

EQUIPMENT GUIDE / SENSING & CONTROL

Radar vs. Ultrasonic Level Sensing Guide

Which sensing technology holds up in your actual tank — foam, vapor, agitation, and chemistry included — not the generic "non-contact level sensor" answer.

THE PROBLEM THIS GUIDE SOLVES

Most instrumentation failures are environment-matching failures, not accuracy failures

A sensor rated for "chemical service" is not a specification. Foam, vapor, agitation, conductivity, and dielectric constant each rule technologies in or out before accuracy is even a question — and the LibertyCES bulk-fertilizer job is a real, documented example of a technology mismatch that looked like a sensor failure but was actually a physics mismatch.

This guide organizes real, vendor-documented selection data by instrumentation category, not by brand. Every material and suitability call-out is sourced to a named vendor document, a LibertyCES field record, or the chemical-compatibility chart.

INSTRUMENTATION SELECTION, AT A GLANCE

Sensing & control categories, by what actually rules a technology in or out

Instrument category	Built for	Watch for
Level Transmitter (radar, ultrasonic, hydrostatic, guided wave)	Tank inventory, overflow protection, sump/clarifier monitoring	Foam and vapor disable ultrasonic; hydrostatic and radar are the two technologies rated for dense surface foam
Flow Meter (magmeter, paddlewheel, turbine, clamp-on ultrasonic)	Process flow measurement across water, chemical, and hydrocarbon lines	Magmeters need 20 $\mu\text{S}/\text{cm}$ minimum conductivity — they physically cannot meter hydrocarbons or deionized water
pH/ORP Instrument & Electrode	Process pH and oxidation-reduction control, disinfection verification	General-purpose electrodes degrade fast in plating/photographic streams — a harsh-chemical electrode family exists specifically for that
Conductivity / Resistivity Electrode	Water purity verification, CIP strength verification, salinity monitoring	Cell constant must match concentration — a UPW-rated cell and a CIP-caustic-rated cell are not interchangeable
Pressure Instrument	Line pressure monitoring, tank level via hydrostatic head	A diaphragm isolator (gauge guard) is standard practice to protect the gauge from corrosive process fluid
Temperature Sensor	Process temperature monitoring in corrosive or plating baths	A PVDF sensor body can replace a metal thermowell entirely — the sensor body itself becomes the corrosion barrier
Controller / Analyzer Panel	Automated disinfection dosing, chrome reduction, cyanide destruction	Setpoints here are regulatory and safety-critical — interlocks exist to prevent hazardous gas release from over- or under-dosing
Toxic / Combustible Gas Detector	Ambient leak detection paired to the same chemistry as the dosing equipment	This is sensor-cell chemistry, not wetted-material compatibility — a different selection question than every other row
Pressure / Leak Monitoring RTU	Distribution-system leak detection, pressure-transient forensics	Power source and accuracy class are the real selection axes, not wetted material — check for vendor-discontinued models

LEVEL TRANSMITTER — EVIDENCE: STRONG

Radar, ultrasonic & hydrostatic — matched to foam, vapor, and agitation



GF Signet Level Application Suitability Matrix

[2250 Hydrostatic](#) · [2260/2270/2284 Ultrasonic](#) · [2280 Tuning Fork](#) · [2285 Float Switch](#) · [2290 Radar](#) · [2291 Guided Wave Radar](#)

Dense Surface Foam

High Surface Agitation

Chemical Vapor / Off-Gassing

Signet's own Application Suitability Matrix is unusually crisp: hydrostatic (2250) and float switch (2285) are the only two technologies rated "+" for both dense surface foam and high surface agitation, while ultrasonic (2260/2270/2284) is rated "-" because foam and turbulence disrupt the acoustic echo. Only ultrasonic and radar are non-contacting. The 2280 Tuning Fork is the broadest-compatibility point-level option — explicitly independent of conductivity, dielectric constant, viscosity, pressure, and temperature. The 2290 radar is the documented exception to the anti-foam pattern, rated to work through fumes, condensation, and light foam.

FIELD RECORD — CALIFORNIA BULK FERTILIZER DISTRIBUTOR

Multiple 40-foot storage towers were relying on ultrasonic level sensors that failed in vapor-heavy conditions: "ultrasonic attenuation from dense chemical vapors caused sensor drop-outs and false readings." Manual tank climbing was a standing safety risk, with roughly \$50,000/year in shrinkage exposure from inventory variance and no real-time cross-tower visibility.

0 ultrasonic drop-outs after switch

80 GHz pulse radar, SCADA-compatible, PLC-integrated with automated pump interlocks and hi/lo alarms — real-time inventory in tons across every tower.

The engineering rule this job confirms independently of the vendor's own matrix: vapor-heavy, foamy, or dusty environments call for radar level sensing, not ultrasonic. Radar uses electromagnetic energy instead of sound, which is why it doesn't share ultrasonic's failure mode in dense vapor — the 2290's real-world behavior in this deployment matches Signet's own suitability rating exactly.

Hard technology limits to check before spec'ing: the 2281 Conductive Multipoint needs $>10 \mu\text{S}/\text{cm}$, so it will not work in DI/UPW service. The 2285 Float Switch is positioned only for tap water, river water, and sump shafts — not general chemical service. The 2291 Guided Wave Radar/TDR requires a minimum dielectric constant of ≥ 1.9 .

MAGMETER / PADDLEWHEEL / TURBINE FLOW METER — EVIDENCE: STRONG

Conductivity requirements rule technologies in or out before accuracy matters



GF Signet 2580 FlowtraMag · 2551/2552 Insertion Magmeter

Also: GF Signet 2536 Paddlewheel · Icon TI/TK/TK3 Paddlewheel · Icon ProPulse Turbine

Sodium Hypochlorite (12.5%)

Potable Water

Sea Water

Hard physical limit: the 2551 and 2552 magmeters both require a minimum conductivity of 20 $\mu\text{S}/\text{cm}$ — they will not work on deionized or ultrapure water. For liquids containing ferrous particles, use magmeters, not paddlewheel or turbine sensors. For multi-material systems, always reference the maximum temperature/pressure spec to the lowest-rated component in the assembly.

The 2536 PVC-body paddlewheel variant's explicit 12.5% sodium hypochlorite rating is an independent instrumentation-category confirmation of hypochlorite compatibility already established for valves and pumps elsewhere in this dataset. Icon's Kalrez FFKM O-ring option on the ProPulse turbine is the documented escalation path when Viton is the limiting component in the system.

CLAMP-ON ULTRASONIC FLOW METER — EVIDENCE: MODERATE

Hydrocarbons — where the compatible option is "no wetted parts at all"

This category matters as an exclusion, not an inclusion: the corpus's own specs rule out most of the flow-instrumentation catalog for hydrocarbon service. Signet's 2551 and 2552 magmeters both require a 20 $\mu\text{S}/\text{cm}$ minimum conductivity, so they physically cannot meter gasoline, diesel, kerosene, crude oil, or lubricating oil. What's left is clamp-on ultrasonic (zero wetted parts, so material compatibility is moot) or a fluoropolymer in-line ultrasonic — GF Signet's 220/330 portable and U1000/U3000-U4000 fixed clamp-on units, or Icon's UltraFlo 500 clamp-on and UltraFlo 1000 PFA Teflon in-line. Note separately: GF Signet's 2000 in-line micro flow rotor is explicitly documented as "not recommended for strong oxidizers."

PH/ORP INSTRUMENT & ELECTRODE — EVIDENCE: STRONG

Acids, caustics, oxidizers & plating chemistries



GF Signet 2764-2767 Harsh Chemicals pH/ORP Electrode

Also: [2774-2777 hybrid](#) · [2734-2736 High Performance](#) · [2724-2726 General Purpose](#) · [Icon P14H/P14F](#) · [ProMinent PHE/RHE/PHED/PHEF](#)

Hexavalent Chromium (Cr6+)

Cyanide (CN-)

Mercury / Copper / Lead

Hydrofluoric Acid <2%

Selection rule: Signet's own Application Matrix rates the 2764-2767 Harsh Chemicals family "Better" (electrode life, not just function) for streams containing mercury, copper, lead, cyanide, sulfide, or silver-complexing chemicals — where general-purpose 2724-2726 and 2734-2736 families only rate "Compatible." Both technically work; electrode life in that chemistry is the entire economics of a plating-line pH loop. The 2774-2777 hybrid is the cheaper middle tier when only copper/lead/mercury are present. ProMinent's PHED independently confirms the same principle, explicitly stated for electroplating streams contaminated with Cr6+ and CN-.

HF service is a hard cutoff, not a gradient: every Signet electrode family rates hydrofluoric acid below 2% as either "Not Recommended" or "Better," with no middle ground — HF service requires the dedicated HF glass variant (2724-HF/2726-HF/2734-HF/2736-HF). Icon's P14 family independently confirms a quantified 4000ppm HF breakpoint driving sensor selection, and GF Signet's PHEF is built specifically for low-pH fluoride-containing media like electroplating etching solutions.

Caustics/bases: this is the fourth independent vendor confirmation in this dataset that pH glass electrodes degrade from strong sodium hydroxide/potassium hydroxide exposure — ProMinent's PHE/RHE families and GF Signet's 2764-2777 both name it explicitly in their calibration guidance.

Oxidizers/disinfectants — evidence: strong. The ATi M-Node (Badger Meter) is explicitly built to span chlorine dioxide, all three chlorine species, hydrogen peroxide, and peracetic acid in one modular platform, using platinum/gold electrodes — corroborated independently by ProMinent's amperometric sensors and GF Signet's 4630 chlorine analyzer.

Photographic solutions: the same 2764-2767 harsh-chemical electrode family's silver-halide and silver-cyanide poisoning-resistance columns are exactly the chemistry photographic fixer solutions present — the plating-line electrode selection and the photo-fixer electrode selection are the same engineering answer.

CONDUCTIVITY / RESISTIVITY ELECTRODE — EVIDENCE: STRONG

Cell constant must match concentration, not just chemistry



GF Signet 2818–2823 Conductivity/Resistivity Electrode Family

Ultrapure Water

CIP Caustic/Acid Verification

Sea Water / Brackish Water

The publishable rule from Signet's own operating-range chart: the higher the cell constant, the more concentrated and aggressive the chemical the electrode is designed for. UPW/USP/rinse water uses the 0.01 cell (2818/2819); bottled water the 0.1 cell (2820); cooling-tower waters the 1.0 or 10.0 cell (2821/2822); deionization regenerant chemicals, alkali cleaners, and acids/bases the 20.0 cell (2823) — the only cell constant in the family explicitly rated for concentrated chemicals. A food plant runs both ends of this same range simultaneously: a 0.01 or 0.1 sanitary cell on WFI/purified water, and a 20.0 sanitary cell (2823) on CIP caustic and acid strength verification.

Material flag: the compatibility chart shows a real, non-obvious divergence — saturated salt water pulls 316SS to "Fair" at both 40°C and 80°C, while sea water leaves it at "Excellent" at the same temperatures. The two are not interchangeable on a datasheet despite looking similar.

TEMPERATURE SENSOR — EVIDENCE: STRONG

Plating baths — the sensor body replaces the thermowell



GF Signet 2350 Temperature Sensor

Chromic Acid

Nickel Sulfate

Plating Rinse Effluent

Plating Bath Temperature Control is the first-listed application on Signet's own 2350 datasheet, and the material argument is unusually clean: the one-piece injection-molded PVDF body "outlasts metal sensors in aggressive liquids and eliminates the need for costly custom thermowells" — the sensor body itself is the corrosion barrier, so there's no metal thermowell for chromic acid to attack. This pairs directly with the compatibility chart finding that 316SS rates only "Fair" on chromic acid at every concentration — the case for a non-metallic temperature sensor on a plating line makes itself.

PRESSURE INSTRUMENT — EVIDENCE: MODERATE

Gauge-guard diaphragm isolators are used consistently to protect standard pressure gauges from corrosive process fluid, confirmed independently across three vendors: Plast-O-Matic's Gauge Guard (GGME/GGMU), Griffco's Gauge & Instrument Guard, and Icon's OBS Gauge Guard, all using a PTFE diaphragm over a PVDF/PP/CPVC housing. GF Signet's 2450 Pressure Sensor uses a matched approach for hydrostatic tank-level measurement – a PVDF housing with a ceramic diaphragm, and end connectors selectable in PVC, CPVC, PP-H, PP-N, or PVDF so the wetted path can be matched to chemistry independently of the sensor body.

CONTROLLER / CHROME REDUCTION & CYANIDE DESTRUCTION CONTROL SYSTEM – EVIDENCE: STRONG

Regulatory setpoints where the interlock is the safety feature



ProMinent DULCOMETER diaLog X · GF Signet 8900/9900/9950 Multi-Parameter Controllers

Sodium Hydroxide (pH 11.5)

Sulfuric Acid (pH 2.0–2.5)

Hexavalent Chromium

Chrome reduction: pH is lowered to 2.0–2.5 with a reducing agent (sulfur dioxide, sodium sulfite, or sodium metabisulfite) – the reaction slows significantly above pH 3.0 and is very slow by pH 4.0. Minimum detention time is 15 minutes; ORP setpoint is –300mV (–400mV max). Vendor documentation explicitly warns that lowering pH further than needed risks releasing hazardous sulfur dioxide gas – the setpoint is a safety limit, not just a process target.

Cyanide destruction (two-stage batch): stage 1 raises pH to 11.5 with sodium hydroxide, adds chlorine until ORP reaches +450mV, and locks out acid injection below pH 11 – pH must be adjusted rapidly in this stage specifically to avoid releasing extremely toxic cyanogen chloride gas. Stage 2 neutralizes with sulfuric acid plus a small amount of chlorine to convert cyanate to carbonate, with detention times up to 4 hours in modern systems. Named cyanide-waste-generating processes: plating of copper, brass, gold, and zinc; conversion coatings; chemical milling; barrel finishing; heat treating.

TOXIC / COMBUSTIBLE GAS DETECTOR – EVIDENCE: STRONG

Ambient leak detection paired to the dosing chemistry



Badger Meter GasSens Detector Family

[D16 PortaSens \(portable\)](#) · [F12D fixed toxic-gas](#) · [B12 wet-gas](#) · [IsoMon dual-channel](#)

Chlorine

Chlorine Dioxide

Hydrogen Peroxide Vapor

Ammonia

This category is a genuine cross-sell, not just a catalog addition: a chemical feed or storage quote for chlorine, chlorine dioxide, or hydrogen peroxide should carry the corresponding ambient gas detector, because the dosing hardware and the leak-detection hardware are governed by the same chemistry. GasSens covers nearly every chemical already documented elsewhere in this dataset across a portable-to-fixed range. Compatibility here is sensor-cell chemistry rather than wetted construction material — a genuinely different selection question than every other instrument category in this guide.

PRESSURE / LEAK MONITORING RTU — EVIDENCE: STRONG



Badger Meter Telog RS-45 Water and Wastewater Monitoring RTU

Also: [Telog Ru-32mA/Ru-32mA](#) · [HPR-32A/HPR-32iA](#) · [PIPEMINDER-ONE](#) loggers

The RS-45 is scoped explicitly to both drinking water and wastewater by name, and is the only unit in this family supporting wired power rather than battery-only — the real distinction between a permanent treatment-plant install and an unmanned field deployment. PIPEMINDER's 128-samples-per-second capture with pressure-waveform classification is high enough resolution for burst/transient forensics, not just periodic level checks. Two products in this family — the Telog PFE-32A and iLR-32A — are marked discontinued by the vendor's own site and should be treated as reference-only, not quotable.

NEXT STEP

Send LibertyCES the process data, not a part number.

Nine instrumentation categories, real vendor selection data, one guide – but your actual tank or line still has specific foam, vapor, agitation, conductivity, and chemistry conditions that determine which technology and wetted material is correct. A spec review checks the exact conditions against the exact equipment, before anything gets ordered.

Fluid, chemistry, concentration, temperature, tank conditions (foam/vapor/agitation), and current equipment – that's what a real spec review needs to start.

Request a spec review

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