Armored Temperature Sensor

I. Product Definition

An armored temperature sensor is a temperature measurement and transmission unit with an armored structure. At its core, the sensing element (thermocouple or resistance temperature detector) is protected by a metal armored sheath. After undergoing electrical isolation, anti-interference filtering, and signal conversion, it outputs standard signals such as 4–20 mA, 0–5 V, or 0–10 V, making it suitable for real-time temperature monitoring and control in harsh industrial environments.

Four Core Functions

---Armored Structure (Core Protection)

Constructed through a multi-step drawing process using a temperature-sensing element, a metal sheath (304/316L/Inconel, etc.), and high-density insulating filler (magnesium oxide/aluminum oxide), the assembly features a diameter as small as 1.5 mm. It is flexible and resistant to high pressure, vibration, and corrosion.

---Precise Temperature Measurement

Supports K/E/N-type thermocouples (-200°C to 1300°C) and PT100/Cu50/PT1000 resistance temperature detectors (-200°C to 650°C), with accuracy ranging from ±0.1% FS to ±0.5% FS and a thermal response time as fast as <1 s.

---Electrical Isolation (Three-Port Isolation)

Complete electrical isolation of three channels: input (sensor), output (signal), and power supply (≥1500 V AC/1 min). This eliminates ground loops and high-voltage crosstalk, protects downstream equipment, and enhances signal immunity to interference.

---Interference Suppression and Signal Transmission

Built-in EMC filtering and common-mode/differential-mode suppression, compliant with GB/T 18268 (IEC 61326-1); linearly converts weak temperature signals into standard industrial signals, supporting long-distance transmission (≥1000 m).

II. Working Principle: Simplified Explanation (Input → Isolation → Processing → Output)

1. Signal Input

Temperature-sensing elements detect temperature: Thermocouples operate based on the Seebeck effect (a thermoelectric potential generated by a temperature difference between two different conductors), while RTDs operate based on the resistance-temperature effect (a change in resistance caused by temperature changes), converting temperature into an initial electrical signal.

2. Three-Point Isolation (Core Interference Suppression)

Input Side: Sensor signal → magnetic isolation / optocoupler isolation, completely disconnected from the input ground, blocking interference from the sensor side.

Power Supply Side: The module's power supply (24 VDC) is independently isolated and does not share a ground with the input or output, preventing power supply interference from affecting measurements.

Output Side: The processed signal is isolated again before output, creating a three-point floating configuration (input, output, and power supply). This completely cuts off interference pathways and protects downstream PLCs/DCS systems from breakdown caused by high voltage or surges.

3. Signal Processing

Amplification / Linearization: Amplifies weak signals and performs nonlinear correction for thermocouples and linear compensation for RTDs.

Noise Filtering: Filters out power-frequency and high-frequency noise, suppresses vibration and electromagnetic interference, and improves signal purity.

High-Precision Conversion: A/D conversion accuracy up to 0.1% FS ensures precise reproduction of temperature signals.

4. Standard Output

Converts to 4–20 mA (most common), 0–5 V, 0–10 V, or RS485 digital signals, enabling stable long-distance transmission to PLCs, DCS systems, recorders, or display instruments for remote monitoring and control.

Advantages of Three-Channel Isolation (Key Takeaway)

The input, output, and power supply channels are mutually "isolated," preventing interference from entering and high voltage from leaking out, ensuring stable equipment operation and accurate signals.

III. Core Value:

Comparison with Unarmored / Non-isolated Scenarios

1. Adaptability to Extreme Environments: No failure under high temperatures, high pressure, or intense vibration

Pain points of unarmored sensors: Standard sensor sheaths are thin and prone to deformation; they burn out easily at high temperatures; signals drift or the sensors are damaged under high pressure or intense vibration; they cannot be used in environments such as reactors, furnace chambers, or compressors.

Qidian's Value: Metal armor + high-density insulating filler, with temperature resistance from -200°C to 1300°C, pressure resistance up to 30 MPa, and vibration resistance up to 10g, making it suitable for extreme operating conditions in metallurgy, power generation, and chemical industries.

2. Stable Transmission: Long-distance / Multi-device Shared Ground Without Distortion

Challenges Without Isolation: During long-distance transmission or when multiple devices share a common ground, ground potential differences create ground loops, causing signal drift, fluctuations, and inaccurate readings, making remote transmission impossible.

Qidian Value: Three-terminal isolation cuts off ground loops, providing strong anti-interference capabilities. Signals are transmitted stably over ≥1000m with an accuracy of **±0.1% FS**, suitable for complex industrial field networking.

3. Equipment Protection: Eliminates Circuit Board Burnouts / Damage

Challenges Without Isolation: On-site lightning strikes, surges, and high-voltage intrusion from inverters can directly damage PLC or instrument input ports, rendering equipment unusable and resulting in high repair costs.

Qidian Value: ≥1500V AC isolation withstand voltage blocks high voltage and surges, protecting downstream core equipment and reducing failure rates and maintenance costs.

4. Extended Lifespan: Reduces Aging and Failures

Challenges without Armored/Isolated Design: Long-term exposure to high temperatures, corrosion, and interference accelerates component aging, reduces stability, shortens lifespan, and increases costs due to frequent replacements.

Value of Qidian: Sealed protective armored structure + isolation design, operating temperature range **-20~+55°C**, long MTBF (Mean Time Between Failures), suitable for harsh industrial environments, and reduced maintenance frequency.

5. Explosion-Proof Compliance: Suitable for Hazardous Locations

Non-Explosion-Proof Design Pain Points: Non-explosion-proof equipment fails to meet Ex hazardous location requirements, is prohibited in petroleum, chemical, and gas applications, and poses safety risks.

Qidian Value: Supports Ex d IIC explosion-proof rating, meets safety regulations for hazardous locations, is suitable for flammable and explosive environments, and complies with industrial safety standards.

6. Flexible Installation: Suitable for Complex Measurement Points

Common Sensor Pain Points: Large diameter, non-flexible, cannot be installed in confined spaces, on curved pipes, or on equipment surfaces; installation is cumbersome.

Qidian Value: Diameter as small as Φ1.5mm, flexible (bending radius ≥ 5 times the diameter), supports various installation methods including threaded, flanged, and sanitary types; quick installation and commissioning by a single person.

IV. One-Sentence Summary for Selection

For industrial temperature measurement in environments involving high temperatures, high pressure, severe vibration, strong corrosion, long-distance transmission, shared grounding among multiple devices, explosion-proof requirements, or equipment safety protection—prioritize Qidian's armored temperature sensors. They offer greater stability, enhanced safety, and better suitability for extreme operating conditions compared to standard or non-isolated solutions.

V. Key Parameters & Specifications

5.1 Basic Temperature Measurement Parameters (Core Performance)

1. Temperature Sensor Type

Resistance Temperature Detectors (RTDs): PT100 (mainstream), PT1000, Cu50

Thermocouples: Types K, E, N, J, T, S, R, B

Configuration: Single-element / Dual-element; Open-end / Shell-connected / Insulated

2. Temperature Measurement Range (by Sensor Type)

PT100: -200°C to +650°C

K : -200°C to +1300°C

E : -200°C to +800°C

S/R: 0°C to +1600°C

B: 0–+1800°C

3. Accuracy Class (by Standard)

PT100 Resistance Thermometer

Class A: ±(0.15 + 0.002|t|) °C

Class B: ±(0.30 + 0.005|t|) °C

Thermocouples (Class I / Class II)

Type K: Class I ±1.5°C or ±0.4% t; Class II ±2.5°C or ±0.75% t

Type E: Class I ±1.5°C or ±0.4% t; Class II ±2.5°C or ±0.75% t

4. Response Time (T90)

Flowing water: ≤1 s

Still air: ≤5 s

Standard operating conditions: ≤3 s (Φ3–Φ8)

5.2, Sheath Parameters (Structure and Protection)

1. Sheath Material (by operating conditions)

304 Stainless Steel: General-purpose, -200 to +800°C

316L Stainless Steel: Corrosion-resistant, -200 to +800°C

Inconel 600/800: High-temperature / oxidation-resistant, -200 to +1200°C

GH3030/GH3039: Ultra-high temperature, -200 to +1300°C

Hastelloy / Titanium Alloy: Customized for highly corrosive environments

2. Outer Diameter / Inner Diameter (Standard Sizes)

O.D.: Φ1.5, Φ2, Φ3, Φ4, Φ5, Φ6, Φ8, Φ10, Φ12 mm

I.D.: O.D. - 1.0 to -1.5 mm (e.g., Φ3 mm braided tube I.D. ≈ 1.5 to 2.0 mm)

Ultra-fine customization: Minimum Φ1.0 mm

3. Bending Radius

Standard: ≥5× the outer diameter of the armored conduit (e.g., Φ3mm ≥ 15mm)

Flexible Customization: ≥3× the outer diameter (for special applications)

4. Conduit Length (L)

Standard: 50, 100, 150, 200, 250, 300, 500, 1000mm

Custom: Any length (insertion depth + junction box height)

Total Length = Insertion Depth + Junction Box Height (approx. 80–120 mm)

5.3. Electrical Parameters (Signal and Insulation)

1. Output Signal Type (Transmitter Type)

Analog: 4–20 mA (2-wire / 3-wire), 0–5 V, 0–10 V

Digital: RS485 (Modbus-RTU)

Switching: Customizable alarm output

2. Insulation Resistance (Core Safety)

Ambient Temperature (25±10°C, RH≤80%): ≥1000 MΩ (500 VDC)

High-Temperature Conditions: ≥100 MΩ (at rated temperature)

3. Dielectric Strength

Three-terminal isolation (input/output/power supply): ≥1500 V AC/1 min, leakage current < 1 mA

4. Lead Material and Length

Material: Silver-plated copper wire (temperature resistance 200°C), nickel-chromium wire (temperature resistance 600°C), high-temperature fluoroplastic / silicone rubber wire

Wire gauge: 0.2–0.5 mm² (multi-strand twisted)

Length: Standard 1 m/2 m/3 m/5 m; Customizable 0.5–20 m

Cable Termination: Direct leads / Waterproof connectors / Aviation connectors

5. Power Supply (Transmitter Type)

DC 24V ±10%; Power consumption ≤1W

5.4 Environmental Adaptation Parameters (Operating Conditions)

1. Operating Temperature and Humidity

Sensor body: -40 to +1300°C (depending on sheath material)

Terminal box / Transmitter module: -20 to +85°C

Humidity: 0–100% RH (non-condensing)

2. Protection Rating

Terminal box: IP65 (waterproof and dustproof); IP67 (outdoor / humid environments)

Armored tube body: IP68 (submersible use)

3. Explosion-Proof Rating (Hazardous Areas)

Flameproof: Ex d IIC T6 (Suitable for chemical, petroleum, and gas industries)

Intrinsically Safe: Ex ia IIC T6 (Can be equipped with a safety barrier)

4. Vibration / Shock Resistance

Vibration Resistance: 10–2000 Hz, 10g (Fault-free)

Shock Resistance: 100g, 11 ms (Accuracy retention >98%)

Pressure resistance: ≤30 MPa (high-pressure vessels / pipelines)

5.5. Physical Parameters (Installation and Structure)

1. Installation Methods (Mainstream)

Threaded Mounting: M12×1.5, M16×1.5, M20×1.5, G1/2“, G3/4”

Flange Mounting: DN15/25/40/50; PN10/PN16/PN25

Ferrule Type: φ6/φ8/φ10 (Quick Installation)

Welded Type: Directly welded to equipment / piping

Sanitary Type: Quick-mount chuck (Food / Pharmaceutical)

2. Dimensions (Typical)

Terminal Box: Square / Round, Height 80–120 mm, Width 60–80 mm

Conduit: Diameter Φ1.5–Φ12 mm, Custom Length

Total Length = Insertion Depth + Terminal Box Height (approx. 80–120 mm)

3. Junction Box Types

Waterproof: Cast aluminum alloy / 304 stainless steel, IP65

Explosion-proof: Ex d flameproof enclosure, IP65

Compact: Small footprint, suitable for confined spaces

Transmitter-equipped: Integrated 4–20mA transmitter module

4. Weight (Typical)

Φ3×100mm: ≈0.15kg

Φ6×200mm: ≈0.3kg

With Transmitter / Explosion-Proof Housing: ≈0.5–0.8kg

5. Material Specifications

Sheath: 304/316L/Inconel 600, etc.Insulation Filler: High-purity magnesium oxide (MgO)

Temperature-sensing Element: Platinum wire (PT100), nickel-chromium / nickel-silicon (Type K), etc.

Terminal Box: Cast aluminum alloy / 304 stainless steel

Lead Wires: Silver-plated copper / nickel-chromium + high-temperature insulation layer

5.6 Quick Selection Guide (Tips for Beginners)

Temperature Range: ≤650°C—select PT100; 650–1300°C—select Type K; >1300°C—select Types S/R/B

Sheath Selection: General-purpose 304; Corrosive environments 316L; High-temperature Inconel 600

Accuracy: For precision control, select Class A PT100 or Class I thermocouples; for general applications, select Class B or Class II

Installation: For confined spaces, select Φ1.5–Φ3 mm; for high-pressure or vibration-prone environments, select Φ6–Φ8 mm

Explosion-proof: Mandatory for hazardous areas: Ex d IIC T6; for long-distance transmission, select 4–20 mA transmitter type

VI: Selection Guide

6.1 Key Selection Criteria

1. Temperature Measurement Range (Top Priority)

≤650°C: Prefer PT100 resistance thermometers (Class A accuracy ±0.15°C, excellent linearity and stability)

650–1300°C: Select Type K thermocouples (fast response, high temperature resistance, suitable for high-temperature applications)

1300–1800°C: Select S/R/B-type thermocouples (designed for ultra-high temperatures; suitable for metallurgy and kilns)

Selection Principle: The measurement range must cover the actual temperature range and include a 10%–20%margin

2. Medium Type (Determines sheath material)

Neutral media (water, steam, air): 304 stainless steel (general-purpose, cost-effective)

Acidic/alkaline / chloride-corrosive media: 316L stainless steel (high corrosion resistance, suitable for chemical and pharmaceutical industries)

Highly corrosive (containing sulfur, hydrofluoric acid): Hastelloy / titanium alloy (custom-made, suitable for extreme corrosion conditions)
High-temperature oxidizing media: Inconel 600/GH3039 (high-temperature and oxidation resistance, suitable for furnace chambers)
3. Sheath Tube Parameters (for installation and operating conditions)
Outer diameter: Φ1.5–Φ12 mm; for confined spaces, select Φ1.5–Φ3 mm (high flexibility); for high-pressure/high-vibration applications, select Φ6–Φ8 mm (high strength)
Bend radius: Standard ≥ 5× OD; Special flexible custom ≥ 3× OD (to prevent damage to the core from excessive bending)
Length: Insertion depth ≥ 8–10× the outer diameter of the sheathed tube; for pipeline temperature measurement, insert 1/2–2/3 of the pipe diameter to ensure sufficient contact with the medium
4. Installation Space (Determines Structure and Method)
Tight Pipes / Equipment Gaps: Ultra-fine Armored (Φ1.5–Φ3 mm) + Direct Insertion / Ferrule Installation
Standard Pipes / Tanks: Threaded Installation (M12×1.5, M20×1.5, G1/2")
Large-Diameter / High-Pressure Vessels: Flange Installation (DN15/25/40, PN10/16/25)
Sanitary Applications (Food / Pharmaceutical): Quick-connect clamps / Sanitary threads (316L, GMP compliant)
5. Explosion-proof / Corrosion-resistant Requirements (Safety Compliance)
Explosion-hazard zones (Chemical, Oil, Gas): Mandatory Ex d IIC T6 flameproof or Ex ia IIC T6 intrinsically safe (with safety barrier)
Corrosive environments: 316L / Hastelloy armored conduit + IP67/IP68-rated junction box (waterproof, dustproof, and corrosion-resistant)
High electromagnetic interference zones (power, variable frequency equipment): Three-terminal isolation + shielded leads (4–20mA output, high interference resistance)
6.2, Industry Application Selection Table (Ready-to-Use)
1. Chemical Industry
Typical Applications: Reactors, distillation columns, chemical pipelines (frequent contact with acids, alkalis, and corrosive media; some are classified as explosion-hazardous areas)
Recommended Selection: Prioritize PT100 temperature sensors (measuring range: -200–450°C, high accuracy, stable linearity); for measuring ranges of 450–1300°C, select Type K thermocouples; choose 316L stainless steel (for standard corrosion scenarios) or Hastelloy (for severe corrosion scenarios) for the sheath material; Installation methods should include threaded or flanged connections to accommodate the installation requirements of pipes and reactors; core configurations must meet the Ex d IIC T6 explosion-proof rating (for hazardous areas), 4–20 mA signal transmission (for easy integration with PLC/DCS), and IP67 protection rating (waterproof, dustproof, and corrosion-resistant).
2. Metallurgical Industry
Typical Applications: Blast furnaces, converters, molten steel monitoring, kilns (extremely high temperatures, severe vibration, oxidizing environments)
Recommended Specifications: Temperature-sensing elements should be Type K, Type S, or Type B thermocouples (suitable for ultra-high-temperature conditions ranging from 650°C to 1800°C); Select Inconel 600 or GH3039 high-temperature alloys for the sheath material (high-temperature resistance and oxidation resistance to prevent sheath damage at high temperatures); choose flange or welded mounting methods to ensure secure installation in high-temperature environments; core configurations must feature an ultra-high-temperature sheathed structure, 10g vibration resistance (to withstand equipment operational vibrations), and ≤1s fast response time (to capture real-time changes in molten steel and furnace chamber temperatures).
3. Power Industry
Typical Scenarios: Boilers, superheaters, steam pipelines (medium-to-high temperature, steam environments; some with strong electromagnetic interference)
Recommended Models: Use PT100 temperature sensors (for standard steam temperature measurement, -200 to 450°C) or Type K thermocouples (for high-temperature boiler measurement, 450 to 1300°C); Select 304 stainless steel (for general steam applications) or 316L stainless steel (for corrosive steam applications) for the sheath; choose threaded or flanged mounting to accommodate installation points on pipes and boilers; core configurations must include three-terminal isolation (to withstand electromagnetic interference from variable-frequency drives), 4–20 mA standard signal output (for integration with power system PLCs), and IP67 waterproof rating (to withstand steam condensate).
4. HVAC Industry
Typical Applications: Heat exchange stations, air conditioning systems, cold storage facilities, HVAC ductwork (ambient to low-to-medium temperatures, no strong corrosion or explosion-proof requirements, cost-effectiveness prioritized)
Recommended Specifications: Temperature sensing elements: PT100 or Cu50 (suitable for -200–450°C, with accuracy meeting HVAC control requirements); Sheath material: 304 stainless steel (for general non-corrosive applications, high cost-effectiveness) ; Installation methods include threaded or ferrule connections for ease of installation and compatibility with HVAC piping; Core configuration features an economical design supporting two-wire or three-wire wiring and an IP65 protection rating (basic water and dust resistance), eliminating the need for complex functions to reduce costs.
5. Food and Pharmaceutical Industry
Typical Applications: Sterilization cabinets, fermentation tanks, CIP cleaning systems (high sanitary standards required; non-corrosive but must be easy to clean and compliant)
Recommended Specifications: Temperature sensing element: Grade A PT100 (4-wire, high accuracy, meets the precise temperature control requirements of the pharmaceutical and food industries); Sheath material: Sanitary-grade 316L stainless steel (no dead corners, easy to clean, meets GMP compliance requirements); Installation methods should use quick-mount clamps or sanitary-grade threads to avoid sanitary dead zones; core configurations must meet GMP compliance standards and IP67 protection rating (to withstand cleaning and disinfection), ensuring no residue remains and materials are not contaminated.
6. Environmental Protection Industry
Typical Applications: Flue gas monitoring, desulfurization systems, wastewater treatment (involving acidic and alkaline corrosive media, with some requiring submerged measurement)
Recommended Specifications: Temperature sensing elements: PT100 (standard temperature measurement: -200 to 450°C) or Type K thermocouple (high-temperature flue gas measurement: 450 to 1300°C); Sheath material: 316L stainless steel (resistant to acid and alkali corrosion, suitable for desulfurization and wastewater treatment applications); Installation methods: threaded or flanged, suitable for flue gas ducts and wastewater tanks; core configuration must include a corrosion-resistant sheath structure, acid and alkali resistance, and IP68 protection rating (supporting submerged use to withstand immersion in wastewater and desulfurization liquids).
6.3 Common Selection Pitfalls (Checklist for Avoiding Mistakes)
1. Incorrect Sheath Material Selection (Most Common)
Mistake: Using 304 stainless steel in corrosive environments, or standard stainless steel in high-temperature environments
Consequences: Corrosion and perforation of the sheath, destruction of the sensor core, measurement failure, and equipment damage
Solution: Select 316L or Hastelloy based on the corrosiveness of the medium; select Inconel or GH series high-temperature alloys based on temperature
2. Insufficient Length / Insertion Depth
Mistake: Insertion depth < 8× the outer diameter of the sheath, or insertion only against the pipe wall
Consequences: Measurement values are affected by ambient temperature, resulting in low readings and significant fluctuations
Solution: For pipe temperature measurement, insert ≥ 1/2 the pipe diameter; for vessel temperature measurement, insert ≥ 2/3 the depth; ensure the probe is fully immersed in the medium
3. Neglecting Explosion-Proof / Corrosion-Resistant / Anti-Interference Features
Misconception: Using non-explosion-proof models in hazardous areas, standard materials in corrosive areas, or no isolation in high-interference areas
Consequences: Safety hazards, non-compliance, signal drift, system failure
Countermeasures: Ex certification is mandatory for explosion-proof zones; select appropriate corrosion-resistant materials for corrosive zones; use three-terminal isolation + shielded cables in high-interference zones

4. Exceeding the bending radius limit
Misconception: Bending radius of the armored cable < 5× the outer diameter (e.g., Φ3mm bent to <15mm)
Consequences: Core breakage, insulation damage, measurement failure
Countermeasure: Strictly adhere to a bending radius of ≥5× the outer diameter; in confined spaces, select flexible custom models (≥3× the outer diameter)
5. Mismatch Between Temperature Sensor and Measurement Range
Common Mistake: Using PT100 for temperatures >650°C, or using Type K for temperatures <-200°C
Consequences: Sensor burnout, loss of accuracy, and data errors
Solution: Select PT100 for ≤650°C; select Type K for 650–1300°C; select Type S/R/B for >1300°C
6.4 Customization Recommendations (Solutions for Non-Standard Requirements)
1. Custom Non-Standard Lengths
Insertion depth: Customizable from 50 mm to 5000 mm (to fit special containers/pipes)
Total length: Insertion depth + terminal box height (80–120 mm), adjustable as needed
2. Custom Materials
Sheath: Titanium alloy, Monel alloy, quartz (for ultra-high temperatures / severe corrosion)
Insulation: High-purity magnesium oxide (MgO), excellent high-temperature stability
Lead wires: Nickel-chromium wire, high-temperature fluoroplastic wire (temperature resistance ≥ 600°C)
3. Customized Junction Boxes
Explosion-proof: Ex d IIC T6 flameproof enclosure (for hazardous areas)
Sanitary: Polished 316L stainless steel enclosure (food/pharmaceutical GMP)
Compact: Small-volume enclosure (for confined installation spaces)
Display-equipped: Integrated digital display (for intuitive on-site readings)
4. Customized Integrated Transmitters
Signal Output: 4–20 mA, 0–5 V, 0–10 V, RS485 (Modbus-RTU)
Functions: Cold-junction compensation, temperature calibration, alarm output, HART protocol
Power Supply: 24 VDC ±10%, power consumption ≤1 W
5. Custom Special Configurations
Dual-element design: One channel for measurement, one for backup (critical applications)
Exposed-tip / Housing-sealed / Insulated: Suitable for varying response speed and anti-interference requirements
Spring-buffered: For high-vibration environments (e.g., pump and compressor outlets), protecting the internal core

VII. Installation and Commissioning
7.1. Pre-installation Preparation
1. Verification of Components
Before installation, carefully check the completeness and conformity of the sensor and its accompanying components to prevent installation failures caused by missing parts or mismatched models. Items to verify include: the armored temperature sensor body (confirm that the sensing element type, sheath material, length, and outer diameter match the selection requirements), the junction box (including terminals and seals), installation accessories (threaded connectors, flanges, ferrules, mounting bolts, etc., compatible with the installation method), lead wires (confirm that the length and material are suitable for the operating conditions, and that there are no damages or breaks), explosion-proof components (if explosion-proof, verify explosion-proof junction boxes, sealing gaskets, explosion-proof gland heads, etc., to ensure they bear Ex certification marks), while also inspecting the sensor's exterior for deformation, the armored tube for damage, and the junction box for cracks.
2. Environmental Inspection
Conduct a comprehensive inspection of the installation site environment in accordance with the sensor's operating requirements to ensure the environment is suitable for sensor operation. First, regarding temperature conditions,verify that the ambient temperature in the installation area falls within the operating range of the junction box/transmitter module (-20 to +85°C) and the sensor body (depending on the armor tube material, -40 to +1300°C), and avoid temperatures exceeding these limits; Second, regarding the process environment, verify the type, corrosiveness, and pressure rating of the medium at the installation point to ensure compatibility with the armored conduit material and protection rating. In corrosive environments, confirm that the armored conduit has been properly treated for corrosion resistance; in high-pressure environments, check the pressure rating of the installation accessories; Third, regarding electromagnetic interference, avoid strong sources of electromagnetic interference such as variable frequency drives, high-voltage cables, and large motors. If avoidance is not possible, prepare shielded leads and implement anti-interference measures in advance; Fourth, installation space: Ensure the installation location has sufficient working space. In confined spaces, plan the bending path of the armored conduit in advance to prevent operational difficulties during installation.
3. Safety Precautions
Implement safety precautions before installation to eliminate potential hazards. Before installation in explosion-proof zones, confirm that power and gas supplies have been shut off on-site, check for explosive gas mixtures, and ensure compliance with Ex explosion-proof rating requirements. Installation is strictly prohibited in environments with live electrical circuits, pressurized systems, or flammable and explosive media; During installation in high-temperature or high-pressure conditions, wear heat-resistant and high-pressure protective gear to prevent burns and high-pressure impacts; for installations at heights, erect safety barriers and wear a safety harness; Before performing wiring operations, ensure that all relevant equipment (PLCs, DCS systems, transmitters) is powered off to prevent electric shock or signal short circuits. Additionally, operators must be familiar with sensor installation specifications and on-site safety procedures; non-compliant operations are strictly prohibited.
7.2 Standard Installation Steps
1. Mounting Installation
Based on the selected installation method, securely mount the sensor according to specifications to ensure a firm, wobble-free installation that is suitable for the on-site conditions. Threaded Installation: Select a threaded connector of the appropriate specification (M12×1.5, M20×1.5, G1/2", etc.). Screw the sensor's threaded end clockwise into the mounting base. Ensure the thread is screwed in deeply enough to achieve a tight seal and prevent loosening. If necessary, wrap Teflon tape to enhance the seal. Do not over-tighten, as this may damage the protective sleeve. Flange Installation: Secure the flange to the sensor, align it with the flange holes on the mounting base, insert bolts, and tighten them evenly to ensure the flange sealing surfaces fit tightly. This method is suitable for pressure ratings such as PN10/16/25. In high-temperature and high-pressure environments, install high-temperature-resistant gaskets; Ferrule Installation: Slide the ferrule over the armored tube, insert it into the mounting port, and tighten the ferrule nut. Ensure the ferrule fits tightly against the armored tube and the port to achieve a quick and secure connection. This method is suitable for confined spaces or temporary installations; Welded Installation: Weld the armored tube to the equipment or pipeline installation point. During welding, avoid high-temperature damage to the sensor core and insulation layer. After welding, remove slag and inspect the weld for leaks or cracks.
2. Insertion Depth Control
Insertion depth directly affects measurement accuracy and must be strictly controlled according to specifications to ensure the temperature-sensing element is in full contact with the measured medium. Pipe Temperature Measurement: The insertion depth must be ≥1/2 to 2/3 of the pipe's inner diameter and no less than 8 to 10 times the outer diameter of the sheathed tube. This prevents the sensor from contacting only the pipe wall, which could cause measurement values to be influenced by ambient temperature, resulting in low readings and significant fluctuations; Vessel Temperature Measurement: The insertion depth must be ≥2/3 of the vessel's depth to ensure the sensing element is deeply immersed in the medium, avoiding interference from the vessel wall, agitators, and other obstructions; Cryogenic and high-temperature conditions: The insertion depth should be appropriately increased to allow for temperature compensation, while avoiding excessive length of the armored cable that could lead to vibration damage; In confined spaces or special operating conditions, adjustments may be made based on actual requirements, but ensure the sensing element is fully immersed in the measured medium; if this cannot be achieved, replace with an ultra-fine armored model.

3. SealingSealing prevents media leakage and the ingress of moisture and dust into the sensor, which could damage the internal components or compromise insulation performance. Comprehensive sealing must be implemented according to the operating conditions. Threaded/flanged installation: Install a suitable gasket on the sealing surface (use high-temperature-resistant gaskets for high-temperature applications and corrosion-resistant gaskets for corrosive environments) to ensure there are no gaps or leaks; Terminal Box Sealing: Tighten the terminal box cover and verify that the sealing gasket is intact to prevent moisture and dust from entering. For outdoor, humid, or corrosive environments, use terminal boxes with an IP67 or IP68 protection rating. If necessary, install a sealing gland at the terminal box cable entry point; Explosion-proof environments: Sealing must comply with explosion-proof requirements. After tightening the terminal box cover, ensure there are no gaps. Tighten the cable after it passes through the explosion-proof cable gland to prevent explosive gas mixtures from entering the terminal box. Additionally, perform proper explosion-proof sealing in accordance with the relevant specifications of AQ 3009-2007.

4. Wiring Guidelines

Wiring must be performed according to standard procedures to avoid wiring errors or poor contact that could cause signal drift or measurement failure. First, organize the wires and distinguish between the temperature-sensing element wires (three-wire/four-wire RTDs, positive and negative terminals of thermocouples) and the transmitter signal wires to prevent confusion; When connecting wires, strip the insulation (to an appropriate length to avoid short circuits caused by excessively long bare sections), connect the wires to the corresponding terminals in the terminal box, and tighten the terminal screws to ensure a secure connection with no looseness or loose contacts. For RTDs, distinguish between the three or four wires; reverse connections are strictly prohibited. Four-wire connections improve measurement accuracy and are suitable for precision temperature measurement applications; For thermocouple wiring, strictly distinguish between positive and negative terminals (positive is typically red, negative is black/blue); reversing the connections will result in inverted measurement data and excessive errors. Additionally, use matching compensation leads to reduce cold-junction errors; wire routing must be neat and organized to avoid tangling or pulling; for outdoor wiring, ensure proper protection to prevent wire aging and damage caused by sun exposure and rain.

7.3 Wiring Diagrams and Requirements

1. Standard Wiring Diagram Instructions

Qidian armored temperature sensors have two wiring configurations; wiring must comply with the specifications for the specific sensor type: Resistance Temperature Detectors (RTDs) (PT100/PT1000/Cu50) Wiring: Three-wire configuration, with two leads connected to the power supply's positive and negative terminals, and one lead connected to the signal output. The corresponding terminals in the junction box are labeled "+", "-", and "S", and should be connected to the corresponding channels in the PLC/DCS; Four-wire connection: Two leads connect to the power supply, and two leads connect to the signal output. This effectively eliminates the influence of lead resistance and is suitable for high-precision measurements. Thermocouple (Type K/E/S/B) Wiring: The two leads are distinguished as positive and negative, corresponding to the terminals in the junction box labeled "+" and "-". Connect the positive lead to the positive terminal of the PLC/DCS signal, and the negative lead to the negative terminal. If using a transmitter module, connect the thermocouple leads to the transmitter module, which will then output a standard 4-20mA or 0-5V signal to the PLC/DCS.

2. Polarity Markings and Precautions

All terminals inside the junction box are clearly marked with positive and negative polarity. Connect the wires strictly according to the markings; reverse connections are strictly prohibited. Resistance Thermometers: There are no explicit positive or negative polarities, but wiring must correspond to the terminal markings to avoid measurement errors caused by incorrect connections; Thermocouples: The positive terminal (+) is typically a red lead, and the negative terminal (-) is a black or blue lead. Terminals marked "+" correspond to the positive terminal, and "-" corresponds to the negative terminal. Reversing the polarity will result in incorrect measurement data and may even damage the transmitter module; Transmitter-type sensors: The output terminals of the transmitter module are also labeled "+" and "-"; they must be connected to the corresponding signal channels on the PLC/DCS Reversing the polarity will result in no signal output or abnormal output.

3. Shielded Cable Grounding Requirements

To enhance interference resistance, sensor leads are typically equipped with a shielding layer. Shielded cables must be grounded according to standard procedures to prevent improper grounding from exacerbating interference. The shielded cable should be grounded at only one end, preferably at the PLC/DCS control cabinet end, with a grounding resistance of ≤4Ω. Grounding at both ends is strictly prohibited (as it creates a ground loop, introducing interference); In explosion-proof environments, grounding must comply with explosion-proof regulations. The shielding wire must be connected to a dedicated grounding busbar using copper cable (≥25 mm²). Sharing grounding wires with non-explosion-proof areas is prohibited. Additionally, ensure proper corrosion protection at the grounding point. Grounding connections must be secure and free of looseness to prevent faulty connections that could compromise shielding effectiveness and render the sensor unable to withstand strong electromagnetic interference.

4. Explosion-Proof Wiring Requirements

The wiring of explosion-proof armored temperature sensors must strictly comply with explosion-proof regulations to eliminate safety hazards. Wiring must be performed in an environment free of flammable or explosive media and with the power disconnected; the selected junction boxes, cable glands, and seals must all meet the corresponding explosion-proof rating (Ex d IIC T6/Ex ia IIC T6) and be compatible with the sensor's explosion-proof rating; when the lead wire passes through the explosion-proof cable gland, ensure a tight seal with no gaps; after tightening the cable gland, the lead wire should not be able to move freely; The length of exposed wiring inside the junction box should not be excessive to prevent short circuits between terminals. After wiring is complete, tighten the junction box cover to ensure a proper seal in accordance with the relevant requirements of GB 50058-2014; it is prohibited to arbitrarily disassemble the junction box within the explosion-proof zone. If maintenance is required, first verify on-site safety and confirm the absence of flammable or explosive media before proceeding.

7.4 Power-On and Commissioning Procedure

1. Signal Verification

Before powering on, recheck the wiring for correctness and the condition of the lead wire connections. After confirming everything is correct, connect the power supply (DC 24V ±10%) to the sensor and associated equipment (PLC/DCS, transmitter module). After power is applied, observe the transmitter module's indicator light (if present); under normal conditions, the light should remain steadily lit without flashing or turning off. Use a multimeter to measure the sensor's output signal: for resistance-type sensors, the measured resistance value must match the resistance value corresponding to the current ambient temperature (e.g., a PT100 has a resistance of approximately 109.73 Ω at 25°C); For thermocouple-type sensors, measure the thermoelectric potential; it must match the thermoelectric potential corresponding to the current ambient temperature; for transmitter-type sensors, measure the output signal; under no-load conditions, the 4–20 mA signal should stabilize at around 4 mA (when no temperature input is present). If the signal is abnormal, inspect the wiring, leads, and transmitter module.

2. Accuracy Verification

After confirming that the signal calibration is normal, perform accuracy verification to ensure the measurement data is accurate. Place the sensor in a medium with a known standard temperature (e.g., a constant-temperature water bath or oven). Once the temperature has stabilized, record the sensor's measured value and the standard temperature value, then calculate the measurement error. For Class A resistance thermometers, the accuracy error must be $\leq \pm(0.15 + 0.002|t|)$°C; for Class B, $\leq \pm(0.30 + 0.005|t|)$°C; For thermocouples, Class I error must be ≤±1.5°C or ±0.4%t, and Class II ≤±2.5°C or ±0.75%t; if the error exceeds the standard range, check the insertion depth and wiring; if necessary, perform calibration and adjustment to ensure accuracy meets requirements and avoid production control issues caused by substandard accuracy.

3. Troubleshooting

During commissioning, if signal abnormalities, measurement inaccuracies, or no output occur, promptly identify the cause and address the issue. Common Anomalies and Troubleshooting Methods: No signal output: Check if the power supply is normal, if the wiring is loose or reversed, or if the leads are damaged or broken;

in explosion-proof environments, verify that the seal is intact and the gland is securely tightened. Signal drift or significant fluctuations: Verify that the installation location is away from interference sources, that the shielding wire is properly grounded, and that the insertion depth is sufficient; also check if the medium flow is unstable. If necessary, adjust the installation position or reinforce the grounding. Excessive measurement deviation: Check whether the temperature-sensing element is damaged, the armored conduit is damaged, the accuracy meets specifications, or the wiring is incorrect; promptly replace damaged components and recalibrate; Transmitter module indicator flashing: Check whether the power supply voltage is stable, the module is damaged, or the wiring between the sensor and the module is faulty.

7.5. Installation Precautions

1. Never forcefully bend the armored conduit

The armored tube is flexible but must strictly adhere to bending radius requirements (standard: ≥5× outer diameter; flexible custom: ≥3× outer diameter). Do not forcefully bend, over-bend, or repeatedly bend the tube, as this may cause the inner core (temperature-sensing element, insulating filler) to fracture or the insulation to fail, resulting in sensor failure. It may also compromise the armored tube's seal integrity, leading to medium leakage. When bending, proceed slowly and follow a reasonable path to ensure the armored tube remains free of deformation or cracks after bending.

2. Strictly Prohibit Use Beyond Rated Temperatures

The sensor's temperature measurement range must strictly match the operating conditions; use beyond the rated temperatures of the sheath material and sensing element is strictly prohibited. For example, PT100 resistance thermometers must not be used in environments exceeding 650°C, Type K thermocouples must not be used in environments exceeding 1300°C, and 304 stainless steel sheaths must not be used in environments exceeding 800°C; Exceeding the rated temperature will cause the sensing element to burn out, the sheath to deform, and the insulation to age and fail, shortening the sensor's service life and potentially creating safety hazards. For high-temperature applications, select the appropriate high-temperature alloy sheath and thermocouple model.

3. Strictly Prohibit Sealing Failure

Sealing is critical for the stable operation of the sensor. Installation and use are strictly prohibited if the seal is compromised or the sealing components are damaged. Sealing failure can allow media (especially corrosive, high-temperature, or high-pressure media) to enter the sensor, damaging the core and terminal blocks, resulting in measurement failure and sensor scrapping. It may also cause media leakage and safety incidents. Inspect the seal after installation and conduct regular checks during operation. If aging or damaged sealing components are found, replace them promptly.

4. Strictly Prohibit Wiring Near Strong Interference Sources

When routing signal wires, never run them parallel to high-voltage cables, variable frequency drives, motors, or other strong sources of electromagnetic interference. Never wrap signal wires around equipment that generates interference. Doing so will introduce electromagnetic interference, causing signal drift, inaccurate measurements, or a loss of signal output. When routing cables, maintain a distance of ≥50 cm from strong interference sources. Shielded cables should be used whenever possible, and proper grounding of the shielding must be ensured. Additionally, avoid pulling or damaging the cables to prevent interference signals from entering through damaged areas and affecting the sensor's normal operation.

Additional Notes: After installation and commissioning are complete, maintain detailed records noting the installation location, sensor model, commissioning data, and installation date to facilitate future maintenance and calibration. During routine operation, periodically inspect the sensor's secure mounting, sealing integrity, and lead condition, and perform regular accuracy calibration to ensure long-term stable operation of the sensor.

VIII: Recommendations for Daily Use and Maintenance

The stable operation of Qidianjia armored temperature sensors relies on proper daily use and scientific maintenance management. This module outlines the key points for daily inspections, periodic maintenance, long-term upkeep, and parameter backup, taking into account the product's structure (armored protection, transmitter modules, etc.) and the characteristics of industrial operating conditions.

It helps users extend product lifespan, ensure measurement accuracy, and reduce operational costs, and is applicable to the entire series of armored temperature sensors (RTDs/thermocouples, including models with transmitter functions).

8.1 Key Points for Daily Inspections (Once per day/shift; rapid hazard identification)

Daily inspections focus on "rapid identification and timely warning," with an emphasis on checking the sensor's operational status. Requiring no complex tools, these inspections are quick, targeted, and effective in preventing minor issues from escalating.

1. Visual Inspection

Focus on inspecting the sensor body and external structure to identify physical damage and abnormal wear: Check the armor tube for bending, cracks, deformation, or damage, particularly at bends and welded/fixed joints. If the 304 stainless steel armor tube in high-temperature zones appears deep blue or iridescent, this indicates severe metal oxidation and reduced strength, requiring immediate attention; Inspect the junction box to ensure there is no damage or cracking, that the box cover is properly sealed, and that there is no loosening or detachment; check that the lead wires show no damage, aging, or signs of pulling. In explosion-proof environments, additionally verify that explosion-proof cable glands and sealing gaskets are not missing or damaged to ensure compliance with explosion-proof requirements; simultaneously verify that the sensor's installation position is not misaligned or loose to prevent displacement caused by equipment vibration.

2. Signal Stability Check

Observe the stability of temperature readings via the PLC/DCS control system or on-site display instruments: Under normal operating conditions, readings should fluctuate smoothly without frequent spikes or abnormal drift (drift must not exceed the permissible accuracy range); If signal fluctuations, no display, or excessive measurement deviations occur, conduct an initial investigation to determine whether the issue is caused by interference, loose wiring, or abnormal medium flow; for models with transmitter functionality, use a multimeter to measure the output signal (4-20mA/0-5V, etc.) to confirm that the signal is stable, shows no significant fluctuations, and matches the actual on-site temperature.

3. Sealing and Wiring Condition Inspection

Sealing performance directly affects the sensor's service life, while wiring conditions determine signal transmission stability: Inspect the sealing of the junction box to ensure no moisture or dust has entered. In outdoor, humid, or corrosive environments, verify that the sealing gasket is intact and shows no signs of aging or cracking. Check that the terminal screws are tight and free of corrosion, and ensure that the leads are securely connected with no loose connections or short circuits. Verify that the leads for resistance temperature detectors (RTDs) and thermocouples are not reversed; In explosion-proof environments, ensure the junction box cover is securely tightened and that leads passing through explosion-proof cable glands are tightly sealed with no gaps to prevent the ingress of explosive gas mixtures; inspect sealing points at pipe and vessel connections for media leaks, particularly in high-temperature, high-pressure, or corrosive conditions; immediately shut down operations and address any detected leaks.

8.2. Regular Maintenance Plan (Performed on a scheduled basis to ensure long-term stability)

Regular maintenance schedules should be established based on the intensity of operating conditions, with a focus on "cleaning, tightening, calibration, and troubleshooting" to prevent component aging and loss of accuracy caused by prolonged operation. Specific intervals may be adjusted appropriately according to on-site conditions (e.g., high temperature, corrosion, severe vibration).

1. Cleaning Frequency and Methods

Cleaning Frequency: Once a month for standard operating conditions (no significant dust or corrosion); once a week for dusty, oily, or corrosive conditions; after each use (or twice a week) for food, pharmaceutical, and sanitary applications. Cleaning Method: Use a dry, lint-free cloth or soft-bristled brush to gently wipe dust and oil from the surface of the junction box and the armored conduit. Avoid using corrosive cleaning agents; The interior of the junction box may be periodically (every 3 months) blown out with dry compressed air (pressure < 0.2 MPa) to remove conductive dust from the terminals, preventing signal abnormalities caused by increased contact resistance; in sanitary applications, wipe with a neutral detergent compliant with GMP

requirements, rinse thoroughly with pure water after cleaning, and allow to air dry before reuse to prevent detergent residue from contaminating materials.

2. Fastening Inspection

Inspection Frequency: Once a month; once every 15 days in high-vibration environments (e.g., metallurgy, power generation). Inspection Items: Tighten the terminal screws, as thermal expansion and contraction, as well as equipment vibration, can cause screws to loosen, resulting in contact resistance and affecting measurement accuracy; Inspect the bolts securing the sensor mounting points (threads, flanges, ferrules) to ensure they are tight and free of looseness, preventing sensor displacement or vibration-induced damage to the protective sheath; check the tightness of explosion-proof junction boxes and cable glands to ensure proper sealing; inspect the lead wire retention clips to prevent pulling or wear, thereby extending the service life of the lead wires.

3. Accuracy Retest

Accuracy retest frequency: Once every 6 months under normal operating conditions; once every 3 months in high-precision control applications and high-temperature environments (>800°C); immediately after maintenance or replacement of core components. Verification Method: Place the sensor in a medium with a known standard temperature (e.g., a constant-temperature water bath or oven). Once the temperature has stabilized, compare the sensor's measured value with the standard temperature value to calculate the measurement error. For resistance thermometers, Class A accuracy error must be $\leq \pm(0.15 + 0.002|t|)$°C, and Class B $\leq \pm(0.30 + 0.005|t|)$°C; For thermocouples, Class I accuracy requires an error of ≤±1.5°C or ±0.4%t, and Class II requires ≤±2.5°C or ±0.75%t; if the error exceeds the standard range, the sensor must be calibrated and adjusted promptly, or the manufacturer must be contacted for professional calibration; use beyond the tolerance limits is strictly prohibited. Calibration must use a standard temperature source (accuracy ±0.1°C) with data points spaced at 150°C intervals; extrapolation to calculate deviations is prohibited.

4. Corrosion Inspection of Sheath Tubes

Inspection Frequency: Once every month under corrosive conditions; once every three months under normal conditions. Inspection Items: Visually inspect the sheath surface for corrosion spots, rust, or peeling, particularly in areas directly exposed to the medium; gently touch the sheath to check for damage or perforations. If the sheath is found to be thinned or has corrosion perforations, it must be replaced immediately to prevent the medium from entering and damaging the temperature-sensing element; For corrosion-resistant sheaths such as 316L and Hastelloy, inspect the surface coating for peeling. If peeling is detected, address it promptly to extend the sheath's service life. Additionally, inspect the bent sections of the sheath for fatigue damage; if cracks are found, replace the sheath immediately to prevent breakage.

8.3 Long-Term Maintenance Tips (Daily Practices to Extend Service Life)

The core of long-term maintenance is "prevention first." By combining product characteristics with operating conditions and implementing simple, effective procedures, component wear can be reduced, operational performance optimized, and failure rates lowered.

1. Dust and Moisture Protection

Keep the junction box dry and clean, preventing moisture and dust from entering. When used outdoors, install a rain cover to prevent rainwater from soaking the junction box. In humid or foggy environments, inspect the interior of the junction box for condensation on a regular basis (once a month). If condensation is present, open the box cover to air it out; if necessary, place a desiccant (such as silica gel) inside to prevent condensation from causing terminal corrosion or reduced insulation performance. Sensors that will be out of service for an extended period should be removed, thoroughly cleaned, and stored in a dry, well-ventilated environment to prevent damage from moisture and dust. Store them in a vertical, suspended position; never lay them flat or stack them, as this may cause the armored cable to bend or damage the inner core.

2. Maintenance to Prevent Mechanical Damage

Avoid impacts, compression, or forced bending of the armored cable. Strictly adhere to the bending radius requirements (standard: ≥5× the outer diameter of the armored cable; flexible custom: ≥3× the outer diameter). When bending, proceed slowly and follow a reasonable path. Excessive or repeated bending is strictly prohibited to prevent breakage of the inner core (temperature-sensing elements and insulating filler). During equipment maintenance and on-site operations, avoid tools colliding with or scratching the armored tube and junction box. When installing or removing the sensor, handle it gently and avoid pulling on the lead wires to prevent breakage or loose connections. In environments with strong vibrations, install spring buffer devices to reduce vibration-induced damage to the sensor and extend its service life. When shutting down the system, wait until the furnace temperature drops below 200°C before removing the sensor to prevent thermal stress cracks in the armored tube caused by rapid cooling from high temperatures.

3. Anti-Interference Optimization and Maintenance

Keep sensor leads at a distance of no less than 50 cm from strong electromagnetic interference sources such as high-voltage cables, variable frequency drives, and large motors. Parallel routing or wrapping the leads around such equipment is strictly prohibited. Regularly inspect the shielding layer of shielded leads; if damaged, replace them promptly to ensure effective shielding. Properly inspect the grounding of the shielded cable to ensure that only one end (the PLC/DCS control cabinet end) is grounded, with a grounding resistance of ≤4 Ω. Grounding at both ends is prohibited to prevent the formation of ground loops that introduce interference. For models with transmitter functionality, regularly check the grounding status of the transmitter module to ensure proper grounding and minimize the impact of electromagnetic interference on the signal. If on-site interference is severe, install an anti-interference device to optimize signal transmission stability.

IX. Troubleshooting & Emergency Response

This module compiles common faults encountered in industrial settings for the entire series of Qidianjia armored temperature sensors (including RTDs, thermocouples, and integrated transmitter models). It provides clear cause analyses, step-by-step troubleshooting solutions, and emergency replacement plans, along with comprehensive after-sales repair guidelines. This helps on-site personnel quickly resolve issues, resume production, and minimize downtime losses.

9.1 List of Common Faults

In industrial applications, common faults with armored temperature sensors fall into five major categories: signal transmission, measurement accuracy, insulation performance, and wiring connections. These cover the vast majority of abnormal operating conditions, as detailed below:

---No Signal/No Display: The control system displays no temperature values or shows a black screen; transmitter models produce no 4–20 mA current output; a multimeter detects no signal feedback

- --Signal Drift/Fluctuation: Temperature readings fluctuate up and down without cause, gradually drift higher or lower, exhibit irregular jumps, or fail to stabilize

- --Inaccurate Measurement/Excessive Deviation: Significant discrepancy between measured values and actual temperature; error far exceeds the allowable accuracy range; values consistently deviate

--- Poor Insulation: Low insulation resistance; severe signal interference; frequent failures in humid environments; potential risk of electrical leakage

- -- Wiring Faults: Overheating or arcing at connection points; corroded or loose terminals; poor circuit contact; intermittent disconnections

9.2, Analysis of Fault Causes

1. No Signal/No Display

The primary causes are typically issues with power supply, wiring, or component open circuits: power loss in the transmitter module or loose power connections; broken or shorted leads; loose or detached terminals; damaged sheaths allowing water ingress, resulting in the destruction of temperature-sensing elements or internal circuit open circuits; damage to the integrated transmitter module preventing normal operation; complete reversal of thermocouple polarity; or incorrect wiring of resistance temperature detectors (RTDs).

2. Signal Drift/Fluctuation

Primarily caused by interference, contact issues, or environmental factors: strong electromagnetic interference at the site (from inverters, high-voltage switchgear, or running motors); shielded cables grounded incorrectly or not grounded at all; Loose or corroded terminal blocks, resulting in unstable contact resistance; minor damage to the armored tube allowing moisture to penetrate the interior and dampen the insulation; ground potential differences creating loop interference; unstable flow velocity at the measurement point and severe temperature fluctuations.

3. Inaccurate Temperature Measurement/Excessive Deviation
Measurement accuracy issues are often related to components, installation, and selection: aging or damaged temperature-sensing elements with degraded performance; insufficient insertion depth during installation, resulting in the probe not being fully immersed in the medium and being affected by tube wall or surface temperatures; incorrect use of thermocouple compensation leads or reversed polarity; failed cold-junction compensation; incorrect range settings or misconfigured transmitter module parameters; excessive scaling or dust accumulation on the armored tube, obstructing heat transfer.
4. Poor Insulation
Deterioration in insulation performance is often caused by protective failure or material aging: failed sealing of the junction box, allowing moisture and dust to enter; damaged or cracked sheath, allowing the medium or moisture to penetrate, causing the magnesium oxide insulation filler to become damp; damaged insulation on the lead wires, resulting in contact with the metal housing; long-term high-temperature operation, causing the insulation material to age and fail; incorrect grounding, creating a leakage current path.
5. Wiring Faults
Wiring issues are often caused by improper installation or long-term wear and tear: terminal screws not tightened, loosening due to prolonged vibration; mismatched wire specifications, with excessively thin wires causing overheating; corroded or oxidized terminals resulting in poor contact; explosion-proof cable glands not properly sealed, allowing moisture to corrode terminals; disorganized wiring, with cables crushed or damaged, leading to short circuits.
General Common Causes
Damage, corrosion, or perforation of the armored conduit; burnout or aging failure of temperature-sensing elements; lack of protection against environmental interference; non-standard installation or mismatched model selection; prolonged operation under excessive temperature, pressure, or vibration, accelerating component damage.
9.3 Step-by-Step Troubleshooting
(1) No Signal/No Display: Step-by-Step Troubleshooting
Step 1: Check Power Supply (Prioritize Transmitter-Type Modules)
Use a multimeter to measure the module's supply voltage and confirm that the 24 VDC is normal, with no undervoltage or power loss. Inspect the power supply wiring and tighten the positive and negative terminals to rule out loose connections or disconnections.
Step 2: Check Circuit Continuity
Disconnect the power supply. Using the continuity test function on a multimeter, check whether the sensor leads and terminals are conductive; inspect the leads for breaks or damage, paying particular attention to bent sections and the openings of conduit pipes.
Step 3: Verify Wiring Correctness
Refer to the wiring diagram to verify the three-wire/four-wire connections for resistance temperature detectors (RTDs) and the positive/negative polarity for thermocouples; correct any reversed or incorrect connections; clean any oxidation from the terminals and retighten the screws.
Step 4: Inspect Sensors and Modules
Measure the resistance or thermoelectric potential of the temperature-sensing elements to determine if they are open-circuited or damaged; if the power supply and wiring are normal but there is still no signal, this indicates that the transmitter module or internal core is damaged; perform an emergency replacement.
Emergency Procedure
Immediately replace with a spare sensor of the same specification, quickly complete the wiring and mounting, and resume temperature measurement; as a temporary measure, short-circuit the signal terminals for preliminary diagnosis. Under no circumstances should explosion-proof models be replaced while energized.
(II) Signal Drift/Fluctuation Step-by-Step Troubleshooting
1: Eliminate Electromagnetic Interference
Check whether the cable runs parallel to high-voltage cables or variable frequency drives; reroute the cable to maintain a safe distance. Ensure shielded cables are grounded at a single point with a grounding resistance ≤4Ω; avoid grounding at both ends.
Step 2: Tighten Terminal Connections
Tighten all terminal connections one by one, remove rust and oxidation layers to ensure good contact; replace aged or damaged leads, and secure the wiring to prevent movement.
Step 3: Inspect Moisture Seals
Open the junction box to check for condensation or water accumulation; wipe dry and use a heat gun to dry thoroughly; replace the sealing gasket. Immediately replace any damaged junction boxes and ensure proper sealing.
Emergency Measures
Install signal isolators and anti-interference modules to stabilize signal output; temporarily relocate the sensor to a location with minimal interference for temperature measurement, and perform a thorough overhaul after the system is shut down.
(3) Inaccurate Temperature Measurement / Excessive Deviation: Step-by-Step Troubleshooting
Step 1: Verify Installation and Operating Conditions
Check if the insertion depth meets specifications and ensure the probe is fully immersed in the medium; clean dirt and coke deposits from the sheath surface to ensure proper heat transfer.
Step 2: Verify Wiring and Accessories
Check if the thermocouple compensation leads are properly matched and correct polarity; confirm that cold-junction compensation is functioning normally, with no failures or damage.
Step 3: Accuracy Retest and Calibration
Compare measurements against a standard temperature source to assess element accuracy; recalibrate the transmitter module parameters, correcting range and zero-point deviations.
Emergency Plan
Replace with a spare sensor that meets accuracy standards; temporarily use a portable temperature meter for comparative monitoring to ensure production oversight.
(4) Poor Insulation: Step-by-Step Troubleshooting
Step 1: Measure Insulation Resistance
Use a 500V megohmmeter to measure; insulation resistance at room temperature should be ≥1000 MΩ. A value below this indicates insulation failure.
Step 2: Locate Points of Moisture or Damage
Inspect the sealing of junction boxes and the integrity of the armored conduit; seal any damaged areas; dry moisture-affected components; replace damaged armored conduits and seals.
Step 3: Rectify Grounding Wiring
Standardize grounding circuits to eliminate leakage and cross-current; replace leads with damaged insulation and apply protective treatment.
Emergency Plan
Deactivate and isolate the faulty sensor, and replace it with a spare; install moisture-proof and waterproof sleeves in damp environments to prevent the fault from escalating.
(5) Wiring Faults: Step-by-Step Troubleshooting
Step 1: Power Off and Inspect Wiring
After completely disconnecting power, inspect terminals for signs of overheating or arcing, and replace any burnt terminals; re-wire according to specifications and tighten all mounting screws.
Step 2: Replace Damaged Cables
Replace damaged or aged cables with appropriate gauge; organize wiring to prevent crushing or pulling.
Step 3: Ensure Proper Sealing and Protection
Tighten explosion-proof cable glands and replace sealing gaskets to prevent moisture corrosion; install waterproof protective boxes for outdoor wiring.
Emergency Procedures
Temporarily replace with spare terminals and wiring to quickly restore connections; strictly prohibit working on overheating or arcing faults while the system is energized to prevent short circuits and electric shock.
9.4, After-Sales Repair Guidelines
1. Fault Diagnosis (Confirm Before Reporting)
First, conduct a basic troubleshooting to rule out external causes such as human wiring errors, power supply abnormalities, improper installation, or environmental interference; confirm sensor unit faults: non-human-induced damage issues such as damaged armor tubing, burnt-out inner core, insulation failure, damaged transmitter module, or component aging; preserve the fault scene, take photos to document the fault symptoms, and have the product model, serial number, and purchase date ready to improve repair efficiency.

2. Repair Process

Step 1: Contact After-Sales Support

Initiate a repair request via the official hotline, online customer service, or regional sales channels, clearly stating the product model, fault symptoms, operating conditions, and purchase date.

Step 2: Submit Information

As required by after-sales support, provide photos of the fault, troubleshooting records, and product nameplate information to assist technicians with remote fault diagnosis.

Step 3: Repair and Resolution

Simple faults can be repaired following remote guidance; For issues that cannot be resolved on-site, return the product for repair or request on-site service as guided by after-sales support; explosion-proof and special models must not be disassembled or repaired by unauthorized personnel and must be handled by qualified professionals.

Step 4: Acceptance and Closure

After repair or replacement is complete, power on the unit for testing to confirm normal signal and accuracy. Complete the acceptance process and retain the repair record.

3. Warranty Coverage

Standard Warranty Coverage (Free Repair/Replacement): Faults caused by material defects or manufacturing issues in the product itself; Performance failures or component damage resulting from non-human factors under normal operating conditions.

Outside Warranty Coverage (Charged Repairs): Damage caused by misuse, such as operating beyond temperature, pressure, or corrosion limits; faults resulting from accidental impact, forced bending, or unauthorized disassembly; damage caused by incorrect installation, wiring errors, or improper maintenance; damage due to force majeure or on-site accidents; product failures occurring after the warranty period has expired.

4. Contact Information

Official After-Sales Hotline: 19715617532 (Weekdays 9:00 AM–6:00 PM)

Regional Technical Support: Contact your assigned sales engineer to arrange on-site repair services

Repair Request Email: sales008@qd-zdk.com (Please include the product model and details of the malfunction)