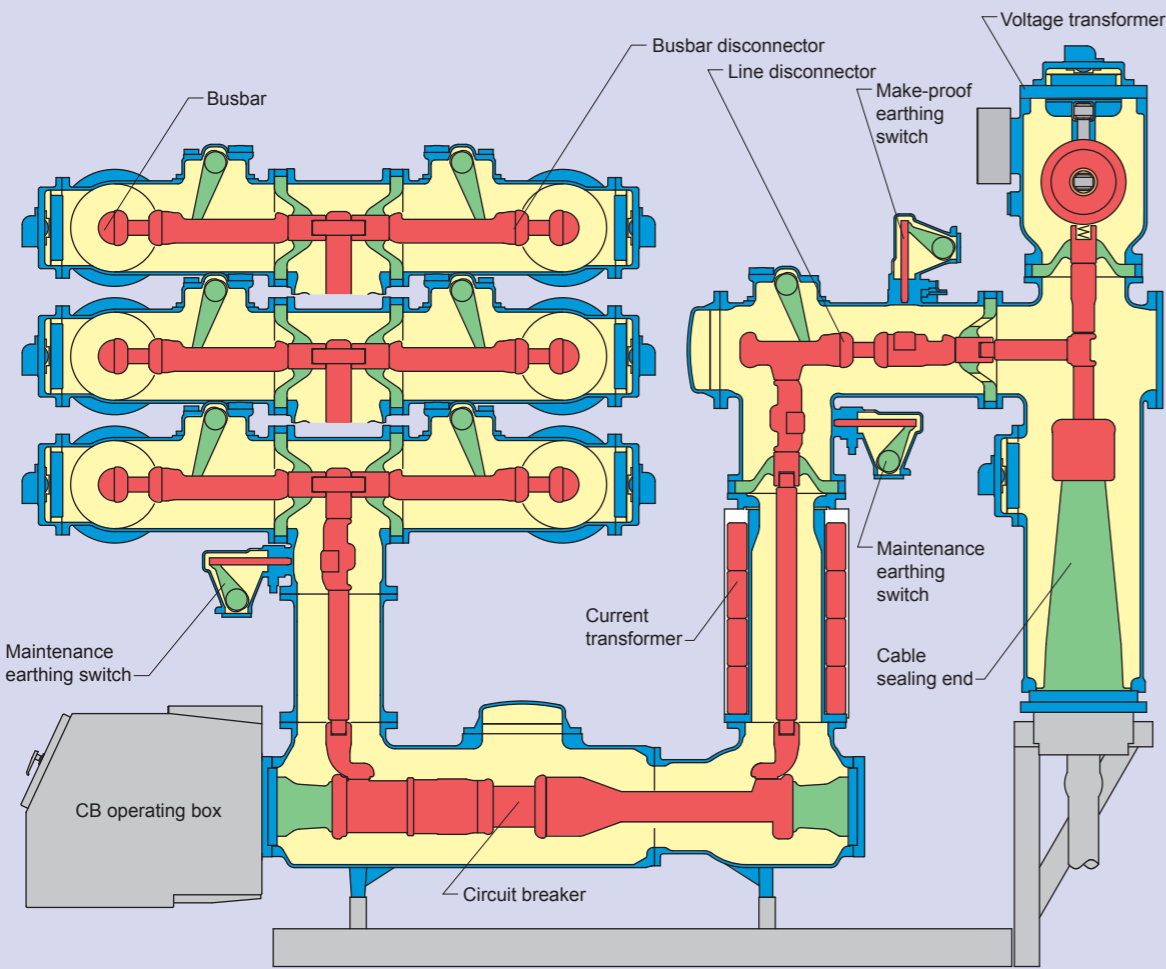
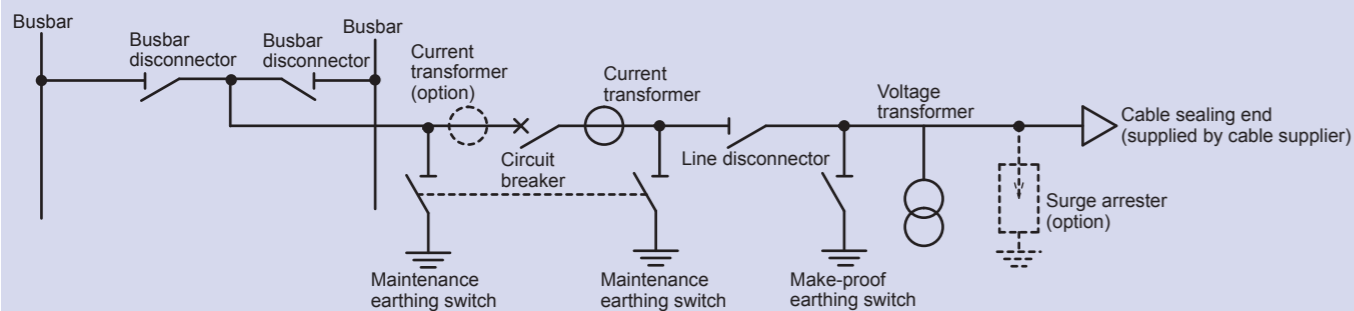


Fig.2 Single line diagram of cable feeder bay with double busbar



Circuit breaker

Thousands of Fuji SF₆ gas circuit breakers with hydraulic operating mechanism were delivered into all over the world and have been in satisfactory operation since 1973.

The SF₆ switchgear is equipped with the single pressure puffer type gas circuit breaker with hydraulic operating mechanism which is used uniformly also for outdoor circuit breakers.

Fuji SF₆ gas circuit breaker has the advantages:

- Low noise level during operation
- Excellent interruption performance
- Long maintenance intervals
- Individual energy supply, no air-compressor necessary

The earthed metal housing accommodates single pole interrupter fixed on insulating mount and support insulator for each phase. At the front of the circuit breaker, three pole common operating box is arranged, which accommodates hydraulic operating mechanisms and monitoring unit for the circuit breaker suitable for individual single pole operation.

The moving section is composed of nozzle, moving contact and puffer cylinder connected to hydraulic operating mechanism through insulating rod mechanically.

The current path is composed of fixed contact, moving contact and moving contact support. Arc energy is used effectively to make compact interrupter. At the initial stage of opening, the movement of the puffer cylinder compresses SF₆ gas in the puffer cylinder. In addition, pressure of the SF₆ gas is increased further due to arc heat while the arc current is large. Then the compressed gas flows in order to distinguish effectively the arc generated at arc contacts. In case of the arc current is small, the compressed SF₆ gas, which is produced by the movement of the puffer cylinder, flows to distinguish the arc. Removing the access cover makes it possible to carry out the inspection and replacement of nozzle and arcing contacts.

Fig.3 Section of SF₆ circuit breaker

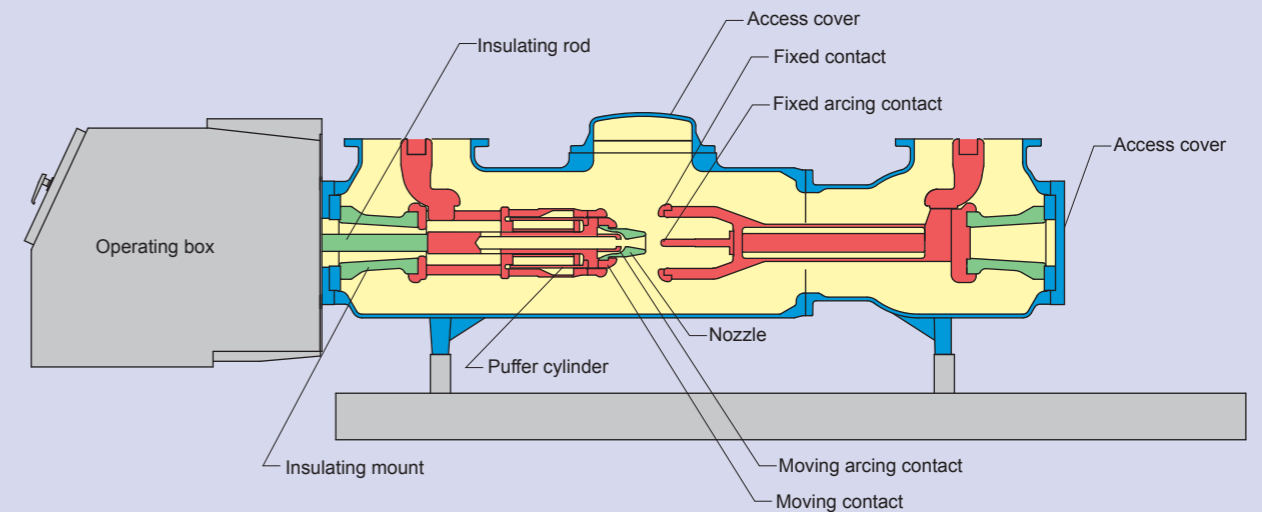
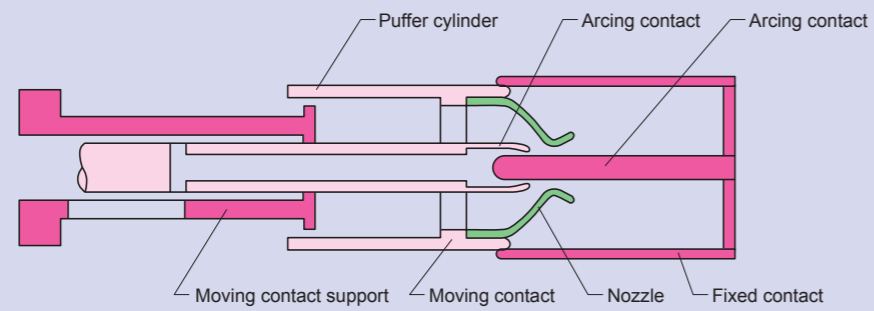


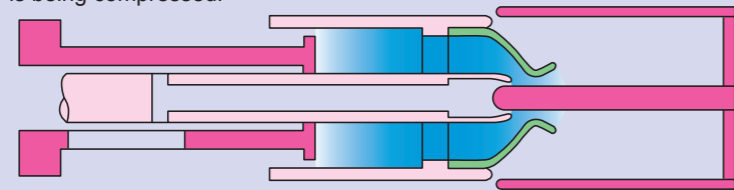
Fig.4 Principle of arc quenching

● Closed position



● Opening(priming)

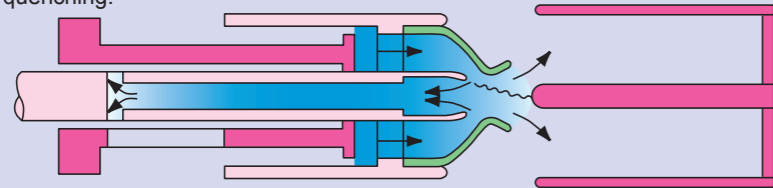
SF₆ gas in the puffer cylinder is being compressed.



When trip commences, the puffer cylinder is driven towards the moving contact support. The SF₆ gas trapped in the enclosed space is thereby compressed.

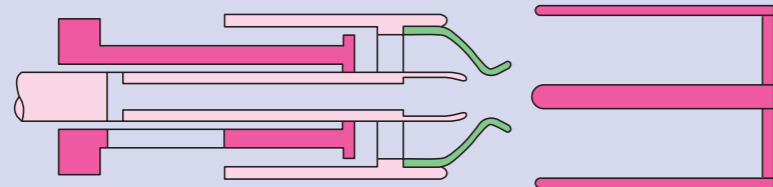
● Opening(arc quenching)

SF₆ gas flows during arc quenching.



As soon as the arcing contacts separate, the compressed SF₆ gas flows through the arc quenching nozzle and extinguishes the arc.

● Open position

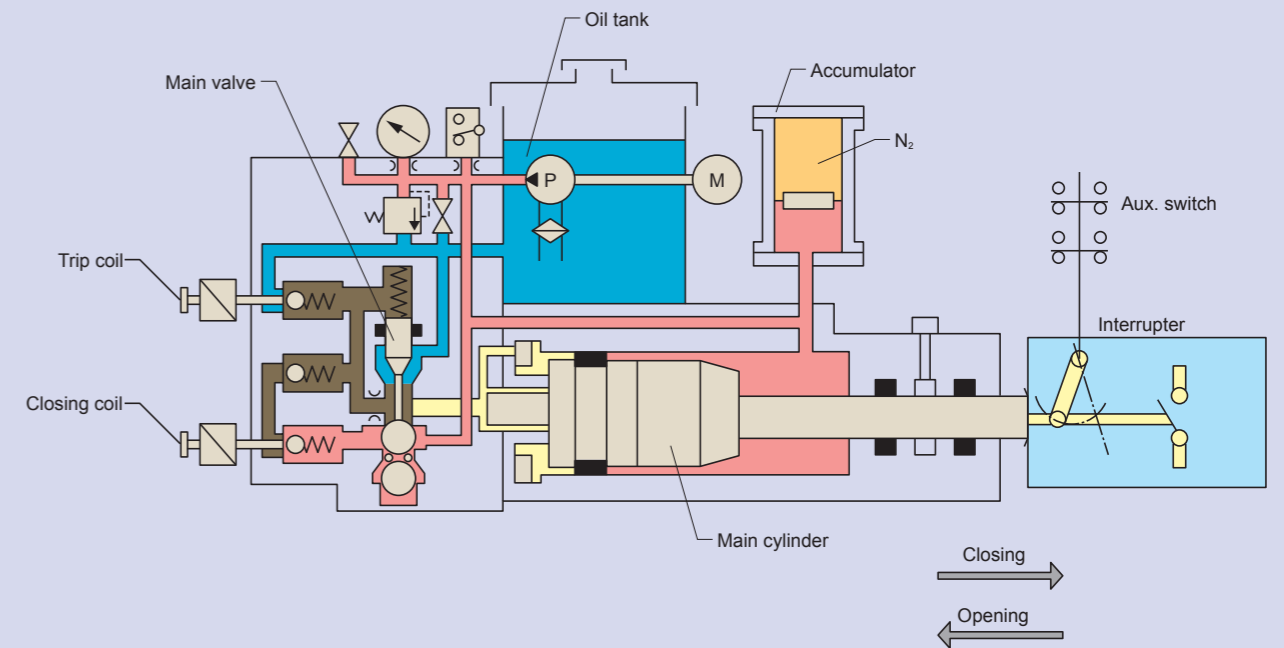


Hydraulic operating mechanism

Oil-hydraulic operating mechanism has almost free from rust and corrosion unlike other operating mechanisms such as motor-spring or pneumatic systems. Oil pump, oil tank, main valve unit, pressure switches and gauges are incorporated as one block unit and connected directly to main cylinder.

Therefore, a compact, very reliable and pipeless hydraulic operating mechanism is realized. The valve seal of oil system is made of metal seat and metal ball, which eliminate damage of valve seat due to eccentricity and are good for permanent use without necessity of replacement.

Fig. 5 Hydraulic operating mechanism



Operation

Closing

- Closing coil energized
- Main valve opens
- Main cylinder moves

Opening

- Trip coil energized
- Main valve closes
- Main cylinder moves
- 31.5 MPa
- 0 MPa

Busbar

The single-phase conductor made of aluminium or copper, depending on the current rating, is supported by the gas tight insulators.

Disconnectors and earthing switches

Line disconnector is incorporated together with earthing switches in one housing as a combined disconnector/earthing switch. Bus disconnector is assembled in each bus enclosure. Disconnectors and earthing switches are normally motor or manual-operated.

The disconnectors have a switching capability of bus-transfer current, small capacitive current as bus charging and small inductive current as transformer magnetizing current, if required. The make-proof earthing switch is provided with the motor-charged spring operation mechanism.

Maintenance earthing switches on the both sides of the circuit breaker are linked together by an operating rod and operated by the common operating mechanism.

Earthed side of the earthing switch is brought out from the earthed metal housing and earthed to it through a removable bolted link for primary injection test.

Current transformer

The current transformer is of foil-insulated bushing type with ring core mounted in CT housing.

The cable through type current transformer is also used for cable feeder unit, if necessary.

Voltage transformer

The voltage transformer is of induction type. SF₆ gas provides the high-voltage insulation.

The high-voltage winding discs are well insulated by plastic foils.

Surge arrester

The surge arrester consists of zinc oxide(ZnO) element with excellent low residual voltage characteristics and long service life.

Fig.6 Line disconnector and earthing switches

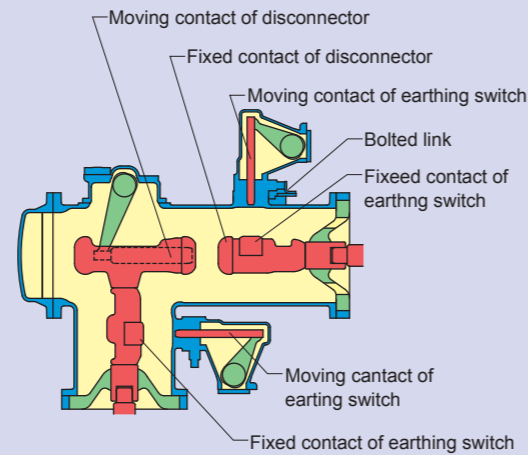


Fig.7 Current transformer

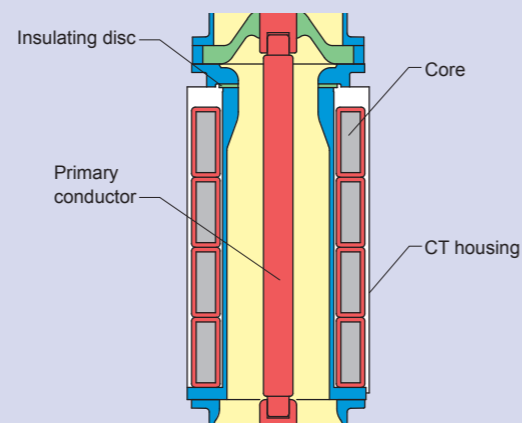
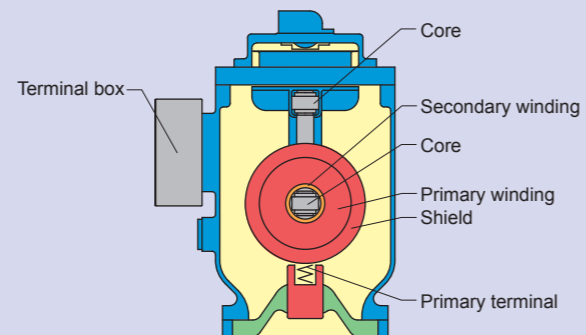


Fig.8 Voltage transformer



SF₆ gas system

Rated SF₆ gas pressure is unified at 0.6 MPa, gauge for all compartments.

SF₆ gas pressure changes depending on the ambient temperature as shown in Fig. 9 pressure-temperature characteristic curve.

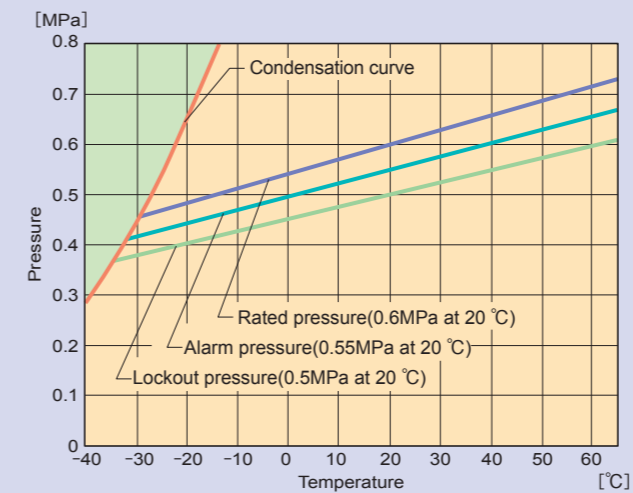
The monitoring of SF₆ gas is carried out by means of temperature compensated pressure switches in the manner as tabled below.

Components	Rated SF ₆ gas pressure [MPa]	Low alarm pressure [MPa]	Operation lockout pressure [MPa]
Circuit breakers	0.6	0.55	0.5
Disconnectors and earthing switches	0.6	0.55	Note 1
Other components	0.6	0.55	—

[at 20 °C]

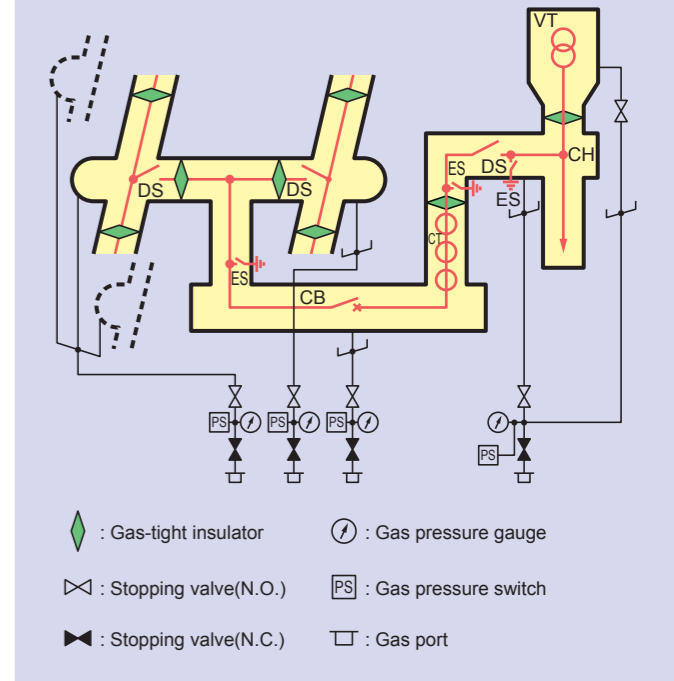
Note 1 : Operation lockout at 0.5 MPa(at 20 °C) is upon request.

Fig.9 Pressure-temperature characteristic curve of SF₆ gas

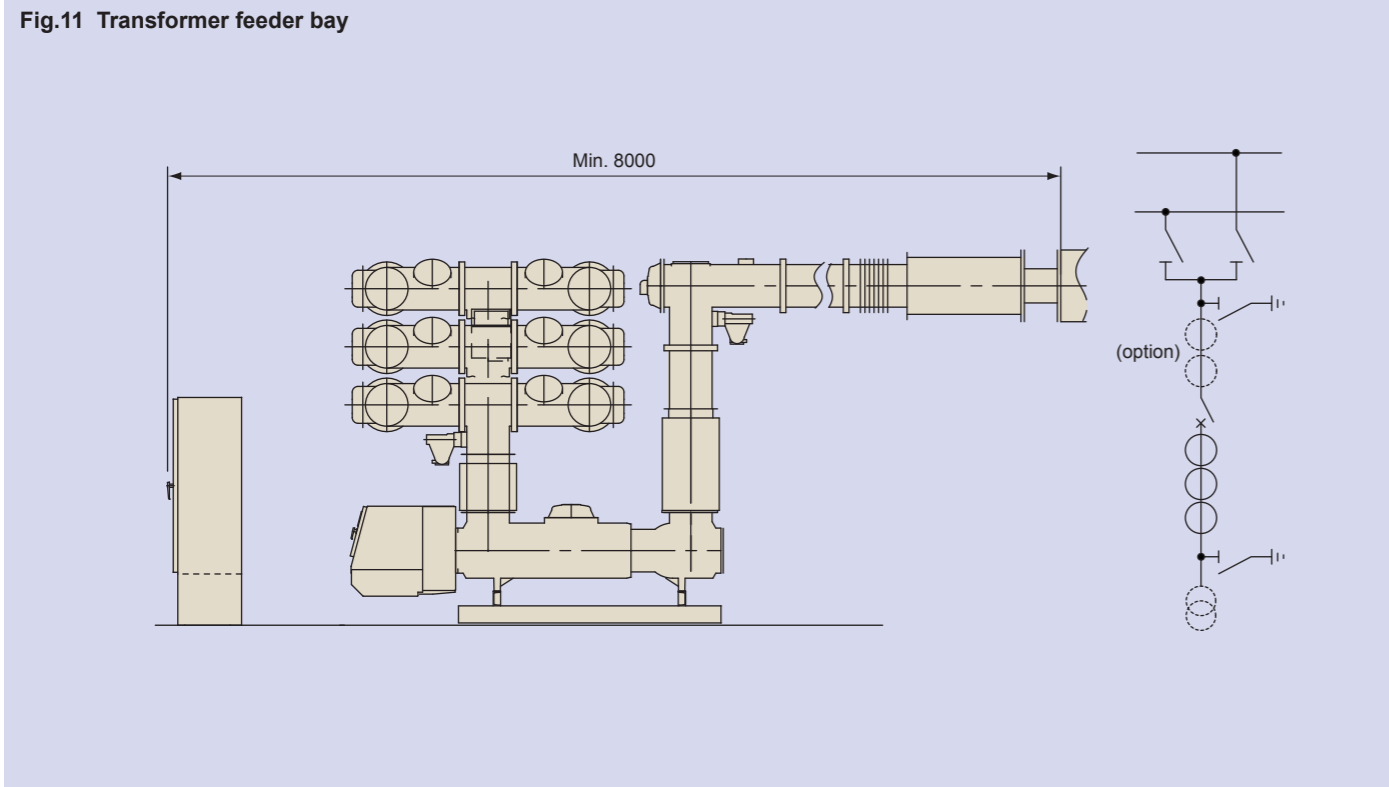


The SF₆ gas filled disconnector/bus chamber is sealed off from the adjacent unit by gas tight and arc-proof insulators. A similar insulator seals off this chamber from the circuit breaker. All gas zones are monitored by gas density relays. Three phase chambers are monitored in common. The switchgear has a very low gas leakage rate. Guaranteed gas loss is less than 0.5 % per annum.

Fig.10 SF₆ gas system



[Unit : mm]



[Unit : mm]

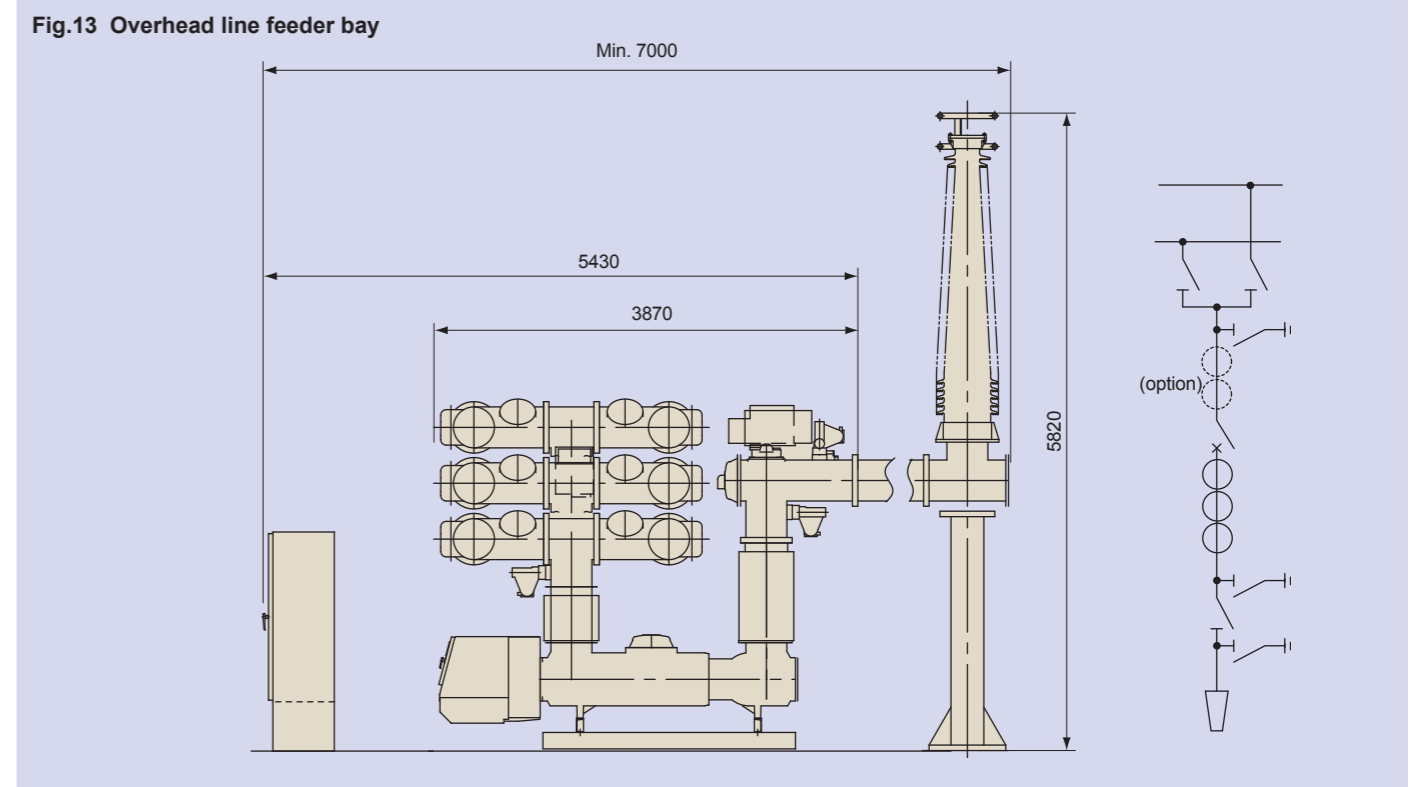


Fig.12 Bus coupler bay

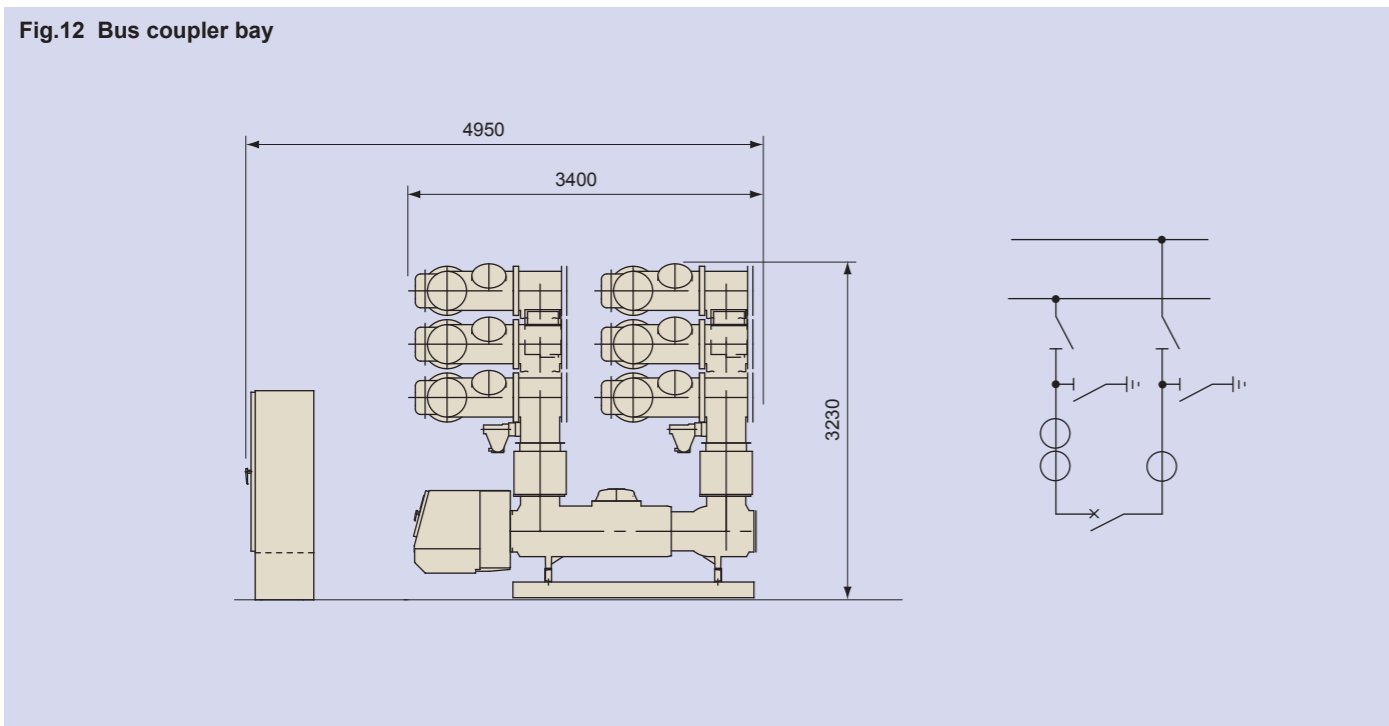
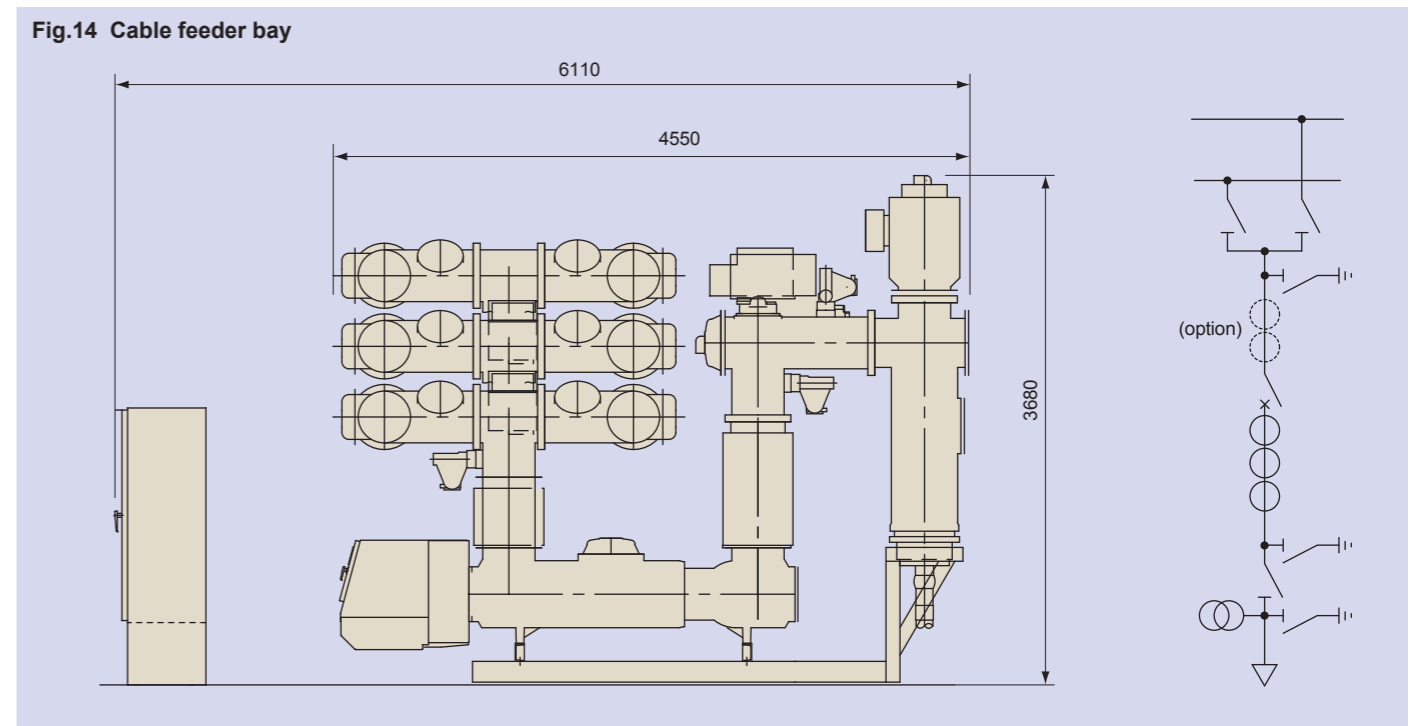


Fig.14 Cable feeder bay



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Information in this catalog is subject to change without notice.

2013-3(C2013/C2002)DE-H/CTP3M Printed in Japan