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NATIONAL STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

GB/T 47577-2026

Non-destructive testing - Optical gas imaging method for the detection of volatile organic compound (VOC) leaks

无损检测 挥发性有机物（VOCs）泄漏光学气体成像检测方法

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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04 Non-destructive testing for volatile organic compound (VOC) leaks Optical gas imaging detection method Released on 2026-05-

25 Implemented on December 1, 2026 State Administration for Market Regulation The State Administration for Standardization issued a statement.

1.Scope This document describes a method for detecting volatile organic compound (VOC) leaks based on optical gas imaging, and provides the optical gas imaging... The detection principle specifies the detection environment, detection system, detection procedures, detection processes, data storage and analysis, and detection of optical gas imaging. Records and reports. This document applies to industrial enterprises, including those in the oil refining and chemical industries, that handle equipment and pipeline components and waste gas collection systems that emit volatile organic compounds. Leak detection of pipeline assemblies using optical gas imaging. For other gas leaks with infrared absorption characteristics, refer to the same procedure.

4.Detection Principle Volatile organic compounds (VOCs) exhibit infrared radiation

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absorption characteristics. Detection equipment can be used to capture VOCs gases at specific wavelengths. The infrared radiation absorption characteristics within the range transform previously invisible VOCs gas leaks into intuitive, visual images. Infrared radiation within a specific wavelength range in optical paths passing through VOCs gases (gas optical path) and optical paths not passing through VOCs gases. A difference in infrared radiation energy occurs between the non-gas optical paths, causing variations in the radiation energy received by the infrared detectors, thus creating a leak. A visual image of the gas is shown in Figure 1.

5 Testing Environment

5.1 Environmental Conditions During the testing process, the environmental conditions at the testing site must meet the following requirements.

a) The optical gas imaging system and related equipment shall not be subjected to impact, vibration, external electromagnetic fields, or external factors that may affect the readings of the measuring instruments. The effects of radiation sources;

b) The operating ambient temperature range should be -20 °C to 50 °C;

c) The relative humidity of the working environment should be less than 95%;

d) Avoid use in environments with fog, rain, direct sunlight, high wind speeds, or high concentrations of particulate matter.

e) Considering the potential danger of VOCs gas leaks at the site, avoid hazards such as harmful gases, fire, and explosion during testing. risk;

f) Power supplies should not be changed or live equipment should not be plugged or unplugged at the work site.

5.2 Interference Avoidance To avoid signal interference from the target background due to temperature differences, a uniform temperature distribution should be ensured. In actual testing, multiple methods can be used. Measures such as setting up detection points and removing interfering objects around the equipment under test are taken to reduce or eliminate the adverse effects caused by temperature differences. This is to obtain optimal contrast. Leakage detection imagery (including videos and photos) should be compiled in conjunction with key factors such as weather conditions, detection time period, and process parameters to create necessary conditions. The condition ensures that the temperature difference (Deltat) between the leaked gas and the target background is greater than 2 °C.

6 Detection System

6.1 System Composition A typical optical gas imaging detection system includes a detector, image analysis software, and a display module, as shown in Figure 2. The detector should include an infrared lens, an infrared detector, an infrared imaging module, a visible light

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component, and a signal processing module. (Infrared lens, infrared...) The detector achieves two-dimensional spatial analysis of the scene's infrared radiation energy, forming a certain field of view and resolution. After processing by the infrared imaging module, the image is then... For digital video output, a visible light component has been added to facilitate verification and comparison. The signal processing module receives visible light and infrared imaging digital video. Input is used to complete signal fusion and storage. Image analysis software performs VOCs gas leak location analysis, image enhancement, and noise reduction. Processing. Parameter settings for calibration instruments using standard gases, blackbody simulators, etc. In specific cases, an infrared detector cooling system can also be configured. (Cooled detectors only), laser rangefinders, positioning modules, hygrometers, weather instruments and other auxiliary devices.

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6.2 Detector

6.2.1 General Requirements The testing instrument should meet the following requirements. --It has the function of real-time acquisition and transmission of infrared images and infrared video data; --In infrared mode, it offers multiple display modes including incandescent and black-and-white (with various pseudo-color palettes available); --Adjust the focus manually or automatically to ensure a clear image; --The image analysis software has a VOCs gas leak location function; --Real-time adjustment of imaging contrast and brightness, manual/automatic adjustment of color mark, and switching between infrared/visible light display; --Powered by battery, the continuous and stable working time is no less than 3 hours, provided that all functions are normal.

6.2.2 Performance of the Detector

6.2.2.1 Field of View The testing instrument should specify the field of view of the lens. Different lens specifications can be selected according to the testing distance to obtain the corresponding field of view. When testing... When the measurement distance is greater than 50 m, the field of view should not exceed 10°. When the measurement distance is between 10 m and 50 m, the field of view should be greater than 10° and less than [missing value]. 38°. When the detection distance is less than 10 m, the field of view should not be less than 38°. The error between the measured value and the nominal value of the field of view should not exceed ±5%.

6.2.2.2 Spatial resolution The spatial resolution should be selected based on the size of the object being inspected and the detection distance. When the detection distance is greater than 50 m, the spatial resolution should be selected as [specific value needed]. Choose a spatial resolution of

0.2 mrad to

0.7 mrad. When the detection distance is 10 m to 50 m, a spatial resolution of

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0.7 mrad to

1.0 mrad is recommended. When the distance to be measured is less than 10 m, the spatial resolution should preferably be selected from

6.2.2.3 Sampling Frame Rate The frame rate for acquiring and transmitting infrared video data should not be lower than

6.2.2.4 Minimum Detectable Leak Rate (MDLR) 6.2.2.4.1 In the laboratory environment, the temperature is 23°C±5°C, the relative humidity is 40%~80%, and the temperature difference between the standard gas and the blackbody simulator is... Under the conditions of 2 °C, a distance of 2 m, and where both the gas outflow and direction are visible to the detector. --Methane standard gas, concentration of 99.99% mol/mol, minimum detectable leakage rate less than or equal to 15 mL/min; -- n-Butane standard gas, concentration of 2.0% mol/mol, minimum detectable leakage rate less than or equal to 100 mL/min. 6.2.2.4.2 On a sunny day with sufficient sunlight, an ambient temperature of 10°C~25°C, a wind speed not exceeding 4 m/s, and a relative humidity of 5%~80%, the distance... Under the condition of 3 m, and when both the gas outflow and direction are visible to the detector. --Ethylene standard gas. concentration of 3.0% mol/mol, minimum detectable leakage rate less than or equal to

2.5 L/min; --Methane standard gas. concentration 5.0% mol/mol, minimum detectable leakage rate less than or equal to

0.5 L/min; concentration is At a concentration of 2.5% mol/mol, the minimum detectable leakage rate is less than or equal to

6.2.2.5 Detectable gas types Depending on the VOCs gaseous medium inside the equipment being tested, the detector's detection range should cover its absorption spectrum or characteristic absorption band. Infrared optical gas imaging detection can detect volatile organic compounds including, but not limited to. methane, ethane, propane, butane, pentane, hexane, and heptane. Alkanes, methanol, ethanol, benzene, xylene, propionaldehyde, acetylene, etc. Long-infrared optical gas imaging detection can detect volatile organic compounds including, but not limited to, those listed below. Limited to toluene, ethylene, ethylbenzene, propylene, etc. The spectral absorption characteristics of common VOCs in the infrared and long-infrared bands are shown in Appendix A.

6.3 Maintenance and verification of testing equipment The equipment should be maintained and checked every 12 months to ensure its functionality meets testing requirements. Minimum detectable depth in a laboratory environment. The leak rate (MDLR) test shall be performed in accordance with the provisions of

8.2 and shall meet the requirements of 6.2.2.4.1. Before on-site testing, the equipment should be verified using known emission sources (such as butane lighters or propane cylinders). If the equipment is at its minimum... If a clear real-time gas image can be

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