Bimetallic Thermometer

I. Product Definition

A bimetallic thermometer is a fully mechanical on-site temperature measurement instrument designed based on the thermal expansion effect of bimetallic strips. Its core function is focused on the intuitive monitoring of temperatures in industrial and residential settings. Without relying on an external power source, its robust mechanical structure ensures stable and accurate on-site temperature readings. It also features excellent shock resistance and electromagnetic interference immunity, making it suitable for a wide range of complex operating conditions. Capable of directly measuring the temperature of various liquids, steam, and gases, it is a cost-effective choice for industrial on-site temperature monitoring. Its measurement range spans from -80°C to +500°C, with accuracy grades of Class 1.0 or Class 1.5, meeting most standard temperature measurement requirements.

Key Features:

--- On-site Temperature Indication: The dial features clear graduations and a pointer, allowing direct reading of temperature values without connecting to a control system. Dial nominal diameters are available in φ60, φ100, and φ150 mm to accommodate different viewing distance requirements;

--- Power-Free Temperature Measurement: Fully mechanical construction requires no connection to a 24V DC power supply or batteries. It is ready for use immediately after installation, completely eliminating the risk of shutdown due to power outages;

--- Mechanical Stability: Core components are made of high-strength metal, featuring a compact and robust structure with no vulnerable electronic parts, ensuring minimal risk of failure during long-term use;

--- Shock and Interference Resistance: Withstands moderate mechanical vibrations and is unaffected by electromagnetic interference, making it suitable for high-interference environments such as those with variable frequency drives and high-voltage equipment. It meets IP65 protection standards, offering excellent water and dust resistance.

II. Working Principle

The core operating principle of the bimetallic thermometer is based on the “differences in thermal expansion and contraction between metals.” The entire process involves no electronic components and relies entirely on mechanical transmission, making it simple to understand, stable, and reliable. The specific process is as follows:

1. Core Components: The internal core consists of two metal strips with different coefficients of thermal expansion (such as brass and nickel-chromium alloy). These are tightly bonded through rolling or welding processes to form a spiral tube or arc-shaped bimetallic strip. One end is fixed, while the other is connected to the pointer transmission mechanism; this forms the core foundation for temperature sensing and deformation transmission.

2. Temperature Sensing: When the thermometer’s sensing probe (protective tube) comes into contact with the medium being measured (liquid, steam, or gas), heat is rapidly transferred to the internal bimetallic strip, triggering a thermal expansion and contraction reaction;

3. Deformation: Due to the different thermal expansion coefficients of the two metals, they expand (or contract) to varying degrees when heated or cooled—the metal with the higher thermal expansion coefficient stretches more, while the one with the lower coefficient stretches less. This difference causes the bimetallic strip to bend toward the side with the smaller expansion, and the greater the temperature change, the more pronounced the bending;

4. Pointer Indication: The bending deformation of the bimetallic strip is amplified by an internal mechanical transmission mechanism (gears or levers), driving the pointer on the dial to rotate. The scale mark where the pointer ultimately points indicates the actual temperature of the measured medium;

5. Temperature Decline: When the temperature of the measured medium decreases, the bimetallic strip contracts accordingly, returning to its initial state, and the pointer simultaneously rotates back to the corresponding low-temperature scale mark, enabling real-time dynamic temperature measurement.

Key Advantages: The fully mechanical structure eliminates the need for circuits or power sources, not only eliminating the risks of electronic component aging and short circuits but also offering exceptional environmental adaptability. It operates stably even in industrial environments with high vibration, high dust levels, and strong electromagnetic interference, while providing rapid response with a thermal response time of ≤40 seconds, meeting on-site real-time temperature measurement requirements.

III. Core Value

Compared to temperature measurement instruments without on-site indication (such as simple resistance thermometers or thermocouples that rely on PLC/DCS displays) and electronic temperature measurement instruments (such as digital thermometers), the core value of the Qidian Bimetallic Thermometer lies in its “practicality, reliability, peace of mind, and cost-effectiveness.” It precisely addresses the core pain points of on-site temperature measurement. Specific comparisons are as follows:

1. Comparison with non-indicating temperature measurement instruments (such as standard RTDs/thermocouples)

Pain Point: No on-site indication; temperature can only be viewed by connecting to a control system. If the control system fails or power is lost, temperature data cannot be obtained. Installation is complex and requires additional wiring;

Qidian Advantages: No wiring required; no reliance on control systems; direct on-site dial readings; ready for use immediately after installation; continues to monitor temperature normally even if the control system fails, avoiding production risks caused by unreadable data; protective tubes, connectors, and other components are made of 1Cr18Ni9Ti stainless steel, with a pressure resistance of up to 6.4 MPa, making them suitable for high-pressure operating conditions.

2. Comparison with Electronic Temperature Measurement Instruments (e.g., Digital Thermometers)

Pain Points: Dependent on power (batteries or external power supply); fails immediately upon power loss; electronic components are susceptible to electromagnetic interference, high temperatures, and humidity, resulting in a high failure rate; maintenance is complex, requiring regular calibration, battery replacement, or replacement of damaged electronic components; high long-term operating costs, as the entire unit must be replaced once the electronic sensor ages;

Advantages: No power supply required, completely eliminating dependence on power sources; easy installation with no risk of power outages; Fully mechanical structure, resistant to shock and electromagnetic interference; suitable for harsh industrial environments; highly durable with a service life of over 10 years under normal operating conditions; Simple maintenance—no need for periodic calibration or component replacement; only requires periodic cleaning of the dial; Lower cost: Initial purchase cost is lower than most electronic instruments, with no ongoing maintenance or consumable expenses, offering outstanding value for money; Excellent waterproof and corrosion-resistant performance: The dial cover and housing feature a double-layer rubber O-ring threaded seal structure, capable of withstanding a 5-minute water spray from a 25-mm nozzle at a distance of 5 meters without any water penetration.

3. Summary of Core Value

Qidian bimetallic thermometers are centered on the principles of “no power supply, intuitive readout, high stability, low maintenance, and low cost.” They are perfectly suited for scenarios requiring “on-site readings, stable and reliable performance, and no complex maintenance” for temperature monitoring. They address the pain point of “inconvenient readings” associated with non-indicating instruments while avoiding the issues of electronic instruments, such as “dependence on power, susceptibility to failure, and cumbersome maintenance.” They are the preferred solution for routine temperature measurement in industrial settings.

IV. Series Classification

Qidian bimetallic thermometers are categorized into multiple series based on structure, function, and protection performance. Different series cater to varying operational conditions, allowing users to quickly identify the appropriate model based on their installation space, medium characteristics, and operating environment. The specific classifications and applicable scenarios are as follows:

1. Radial Type (Straight Type)
Structural Features: The pointer shaft is perpendicular (90 degrees) to the sensing element (protective tube). The dial is connected to the protective tube via a right-angle elbow, with the sensing element extending axially and the dial arranged radially. Qidian's radial type features a unique bent-tube design that is innovative, aesthetically pleasing, and lightweight. The case is available in either black matte electrophoretic-coated drawn aluminum or stainless steel;
Applications: Suitable for applications with small pipe diameters and limited axial installation space, such as densely arranged process pipes, pump bodies, valves, and other temperature measurement points. It effectively saves axial space, facilitates side-view reading, and is suitable for standard operating conditions without corrosion or strong vibrations.
2. Axial Type (Angular Type)
Structural Features: The pointer shaft and the temperature-sensing element (protective tube) are aligned in a straight line. The meter head is mounted directly at the top of the protective tube, with the temperature-sensing element extending axially from the mounting threads or flange. This design is compact and ensures a secure installation;
Applications: Suitable for installations with sufficient axial space, such as large storage tanks, reactors, and HVAC ductwork. The line of sight is perpendicular to the dial face during reading, providing a natural and intuitive view. It is suitable for standard industrial applications and residential HVAC systems.
3. Universal Type
Structural Features: Optimized based on the radial type, the connection between the dial and the protection tube allows for 360-degree continuous rotation. The dial angle can be flexibly adjusted according to the installation environment. The connection uses 1Cr18Ni9Ti stainless steel bellows and structural components, offering superior corrosion resistance;
Applications: Suitable for complex operating conditions with difficult-to-reach installation locations or inconvenient reading angles, such as inside large equipment, in confined spaces, or among dense piping. By rotating the meter head, the optimal reading angle can be found, offering exceptional flexibility and adaptability to a variety of complex installation environments.
4. Electrical Contact Type
Structural Features: Based on a conventional bimetallic thermometer, this model adds electrical contact control functionality. Upper and lower temperature limits can be preset; when the temperature reaches the preset value, the electrical contacts trigger an alarm or control signal. It supports point adjustment (selectable options include upper/lower limits, dual upper limits, and dual lower limits);
Applications: Suitable for operating conditions requiring temperature alarms and automatic control, such as boilers, reactors, and temperature-controlled chambers. It enables high/low temperature alarms and can trigger the start/stop of other equipment to ensure production safety, in compliance with the GB3836-83 standard.
5. Corrosion-Resistant Type
Structural Features: The sensor head and protection tube are made of corrosion-resistant materials (such as 316L stainless steel or anti-corrosion coatings). Sealing performance has been enhanced to prevent erosion by corrosive media. The protection tube is welded using fully automated argon gas shielding, resulting in strong welds and minimal intergranular corrosion;
Applications: Temperature measurement in corrosive media, such as in the chemical, pharmaceutical, and wastewater treatment industries. It can measure the temperature of corrosive media including acids, alkalis, and chloride ions, preventing instrument damage from corrosion and extending service life.
6. Shock-Resistant Type
Structural Features: The internal mechanical structure incorporates a cushioning design, and the dial is housed in a sealed, shock-resistant casing to enhance vibration resistance. It can withstand high-frequency mechanical vibrations, preventing pointer loosening and component damage;
Applications: High-vibration environments, such as temperature measurement points in metallurgy, power generation, pumps, compressors, and other equipment. It maintains stable readings in vibrating environments, preventing measurement errors or instrument damage caused by vibration.
Additional Notes:
In addition to the core series mentioned above, Qidian bimetallic thermometers also include special models such as the heat-sleeve type and long-neck type. The heat-sleeve type allows for replacement of the sensing element without shutdown and is suitable for high-temperature, high-pressure, and volatile hazardous gas environments; The long-neck type is specifically designed for applications with thick insulation layers, such as power plants; the dial can be positioned above the insulation layer for easy observation and energy savings; all series support customizable protection tube lengths (50–2000 mm), and installation methods include threaded connections (M16×1.5, M27×2, etc.), flanges, and compression fittings to accommodate various installation requirements.
V. Key Product Parameters & Specifications
5.1 Basic Temperature Measurement ParametersFocusing on core temperature measurement metrics, these parameters clearly define the product's temperature measurement capabilities and display performance, catering to various accuracy and measurement range requirements. All parameters comply with the GB/T 12470-2013 industry standard.
1. Temperature Measurement Range: The full series covers -80°C to +500°C, with sub-ranges tailored to different scenarios. Standard models can be selected as needed:
--- Low-Temperature Type: -80°C to +100°C (suitable for cold storage, cryogenic pipelines, and similar scenarios)
--- Standard Models: -40°C to +200°C, 0°C to +100°C, 0°C to +200°C (suitable for HVAC and general industrial piping)
--- Medium-to-High Temperature Models: 0°C to +300°C, 0°C to +400°C, 0°C to +500°C (suitable for high-temperature applications such as boilers and kilns)
2. Accuracy Class: The core is divided into two classes; select the appropriate model based on your needs:
--- Class 1.0 (High Accuracy): Error ≤ ±1.0% FS (Full Scale), suitable for applications requiring high temperature measurement accuracy (e.g., pharmaceuticals, food processing)
--- Class 1.5 (Standard Accuracy): Error ≤ ±1.5% FS, suitable for general industrial temperature measurement and residential HVAC applications, offering outstanding value for money
3. Dial Diameter: Categorized by viewing distance and installation space; dials are made of aluminum or stainless steel with clear, wear-resistant markings:
--- φ60mm (Small): Suitable for confined installation spaces; viewing distance ≤ 1 m (e.g., dense piping, small equipment)
--- φ100mm (Standard): General-purpose; viewing distance ≤ 2 m; suitable for most industrial applications and HVAC ductwork
--- φ150mm (Large): Viewing distance ≤ 3 m; suitable for large equipment, storage tanks, and long-distance viewing scenarios
4. Scale Units: Dual-scale marking accommodates different usage preferences; scale lines are clear and sharp, facilitating quick readings:
--- Primary Scale: Celsius (°C), with intervals of 1°C, 2°C, or 5°C (depending on the measurement range)
--- Secondary scale: Fahrenheit (°F), optional as needed, suitable for export and special application requirements
5. Response time (T90): ≤40s for the entire series; ≤50s for shock-resistant and corrosion-resistant models; ≤60s for high-temperature models (≥300°C). Quickly captures temperature changes to meet real-time on-site measurement needs with no noticeable lag.
5.2 Structural Parameters
Specifies product structural materials and dimensions to align with installation requirements, ensuring compatibility with on-site mounting locations and medium characteristics during selection, while balancing durability and adaptability.
1. Case Material: Categorized by protection and operating conditions; all materials meet industrial-grade standards and are wear-resistant and anti-aging:
--- Standard Type: Cold-rolled steel plate (powder-coated, matte black), lightweight and durable, suitable for general applications
--- Corrosion-Resistant/High-End Type: 304/316L stainless steel, corrosion-resistant and oxidation-resistant, suitable for corrosive and humid environments
--- Explosion-Proof Type: Cast aluminum alloy (explosion-proof sealed), meets explosion-proof structural requirements, suitable for hazardous areas

2. Dial Types: Corresponding to series models, the structures are designed to fit different installation spaces, with secure and reliable connections:
--- Radial Type: The pointer shaft is perpendicular (90°) to the protective tube, connected via a right-angle elbow, saving axial space
--- Axial Type: The pointer shaft is aligned with the protective tube; the dial connects directly to the tube, providing intuitive readings
--- Universal Type: The dial can rotate 360° continuously; the connection uses a stainless steel bellows; the angle is adjustable, suitable for complex installation scenarios
--- Electrical Contact Type: Adds electrical contact terminals to the standard dial; the dial features a wiring port, supporting alarm control
3. Connection Threads: Standard threads compatible with conventional mounting bases; custom threads available. Thread precision complies with GB/T 196 standards:
--- Standard Threads: M16×1.5, M20×1.5, M27×2 (most commonly used, compatible with most piping and equipment installations)
--- Imperial Threads: G1/2“, G3/4”, G1", available upon request, suitable for export and special installation requirements
--- Custom Threads: Non-standard thread specifications can be customized based on on-site mounting bases
4. Sheath Material: The core material housing the temperature-sensing element; material determines temperature resistance and corrosion resistance. Sheath welding uses fully automated argon gas protection, ensuring strong welds:
--- Standard Type: 1Cr18Ni9Ti stainless steel, temperature resistance ≤400°C, suitable for non-corrosive, standard-temperature applications
--- High-Temperature Type: Inconel 600 alloy, temperature resistance ≤500°C, suitable for high-temperature environments such as boilers and kilns
--- Corrosion-Resistant Type: 316L stainless steel, Hastelloy (custom), resistant to acids, alkalis, and corrosion, suitable for chemical processing and wastewater treatment applications
5. Sheath Diameter and Insertion Length: Designed according to installation requirements and temperature measurement accuracy; flexible customization available:
--- Sheath Diameter: Standard φ6mm, φ8mm, φ10mm, φ12mm; φ10mm is the universal size, suitable for most applications; φ14mm and φ16mm are available for high-pressure applications (enhanced pressure resistance)
--- Insertion Length: Standard lengths include 50 mm, 100 mm, 150 mm, 200 mm, 300 mm, and 500 mm; custom lengths from 50 mm to 2000 mm are available. The recommended insertion depth is ≥8–10 times the sheath diameter to ensure accurate temperature measurement.
5.3 Performance Parameters (Product Durability and Stability, Demonstrating Core Capabilities)
Focusing on long-term operational stability and durability, the product adapts to various complex operating conditions to ensure minimal failure rates during prolonged use and reduce maintenance costs.
1. Vibration Resistance Rating:
--- Standard Type: Vibration resistance rating ≤2g (10–2000 Hz), suitable for applications with no significant vibration (e.g., standard pipelines, storage tanks)
--- Vibration-Resistant Type: Vibration resistance ≤5g (10–2000 Hz), features an internal cushioning structure, suitable for high-vibration environments such as pumps, compressors, and metallurgical equipment; ensures the pointer remains secure and readings remain stable
2. Corrosion Resistance Rating:
--- Standard Type: Basic corrosion resistance, withstands mild moisture and dust; suitable for non-corrosive environments
--- Corrosion-Resistant Type: Corrosion resistance meets WF2 standard; withstands acids, alkalis, salt spray, and moisture corrosion; suitable for chemical, coastal, and wastewater treatment environments
3. Sealing Rating: The meter cover and housing feature a double-layer rubber O-ring threaded seal; the entire series meets ≥IP65 standards; withstands a 5-minute water jet from a 25-mm nozzle at a distance of 5 meters without water ingress;
--- Waterproof Type (Custom): IP67, capable of short-term submersion; suitable for humid and outdoor rain-exposed environments
--- Explosion-Proof Type: IP65 + explosion-proof sealing, preventing explosive gas mixtures from entering the meter housing
4. Allowable Pressure:
--- Standard Type: ≤6.4 MPa; suitable for general-purpose pressure pipelines and equipment (e.g., HVAC, standard industrial pipelines)
--- High-pressure model (custom): ≤16 MPa, suitable for high-pressure reactors, high-pressure steam pipelines, and similar applications
5. Temperature drift: ≤0.1% FS/°C across the entire series; no significant drift during long-term use (≥1 year), ensuring stable measurement accuracy, eliminating the need for frequent calibration, and reducing maintenance costs.
5.4. Dedicated Parameters for Electrical Contact Models
--- Contact Rating: A core parameter determining control capability, suitable for various loads:
--- Standard Type: AC 220V/3A, DC 24V/5A; capable of driving small relays and alarm lights, suitable for standard alarm applications
--- High-Power Type (Custom): AC 220V/5A; capable of driving large contactors, suitable for equipment start/stop control applications
--- Switching Differential: Adjustable, default 0.5–5°C (divided by range), prevents frequent on/off cycling caused by temperature fluctuations; switching differential adjustment accuracy ≤0.1°C, suitable for various control requirements.
--- Insulation Resistance: At ambient temperature (25±10°C, RH ≤ 80%), ≥100 MΩ (500 VDC), ensuring electrical safety, eliminating leakage risks, and preventing short-circuit failures.
--- Operational Reliability: ≥10,000 continuous operations without failure; response time ≤ 1 s, ensuring precise temperature alarms and control, eliminating false triggers, and safeguarding production safety.
--- Contact Types: Options include upper/lower limits, dual upper limits, and dual lower limits. Customizable based on control requirements, with support for normally open/normally closed switching to accommodate various alarm logics.
5.5 Environmental Adaptation Parameters (Adapted to different field environments to ensure long-term stable operation)
1. Operating Temperature and Humidity:
--- Ambient Temperature: -20°C to +85°C (instrument operating temperature); Protective tube operating temperature varies by material (-80°C to +500°C)
--- Ambient humidity: 0–100% RH, no condensation (for condensation-prone environments, select a waterproof model and install moisture-proof measures)
2. Storage temperature and humidity:
--- Storage temperature: -40°C to +100°C; avoid long-term storage in extreme high- or low-temperature environments
--- Storage humidity: 0–80% RH; storage environment must be dry and well-ventilated; avoid dampness and dust accumulation
3. Protection rating: The entire series defaults to IP65 (waterproof and dustproof); IP67 (submersion-proof) and IP54 (basic dust and water resistance) are available upon request to meet different environmental protection requirements:
--- IP65: Suitable for outdoor, dusty, and slightly humid environments (e.g., workshops, outdoor pipelines)
--- IP67: Suitable for humid, rain-exposed, and short-term immersion environments (e.g., wastewater treatment, outdoor rain-exposed equipment)
4. Explosion-Proof Rating (Applicable to explosion-proof models):
--- Flameproof Type: Ex d IIC T6, suitable for flammable and explosive hazardous areas in the petroleum, chemical, and gas industries (Zone 0/ Zone 1/Zone 2)
--- Intrinsically Safe Type (Custom): Ex ia IIC T6, suitable for more demanding explosion-proof environments; can be used with safety barriers
5.6 Physical Parameters
1. Installation Methods: Categorized according to on-site installation requirements to accommodate various installation scenarios, ensuring convenient and secure installation:
--- Threaded Mounting: Most commonly used, suitable for standard pipes and equipment; select the corresponding thread size (e.g., M16×1.5) and screw into the mounting base
--- Flange Mounting: Suitable for high-pressure, large-diameter pipelines and storage tanks. Flange specifications: DN15/25/40/50, PN10/16/25. Provides secure installation and reliable sealing
--- Clamp Mounting (Custom): Suitable for confined spaces and quick-installation scenarios. Clamp specifications match the diameter of the protective tube, ensuring easy installation

--- Welded Mounting (Custom): Suitable for high-temperature and high-pressure applications; the protective tube is directly welded to equipment or piping, providing excellent sealing performance

2. Dimensions: Categorized by meter head type and dial diameter, featuring a compact design to accommodate various installation spaces:

--- Radial Type: Dial diameter φ60/100/150 mm; total length = insertion length + meter head thickness (25–40 mm)

--- Axial Type: Dial diameter φ60/100/150 mm, total length = insertion length + head thickness (80–120 mm)

--- Universal Type: Dial diameter φ100/150 mm, total length = insertion length + universal joint section (30–50 mm) + head thickness

--- Electrical contact type: Adds a wiring port to the corresponding dial head; slightly larger overall dimensions; dial head thickness increases by 10–15 mm

3. Weight: Classified by dial diameter and material; lightweight and easy to install; no additional installation load:

--- φ60 mm (standard material): ≈0.15–0.2 kg

--- φ100mm (standard material): ≈0.25–0.35 kg

--- φ150mm (stainless steel): ≈0.4–0.6 kg

--- Electrical contact type/Explosion-proof type: 0.1–0.2 kg heavier than the standard model of the same specification (due to additional contacts and explosion-proof structure)

4. Definitions of Pointer and Dial Markings:

--- Pointer: Red or black metal pointer with a clear tip for easy reading; contact-type models additionally feature upper and lower limit alarm pointers (yellow/green) with clear markings

--- Dial Markings: The dial is marked with the product model, accuracy class, temperature measurement range, manufacturer (Qidianjia), serial number, and protection rating; explosion-proof models additionally indicate the explosion-proof rating and explosion-proof symbol; electric contact models indicate parameters such as contact capacity and switching differential, with standardized, clear, and legible markings.

Additional Notes: All parameters can be customized to meet non-standard user requirements (e.g., special measurement ranges, protective tube materials, thread specifications, explosion-proof ratings, etc.). Customized product parameters are subject to the technical agreement confirmed by both parties. All product parameters undergo rigorous testing and comply with national industry standards and Qidianjia's corporate standards, ensuring stable and reliable product quality.

VI. Application-Based Selection Guide

This module serves as the core selection guidance section, addressing users' primary pain points of "not knowing how to choose" or "selecting the wrong model." Centered on "application compatibility," it clarifies key selection criteria, provides precise recommendations for various industry scenarios, highlights common pitfalls to avoid, and offers customized solution suggestions. Throughout, it aligns with the characteristics of Qidian's full range of bimetallic thermometers to help beginners quickly select the correct model while balancing practicality, reliability, and cost-effectiveness. It also draws on industry application experience to ensure that the selected solution meets actual on-site requirements.

6.1 Core Selection Criteria

The core of selection is "matching operating conditions." It is necessary to combine actual on-site requirements and verify the following six key criteria one by one to avoid selection errors caused by overlooking a single criterion. All criteria must align with the product specifications of Qidian bimetallic thermometers to ensure accurate and error-free selection, while balancing measurement accuracy and long-term operational stability.

1. Temperature Measurement Range

First, confirm the actual temperature range of the medium being measured. Select a model with a measurement range that covers the actual temperature and allows for a 10%–20% margin. This prevents insufficient accuracy caused by an excessively wide range and instrument damage caused by an excessively narrow range. Based on industry temperature measurement experience, Qidian's full product line covers -80°C to +500°C. Specific selection guidelines are as follows:

--- Low-temperature applications (-80°C to +100°C): For refrigeration and cold storage, select Qidian's low-temperature bimetallic thermometers to ensure precise measurements in cold environments without freezing or malfunction;

--- Standard applications (-40°C to +200°C): For HVAC and general machinery, choose standard-range models, which offer outstanding value and meet daily temperature measurement needs;

--- Medium-to-high temperature applications (+200°C to +500°C): For applications such as boilers and metallurgy, select the high-temperature model. The protective tube is made of high-temperature-resistant alloy to ensure long-term operation without damage and keep measurement errors within acceptable limits.

2. Dial Configuration (Adapting to Installation Space and Reading Requirements)

Select the appropriate dial face style based on installation space and viewing angle to ensure easy reading and an aesthetically pleasing installation, while adapting to the site layout to avoid reading difficulties or installation obstacles caused by an inappropriate dial face style:

-- - Radial Type: Suitable for limited axial space (e.g., dense piping, small equipment). Designed for side-view reading to save installation space. Qidian's radial type features a bent-tube design with an innovative structure, making it suitable for most confined installation scenarios;

--- Axial Type: Suitable for ample axial space (e.g., large storage tanks, reactors). Offers a vertical, intuitive reading angle without the need to turn sideways, making it suitable for conventional industrial and commercial HVAC applications;

--- Omnidirectional Type: For challenging installation locations (e.g., inside equipment, dense pipe clusters). The meter face can rotate 360° continuously, allowing flexible adjustment of the reading angle to completely eliminate blind spots and adapt to complex installation environments;

--- Electrical Contact Type: Suitable for applications requiring temperature alarms and automatic control (e.g., boilers, incubators). This model adds electrical contact control functionality to the standard dial, supporting upper and lower limit alarms, and is suitable for unattended scenarios.

3. Connection Threads

Confirm the thread specifications of the on-site mounting base. Standard threads are preferred; custom solutions are available for non-standard scenarios to prevent installation failures or seal failures caused by thread mismatches. Thread precision complies with the GB/T 196 standard, ensuring secure installation and reliable sealing:

--- Standard Threads: M16×1.5, M20×1.5, M27×2 (most commonly used, compatible with most industrial pipes and equipment mounting bases);

--- Imperial Threads: G1/2", G3/4", G1", suitable for export and special installation requirements;

-- - Special Requirements: For on-site mounting bases with non-standard threads, custom specifications can be provided to ensure a snug fit, eliminating risks of loosening or leakage.

4. Protection Tube Length and Material

The length of the protection tube determines measurement accuracy, while the material determines temperature resistance and corrosion resistance. Selection must be based on the dimensions of the pipeline/equipment and the characteristics of the medium. Protection tubes are welded using fully automated argon gas shielding, ensuring strong welds and preventing measurement errors or instrument damage caused by protection tube issues:

--- Protection Tube Length: The insertion length must be ≥8–10 times the protection tube diameter and no less than half the pipe's inner diameter. Standard options include 50 mm, 100 mm, 150 mm, and 200 mm; for special applications, custom lengths from 50 mm to 2000 mm are available to ensure the sensing element is in full contact with the measured medium and to prevent thermal conduction errors;

--- Protection Tube Material:

--- Standard media (non-corrosive, ≤400°C): 1Cr18Ni9Ti stainless steel, suitable for general industrial and HVAC applications;

--- High-temperature media (≤500°C): Inconel 600 alloy, suitable for high-temperature environments such as boilers and kilns, with excellent high-temperature resistance;

--- Corrosive media (acids, alkalis, salt spray): 316L stainless steel, Hastelloy (custom), suitable for chemical processing and wastewater treatment applications, with corrosion resistance several times greater than that of standard stainless steel;

--- Food and pharmaceutical applications: 316L stainless steel (food-grade), with no sanitary dead zones, compliant with GMP certification requirements.

5. Shock-Resistant/Corrosion-Resistant/Explosion-Proof Requirements
Select the appropriate model based on whether the on-site environment involves vibration, corrosion, or flammable/explosive risks to prevent instrument damage, safety hazards, or measurement inaccuracies caused by improper environmental adaptation. Refer to industry environmental adaptation standards:
--- High-vibration environments (pumps, compressors, metallurgical equipment): Select the shock-resistant model, which features an internal cushioning structure with a vibration resistance rating of ≤5g, ensuring the pointer remains secure and readings are stable in environments with vibration frequencies ≤10Hz;
--- Corrosive environments (chemical plants, coastal areas, wastewater treatment): Select the corrosion-resistant model with a corrosion resistance rating of WF2. The protective tubing and case are made of corrosion-resistant materials, capable of withstanding acid, alkali, and salt spray corrosion, thereby extending service life;
--- Flammable and explosive environments (oil, gas, and chemical explosion-proof zones): Select explosion-proof models, including flameproof type Ex d IIC T6 (standard) and intrinsically safe type Ex ia IIC T6 (custom), compliant with GB3836-83 standards to eliminate safety hazards;
--- Humid/outdoor environments: Select IP67 protection rating (custom), which is waterproof and dustproof and can withstand brief immersion, preventing moisture from entering the meter and causing component damage.
6. Installation Space
Select a model with appropriate dimensions based on the available space at the installation site to avoid installation failures due to insufficient space or interference with other equipment after installation, while also ensuring ease of installation:
--- Confined Spaces (Dense Piping, Small Equipment): Select a φ60mm dial with a radial or universal mounting configuration for a compact design that minimizes space usage;
--- Standard Spaces (Standard Piping, Equipment): Select a φ100mm dial with an axial or radial mounting configuration to balance ease of reading with aesthetic installation;
--- Long-Distance Reading (Large Equipment, Storage Tanks): Select a 150mm dial for clear readings, suitable for observation distances ≤3m.
6.2 Industry Application Selection Table
Based on the operational characteristics of various industries, this table recommends suitable Qidian bimetallic thermometer models and specifies key parameters. Users can directly select models based on their specific industry scenarios without having to verify parameters one by one. Additionally, reference industry application cases to optimize selection plans, ensuring suitability and practicality.
1. HVAC Industry (Residential Heating, District Heating Pipelines): Core operating conditions include standard temperatures (0°C–100°C), no corrosion, and no strong vibrations. On-site visual readings are required, installation spaces vary, and some scenarios involve humid environments; Recommended: Standard radial/axial models. Key parameters: Measurement range 0°C–100°C, accuracy class 1.5, dial diameter 100 mm, thread M20×1.5, protection tube 1Cr18Ni9Ti (10 mm diameter), insertion length 100–150 mm, protection rating IP65.
2. Refrigeration Industry (Cold Storage, Refrigeration Piping): Core operating conditions include low temperatures (-40°C to +50°C), non-corrosive environments, and slight vibration in some scenarios; requires low-temperature compatibility to prevent instrument freezing; Recommended: Low-temperature radial/universal types. Key parameters: Temperature range -40°C to +50°C, accuracy class 1.5, dial diameter φ60/100mm, thread M16×1.5, protective tube 1Cr18Ni9Ti (φ8 mm), insertion length 100 mm, protection rating IP65.
3. Food Industry (Food Processing, Storage Tanks): Core operating conditions include standard temperatures (0°C to 150°C), non-corrosive environments, and sanitary requirements; food-grade materials are required to eliminate sanitary dead zones and comply with GMP certification; Recommended: Standard axial type (food-grade). Key parameters: Measurement range 0°C–150°C, accuracy Class 1.0, dial diameter 100 mm, thread M20×1.5, protective tube 316L stainless steel (10 mm diameter), insertion length 150 mm, protection rating IP65, case with electropolished finish.
4. Pharmaceutical Industry (Reactors, Pharmaceutical Piping): Core operating conditions include moderate temperatures (0°C to 200°C), non-corrosive environments, and high-precision requirements. Food-grade materials are required. Some applications involve slight vibration, necessitating precise temperature measurement to ensure product quality; Recommended: High-precision axial/universal type (food-grade). Key parameters: Temperature range 0°C–200°C, accuracy Class 1.0, dial diameter φ100/150 mm, M27×2 thread, 316L stainless steel protective tube (φ10 mm), insertion length 200 mm, IP65 protection rating, with customizable sanitary-grade chuck connection.
5. Mechanical Industry (Motors, Equipment Bearings): Core operating conditions include standard temperatures (0°C to 150°C), slight vibration, and limited installation space; requires shock resistance, compact size, and easy close-range reading; Recommended: Shock-resistant radial or universal models. Key parameters: Temperature range 0°C–150°C, accuracy class 1.5, dial diameter 60/100 mm, thread M16×1.5, protective tube 1Cr18Ni9Ti (φ8 mm), insertion length 50–100 mm, vibration resistance ≤5g, protection rating IP65.
6. Metallurgical Industry (blast furnaces, steel rolling equipment): Core operating conditions include high temperatures (200°C–500°C), strong vibrations, and no significant corrosion. The thermometers must be heat-resistant and shock-resistant to ensure stable operation in harsh environments; Recommended: High-temperature, vibration-resistant axial/radial types. Key parameters: Temperature measurement range 0°C–500°C, accuracy Class 1.0, dial diameter φ150 mm, thread M27×2, protective tube made of Inconel 600 alloy (φ12 mm), insertion length 300 mm, vibration resistance rating ≤5g, protection rating IP65.
7. Chemical Industry (chemical pipelines, reactors): Core operating conditions include medium to high temperatures (0°C to 300°C) and corrosive media (acids, alkalis, salt spray); some scenarios require explosion-proof capabilities. The thermometers must be corrosion-resistant and explosion-proof to prevent media erosion; Recommended: Corrosion-resistant or explosion-proof/corrosion-resistant models. Key parameters: Temperature measurement range 0°C–300°C, accuracy Class 1.0, dial diameter φ100/150 mm, thread M20×1.5, protection tube 316L/Hastelloy (φ10 mm), insertion length 200–300 mm, corrosion resistance grade WF2, explosion-proof rating Ex d IIC T6.
8. Boiler Industry (Boiler Piping, Steam Piping): Core operating conditions include high temperature and high pressure (200°C–400°C), severe vibration, and steam media. The instrument must be resistant to high temperatures, high pressure, and vibration to ensure measurement accuracy and guarantee safe boiler operation. Recommended: High-temperature, vibration-resistant axial type (high-pressure model). Key parameters: Temperature measurement range 0°C–400°C, accuracy class 1.0, dial diameter φ150 mm, thread M27×2/flange DN25, protection tube made of Inconel 600 alloy (φ12 mm), insertion length 300–500 mm, allowable pressure ≤16 MPa, vibration resistance rating ≤5 g, protection rating IP65.
9. Environmental Protection Industry (Waste Incineration, Wastewater Treatment): Core operating conditions include medium to high temperatures (0°C to 300°C), strong corrosion, and high dust levels. The instrument must be corrosion-resistant and dust-proof, suitable for harsh environments, and capable of long-term operation without damage; Recommended: Corrosion-resistant radial/universal types. Key parameters: Temperature measurement range 0°C–300°C, accuracy class 1.5, dial diameter φ100mm, thread M20×1.5, protection tube made of Hastelloy (φ10mm), insertion length 200mm, corrosion resistance class WF2, protection rating IP65.
6.3 Common Selection Pitfalls
Based on actual on-site selection cases, we summarize five major high-frequency selection pitfalls, clarify the risks associated with these errors and the correct approaches, and help users avoid selection mistakes. This prevents instrument damage, measurement inaccuracies, safety hazards, or cost wastage caused by improper selection, while also optimizing solutions to avoid pitfalls by referencing industry-specific selection risk warnings.
Pitfall 1: Incorrect selection of meter head orientation, resulting in inconvenient reading or installation failure
Common errors: Selecting an axial type in dense piping or confined spaces, resulting in the meter head being unable to install or the reading angle being obstructed; selecting a radial type for large equipment or long-distance scenarios, resulting in difficult reading. According to industry research, such selection errors account for over 30% of cases, severely impacting the on-site user experience.

Correct Approach: Select based on installation space and reading angle—choose radial or universal models for confined spaces or side-view reading; choose axial models for spaces with sufficient axial clearance and front-view reading; choose universal models for awkward installation locations, as they allow 360° adjustment of the reading angle, completely eliminating blind spots.

Misconception 2: Insulation tube length is insufficient or excessive, affecting temperature measurement accuracy or installation

Common errors: Insufficient insulation tube length prevents the temperature-sensing element from fully contacting the measured medium, resulting in low readings and excessive errors; excessive insulation tube length exceeds the installation space, may cause the tube to break during vibration, and simultaneously increases installation difficulty and cost.

Correct Approach: The insertion length of the protection tube should be ≥8–10 times the tube's diameter and no less than half the pipe's inner diameter. Select standard lengths (50–500 mm) based on pipe/equipment dimensions, or custom lengths (50–2000 mm) for special scenarios, ensuring the sensing element makes full contact with the medium while fitting the installation space to avoid being too long or too short.

Misconception 3: Material incompatibility with the medium, leading to instrument corrosion and damage

Common Mistakes: Using standard 1Cr18Ni9Ti stainless steel protection tubes for corrosive chemical media (such as acids, alkalis, or chloride-containing media), resulting in tube corrosion, perforation, and instrument failure; using standard materials in high-temperature environments (>400°C), leading to tube deformation and sensor burnout. A case study from a coastal chemical plant shows that material mismatch can reduce the average instrument lifespan from 3 years to 8 months.

Correct Approach: Select the protective tube material based on the characteristics of the medium—choose 1Cr18Ni9Ti for non-corrosive, standard-temperature applications; select Inconel 600 alloy for high-temperature ($>$ 400°C) applications; choose 316L or Hastelloy for corrosive media; and select 316L food-grade material for food and pharmaceutical applications. Ensure material compatibility with the medium to extend the instrument's service life.

Misconception 4: Using non-vibration-resistant models in vibrating environments, leading to instrument failure

Common mistake: Using standard bimetallic thermometers in high-vibration environments such as pump housings, compressors, and metallurgical equipment, resulting in loose pointers, damage to mechanical transmission components, and faults such as erratic readings or loss of indication, which affect production monitoring.

Correct Practice: In high-vibration environments (where vibration resistance requirements exceed 2g), shock-resistant models must be selected. These feature internal cushioning structures with a vibration resistance rating of ≤5g, enabling stable operation in environments with vibration frequencies ≤10 Hz. This prevents instrument failure caused by vibration and ensures stable readings.

Misconception 5: Selecting standard models for explosion-proof environments poses safety hazards

Common mistake: In oil, gas, and chemical explosion-proof zones (Zone 0/Zone 1/Zone 2), selecting standard bimetallic thermometers that have not undergone explosion-proof treatment may allow explosive gas mixtures to enter the instrument housing, leading to safety incidents and violating explosion-proof safety regulations.

Correct Approach: In explosion-proof environments, Qidian's explosion-proof bimetallic thermometers must be selected—flameproof type Ex d IIC T6 (for standard explosion-proof scenarios) or intrinsically safe type Ex ia IIC T6 (for severe explosion-proof scenarios). These must be paired with explosion-proof gland heads and seals to ensure compliance with GB3836-83 standards and eliminate safety hazards.

6.4 Customization Recommendations

For non-standard on-site conditions, Qidian offers comprehensive customization services—from parameters and structure to functionality—to precisely meet specific requirements and resolve issues where standard models are unsuitable. We have established rapid prototyping and flexible production mechanisms to ensure prompt delivery of customized products. Drawing on our industry experience in customization services, we provide the following recommendations:

1. Customization of Non-Standard Temperature Measurement Ranges

Applicable Scenarios: When the temperature of the measured medium exceeds the standard range (e.g., cryogenic environments below -80°C or high-temperature environments above 500°C), or when narrow-range, high-precision measurement is required (e.g., 0°C to 50°C with Class 0.5 accuracy).

Customization Recommendations: Provide the actual temperature measurement range. Qidian will adjust the material composition of the bimetallic strip and the torsion of the spiral coil to optimize the performance of the temperature-sensing element. This ensures optimal linearity near common operating points, avoids issues such as "excessively wide dial ranges and inaccurate readings at common points," and meets special temperature measurement requirements.

2. Custom Threads/Flanges

Applicable Scenarios: On-site mounting bases with non-standard threads (e.g., American NPT tapered pipe threads) or special-specification flanges (e.g., ANSI/JIS standard flanges), or situations requiring custom loose-fitting flanges or integral flanges where standard models are incompatible.

Customization Recommendations: Provide thread/ flange specifications, dimensional drawings, or samples of existing components. Qidian can customize corresponding connection parts to ensure a perfect fit, eliminate the risk of leakage, and accommodate mixed environments with both new and old equipment.

3. Custom Extended Protection Tubes

Applicable Scenarios: Large storage tanks, deep reactors, and equipment with thick insulation layers (e.g., power plants) require extended protection tubes to ensure the temperature sensor makes contact with the medium, as standard tube lengths cannot meet these requirements.

Customization Recommendations: Provide installation depth and equipment dimensions. Qidian can customize protection tubes in any length from 50 mm to 2000 mm. We also optimize the material and structure of the protection tubes to increase strength and prevent vibration-induced fractures after extension. For applications with thick insulation layers, we can customize long-neck protection tubes where the sensor head extends above the insulation layer, facilitating observation and saving energy.

4. Customization of Special Anti-Corrosion Coatings

Applicable Scenarios: Highly corrosive environments (e.g., high-concentration acids and alkalis, chloride-containing media, coastal salt fog environments). Conventional anti-corrosion materials (such as 316L) cannot meet long-term usage requirements, necessitating further enhancement of corrosion resistance.

Customization Recommendations: Select special anti-corrosion coatings (such as PTFE lining or Hastelloy spraying), or opt for a fully Hastelloy protective tube. These solutions offer corrosion resistance several times greater than standard materials, making them suitable for highly corrosive environments such as chemical plants, coastal areas, and wastewater treatment facilities, thereby extending the instrument's service life.

5. Integrated Transmitter Solution

Applicable Scenarios: Applications requiring both on-site temperature indication and transmission of temperature signals to PLC/DCS control systems for remote monitoring. Conventional bimetallic thermometers cannot meet signal transmission requirements, making this solution suitable for digital factory retrofit projects.

Customization Recommendation: Choose Qidian's integrated transmitter solution, which incorporates a transmitter module into a bimetallic thermometer to output standard 4-20mA/0-5V/RS485 signals. This design combines on-site indication with remote transmission, eliminating the need for an additional transmitter and simplifying the installation process. It also supports parameter calibration and signal debugging, meeting industrial automation control requirements.

Additional Notes: For customized products, please consult with Qidian's technical team in advance and provide detailed operating parameters (temperature measurement range, medium characteristics, mounting dimensions, functional requirements, etc.). The technical team will prepare a customized solution and drawings; production will be scheduled upon confirmation. Customized products are covered by Qidian's warranty service. A parameter test report will be provided upon delivery to ensure the product meets the customized requirements, and 24-hour technical support is available to resolve any issues during installation and commissioning.

VII. Installation and Commissioning Guidelines

7.1. Pre-installation Preparation

A comprehensive inspection and preparation must be completed prior to installation to prevent installation failures caused by missing parts, unsuitable environments, insufficient tools, or improper operation. This ensures the smooth progress of the installation work and safeguards the safety of the installation personnel.

(1) Component Verification

Compare the product against the shipping list to verify the completeness and compatibility of each component, ensuring there are no missing or damaged parts and that all models match. Keep a record after verification to avoid interruptions during installation due to component issues:

--- Core Components: Qidian bimetallic thermometer body (dial, protective tube), mounting fittings (threaded/flanged), sealing gaskets (rubber/PTFE), mounting screws;

--- Additional Checks for Electric Contact Type: Terminal blocks, explosion-proof cable glands (for explosion-proof models), connection cables (high-temperature resistant/corrosion-resistant), contact instruction manual;

--- Key Verification Points: Ensure the protective tube is free of bends, damage, or corrosion; the dial glass has no cracks; the pointer is secure; threads/flanges show no deformation or stripping; sealing gaskets show no signs of aging or damage; and that component models match the instrument body and on-site installation requirements. Verify that critical dimensions, such as protective tube diameter and connection threads, are compatible.

(2) Environmental Inspection

Based on the instrument model and on-site conditions, verify that the installation environment meets requirements to prevent future failures caused by unsuitable conditions. Additionally, ensure sufficient installation space for ease of operation:

--- Standard Conditions: The installation location must be free of significant vibration and leaks of corrosive gases or liquids. The installation space must accommodate the instrument's dimensions, avoid obstructing the dial's viewing angle, and be positioned away from valves, elbows, and pipe dead ends to ensure accurate temperature measurement;

--- High-Temperature Scenarios: The installation location must be free of high-temperature radiation and open flames, with no flammable or fragile components nearby. Allow sufficient space for heat dissipation to prevent high-temperature environments from affecting the instrument's service life. Additionally, verify the high-temperature resistance of the installation site to ensure it matches the temperature rating of the instrument's protective tube;

--- High-pressure scenarios: The pressure in the installation piping/equipment must be stable with no risk of leakage. Installation fittings and sealing components must be suitable for high-pressure conditions and comply with the installation requirements for Qidian high-pressure instruments. Installation is strictly prohibited while the system is still under pressure;

--- Explosion-proof environments: The installation area must be free of explosive gas mixtures and dust accumulation, with adequate ventilation. The installation location must comply with explosion-proof zone classification requirements. Avoid proximity to ignition sources, power switches, and other components that may generate sparks. Ensure the installation environment for explosion-proof instruments complies with the relevant standards of GB3836-83;

--- Damp/Outdoor Environments: The installation site must be free of standing water and condensation. Implement rain and moisture protection measures to ensure the instrument's protection rating is adequate (IP65 or higher) and prevent moisture from entering the instrument housing and causing component damage.

(3) Tool List

Based on the installation method (threaded/flanged) and instrument model, prepare all necessary tools in advance. Ensure tools are in good condition and of the correct specifications to prevent installation quality issues caused by missing or inappropriate tools:

--- Basic Tools: Adjustable wrench, socket wrench (matching thread/flange specifications), screwdrivers (Phillips/flathead), tape measure, spirit level (for adjusting installation orientation), sandpaper (for removing thread oxidation);

applications), wire crimping pliers (for electrical contact wiring);

--- Safety Tools: Heat-resistant gloves, insulated gloves (for electrical contacts/high-voltage applications), explosion-proof wrenches (for explosion-proof environments), safety goggles (for high-temperature/high-voltage applications);

--- Commissioning tools: Standard thermometer (for calibration), multimeter (for electrical connection testing), megohmmeter (for insulation resistance testing, electrical connection type), temperature-controlled bath (for precise calibration, optional).

(4) Safety Precautions

Strictly adhere to safety operating procedures based on different operating conditions to ensure the personal safety of construction personnel and the safety of equipment, and prevent safety accidents:

--- High-temperature environments: Before construction, confirm that the medium being measured has cooled to a safe temperature (≤50°C). Wear high-temperature-resistant gloves to avoid burns. It is strictly prohibited to disassemble or install instruments while the medium has not cooled down;

--- High-pressure scenarios: Before installation, valves must be closed and pressure relieved; installation may only proceed after confirming that the pressure in the pipeline/equipment is 0. Opening valves during installation is strictly prohibited to prevent injury from high-pressure medium leaks. A pressure test must be conducted after installation to ensure there are no leaks;

--- Explosion-proof environments: Smoking and the use of open flames are strictly prohibited in the installation area. All tools must be explosion-proof to prevent sparks. Strictly adhere to explosion-proof sealing requirements during wiring; live wiring is strictly prohibited. Ensure the explosion-proof structure remains intact and prevent explosive gas mixtures from entering the meter housing;

--- General Safety: Installation personnel must wear personal protective equipment. Safety harnesses must be worn during high-altitude installation. Avoid collisions or dropping instruments during installation. Unauthorized operations are strictly prohibited. Maintain communication with dispatch to report installation progress and proceed only after receiving approval.

7.2 Standard Installation Procedures

Install according to the following procedures, ensuring secure mounting, reliable sealing, and accurate temperature measurement. All steps must be performed in accordance with the structural characteristics of the Qidian bimetallic thermometer to prevent instrument damage or measurement errors caused by improper operation. Take care to protect the instrument head and protective tube during installation.

Step 1: Thread Sealing (Threaded Installation Models)

For threaded-installation instruments, properly seal the threads to prevent medium leakage while ensuring the seal does not interfere with secure instrument mounting:

--- Use sandpaper to clean the instrument threads and the threads of the on-site mounting base, removing oxidation, rust, and debris to ensure the threads are smooth and free of snags, preventing stripped threads;

--- Wrap PTFE tape evenly around the instrument threads (in the same direction as the tightening direction), applying 8–12 layers. For special media (e.g., corrosive, high-temperature, or high-pressure), apply a small amount of sealant over the PTFE tape to enhance the seal;

--- Flange-mounted models: Place the sealing gasket (rubber/PTFE) into the flange groove, ensuring it lies flat and is not misaligned to prevent damage. The flange mating surfaces must be thoroughly cleaned of debris and oil to ensure a tight seal.

Step 2: Adjusting the Installation Orientation

Adjust the meter's installation orientation based on its type to ensure easy reading and a clear viewing angle, while accommodating the on-site installation space to avoid obstruction or collision:

--- Axial Type: Ensure the meter head aligns in a straight line with the protective tube. After installation, the front of the dial should face the reading angle so that the reading can be taken without turning sideways, while also preventing the meter head from colliding with other equipment;

--- Universal Type: First secure the instrument in place, then rotate the meter head to the optimal reading angle (360° stepless rotation). After adjustment, ensure the meter head is stable with no looseness. The connection uses a stainless steel bellows, allowing flexible adaptation to complex installation angles;

--- Electrical contact type: When adjusting the meter head's orientation, allow sufficient space for wiring to prevent pulling on the wires during connection. Also, ensure the junction box is positioned for easy wiring and future maintenance.

Step 3: Torque Control

Use a suitable wrench to evenly tighten the instrument, controlling the tightening torque to prevent leaks caused by insufficient tightness or damage to the instrument and stripped threads caused by excessive tightness. Different thread specifications require different tightening torques; refer to the following details:

--- M16×1.5 thread: Tightening torque is 15–20 N·m; avoid excessive force to prevent thread damage;

--- M20×1.5 and M27×2 threads: Tightening torque is 25–30 N·m to ensure a secure, wobble-free connection;

--- Flange-mounted models: Tighten the flange mounting screws evenly using a cross-pattern method to ensure uniform force distribution across the flange face, prevent skewing, and avoid seal failure caused by excessive localized stress;

--- Note: When tightening, hold the instrument connector; never grip the dial or the protective tube to tighten, to prevent damage to internal mechanical components or bending/deformation of the protective tube. Do not rotate the dial during the installation of the bimetallic thermometer.

Step 4: Control of Protective Tube Insertion Depth

The insertion depth of the protective tube directly affects measurement accuracy. Based on the dimensions of the pipeline/equipment and the characteristics of the medium, ensure that the insertion depth meets the requirements so that the sensing element is in full contact with the medium being measured. Specific requirements are as follows:

--- Conventional Pipelines: The insertion depth of the protection tube must be ≥8–10 times the tube's diameter and no less than half the pipe's inner diameter. For example, for a 10 mm diameter protection tube, the insertion depth must be no less than 80–100 mm to ensure the sensing element is in full contact with the medium;

--- High-temperature, high-pressure, and high-velocity fluid applications (e.g., steam pipelines): A shallow insertion method may be used, with a protective tube insertion depth of no less than 75 mm, or a thermal sleeve-type protective tube may be selected, with a standard insertion depth of 100 mm, to reduce the protective tube's resistance to the fluid and prevent tube fracture;

--- Large storage tanks and flue ducts: Adjust the insertion depth of the protective tube according to the equipment dimensions. For flue duct temperature measurement, the insertion depth must be no less than 1 m. For storage tank temperature measurement, the insertion depth must ensure contact with the core area of the medium to avoid measurement errors caused by insufficient insertion depth;

--- Extended protection tubes (□1m): Install as vertically as possible, or add support brackets to enhance stability and prevent breakage caused by vibration, while ensuring full contact between the protection tube and the measured medium.

Step 5: Sealing (Final Inspection)

After installation, perform a thorough seal inspection and make any necessary adjustments to prevent medium leakage or moisture ingress, ensuring long-term stable operation of the instrument:

--- Threaded/flanged connections: Check for medium leakage at sealing points. Apply soapy water to the seal and observe for bubbles. If leakage is detected, retighten the connection or replace the sealing gasket and PTFE tape;

--- Dial Sealing: Inspect the sealing of the connection between the dial glass and the case, as well as the junction box (for electric contact types). Ensure the sealing gasket is intact and the junction box cover is tightly secured to prevent moisture and dust from entering the dial. The connection between the protective tube and the dial must be securely sealed with no looseness;

--- Explosion-proof instruments: Verify that the explosion-proof gland is securely installed, the cable seal is intact, and the explosion-proof surfaces are free of damage and debris. Ensure that explosion-proof performance meets standards and complies with explosion-proof safety regulations;

--- Additional Measures: In outdoor or humid environments, install a waterproof sleeve on the exterior of the junction box to enhance moisture protection and prevent rainwater corrosion. In high-temperature environments, install thermal insulation pads at the connection points between the protective conduit and mounting fittings to reduce heat transfer to the meter head.

7.3 Wiring Diagram (For Electrical Contact Type Only; Standard Wiring)

Wiring for Qidian electrical contact-type bimetallic thermometers must strictly adhere to the following specifications: distinguish terminal functions, clearly identify positive and negative terminals, and ensure proper grounding. This prevents wiring errors that could lead to electrical contact failure, short circuits, or safety hazards. Ensure the power is disconnected before wiring, and perform insulation testing after completion. The operating principle of the electrical contact is as follows: When the temperature reaches the preset value, the moving contact on the pointer makes contact with the stationary contact at the set point, closing the circuit and driving the external device to operate.

(1) Distinguishing Power Supply/Contact Output Terminals

The terminals inside the instrument's terminal box are clearly labeled by function; mixing connections is strictly prohibited. The terminal labels and functions are as follows; refer to the instrument wiring diagram (included with the product):

--- Power Terminals: Labeled "L" (Live) and "N" (Neutral). These are used only for contact models requiring an external power supply (some models do not require an external power supply and operate solely on contact signal output). The input voltage is AC 220V (standard) or DC 24V (custom). Ensure the voltage matches the terminal labeling;

--- Contact Output Terminals: Labeled "Upper Limit," "Lower Limit," and "Common" (COM). "Upper Limit" corresponds to the high-temperature alarm terminal, "Lower Limit" corresponds to the low-temperature alarm terminal, and "Common" is the shared terminal;

--- Ground terminal: Labeled "PE" (ground symbol). Available only on explosion-proof and high-voltage models, used for grounding protection to prevent electrical leakage and static buildup, ensuring electrical safety.

(2) Polarity Markings and Wiring Specifications

--- Polarity Distinction: Connect the "L" terminal to the live wire (red wire) and the "N" terminal to the neutral wire (blue wire). Reversing the connections is strictly prohibited, as it may damage the electrical contact module and prevent the instrument from functioning properly;

--- Contact Output Wiring: Connect the "Common" (COM) terminal to the common end of the control wires; connect the "Upper Limit" terminal to the high-temperature alarm control wire; connect the "Lower Limit" terminal to the low-temperature alarm control wire. Use control wires of the appropriate specifications (copper core, wire gauge 0.75–1.5 mm²), to prevent overheating caused by wires that are too thin;

--- Wiring Requirements: Strip 5–8 mm of insulation from the wires. After inserting them into the terminals, tighten the securing screws to ensure good contact with no looseness or loose connections, and to prevent short circuits caused by exposed wires. Use wire lugs for multi-strand wires to prevent the strands from coming loose;

--- Cable routing: Control cables must be routed away from high-voltage cables, variable frequency drives, and other sources of strong electromagnetic interference to prevent false triggering of contact signals. Cables must be routed in a standardized manner to avoid pulling or crushing. Outdoor connections must be properly waterproofed to prevent rainwater from corroding the wires.

(3) Explosion-proof Grounding Requirements (Applicable to explosion-proof models)

When wiring explosion-proof electric contact bimetallic thermometers, proper grounding must be ensured to maintain explosion-proof performance and eliminate safety hazards, strictly adhering to the relevant standards of GB3836-83:

--- The "PE" grounding terminal must be connected to the on-site grounding busbar, with a grounding resistance ≤4Ω, to ensure reliable grounding and prevent static electricity buildup or leakage currents from igniting explosive gas mixtures;

--- Use yellow-green copper-core wire with a cross-sectional area of no less than 1.5 mm² for the grounding conductor. Ensure the grounding connection is secure, with no looseness or loose connections, to prevent grounding failure;

--- After all wires in the junction box are connected, tighten the junction box cover to ensure explosion-proof sealing. The explosion-proof surfaces must be clean and undamaged. Do not leave debris or wire ends inside the junction box to prevent sparks;

--- It is strictly prohibited to share the grounding terminal with the power supply neutral wire to prevent poor grounding. Ensure the grounding system complies with on-site explosion-proof safety regulations and periodically inspect the reliability of the grounding.

7.4 Power-On/Commissioning Procedure (Precise Calibration to Ensure Normal Instrument Operation)

After installation and wiring are complete, follow the procedure below for power-up and commissioning to troubleshoot instrument faults, calibrate measurement accuracy, and ensure reliable operation of electrical contacts. Strictly adhere to operating procedures during commissioning to prevent instrument damage. Refer to the JJG226 Verification Regulations for Bimetallic Thermometers for commissioning standards.

Step 1: Zero Point Check (Calibration at Ambient Temperature)

In a room-temperature environment (25±5°C), check whether the instrument's zero point is accurate, ensuring there is no mechanical binding and that the pointer indicates normally:

--- Place the instrument in a room-temperature environment and let it stand for 10–15 minutes. Once the pointer has stabilized, observe whether it points to the room-temperature mark (error ≤ ±1.0°C/1.5°C, depending on the accuracy class);

--- If the pointer deviates from zero, fine-tune it using the internal adjustment screw (available on some models). Turn the screw slowly to avoid damaging the pointer due to excessive force, and observe the pointer's stability again after adjustment;

--- When performing a 0°C calibration, insert the instrument into a freezing point bath containing a mixture of ice and water. Read the value once the reading has stabilized to ensure the pointer indicates a value close to 0°C, with the error within the permissible range.

Step 2: Reading Verification (Accuracy Calibration)

Use a standard thermometer for comparative verification to ensure the instrument's measurement accuracy meets requirements. Verification points should be evenly distributed to avoid excessive measurement errors:

--- Simultaneously insert the Qidian bimetallic thermometer and a standard thermometer (with accuracy one grade higher than the instrument's) into a temperature-controlled bath or the medium being measured. Ensure that the temperature-sensing parts of both instruments are in full contact with the medium. Perform the verification after the temperature of the bath has stabilized;

--- Selection of calibration points: Select at least 4 evenly distributed calibration points (including the upper limit, lower limit, and midpoint of the measurement range). For in-service instruments, select no fewer than 3 calibration points. Perform the calibration point by point along both the forward and reverse travel ranges; for the upper and lower limits, check only one travel range;

--- Accuracy Assessment: Compare the readings of both instruments; the error must comply with the instrument's accuracy class (Class 1.0 ≤ ±1.0% FS, Class 1.5 ≤ ±1.5% FS). If the error exceeds this range, fine-tune the instrument using its internal calibration mechanism, or contact Qidian's after-sales service for professional calibration;

--- Reading Requirements: When taking readings, the line of sight should be perpendicular to the dial. When using a magnifying glass, the line of sight should pass through the center of the magnifying glass to avoid reading errors caused by viewing angle deviations.

Step 3: Setting the Electrical Contact Action (For Electrical Contact Models Only)

Set the upper and lower limit temperatures for the electrical contacts according to on-site control requirements to ensure reliable operation and accurate alarms, and to prevent false trips. The electrical contacts support various configurations, including single upper limit, single lower limit, and dual upper/lower limits:

--- Turn the upper and lower limit setting knobs (or adjustment screws) on the instrument dial to adjust the setting pointer to the desired temperature value. When setting, refer to on-site process requirements and allow for a reasonable temperature margin to avoid frequent alarms;

--- Operation Test: Use a multimeter to check the contact closure and opening status. When the medium temperature reaches the set value, the electrical contacts should reliably close; when the temperature is below (or above) the set value, the contacts should reliably open. Perform continuous testing 3–5 times to ensure smooth operation without sticking or false triggering. The contacts should operate continuously for ≥10,000 cycles without failure;

--- Switching Differential Adjustment: The default switching differential is 0.5–5°C (determined by the measurement range). It can be fine-tuned according to on-site requirements to prevent frequent on/off cycling of the contacts caused by temperature fluctuations. The adjustment accuracy of the switching differential is ≤0.1°C.

Step 4: Error Calibration Method

If the error exceeds the permissible range during indication verification, perform calibration using the following method. After calibration, re-verify to ensure accuracy meets standards. Follow standard operating procedures during calibration to avoid damaging internal instrument components:

--- Mechanical Calibration (General Error): Open the meter housing (for non-explosion-proof models; unauthorized disassembly or repair of explosion-proof models is strictly prohibited). Slowly adjust the internal calibration screw while observing the deviation between the pointer reading and the standard thermometer. Gradually adjust until the error falls within the permissible range. After calibration, tighten the housing screws and ensure proper sealing;

--- Electrical Contact Calibration (Contact Deviation): If the operating temperature of the electrical contacts deviates significantly from the set value, adjust the setting knob while using a multimeter to monitor the contact activation timing until the operating temperature matches the set value. Ensure the contact response time is ≤1s;

--- Professional Calibration: If the error is excessive (e.g., exceeding twice the accuracy class) or the instrument fails to meet standards after mechanical calibration, contact Qidian After-Sales Service. Professional technicians will calibrate the instrument using specialized equipment or replace internal components. Under no circumstances should explosion-proof or high-temperature instruments be disassembled or repaired by unauthorized personnel.

7.5 Installation Prohibitions (Strictly Avoid to Eliminate Potential Faults)

The following operations are strictly prohibited, as they may result in instrument damage, measurement errors, safety hazards, or even a shortened service life. All prohibitions are formulated based on the structural characteristics of Qidian bimetallic thermometers and lessons learned from industry practice, and must be strictly adhered to:

1. Do not strike the dial

The interior of the dial contains a precision mechanical transmission mechanism (bimetallic strip, gears, and pointer). Striking the dial may cause damage to internal components, loosening of the pointer, mechanical jamming, or even failure to indicate temperature. During installation, commissioning, and maintenance, avoid subjecting the dial to impacts or blows, and do not use the instrument as a tool such as a wrench.

2. Do not operate beyond temperature or pressure limits

The instrument's temperature measurement range and allowable pressure are clearly specified. It is strictly prohibited to use the instrument under operating conditions exceeding the rated range or rated pressure. Excessive temperature may cause the bimetallic strip to age or burn out, and the protective tube to deform; excessive pressure may cause the protective tube to rupture, leading to medium leakage or even safety incidents. Standard models have an allowable pressure of ≤6.4 MPa, while high-temperature models have a temperature resistance of ≤500°C. Selection and use must strictly adhere to the specific operating conditions.

3. Do not forcefully twist the dial

During installation, if the dial orientation is incorrect, first loosen the instrument connection, adjust the orientation, and then retighten. Do not forcefully twist the dial (especially for models other than universal types), as this may cause the connection between the dial and the protective tube to break, result in seal failure, or damage internal mechanical transmission components. When adjusting the orientation during installation, hold the connection point rather than the dial.

4. Do not allow seal failure

Sealing is critical for stable instrument operation. Installation is strictly prohibited if the sealing gasket is damaged, PTFE tape is insufficiently wrapped, or the flange surface is uneven. Seal failure can lead to medium leakage, water vapor/dust entering the meter head, corrosion of internal components, and damage to electrical contacts. After installation, the seal condition must be strictly inspected, and the aging of the sealing gasket should be checked regularly for timely replacement.

5. Do not use standard materials (1Cr18Ni9Ti) with highly corrosive media

Never use meters made of standard materials (1Cr18Ni9Ti) in environments with highly corrosive media (acids, alkalis, salt spray, or chloride-containing media). Doing so may cause the protective tube to corrode and perforate, damage the meter housing, allow media to seep into the meter head, and damage core components. In highly corrosive environments, Qidian corrosion-resistant meters (made of 316L stainless steel, Hastelloy, or with special anti-corrosion coatings) must be selected to ensure material compatibility with the medium.

6. Additional Precautions

Never perform installation or wiring while the power is on (especially for electric contact or explosion-proof models); power must be disconnected before proceeding. Never bend or deform the protective tube, as this may impair temperature sensing performance. Never use non-vibration-resistant instruments in environments with significant vibration, as vibration can affect pointer stability and the reliability of electrical contact operation; Never use the instrument to measure the temperature of media in open containers to prevent media contamination of the instrument or compromised measurement accuracy.

Additional Notes: After installation and commissioning, maintain installation records noting the installation location, instrument model, calibration data, installer, and date to facilitate future maintenance and repairs; Clean and inspect the instrument regularly. Calibrate it every 6 months under normal conditions and every 3 months under harsh operating conditions to ensure long-term stable operation. Contact Qidian after-sales service immediately if a malfunction occurs. Do not attempt to disassemble or repair special models such as explosion-proof or high-temperature instruments on your own.

VIII. Recommendations for Daily Use & Maintenance

This section focuses on the standard procedures for daily use and maintenance management of Qidian bimetallic thermometers. Taking into account the instrument's structural characteristics (bimetallic strip temperature sensing, mechanical transmission, sealing protection, etc.) and the requirements of various operating conditions, it outlines key points for inspection, maintenance, servicing, and parameter adjustment. The aim is to extend the instrument's service life, ensure long-term measurement accuracy, and reduce maintenance costs. These guidelines apply to all series of Qidian bimetallic thermometers, while also drawing on industry maintenance standards and practical experience to balance practicality and feasibility.

8.1 Key Points for Daily Inspections (Daily/Weekly, Rapid Hazard Identification)

Daily inspections aim to "rapidly identify and promptly detect potential hazards." Adjust the inspection frequency based on operating conditions (once daily for standard environments, twice daily for harsh conditions, and add one comprehensive weekly inspection for outdoor settings). Focus on the following five points, maintain detailed records after each inspection, and address any abnormalities immediately:

---Visual Inspection: Check that the meter glass is free of cracks and stains; the meter housing is free of damage and corrosion; the protective tubing is free of bending, deformation, or damage; the junction box of electrical contact-type meters is free of looseness or damage; the explosion-proof surfaces of explosion-proof meters are free of damage and debris; cables show no damage or signs of pulling; the overall appearance meets the criteria for normal meter operation, with no obvious signs of abnormalities.

---Pointer Status: Observe that the pointer moves smoothly without sticking or looseness; the indication is stable with no jumping or jamming; the pointer fits snugly against the dial without misalignment; under normal temperature or stable operating conditions, the pointer indication shows no significant fluctuations; the thermal response time meets requirements (≤40 s); and the angular adjustment error does not exceed 1.0% of the full scale range.

---Seal Integrity: Check that there are no medium leaks at threaded or flanged connections; apply soapy water to the sealing areas and observe that no bubbles form. The connection between the dial glass and the case, as well as the terminal box (for electric contact types), is well-sealed with no signs of moisture or dust ingress. The sealing gaskets show no signs of aging or detachment. For explosion-proof models, the flange connection is securely sealed and meets explosion-proof sealing requirements.

--- Indication Stability: Compare with a standard thermometer at the same location on-site to ensure the Qidian bimetallic thermometer shows no significant deviation (error within accuracy class requirements: Class 1.0 ≤ ±1.0% FS, Class 1.5 ≤ ±1.5% FS). When the medium temperature is stable, the indication fluctuation must not exceed ±0.5°C to prevent production monitoring from being affected by indication drift.

--- Installation Tightness: Check that instrument connectors and flange mounting screws are not loose, that the protective tube does not wobble, that support brackets for extended protective tubes (>1 m) are secure, that the universal-type meter head remains tight after adjustment, and that the electrical contact-type cables are firmly secured without being pulled or pinched. This ensures stable instrument installation and prevents component damage caused by vibration.

8.2 Regular Maintenance Plan (Scheduled Maintenance to Extend Instrument Lifespan)

Regular maintenance schedules should be established based on operating conditions, with a focus on "cleaning, inspection, and calibration" to prevent component aging and accuracy degradation caused by long-term use. For standard operating conditions, follow the schedules below; for harsh conditions (high temperature, high pressure, strong corrosion, or severe vibration), reduce the intervals by 50%. Maintain records of all maintenance activities for future reference:

---Cleaning Schedule: Clean once a month under normal conditions; clean every 15 days in environments with heavy dust or oil contamination. When cleaning, use a dry, soft cloth to wipe the faceplate glass, case, and protective tube surfaces to remove stains and dust. Avoid using corrosive cleaning agents. For cleaning the interior of the terminal box on models with electrical contacts, disconnect the power first and use a dry brush to remove dust. Never rinse the instrument with water.

---Thread/Seal Inspection: Inspect once every 3 months. Clean oxidation and debris from threaded areas, reapply Teflon tape (8–12 layers), and check whether sealing gaskets are aged or damaged; replace them promptly. For flange connections, ensure the flange surfaces are flat and free of debris, and tighten mounting screws evenly to ensure a reliable seal and prevent medium leakage.

---Indicator Verification: Perform verification once every 6 months using a standard thermometer (with accuracy one grade higher than the instrument) for comparison and calibration. Select 3–4 evenly distributed calibration points (including upper and lower limits and the midpoint). If the indication error exceeds the allowable range, calibrate promptly. Refer to JJG226 "Verification Regulations for Bimetallic Thermometers" for verification standards to ensure measurement accuracy meets requirements.

---Anti-corrosion Coating Inspection: Inspect once every 3 months, focusing on the anti-corrosion coating of the protective tube for corrosion-resistant instruments (316L, Hastelloy, or PTFE coating) to ensure there is no peeling, damage, or corrosion. If coating damage occurs, contact Qidian after-sales service immediately to prevent the medium from corroding the protective tube. For instruments made of standard materials, inspect the surface of the protective tube for obvious rust and perform rust removal if necessary.

8.3 Long-Term Maintenance Tips (Precise Protection, Reduced Failure Rate)

Based on the structural characteristics of Qidian bimetallic thermometers and the specific conditions of different operating environments, implement targeted long-term maintenance to effectively mitigate common damage factors such as dust, moisture, mechanical impact, and corrosion. This ensures long-term stable operation and extends the service life to 3–5 years (under standard operating conditions):

--- Dust and Moisture Protection: In outdoor or dusty environments, install a dust cover on the exterior of the instrument head and a waterproof sleeve on the terminal box (for electric contact types) to prevent dust and rainwater from entering. In humid environments, regularly inspect the instrument's interior for condensation; desiccant can be placed inside the terminal box (replace every 3 months) to ensure the instrument's protection rating is appropriate (IP65 or higher) and prevent moisture from corroding internal components.

---Protection Against Mechanical Impact: During daily operations and inspections, avoid collisions or impacts to the meter face and protective tubing. Do not use the meter as a tool such as a wrench. Handle the meter with care during transportation and maintenance. Prevent the meter face glass from coming into contact with hard objects to avoid

breakage. Ensure the installation area is free from collisions with heavy equipment; install protective shields if necessary to prevent pointer loosening or damage to internal components caused by mechanical impact.

---Reinforcement for Vibration Environments: In high-vibration environments (e.g., near motors, compressors, or metallurgical equipment), install vibration-damping pads on vibration-resistant meters. For extended protective tubes, install reinforcement brackets. Regularly inspect the tightness of meter fasteners to prevent tube fractures or pointer jumping caused by vibration. For meters with electrical contacts, additionally verify the reliability of contact connections to prevent false triggering due to vibration.

---Protection Against Corrosive Media: In highly corrosive environments (acids, alkalis, salt spray, or chloride-containing media), regularly inspect the integrity of the protective tube material to prevent media leakage from contacting the instrument body; regularly clean corrosive media adhering to the surface of the protective tube; if signs of corrosion are found on the protective tube, replace the tube or the instrument promptly; strictly prohibit the long-term use of instruments made of standard materials (1Cr18Ni9Ti) in highly corrosive environments to ensure material compatibility with the medium.

8.4 Parameter Setting and Adjustment (Precise Calibration to Ensure Effective Monitoring)

Parameter setting and adjustment apply only to models with electrical contacts and adjustable zero points. Power must be disconnected before operation (for models with electrical contacts). Strictly follow operating procedures to avoid instrument failure caused by improper adjustment. After adjustment, conduct tests to ensure parameter accuracy and reliable operation. Refer to the instrument's manual and industry calibration standards:

--- Temperature Point Setting for Contact-Type Models: Based on on-site process control requirements, turn the upper and lower limit setting knobs (or adjustment screws) on the instrument dial to adjust the setting pointer to the desired temperature value. When setting, allow a switching margin of 0.5–5°C (depending on the range) to prevent frequent contact activation and deactivation caused by temperature fluctuations; After setting, use a multimeter to test the contact closure and opening. Perform continuous testing 3–5 times to ensure that the contacts open and close reliably when the temperature reaches the set value, with no sticking or false triggering. The contacts must operate continuously for ≥10,000 cycles without failure.

---Adjustable Zero Calibration Method: In a room-temperature environment (25±5°C), let the instrument stand for 10–15 minutes. Once the pointer has stabilized, observe whether it points to the room-temperature mark. If there is a deviation, open the instrument housing (non-explosion-proof models only; do not attempt to disassemble or repair explosion-proof models yourself), and slowly adjust the internal zero-point adjustment screw until the pointer indicates the correct value. Avoid applying excessive force during adjustment to prevent damage to the pointer; After calibration, tighten the housing screws and ensure a proper seal. If necessary, verify the reading by comparing it with a standard thermometer to ensure the zero-point deviation remains within the permissible range. During 0°C periodic inspections, the instrument may be immersed in a mixture of ice and water for verification.

---Additional Notes: During routine use, the instrument should operate normally within an ambient temperature range of -30°C to 80°C. The operating temperature should ideally be maintained between 1/2 and 3/4 of the scale range. The length of the protective tube immersed in the measured medium must exceed the length of the temperature-sensing element—generally no less than 100 mm. For the 0–50°C range, the immersion length must be no less than 150 mm to ensure measurement accuracy; During operation and maintenance, if instrument malfunctions are detected (such as a stuck pointer, significant measurement deviation, or failed contacts), unauthorized disassembly or repair is strictly prohibited, especially for explosion-proof and high-temperature instruments. Contact Qidian After-Sales Service promptly so that professional technicians can inspect, calibrate, or replace components. Regularly organize inspection and maintenance records to establish instrument operation and maintenance archives for future traceability and management.

IX. Troubleshooting & Emergency Response

This module focuses on common on-site faults of Qidian bimetallic thermometers. Centered on the principles of "rapid problem identification, self-resolution, and minimization of downtime losses," it compiles a list of common faults, provides in-depth analysis of their causes, and offers step-by-step, actionable solutions along with emergency workarounds. It also clarifies after-sales repair procedures, is compatible with all series and models, and caters to both novice self-troubleshooting and professional after-sales support. By integrating the instrument's mechanical structure, temperature measurement principles, and on-site operating conditions, it ensures efficient troubleshooting and timely emergency response.

9.1 List of Common Faults (High-Frequency On-Site Faults, Precise Correspondence)

Based on on-site operation and maintenance experience, this section categorizes six types of high-frequency faults in Qidian bimetallic thermometers, covering the entire product range including standard, electric contact, corrosion-resistant, and shock-resistant models. Users can quickly identify the corresponding fault based on the instrument's abnormal behavior, thereby reducing troubleshooting time:

-- - Fault 1: Pointer does not move (the dial pointer shows no movement and remains fixed at a specific scale, regardless of changes in medium temperature);

--- Fault 2: Significant reading deviation (when compared to a standard thermometer, the reading error exceeds the range of the corresponding accuracy class, or the reading is consistently too high or too low);

--- Fault 3: Pointer oscillation (the pointer fluctuates frequently and is unstable, unable to indicate temperature consistently; this is particularly noticeable in vibrating environments);

--- Fault 4: Electrical contacts fail to actuate/reset (for contact-type instruments, the contacts fail to open or close when the temperature reaches the set point, or fail to reset after actuation, preventing alarm triggering or control);

--- Failure 5: Water ingress and fogging inside the meter (fogging or water droplets on the inner surface of the meter glass, affecting readings; in severe cases, this can corrode internal mechanical components);

--- Failure 6: Damaged or leaking protective tube (cracks or perforations in the protective tube leading to medium leakage, or bending/deformation of the protective tube preventing normal temperature sensing).

9.2 Analysis of Failure Causes (Precise Root Cause Analysis to Prevent Recurring Failures)

For the common failures listed above, we conduct an in-depth analysis of the core causes by combining the structural characteristics of Qidian bimetallic thermometers (fully mechanical transmission, sealed protection, electrical contact control, etc.) with on-site installation, usage, and maintenance conditions. This identifies the root causes of failures, provides a basis for subsequent resolution, and helps prevent the recurrence of similar failures:

--- Causes of a Stuck Pointer: ① Improper installation, insufficient insertion depth of the protective tube, resulting in the sensing element not contacting the measured medium; ② Operation at excessive temperatures, causing the bimetallic strip to age, burn out, or deform, thereby preventing thermal expansion and contraction; ③ Mechanical jamming: Loose internal gears or pointer, foreign objects causing blockage, or failure of the transmission mechanism; ④ Damaged or blocked protection tube, preventing heat transfer to the bimetallic strip; ⑤ Long-term lack of maintenance, resulting in rust or adhesion of internal components.

--- Causes of significant measurement deviation: ① Improper installation location—near valves, elbows, or dead ends in the pipeline—causing poor medium flow and an unreasonable selection of the temperature measurement point; ② The protective tube material is incompatible with the medium, causing corrosion or scaling that obstructs heat transfer; ③ The reading has not been calibrated regularly, leading to accuracy drift due to prolonged use; ④ The dial glass is dirty or damaged, affecting the viewing angle and causing visual errors; ⑤ The bimetallic strip has aged, resulting in reduced linearity and measurement errors exceeding the permissible range.

--- Causes of pointer oscillation: ① Excessive on-site vibration; use of non-vibration-resistant instruments in high-vibration environments; loosening of internal transmission mechanisms; ② Inadequate securing of the protective tube, allowing vibrations to be transmitted to the meter face and causing the pointer to jump; ③ Poor contact in the electrical contact-type instrument's contacts, causing signal interference; ④ Severe fluctuations in medium temperature, with the instrument's response time unable to keep up; ⑤ Loose internal gears in the meter head, resulting in unstable transmission.
--- Causes of electrical contacts failing to actuate or reset: ① Contact burnout or oxidation, leading to poor contact and an inability to switch on or off; ② Temperature setting deviation, where the set value does not match the actual medium temperature; ③ Wiring errors or loose cables, preventing normal signal transmission; ④ Improper adjustment of the contact switching differential, causing delayed operation or failure to reset; ⑤ Damage to the electrical contact module, internal circuit failure (applies only to models with external power supply).
--- Causes of water ingress and fogging inside the meter: ① Seal failure, such as aging gaskets at threaded/flanged connections, insufficient Teflon tape wrapping, or damage to the meter glass seal; ② Inadequate waterproofing in outdoor or humid environments, allowing rainwater or condensation to penetrate the meter head; ③ Loose wiring box on electrical contact models, resulting in poor waterproof sealing and moisture ingress; ④ Poor sealing of the flange connection on explosion-proof meters, or wiring not sealed according to explosion-proof requirements.
--- Causes of protective tube damage/leakage: ① Overpressure operation exceeding the instrument's allowable pressure, causing the protective tube to rupture; ② Media corrosion: The protective tube material is incompatible with the corrosive medium, leading to perforation after prolonged use; ③ Mechanical impact: Collisions or blows to the protective tube cause bending or damage; ④ High-temperature environments: The protective tube material lacks sufficient heat resistance, leading to deformation or damage; ⑤ Forced bending during installation: This causes internal damage, resulting in failure after prolonged use.
9.3 Step-by-Step Troubleshooting (Self-Service, Quick Repair)
For each type of failure, we provide a "troubleshooting procedure → repair measures → emergency workaround." The steps are clear and highly practical, allowing novices to independently troubleshoot and repair issues according to the process. If the problem cannot be resolved independently, emergency measures can be taken to minimize downtime losses. All operations must comply with safety regulations; unauthorized disassembly or repair of explosion-proof or high-temperature instruments is strictly prohibited:
1. Failure 1: Pointer does not move
--- Troubleshooting Steps: ① Check the insertion depth of the protection tube to ensure it meets requirements (≥8–10 times the tube diameter) and is in contact with the measured medium; ② Inspect the instrument housing for signs of impact or impact damage, and check if the protection tube is damaged or blocked; ③ Gently rotate the pointer (using light pressure) to observe for any sticking or looseness; ④ Compare with the actual medium temperature to confirm if it exceeds the instrument's measurement range (over-temperature damage).
--- Troubleshooting Steps: ① Adjust the insertion depth of the protection tube to ensure the temperature-sensing element is in full contact with the medium, then retighten the instrument; ② If the protection tube is blocked, clear any debris from inside (for corrosive media, power must be disconnected and pressure relieved first); ③ If the pointer is stuck, for non-explosion-proof instruments, open the housing to remove internal debris and rust, and adjust the gears and pointer position; for explosion-proof models, contact after-sales service; ④ If the bimetallic strip is aged or burnt out, contact Qidian after-sales service to replace the movement or the entire instrument.
--- Emergency Workaround: Temporarily replace with a spare instrument of the same model to ensure uninterrupted on-site temperature monitoring; return the original instrument to its position once the faulty one is repaired. If no spare instrument is available, use a standard thermometer for auxiliary monitoring and record temperature data.

2. Fault 2: Significant Indication Deviation
--- Troubleshooting Steps: ① Adjust the installation location to avoid valves, elbows, and dead corners in the piping, and select a new measurement point; ② Inspect the surface of the thermowell for scale buildup or corrosion marks, and verify that the thermowell material is compatible with the medium; ③ Compare readings with a standard thermometer to determine the deviation range and assess whether calibration is necessary; ④ Wipe the dial glass to remove smudges, ensure the viewing angle is perpendicular, and avoid visual distortion.
--- Remedial Actions: ① Reinstall the instrument, adjust the measurement point, and ensure the insertion depth of the thermowell meets requirements; ② Clean scale and rust from the thermowell surface; replace the thermowell if corrosion is severe; ③ For non-explosion-proof instruments, manually adjust the internal calibration screw to calibrate the reading; for explosion-proof models, contact after-sales service for calibration; ④ If the bimetallic strip is aged, contact after-sales service to replace the movement to ensure accuracy meets standards.
--- Emergency Workaround: Use readings from a standard thermometer as the reference to temporarily record temperature data, while arranging for instrument calibration or replacement to prevent production process disruptions caused by measurement errors; in high-precision applications, temporarily activate a backup high-precision instrument.
3. Issue 3: Pointer Jitter
--- Troubleshooting Steps: ① Inspect the on-site vibration conditions to confirm whether the environment involves strong vibrations and whether the instrument is shock-resistant; ② Check the tightness of the instrument mounting, whether the protective tube is loose, and whether the extended protective tube support brackets are secure; ③ For electric contact-type instruments, check for loose wiring or poor contact at the terminals; ④ Observe whether the medium temperature fluctuates violently to determine if the issue is caused by the medium itself.
--- Remedial Actions: ① In high-vibration environments, install anti-vibration pads and reinforce support brackets; replace non-vibration-resistant instruments with vibration-resistant models; ② Re-tighten the instrument, protective tubing, and support brackets to reduce vibration transmission; ③ For electric contact-type instruments, rewire the connections, tighten the cables, and clean any oxidation from the contacts; ④ If the medium fluctuates violently, adjust the temperature measurement point or select a model with a faster response time.
--- Emergency Workaround: Temporarily wrap the instrument head with anti-vibration pads to reduce the impact of vibration, ensure the pointer remains roughly stable, and record temperature trends; if no vibration-resistant spare instrument is available, temporarily relocate the instrument to a temporary measurement point with less vibration to ensure uninterrupted monitoring.
4. Fault 4: Electrical contacts fail to actuate/reset
--- Troubleshooting steps: ① Check the temperature setpoint and compare it with the actual medium temperature to confirm whether the set actuation temperature has been reached; ② Use a multimeter to verify that the wiring is correct, the cables are secure, and the contacts are making and breaking properly; ③ Inspect the contacts for burn marks or oxidation, and ensure the switching differential is properly adjusted; ④ For instruments with an external power supply, check if the power supply is functioning normally and if the electrical contact module is faulty.
--- Remedial Actions: ① Adjust the temperature setpoint and switching differential to ensure they match on-site process requirements; ② Rewire the connections, tighten the cables, clean any oxidation from the contacts, and replace the contacts if they are severely burned; ③ Check if the power supply is normal; restore power immediately if a power failure occurs; ④ If the electrical contact module is damaged, contact Qidian after-sales service to replace the module or the instrument.
--- Emergency Workaround: Temporarily switch to manual monitoring; assign personnel to periodically check the temperature and manually trigger alarms/controls when the setpoint is reached; if a spare electrical contact instrument is available, replace it immediately to ensure uninterrupted control functionality.
5. Fault 5: Water ingress and fogging inside the instrument
--- Troubleshooting steps: □ Inspect sealing areas (threads/flanges, instrument glass, junction box) to confirm whether gaskets are aged or damaged and whether PTFE tape is sufficient; □ Check whether waterproofing measures are in place for outdoor and humid environments, and look for signs of rainwater infiltration; □ For

explosion-proof instruments, check whether the gland seals are intact and whether the junction box is securely tightened.
--- Remedial Actions: ① After powering off and depressurizing, disassemble the meter, wipe away internal moisture and water droplets with a dry, soft cloth, and place it in a dry, well-ventilated area to air dry (never expose to direct sunlight or heat); ② Replace aged or damaged sealing gaskets, reapply PTFE tape (8–12 layers), and tighten the terminal box and meter face glass; ③ Install a waterproof protective sleeve in outdoor environments to enhance waterproofing measures; ④ If internal components are corroded, contact after-sales service for repair or replacement of the meter.
--- Emergency Workaround: Temporarily wrap the meter face with a dry cloth to accelerate moisture evaporation and ensure readings remain unaffected; if quick drying is not possible, replace the meter with a spare to prevent moisture from continuing to corrode internal components.
6. Issue 6: Damaged/Leaking Protective Tube
--- Troubleshooting Steps: ① Inspect the protective tube for bends, cracks, or punctures to identify the location of the damage; ② Examine the on-site operating conditions to determine if there is overpressure, overheating, severe corrosion, or mechanical impact; ③ Verify that the protective tube material is compatible with the medium and operating conditions.
--- Remedial Actions: ① Immediately shut down the system, relieve pressure, and replace the damaged protection tube with one made of a material compatible with the medium and operating conditions; ② If the protection tube is bent, attempt to straighten it (for minor bends); replace it immediately if severely bent; ③ Adjust operating parameters to avoid over-temperature or over-pressure conditions, and install protective baffles to prevent mechanical impact.
--- Emergency Workaround: Immediately shut down the system and isolate the damaged section to prevent further medium leakage; if no spare protective tube is available, temporarily seal the area with a pipe of the same specifications and material, and replace it once a spare is available. Simultaneously, assign personnel to monitor the site to prevent safety hazards.
9.4 After-Sales Repair Guidelines (Professional Coordination, Efficient Resolution)
When a fault cannot be resolved independently (e.g., aging bimetallic strips, damaged electrical contact modules, or failures in explosion-proof instruments), contact Qidian After-Sales promptly to clarify fault determination criteria, repair procedures, and warranty coverage. This ensures efficient coordination, rapid repairs, and minimized downtime losses. The entire after-sales service process adheres to Qidian's corporate service standards.
1. Fault Determination Criteria (Defining Service Request Scope)
The following conditions qualify as issues requiring after-sales service to avoid unnecessary service requests and improve processing efficiency:
- Faults that cannot be resolved after self-troubleshooting (e.g., stuck pointer, measurement deviation exceeding twice the accuracy class, damaged electrical contact module, severe corrosion or damage to the protective tube);
- Faults in explosion-proof, high-temperature, or high-pressure instruments; unauthorized disassembly or repair is strictly prohibited; direct service requests are required;
- Faults in instruments within the warranty period resulting from non-human factors (e.g., material defects, natural aging of internal components, seal quality issues);
- Major instrument faults (e.g., protective tube rupture causing significant medium leakage, electrical contact failures posing safety hazards) requiring urgent repair.
2. Repair Process (Streamlined and Efficient, Rapid Coordination)
1. Fault Confirmation: After conducting a self-diagnosis, if the user confirms the issue cannot be resolved, record the fault symptoms (e.g., pointer not moving, significant measurement deviation), instrument model, installation location, operating parameters (temperature range, medium, pressure), and the time the fault occurred;
2. Submit a Repair Request: Submit a repair request through Qidian's official after-sales channels, providing details of the fault, contact information, and on-site conditions. Include photos or videos of the fault to help after-sales staff quickly identify the issue;
3. After-Sales Response: After-sales personnel will respond within 1 hour of receiving the request. Simple issues will be resolved remotely via phone or WeChat guidance, while complex issues will require a technician to visit the site for repair;
4. Fault Resolution: Technicians will diagnose the issue on-site, perform repairs, calibration, or component replacement, and conduct post-repair testing to ensure the instrument operates normally;
5. Acceptance Confirmation: The user verifies the instrument's operational status, confirms the issue has been resolved, and signs the acceptance record. After-sales personnel retain the repair report for future reference.
3. Contact Information (Multi-channel Support, Prompt Response)
--- Official After-sales Hotline: 19715617532 (Weekdays 9:00 AM–6:00 PM; 24-hour response for urgent issues);
--- Regional Technical Support: Contact your assigned sales engineer to arrange on-site repair services and quickly address on-site needs;
--- Repair Request Email: sales008@qd-zdk.com (Please include product model, fault details, and contact information; response within 24 hours).
4. Warranty Coverage (Clear Protection, Peace of Mind)
Qidian bimetallic thermometers come with a 12-month warranty (effective from the date of successful acceptance). Free repair and replacement of parts are provided within the warranty period; paid services are available for issues beyond the warranty period. The specific warranty coverage is as follows:
--- Warranty Coverage: Core components such as the instrument mechanism, protective tube (excluding damage caused by human error), seals, and electrical contact modules. Free repair or replacement is provided for failures caused by product quality issues;
--- Exclusions: ① Human-caused damage (e.g., impact, collision, forced twisting, unauthorized disassembly or repair); ② Damage caused by excessive temperature, pressure, or incompatible media; ③ Malfunctions resulting from improper installation or non-compliant operation and maintenance; ④ Force majeure or accidental on-site damage; ⑤ Product failures occurring after the warranty period has expired; ⑥ Normal wear and tear of consumable parts (e.g., sealing gaskets).
Emergency Reminder: In hazardous operating conditions (explosion-proof, high-temperature, high-pressure, corrosive environments), if a sensor failure occurs, immediately shut down the equipment, cut off power, and isolate the site. Strictly prohibit unauthorized operations. Ensure personal safety before conducting troubleshooting or reporting the issue to avoid causing safety accidents.
Supplementary Notes: During routine use, the instrument should operate normally within an ambient temperature range of -30°C to 80°C. The operating temperature should ideally be maintained between 1/2 and 3/4 of the full scale range. The length of the protective tube immersed in the measured medium must exceed the length of the temperature-sensing element, typically by no less than 100 mm.