

# DESIGN FOR HAZARDOUS LOCATIONS

How to Avoid Costly Delays and get to Market Faster

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# Objectives

- Tips to Minimize Time and Cost of a Certification Project
- Intertek's Haz Loc Services
- Haz Loc Basics
- ATEX
- IECEx
- Close, Q&A



PHOTO: U.S. COAST GUARD, VIA GETTY IMAGES

# Designing and Developing Products for Hazardous Locations



- **Know your market:** US, Canada, ATEX, IEC Ex
- **Know the classification** of the area in which the equipment will be used, i.e. Class I, Division 1, Class I, Zone 0, etc.
- **Determine** the appropriate **protection concept:** Intrinsic safety, flameproof, etc.
- **Indicate environmental considerations:** Enclosure ratings, Extended Ambient Temperature Range, etc.
- **Assess Quality Management System:** ISO 9001 a good starting point for manufacturers pursuing ATEX and IEC Ex.
- **Involve Intertek early and often:** Preliminary Design Reviews, Informal Phone Calls, Meetings, Sub-Component Evaluations, Long Term Testing

# Preliminary Design Reviews



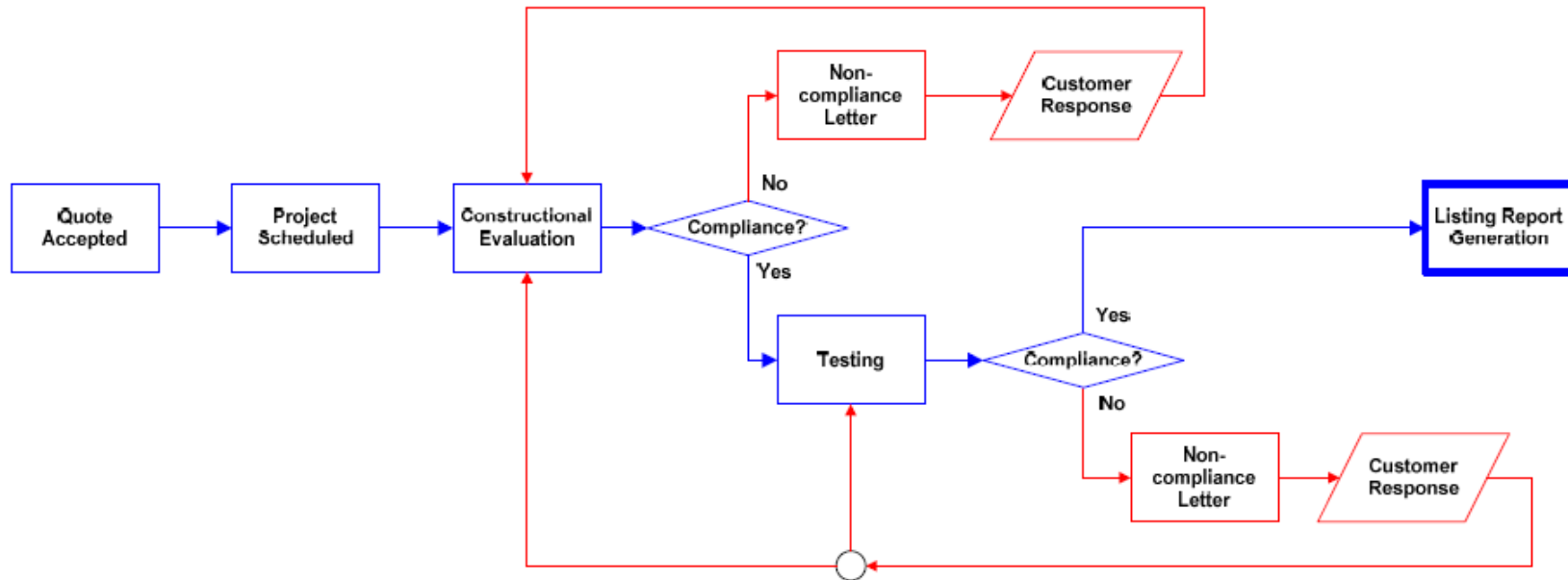
A Preliminary Design Review (PDR) is a **brief review** of the critical aspects of a product's design **intended to identify major non-compliances**.

Preliminary Design Reviews can:

- **Minimize certification time and cost**
- **Identify** potential design **changes up-front** in the development cycle
- **Confirm assumptions of product's compliance**
- **Build confidence** that the product will comply when the time comes to submit for final certification.

In most cases the cost of the PDR can be credited against the complete evaluation project.

# Product Certification Flowchart



# Preparing for your Haz Loc Project

**Intertek**

- Schematics/Wiring Diagrams
- Product drawings, description, application, use
- Environmental considerations (indoor vs. outdoor, enclosure ratings)
- Ambient temperature range, temperature classification
- Hazardous area classification
- Bill of materials
- Completion schedule
- PCB Trace Layout/Gerber Files
- Date when samples and documentation will be available
- Desired certifications, i.e. cETLus, ATEX, IEC Ex
- Protection Method, i.e. Intrinsic Safety, Flameproof, etc.
- Quality Assurance Certificates (ATEX/IEC Ex)
- Component Certificates
- Power source ratings
- User manual, Label Drawings
- Theory of Protection
- Control/Installation Drawings for Intrinsically Safe Products

# Common Pitfalls when Submitting Haz Loc Products for Certification

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- Use of non-certified components.
- Modifications to Certified Products, e.g. Explosion proof Enclosures
- Long Term Testing
- Not using components within their conditions of acceptability.
- Availability of samples

# Additional Items Needed to Initiate an Evaluation



- **One functional sample** that affords access to internals, i.e. un-potted, unsealed, etc.
- Any **support equipment** needed to achieve maximum loading.
- **Bill of materials** that includes manufacturer's **ratings, part numbers, value, tolerance, etc.**
- **Unpopulated and populated PCB samples.**
- Manufacturer's **data sheets** for critical components.
- Input **ratings including voltage, current, frequency, power.**
- **Conditions of Acceptability for Recognized Components.**



# Additional Items for Intrinsic Safety Evaluations



- **Data Sheets** for all protective components and semiconductors. Specify thermal resistance.
- **Special samples** as necessary (may be determined during a PDR)
- Conformably coated **PCB samples** if coating relied on to meet spacing requirements.
- **Ten samples of each battery type if battery powered. Twenty needed if battery fails spark ignition comparison method.**
- **Ten samples of capacitors and inductors if manufacturer's data sheet does not provide adequate information to determine value and tolerance.**
- **Ten fuse samples** if fuse cold resistance relied on for spark ignition compliance.

# Additional Items for Explosion Proof Evaluations



- **Full Mechanical documentation** on the enclosure which details
  - Materials
  - Material Thickness
  - Flame paths, dimensions & tolerances
  - Details on any entries, windows, seals, etc.
- An **additional sample with modified flame paths or joints** may be required for explosion testing.

# Intertek's Haz Loc Services



- **OSHA accredited** Nationally Recognized Testing Laboratory (**NRTL**) for Listing in the U.S.
- **Standards Council of Canada** accredited Certification Organization (**CO**) and Testing Organization (**TO**) for Listing in Canada
- **UKAS** Accredited **Notified Body** for the ATEX Directive (94/9/EC)
- **IECEX** Certification Body (**CB**) and Test Laboratory (**TL**)
- **Full Hazloc Training provider**, including an Accredited **COMPEX** Training Center
- **Site Safety Services provider** (Risk Assessment, Area Classification and Inspection)

# Hazardous Location Technical Services



## Product Certification

- US/CAN – cETLus Listing
- ATEX – EU and other adoptive regions (Middle East, etc.)
- IECEx – Members Countries of the International IECEx Scheme

## Field Evaluations/Inspections

### Site Services

- Consultancy
- Inspections and Risk Assessments (Assemblies or Plant)
- Audits & Certification

### Training

- Open session
- Tailored

# What is Potentially Explosive Atmosphere Certification and why might you need it?

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Any industry that processes, uses or manufactures materials that may give rise to a flammable atmosphere (gas, mist, liquid, dusts or even small fibres) may have a potentially explosive atmosphere.

## Such industries/processes include:

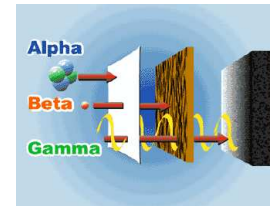
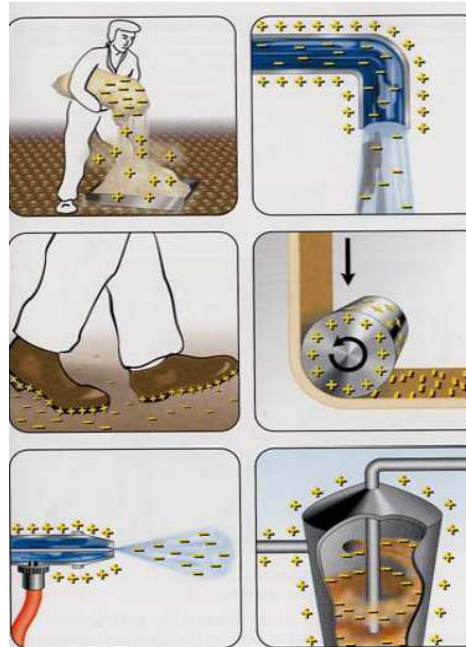
- Oil and Gas Drilling
- Petrochemical Refining and Processing
- Fuel Storage
- Chemical manufacturing
- Car Manufacturing
- Water Treatment
- Power Generation
- Pharmaceutical
- Distilleries
- Food manufacturers
- Aviation
- Military
- Painting



# Potential Ignition Sources



- Hot surfaces
- Flames
- Mechanically generated sparks
- Stray electric currents
- Static
- Lightning
- Radio Frequency (Range 1 & 2)
- Ionising Radiation
- Ultrasonic
- Adiabatic compression and shock waves
- Exothermic reactions (inc. self ignition of dusts)



# Protection Concepts

- ATEX, IEC and NEC 505 use the same protection concepts.
- NEC 500 only uses Explosion proof, Intrinsic Safety, DIV 2 and
- Purge.
- Only intrinsic safety is very similar.

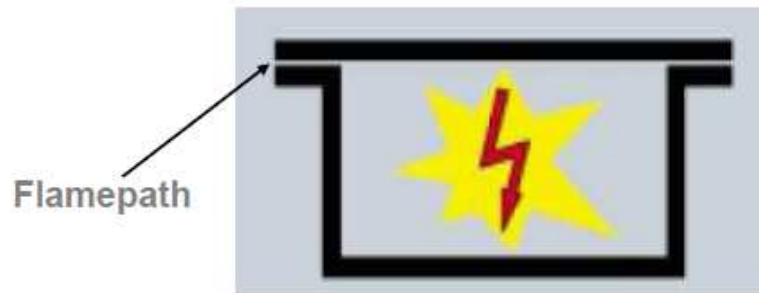
# Flameproof (Explosion-proof) Ex d



It is assumed that the surrounding explosive atmosphere can enter the enclosure and that there will be internal explosions during the life of the equipment. The enclosure therefore has to be strong enough not to fracture or distort under the internal pressures generated.

**Contains explosions and prevents propagation**

**Applications:** Switchgear, motors, lights

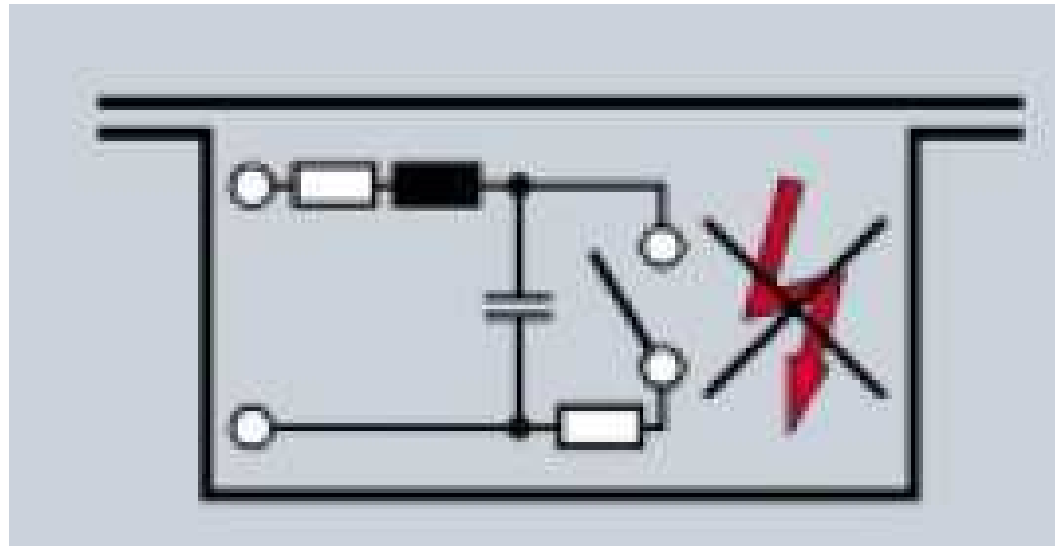




# Intrinsic Safety



Low energy levels prevents incendive sparking and hotspots



# Purged and Pressurized

- Excludes gas by positive pressure differential
- 3 types: Static, leakage compensation and continuous dilution
- Applications: Control cabinets, analyser units and analytical instruments



# Type 'n' Protection for Zone 2



## Methods:

- Non sparking/arcng parts
- Restricted breathing
- Simplified pressurization
- Energy limiting apparatus
- Sealed or encapsulated device
- Hermetically sealed
- Encapsulated



# Other Protection Concepts

- **Increased Safety**
  - **Ex e:** The apparatus must not arc, spark, or produce ignition capable hot surfaces in normal operation.
- **Oil Immersion**
  - **Ex o:** Protection by immersion in oil.
- **Powder Filling**
  - **Ex q:** Protection by filling electrical enclosure with powder.
- **Encapsulation**
  - **Ex m:** Protection by encapsulation of electronics.

# Protection Concept for Dust Classified Areas

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- **Prevent dust from entering** the enclosure or apparatus.
- **Maximum surface temperature** of the equipment to which the dust can be exposed **shall not exceed the ignition temperature of the dust.**
- **IP (Ingress Protection) rating system classifies the degree of protection from foreign bodies and liquids.**
- **IEC/EN 60529** covers electrical equipment and apparatus.

# An Explanation of ATEX, NEC and IEC Systems



- Environments that generate potentially explosive atmospheres classify the dangerous areas based on the likelihood and duration of the explosive atmospheres presence.
- This is referred to as a “**Zone**” (Europe and NEC 505) or “**Division**” (NEC 500)

# Equipment Groups



Apparatus is divided into Equipment groups:

- **Group I** for mines susceptible to methane (firedamp).
- **Group II** for explosive gases for locations other than mines
- **Group III** for dusts

Zoning Definitions			Equipment Categories	
Gas: EN 60079-10	Dust: EN 61241-10	Definitions	ATEX Category:	Typical Zone Suitability:
0	20	A place in which an explosive atmosphere is continually present	1 G 1 D	Equip. suitable for Zones 0,1,2 Equip. suitable for Zones 20,21,22
1	21	A place in which an explosive atmosphere is likely to occur in normal operation occasionally	2 G 2 D	Equip. suitable for Zones 1,2 Equip. suitable for Zones 21,22
2	22	A place in which an explosive atmosphere is not likely to occur in normal operation, but if it does only occurs for short periods	3 G 3 D	Equip. suitable for Zone 2 Equip. suitable for Zone 22

# Equipment Categories



## Further divided into categories:

- M1 and M2 for mining
- Category 1 (Zone 0, 20), 2 (Zone 1, 21) and 3 (Zone 2, 22) for all other industries.

<b>Equipment Group [ATEX (94/9/EC)]</b>				
<b>Equipment Group:</b>	<b>Equipment Category:</b>	<b>Atmosphere:</b>	<b>Protection Level:</b>	<b>Required Protection Performance &amp; Operation:</b>
I (Mines)	M1	Methane & Dust	Very High	• Two Faults, Remain energized and functioning
I (Mines)	M2	Methane & Dust	High	• Severe normal operation, De-energize in exp. atm.
II (Above Ground)	1	Gas, Vapor, Mist, Dust	Very High	• Two Faults
II (Above Ground)	2	Gas, Vapor, Mist, Dust	High	• One Fault
II (Above Ground)	3	Gas, Vapor, Mist, Dust	Low	• Normal operation



# Zone Definitions

A place in which an explosive atmosphere in the form of a gas/vapour (or cloud of combustible dust) in air....

## **Zone 0 (Zone 20)**

....is present continuously, or for long periods or frequently.

## **Zone 1 (Zone 21)**

....is likely to occur in normal operation occasionally.

## **Zone 2 (Zone 22)**

....is not likely to occur in normal operation but if it does occur, will persist for a short period only.

# Class/Division Definitions



**Class I** - Contains flammable gases or vapors in quantities large enough to produce an explosion.

**Class II** - Is hazardous due to the presence of combustibile dust in the air.

**Class III** - Contains easily ignitable fibers or flyings in the air. However, the quantities of fibers and flyings suspended in the air are not likely to be large enough to cause an explosion.

- **Division 1** - There is a high probability of an explosive atmosphere in normal operation. This can be for part of the time, up to all the time.
- **Division 2** - There is a low probability of an explosive atmosphere being present during normal operation.

\*Group designations further define the types of gases, and dusts (A, B, C, D) (E, F, G)

\*Example of an American certification would be:

- Class I, Div 1, Groups A, B and C; Class II, Div 2, Groups F and G

# Correlation – Somewhat?



Area Classification		Flammable Material Present Continuously	Flammable Material Present Intermittently	Flammable Material Present Abnormally
<b>IEC/EU</b>		Zone 0	Zone 1	Zone 2
<b>US</b>	NEC® 505	Zone 0	Zone 1	Zone 2
	NEC® 500	Division 1		Division 2
<b>CA</b>	CEC Section 18	Zone 0	Zone 1	Zone 2
	CEC Annex J	Division 1		Division 2

*IEC classification per IEC 60079-10*  
*EU classification per EN 60079-10*  
*US classification per ANSI/NF PA 70 National Electrical Code® (NEC®) Article 500 or Article 505*  
*CA Classification per CSA C22.1 Canadian Electrical Code (CEC) Section 18 or Annex J.*

# Gas Groups (ATEX, IEC and NEC 505)



Group II is further divided into three sub-divisions (groups):

- **IIA**, for atmospheres containing propane or gases of an equivalent hazard.
- **IIB**, for atmospheres containing ethylene or gases of an equivalent hazard.
- **IIC**, for atmospheres containing hydrogen or gases of an equivalent hazard.

Gas Group						
Substance:	Hazard Class:	ATEX:	NEC 500:	NEC 505:	Lower Exposure Limit:	Upper Exposure Limit:
Any Gas	Class I	II				
Acetylene		IIC	Group A	IIC	2.3 %	100 %
Hydrogen		IIC	Group B	IIC	4 %	77 %
Ethylene		IIB	Group C	IIB	2.3 %	36 %
Propane		IIA	Group D	IIA	1.7 %	11 %
Methane ( <i>mining</i> )		I	Group D		4.4 %	17 %
Metal (Conductive) Dust	Class II		Group E			
Coal (Carbonaceous) Dust			Group F			
Grain Dust			Group G			

# Apparatus Grouping

Typical Gas	US (NEC <sup>®</sup> 505) CA (CEC Section 18) EU IEC	US (NEC <sup>®</sup> 500) CA (CEC Annex J)
<b>Acetylene</b>	Group IIC	Class I/Group A
<b>Hydrogen</b>	(Group IIB + H <sub>2</sub> )	Class I/Group B
<b>Ethylene</b>	Group IIB	Class I/Group C
<b>Propane</b>	Group IIA	Class I/Group D
<b>Methane</b>	Group I*	Mining*

*\*Not within scope of NEC<sup>®</sup>. Under jurisdiction of MSHA. Not within scope of CEC.*

# What is Atex?



Set of **European Directives relating to Hazardous Area Installations** and spells out a set of Essential Health & Safety Requirements (EHSR's)

**ATEX 95/100a (94/9/EC)** - Equipment

**ATEX 137 (1999/92/EC)** - Installations



## Why was ATEX introduced ?

To ensure that manufacturers adhere strictly to the latest European Normatives (EN Standards) with respect to design construction & certification.

## When Did the ATEX Directive Go Into Effect ?

The ATEX Directive took effect on a voluntary basis on March 1, 1996. **Effective July 1, 2003, all products** placed on the market or put into service **in the EU for use in potentially explosive atmospheres must comply** with the ATEX directive

# CE Requirements - ATEX



Before being placed on the market, equipment must have affixed to it the CE marking attesting to its conformity to the provisions of this Directive, including the conformity assessment procedures

Where equipment is subject to other Directives concerning other aspects which also provide for the affixing of the CE marking, the latter shall indicate that the equipment in question is also presumed to conform to the provisions of those other Directives

Compliance with the Essential Health and Safety Requirements of each Directive must be demonstrated.

Harmonized standards may be used to show presumption of conformity to some of these EHSR's.



# ATEX Equipment Types



- Equipment
- Protective Systems (Flame Arrestors etc.)
- Safety Devices (Intrinsic Safety Barriers etc.)
- Components



# Quality System Requirements



It is **Mandatory for a Quality Assurance Notification (QAN) Certificate to be issued for CAT 1 and CAT 2 electrical equipment and CAT 1 non-electrical equipment.**

The Notified Body responsible for the QAN can be identified by a 4 digit number under or adjacent to the CE Mark

# ATEX 94/9/EC Certification



## Product Certification – Electrical

- **Categories 1 & 2 (M1 & M2)**
  - Certification of equipment by Notified Body
  - Certification of Quality System by Notified Body
- **Category 3 – Self Declaration by manufacturer**
  - Internal Control of Production
- **Product Certification - Non-Electrical**
- **Category 1 & M1**
  - Certification of equipment by Notified Body
  - Certification of Quality System by Notified Body
- **Category 2 & M2 – Requires a Technical Dossier to be lodged with a Notified Body**
- **Category 3 – Self Declaration by manufacturer**
  - Internal Control of Production

# IECEX Scheme



Multilateral Certification Scheme used to obtain National Certification in participating member countries.

- Ex Equipment Certification
- Ex Personnel Certification
- Ex Service Facility Certification



# IECEX Scheme



30 Member countries:



# IECEX Scheme - Equipment



## Requires:

- **Evaluation and Testing by IECEX TL** to IEC standards. IECEX TL issues an IECEX Test Report (TR).
- IECEX CB conducts an **audit of the Quality Management System** of the manufacturer. IECEX CB issues a Quality Assessment Report (QAR).
- TR is endorsed by CB and is used in conjunction with the QAR to create **IECEX Certificate of Conformity (CoC)**.

## Challenges:

- IECEX CoC is not solely accepted for National Certification by many member countries.
- Most member countries have extensive national deviations to the base IEC standards (including using different editions of the base standard).
- Limited availability of IECEX certified components.



# Why Intertek for HAZ LOC



- Hazardous Locations Test Facilities and Experts in **Boxborough, MA, Cortland, NY and Dallas, TX.**
- **Timelines** that can meet your business needs.
- Intertek will work with you **throughout the lifecycle** of your product from concept to end of life.
- Our team of experts can **assist you in achieving the desired level of certification** for the markets you require.
- **Cost savings** of parallel testing efforts and combined audits.
- **48 hour response** to request for quotes.
- Your products under test in **10 days or less.**
- **Availability and responsiveness** of Intertek team throughout the certification process.



# HAZ LOC Resources



Program Information: [www.intertek-hazloc.com](http://www.intertek-hazloc.com)

Questions: [hazloc@intertek.com](mailto:hazloc@intertek.com)

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Questions?

