

**Airo® Wireless**  
**Intrinsically Safe White Paper**

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# Intrinsically Safe Cell Phone/Smartphone/PDA

“Intrinsically Safe” (IS) is a protection certification for safe operation with electronic equipment in explosive atmospheres. The concept was developed for safe operation of process control instrumentation in hazardous areas, particularly around petro-chemicals.

A device termed “intrinsically safe” is designed and certified to eliminate or encapsulate any components that produce sparks or which could generate enough heat to cause an ignition in areas with flammable gasses, dusts or fuels. Cell phones, smart phones, PDA's and other hand held devices can be ignition sources for explosives. A truly intrinsically safe cell phone will not ignite explosives.

Understanding IS approval ratings can be a difficult proposition. The certification process for North America is different from that in Europe, but the two certifications have nearly identical results. The U.S. and Canada organize hazardous areas by classes, divisions, and groups and certify devices for use in those areas under the UL 913 Standard. Europe applies a classification system based on zones generally referred to as ATEX certification (an acronym for the French language EU law that covers intrinsically safe certification).

Additionally, presence of an IS rating on a device does not mean that the device is safe for use in any IS area. Each intrinsically safe device is certified for different levels of IS approval, and should only be used in specific hazardous environments, if explosions are to be avoided. Close attention must be given to the specific IS approval certification for each individual piece of equipment to prevent loss of life and facilities. Each type of hazardous environment has specific certification requirements for equipment to be considered IS. Intrinsically safe equipment must be labeled as such; with the exact IS rating for the equipment, the name of the Nationally Recognized Testing Laboratory that tested it and a certification string detailing the types of threats for which the device is safe.

Although understanding the differences in different IS approval certifications can be a difficult task, and can make a purchasing decision for an IS device a painful and lengthy process, this verification process is extremely important to ensure the safety of your people and facilities.

## EU Labeling

In Europe, all equipment certified for use in hazardous areas must be labeled to show the type and level of protection applied. In addition to the European CE mark showing that the product has met EU consumer safety, health or

environmental requirements, and the code number of the certifying body for the 'quality certificate', the label must show:

1. The Explosion Protection String, which provides general level and type of protection by indicating, in order, the following:

Ex mark (CENELEC Hexagon enclosing an "Ex"); Gas Group Roman numeral; Temperature Category number; and if Group II equipment, the indication relating to gasses (G) or dust (D).

For example:

- Ex II 1 G (Explosion protected, Any Group II Gas, Temperature Category 1, Gas)

2. In addition, the normative marking "EEx" will be able to establish the specific type or types of protection being used. As examples:

- Ex II 2 G EEx ia IIC T4. (Type ia, Group 2C gasses, Temperature category 4).

- Ex II 2 G EEx na II T3 X. (Type n- non-sparking, Group 2 gasses, Temperature category 3, special conditions apply).

3. The IP (Ingress Protection) code should also be indicated where appropriate.

4. Also included in the marking are at least:

a) The manufacturers name or trademark, and address.

b) The apparatus type, name and serial number.

c) Year of manufacture.

d) Any special conditions of use.

5. Examples of cell phone certifications:

- (Airo A25is): Ex II 6 GD EEx ia II T6 IP67. UL 913 Division 1 Zone 1. (Explosion protected; Any Group II Gas; Temperature Category 6 – lacking heat to ignite explosives; protects in Gas and Dust; Certified to the following CENELEC standard of Explosion protection; Type ia – okay for zones where explosive atmosphere highly likely; All Group II Gasses; Temperature Category; Complete protection against ingress of dust, and Protection against temporary immersion in water ) (Underwriters Laboratory Certification under Section 913 - Intrinsically Safe Apparatus for Use in Class I areas, where ignitable concentrations of flammable gases, vapors or liquids can exist all of the time or some of the time under normal operating conditions.)

- (Common Ex-Handset): Ex II 2 G EEx ib IIC T4. (Explosion protected; Any Group II Gas; Temperature Category 2 – 300°C may ignite naphtha and carbon disulfide; protects in Gas only; Certified to the following CENELEC standard of Explosion protection; Type ib – okay for zones where explosive atmosphere possible; Group IIC Gasses; Temperature Category 4 ) (NB: Ex-Handy 04 is only intrinsically safe when kept in holster.)

- (Common Ex-GSM Handset): Ex II 3 G EEx nA nL IIC T6. (Explosion protected; Any Group II Gas; Temperature Category 3 – 200°C may ignite carbon disulfide; Gas only; Certified to the following CENELEC standard of Explosion protection; Type nA/nL – nonsparking and limited energy; Group IIC Gasses; Temperature Category 4;

## EU Labeling Considerations

### Gas groups

Group	Representative Gasses
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I	All Underground Coal Mining. Firedamp (methane)
IIA	Industrial methane, propane, petrol and most industrial gasses
IIB	Ethylene, coke oven gas and other industrial gasses
IIC	Hydrogen, acetylene, carbon disulphide

An indication of II without an A, B, or C after is suitable for any gas group.

The list above is in order of least volatile (I) to most volatile (IIC). The groups also indicate how much energy is required to ignite the gas by spark ignition, Group I requiring the most energy and IIC the least.

Some listings add Dust as a Group III

### Temperature classification

It is possible the surface temperature of the electrical equipment may rise beyond the auto-ignition temperature of ambient flammable gas or vapor, causing explosion. Temperature Class should match expected environmental chemicals.

The temperature classification on the electrical equipment label will be one of the following (in degree Celsius):

America °C		UK °C	Germany °C Continuous - Short Time
T1 - 450	T3A - 180	T1 - 450	G1: 360 - 400
T2 - 300	T3B - 165	T2 - 300	G2: 240 - 270
T2A - 280	T3C - 160	T3 - 200	G3: 160 - 180
T2B - 260	T4 - 135	T4 - 135	G4: 110 - 125
T2C - 230	T4A - 120	T5 - 100	G5: 80 - 90
T2D - 215	T5 - 100	T6 - 85	
T3 - 200	T6 - 85		

The above table tells us that the surface temperature of a piece of equipment with a temperature classification of T6 will not rise above 85 °C or 185 °F. The T6 Temperature Classification is safest, while T1 will still ignite many explosives as listed below.

## Auto-ignition temperatures

The auto-ignition temperature is the temperature at which a substance will ignite automatically by itself without a spark. Examples for common substances are:

Vapors & Gasses		Dusts	
Methane	= 580 °C/	Sugar	= 460 °C
Hydrogen	= 560 °C	Wood	= 340 °C
Ethylene	= 425 °C	Flour	= 340 °C
Acetylene	= 305 °C	Grain dust	= 300 °C
Naphtha	= 290 °C	Tea	= 300 °C
Carbon disulfide	= 102 °C		

## Equipment Code

Electrical apparatus for use in hazardous areas needs to be designed and constructed in such a way that it will not provide a source of ignition. There are ten recognized types of protection for hazardous area electrical apparatus. Each type of protection achieves its safety from ignition in different ways and not all are equally safe. In addition to the equipment being suitable for the Gas Group and the Temperature Class required, the type of protection must be suitable for the zone in which it is to be installed. The different types of protection and the zones for which they are suitable are as follows:

Equipment Code	Description	Suitable for zones...
EEx ia	Intrinsic safety 'ia'	0, 1, 2
EEx ib	Intrinsic safety 'ib'	1,2

EEx ic	Intrinsic Safety 'ic'	2
EEx d	Flameproof protection	1,2
EEx p	Purge/pressurized protection	1,2
EEx px	Purge/pressurized protection 'px'	1,2
EEx py	Purge/pressurized protection 'py'	1,2
EEx pz	Purge/pressurized protection 'pz'	2
EEx e	Increased safety	1,2
EEx m	Encapsulation	1,2
EEx ma	Encapsulation	0,1,2
EEx mb	Encapsulation	1,2
EEx o	Oil immersion	1,2
EEx q	Sand / powder (quartz) filling	1,2
EEx n	Type - n protection	2
EEx s	Special protection	Normally 1 and 2

There are three zones for gasses and vapors:

Zone 0	Flammable atmosphere highly likely to be present - may be present for long periods or even continuously
Zone 1	Flammable atmosphere possible but unlikely to be present for long periods
Zone 2	Flammable atmosphere unlikely to be present except for short periods of time - typically as a result of a process fault condition.

## The 'IP' Code

The IP (Ingress Protection) Code gives an indication of the equipment's ability to keep out unwanted liquids and solids. The code is given in the form of two numbers, for example: IP54. The first numerical digit, in the previous example '5', is the degree of protection against solids and is given a value between 0 and 6. The second number is the degree of protection against liquids, and has a value between 0 and 8.

A third number to indicate resistance to impacts is being considered, and will be based on a standard impact, measured in joules.

# Table of Reference

1st Digit	Degree of Protection (Foreign Bodies)	2nd Digit	Degree of Protection (Liquids)
0	No protection	0	No protection
1	Protection against ingress of large solid foreign bodies	1	Protection against drops of water
2	Protection against ingress of medium sized solid foreign bodies	2	Protection against drops of liquid falling at any angle up to 15° from vertical
3	Protection against ingress of small solid foreign bodies greater in diameter than 2.5 mm	3	Protection against drops of liquid falling at any angle up to 60° from the vertical
4	Protection against ingress of small solid foreign bodies greater in diameter than 1 mm	4	Protection against splashing. Liquid splashed from any direction shall have no harmful effect
5	Protection against the ingress of dust in an amount sufficient to interfere with satisfactory operation of the enclosed equipment	5	Protection against water projected by nozzle from any direction
6	Complete protection against ingress of dust	6	Protection against powerful water jets
		7	Protection against temporary immersion in water
		8	Protection against immersion in water for a defined pressure and time

## North American Labeling

### CLASS I - FLAMMABLE GASES, VAPORS OR LIQUIDS

#### Class I Area Classifications

##### **Division 1:**

Where ignitable concentrations of flammable gases, vapors or liquids can exist all of the time or some of the time under normal operating conditions.

##### **Division 2:**

Where ignitable concentrations of flammable gases, vapors or liquids are not

likely to exist under normal operating conditions.

##### **Zone 0:**

Where ignitable concentrations of flammable gases, vapors or liquids can exist all of the time or for long periods of time under normal operating conditions.

**Zone 1:**

Where ignitable concentrations of flammable gases, vapors or liquids can exist some of the time under normal operating conditions.

**Zone 2:**

Where ignitable concentrations of flammable gases, vapors or liquids can exist some of the time under normal operating conditions.

## Class I Groups

**Division 1 & 2**

A (acetylene)  
 B (hydrogen)  
 C (ethylene)  
 D (propane)

**Zone 0, 1 and 2**

IIC (acetylene & hydrogen)  
 IIB (ethylene)  
 IIA (propane)

## Class I Temperature Codes

**Division 1 & 2**

T1 ( $\leq 450^{\circ}\text{C}$ )  
 T2 ( $\leq 300^{\circ}\text{C}$ )  
 T2A, T2B, T2C, T2D  
 ( $\leq 280^{\circ}\text{C}$ ,  $\leq 260^{\circ}\text{C}$ ,  $\leq 230^{\circ}\text{C}$ ,  $\leq 215^{\circ}\text{C}$ )  
 T3 ( $\leq 200^{\circ}\text{C}$ )  
 T3A, T3B, T3C  
 ( $\leq 180^{\circ}\text{C}$ ,  $\leq 165^{\circ}\text{C}$ ,  $\leq 160^{\circ}\text{C}$ )  
 T4 ( $\leq 135^{\circ}\text{C}$ )  
 T4A ( $\leq 120^{\circ}\text{C}$ )  
 T5 ( $\leq 100^{\circ}\text{C}$ )  
 T6 ( $\leq 85^{\circ}\text{C}$ )

**Zone 0, 1 and 2**

T1 ( $\leq 450^{\circ}\text{C}$ )  
 T2 ( $\leq 300^{\circ}\text{C}$ )  
  
 T3 ( $\leq 200^{\circ}\text{C}$ )  
  
 T4 ( $\leq 135^{\circ}\text{C}$ )  
  
 T5 ( $\leq 100^{\circ}\text{C}$ )  
 T6 ( $\leq 85^{\circ}\text{C}$ )

## Class I, Division 1 and 2 Protection Methods

Area	Protection Methods	Applicable Certification Standards	
		U.S.	Canada
Div. 1	Explosion proof	ANSI/UL 1203	CSA-30
	Intrinsically safe (2 fault)	ANSI/UL 913	CSA-157
	Purged/pressurized (Type X or Y)	ANSI/NFPA 496	ANSI/NFPA 496
Div. 2	Nonincendive	UL 1604	CSA-213
	Non-sparking device	UL 1604	CSA-213
	Purged/pressurized (Type Z)	ANSI/NFPA 496	ANSI/NFPA 496
	Hermetically sealed	UL 1604	CSA-213
	Any Class I, Div. 1 method	----	----

## Class I, Zone 0, 1 and 2 Protection Methods

Area	Protection Methods	Applicable Certification Standards			
		U.S.	Canada	IEC	Europe
Zone 0 - Intrinsically safe, 'ia' (2 fault);		UL 2279, Pt. 11	CSA-E79-11	IEC 79-11	EN 50020
Class I, Div. 1 intrinsically safe (2 fault)		ANSI/UL 913	CSA-157	----	----
Zone 1 • Encapsulation, 'm'		UL 2279, Pt. 18	CSA-E79-18	IEC 79-18	EN 50028
Flameproof 'd'		UL 2279, Pt. 1	CSA-E79-1	IEC 79-1	EN 50018
Increased safety 'e'		UL 2279, Pt. 7	CSA-E79-7	IEC 79-7	EN 50019
Intrinsically safe '1b' (1 flt)		UL 2279, Pt. 11	CSA-E79-11	IEC 79-11	EN 50020
Oil immersion 'o'		UL 2279	CSA-E79-6	IEC 79-6	EN 50015
Powder filling 'q'		UL 2279	CSA-E79-5	IEC 79-5	EN 50017
Purged/pressurized 'p'		UL 2279, Pt. 2	CSA-E79-2	IEC 79-2	EN 50016
Any Class I, Zone 0 method		----	----	----	----
Any Class I, Div. 1 method		----	----	----	----
Zone 2 • Nonincendive 'nC'		UL 2279, Pt. 15	CSA-E79-15	IEC 79-15	prEN 50021
Non-sparking device 'nA'		UL 2279, Pt. 15	CSA-E79-15	IEC 79-15	prEN 50021
Restricted breathing 'nR'		UL 2279, Pt. 15	CSA-E79-15	IEC 79-15	prEN 50021
Hermetically sealed 'nC'		UL 2279, Pt. 15	CSA-E79-15	IEC 79-15	prEN 50021
Any Class I, Zone 0 or 1 method		----	----	----	----
Any Class I, Div. 1 or 2 method		----	----	----	----

