Troubleshooting Manual

This section contains the core content of the manual and provides standardized troubleshooting and resolution procedures for various types of faults commonly encountered in industrial settings.

A. Signal Output-Related Faults

Fault Symptoms	Possible Causes	Troubleshooting Steps	Solutions
1. No output signal (PLC displays 0 mA or no reading)	1. 24V power supply missing or voltage too low 2. Signal wire break or loose connection 3. Positive and negative terminals reversed 4. Internal module/transmitter burned out 5. Internal open circuit in the Pt100 resistance thermometer	1. Use a multimeter to check if the supply voltage at the terminal block is normal. 2. Test the signal circuit for continuity and check whether the terminals at both ends are loose. 3. Refer to the schematics and verify the polarity of the compensation leads/signal wires. 4. Remove the sensor, short-circuit the input terminals, and observe whether the PLC responds. 5. Measure the resistance of the sensor body to determine if it is infinite.	1. Restore power or replace the power supply module. 2. Re-crimp the terminals or replace any broken wires. 3. Correct the wiring polarity. 4. Replace the damaged transmitter module. 5. Install a new temperature sensor.
2. Output signal remains at full scale (e.g., consistently at 20 mA or over-range alarm)	1. Internal short circuit in the Pt100 resistance thermometer 2. Actual temperature exceeds the upper limit of the instrument's set range 3. Incorrect range parameter settings 4. Signal wire shorted to ground	1. Check whether the sensor's resistance is close to 0 Ω. 2. Use a portable temperature meter to compare with the actual on-site temperature. 3. Check the internal range settings of the PLC/DCS or transmitter. 4. Measure the insulation resistance between the signal wire and ground.	1. Replace the short-circuited RTD sensor. 2. Expand the instrument's measurement range or replace the sensor with a high-temperature-resistant model. 3. Recalibrate and set the correct range parameters. 4. Repair damaged cables and ensure proper insulation and shielding.
3. Output signal is unstable, fluctuates, or exhibits significant variations	1. Loose or oxidized terminal blocks 2. Incorrect shield grounding or multiple grounding points 3. High-voltage interference from inverters, motors, etc. 4. Water ingress or condensation inside the housing 5. Probe affected by mechanical vibration	1. Retighten the terminal blocks and polish off any oxidation. 2. Inspect the shielded cable to ensure it is grounded at only one end in the control room. 3. Check whether the signal wires are laid parallel to power lines. 4. Open the junction box and check for moisture or condensation. 5. Check whether the mounting bracket is secure and whether the medium flow velocity is causing resonance.	1. Tighten the terminals and replace the terminal blocks if necessary. 2. Standardize the shield grounding procedure. 3. Route signal wires through metal conduits for isolation and install a filter. 4. Dry out internal moisture and replace the waterproof connector or gasket. 5. Reinforce the mounting or replace the sensor with a vibration-resistant armored model.
4. Output signal drift (zero-point or full-scale drift)	1. Internal insulating powder has absorbed moisture, causing a drop in insulation resistance 2. Aging of the transmitter's electronic components 3. Cold-junction compensation failure due to drastic changes in ambient temperature	1. Measure the insulation resistance between the sensor's positive and negative terminals and ground. 2. Observe whether the drift follows a pattern (e.g., changes with diurnal temperature variations). 3. Check the junction box seal and the ambient temperature conditions.	1. Bake the sensor to remove moisture; replace it if it cannot be restored. 2. Recalibrate the transmitter or replace it with a new unit. 3. Improve the insulation and heat dissipation conditions in the junction box to ensure a stable cold-junction temperature.

B. Measurement Accuracy-Related Faults

Symptoms	Possible Causes	Troubleshooting Steps	Solutions
5. High measured temperature (displayed value higher than actual)	1. Insufficient insertion depth; affected by ambient thermal radiation. 2. Thick scale buildup on the outer wall of the protective sheath, causing abnormal heat transfer. 3. Mismatch between the compensation leads and the thermocouple. 4. Reference junction (cold junction) temperature is too high.	1. Verify that the insertion depth is between 1/2 and 2/3 of the pipe diameter. 2. Check the casing surface for severe coking or scaling. 3. Verify the calibration number markings on the compensation leads. 4. Measure the ambient temperature inside the junction box.	1. Replace with a longer probe or adjust the installation position. 2. Clean scale buildup from the protective sleeve surface. 3. Replace with compatible compensation leads. 4. Improve ventilation and heat dissipation in the junction box, or switch to a cold-junction design.
6. Low measured temperature (displayed value lower than actual)	1. Poor contact between the sensing element and the sheath wall. 2. Insufficient insertion depth; not in contact with the core medium. 3. Extremely low medium flow velocity; insufficient heat exchange. 4. Deterioration of the thermocouple electrodes	1. Check whether the sensor is loose or improperly installed. 2. Confirm the insertion depth and the direction of the medium flow. 3. Check the valve opening and flow velocity in the process pipeline. 4. Compare with a standard temperature meter to determine if material degradation has occurred.	1. Retighten the mounting threads. 2. Increase the insertion depth or install against the flow. 3. Adjust process parameters, or select a sensor with a smaller tube diameter or a thin-film design. 4. Replace with a new thermocouple sensor.
7. Decreased measurement accuracy/large error	1. Exceeds the permissible error specified by national standards (typically ±3°C) 2. Material aging or manufacturing defects 3. Measurement range setting does not match actual operating conditions	1. Perform multi-point comparisons using a high-precision portable temperature meter. 2. Check the sensor's service life and the severity of operating conditions. 3. Verify the control system's range parameters.	1. If the error exceeds the allowable tolerance and cannot be calibrated, replace the sensor immediately. 2. Select a product with a higher material grade for harsh operating conditions. 3. Reset the correct measurement range.
8. Slow temperature response/ lag	1. Thick scale buildup on the exterior of the probe 2. Protective sheath wall is too thick 3. Extremely low medium flow velocity 4. Sensor inserted too deeply or too shallowly	1. Check the cleanliness of the protective sleeve's surface. 2. Verify the selected pipe diameter and wall thickness. 3. Evaluate the process flow velocity. 4. Check the installation location.	1. Shut down the system to remove scale buildup. 2. Replace with a smaller-diameter or thin-walled armored sensor. 3. Improve the flow conditions of the medium. 4. Adjust to the optimal insertion depth.

C. Hardware-Related Failures

Fault Symptoms	Possible Causes	Troubleshooting Steps	Solutions
9. Sensor open circuit (displays "infinity" or open-circuit alarm)	1. Internal lead wire breakage within the armor (partially broken) 2. Open circuit in external wiring or loose terminal 3. Internal solder joints coming loose due to severe vibration	1. Measure the resistance/potential of the sensor body. 2. Check the external wiring circuit. 3. Check the mounting bracket and the vibration of the medium.	1. Replace the sensor. 2. Rewire and tighten the connections. 3. Install vibration-damping mounts; select vibration-resistant products.
10. Sensor short circuit	1. Insulation breakdown caused by moisture in the internal insulating powder 2. Insulation failure between thermoelements 3. Short circuit caused by metal foreign objects between terminals	1. Measure the resistance between the two electrodes. 2. Check the cleanliness inside the junction box. 3. Check the insulation resistance.	1. Dry or replace the sensor. 2. Remove foreign objects and reinforce the seal. 3. Replace with a qualified product.

11. Corrosion/damage to the protective conduit	1. The corrosiveness of the medium exceeds the material's tolerance range. 2. Abrasive wear caused by the medium. 3. High-temperature oxidation.	1. Shut down the unit and inspect the outer casing. 2. Analyze the composition and flow rate of the medium. 3. Verify the temperature and corrosion resistance parameters of the material.	1. Upgrade the liner material (e.g., switch to 316L or Hastelloy) 2. Install a wear-resistant liner or adjust the installation angle 3. Shorten the replacement cycle and increase the frequency of inspections
12. Water ingress/moisture in the junction box	1. The cable entry hole is not installed facing downward. 2. The waterproof connector is worn out or not tightened properly. 3. The housing gasket is damaged.	1. Inspect the installation orientation and waterproof connectors. 2. Open the junction box and inspect the interior. 3. Inspect the gasket on the flameproof joint.	1. Adjust the installation orientation and tighten the joints 2. Dry the interior and replace the gasket 3. Replace the seals and apply anti-rust grease
13. Failure of the explosion-proof junction box seal	1. The flameproof surfaces have been bumped or scratched. 2. Fastening bolts are missing or loose. 3. The gasket has aged and lost its elasticity.	1. Visually inspect the flameproof joint surface. 2. Check the integrity of the bolts. 3. Press the gasket to check its elasticity.	1. Minor scratches can be sanded out; replace the housing for severe damage. 2. Replenish and tighten the bolts. 3. Replace the original explosion-proof gasket.

D. Installation and Usage Issues

Fault Symptoms	Possible Causes	Troubleshooting Steps	Solutions
14. Insufficient insertion depth	1. Incorrect model length selected 2. Installation base/sleeve is too long 3. Pipe diameter changes were not recalculated	1. Measure the actual insertion length. 2. Verify that the pipe dimensions on-site match those in the drawings.	1. Replace the sensor with one of the appropriate length. 2. Shorten the protective sleeve or replace the base. 3. Recalculate and select the appropriate model.
15. Improper installation location	1. Installed in a dead end or vortex zone 2. Installed downstream 3. Located near a heating/cooling source	1. Check the process piping drawings. 2. Observe the flow conditions of the medium.	1. Relocate the temperature measurement point to a straight pipe section. 2. Install the sensor in the counter-current direction. 3. Avoid local heat sources.
16. Incorrect use of compensation leads	1. Incorrect temperature coefficient (e.g., using Type E wire with a Type K sensor) 2. Reversed positive and negative terminals 3. Damaged wire insulation	1. Verify wire markings 2. Measure thermocouple polarity 3. Check circuit insulation	1. Replace with compatible compensation leads. 2. Reverse the wiring polarity. 3. Replace damaged wires.
17. Interference caused by poor grounding	1. External ground wire not connected 2. Ground resistance exceeds specifications 3. Shared ground with high-voltage power lines	1. Check ground wire connections 2. Measure ground resistance 3. Inspect the grounding busbar	1. Ensure a reliable connection to the external ground terminal 2. Re-fabricate the grounding electrode 3. Use a dedicated instrument ground
18. Insufficient bend radius	1. Forced bending during installation 2. Insufficient clearance due to space constraints	1. Inspect the bent sections of the probe 2. Measure the bending radius	1. If the interior is damaged, replace the unit 2. Re-plan the installation space to ensure a clearance of ≥5 times the outer diameter

E. Explosion-Proof Safety-Related Faults

Fault Symptoms	Possible Causes	Troubleshooting Steps	Solutions
19. Damage to the explosion-proof surface	1. Impact while opening the cover 2. Rust not removed 3. Rough handling during disassembly and reassembly	1. Carefully inspect the mating surfaces. 2. Use a feeler gauge to check the clearance.	1. Sand and repair minor damage. 2. Replace the housing if severely deformed. 3. Follow standard operating procedures and apply anti-rust grease.
20. Expired or mismatched explosion-proof certification	1. Changes in the on-site environment 2. Product replacement not reviewed	1. Verify the on-site explosion-proof zone classification. 2. Inspect the product nameplate and certificates.	1. Select a new model to ensure the explosion-proof rating matches. 2. Replace with a compliant product.
21. Improper operation involving opening the cover while the equipment is energized	1. Lack of safety awareness 2. Failure to follow LOTO procedures	1. Review the operating records. 2. Check the status of the “Power Off” tags.	1. Never open the cover while the device is energized. 2. Strictly follow the procedures for power disconnection, voltage testing, and tagging.
22. Grounding resistance exceeds the specified limit	1. Broken grounding wire 2. Dry soil 3. Corrosion at connection points	1. Measure using a ground resistance tester. 2. Check the grounding grid connections.	1. Repair the grounding wire. 2. Add a grounding electrode or resistance-reducing agent. 3. Remove rust and tighten the connecting bolts.

F. Environment-Related Failures

Failure Symptoms	Possible Causes	Troubleshooting Steps	Solutions
23. Transmitter damage caused by high temperatures	1. Ambient temperature exceeds limits 2. Cold-end configuration not used 3. Insufficient heat dissipation	1. Measure the surface temperature of the junction box. 2. Inspect the mounting structure.	1. Install a heat sink or extension neck. 2. Replace the cold-junction sensor. 3. Improve ventilation or install a sunshade.
24. Damage caused by corrosive media	1. Incorrect material selection 2. Corrosion of the casing welds	1. Analyze the composition of the medium. 2. Inspect the corroded areas.	1. Upgrade to corrosion-resistant materials. 2. Add a corrosion-resistant coating or protective sleeve.
25. Internal wire breakage caused by vibration	1. Near the pump/compressor 2. Cavitation/water hammer in the medium 3. Loose mounting brackets	1. Measure the vibration amplitude. 2. Inspect the fastenings.	1. Install shock absorbers. 2. Select vibration-resistant or oil-filled sensors. 3. Reinforce the mounting brackets.
26. Signal abnormalities caused by electromagnetic interference	1. Connected in parallel with the variable-frequency drive 2. No shielding or poor grounding 3. Spatial radiation interference	1. Inspect the cable routing. 2. Inspect the shielding.	1. Run the cable through a metal conduit 2. Ensure the shield is reliably grounded at one end 3. Add a signal isolator