



GIS (Gas Insulated Switchgear)



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Power & Industrial Systems Performance Group

Power & Industrial Systems Performance Group of Hyosung(HICO) has made remarkable contributions to the development of electric industry and industrial machinery in Korea through its advanced technology, production capacity, and the best customer service for the past 40 years since it started its operation in 1962, ushering in a new era of Korean heavy industry. Hyosung Corporation is the leading supplier of electrical equipment for power transmission and distribution in Korea.

Power Systems Performance Unit

- UHV Power Transformer Power TR
- EHV Power Transformer Power TR
- Distribution Transformer
- Cast Resin Transformer
- Gas Circuit Breaker
- Gas Insulated Switchgear**
- Control Panel

Industrial Machinery Performance Unit

- Electric Motor
- Gear Reducer
- Industrial Machinery

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More Compactness, Higher Reliability, Less Maintenance



General

To meet the customer's various requirements of today's substations, we, HYOSUNG, design and manufacture a wide variety of SF₆ Gas-Insulated-Switchgear(GIS) system. We believe that although many GIS manufacturers produce a product similar to ours, it is our ability of giving you a high quality system at a reasonable price that sets us apart. Our units are currently used in urban areas, closely built-up industrial areas, underground power substations of large commercial buildings, switchyards of power plants, as well as new or expanding substations.

We, HYOSUNG, pride ourselves on our ability to design and manufacture a GIS that is 100% compatible with your existing and future needs anywhere in the world today. We design and construct a wide variety of high voltage SF₆ GIS ranging from 25.8kV units to 800kV units, with short circuit ratings up to 63kA. All of our equipment complies with IEC, ANSI, IEEE and other international standards. We have shipped over 5,000 GIS bays to customers around the world.

Special Features

High Reliability	Enhanced insulating properties and reduced long-term operational costs by means of sealed metal enclosure filled with SF ₆ gas.
Compact Design	Extensive experience in designing optimum phase and feeder spacing dimensions according to site conditions enable compact dimensions that reduce space requirements to less than 20% of conventional air-insulated substations.
Safety	Ensured personnel safety by earthed enclosure, numerous interlocks and lockout devices. Increased stability during earthquakes with a low center of gravity.
Elimination of Periodic Maintenance	Virtual elimination of long-term maintenance costs and contamination of critical components by means of SF ₆ gas-filled metal enclosures, automatic monitoring of operating mechanisms and SF ₆ gas system.
Efficient Installation	Assembly at factory and shipment in one complete bay dramatically reduces installation time and customer's costs.
Environmental Compatibility	Minimized operation noise levels allow installation in urban and suburban indoor substations. Elimination of radio interference problems and individual painting of enclosures with the color of customer choice.

About Quality Assurance at HYOSUNG

HYOSUNG's total quality commitment to our customers is demonstrated in our on-time delivery of the highest quality product at the most competitive price. Our high quality level is achieved through our integrated quality assurance program. We have manufactured and delivered more than 5,000 bays to customers around the world.

This level of experience, combined with our extensive operating knowledge from the earliest phases of industry development, allows HYOSUNG quality assurance and reliability to equal or exceed those of our competitors. Our customer's goal is our goal, and that is for the best quality product. From design to assembly, testing, and installation, our customer's requirements are our minimum standards.



Quality Assurance

3.1 Design Process

HYOSUNG's Research and Development activities are dedicated to providing our customers with the products in demand not only for today but for the future. The latest computer assisted software and systems are applied to the design analysis of each GIS for the best quality and reliability.

3.2 Assembly Process

All critical components of HYOSUNG GIS are assembled in a "clean room" as a safety measure against contaminants. These critical components are then installed in their enclosure and pressurized with SF₆ gas. All openings are sealed to prevent dust from entering during shipping.



Clean Room



3.3 Testing Process

All tests are based on international standards and our customer's requirements. HYOSUNG then seeks to exceed all established testing criteria by carrying out additional tests that we consider essential in producing a higher quality product.

3.4 Installation Process

All components are completely assembled into one compact unit and tested in the factory. Through this, we can reduce the installation time and cost to meet our customer's needs better. We then ship each unit as one complete bay. A HYOSUNG engineer will be at your service during installation to ensure that your new GIS is not only installed correctly but functioning to your specification. We provide all the necessary special tools and test equipment needed to accomplish this. Final commissioning test is conducted involving various essential tests before your final acceptance.



Hydrostatic & Leakage Test

Dielectric Test

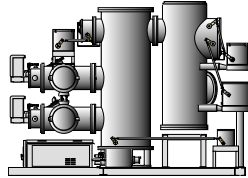
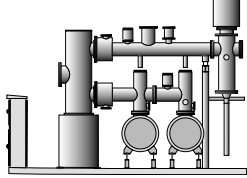


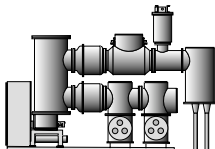
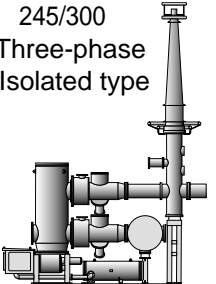
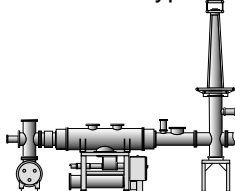
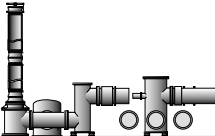



Design and Technical Details

4.1 Type and Rating

HYOSUNG GIS is available for all voltage ratings from 25.8kV to 800kV with designs that satisfy all busbar configuration requirements. The 245kV and below series typically feature the three-phase common-enclosure design, while those above 170kV employ the isolated design. Upon customer request, the isolated design is also available for units 245kV and below.

Rated voltage(kV)	123/145	170
Type	Three-phase Common-enclosure Type	
Rated interrupting current(kA)	25 / 31.5 / 40	31.5 / 50
Lightning impulse withstand voltage(kV)	550 / 650	750
AC withstand voltage(kV)	230 / 275	325
Rated pressure (kPa / kg / cm ² · G)	490 / 5	490 / 5
Arrangement	123-145 Three-phase Common type 	170 Three-phase Common type 
Bay dimensions (Meter Approx.)		
- Width	1.1	1.7
- Length	4.5	6.0
- Height	3	3.6

170	245 / 300	362	420 / 550	800
Three-phase Isolated Type				
31.5 / 50	40 / 50	40 / 50 / 63	40 / 50	50
750	1050	1175	1425 / 1550	2100
325	460	520	650 / 710	960
490 / 5	490 / 5	490 / 5	490 / 5	490 / 5
170 Three-phase Isolated type 	245/300 Three-phase Isolated type 	362 Three-phase Isolated type 	420 / 550 Three-phase Isolated type 	800 Three-phase Isolated type  * 800kV GIS
2.4	3.0	4 / 4	4 / 5	10
5.7	5.0	6.5 / 9.5	11.5	15.5
3.6	3.6	5.7 / 5.5	6	7.0



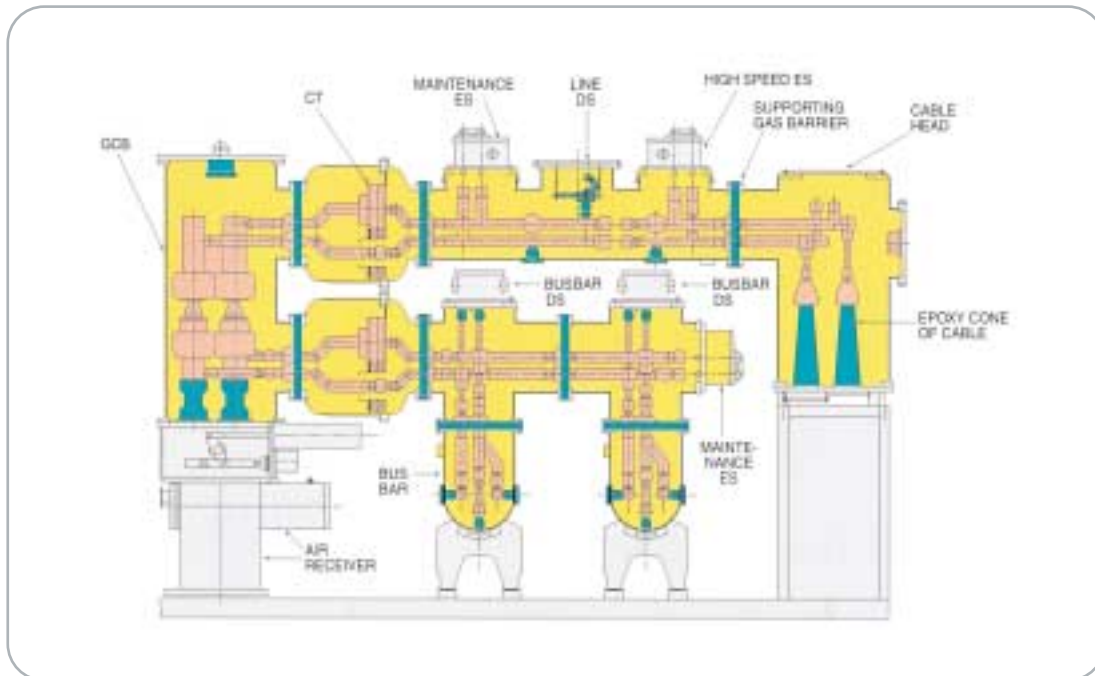
Design and Technical Details

4.2 Construction of GIS 72.5-145kV

To meet our customer's needs for GIS of this class to be as compact as possible, we use the three-phase common-enclosure construction. We have also greatly reduced the installation time and costs by having all the components completely assembled on one common base and tested in the factory. We then ship each unit as one complete bay.



145kV GIS in Saudi Arabia



Cross Section of Typical GIS 72.5-145kV

4.3 Construction of GIS 170-245kV

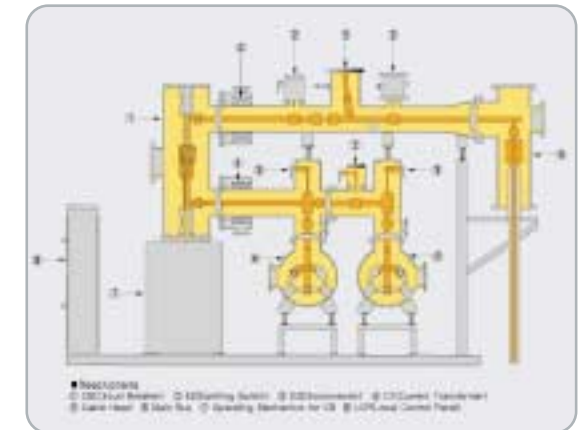
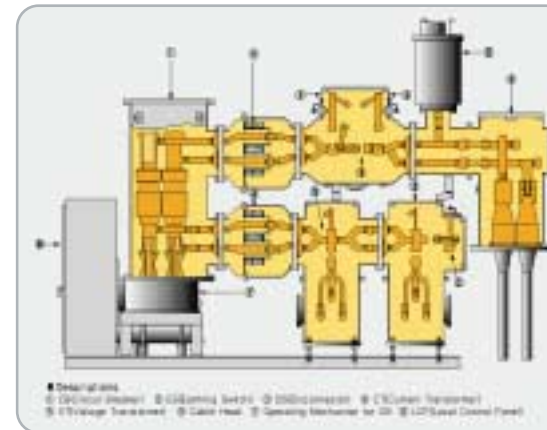
In this series the three-phase common-enclosure type and the three-phase isolated type designs are used in the busbars. As in the smaller units, all components are assembled on a common base, then tested and shipped as one complete bay subject to no shipment limitations.



Three-phase Common-enclosure Type



Three-phase Isolated Type





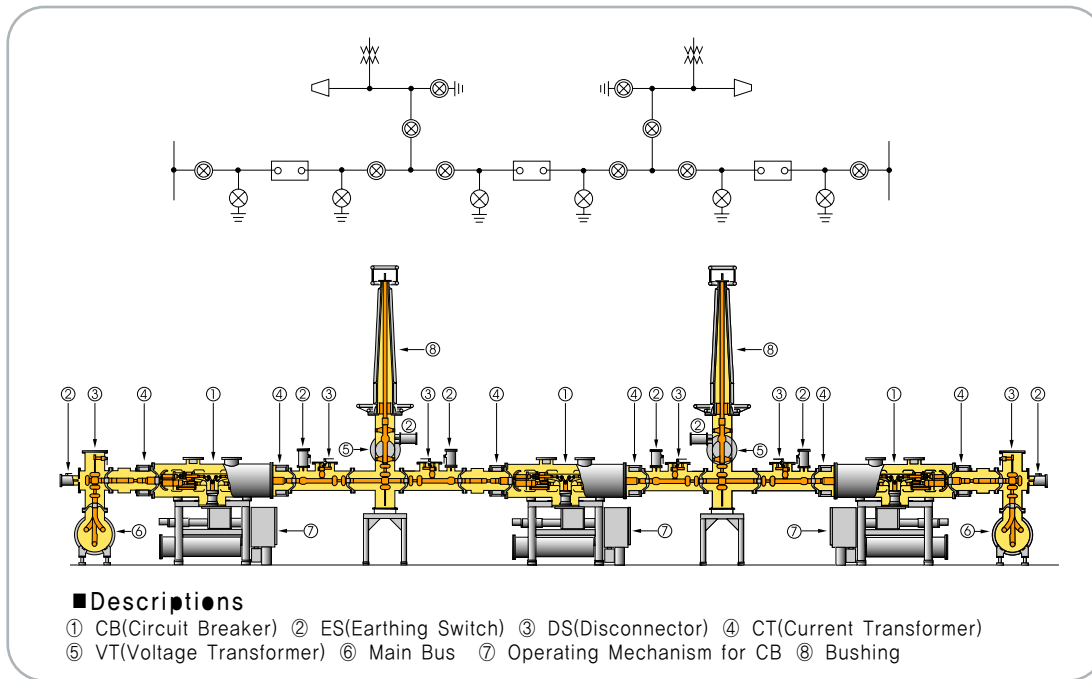
Design and Technical Details

4.4 Construction of GIS 300-800kV

A lower profile design is achieved by positioning the circuit breakers horizontally. This also improves the circuit breakers' resistance to vibrations and makes the unit easier to ship.

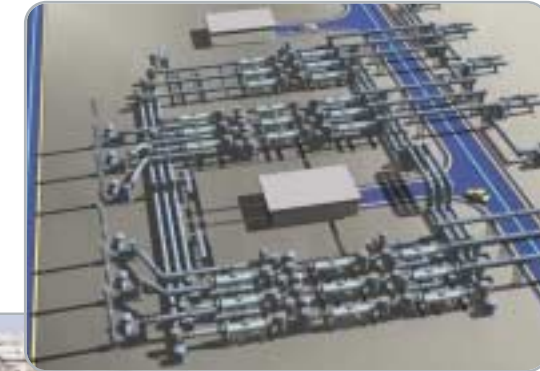


362kV GIS in Korea



Cross Section of Typical GIS 300-800kV

3-Dimensional Configuration for 800kV GIS



800kV GIS under Commercial Operation



362kV & 800kV GIS under Commercial Operation



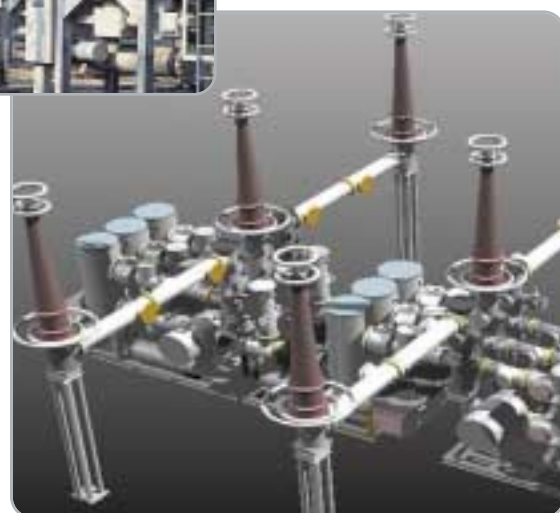
Construction Details of Equipment

About HYOSUNG GIS Construction Details

A typical GIS arrangement consists of a circuit breaker, disconnecting switch, earthing switch, busbar, voltage transformer, current transformer, and lightning arrester. Gas sections are used as spacers in order to minimize the range of trouble, allow for prompt repair, and monitor the gas effectively. Manholes are available in each section to facilitate inspection and maintenance. This arrangement allows connections to the bushings, cable head, and bus duct.



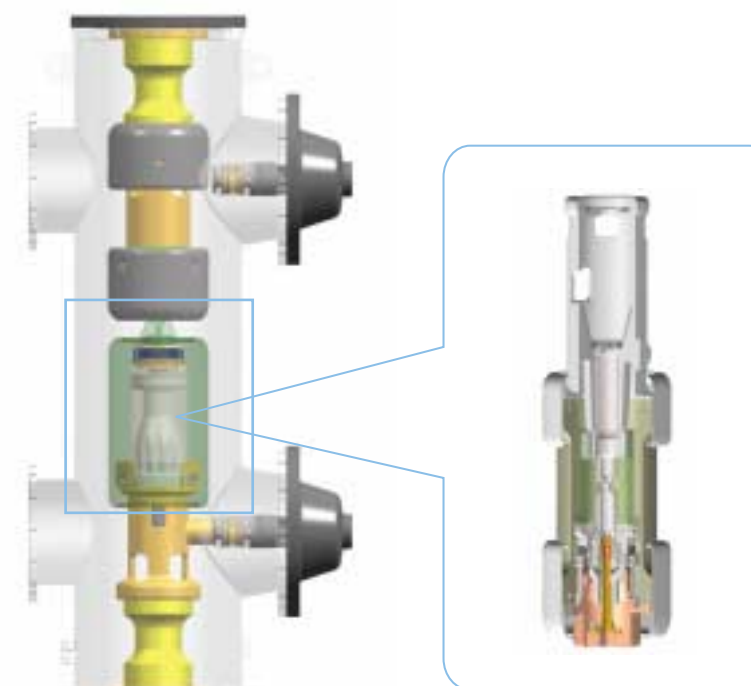
362kV GIS under Commercial Operation



3-Dimensional Configuration for 362kV GIS

5.1 Circuit Breakers

- Double flow synchronized axial blast method significantly boosts circuit breaking performance and enables single-pole structure
- Double trip coils ensure reliable circuit breaking performance combined with anti-pumping and trip-free function
- Hydraulic and spring mechanism, as well as highly reliable pneumatic operating mechanism based on HYOSUNG's long experience, is available upon request
- An accumulator(reservoir) enables the circuit breaker to close and open twice before needing to be recharged
- Structure that provides ease of maintenance



Configuration of Circuit Breaker

Configuration of Interruptor



Construction Details of Equipment

5.2 Disconnecting Switches

The disconnecting switches are motor driven, motor drive-spring charged, or pneumatic and features three-phase gang operation. Essentially, this design supports only no-load switching operations, but upon customer request, facilities for capacitive charging current, transformer magnetizing current, and loop current can be added. A mechanical indicator fixed to the operating shaft inside the operating mechanism box provides a visual means of checking operating position. Visual inspection windows can be installed as well.



Assembly of Disconnecting Switch & Earthing Switches for GIS

5.3 Earthing Switches

Every earthing switch has a short-time current endurance function. They are divided into two types with each one having its own particular functions. The first is the maintenance earthing switch, and it is motor driven or pneumatic. The second, the high-speed earthing switch, can be motor drive-spring charged or pneumatic. Manual operation is possible for all types. High-speed earthing switch has a short circuit making current capability.

The earthing switches can be used as primary injection terminals for checking voltages and currents. It is therefore possible to check the current transformer's ratio and contact resistance without draining the SF₆ gas.

A mechanical indicator fixed to the operating shaft inside the operating mechanism box provides a visual means of checking operating position.



Earthing Switch

5.4 Busbars

To allow for greater compactness, HYOSUNG GIS utilize three-phase common-enclosure for voltage ratings from 25.8kV to 800kV and rated current up to 8,000A. The finger-type tulip connectors enable convenient plug-in and plug-out, while providing elasticity and tolerance.

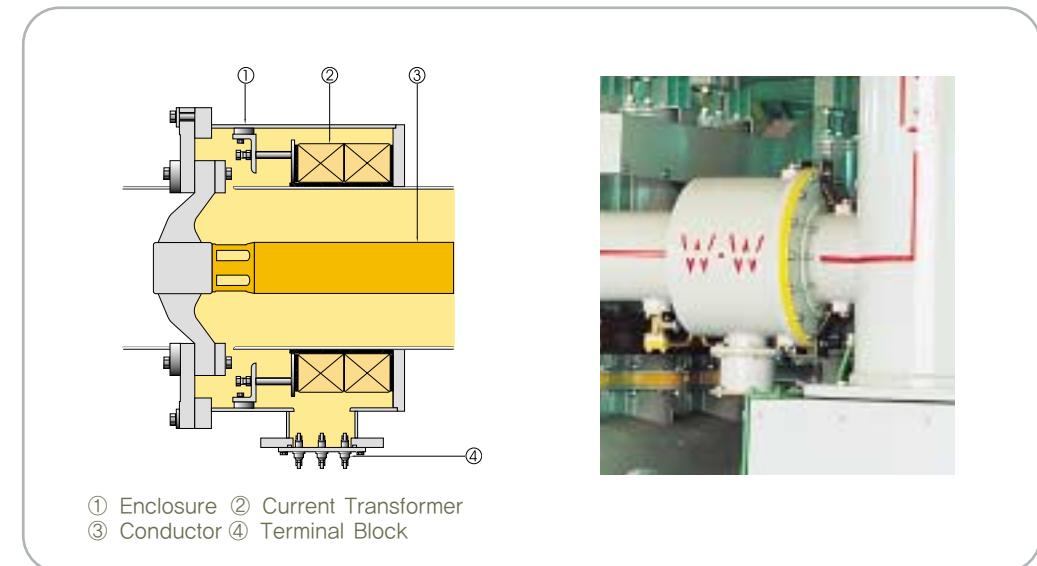
According to the rating current specified, the conductors are made of copper or aluminum and the enclosures are made of mild or stainless steel, or aluminum. The installation of bellows provides elasticity in assembly tolerance and protection against possible future foundation sinkage.



Busbar

5.5 Current Transformers

The current transformer is the ring type (HYOSUNG maker) used for equipment protection. To prevent moisture, the ring types have epoxy-fiber-glass applied. The ring type current transformer can be used with both three-phase common-enclosure and isolated type GIS.



Current Transformer(Three-phase Isolated type)



5.6 Voltage Transformers

HYOSUNG uses electromagnetic transformers with highly reliable SF₆ insulation. These compact models may be attached to the GIS from any position. They can be equipped as a three-phase common-enclosure type or isolated type.

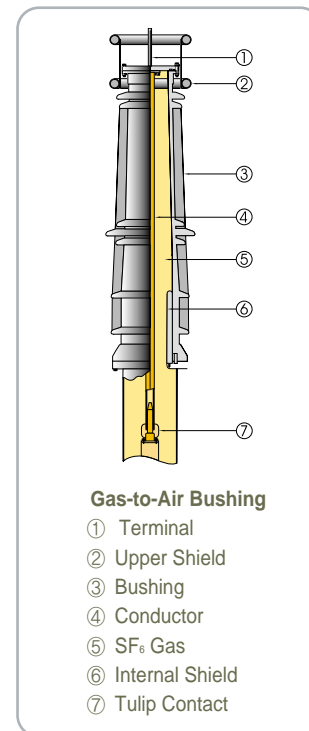
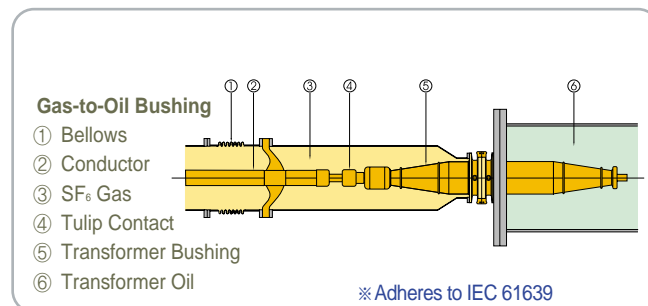
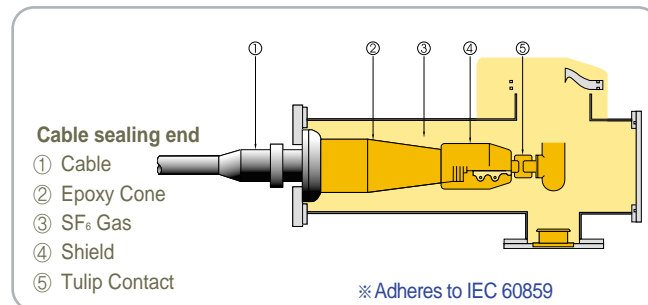


Voltage Transformer

5.7 Interfaces

HYOSUNG provides for customer use the connector, chamber, bushing and accessories that are necessary to connect any cable end. This facilitates future maintenance by allowing independent testing of key areas of HYOSUNG GIS without system degradation.

Our engineers will design and install bushings used in gas-to-air, gas-to-oil, or standard cable connections. HYOSUNG provides the necessary connecting chamber, contacts, and bellows that are required to compensate for alignment errors and to absorb excess vibration.



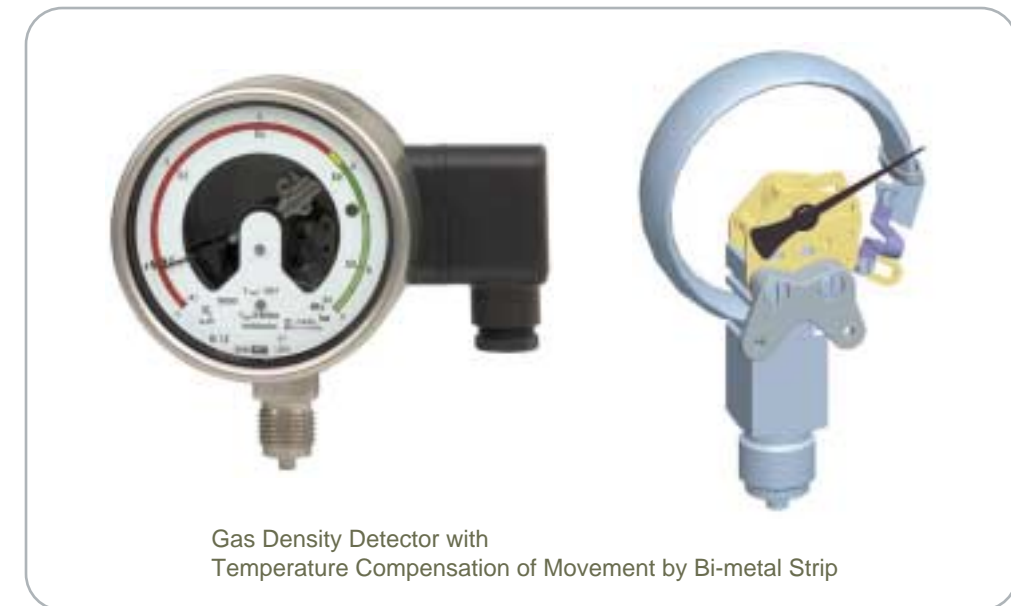
6.1 Pressure Relief Device

- Increased bursting accuracy with a tolerance within $\pm 3\%$ of the rated level
- Stainless steel disc instead of graphite adds increased protection from mechanical shock
- Welded disc prevents gas leakage
- Elimination of periodic maintenance
- A life expectancy of more than 20 years
- Not affected by creepage or metal fatigue caused by compressed gas
- In case of excessive pressure, the disc strikes the knife assembly and is cut into four equal fragments

6.2 Gas Section Design

Gas section design for efficient GIS operation is based on the following criteria:

- a) The number of disabled sections are minimized during sudden gas pressure drop or equipment malfunction
- b) The number of positions to be shut down during future GIS extension is minimized
- c) Each circuit breaker is in an independent gas compartment to facilitate inspection and maintenance





6.3 Interlock System

The circuit breaker, isolator and earthing switch are interlocked with each other to prevent sequential operation errors. Each interlock system has an exclusive electrical system.



Interlock Systems Installed between Each Equipment

7.1 Transportation

Following factory assembly and testing, the GIS is disassembled for packing and shipment. The equipment is designed to minimize the number of disassembled parts, while considering performance, maintenance, ease of installation and transportation. The disassembled parts are packed as a complete unit whenever possible to reduce the construction cost at the site.

7.2 Commissioning Test

The commissioning tests are performed in the presence of a HYOSUNG commissioning engineer to assure faultless operation of the GIS.

The test items are listed below.

1. Construction Check
2. GCB, DS, and ES Operation Tests
3. Gas Leak Test
4. AC High Voltage Test(80% of power frequency withstand voltage)
5. Main Circuit Resistance Measurement
6. Insulation Resistance Measurement
7. SF₆ Gas Moisture Check
8. Sequence and Wiring Check



Factory Storage



Site Installation



Bay Unit Transportation



Installation and Maintenance

7.3 Maintenance

The interior of GIS equipment is designed to eliminate almost all inspection and maintenance. To maintain the highest criteria of operating reliability, a routine inspection and maintenance schedule may be recommended.

	Number of switching CB operations *1	Since service begun	Inspection
Ordinary Inspection		Every 2 months	1. Gas pressure and operating pressure check 2. Recording number of operations of CB and lightning arrester
Regular Inspection	Every 500 times	Every 3 years	1. Gas leakage test 2. Operating device inspection and lubrication
Detailed Inspection *2	Every 2,000 times	Every 6 years	1. Detailed inspection of operating device 2. Internal check of CBs

Routine Inspection and Maintenance Schedule

*1 Number of switching operations at rated current of circuit breaker

*2 Only CB portion is inspected. Busbar and disconnecting switch portions do not require inspection except for the operating device

