

Analytical Instrumentation Specialist — Technical Portfolio

Precision electrochemistry · ISO 17025 consulting · Custom electrode fabrication

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Also available in Português (BR), Français (CA), and Español (LatAm). See embedded attachments or schrodinger.ca/portfolio/

Expertise

Discipline	Description
pH Measurement	Proprietary glass membrane formulation (hand-blown, -10°C to 135°C , 10 bar). Electrode body fabrication in HDPE, Polycarbonate, PEI (Ultem), PTFE, AISI 304. Buffer preparation from primary reagents (NRC/NIST-traceable). Multi-point standardization in harsh environments (high-temperature, saline, organic solvents). ASTM D1293 compliance.
ORP / Redox	Platinum and gold electrode fabrication. Combined (ORP + reference) or independent configurations. Single and double junction, reloadable or sealed. Reference selection: Ag/AgCl (KCl 3M + AgCl sat.), Hg/Hg ₂ Cl ₂ (KCl sat.). Eh-pH diagrams, quinone calibration (± 468 mV, 25°C). -10°C to 135°C , 10 bar.
Ion-Selective (ISE)	Crystalline: F ⁻ (LaF ₃), S ²⁻ /Ag ⁺ (Ag ₂ S), Pb ²⁺ (PbS/Ag ₂ S), Cl ⁻ /Br ⁻ /I ⁻ (AgX), CN ⁻ (AgI/Ag ₂ S), Cu ²⁺ (CuS/Ag ₂ S). Gas/Severinghaus: NH ₃ , CO ₂ . Polymeric (PVC+ionophore): Ca ²⁺ , K ⁺ , Na ⁺ , NO ₃ ⁻ , BF ₄ ⁻ . Nernst characterization (slope, offset), interference compensation.
Dissolved Oxygen	Clark galvanic cell fabrication (silver cathode / lead anode, PTFE membrane). Calibration against certified reference gases (0%, 100% O ₂). Membrane maintenance protocols for biofilm-prone environments. Optical DO (LDO): evaluation and third-party specification — not manufactured in-house.
Conductivity / EC / TDS	2-electrode and 4-electrode cell design (platinum and/or graphite). K=0.1/1.0/10, range 0.01 $\mu\text{S}/\text{cm}$ to 200,000 mS/cm. Cell constant determination per ISO 7888. Temperature compensation (α -factor), cell fouling, electrode coating effects.

Capabilities

Design & Fabrication

- Glassblower: proprietary glass membranes, electrochemical cells, custom glassware
- Precision machinist: manual lathe — micro-machining of electrode bodies, PTFE junctions, sensor housings
- Custom PCB with dedicated analog IC, high-impedance buffer ($>10^{12} \Omega$), galvanic isolation
- Proprietary PTFE porous junctions (-10°C to 135°C , 10 bar)
- Counter-electrodes: glassy carbon, platinum, gold
- Complete electrochemical cells for voltammetry
- 3D-printed prototyping for rapid iteration

Embedded Systems & Firmware

- Languages: C, C++, Python, MicroPython
- Platforms: ESP32, custom PCB (FreeRTOS or bare-metal)
- Protocols: Modbus RTU/TCP, HART, MQTT, OPC-UA
- 4-20 mA transmitter design with galvanic isolation
- ADC linearization, Nernst correction in firmware
- OTA updates, IP65/67/68+ enclosures
- SCADA/DCS integration

Calibration & Metrology

- ISO 17025 implementation consulting (not auditor — no ILAC/IAF/CGCRE credential)
- ISO 17034 reference material advisory
- GUM uncertainty budgets (Type A + Type B)
- Traceability: NRC (Canada), NIST (US), Inmetro/RBC (Brazil)
- AEPA testing protocols and CSA alignment
- ASTM D1293 (pH), EPA 150.1 (conductivity)
- Proficiency testing programs (z-score analysis)

Digital Metrology Platforms (SaaS)

- 12 production SaaS platforms built solo
- 1,600+ API endpoints, 648 database tables, RLS 100%
- LIMS + ELN + QMS: sample lifecycle, chain of custody, CAPA, audit trail, CoA with QR
- Trust Score: proprietary algorithm — drift-based calibration prediction
- ERP (608 endpoints), Healthcare (TISS 3.05), LMS, Sales Intelligence
- OmniDesk (omnidesk.cloud): ERP/accounting for Canadian SMBs, bilingual EN/FR, GST/HST
- Labrix (labrix.ca): LIMS for Canadian labs, SCC/CALA format, NRC traceability
- AI Engine: 125 crews, 140 agents, multi-LLM (Groq/OpenAI/Anthropic)
- Stack: Python/FastAPI, TypeScript/Next.js, PostgreSQL, Docker, Caddy, Redis

Cybersecurity & OT Pentest

- Red Valkyrie (redvalkyrie.ca) — continuous red-team platform
- OWASP ZAP automated scanning, penetration testing
- SOC 2 evidence automation, CCCS reporting
- Red-team tested: 39/39 attacks blocked on own infrastructure
- OT/SCADA/ICS security — directly relevant to O&G and utilities
- Bill C-26 / PIPEDA alignment for Canadian critical infrastructure
- Custom Linux distribution (RedValkyrieOS): 3 variants (Pentest, Stealth, Server)

Installation & Support

- Remote-first consulting (all Americas)
- On-site: Canada & select US locations
- Sensor installation, zero-point verification, commissioning
- Operator training (EN, PT-BR, ES, FR)
- Maintenance protocols, spare parts management
- Legacy instrument troubleshooting and repair
- Production capacity: 200 units/day solo, ~2 weeks lead time

Industries Served

Sector	Applications
Oil & Gas (Alberta)	SAGD produced water, sour water H ₂ S, amine treating, corrosion control, custody transfer conductivity, downhole sensor development
Water Treatment & Municipal	Drinking water pH adjustment, chlorine residual (ORP), disinfection by-product control, wastewater aeration dosing (DO), discharge compliance
Sugar & Ethanol	High-Brix pH measurement, fermentation monitoring, CIP/SIP resistant electrodes, vinasse treatment, evaporator stations
Mining & Mineral Processing	Flotation reagent pH control, tailings pond monitoring, acid mine drainage (AMD) assessment and remediation
Environmental Labs & Monitoring	River/lake quality assessment, groundwater contamination tracking, atmospheric precipitation analysis, sediment pore-water profiling
Industrial Process Labs	Food & beverage fermentation, pharmaceutical water systems, petrochemical, electroplating solution chemistry, feed-stock analysis
Nuclear & Research	Standard electrodes (glass/PTFE) for nuclear applications, electrochemical cells for voltammetry research (CNPEM/SIRIUS, LNLS, CNEN, CDTN, INPE)

Instruments & Equipment

Category	Specifications
Benchtop Analyzers	Multi-parameter water quality analyzers (pH, ORP, DO, conductivity, ISE) with data logging and USB export. Custom PCB, dedicated analog front-end.

Field Instruments	Portable pH, ORP, DO, conductivity probes for harsh environments (mining, O&G, construction). IP65/67/68+.
Industrial Transmitters	4-20 mA and Modbus RTU/TCP transmitters. NEMA 4X / IP67. AISI 304 or polycarbonate enclosures. Configurable hysteresis, averaging, alarm outputs.
Multi-parameter Analyzer (Roadmap)	pH/ORP/conductivity/TDS/salinity/ISE/DO Clark — benchtop + process. Designed from zero, custom analog IC.

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