APPLICATION NOTE

Making sense of intrinsic safety and intrinsically safe tools

Whenever work is performed in an area where combustible material is present it is essential to take steps to minimize the risk of ignition. Intrinsically safe (IS) tools play a role in these hazardous environments. IS tools reduce the available energy to a level where it is too low to cause ignition.

What is "intrinsically safe?"

Intrinsic safety is a protection standard employed in potentially explosive atmospheres. Devices that are certified as "intrinsically safe" are designed to prevent the release of sufficient energy, by either thermal or electrical means, to cause ignition of flammable material (gas, dust/particulates). Intrinsically safe standards apply to all equipment that can create one or more of a range of defined potential explosion sources:

- Electrical sparks
- Electrical arcs
- Flames
- Hot surfaces
- Static electricity
- Electromagnetic radiation
- Chemical reactions
- Mechanical impact
- Mechanical friction
- Compression ignition
- Acoustic energy
- Ionizing radiation

What industries are intrinsically safe products designed for?

- Petro-chemical
- Oil platforms and refineries
- Pharmaceutical
- Bulk materials
- Mining
- Pipelines
- Grain handling & processing
- Any environment where explosive gases are present

What organizations are defining intrinsically safe standards?

There are no global intrinsically safe standards or certifications, but there are organizations that influence directives in certain world geographies.

ATEX

The primary intrinsically safe standard has been set in the European Union with the **2014/34/EU**, commonly called **ATEX** ("**At**mosphères **Ex**plosibles," French for explosive atmospheres). The stated goal of the guidelines is to "help ensure the free movement of products in the European Union" by "minimizing the number of safeguard clause applications, at least those originating from divergent interpretations." ATEX is intended to serve as total harmonization directive, laying down essential health and safety requirements, and replacing existing divergent national and European legislation which covers the same subjects. The rules are mandatory on electrical and electronic equipment for use in environments subject to explosion hazard sold in the EU as of April 20, 2016.

Factory Mutual

In the United States, **Factory Mutual Research**, managed by Factory Mutual (FM) Global, is a not-for-profit scientific and testing organization that has tested and certified over 40,000 products in the last 165 years. FM Research has set certification guidelines for equipment used in potentially explosive atmospheres.

NEC

The NFPA (National Fire Protection Association) 70, **National Electrical Code**, also known as the NEC, is the basis for all electrical codes in the United States. Classifications and related product markings for hazardous areas are covered in NEC 500 and 505. These are similar to, but not exactly the same as, those in ATEX.

IEC

The International Electrotechnical Commission (**IEC**) is responsible for setting international standards for electrical technology. Its technical committee TC31 deals with explosion protection for electrical apparatus. It has introduced a procedure, the IECEx Scheme, which has become a globally recognized test and certification procedure for explosion protection. The objective of the IECEx Scheme is to facilitate international trade in electrical equipment intended for use in explosive atmospheres by:

- Reducing testing and certification costs to manufacturers
- Reducing time to market
- Providing international confidence in the product assessment process
- Providing one international database listing

OSHA

OSHA (Occupational Safety &Health Administration of the U.S. Department of Labor) participates in the **US-EU Cooperation on Workplace Safety & Health**. This is a project of the U.S. DOL, OSHA, and the EU European Agency for Health and Safety at Work. The goal is to promote sharing of information on current safety and health topics of common interest.
Intrinsic safety is covered under Regulations (Standards – 29 CFR), Hazardous (classified) locations 1910.307 and 1926.407. OSHA references the NEC guidelines for determining the type and design of equipment and installations which will meet this requirement.

Who is affected by the ATEX intrinsically safe standards?

Currently the standard affects only manufacturers who are selling product into the European Union (EU) that are intended for environments subject to explosion hazard. Considering the joint effort of OSHA and the EU, the longterm effect of ATEX may be a global standard to which all manufacturers would need to comply.

What is the impact of ATEX on tool manufacturers?

For manufacturers selling devices designed to be used in potentially explosive environments into the EU, they will need to redesign the devices to meet the standard and have those devices certified that they meet the regulations. Manufacturers not selling product in the EU are not impacted.

Why is there so much interest in intrinsically safe products now?

The new ATEX regulations have focused attention on the issue of providing intrinsically safe products in potentially dangerous environments.

However, there has already been a great deal of attention placed on workplace safety by regulatory groups as well as manufacturers.

Principles of explosion protection

The important principles of an integrated approach to explosion protection are:

1. Measures are taken to avoid hazardous atmospheres wherever possible.
2. Measures are taken to prevent the ignition of any hazardous atmospheres.
3. Measures are taken to limit the explosive effect to a safe degree.

The EU Directive 94/9/EC relates specifically to the second of these measures, thereby ensuring that the chance that equipment and installations will cause ignition of any potentially explosive atmosphere that may arise is reduced to an absolute minimum.

Hazardous zones are classified according to the frequency and duration with which potentially explosive atmospheres may occur. In these zones hydrocarbons and/or gases may be present during either normal or abnormal operation, respectively. This means that in Zone 1 potentially explosive atmospheres may be present occasionally, while in Zone 2 they may be present only rarely and will be of a short duration.

FLUKE®

Explaining the ATEX classifcation

Any product certified as meeting the ATEX directive carries a marking, which specifies exactly what criteria the product meets. Understanding what the certification means is as simple as knowing the ATEX nomenclature.

Explaining markings

Most certified products carry CE 0102 or CE 0344 markings. The CE mark with numerical code assigned to the notified bodyresponsible for certifying ATEX compliance (0102 for ZELM/DEKRA and 0344 for KEMA).

The ATEX examination mark. This sign is required on all devices used in European hazard-ous areas.

Classification of zones example

Fluke 707Ex is ATEX compliant

CE 0102 Ex II 2 G EEx ia IIC T4

Classification of zones example

ATEX Marking		Group
I		Group I: electrical equipment for mining
II		Group II: electrical equipment for all remaining hazardous areas
ATEX Marking		**Zone**
Gas	Dust	
0	20	Flammable material present continuously
1	21	Flammable material present intermittently
2	22	Flammable material present abnormally
ATEX Marking		**Group**
G		Gas, vapors, mist
D		Dust

Types of protection

In areas where the presence of an explosive mixture of air and flammable material cannot be prevented, special measures for the prevention of ignition sources are to be taken. Example:

Fluke 707Ex is ATEX compliant

Ex II 2 G EEx ia IIC T4

Type of protection

ATEX Marking	Measures Taken
o	**Separation** (oil immersion)
q	**Separation** (powder filling)
m	**Separation** (encapsulation)
p	**Exclusion** (pressurized apparatus)
d	**Special mechanical construction** (flameproof enclosure)
e	**Special mechanical construction** (increased level of safety)
ia	**Limitation of energy** (incapable of causing ignition under normal operation and if one fault occurs or if a combination of any two faults occurs)
ib	**Limitation of energy** (unable to cause the ignition of one substance during normal operation or in the event of one fault)
s	Other methods

Explosion groups

The European standards differentiate between two groups of equipment:

Group I: electrical equipment for mining

Group II: electrical equipment for all remaining hazardous areas

For Group II products, there can be further classification into the explosion gas groups. Example:

Fluke 707Ex is ATEX compliant

Ex II 2 G EEx ia IIC T4

ATEX Marking	Type of Gas	Ignition Energy (µJ)
I	Methane	280
IIA	Propane	>180
IIB	Ethylene	60 – 180
IIC	Hydrogen	<60

ATEX certification for IIC gases also includes types IIB, IIA and I gases.

Temperature class

A gas/air mixture can ignite when it comes into close contact with an excessively hot surface, so the surface temperature at which equipment operates is of crucial importance. If a specific tempera-ture is designated such as with the 725Ex, this temperature value supercedes the class rating. Equipment is temperature classified as follows (example):

Fluke 707Ex is ATEX compliant

Ex II 2 G EEx ia IIC T4

The NFPA (National Fire Protection Association) 70, National Electri-cal Code, also known as the NEC, is the basis for all electrical codes in the United States. Classifications and related product markings for hazardous areas are covered in NEC 500 and 505. These are similar to, but not exactly the same as, those in ATEX.

Two of the leading bodies that certify products as meeting NEC-500 regulations are Factory Mutual (FM) and the Canadian Standards Association (CSA).

ATEX Marking	Maximum Surface Temperature
T1	450 °C
T2	300 °C
T3	200 °C
171 °C	171 °C
T4	135 °C
T5	100 °C
T6	85 °C

NEC-500

Explaining NEC-500 regulations

Any product certified as meeting NEC-500 carries a marking, which specifies exactly what criteria the product meets. Understanding what the certification means is as simple as knowing the nomenclature.

Explaining markings

The Factory Mutual Approved mark. or the CSA marks for Canada and the U.S. with Certificate of Compliance master contract numbers (LR 110460 for both the 718Ex and 725Ex, and 221839 for the 700PEx).

Types of protection

Example:
Fluke 718Ex I.S. Class I, Div 1, Groups A-D T4

Type of protection

NEC-500 Marking	Type of Protection
XP	Explosion proof
IS	IS Intrinsically safe apparatus
AIS	Associated apparatus with intrinsically safe connections
ANI	Associated nonincendive field wiring circuit
PX, PY, PZ	Pressurized
APX, APY, APZ	Associated pressurization systems/components
NI	Nonincendive apparatus and nonincendive field wiring apparatus
DIP	Dust-ignition proof
S	Special protection

Classification of combustibles

Example:
Fluke 718Ex I.S. Class I, Div 1, Groups A-D T4

Classification of combustibles

NEC-500 Marking	Type of Combustible
Class I	Gases, vapors, liquids
Class II	Dust
Class III	Fibers, flyings

Approved ATEX zones

Example:
Fluke 718Ex I.S. Class I, Div 1, Groups A-D T4

NEC-500 Marking	ATEX Zone
Division 1	Zone 0 and 1 (Flammable material present continuously or intermittently)
Division 2	Zone 2 (Flammable material present abnormally)

NEC-500 Marking	ATEX Equivalent
Class I/Group A	Group IIC (acetylen)
Class I/Group B	Group IIC+H2 (hydrogen)
Class I/Group C	Group IIB (ethylene)
Class I/Group D	Group IIA (propane)
Class II/Group E	None (metal dust)
Class II/Group F	None (coal dust)
Class II/Group F	None (grain dust)
Class III	None (fibers, flyings)

Temperature class

A gas/air mixture can ignite when it comes into close contact with an excessively hot surface, so the surface temperature at which equipment operates is of crucial importance. If a specific temperature is designated, such as the 725Ex, this temperature value supercedes the class rating. Example:

Fluke 718Ex I.S. Class I, Div 1, Groups A-D T4

T4 temperature class gives the user the maximum-temperature of a surface that may be in contact to the Ex-atmosphere under fault conditions. T4 is rated at 135 °C.

ATEX Marking	Maximum Surface Temperature
T1	450 °C
T2	300 °C
T3	200 °C
T4	135 °C
T5	100 °C
T6	85 °C

Intrinsically safe products from Fluke

	Fluke Products	Certifications
	707Ex Intrinsically Safe mA Loop Calibrator	Ex II G Ex ia IIC T4 Zones 1 and 2, ZELM 02 ATEX 0120 X N.I. Class I, Div 2, Groups A–D T4
	718Ex Intrinsically Safe Pressure Calibrator	II 1 G Ex ia IIC T4, KEMA 04 ATEX 1061, Ta = –10 °C to +55 °C
	725Ex Intrinsically Safe Multifunc-tion Calibrator	Class I Div. 1 Groups B, C, and D; Class I Zone 0 AEx/Ex ia IIB 171 °C, Ta = –10 °C… +55 °C
	721EX Precision Pressure Calibrator	Ex ia IIB T3 Gb (Zone 1)
	700G Pressure Gauge Calibrator	II 3 G Ex nA IIB T6 CSA: Class 1, Div2, Groups A–D
	Fluke 750P Series Pressure Modules	II 1 G Ex ia IIC T4 Ga CIass I, Division 1, Groups A–D,T4

	Fluke Products	Certifications
	Fluke 28 II Ex Intrinsically Safe True-RMS Digital Multimeter	II 2 G Ex ia IIC T4 Gb, II 2 D Ex ia IIIC T130°C Db, I M1 Ex ia I Ma
	568 Ex Intrinsically Safe Mini Infra-red Thermometer	Zone 1 and 2, IECEx EPS 13.0006X, Ex ia IIC T4 Gb, 0 °C ≤ Ta ≤ 50 °C, EPS 13 ATEX 1.525 X, II 2G Ex ia IIC T4 Gb
	FL-45 EX Intrinsically Safe Flashlight	UL USA: E336598 • Class 1 Div 1 and 2 Group ABCD • Class II Div 1 and 2 Group EFG • Class III T5 IP67 II 1 G Ex ia IIC T5 Ga • I M1 Ex ia Ma • Ta = -20 °C to +40 °C • DEMKO 18 ATEX 2024X • Ex ia IIC T5 Ga, Ex ia I Ma • IECEx UL 18.0021x CE0344 UL913, Eighth • CSA C22.2 No.157-92, 2016
	FL-120 EX Intrinsically Safe Flashlight	UL USA: E336598 • Class 1 Div 1 and 2 Group ABCD • Class II Div 1 and 2 Group EFG • Class III T4 IP6X II 1 G Ex ia IIC T4 Ga • I M 1 Ex ia I Ma • DEMKO 18 ATEX 2024X • Ta = -20 °C to +40 °C • Ex ia IIC T4 Ga, Ex ia I Ma • IECEx UL 18.0021x CE0344 UL913, Seventh • CSA C22.2 No.157-92, Reaffirmed 2016
	FL-150 EX Intrinsically Safe Flashlight	UL USA: E336598 • Class 1 Div 1 and 2 Group ABCD • Class II Div 1 and 2 Group EFG • Class III T4 IP67 II 1 G Ex ia IIC T4 Ga • Ta = -20 °C to +40 °C • I M 1 Ex ia I Ma • DEMKO 18 ATEX 2024X • Ex ia IIC T4 Ga, Ex ia I Ma • IECEx UL 18.0021x CE0344 UL913, Seventh • CSA C22.2 No.157-92, Reaffirmed 2016
	HL-200 EX Intrinsically Safe Headlamp	UL USA: E336598 • Class 1 Div 1 and 2 Group ABCD • Class II Div 1 and 2 Group EFG • Class III T4 IP67 II 1 G Ex ia IIC T4 Ga • DEMKO 18 ATEX 2024X • Ex ia IIC T4 Ga • Ta = -20 °C to +40 °C • IECEx UL 18.0021x CE0344 UL913, Seventh • CSA C22.2 No.157-92, Reaffirmed 2016

	Fluke Products	Certifications
	Fluke 1551a Stik Thermometer & Temperature Calibrator	NVLAP-accreditation and NIST-traceable calibration
	Fluke 1552a Stik Thermometer & Temperature Calibrator	NVLAP-accreditation and NIST-traceable calibration

Fluke. *Keeping your world up and running.®*

Fluke Corporation
PO Box 9090, Everett, WA 98206 U.S.A.

Fluke Europe B.V.
PO Box 1186, 5602 BD
Eindhoven, The Netherlands

For more information call:
For more information call:
In the U.S.A. (800) 443-5853 or
Fax (425) 446-5116
In Europe/M-East/Africa +31 (0) 40 2675 200 or
Fax +31 (0) 40 2675 222
In Canada (800)-36-FLUKE or
Fax (905) 890-6866
From other countries +1 (425) 446-5500 or
Fax +1 (425) 446-5116
Web access: http://www.fluke.com

©2005, 2018 Fluke Corporation.
Specifications subject to change without notice.
Printed in U.S.A. 8/2018 2096400f-en