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HAZARDOUS AREA SAFETY MONITORING: ATEX & IECEX COMPLIANCE GUIDE FOR INDIA

Zone Classification | ATEX/IECEX/PESO Certification | Gas Detection System Design

Published by **Palladium Dynamics**

Industrial Automation | Process Control | Worker Safety | Hazardous Area Specialists

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About Palladium Dynamics

Palladium Dynamics is a trusted engineering partner specializing in industrial automation, process control, and safety systems for mission-critical operations. We deliver engineered, high-quality solutions that protect workers, automate production, and optimize industrial operations for manufacturers across India and globally. Our expertise spans PLC SCADA HMI programming, smart factory Industry 4.0 implementation, Industrial AI, RTLS personnel safety tracking, industrial safety monitoring for hazardous areas, worker safety monitoring, robot safety fencing, and machine guarding systems.

In hazardous area safety, we bring the depth of engineers who have designed, certified, and commissioned explosion-proof monitoring systems across chemical plants, pharmaceutical facilities, refineries, and paint shops from Kashmir to Kanyakumari. We do not read standards for the first time in your boardroom. We have already lived them on your type of plant floor.

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Key Standards Referenced in This Guide

This guide draws on the following international and Indian standards. All installations, assessments, and compliance programs referenced herein are designed to meet or exceed these requirements.

Standard	Title	Relevance
IEC 60079-0	Explosive atmospheres: General requirements	Foundation standard for all Ex equipment
IEC 60079-10-1	Explosive atmospheres: Classification of areas for gases and vapours	Zone 0/1/2 classification methodology
IEC 60079-14	Explosive atmospheres: Electrical installations design and selection	Installation engineering requirements
IEC 60079-17	Explosive atmospheres: Inspection and maintenance of installations	Ongoing compliance and inspection schedules
IEC 61511	Functional safety: Safety instrumented systems for process industries	SIS and SIL requirements for gas detection
ATEX 114	EU Directive 2014/34/EU: Equipment and protective systems	Equipment design and certification basis (EU)
IS 5572	Classification of hazardous areas (Bureau of Indian Standards)	Indian standard aligned with IEC 60079-10-1
Petroleum Act 1934 / PESO	Petroleum and Explosives Safety Organisation regulations	Mandatory Indian statutory approval requirement

1. Why Hazardous Area Safety Cannot Be Improvised

In March 2018, a solvent storage facility in Gujarat experienced a catastrophic explosion during routine maintenance. The casualty count was eleven workers. The investigation report, released eight months later, identified the proximate cause as a non-certified electrical fitting that had been substituted when the original ATEX-rated component was unavailable. The fitting cost three hundred and forty rupees. The total financial loss exceeded sixty crore rupees. The human cost had no number.

This is the hazardous area safety problem in India: not ignorance of the risks, but a systematic pattern of treating explosive atmosphere protection as a procurement inconvenience rather than an engineering discipline. The Zone classification is done on paper. The certificates are filed in a folder. The actual equipment installed may or may not match the documentation. And then one day, a spark finds a cloud of vapour and the folder is evidence at an inquest.

"Explosion-proof compliance is not a one-time project. It is a living engineering system that must be designed correctly, installed precisely, commissioned thoroughly, and maintained without compromise throughout the life of the plant."

The Regulatory and Legal Stakes

Under Indian law, industrial accidents in notified hazardous processes trigger liability under the Factories Act 1948, the Environment Protection Act 1986, the Public Liability Insurance Act 1991, and in severe cases, the Indian Penal Code. Post the Bhopal Gas Tragedy, courts have interpreted strict liability for hazardous industries, meaning that proof of negligence is not required for compensation awards. A plant manager cannot argue that the explosion was unexpected if the Zone classification had not been done, or if equipment certification had lapsed.

Beyond legal liability, the commercial consequences are equally severe. Insurance policies for chemical and petrochemical facilities explicitly exclude claims arising from non-compliance with applicable hazardous area standards. A plant that cannot demonstrate ATEX, IECEx, or PESO compliance on installed equipment may find its insurance policy voided at precisely the moment it is needed most.

What This Guide Gives You

- A clear explanation of Zone 0, Zone 1, and Zone 2 classification principles and methodology
- A working understanding of ATEX, IECEx, and PESO certification requirements and their differences
- A practical framework for gas detection system design appropriate to Indian plant environments
- Equipment selection criteria and common specification mistakes that create compliance gaps
- Installation and maintenance requirements that keep your compliance valid over the plant lifecycle
- Real-world insight from engineers who have navigated Indian hazardous area compliance at scale

2. The Indian Reality: Chemical Plants, Paint Shops, Pharma

India operates the world's third-largest chemical industry by volume, the largest generic pharmaceutical manufacturing sector globally, and one of the fastest-growing automotive paint and coatings markets in Asia. Each of these sectors generates explosive atmosphere hazards at industrial scale, and each faces specific compliance challenges that are distinct from the European plants where ATEX was originally designed and codified.

Scale of the Challenge

40,000+ chemical manufacturing units registered under the Factories Act

3,000+ pharmaceutical manufacturing facilities with flammable solvent processes

Less than 15% of hazardous area installations are fully PESO-compliant, per industry estimates

INR 2,200 Crore estimated annual cost of industrial fire and explosion incidents in India

64% of incidents occur in plants that had a Zone classification document on file

Three Sectors, Three Hazard Profiles

Chemical and Petrochemical. The dominant hazard is flammable vapour from solvents, monomers, and process intermediates. Zone 0 conditions exist inside reactors, storage tanks, and process vessels. Zone 1 covers pump rooms, loading bays, and areas adjacent to process equipment. The classification must account for the full range of materials handled, not just the primary product.

Pharmaceutical Manufacturing. The shift to continuous manufacturing and the use of highly flammable ethanol, methanol, acetone, and chlorinated solvents creates hazardous atmospheres that are often underestimated in pharma plants designed to GMP standards but not to ATEX. The combination of solvent use and dust from active pharmaceutical ingredients can create hybrid explosion hazards requiring a more conservative Zone classification.

Paint, Coatings, and Adhesives. These facilities handle flammable liquids in high volumes in processes that include open mixing, spray application, and solvent recovery. The mixing room, spray booths, and solvent storage represent Zone 1 conditions in virtually all facilities, yet field inspections routinely find standard industrial electrical equipment installed in these areas.

The Compliance Gap: Why Good Intent Fails in Execution

Fifteen years of conducting hazardous area assessments across Indian plants have shown us a consistent pattern. The plant's EHS manager knows the regulations. The engineering team has read the standards. The documentation folder is impressively thick. But between the Zone classification drawing prepared by a consultant five years ago and the actual physical reality of the plant today, there is a gap that is sometimes breathtaking in its width.

Equipment has been replaced during maintenance with whatever was available in the stores. Process changes have extended the boundary of a classified zone without updating the Area Classification drawing. New electrical circuits have been run through classified zones by contractors who did not check the drawing. Cable glands have been changed without verifying the protection concept. Junction boxes have been opened for fault-finding and not

fully re-assembled. Each of these acts individually is a minor deviation. Collectively, they produce a plant that is legally non-compliant and physically dangerous.

IMPORTANT

A Zone classification document that does not match the current physical plant is worse than no document at all. It creates a false sense of compliance while the actual hazard remains unmanaged.

3. Hazardous Area Zone Classification: Zone 0, 1, and 2

Zone classification is the foundational act of hazardous area safety engineering. Every subsequent decision about equipment selection, installation method, maintenance procedure, and inspection frequency flows from the Zone classification. Getting it wrong invalidates everything downstream.

The IEC 60079-10-1 Classification Framework for Gas and Vapour

Zone	Definition	Frequency of Explosive Atmosphere	Typical Locations
Zone 0	Explosive atmosphere present continuously or for long periods or frequently	More than 1,000 hours/year	Inside storage tanks, inside process vessels, inside pipework at vents
Zone 1	Explosive atmosphere likely to occur in normal operation occasionally	10 to 1,000 hours/year	Areas adjacent to Zone 0, pump rooms, loading and unloading areas, vented areas
Zone 2	Explosive atmosphere not likely to occur in normal operation; if it does, present only briefly	Less than 10 hours/year	Areas surrounding Zone 1, compressor houses, battery rooms, areas with double seals

Zone Classification Methodology: The Right Way to Do It

Zone classification is not a desktop exercise. It requires a multidisciplinary team including process engineers (who know what materials are handled and at what conditions), safety engineers (who understand release scenarios and ventilation), and electrical engineers (who need to translate the classification into equipment and installation specifications). The process follows six steps:

Step 1: Identify All Flammable Materials

Compile a complete inventory of all flammable gases, vapours, mists, and dusts present in the facility. For each material, determine the flash point, boiling point, auto-ignition temperature, lower explosive limit (LEL), upper explosive limit (UEL), and vapour density relative to air. These properties determine both the likelihood of hazardous atmosphere formation and the equipment protection level required.

Step 2: Identify All Release Sources

A release source is any point from which a flammable substance can be released to form an explosive atmosphere. IEC 60079-10-1 classifies release sources as continuous grade (present continuously or for long periods), primary grade (likely to occur periodically in normal operation), or secondary grade (not expected to occur in normal operation but may occur infrequently and only for short periods).

Step 3: Assess Ventilation

Ventilation is the single most important factor determining Zone extent. High ventilation reduces the size and persistence of flammable clouds and can in some cases eliminate the hazardous area entirely for secondary grade releases. The assessment must consider both natural and mechanical ventilation effectiveness and the availability of ventilation in all operating conditions.

Step 4: Determine Zone Type and Extent

The Zone type is determined by the grade of release source and the degree of ventilation. Zone extent is determined by a combination of the release rate (how much flammable material is released), the ventilation effectiveness, and the LEL of the substance. IEC 60079-10-1 provides calculation methods and worked examples that must be applied with engineering judgement to site-specific conditions.

Step 5: Produce the Area Classification Drawing

The output is an engineering drawing showing Zone boundaries in plan and elevation views for each area of the facility. The drawing must be version-controlled, dated, signed by a competent person, and reviewed whenever process changes occur or at a minimum every three years.

Step 6: Document the Basis of Classification

The supporting documentation must record the basis for each classification decision: the release source grade, the ventilation assessment, the material properties used, and the calculation method applied. Without this documentation, the drawing cannot be reviewed or verified and cannot be defended in a post-incident investigation.

4. ATEX and IECEx: What the Certifications Actually Mean

ATEX and IECEx are the two internationally recognised certification frameworks for equipment intended for use in explosive atmospheres. They are frequently confused, frequently misquoted in procurement specifications, and frequently misunderstood at the equipment selection stage. This section gives you the working understanding you need to specify and verify compliant equipment.

ATEX: The European Directive

ATEX is derived from the French 'ATmospheres EXplosibles'. It comprises two European Union Directives: ATEX 114 (Directive 2014/34/EU) governing the design and manufacture of equipment for use in explosive atmospheres, and ATEX 153 (Directive 1999/92/EC) governing the minimum requirements for improving the safety and health protection of workers at risk from explosive atmospheres. For equipment selection in India, it is ATEX 114 that is relevant.

ATEX-certified equipment carries a marking that encodes the protection concept, gas group, and temperature class. Understanding how to read this marking is an essential competence for anyone specifying or approving hazardous area equipment in India.

ATEX Marking Element	What It Means	Example Values
Ex	Explosion protection marking	Ex (mandatory on all ATEX equipment)
Category	Equipment Category defines frequency of explosive atmosphere use	1G (Zone 0), 2G (Zone 1), 3G (Zone 2)
Protection Concept	The engineering method used to prevent ignition	d (flameproof), e (increased safety), ia/ib (intrinsic safety), m (encapsulation)
Gas Group	The gas group for which the equipment is certified	IIA (propane), IIB (ethylene), IIC (hydrogen, acetylene)
Temperature Class	Maximum surface temperature of the equipment	T1 (450C) through T6 (85C)
EPL	Equipment Protection Level: additional risk-based classification	Ga (Zone 0), Gb (Zone 1), Gc (Zone 2)

IECEx: The Global Scheme

IECEx is the International Electrotechnical Commission's certification scheme for explosion-protected equipment. Unlike ATEX, which is a regulatory directive applying within the EU, IECEx is a voluntary international scheme that provides a single certification accepted in over 50 participating countries. For Indian plants procuring equipment globally or exporting to international markets, IECEx certification provides the widest acceptance.

ATEX vs IECEx: Key Differences

Geographic scope: ATEX is mandatory in the EU. IECEx is internationally voluntary but widely accepted.

Regulatory basis: ATEX is an EU Directive with legal force. IECEx is a certification scheme administered by the IEC.

Marking: ATEX uses the 'Ex' hexagon mark with CE marking. IECEx uses the IECEx mark with a certificate number.

In India: Both are accepted for hazardous area equipment. PESO also recognises both as basis for Indian certification.

Equipment Protection Concepts: Which to Specify When

Flameproof enclosure (Ex d): The most widely used concept in India. The enclosure withstands an internal explosion and quenches the flame before it can ignite the external atmosphere. Suitable for Zone 1, robust, but requires careful gland and cable selection.

Intrinsic safety (Ex ia/ib): Limits electrical energy in the circuit to levels insufficient to ignite the explosive atmosphere. The only concept certified for Zone 0 (Ex ia). Preferred for instrumentation and sensing applications. Requires an associated apparatus (barrier or isolator) in the safe area.

Increased safety (Ex e): Prevents the occurrence of sparks, arcs, and excessive temperatures in normal operation. Used for terminal boxes, motors (where combined with other concepts), and lighting. Not suitable for Zone 0.

Pressurization (Ex p): Maintains the internal pressure of an enclosure above atmospheric, preventing entry of the external explosive atmosphere. Used for analyser shelters, large panels, and control rooms where standard equipment must be used in a classified location.

5. PESO Certification: The Indian Regulatory Layer

The Petroleum and Explosives Safety Organisation (PESO) is the Indian statutory body responsible for regulating the manufacture, storage, transport, import, and use of explosives, petroleum, and compressed gas. For hazardous area equipment used in Indian plants, PESO approval is a mandatory statutory requirement that exists alongside, and independent of, ATEX or IECEx certification.

The Three-Layer Compliance Requirement for India

Many Indian plant managers incorrectly assume that ATEX or IECEx certification is sufficient for legal compliance in India. It is not. The full compliance picture for electrical equipment installed in classified areas in India requires three layers:

Layer 1

International Equipment Certification (ATEX or IECEx)

Confirms that the equipment has been designed and manufactured to an internationally recognised explosion protection standard and has been independently tested by a recognised certification body. This is the foundation of technical credibility but is not itself a legal requirement under Indian statute.

Layer 2

PESO Approval

The Petroleum and Explosives Safety Organisation approves the use of electrical apparatus in hazardous areas under the Petroleum Act 1934 and Explosives Act 1884. PESO recognises ATEX and IECEx certificates as the basis for Indian approval, but the Indian approval must be obtained separately and is plant-specific and site-specific in some categories. PESO approval is the legal requirement under Indian law.

Layer 3

Factories Act Compliance and Competent Person Certification

The Chief Inspector of Factories in each state has authority to require specific standards for electrical installations in notified hazardous processes under the Factories Act. This includes requirements for periodic testing and inspection by a competent person whose qualifications are recognised by the relevant state authority. This layer is the one most frequently overlooked during plant design and most frequently cited in post-incident investigations.

Navigating the PESO Approval Process

Obtaining PESO approval for a new installation or equipment type involves submission of the equipment's ATEX or IECEx certificate, the technical documentation for the protection concept, and in some cases a test report from a PESO-recognised test laboratory. The process is managed through the PESO regional offices and the online portal at explosives.gov.in. Lead times for PESO approval can range from three weeks for standard equipment with existing PESO recognition to six months or more for novel protection concepts or equipment from manufacturers without an established PESO relationship.

Palladium Dynamics maintains an active library of PESO-approved equipment from all major hazardous area manufacturers, which significantly reduces procurement lead times for our clients. When a specific equipment type does not have existing PESO approval, we manage the application process on behalf of our clients as part of the project engineering scope.

6. Gas Detection System Design: Engineering the Right Solution

A gas detection system is the early warning system of a hazardous area safety installation. When designed correctly it detects the formation of a flammable or toxic atmosphere before concentrations reach dangerous levels, triggering alarms and automatic protective actions that prevent ignition or protect personnel. When designed incorrectly it creates a false sense of security while failing to detect the hazard it was installed to monitor.

Gas Detector Technology Selection

Technology	Detection Principle	Best For	Limitations
Catalytic Bead (Pellistor)	Catalytic combustion on heated bead changes resistance	General flammable gas and vapour detection, Zones 1 and 2	Poisoned by silicones, lead, H ₂ S; requires O ₂ to operate; loses sensitivity with age
Infrared (IR)	Absorption of infrared energy at gas-specific wavelength	Hydrocarbon vapours, CO ₂ , situations where catalyst poisoning is a risk	Cannot detect H ₂ or NH ₃ ; higher cost than catalytic bead
Electrochemical	Electrochemical reaction generates current proportional to gas concentration	Toxic gas detection: H ₂ S, CO, NO ₂ , Cl ₂ , SO ₂ , HCN	Limited cross-sensitivity management needed; sensor life typically 1-3 years
Semiconductor (MOS)	Change in resistance of metal oxide surface on gas contact	Leak detection in lower-risk applications, confined space entry monitoring	Not suitable for SIL-rated applications; significant temperature and humidity sensitivity
Open Path / Laser	Infrared or laser beam between transmitter and receiver	Large outdoor areas, fenceline monitoring, tank farms where point detectors are impractical	Beam obstruction (rain, fog, dust) can cause false alarms; requires clear line of sight
Ultrasonic Gas Leak Detection (UGLD)	Detects ultrasonic component of pressurised gas release	High-pressure gas leak detection in outdoor and ventilated areas	Only detects pressurised releases; not effective for low-pressure or vapour evaporation

Detector Placement: The Engineering Decisions That Determine Effectiveness

No gas detection system has ever worked in a location where detectors were not placed correctly. This seems obvious until you conduct a field inspection of a real plant and count the number of detectors positioned at head height in a facility handling propane, which is heavier than air and accumulates at floor level. Or the number of detectors positioned at floor level in a hydrogen plant, where the gas rises to the roof. Detector placement must be based on the physical properties of the gases being monitored and the likely release scenarios.

Vapour Density Relative to Air

Gases and vapours lighter than air (hydrogen, methane, ammonia) rise and accumulate at high points. Detectors should be placed near potential release points and at high levels. Gases heavier than air (LPG, butane, most hydrocarbon vapours) sink and accumulate at low points, in pits, sumps, and trenches. Detectors should be placed near floor level and in low-lying areas where accumulation occurs.

Release Source Location and Direction

Detectors should be placed in the likely dispersion path of a release from each significant release source, taking account of prevailing wind direction for outdoor installations. A detector positioned upwind of a release source will never detect a release from that source.

Ventilation Patterns

In mechanically ventilated enclosed areas, detectors should be positioned in the exhaust airstream, downstream of areas where hazardous accumulation is most likely. The ventilation design and the detector placement design must be developed together, not independently.

Number of Detectors: Redundancy and Coverage

Safety instrumented system (SIS) design principles require consideration of the voting logic. A 2oo3 (two out of three) voting arrangement, where a protective action is triggered only when two out of three detectors in a zone are in alarm, reduces both false trip rate and the probability of failure to detect. The number of detectors required depends on Zone size, detector range, and the required safety integrity level.

7. Explosion-Proof Equipment Selection Framework

Equipment selection for classified areas is a process of matching equipment properties to the requirements imposed by the Zone classification, the gas group, and the temperature class of the hazardous atmosphere. Every element of this matching must be documented and verified. A single mismatch can create an ignition risk that negates the entire safety design.

The Five-Step Equipment Selection Process

Step 1: Determine the Zone from the Area Classification Drawing

The starting point is always the Area Classification Drawing. Do not rely on verbal descriptions or approximate knowledge of Zone boundaries. If the drawing does not exist, is out of date, or does not cover the specific location, the drawing must be produced or updated before equipment selection proceeds. This is not optional.

Step 2: Identify the Gas Group

Every flammable material belongs to a gas group that reflects the energy required to ignite it and the ability of a flameproof gap to arrest a flame front. Gas Group IIA covers materials like propane and hexane. IIB covers more hazardous materials like ethylene. IIC covers the most hazardous: hydrogen and acetylene. Equipment certified for a higher gas group is always suitable for a lower group: IIC equipment can be used in any gas group environment. IIA equipment can only be used in an IIA environment.

Step 3: Verify the Temperature Class

The auto-ignition temperature (AIT) of the most hazardous substance present determines the maximum surface temperature that installed equipment may reach. The T-class of selected equipment must be lower than the AIT of the substance. For example, carbon disulphide has an AIT of 90 degrees Celsius, requiring T6-rated equipment. Most common industrial chemicals require T3 or T4 rated equipment, but the calculation must be performed for the specific substance.

Step 4: Match the Protection Concept to the Zone

Zone 0 requires equipment certified to Category 1G (EPL Ga) using protection concepts suitable for Zone 0: Ex ia, Ex ma, Ex da, Ex op is, or special protection Ex s. Zone 1 requires Category 1G or 2G equipment (EPL Ga or Gb). Zone 2 requires Category 1G, 2G, or 3G equipment (any EPL). Never install Zone 2 equipment in a Zone 1 location, regardless of apparent similarity.

Step 5: Verify Certification Documentation and Scope

The ATEX or IECEx certificate must be current (not expired or withdrawn), must cover the specific model and variant being installed (not a related model from the same range), and must include the Zone, gas group, and temperature class required. Special conditions of safe use (denoted by 'X' at the end of the certificate number) must be read and complied with. PESO approval must be verified for the specific equipment type and variant.

"The most common equipment selection error we encounter is the installation of equipment certified for Zone 2 in a Zone 1 location. It happens because the Zone 2 certificate looks convincing and the difference is not visible to the eye. The difference becomes visible only in the explosion report."

8. Installation, Commissioning, and Inspection Standards

The most perfectly specified and certified equipment in the world provides zero protection if it is installed incorrectly. Installation of hazardous area electrical equipment is a specialist discipline governed by IEC 60079-14 (installation) and IEC 60079-17 (inspection and maintenance). These standards are not guidelines. They are engineering requirements that must be met in full.

Critical Installation Requirements

Cable Glands and Cable Selection

The cable gland is the most frequently incorrect element in hazardous area electrical installations. The gland must be certified for the protection concept of the enclosure, appropriate for the cable type (armoured, unarmoured, screened), and correctly sized for the cable outer diameter. The gland must be fully tightened to the manufacturer's specification. Finger-tight is not tightened. The cable armour or braid must be properly terminated in the gland to maintain its mechanical protection and screening function.

Conduit and Cable Routing

Conduit systems used in classified areas must be of a type certified for hazardous areas. All conduit entries to enclosures must be sealed with approved compound to prevent gas migration from the classified area to non-classified areas via the conduit. Conduit sealing is one of the most commonly missed requirements in Indian hazardous area installations.

Earthing and Bonding

Electrostatic discharge is an ignition source in explosive atmospheres. All conductive equipment and pipework in classified areas must be bonded and earthed to prevent the accumulation of static charge. Earth continuity values must be measured and recorded during commissioning. The threshold is typically 1 ohm for safety earthing in explosive atmosphere locations.

Minimum Distances and Mechanical Protection

Equipment installed in classified areas must be protected from mechanical damage by vehicles, falling objects, or process activities. Where mechanical damage risk exists, guard rails, protective channels, or mechanical protection must be provided. The Zone boundary must be maintained: structural changes that alter ventilation or extend a potential release source automatically extend the Zone boundary.

The Initial Inspection: IEC 60079-17 Compliance

Before any installation in a classified area is energised, an initial inspection must be carried out by a competent person to verify compliance with the installation design and the applicable standards. IEC 60079-17 defines three levels of inspection: Close inspection (involves opening enclosures and examining all internal elements), Detailed inspection (external examination of all visible aspects without opening), and Visual inspection (identification of obvious defects that are visible without the use of access equipment or tools).

The initial inspection must be Close in scope for all equipment. The inspection record must document each item inspected, the result, any deficiencies found, and the corrective action taken before the installation was approved for energisation. This record is a legal document.

9. Ongoing Compliance: Maintenance, Testing, and Documentation

Hazardous area compliance is not achieved at commissioning and then held passively. It degrades continuously through the normal processes of plant operation: equipment ageing, maintenance activities, process changes, and incremental physical modifications. Maintaining compliance requires an active, structured program that treats every piece of hazardous area equipment as a safety-critical asset.

The Periodic Inspection Schedule

Inspection Level	Frequency	Scope	Competence Required
Visual Inspection	Monthly (or per risk assessment)	External condition, obvious damage, security of covers, legibility of certification marking	Trained personnel: Ex01 or equivalent awareness level
Detailed Inspection	Annually (minimum)	All externally visible aspects without opening enclosures: flameproof gaps, cable glands, ingress protection, earthing connections, conduit integrity	Competent person: Ex02 or equivalent inspection qualification
Close Inspection	Every 3 years or as risk-assessed	Opening and internal examination of enclosures, internal wiring and connections, sealing compound integrity, barrier condition for Ex i circuits	Competent person: Ex02 with appropriate task qualification
Gas Detector Calibration and Functional Test	Every 3-6 months depending on manufacturer requirement and risk assessment	Bump test with certified calibration gas, zero calibration verification, alarm setpoint verification, output and interface testing	Trained technician with manufacturer calibration training

The Ex Equipment Register: Your Compliance Foundation

The Ex Equipment Register is the master document that underpins every aspect of hazardous area compliance management. It is a controlled engineering document that lists every piece of electrical equipment installed in a classified area with the following information for each item:

- Equipment tag number and physical location (area, elevation, grid reference on the Area Classification Drawing)
- Manufacturer, model, and serial number
- Protection concept (Ex d, Ex ia, Ex e, etc.) and equipment category

- Gas group and temperature class of the certificate
- ATEX or IECEx certificate number and issuing body
- PESO approval reference number
- Date of installation and date of last inspection
- Inspection schedule and next due date
- Record of all maintenance, replacement, and modification activities

Without this register, it is not possible to demonstrate compliance, plan inspections systematically, or identify the impact of a process change on the Zone classification and equipment requirements. For plants that do not have this register in place, creating it is the first corrective action we recommend.

10. Common Compliance Failures and How to Prevent Them

Every hazardous area assessment we conduct reveals a recognisable set of compliance failures. They are not random. They follow predictable patterns driven by procurement shortcuts, contractor knowledge gaps, and the incremental erosion of standards during plant operation. Knowing them in advance is the most effective form of prevention.

Failure 1: Zone Classification Drawings Not Maintained Post-Commissioning

The Problem

The initial Zone classification is often done thoroughly. Then the plant starts up, engineers move on, and the drawing goes into a folder. Three years later, a new solvent has been introduced, a ventilation fan has been relocated, and a new pump seal has been changed to a type with a higher leak rate. None of these changes has triggered a review of the Zone classification drawing. The drawing now describes a plant that no longer exists.

Prevention

Prevention: Establish a formal management of change (MOC) process that mandates Zone classification review for any process change involving flammable materials, any change to ventilation systems, or any physical modification within or adjacent to a classified area.

Failure 2: Certificate Substitution During Maintenance

The Problem

A flameproof junction box is damaged and needs replacement. The original model is no longer available or has a lead time of six weeks. The stores have a similar-looking box from a different manufacturer. It is installed without checking whether it has the correct certification. It does not.

Prevention

Prevention: Maintain an approved equipment list for all classified area equipment. Only items on the approved list may be used as replacements. The approved list must be updated when items are discontinued and approved replacements identified before an emergency creates pressure to substitute.

Failure 3: Cable Gland Non-Compliance

The Problem

Cable glands are specified as explosion-proof in the procurement specification. The contractor orders glands that are certified but not of the correct type for the cable being installed: an armoured cable gland fitted to an unarmoured cable, or a gland with the wrong thread form for the enclosure entry. The wrong gland creates either a reduced degree of ingress protection or a compromised flameproof path.

Prevention

Prevention: The cable schedule must specify the gland type (including cable type, armour type, cable OD, thread form, and certification requirements) for every cable entry. The contractor must submit a cable gland schedule for approval before ordering. Installed glands must be verified during the close inspection.

Failure 4: Gas Detectors Not Calibrated

The Problem

The plant has a gas detection system. The detectors were calibrated at commissioning five years ago. There is no calibration record since then. The operations team has noticed that two detectors give occasional readings when there is no visible leak but has inhibited them to avoid nuisance alarms. Three of the remaining detectors have catalyst beads poisoned by a silicone-based lubricant used in the area. The gas detection system is providing zero protection.

Prevention

Prevention: Gas detector calibration must be on a formal preventive maintenance schedule with records maintained in the asset management system. Inhibited detectors must trigger an automatic escalation to management and a risk assessment. Detector response time and sensitivity must be verified with test gas at every calibration.

Failure 5: Competence Gap in the Maintenance Team

The Problem

The electrical maintenance team is highly skilled in general industrial electrical maintenance. They have never received formal hazardous area training. When they open an Ex d enclosure for fault-finding, they do not check the condition of the flameproof joint. When they re-assemble it, they do not torque the fasteners to specification. When they re-route a cable, they use a standard industrial gland from the stores. Each action is carried out with confidence and professional competence in everything except the hazardous area requirements.

Prevention

Prevention: All personnel who work on electrical equipment in classified areas must hold a recognised hazardous area competence qualification. The CompEx scheme (Certificate of Competency in Explosive Atmospheres) is the internationally recognised standard. PESO also publishes competency requirements for Indian hazardous area practitioners.

11. How Palladium Dynamics Delivers Compliant Safety Systems

We are engineers, not compliance consultants. There is a meaningful difference. A compliance consultant tells you what the standard requires and writes a gap report. We design and build the system that closes the gap. Every engagement we lead results in a physical installation that is certified, inspected, commissioned, and documented to the standard required for legal compliance in India.

Hazardous Area Zone Classification and Assessment

We conduct full site assessments to IEC 60079-10-1, producing or updating Zone classification drawings and supporting documentation. Our assessments identify every deviation between the current physical plant and the existing classification, and provide a prioritised remediation plan.

Gas Detection System Design and Installation

From detector technology selection and placement design to full system integration with the plant's DCS, SIS, or standalone controller, we design, supply, install, and commission gas detection systems that meet the required safety integrity level and PESO approval requirements.

Explosion-Proof Electrical Installations

Our electrical engineers are CompEx-qualified and experienced in all major protection concepts. We design, install, and commission Ex d, Ex e, Ex ia, and Ex p installations to IEC 60079-14 requirements, producing the full suite of documentation required for initial inspection and ongoing compliance management.

ATEX, IECEx, and PESO Compliance Audits

We conduct thorough compliance audits of existing hazardous area installations, comparing the physical plant against the Zone classification drawing and the Ex Equipment Register, verifying certification status of all installed equipment, and assessing the maintenance and inspection program against IEC 60079-17 requirements.

PLC SCADA HMI Integration for Hazardous Area Safety Systems

Our industrial automation capability means that gas detection, fire and gas systems, and safety instrumented systems are integrated with the plant's control and monitoring infrastructure by the same team that designed them. No handoff between specialist and automation contractor. No interface management risk. One team, one scope, one delivery.

Contact Palladium Dynamics

+91 9561748741 info@palladiumdynamics.com

12. Next Steps: Free Hazardous Area Assessment

You have read the framework. You understand the Zone classification requirements, the certification landscape, the gas detection design principles, and the compliance failure patterns. The next question is the only one that actually matters: how compliant is your plant right now?

We are offering chemical, pharmaceutical, paint, and petrochemical plant operators across India a complimentary Hazardous Area Preliminary Assessment conducted by a Palladium Dynamics engineer. This is a half-day structured site walkthrough and documentation review that gives you an honest, engineering-based answer to that question.

You will receive a written preliminary report identifying the top five compliance priorities for your specific plant, with indicative remediation cost and risk severity for each. There is no obligation to engage us for any remediation work. We do this because we believe that better information produces safer plants, and safer plants are better for Indian industry.

What You Receive

- ✓ Zone Classification Drawing review and gap assessment
- ✓ Ex Equipment Register status review
- ✓ Sample installation inspection (3 to 5 items)
- ✓ Gas detection coverage assessment
- ✓ Top 5 compliance priorities with risk rating
- ✓ Written preliminary report within five business days
- ✓ Zero cost. Zero obligation.

Schedule Your Assessment

Call or WhatsApp

+91 9561748741

Email

info@palladiumdynamics.com

We work with chemical plants, pharmaceutical manufacturers, paint and coatings facilities, petrochemical refineries, and general industry across India. Our engineers are CompEx-qualified and PESO-experienced.

Industries We Serve

- Chemical and Specialty Chemical Manufacturing
- Paint, Coatings, and Adhesives Manufacturing
- Solvent Recovery and Distillation
- Offshore and Onshore Oil and Gas Facilities
- Pharmaceutical and Life Sciences
- Petrochemical Refining and Processing
- Fertiliser and Agrochemical Plants
- Power Generation with Hydrogen or Ammonia

"Safety in a hazardous area is not a feeling. It is a set of engineering decisions, correctly made, correctly implemented, and correctly maintained. Everything else is hope. We do not deliver hope. We deliver engineered protection."



Thank You

for reading the Palladium Dynamics Hazardous Area Safety Monitoring: ATEX
and IECEx Compliance Guide

This guide was written for the plant managers, safety engineers, electrical engineers, and operations leaders who carry the real weight of keeping people safe in environments where a single ignition source can end a life. If even one installation decision in your facility is made better because of what you have read here, this document has done its work.

Your workers come home safe. That is the only metric that counts.

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info@palladiumdynamics.com

Palladium Dynamics | Industrial Automation | Process Control | Safety Systems | Hazardous Areas