Tuning Fork Level Switch

I. Product Definition

A tuning fork level switch is a **point-level detection instrument based on the principle of vibrational resonance** that can be used to detect the presence or absence of liquids, slurries, powders, and granular solids, enabling high-level overflow alarms, low-level bin protection, pump start/stop interlocks, and silo low-level/full-level alarms.

The complete instrument consists of a **tuning fork sensor, a piezoelectric vibration driver, a signal detection circuit, a housing chamber, and electrical connection terminals**.

It is divided into multiple series based on structure and operating conditions:

1. By operating condition: Standard, High-Temperature, and Corrosion-Resistant;
2. By fork size: Small, Standard, and Large;
3. By electrical connector: M12 aviation connector, G1/2 threaded junction box, cable gland connector, explosion-proof junction box;
4. Extended and improved models: extended-rod type, split-type, intrinsically safe explosion-proof type, flameproof type, anti-material-adhesion type, low-viscosity-specific type, and dust silo-specific type.

Common instrument output formats include relay contacts and NPN/PNP transistor switch signals; some models feature self-diagnostic capabilities. Designed solely for **single-point level monitoring**—not for continuous height measurement. When material contacts or leaves the fork body, the instrument outputs a digital signal that can be connected to PLCs, DCS systems, audible and visual alarms, or pump control circuits.

Suitable media: clean water, wastewater, acidic and alkaline liquids, oils, slurry, flour, plastic pellets, pulverized coal, grain particles, etc.; different materials, fork sizes, and temperature ratings are available to accommodate various media environments.

II. Working Principle

A piezoelectric crystal is installed inside the tuning fork. When powered, the piezoelectric element excites the tuning fork, causing the fork to vibrate continuously at its natural frequency.

Operating Process:

1. When the instrument is powered on, the internal driver activates the piezoelectric element, causing the tuning fork to produce mechanical vibrations at a fixed frequency; the detection circuit continuously and in real-time captures the vibration frequency and amplitude.

2. **No Material (Air)**: The tuning fork vibrates freely with a large amplitude and stable frequency; the circuit determines this as “No Material” and outputs the corresponding switch state.

3. **Material covers the fork**: Liquid or solid material envelops the tuning fork, increasing damping and suppressing its vibration; the amplitude decreases and the frequency changes. The detection circuit recognizes these changes in vibration, inverts the switch output signal, and determines “Material Present.”

4. **Material leaves the fork**: Damping disappears, and the tuning fork returns to its original vibration frequency and amplitude; the instrument automatically resets, and the switch signal reverts to its original state.

5. Built-in Fault Diagnosis: In the event of a broken fork, circuit failure, or cable break, the instrument can trigger a fault alarm output to prevent erroneous interlocks on-site.

> Simple Explanation: Similar to a tuning fork, it vibrates continuously when in the air; when submerged in water or buried in powdered material, the vibration is dampened and the sound weakens. The instrument detects this change in vibration and outputs a switch signal.

III. Core Value

Core Product Value

Tuning fork switches are highly reliable level measurement instruments that are unaffected by the color, turbidity, foam (within reasonable limits), or dielectric constant of the medium. Compared to float, capacitive, and RF admittance sensors, they are less prone to material buildup and false triggers; they are easy to install and require minimal maintenance; and a variety of models are available to cover applications such as ambient temperature, high temperature, highly corrosive environments, powder silos, and confined spaces.

They address common customer pain points: float-type switches getting stuck or failing; false alarms from capacitive level sensors due to changes in the medium; inability to install large instruments in tanks with narrow openings; damage to standard probes caused by high-temperature media; corrosion of probes in acidic or alkaline media; inaccurate detection due to bridging in powdered materials; and the need for high/low-level interlock protection. They help customers implement overflow protection and dry-run protection, preventing equipment damage from running dry and material overflow accidents, while reducing the frequency of on-site operation, maintenance, and repairs.

Key Pain Points

Q: Float-type level switches often get stuck or jammed by debris, causing frequent false alarms. What can be done?

A: Choose a tuning fork level switch. With no moving mechanical parts, it eliminates issues such as float jamming or sticking. It provides stable detection in wastewater and slurry applications containing impurities, reducing false alarms.

Q: Capacitive level switches are easily affected by changes in the medium's dielectric constant and material buildup on tank walls, causing erratic readings. How can this be resolved?
A: Tuning fork switches rely on mechanical vibration damping for detection and are not dependent on the dielectric constant; Use an anti-fouling, improved-design fork to reduce false triggers caused by material adhesion; this is suitable for media prone to scaling and fouling.

Q: The tank connection port is very small, and standard level instruments won't fit. Are there any compact level detection solutions?
A: Choose the **compact fork** model. Its compact design is suitable for narrow tank openings, small pipes, small reactors, and side-mounted level monitoring in small-diameter pipes.

Q: The process temperature is high, and standard level probes tend to age and fail under high temperatures. Is there a level detection solution for high-temperature applications?
A: Select the **high-temperature fork-type level sensor**, which features a high-temperature-resistant fork body and piezoelectric components, making it suitable for high-temperature liquids and powders, and capable of providing level alarms for high-temperature tanks, thermal oil systems, and high-temperature silos.

Q: The medium contains acids and alkalis. Standard stainless steel probes corrode and perforate quickly, leading to frequent instrument replacements and high costs.
A: Select a **corrosion-resistant tuning fork**. The fork body is made of corrosion-resistant materials such as PTFE-coated surfaces or Hastelloy, making it resistant to weak acids, strong alkalis, and highly corrosive chemical media. This extends the instrument's service life and reduces replacement costs.

Q: Powder silos contain large particles and thick, heavy buildup—are small tuning forks prone to being buried, resulting in insufficient detection sensitivity?
A: Select a **large tuning fork** model. The fork body has a larger vibrating surface area, providing sensitivity suitable for detecting solid material levels such as granular materials, grains, plastic pellets, and pulverized coal, thereby reducing detection failures caused by bridging in powdered materials.

Q: The site has explosion-hazardous areas where standard instruments cannot be used; explosion-proof safety requirements must be met.
A: Select an extended, improved intrinsically safe or flameproof fork-type level sensor, paired with the corresponding safety barrier (for intrinsically safe models), to meet explosion-proof standards for chemical and hazardous material silos, allowing installation in hazardous areas.

Q: The tank is very deep, and a short fork body cannot reach the required detection point. How can long-distance level monitoring be achieved?
A: Select the **extended-rod tuning fork**. Customize extension rods of various lengths to extend the fork body to the specified height inside the tank. Install it at the top of the tank to detect the material level in the lower part of the tank.

Q: Space is limited at the site, and quick plug-and-play installation is required to facilitate future disassembly and maintenance.
A: You can opt for the M12 aviation-grade electrical connector version, which features a quick-connect design—no need to open the cover or rewire during installation or removal; Alternatively, choose from a variety of electrical connectors—such as Glen cable connectors and standard junction boxes—to accommodate different installation preferences.

Q: Are you concerned that a failure in the instrument itself might go undetected, leading to dry running of the pump or material spillage?
A: The fork-type level transmitter features a built-in self-diagnostic function. It automatically triggers a fault alarm output in the event of fork breakage, circuit failure, or wire disconnection. The system can identify instrument malfunctions, prompt timely maintenance, and prevent safety incidents.

Key Product Specifications & Detailed Specifications

I. Basic Electrical Parameters

Detection Principle	Piezoelectric Resonance Vibration Damping Detection (Limit Switch, Discrete Measurement)
Output Signal Type	NPN/PNP 3-wire transistor output; SPDT relay dry contacts; NAMUR intrinsically safe signal; IO-Link (optional)
Transistor Load Capacity	NPN/PNP: Max. 200 mA
Relay Contact Rating	SPDT: 250 VAC/5 A, 30 VDC/5 A
Detectable Medium Density	Liquids ≥ 0.5 g/cm³; Solid powders ≥ 0.2 g/cm³ (For large-tine powder applications)
Maximum Medium Viscosity	Standard model: ≤10,000 mm²/s; low-viscosity modified model expands the applicable range
Response Time	0.5 s; output delay can be software-configured from 1 to 60 s to suppress false triggers caused by material fluctuations
Vibration Frequency	Small tine ≈ 1,200 Hz; standard tine ≈ 400 Hz; large tine (material tine) ≈ 200 Hz
Built-in Functions	Self-test for fork breakage, wire breakage fault diagnosis, and fault alarm output; configurable high-level/low-level operating modes
Operating Pressure	Standard: -0.1–1.6 MPa; high-pressure modified version supports up to 10 MPa
Electromagnetic Compatibility	Complies with industrial EMC standards; resistant to interference from variable frequency drives and motor start/stop cycles
Mechanical Vibration Resistance	10–2000 Hz, 10 g, with no degradation in instrument performance

II. Insulation Performance Parameters

Media Isolation Methods	The metal/fluorinated fork body isolates the medium from the internal piezoelectric elements; the corrosion-resistant version features a PTFE/ETFE coating for medium-resistant isolation
Insulation Resistance	≥100 MΩ @ 250 V DC (between the housing and signal terminals)
Electrical Signal Isolation	The instrument body does not feature built-in electrical isolation; for ground loops or high-interference environments, an optional external 4–20 mA / digital input isolation module is available, with an isolation withstand voltage of 1500 V AC
Shielding Isolation	The cable shield is grounded at a single point to suppress common-mode interference; the shield is physically separated from the signal wires
Intrinsically Safe Circuit Isolation	Intrinsically safe tuning forks rely on external safety barriers to achieve energy isolation between hazardous and safe areas; the instrument itself does not provide energy isolation capabilities
Explosion-Proof Enclosure Isolation (Flameproof Type)	The explosion-proof enclosure isolates the energy of an internal explosion, preventing it from propagating outward

III. Power Supply & Power Consumption Specifications

Standard Power Supply	DC 18–30 V, typically DC 24 V; optional AC 220 V version available
Intrinsically Safe NAMUR Version Power Supply	DC 8.2 V (Must be powered by an intrinsically safe barrier)
Power Consumption at Full Load (24 V DC Transistor Type)	≤0.5W
Power Consumption at Full Load (Relay Output Type)	≤0.8W
Power Consumption at Full Load (220 V AC Version)	≤1.5W
Power Distribution Output	The instrument itself has no power output; the IO-Link version is powered
Power Supply Ripple Limit	by the master station and has no external power output ≤100mVpp
Wiring Type	3-wire NPN/PNP; independent passive relay circuit; NAMUR 2-wire

IV. Environmental Adaptation Parameters

Medium Temperature (Fork Body) – Standard Type	-40°C to +120°C
Medium Temperature (Fork Body) – High-Temperature Type	-40°C to +250°C (with heat sink)
Medium Temperature (Fork Body) – Corrosion-Resistant Type	PTFE (fluorinated lining) -20 to +120°C
Electronic Chamber Ambient Temperature	-40°C to +70°C (regardless of the high temperature of the fork body, the electronic compartment of the indicator must not exceed 70°C)
Relative Humidity	0 to 95% RH, non-condensing (indicator wiring compartment)
Storage Temperature	-40°C to +85°C
Protection Rating – M12 Aviation Connector	IP67
Protection Rating – Aluminum Alloy Junction Box / Grommet	IP65
Cable Gland	IP66
Protection Rating – Flameproof Junction Box	Ex ia II C T6 Ga
Explosion-Proof Rating (Optional) – Intrinsically Safe	Ex d II C T6
Explosion-Proof Rating (Optional) – Flameproof	Ui ≤ 28 V, Ii ≤ 100 mA, Pi ≤ 0.7 W; isolated safety barriers are recommended, as
Compatible Intrinsically Safe Barrier Parameters	they offer better interference resistance than Zener safety barriers
Media Compatibility – Standard	316L, clean water, wastewater, oils
Media Compatibility – Corrosion-Resistant	316L lined with PTFE or Hastelloy, weak acids and strong alkalis

V. Physical Parameters

5.1 Summary of Basic Physics

Installation Method	Top-mounted threaded, side-mounted threaded, flanged, and sanitary clamp connections; can be installed vertically or at an angle; extended-rod version for tank-top installation, with the probe extending into the tank
Housing Material	Indicator housing: Die-cast aluminum alloy (standard); optional 316L stainless steel sanitary-grade indicator
Fork Material	Standard: 316L stainless steel; High-temperature: 316L/304; Corrosion-resistant: 316L base with PTFE coating, Hastelloy C
Seals	Standard: FKM fluorocarbon rubber; EPDM available for low-temperature applications

5.2 Comparison Table of Fork Body Models and Dimensions

Tuning Fork Model	Total Height of Fork Body	Fork Width	Connection Thread	Applications
Small Tuning Fork	40 mm	12 mm	G1/2	Small-diameter pipes, small reactors, and small pipes with a diameter of DN25 or larger
Standard Tuning Fork	80 mm	22 mm	G1/2 / G1	General-purpose level detection for wastewater and reactors (mainstream model)
Large Tuning Fork	140 mm	45 mm	G1 or Flange	Grain, plastic pellets, pulverized coal, and powder silos

5.3 Table of Structural Parameters for the Extended and Improved Model

Upgraded Model	Structural Features	Key Parameters
Extended-Shaft Type	The probe is extended, with the fork reaching a specified height inside the tank; the electronic control box is installed on the tank top	Probe lengths can be custom-made to non-standard specifications ranging from 100 mm to 3,000 mm; probe material: 316L; tip retains standard or large fork structure
Split-Type	The piezoelectric sensor fork is separated from the electronic control box; in high-temperature operating conditions, the electronic box is located away from the high-temperature tank area	Connects to a remote electronic display via a high-temperature-resistant cable; withstands media temperatures up to 250°C
Intrinsically Safe Type	Intrinsically safe circuit for hazardous areas, equipped with a safety barrier	Ex ia II C T6 Ga; requires a compatible safety barrier
Flameproof Type	Thickened explosion-proof housing for use in hazardous areas	Ex d II C T6; explosion-proof junction box, IP66
Anti-Clogging Type	Polished, mirror-finish fork to minimize material adhesion	Reduces false triggers caused by material buildup; suitable for media prone to scaling and adhesion
Low-Viscosity Type	Optimized fork design for detecting low-viscosity media	Improves detection reliability in low-viscosity applications
Dust Silo Type	Large tuning fork structure for measuring the density of powdered materials	Detects media with a density of ≥0.2 g/cm³

5.4 Comparison Table of Different Electrical Connector Specifications

Types of Electrical Connectors	Protection Rating	Connection Methods	Applications	Features
M12 Aviation Connector (4-pin, A-coded)	IP67	Quick-connect (no need to open the cover)	Frequent installation and removal, confined spaces	Mating cycle life ≥ 1,000 cycles; lightweight; no need to open the cover for wiring
G1/2 Aluminum Alloy Threaded Junction Box	IP65	Unscrew the cover to connect wires	General-purpose on-site use (most versatile model)	Built-in terminal blocks for standard wiring
PG9/PG13.5 Cable Gland Sealed Connector	IP65	Direct cable entry with locking mechanism	Outdoor and humid environments	Sealed and locked design; moisture- and water-resistant
Explosion-Proof Junction Box	IP66	Explosion-proof threaded connection	Hazardous areas (flameproof model)	Reinforced aluminum alloy housing; explosion-proof certification available

5.5 Weight Comparison Table

Model / Connector Configuration	Model / Connector Configuration
Small Tuning Fork (M12 Connector)	Small Tuning Fork (M12 Connector)
Standard Tuning Fork (G1/2 Junction Box)	Standard Tuning Fork (G1/2 Junction Box)
Large Tuning Fork (G1 Junction Box)	Large Tuning Fork (G1 Junction Box)
Extended-Shaft Version	Extended-Shaft Version

5.6 Comparison Table of Protective Structure Details

Protection Options	Technical Details	Function
Between the Meter Head and the Y-Body	High-temperature models are equipped with heat dissipation fins.	Prevents heat transfer to the electronic compartment, protecting the circuit board
Corrosion-Resistant Model	The fork body is fully coated with PTFE on the exterior, and the threaded sections also undergo anti-corrosion treatment.	Corrosion-resistant; compatible with acidic and alkaline chemical media
Improved Model with Anti-Deposit Design	Mirror-polished fork body.	Reduces material adhesion, minimizing false triggers caused by material buildup
Improved Split-Type Model	The sensor fork body is connected to the remote electronic display via a high-temperature-resistant cable.	Withstands media temperatures up to 250°C, protecting the circuit board

Scenario-Based Selection Guide

I. Key Selection Criteria

1.Signal Type: Prioritize compatibility with input modules of on-site PLC and DCS control systems. When connecting to standard PLC digital channels, prioritize NPN/PNP transistor outputs; when passive dry contacts are required for pump start/stop and audible/visual alarm interlocks, select SPDT relay contact outputs; For use with safety barriers in explosion-hazardous areas, select NAMUR intrinsically safe signals; for digital data acquisition via industrial buses, the optional IO-Link version may be selected.

2.Number of Channels: Tuning fork switches are single-point level detection instruments; a single unit supports only one detection channel. A single instrument can monitor only one high or low level position; monitoring multiple liquid or material level points requires the combined installation of multiple tuning fork switches.

3.Power Supply: For the vast majority of automation projects, a standard 24 V DC power supply is recommended for compatibility with industrial PLC systems; if no DC power source is available on-site and the control circuit is directly connected to mains power, the 220 V AC version may be selected; for intrinsically safe NAMUR models, a 8.2 V DC intrinsically safe power supply provided by a matching safety barrier must be used—they must not be directly connected to a 24 V DC power source.

4.Explosion-Proof Requirements: For non-hazardous general-purpose facilities, select the general-purpose standard model directly; for chemical, oil and gas, or dust-prone flammable and explosive areas, select either the intrinsically safe Ex ia II C T6 Ga or flameproof Ex d II C T6 model based on the hazardous area classification; intrinsically safe models must be paired with a safety barrier with matching parameters, while flameproof models require a dedicated explosion-proof junction box.

5.Installation Environment: For narrow tank openings, small-diameter DN25 pipes, and small reactors, use the small tuning fork; for general-purpose storage tanks, sewage tanks, and conventional reactor point monitoring, use the standard tuning fork; for powder silos, grain, plastic pellets, and pulverized coal, use the large tuning fork; if the medium temperature exceeds 120°C, select the high-temperature model with heat sinks; For acids, alkalis, and highly corrosive

media, select versions with PTFE-coated or Hastelloy fork bodies; where installation space is limited or frequent disassembly and maintenance are required, prioritize M12 aviation connectors; for outdoor humid environments or standard indoor fixed installations, use G1/2 threaded junction boxes or PG cable glands; for deep tanks where the detection point is far from the tank top, choose the extended-rod version; For high-temperature applications where the gauge cannot be placed near the tank's heat source, select the split-type modified version.

6.Medium parameters: The density of liquid media must be no less than 0.5 g/cm³, and that of powdered materials no less than 0.2 g/cm³; for high-viscosity media prone to scaling and adhesion, prioritize the anti-fouling polished fork body version; also verify the medium pressure—for high-pressure applications, select the high-pressure modified version.

II. Selection Guidelines for Industry Applications

1. Chemical Industry: For standard water and solvent storage tanks, use conventional standard fork-type level switches paired with a G1/2 junction box; for acid, alkali, and highly corrosive reactors, use corrosion-resistant fork-type level switches with PTFE-coated or Hastelloy fork bodies; for high-temperature thermal oil and high-temperature reactors, use high-temperature fork-type level switches; when the heat source of the tank is close to the indicator in high-temperature operating conditions, use a split-type modified structure; For material tanks in explosion-proof workshops, use intrinsically safe or flameproof fork-type level switches; for side-mounted monitoring of small-diameter pipes, use small fork-type level switches; for powdered raw material silos and solid powder feed hoppers, use large fork-type level switches.

2. Power Industry: For power plant wastewater tanks and demineralized water tanks, use standard conventional fork-type level switches with Glen cable glands; For high-temperature condensate and high-temperature medium tanks, use high-temperature models; for desulfurization and corrosive slurry applications, use corrosion-resistant models; for raw coal silos and fly ash silos, use large-size fork-type level switches specifically designed for dust-filled silos; for outdoor pump station installations, prioritize IP67-rated M12 connectors or IP65-rated gland connectors.

3. Metallurgical Industry: For level monitoring in circulating water and cooling water tanks, use standard tuning forks; for pickling tanks and corrosive process tanks, use corrosion-resistant tuning forks; for high-temperature molten auxiliary material silos and high-temperature hoppers, use a combination of high-temperature models and large tuning forks; for high-dust silos, use modified models with anti-material buildup features; in smelting workshops with high on-site vibration, prioritize confirming the instrument's vibration resistance specifications during selection and choose reinforced fork structures.

4. Pharmaceutical Industry: For clean reactors and purified water tanks, use standard sanitary-grade tuning forks; for narrow sanitary pipelines and small solution preparation tanks, use small tuning forks; for storage tanks containing acidic or alkaline cleaning solutions, use corrosion-resistant models; for frequent disassembly and maintenance in cleanrooms, M12 aviation quick-connect connectors are recommended; for solvent storage tanks in explosion-proof pharmaceutical workshops, use intrinsically safe tuning forks.

5. Smart Manufacturing and Equipment Integration: For complete equipment sets, small automated units, and liquid level protection within pipelines, prioritize small tuning forks and M12 aviation connectors to facilitate equipment integration and rapid wiring; For powder hoppers and plastic pellet storage silos on automated production lines, select large-size fork-type level switches; for standard coolant tanks, use conventional standard-size fork-type level switches; for PLCs in automated production line control cabinets, prioritize NPN/PNP transistor outputs; for level monitoring in high-temperature ovens on production lines, select high-temperature-rated fork-type level switches.

III. Common Selection Misconceptions

1. Neglecting Isolation Levels: Many projects focus solely on the instrument itself during selection, neglecting signal isolation requirements. In field environments with numerous variable-frequency drives and high-power motors, ground loop interference may occur. Directly connecting a fork switch to a PLC can result in signal jitter and false triggering. In intrinsically safe applications, safety barriers are often incorrectly omitted, relying instead on the instrument itself for energy isolation. Note that fork switches do not have built-in electrical isolation; in high-interference environments, a discrete signal isolation module must be selected as an optional accessory. Intrinsically safe models must rely on external safety barriers to achieve energy isolation.

2. Incorrect selection of signal range and output type: Connecting a relay's passive contacts directly to a PLC's active digital input channel, or connecting a NAMUR intrinsically safe signal directly to a standard 24 V DC circuit, can result in signal failure and instrument burnout; mistakenly treating a fork-type level switch as a continuous measurement instrument and expecting to read continuous level height—fork-type switches only support point-level switching alarms and do not provide continuous level values.

3. Neglecting load matching: Selecting NPN/PNP transistor outputs when the downstream load exceeds the 200 mA limit can cause output failure; overloading relay contacts beyond their 5 A rated capacity can result in contact arcing and damage; failing to verify the load and voltage parameters of the PLC's digital input module before selection can prevent signals from switching properly.

4. Incorrect Selection of General-Purpose Models in Explosion-Proof Environments: Purchasing standard, non-explosion-proof fork switches for hazardous areas and installing them directly in explosion-proof tank farms; or mismatching the explosion-proof rating with the site's zone classification, such as mixing intrinsically safe and flameproof models; some users purchase explosion-proof instruments but pair them with standard G1/2 junction boxes instead of explosion-proof-rated junction boxes, thereby compromising explosion-proof compliance.

5. Mismatch between fork dimensions and operating conditions: Small fork switches are selected for powder silos, resulting in insufficient fork surface area; once powder bridges form or the fork becomes buried, detection becomes unstable; standard large fork switches are selected for narrow, small-diameter pipes, making installation impossible; in high-temperature environments, standard models are used instead of high-temperature models with heat sinks, leading to damage to the internal circuit board due to heat conduction.

IV. Customization Recommendations
1. Customized Signals: When standard outputs cannot meet project requirements, we support customization of IO-Link bus signals; delay parameters, fault alarm logic, and high/low-level action reversal logic can be customized; NAMUR signal versions can be customized to meet safety interlock circuit requirements; for special projects, dual-relay outputs can be customized to independently trigger separate alarms for liquid level and instrument failure.

2. Customization for Non-Standard Operating Conditions: If the temperature or pressure of the medium exceeds the range of standard models, we can evaluate and customize versions with higher temperature and pressure resistance; for highly corrosive media, the fork body material can be upgraded to materials such as Hastelloy or titanium; probe lengths can be customized outside the standard range from 100 mm to 3,000 mm; sanitary-grade polishing, food and pharmaceutical-grade clamp connections, special threads, and flange interfaces are available upon request; For media prone to high buildup or high viscosity, an optimized anti-buildup fork structure can be customized; for split-type configurations, extended high-temperature-resistant sensor cables can be customized to accommodate remote installation of the indicator head away from high-temperature tanks.

3. Multi-Channel Integration Solutions: A single tuning fork sensor supports only single-point detection; for multi-point level monitoring, we recommend using multiple tuning fork sensors in conjunction with an integrated junction box to consolidate multiple switch signals into the control system; Signal isolation modules and surge protection modules can be integrated to provide unified interference protection; for turnkey automation projects, we offer a complete integrated solution comprising instruments, mounting brackets, protective cages, and installation accessories, reducing on-site design workload; for bulk equipment deployment scenarios, we can standardize M12 connectors and output types to simplify standardized assembly on production lines.

Installation and Commissioning Specifications

I. Pre-Installation Preparation
1. Check components: Upon unpacking, verify that the product model, fork body specifications (small / standard / large tuning fork), medium-compatible version (standard / high-temperature / corrosion-resistant), and electrical connector type match the order; Inspect the fork body for dents, deformation, or scratches, and ensure the PTFE coating on corrosion-resistant models is intact; take inventory of the included sealing gaskets, PTFE tape, and mounting flanges; for explosion-proof models, additionally verify the explosion-proof markings and certification; for models with optional extended rods or split designs, ensure the probe rod is securely connected to the sensor head; take inventory of accessories, including protective cages, mounting brackets, etc.

2. Environmental Inspection: Confirm that the tank opening dimensions match the instrument's threads or flanges; ensure the installation location is away from the feed inlet, agitator blades, and areas subject to material impact; for liquid applications, avoid areas with vortices or severe splashing; For side-mounted installations in powder silos, a downward tilt of 15–30° is recommended to facilitate material flow; verify the medium's temperature, pressure, and corrosive properties to ensure they do not exceed the instrument's rated parameters; in explosion-proof zones, confirm the hazardous area classification—intrinsically safe and flameproof instruments must be used in their corresponding zones; inspect wiring channels to ensure separation of power and signal lines; confirm that the on-site grounding grid is intact, with grounding resistance ≤4Ω.

3. Tool List: Adjustable wrench, hex wrench, Phillips screwdriver, wire strippers, crimping pliers, multimeter, electrical tape, PTFE tape, cable ties; use explosion-proof tools and flame-retardant cables in explosion-proof work environments; equip confined space detection equipment for work in high-temperature or sealed tanks.

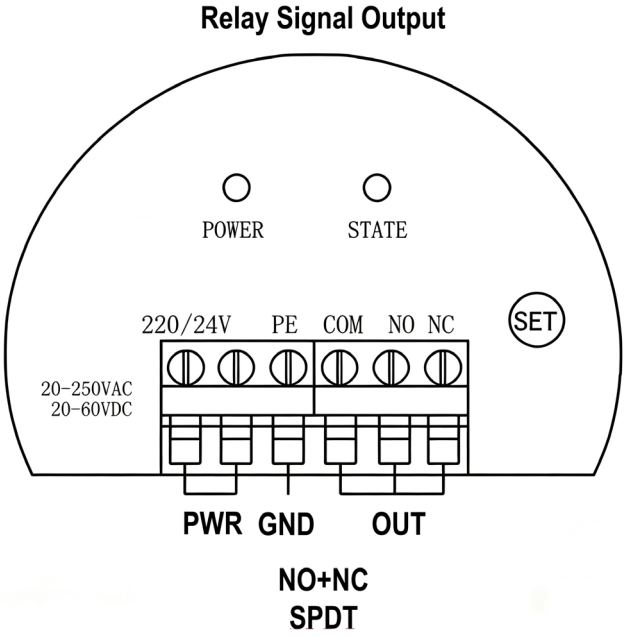
4. Safety Precautions: Before working inside a tank, disconnect the equipment's power supply, depressurize the vessel, and drain the medium; conduct gas testing if necessary, and assign a site supervisor; wiring operations must be performed with the power off; when tightening instruments, grip only the hexagonal threaded portion of the instrument; do not rotate the instrument housing to prevent internal lead wires from breaking; when lowering extension poles or large tuning forks, place them gently to avoid impacting the fork body and damaging the piezoelectric elements; Under no circumstances should wires be plugged into or unplugged from explosion-proof circuits while they are energized; intrinsically safe circuits must not be connected to high-voltage circuits.

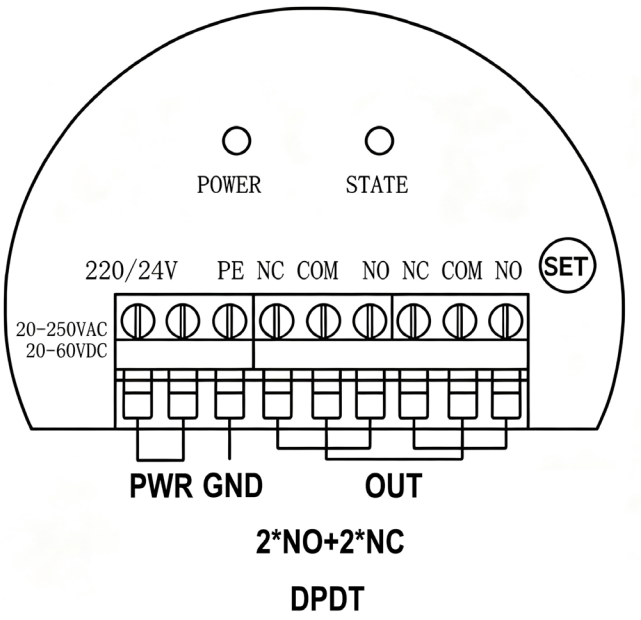
II. Standard Installation Procedures
1. Mechanical Fastening: For threaded installation, wrap Teflon tape around the threads and use a wrench to tighten the instrument's hexagonal section; do not rotate the dial. For top-mount installation, position the extended rod vertically downward until the fork reaches the preset detection point, maintaining a distance of ≥25 mm between the fork and the tank wall. For side-mount level instruments, install horizontally with the fork perpendicular to the ground; For side-mounted installation in powder applications, the fork should be tilted downward at an angle of 15–30°; for flange mounting, tighten the bolts evenly in a diagonal pattern; a rail bracket can be used for mounting on bypass piping; for high-temperature models, ensure that the heat sink is exposed outside the tank after installation to ensure proper heat dissipation; for split-type models, install the sensor fork inside the tank and place the electronic control box in a safe area away from high-temperature heat sources.

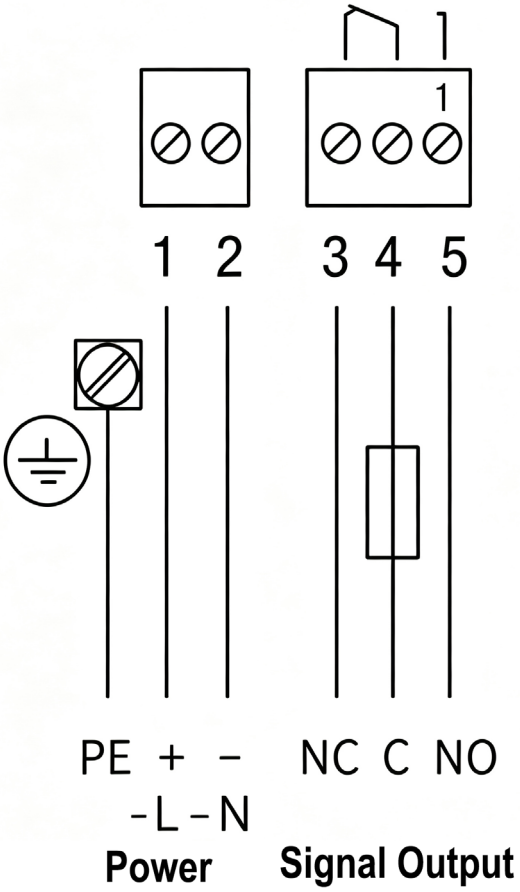
2. Wiring Specifications: Distinguish Between Power Supply, Input, and Output Terminals:
Three-wire NPN/PNP transistor output: V+ is the positive power supply terminal, V– is the negative power supply terminal, and OUT is the signal output terminal, which connects to the PLC's digital DI channel;
SPDT relay output: V+ and V- for power supply; COM is the common terminal; NO is normally open, and NC is normally closed. These are passive dry contacts capable of directly driving audible and visual alarms or relay coils;
NAMUR intrinsically safe two-wire system: Use a two-core signal cable connected to the hazardous side of the safety barrier; do not connect directly to 24 V DC;
IO-Link version: Power supply positive and negative terminals, plus communication A/B signal lines;
M12 aviation connector models: Wire according to the connector pin definitions and lock the plug in place; for gland connectors and G1/2 junction box models, route the cable through the sealing gland, connect to the terminals inside the box, and tighten the gland seal after wiring is complete; for explosion-proof junction boxes, the threaded cover must be fully screwed on and sealed after wiring.

3. Grounding Requirements: Connect the instrument's PE protective terminal to the field protective ground; grounding resistance must be ≤4 Ω. The shield of shielded cables must be grounded at a single point on the control room side only; on the instrument side, the shield must be insulated and left floating—

grounding at both ends is prohibited. The housing of flameproof instruments must be reliably grounded. The housing of intrinsically safe safety barriers must be grounded separately. Signal line grounding must be separated from power equipment grounding to avoid common-mode interference.







Supply Voltage: 20–250 VAC, 19–72 VDC
Signal Output: DPDT relay
POWER: Green power indicator; turns red when the output is active.
DIP Switches: The left DIP switch is used to toggle the relay's normally open mode; the right DIP switch is used to adjust sensitivity.
SET: Self-test function. This overcomes vibration absorption that may occur after installation on a drum wall, prevents noise interference, and avoids false triggering. The function test is performed when the instrument is powered on. With the tuning fork not in contact with the material, press and hold the SET button; release the button when the red and green indicator lights flash alternately. The self-test is successful once the instrument lights stop flashing.

The sensitivity is factory-set to the highest level, suitable for applications where the material being measured is relatively stable. If the surface of the material being measured fluctuates significantly, the sensitivity should be lowered to prevent false alarms. When installing the tuning fork, avoid locations with significant vibration as much as possible to prevent false triggering. If this cannot be avoided, please perform a self-test again at the installation location.

III. Written Explanation of the Wiring Diagram

1. Three-wire NPN/PNP (24 V DC; most commonly used standard tuning fork, small tuning fork, and large tuning fork)
Terminals: 1 = V+ (DC 24V positive), 2 = V- (DC 24V negative), 3 = OUT (signal output), PE = protective ground; connect the brown wire to V+, the blue wire to V-, and the black wire to the OUT signal line; ground the shield at the control room end, and leave the shield at the instrument end floating by wrapping it with insulating tape. No built-in power distribution output; If isolation is required, connect the instrument's output to the input of an external digital signal isolation module, and then connect the isolation module's output to the PLC.

2. SPDT Relay Output (Standard / High-Temperature / Corrosion-Resistant Tuning Fork—Universal)
Terminals: V+, V—power supply terminals; COM (Common), NO (Normally Open), NC (Normally Closed); passive contacts; contact circuits are independent and separated from the instrument's power supply circuit; connect the load between COM and NO/NC.

3. NAMUR Intrinsically Safe Model

Two-wire terminals; connect to the hazardous side of the safety barrier; connect the safe side of the safety barrier to 24 VDC and the PLC; intrinsically safe cables must be routed separately, with shielding grounded at a single point; intrinsically safe cables must not be routed in the same conduit as power cables.

4. M12 Aviation Connector Version (4-pin, A-coded)
Pin 1: DC 24 V+; Pin 2: OUT signal; Pin 3: DC 24 V−; Pin 4: PE shield ground; Tighten the connector fully to achieve IP67 protection.

5. Cable Gland / Explosion-Proof Junction Box: Cables pass through a sealed cable gland; wiring is performed at the terminals inside the box; unused wire ends inside the box are insulated; the threads of the explosion-proof box are fully engaged.

Correct vs. Incorrect Wiring Comparison:
Correct: Shield grounded at a single point; power and signal cables routed through separate conduits; NPN/PNP power supply positive and negative terminals not reversed; NAMUR must be used with a safety barrier; explosion-proof box tightly sealed; unused terminals insulated.

Incorrect: Shield grounded at both ends, causing ground loops; power cables and instrument signal wires run through the same conduit; NAMUR devices directly connected to 24 V DC, causing instrument burnout; relay contact load exceeds 5 A; junction box entry port facing upward, allowing rainwater to seep in; explosion-proof box cover not tightened, resulting in loss of explosion protection.

IV. Power-On and Commissioning Procedure
1. No-Load Test: Once all wiring is complete, double-check the wiring to ensure there are no short circuits; Before powering on, place the fork assembly in the air (with no contact with material), then apply power; use a multimeter to measure the supply voltage and confirm it is within the rated range; observe the instrument's indicator lights—the power supply light should remain on when power is normal; in the air state, the instrument should detect "no material" and output the corresponding switch state; for relay models, use a multimeter to measure the continuity of COM/NO/NC; for transistor models, use a multimeter to measure the output level.

2. Signal Verification: Simulate material covering the fork by holding it in your hand or immersing it in clean water; the instrument should invert the output signal. Remove the medium, and the instrument should return to its original state. An action delay of 1–60 seconds can be set within the instrument to suppress false triggers caused by medium fluctuations or powder discharge. For powder applications, sensitivity can be fine-tuned to accommodate detection in large fork-type hoppers.

3. Indicator Light Status Interpretation: Steady green light = Normal power supply; Yellow light = Operation status indicator—lights up when the medium covers the fork; Steady red light = Fault alarm (broken fork, damaged piezoelectric element, or broken circuit); Flashing red light = continuous alarm due to material buildup; No light: power failure or open circuit. For split-type models, check the indicator lights on the remote electronic box.

4. Calibration Method: The tuning fork is factory-calibrated and generally does not require zero-point calibration; On-site verification involves only operational testing to confirm that the switch reliably toggles when the medium covers or leaves the fork; if the process medium is special, enter the instrument's parameter menu to adjust sensitivity and actuation delay; during verification, check the interlock logic to ensure that the high-level/low-level alarm logic matches the automated control system; after verification, save the parameters and repeat the test 3–5 times to ensure stable operation.

V. Installation Precautions
1. Never exceed the rated supply voltage: DC supply must not exceed 30 V DC; NAMUR intrinsically safe models must never be directly connected to 24 V DC; do not connect AC 220 V to DC-version instruments, as overvoltage will immediately burn out the internal circuit board; install surge protection on the power supply.

2. Avoid High-Voltage Interference: Instrument signal cables must not share cable trays or conduit with variable frequency drives (VFDs), high-power motors, or contactor power cables; the minimum spacing between them must be ≥30 cm; if interference from VFDs is severe, install an external digital signal isolation module and a surge arrester; use shielded twisted-pair cables whenever possible.

3. Protective Measures for Humid Environments: Select models with IP65/IP67 connectors for outdoor or humid pump rooms; orient the junction box's cable entry downward to prevent rainwater ingress; provide drainage holes in the junction box; place desiccant inside the box; ensure cable glands are securely tightened and properly sealed; in explosion-proof environments, ensure that the sealing gaskets on explosion-proof junction boxes are not missing or damaged; install split-type electronic display units in dry, well-ventilated locations.

4. Other Precautions: Do not install in locations subject to continuous impact from materials; the fork body must not be in close contact with the tank wall or internal tank components; do not remove the heat sinks from high-temperature models; for corrosion-resistant models, avoid impacts or scratches to the PTFE coating; do not use the instrument housing as a wrench to tighten the instrument; the extension rod must not be subjected to lateral forces that could cause bending; do not forcefully pull on the M12 aviation connector cable.

Recommendations for Daily Use & Operations and Maintenance

I. Key Points for Routine Inspections
1. Signal Stability Monitoring: Continuously monitor the switch status via the central control or local control system, paying particular attention to any abnormalities such as irregular and frequent signal fluctuations, malfunctions, or signals that remain stuck. For models with NPN/PNP transistor outputs, periodically record changes in output status; for models with relay outputs, pay attention to whether contact operation is crisp and free of chattering; for NAMUR intrinsically safe models, simultaneously observe the status indicator lights of the 配套 safety barrier; if the safety barrier triggers a fault alarm, immediately mark the issue and troubleshoot the circuit; for IO-Link versions, instrument status and fault information can be read remotely. During inspections, simultaneously record operating conditions to distinguish whether an action was triggered by medium fluctuations or by a fault in the instrument itself.

2. Temperature and Humidity Monitoring: Monitor the actual temperature of the medium to ensure it does not exceed the fork body's rated temperature range; for high-temperature models, focus on checking the temperature of the heat sink to ensure unobstructed airflow and that no dust or material is accumulating on or around the heat dissipation structure; for split-type models, focus on monitoring the ambient temperature and humidity of the remote electronic control box—the temperature inside the electronic compartment must not exceed 70°C. Inspect the interior of the wiring compartment; condensation or standing water is not permitted inside the junction box. For outdoor installations or humid pump rooms, increase the frequency of temperature and humidity inspections.

3. Fork Body Visual Inspection: Conduct a visual on-site inspection of the fork body. For small tuning forks, focus on checking for impurities lodged at the small tube openings; for standard tuning forks, check for surface scaling; for large tuning forks designed for powdered materials, check whether the fork body is extensively buried in powder or has bridging or material buildup; for corrosion-resistant models, focus on checking the PTFE coating for chips, damage, or peeling; for all models, observe the fork body for deformation or cracks.

4. Connector and Cable Inspection: For M12 aviation connectors, check whether the plug is securely tightened and whether the sealing surfaces have dirt or signs of aging; For G1/2 junction boxes and gland connectors, check the box seal and gland tightness; for explosion-proof junction boxes, verify that the cover threads and gasket are intact and free of looseness; inspect the cable sheath for crushing, scratches, aging, or cracking, paying special attention to areas subject to tensile stress.

5. Installation Structure Inspection: Check the tightness of instrument threads and flanges; for extended-rod models, verify that the probe is free of bending and lateral stress; for side-mounted tuning forks in powder silos, confirm that the tilt angle is maintained between 15° and 30° to allow material to slide down smoothly; ensure there is a safe clearance between the instrument and the tank wall or internal components, and that the fork body does not come into contact with internal supports or piping.

II. Regular Maintenance Plan
1. Cleaning Intervals, Categorized by Operating Conditions:
For clean media such as plain water and oil at room temperature, standard and small tuning forks should be cleaned once every 6 to 12 months; only a visual inspection of the exterior is required, and cleaning may be postponed if no obvious scaling is present. For wastewater and media with slight scaling, standard and corrosion-resistant tuning forks should be cleaned once every 3 months. For high-viscosity, sticky slurries, and conditions prone to scaling, use anti-adhesion modified fork-type sensors and clean them every 1–2 months; large fork-type sensors used in silos for powdered materials such as pulverized coal, grain, and plastic pellets should have material buildup on the fork body removed every month to prevent powder accumulation from encasing the fork and causing false triggers; High-temperature cleaning operations must be performed after shutdown and cooling; direct contact with the fork body while it is hot is prohibited; when cleaning corrosion-resistant models, do not use wire brushes or hard objects to scrape the PTFE coating; only rinse with low-pressure clean water.

2. Wiring and Fastening Inspection: For standard indoor operating conditions, inspect terminal connections quarterly; for outdoor, humid, or high-vibration metallurgical/powder handling workshops, shorten the interval to once every 2 months. After powering down, open the junction box to check terminals for looseness, oxidation, or verdigris, and retighten the connections; inspect the condition of the shielding wire insulation; Disassemble M12 aviation connectors to inspect pins for oxidation; clean them and retighten the connectors; maintenance of explosion-proof models must comply with explosion-proof work regulations; inspect the integrity of the seals and threads on explosion-proof junction boxes; for intrinsically safe circuits, check the tightness of the safety barrier terminal connections.
Recommendations for Accuracy Retesting:

3. Under normal operating conditions with clean media, perform a functional retest every 6 months; In harsh conditions such as corrosion, high temperatures, dust, or strong vibrations, perform retesting every 3 months. The tuning fork does not require complex zero-point calibration; instead, use a simulated medium for verification: in unloaded air, confirm the "no material" state; immerse the fork body in liquid or bury it in a small amount of powder to simulate the presence of material; verify that the signal reliably switches; repeat the test 3–5 times; during retesting, verify the instrument's delay and sensitivity parameters; For split-type models, simultaneously verify signal transmission between the sensor fork and the remote electronics module; perform offline calibration on explosion-proof instruments—do not open the housing for debugging within hazardous areas. Record test results after recalibration; if operation is unstable, first check for material buildup on the fork or cable damage; only determine an instrument malfunction after ruling out external factors.

4. Periodic Inspection of Sealing Components: Sealing gaskets and O-rings are consumable parts; inspect them annually under normal operating conditions; inspect them every six months in high-temperature or acidic/alkaline corrosive environments. Replace them immediately if hardening, cracking, or swelling occurs to prevent media from seeping into the meter head.
The housing cover must be fully tightened to restore the explosion-proof seal; intrinsically safe cables must not share cable trays with power cables.

III. Long-Term Maintenance Tips: Dust and Moisture Protection, Interference Mitigation and Optimization, and Protection Against Extreme Environments
1. Dust and Moisture Protection:
Keep the cable entry port of the junction box facing downward to prevent rainwater and condensation from entering; ensure that the sealing gaskets on gland fittings and explosion-proof junction boxes are not missing or damaged; place desiccant inside the junction box and replace it regularly; When M12 aviation connectors are not in use, install dust caps; for large tuning forks installed in dust-prone silos, attach simple dust covers to the exterior of the instruments to reduce dust accumulation on the display and heat sinks; for instruments kept in long-term standby, clean and dry them before storing in a dry, well-ventilated warehouse, and ensure the fork body is properly protected to avoid scratching the anti-corrosion coating.

2. Optimization for Interference Resistance:
Use shielded twisted-pair cables throughout the signal lines; ensure the shield is grounded at a single point in the control room, while leaving the shield at the instrument end floating—do not ground it at both ends; route instrument signal cables separately from variable frequency drive (VFD) and high-power motor power cables, maintaining a distance of ≥30 cm and using separate conduit; In cases of severe on-site interference, install external digital signal isolation modules and surge protection devices; in multi-point systems where multiple tuning forks are monitored in parallel, route the signal cables for each instrument independently to reduce mutual inductive interference; minimize IO-Link bus cable lengths to reduce communication interference.

3. Protection in Extreme Environments:

High-temperature conditions (high-temperature models): Keep heat sinks exposed and unobstructed; do not wrap heat dissipation structures with insulation materials; regularly clean dust from heat sinks; for split-type models, position the electronic control box in a well-ventilated, shaded location away from high-temperature tanks, and ensure high-temperature-resistant sensor cables are not kinked or pulled.

Highly Corrosive Conditions (Corrosion-Resistant Type): Protect the PTFE coating throughout installation and maintenance; if the coating is damaged, the medium will rapidly corrode the base material—promptly assess and repair or replace the instrument upon discovering damage; regularly inspect the corrosion-resistant coating on threaded areas.

Low-Temperature Freezing Environments: Ensure the fork body is not directly compressed by ice; if necessary, install a protective cage to shield the instrument; use EPDM seals suitable for low temperatures to prevent seal hardening and failure due to cold.

High-Dust Silos (Large Fork-Type Instruments): Maintain a downward tilt angle during side mounting to reduce powder accumulation; enable the instrument's delay function to minimize false alarms caused by the impact of falling material; avoid direct impact of material from the inlet onto the fork body.

Operation and Maintenance in Explosion-Proof Zones: Intrinsically safe and flameproof instruments must not be fitted with non-original manufacturer parts; after maintenance involving the opening of explosion-proof junction boxes, the box cover must be fully tightened to restore the explosion-proof seal; intrinsically safe cables must not share cable trays with power cables.

Troubleshooting & Emergency Response

I. List of Common Faults
1. No Output: No switch signal is output after the instrument is powered on; no state change in the NPN/PNP or relay circuits; IO-Link communication fails; on versions with indicator lights, none of the lights illuminate.

2. Signal Drift: The medium level remains constant, but the tuning fork switch frequently malfunctions; the sensor occasionally reports a material presence when the chamber is empty, or fails to trigger an alarm when material coats the fork; the zero point slowly drifts due to ambient temperature or dust accumulation.

3. Indicator Light Abnormalities: The power indicator does not illuminate after power-on; the operation indicator flashes for no apparent reason; the red fault light remains constantly on or flashes intermittently; for split-type models, the indicator light status on the remote display does not match the actual operating condition of the on-site fork; the fault light on the NAMUR-compatible safety barrier triggers an alarm.

4. Abnormal Alarm Triggering: High and low liquid/material level alarms are triggered prematurely before reaching the set material level; the material has already covered the fork, yet the alarm does not trigger; the alarm signal is intermittent, appearing and disappearing sporadically.

5. Interference and Distortion: Under stable liquid or material level conditions, the signal exhibits random fluctuations and frequently oscillates back and forth; false alarms occur simultaneously with instrument operations and the start/stop cycles of pumps or variable frequency drives; random signal glitches occur, causing frequent disturbances in the interlock circuit.

II. Analysis of Failure Causes
1. Wiring errors: Reversed positive and negative power supply terminals; NAMUR intrinsically safe instruments connected directly to a 24 V DC power supply; both ends of shielded cables grounded simultaneously, creating a ground loop; relays or NPN/PNP signal wires connected to the wrong terminals; incorrect pin assignments in M12 aviation connectors; loose connections or short circuits in cables inside the explosion-proof junction box; signal wires routed alongside power cables.

2. Power Supply Abnormalities: Supply voltage is below 18 V DC or exceeds 30 V DC; excessive power supply ripple or insufficient load-carrying capacity; the safety barrier in the intrinsically safe circuit is damaged and cannot provide the rated power supply; excessive voltage drop due to long wiring runs, resulting in insufficient power supply to the instrument.

3. Signal Overload: NPN/PNP downstream load current exceeds 200 mA; relay contact load exceeds 5 A, causing arcing and erosion of the contacts; short circuit in the downstream PLC digital channel, resulting in overload damage to the output circuit.

4. Environmental Interference: Electromagnetic interference generated by variable frequency drives, high-power motors, and contactors; signal wires and power cables routed through the same conduit or cable tray; Disorganized on-site grounding with multiple shared ground points; vibration interference caused by dust in silos or material impact inside tanks.

5. Equipment Damage: The fork body is deformed or fractured due to impact; damage to the corrosion-resistant PTFE coating, resulting in the medium corroding the fork body; failure of the piezoelectric vibration element; water ingress causing the instrument's internal circuit board to burn out; the extended probe rod bends under stress; damage to the cable jacket allowing water ingress, resulting in broken internal conductors.

III. Step-by-Step Troubleshooting

Fault 1: No output; the instrument shows no signal, and the indicator light is off

Troubleshooting Steps:

① Disconnect the power supply and inspect the junction box and M12 connectors for cable damage or signs of short circuits or burn marks on the terminals;

② Use a multimeter to measure the voltage at the power supply input and confirm that it falls within the instrument's rated operating range;

③ Verify the wiring definition, distinguishing between NPN/PNP, relay, NAMUR, and IO-Link terminal types;

④ Inspect areas where the cable is bent or pulled to determine if there is an open circuit in the cable conductors;

⑤ For split-type models, check the connection cable between the sensor fork and the remote electronics box.

Remedial Measures:

Loose or oxidized terminals: Disconnect power, re-crimp and tighten the terminals, and remove any copper oxide buildup;

Reversed power polarity: Swap the positive and negative power terminals;

Oxidized M12 connector pins: Clean the pins and retighten the connector; For localized cable damage, repair using a waterproof connector; if the damage is severe, replace the cable directly.

Contingency Plan: When production cannot be halted, temporarily replace the faulty unit with a spare tuning fork of the same model to quickly restore interlock monitoring; repair the faulty instrument during the next scheduled downtime.

Fault 2: Signal drift, material condition unchanged, frequent false alarms from the instrument

Troubleshooting Steps:

① Visually inspect the fork assembly on-site to check for powder buildup, scaling, or material adhesion; for large forks, focus on checking for powder bridging that encases the fork assembly; for corrosion-resistant models, check the integrity of the coating;

② Verify the instrument's delay parameters; a delay setting that is too short can easily trigger false alarms;

③ Check the grounding method of the shielded cable to confirm whether both ends are grounded;

④ For high-temperature models, check whether the heat sink is covered by material, causing abnormal internal temperatures;

⑤ Clean the fork body thoroughly, place it in the open air for a no-load test, and observe the signal status.

Remedial Measures:

Material buildup or scaling on the fork body: Shut down the system and clean the fork body; for corrosion-resistant models, use low-pressure clean water for rinsing; do not scrape the PTFE coating with hard objects;

Unreasonable delay parameters: Increase the instrument's response delay (1–60 s) to suppress transient material disturbances;

Grounding error: Insulate the instrument's shielding layer, retaining only a single-point ground in the control room;

Contingency plan: Temporarily add software filtering to the PLC interlock program to suppress false triggers; shut down the system during a maintenance window to clean the fork assembly. Do not rely on software compensation long-term.

Fault 3: Abnormal Indicator Lights, Fault Light Alarm

Troubleshooting Steps:

 Power indicator light is off: First check the power supply circuit for an open circuit;

 Action light flashes erratically: This is usually caused by loose connections, poor cable contact, or continuous material buildup;

 Red fault light remains on: Fork breakage, damaged piezoelectric element, or broken wiring;

 Red alarm on the NAMUR intrinsically safe safety barrier: Check whether the hazardous-side cable is grounded or short-circuited.

Remedial Actions:

Loose connections: Turn off the power, tighten the terminals, and re-terminate the cables;

Safety barrier alarm: Immediately disconnect the hazardous-side circuit, inspect for cable damage, and restart the safety barrier after troubleshooting; if the safety barrier is damaged, replace it directly with one of the same specifications;

If the fork body is broken or the piezoelectric element is damaged—and on-site repair is not possible—arrange for factory repair.

Emergency Plan: In explosion-proof environments, do not open the cover for maintenance in hazardous areas; temporarily switch to manual on-site inspection and suspend automatic interlocks to prevent equipment malfunctions.

Fault 4: Abnormal alarm triggering, false alarms, or no alarms

Troubleshooting Steps:

① Enter the instrument parameters interface, verify the high- and low-level action logic, and confirm that the high-level and low-level settings match the process requirements;

② Simulate material covering and leaving the fork body, repeat the test 3–5 times, and verify the switch's operating status;

③ Check the relay contacts for burnout or sticking; check the load size in the transistor output circuit;

④ For powder applications, check whether material bridging is occurring on the large fork; for liquid applications, check for continuous splashing impacting the fork.

Remedial Measures:

Incorrect operation logic settings: Modify the instrument's high/low-level reversal logic, increase the alarm hysteresis, and reduce false triggers caused by minor disturbances;

Stuck relay contacts: Replace the instrument or the relay output module;

Contingency Plan: Temporarily disable the automatic interlock and switch to manual monitoring; once the fault has been repaired, re-enable automatic control to prevent erroneous start-up or shutdown of pumps and valves.

Fault 5: Interference distortion, signal jitter, random inversion
Troubleshooting Steps:
① Check whether the signal cables share the same cable tray or conduit with the inverter or motor power cables;
② Check the shield grounding method and confirm whether there is multi-point grounding;
③ Measure the load size and confirm that the NPN/PNP and relay loads do not exceed the rated limit;
④ Observe whether signal jitter is synchronized with the start/stop cycles of the pump and the variable frequency drive.

Remedial Measures:
Mixing of power and control circuits: Run signal wires through separate conduits, maintaining a distance of ≥30 cm from power cables;
Ground loop interference: Modify the shield grounding to single-point grounding in the control room and add an external digital isolation module;
Medium fluctuations: Increase the instrument's response delay to reduce disturbances caused by transient vibrations;
Contingency Plan: Temporarily implement software filtering on the PLC side to minimize the impact of jitter on interlocks; subsequently, retrofit the cable routing and install isolation modules to permanently eliminate interference.

IV. After-Sales Repair Guidelines
1. Criteria for Determining Malfunctions (If any of the following conditions occur, contact after-sales service to report the issue; do not disassemble the instrument on-site)
 The fork body is broken or deformed; the corrosion-resistant PTFE coating is extensively damaged; or the medium is corroding the fork body;
 Water has entered the instrument; after reconnecting the wires, cleaning, and troubleshooting, there is still no output and the indicator light does not illuminate;
 The instrument's operational logic is disrupted; it fails to switch stably after multiple calibrations, and the red fault indicator remains lit;
 The extended probe rod is bent or damaged, or there is an internal break in the split-type sensor cable;
 The circuit board is burned out, or components are damaged;
 The explosion-proof housing or threaded structure of an explosion-proof instrument is damaged, the explosion-proof marking is damaged, or the instrument no longer complies with explosion-proof regulations.
Note: The instrument head features a sealed, integrated design. Users are strictly prohibited from disassembling the housing on their own; unauthorized disassembly will result in immediate voiding of the product warranty.

2. Repair Process
Compile basic information: product model, fork type (small / standard / large fork), version (standard / high-temperature / corrosion-resistant), electrical connector type, and serial number; record on-site operating conditions, including medium, temperature, pressure, and whether the location is a hazardous area;
Thoroughly document the fault symptoms: time of occurrence, symptoms, troubleshooting steps already taken, and multimeter test data; include photos of the probes, junction box, and installation site;
Contact after-sales technical support, submit the documentation, and have an engineer assist with remote troubleshooting;
Remote troubleshooting confirms a hardware failure and assesses whether the unit needs to be returned to the factory;
Before returning the instrument to the factory, clean and dry it, package it according to specifications, and label the outer packaging with the fault details;
Once factory repairs are complete, the instrument will be recalibrated and returned along with a test report.

3. Warranty Coverage
Warranty Period: The warranty is valid for 12 months from the date of shipment. During the warranty period, free repairs or replacement of parts will be provided for failures of circuit boards, piezoelectric components, or seals caused by neither human error nor medium corrosion.
Exclusions from Warranty Coverage:
 Physical damage (such as bumps or scratches) to the fork body caused by human error, or unauthorized disassembly of the instrument housing;
 Damage to the fork body or cables caused by incorrect model selection or medium corrosion;
 Circuit board burnout caused by overvoltage or short circuits;
 Damage to the extension rod or cables caused by external impact, pulling, or bending;
 Normal wear-and-tear parts, such as sealing gaskets and O-rings;
 Issues occurring after the warranty period has expired.