

ICS 25.040
CCS N 10



**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 47696-2026

**Proof testing of safety instrumented systems for the process
industry sector**

过程工业安全仪表系统检验测试

Issued on: May 25, 2026

Implemented on: December 1, 2026

**Issued by: State Administration for Market Regulation;
Standardization Administration of the PRC**

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5 General Requirements

5.1 Purpose Inspection and testing are part of the operation and maintenance activities of SIS, and their purpose is to ensure that SIS continues to be in "like new" condition or as good as possible during its use. Approaching "new" condition. The main objectives to be achieved through SIS testing include.

- a) Ensure the SIS meets the expected security integrity level by uncovering potential faults;
- b) The expected SIL and its security-related parameters (e.g., PFDavg/PFH) of each SIF in the SIS are continuously met throughout the security lifecycle. Requirements of SIS security requirements specifications;
- c) Evaluate the operational status of the SIS through inspection and testing, effectively collect field failure data, and provide data for the continuous and stable operation of the SIS. Support and suggestions.

5.2 Management Requirements

5.2.1 Testing and inspection consist of numerous activities involving multiple departments and roles, which should be planned and coordinated throughout the SIS lifecycle. The investigation should establish written procedures to regulate the organization, teams, personnel, procedures, and technical requirements involved in the testing and inspection.

5.2.2 A dedicated inspection and testing team should be established to clearly define the responsibilities for the planning, implementation, recovery, and rectification of inspection and testing.

5.2.3 Personnel performing inspection and testing shall receive relevant training, the training content of which shall cover basic knowledge of functional safety and inspection and testing methods. And the use of on-site instruments/equipment, etc.

5.2.4 Management procedures should be used to review and approve delays in inspection and testing to prevent significant delays.

5.2.5 When changes occur that affect the SIF, the testing requirements should be redefined, including determining the testing intervals and testing plan. Requirements for inspection and testing implementation, etc.

5.2.6 Newly installed SIF equipment should be "new" or as close to "new" as possible; equipment that has been unused for a certain period of time should... Installation and use can only proceed after inspection, testing, and confirmation that the requirements are met.

Note. "A certain time" may vary for different equipment. For example, for measuring instruments, it may be the calibration cycle, while for other equipment, it may be the time specified by the manufacturer.

5.3.1 Inspection and Testing Content

5.3.1.1 The inspection and testing shall comply with the relevant provisions of GB/T 20438 (all parts) and GB/T 21109 (all parts).

5.3.1.2 Inspection and testing shall comply with the overall SRS, as well as the requirements of the SIS equipment safety manual, user manual, and relevant manufacturer

information.

5.3.1.3 The entire SIS should be inspected and tested, including sensors, logic solvers, and final components, and the SIF loop should be inspected. Testing includes verification tests of the signal path from the SIF sensor to the logic solver, and from the logic solver to the final component.

5.3.1.4 The content of the inspection and testing should be based on the relevant documents provided by the manufacturer, such as the overall SRS, system design documents, and safety manuals. Regulation.

5.3.1.5 The inspection and testing shall include at least the following.

- a) Testing the effectiveness of the performed safety functions, such as determining whether any undetected dangerous failures have occurred. (λ_{DU});
- b) Testing the safety-related performance of the performed safety functions, such as safety response time, safety measurement accuracy, fault degradation mechanisms, and Safety-oriented capabilities, fault-tolerant capabilities, etc.;
- c) Testing the effectiveness of diagnostic functions.

5.3.2 Inspection and Testing Methods

5.3.2.1 SIS testing can be conducted in an end-to-end, segmented, or single-device manner.

5.3.2.2 Before a new or modified SIF is put into use, a full-function verification test should be performed using end-to-end testing to validate the SIF. It meets the requirements. Afterwards, end-to-end inspection and testing, segmented inspection and testing, or individual equipment inspection and testing can be selected as needed.

5.3.2.3 During planned shutdowns for maintenance, enterprises should employ end-to-end or segmented inspection and testing. During non-planned shutdowns for maintenance, [further procedures may be implemented]. Individual equipment inspection and testing, end-to-end inspection and testing, and segmented inspection and testing are adopted.

5.3.2.4 Defects discovered during inspection and testing should be repaired in a safe and timely manner. After repair, another inspection should be conducted. Test.

5.3.2.5 Inspection and testing should minimize the physical modifications required for inspection and testing (e.g., jumpers).

5.3.2.6 Inspection and testing should meet functional safety requirements, and the impact of inspection and testing on on-site production operations should also be considered. Specific inspection and testing... The trial plan or process should be coordinated with the on-site production operation.

Note. Effective safety testing varies depending on the specific application. Hazards, resources, and site conditions can differ significantly. Regardless of the method used... All tests and inspections used to ensure the security and integrity of SIFs need to consider practical operability, and maintenance activities should be integrated with security considerations. And minimize operating costs.

5.4 Inspection and Testing Procedure The inspection and testing should be carried out according to the process shown in Figure 1.

6.1 General Provisions

6.1.1 Conduct testing and inspection planning before implementing the testing and inspection.

6.1.2 The input information for verifying the test plan should include at least the following.

- b) Safety manuals and user manuals for all devices in the SIS;
- c) Information on the relevant installation, layout, environmental conditions, and operation and maintenance procedures of the SIS application site.

6.1.3 The personnel involved in the development of the testing and inspection plan shall include at least the following.

- a) On-site operation and maintenance personnel for SIS applications;
- b) Manufacturers of critical and complex equipment in SIS;
- c) Necessary safety supervisors.

6.2 Planning Content

6.2.1 Plan the overall inspection and testing strategy, including the specific testing methods, testing time, and personnel requirements, at least considering... Considering the following.

- a) Inspection and testing methods, including end-to-end inspection and testing, segmented inspection and testing, and individual equipment inspection and testing; Example. This includes all components required for the entire loop operation, such as thermocouple sheaths, thermocouples, transmitters, inputs, logic operations, outputs, and final components. test.
- b) Determine whether the safety instrumented function test needs to be conducted as a single, centralized test, or whether it can be performed at different times as needed. Each component of the safety instrumented function is tested separately to achieve the corresponding safety integrity level;
- c) Confirm the feasibility and necessity of online testing, and the allocation ratio between online and offline testing;