

# SF<sub>6</sub> Electrical Equipment Decomposition Products Detector

SF<sub>6</sub> Electrical equipment initial failure detection expert



## JH Series



Xiamen Jiahua Electrical Technology Co., Ltd.

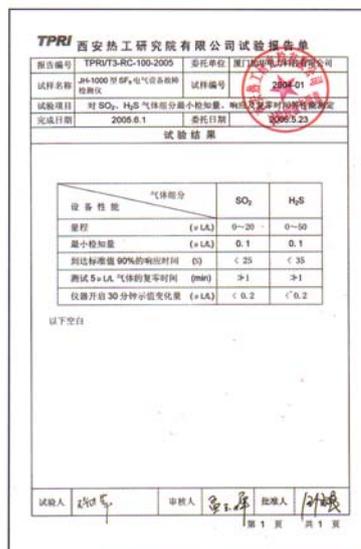
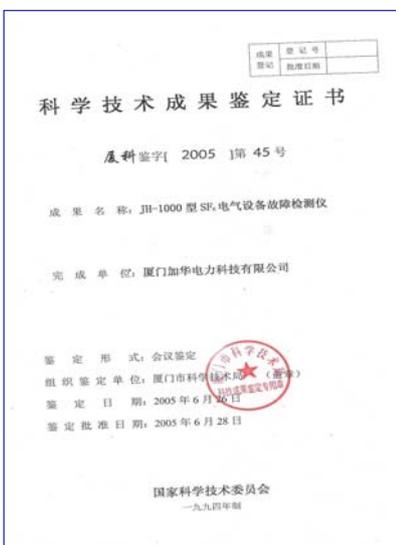


Sino-foreign joint venture  
Jiahua Electrical

JH 3000 Series SF<sub>6</sub> Electrical Equipment Decomposition Products Detector



Located at the scenic Xiamen State High-tech Innovation Center - Xiamen Entrepreneur Park for Overseas Chinese Scholars, Xiamen Jiahua Electrical Technology Co., Ltd. is a Sino-foreign joint-venture company engaged in high technology. With an aim at the R&D, production, sales and technical services for the products that are able to detect the failure inside the electrical devices, this company owns a technical team with a strong expertise in scientific research and a professional service team oriented to customer care. The major engineers involved in scientific research are the members of the National Technical Committee in Electric Chemistry of Standardization Administration of China. Using the international advanced technology, the company successfully developed a patented product which received a proprietary intellectual property rights in 2005. JH 1000 SF<sub>6</sub> electrical equipment failure detector, which ranks in the leading position in the world in terms of major performance standards. Based on JH 1000 SF<sub>6</sub>, the company has, in turn, successfully developed JH 2000 and multi-functional JH 3000 series of SF<sub>6</sub> electrical equipment decomposition product detectors over the past two years. Currently, the detectors have been widely applied in the provincial-level power generation and supply enterprises in Beijing, Shanxi, Zhejiang, Fujian, Jiangsu, Yunnan, Guangdong, Hunan, and Hebei as well as Shiky Corporation. They have successfully detected 76 pieces of faulty equipments and thus avoided many potential accidents and also received favorable comments from their users. With the principle of “taking technology as the top priority, giving quality the first consideration, and attaching a paramount importance to customers service”, the company endeavors to do its part to ensure a safe and economic operation of electrical equipment.





## SF<sub>6</sub> Electrical Equipment Safety Guard, An Expert in Early Fault Detection



JH3000 series SF<sub>6</sub> electrical equipment decomposition product detector is a precise, intelligent and portable comprehensive detector. It can make a judgment quickly and correctly based on the detection of the contents of main decomposed products, i.e., SO<sub>2</sub>+SO<sub>2</sub>F<sub>2</sub>, H<sub>2</sub>S, CO and HF, from the cracking of the insulation material if the electrical equipment, such as, SF<sub>6</sub> circuit breaker, instrument transformer, GIS and transformer etc. fails at the early stage. The portable SF<sub>6</sub> decomposition product detector operates with the highest precision and the ability to detect the most composition in the world. Furthermore, JH3000-5 detector is able to carry out the dew-point test at the same time so as to provide the more complete and efficient technical means for SF<sub>6</sub> electrical equipment in terms of insulation defective diagnose, SF<sub>6</sub> live steam quality monitoring and toxicity testing.

### Product features

- **Detection of more composition, high precision and excellent stability**  
The detector is able to rapidly detect SO<sub>2</sub>+ SO<sub>2</sub>F<sub>2</sub>, H<sub>2</sub>S, CO, HF decomposition products and is also able to carry out the dew-point test. It operates with high precision and stability.
- **Simple and rapid test with less consumption of gas, thus conducive to environmental protection**  
Detection of decomposition products is carried out with test flowrate of 100ml/min, requiring 1.5 minutes and less consumption of gas to complete the detection. With the installation of a tail gas recovery device, the detection progresses with no environment impact..
- **Complete functions and advanced process technology**
  - The big-screen operation interface is fully in Chinese to facilitate the operation
  - Adoption of temperature compensation and detection terminal automatic judgment technology is beneficial to the improved accuracy of test data.
  - Over high concentration protection technology is used to extend the service life of sensors.
  - The instrument expert diagnosis system is able to analyze and make judgments on the circuit breaker and other units respectively and to provide the solutions.
  - The functions are available for data storage, inquiry and transmission.
  - Built-in electronics flow meter is able to display the gas flow rate over the process
  - Intake pressure is able to take 1.0Mpa and suits the test of any kind of SF<sub>6</sub> electrical equipment.
  - Built-in high-capacity charging battery is able to operate for a long period of time.
  - The instrument is equipped with a self-checking function that is able to check main parameters after the startup.



● **Patent technology:**

➤ The detector was evaluated by technical experts and was awarded a number of state patents.

## Performance index

**Minimum detectable amount:** SO<sub>2</sub>+ SOF<sub>2</sub>, H<sub>2</sub>S and HF ≤0.1μl/L, CO≤0.5μl/L, sensitivity-0.1℃ in the case of dew-point detection being -20℃~-80℃.

● **Accuracy:**

Composition	Deviation
SO <sub>2</sub> +SOF <sub>2</sub> , H <sub>2</sub> S and HF	With measurement value ≤2μl/L, deviation ≤±0.1μl/L; With measurement value >2μl/L, deviation ≤±0.2μl/L
CO	With measurement value ≤10μl/L, deviation ≤±0.5μl/L With measurement value >10μl/L, deviation ≤±1.0μl/L
Dew point	With dew point at -20~-80℃, deviation ≤±0.5℃

- **Stability:** With temperature ranging at 20℃~40℃, max. zero drift: SO<sub>2</sub>+SOF<sub>2</sub>, H<sub>2</sub>S, HF≤±0.1μl/L  
CO≤±0.5μl/L, dew point ≤±1℃
- **Repeatability:** SO<sub>2</sub>+SOF<sub>2</sub>, H<sub>2</sub>S≤±2% or ±0.1μl/L, whichever is greater; CO≤±2% or ±0.5μl/L, whichever is greater; HF≤±2% or ±0.1μl/L, whichever is greater; dew point ≤±1% or ±0.5℃, whichever is greater.
- **Range:** Effective range for SO<sub>2</sub>+SOF<sub>2</sub>, H<sub>2</sub>S is 0~100μl/L, HF 0~20μl/L, CO 0~1000μl/L; dew point -80℃~+20℃
- **Gas flow rate:** 150±10ml/min
- **Intake pressure:** Not less than 1.0Mpa
- **Environmental condition:** Temperature: -40℃ ~ + 50℃ ;  
Humidity: 15~95%RH  
Above sea level ≤4000M
- **Communication interface:** USB
- **Power supply:** Built-in high-performance charging battery is able to continuously operate for more than 10hrs with an exception of detection of the dew point, the duration of which varies depending on different compositions.
- **Size:** L×W×H: 372mm x 266mm x 134mm ; Net weight - 4.3 kg
- **Calibration interval:** Once a year
- **Intake connection:** A set of chrome-coated brass connector equipped with filter is provided for connection to the exhaust port of majority of SF<sub>6</sub> electrical equipment. Furthermore, coupling for connection to DP19, DP99 gas tube is provided to share the union.



## Detection necessity

Despite of excellent chemical stability and electrical performance with SF<sub>6</sub> gas, the equipment inside may experience insulation defective and improper connection of conducting bar as a result of design, material and process. This may cause the disintegration of SF<sub>6</sub> gas and solid insulation material and even accidents. Currently there are two major methods used to detect the fault inside the SF<sub>6</sub> electrical equipment. The electrical method is generally carried out during power-off and has difficulty detecting the initial failure due to the low test voltage and current. The chemical method as specified in the criteria includes SF<sub>6</sub> purity, humidity and leak test. This method is only able to evaluate the installation and maintenance process and has nothing to do with internal failure. Now, some institutes have used the chemical colorimetric tube method to detect the decomposition products. However, due to low sensitivity, this method is only used for the qualitative and semi-quantitative detection. It is appropriate for locating failed parts by following the accident but has difficulty detecting the initial early failure. Our technical engineers have been working in monitoring and troubleshooting of oil-charged and gas-charged electrical equipments for a long time. Based on the thorough investigation and research, the electro-chemical sensor with high sensitivity and excellent stability, in conjunction with the advanced detection procedure and troubleshooting software, can measure the contents of such decomposition products as SO<sub>2</sub>+SOF<sub>2</sub>, H<sub>2</sub>S, CO. This helps a quick and correct diagnosis of any failure inside the equipment.

## Detection principle

Why are we able to detect insulation defects inside the equipment by analyzing the content of such decomposition products as SO<sub>2</sub>, SOF<sub>2</sub>, H<sub>2</sub>S and CO in SF<sub>6</sub> gas? Available information tells us that in the case of failure with SF<sub>6</sub> electrical equipment, SF<sub>6</sub> gas and solid insulation material exposed in the failure area may crack under the heat and electricity, then generating sulfide, fluoride and carbide. Sulfide may include SO<sub>2</sub>, H<sub>2</sub>S, SOF<sub>2</sub>, SF<sub>4</sub> and SO<sub>2</sub>F<sub>2</sub>; fluoride may include HF, CF<sub>4</sub> and metal fluoride; carbide may include CO, CO<sub>2</sub> and low molecular hydrocarbons. The above decomposition products, except SO<sub>2</sub>, H<sub>2</sub>S, CO and SF<sub>4</sub>, are all violent in toxicity and are less present inside the equipment in an unstable state. Among them, SOF<sub>2</sub> and SF<sub>4</sub>, etc. will further generate SO<sub>2</sub> and HF via hydrolytic decomposition. Thus, SO<sub>2</sub> concentration in SF<sub>6</sub> gas is the sum of those from direct decomposition and hydrolytic decomposition. Since SO<sub>2</sub> and SOF<sub>2</sub> are similar in nature, a great number of tests show that SO<sub>2</sub> sensor we selected is also sensitive to SOF<sub>2</sub> and the detection value is actually the total content of SO<sub>2</sub> and SOF<sub>2</sub>. Based on the investigation into a great amount of SF<sub>6</sub> electrical equipment, our technical engineers have proposed that H<sub>2</sub>S should be the characteristic composition from cracking of thermosetting epoxy resin and that CO should be the characteristic composition from cracking of polyester ethylene and paper. The detection of H<sub>2</sub>S and CO is conducive to troubleshooting of failure inside the SF<sub>6</sub> instrument transformer, sleeve and transformer. A preventative test is carried out to assess whether the equipment under test is working well and to detect the initial failure inside the equipment rather than conduct a comprehensive diagnosis. Therefore, it is unnecessary and also impossible to carry out detection on all decomposition products in the field. We developed JH-3000 detector based on JH-2000 to detect the content of such decomposition products as SO<sub>2</sub>+SOF<sub>2</sub>, H<sub>2</sub>S, CO at the same time. Upon the request from the user, we may be able to do the detection of HF and dew point so as to have a full picture of nature and locate the failure inside the SF<sub>6</sub> electrical equipment of any kind.

Over the recent three years, the detector has successfully detected 46 pieces of failed equipment in Fujian, Guangdong, Shanxi, Hebei, Xinjiang, Ningxia, Jiangsu, Zhejiang, etc., where 15 pieces of them were troubleshot during operation. The detection provided the scientific and reliable basis for equipment status maintenance and avoided many accidents. It also demonstrates the necessity and effectiveness of our JH series SF<sub>6</sub> electrical equipment decomposition product detector in the detection of failure inside the SF<sub>6</sub> electrical equipment.



## ◆ Test examples

Our technical engineer have been engaged in SF<sub>6</sub> electrical equipment-related gas quality monitor and internal troubleshooting for many years and have carried out inspection on thousands of equipment. Over recent years, the detector has successfully detected 76 failed equipment in Guangdong, Zhejiang, Fujian, Jiangsu, Shanxi, Hebei, Hunan, Xinjiang, Ningxia, etc., where potential failures were troubleshot in 36 of them to avoid the accidents, while in the other 40 parts were located by following the accident so as to save time for emergency repair. Many examples demonstrate that the detection with the instrument is workable. Some typical failure examples are shown in Figures 1-6 below.

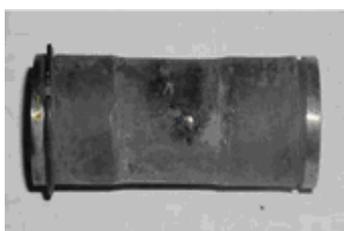


Fig. 1 On-line detection of discharging of suspension potential of plug pin for connection of pulling rod at Phase A of 220kv circuit breaker in XX hydraulic power plant



Fig. 2 On-line detection of overheating failure of contact connecting Phase A bus in 330kv GIS GM24 air chamber of xx substation

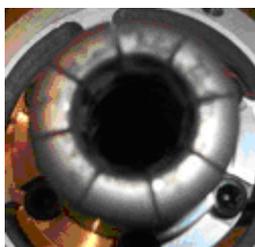


Fig. 3 On-line detection of contact being burnt from reignition of electric arc when 500kv 5013 Phase C circuit breaker is off in xx substation



Fig. 4 On-line detection of internal failure of 500kVCT xx substation in the southern grid.



Fig. 5 On-line detection of overheating failure of star contact connecting Phase B bus in 330kv GIS GM1 air chamber of xx substation

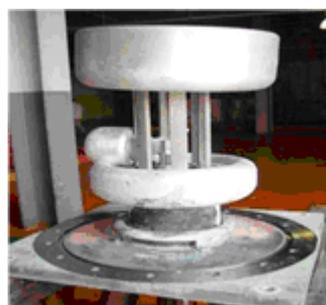


Fig. 6 Failure of insulation pulling-rod discharging in 220kv GIS Phase B circuit breaker of xx power plant