CLOVER iQ

Shaping Connectivity for Industrial Excellence

TECHNICAL BRIEF

Intrinsically Safe Device Selection & Integration

A Practical Guide for Petrochemical Sites & Facilities

Audience: HSE Managers · IT/OT Managers · Operations Directors

Sectors: Oil & Gas · Chemical Manufacturing · Petrochemical

Standards: NEC 500/505 · IEC 60079 · ISA/IEC 62443

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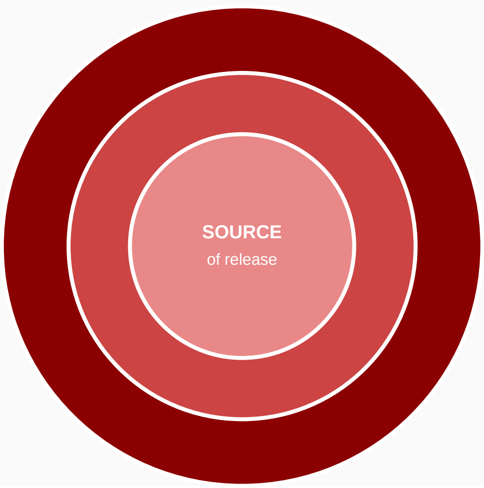
Executive Summary

Selecting and integrating intrinsically safe (IS) devices in petrochemical environments is one of the most consequential decisions a facility team will make. A wrong choice doesn't just risk compliance gaps — it exposes personnel to ignition hazards, disrupts process continuity, and creates cascading OT security vulnerabilities. This technical brief provides a concise, field-oriented guide to IS device selection, barrier architecture, and integration best practices for Class I, Division 1 and Division 2 locations commonly found in oil & gas and chemical manufacturing operations.

Clover IQ approaches IS integration as a systems challenge — not just a procurement exercise. Every device, barrier, cable run, and grounding connection must be engineered as a unified loop that satisfies both safety certification and operational performance requirements.

HAZARDOUS AREA ZONE CLASSIFICATION — NEC & IEC MAPPING



Zone 0 / Div 1
Continuous hazard

Zone 1 / Div 1
Likely in normal ops

Zone 2 / Div 2
Abnormal conditions

Non-Hazardous / Safe Area
General purpose equipment permitted

Protection Methods

Ex ia	Intrinsic Safety
Ex d	Flameproof
Ex p	Pressurization
Ex e	Increased Safety
Ex n	Non-sparking

Understanding Hazardous Area Classification

Before selecting any IS device, the facility's hazardous area classification must be clearly established. In North America, this is governed by the National Electrical Code (NEC) Articles 500 and 505. Internationally, the IEC 60079 series applies. The two systems differ in terminology — NEC uses Divisions (1 and 2), while IEC uses Zones (0, 1, 2) — but both serve the same purpose: defining the probability and duration of flammable gas or vapor presence so that equipment protection levels can be matched to real risk.

In petrochemical facilities, typical Class I, Division 1 areas include the interior of process vessels, areas near relief valves, and pump seal zones. Division 2 areas extend outward to include adequately ventilated spaces adjacent to Division 1 boundaries. Correctly mapping these boundaries is the foundation of every subsequent device and barrier selection decision.

Gas Group & Temperature Classification

Every IS-rated device is certified for specific gas groups and temperature classes. Mismatching these ratings to the actual gases present at the site is one of the most common — and most dangerous — specification errors. The table below summarizes the key classifications relevant to petrochemical operations.

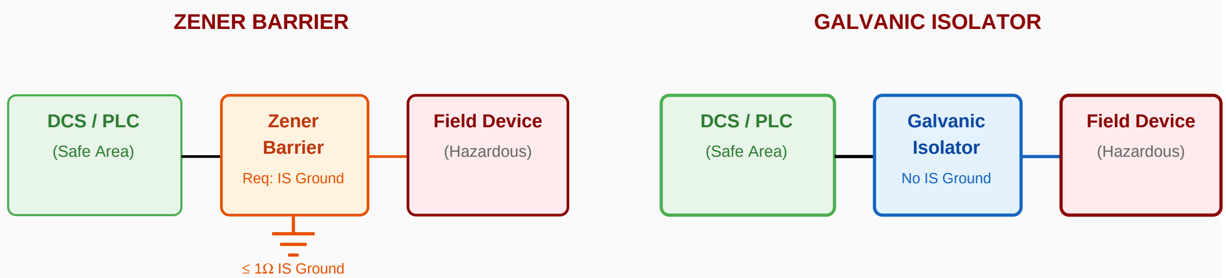
NEC Group	IEC Group	Representative Gases	Common Petrochem Location
A	IIC	Acetylene	Welding areas, acetylene plants
B	IIC+	Hydrogen, fuel gas	Reformers, HDS units, fuel systems
C	IIB	Ethylene, propylene	Ethylene crackers, polymer units
D	IIA	Methane, propane, hexane	Refineries, gas processing, tank farms

T-Class	Max Surface Temp	Typical Application
T1	450°C (842°F)	General industrial, most IS transmitters
T3	200°C (392°F)	Gasoline vapor areas, light hydrocarbon zones
T4	135°C (275°F)	Low flash-point chemicals, acetaldehyde areas
T6	85°C (185°F)	Carbon disulfide handling (rare in petrochem)

IS Barrier Selection: Zener vs. Galvanic

The intrinsic safety barrier is the critical interface between the safe area control system and the hazardous area field device. It limits the energy delivered to the field, ensuring that even under fault conditions, the available energy cannot ignite the surrounding atmosphere. Two primary barrier types dominate petrochemical installations:

IS BARRIER ARCHITECTURES — ZENER vs. GALVANIC ISOLATOR



Zener: Lower cost, requires dedicated IS ground, passes fault energy to ground.

Galvanic: Higher cost, no IS ground needed, provides signal isolation — preferred for new installations.

Entity Parameter Verification

Entity parameter verification is the mathematical proof that an IS circuit is safe. Every loop must satisfy a set of inequalities that ensure the barrier's output cannot deliver enough energy to ignite the hazardous atmosphere, even accounting for stored energy in cables and devices. The four critical parameters are:

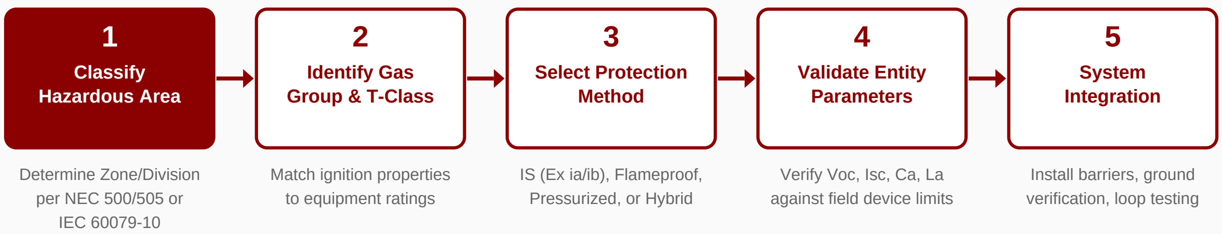
Parameter	Barrier Output	Relationship	Device Input
Open-circuit voltage	Voc (from barrier)	≤	Vmax (device rating)
Short-circuit current	Isc (from barrier)	≤	Imax (device rating)
Allowed capacitance	Ca (from barrier)	≥	Ci + Ccable (total loop)
Allowed inductance	La (from barrier)	≥	Li + Lcable (total loop)

Critical note: Cable capacitance and inductance must be calculated for the actual installed cable length and type — not estimated. Manufacturers publish per-meter values (typically 80–200 pF/m capacitance and 0.5–1.0 µH/m inductance for standard IS-rated cable). Always use worst-case figures and include a safety margin.

Integration Workflow

Successful IS device integration follows a disciplined, sequential process. Skipping steps — particularly entity parameter verification or cable segregation planning — is the most common root cause of failed inspections and, more critically, latent safety risks. The workflow below reflects Clover IQ's field-proven methodology for petrochemical IS installations.

IS DEVICE SELECTION & INTEGRATION WORKFLOW



KEY INTEGRATION CONSIDERATIONS

- Entity parameters (Voc, Isc, Ca, La) must be verified across the entire loop — barrier + cable + field device.
- Zener barriers require a dedicated IS ground (≤1Ω). Galvanic isolators eliminate this requirement.
- Cable segregation is mandatory: IS wiring must be physically separated from non-IS circuits.
- All IS equipment must be listed/certified by a Nationally Recognized Testing Laboratory (NRTL).
- Documentation: maintain an up-to-date loop diagram for every IS circuit for AHJ inspection.

Field-Proven Best Practices

Prefer galvanic isolators for new installations. While Zener barriers are proven and cost-effective, galvanic isolators eliminate the IS ground requirement, provide signal isolation, and reduce troubleshooting complexity. The incremental cost is justified in most petrochemical applications.

Never mix IS and non-IS wiring. IS circuits must be physically separated from non-IS circuits in cable trays, marshalling cabinets, and junction boxes. Use blue-colored cable and labeling per ISA/IEC standards to visually distinguish IS wiring.

Document every loop. Each IS circuit should have a complete loop diagram showing the barrier, field device, cable specifications, calculated entity parameters, and certification references. This is not optional documentation — it is a regulatory requirement for AHJ inspections.

Verify certifications end-to-end. An IS-rated transmitter connected through an uncertified junction box invalidates the entire loop's IS rating. Every component in the circuit, including terminals, cables, and connectors, must carry appropriate certification.

Plan for cybersecurity from day one. Modern IS field devices increasingly include HART, WirelessHART, or Foundation Fieldbus communications. These digital interfaces must be included in the facility's OT cybersecurity assessment per ISA/IEC 62443 to prevent IS instrumentation from becoming an unmonitored attack surface.

How Clover IQ supports IS integration: As a vendor-agnostic industrial systems integrator, Clover IQ helps petrochemical teams with hazardous area assessments, barrier and device selection, entity parameter verification, wiring design, and commissioning support — ensuring every IS loop is compliant, documented, and integrated with your broader OT infrastructure and cybersecurity strategy.