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MACHINE SAFETY IN EXPLOSIVE ATMOSPHERE

94/9/CE Guideline

Certified by INERIS
N° 06 ATEX 0007

Polyamid PL-II 1GD-EEx ia IIc T4 → Zone 0
Stainless Steel OX-II2 GD-EEx ia IIC T4 → Zone 1

EEx SYST (ia IIC T4)

PROCESS ACOTOM ®

AWAX26XXL-EEX
ATEX + safety module category 4 according to EN954-1

ANATOM78S-EEX
With LED status display of auxiliary contact

High protection level of ATEX and reliable solution for machine safety

Read how to determine :
- The atex area and its category
- The temperature level from T1 to T6
- The most suitable solution for your application

Produced by BTI F-93160 Noisy Le Grand

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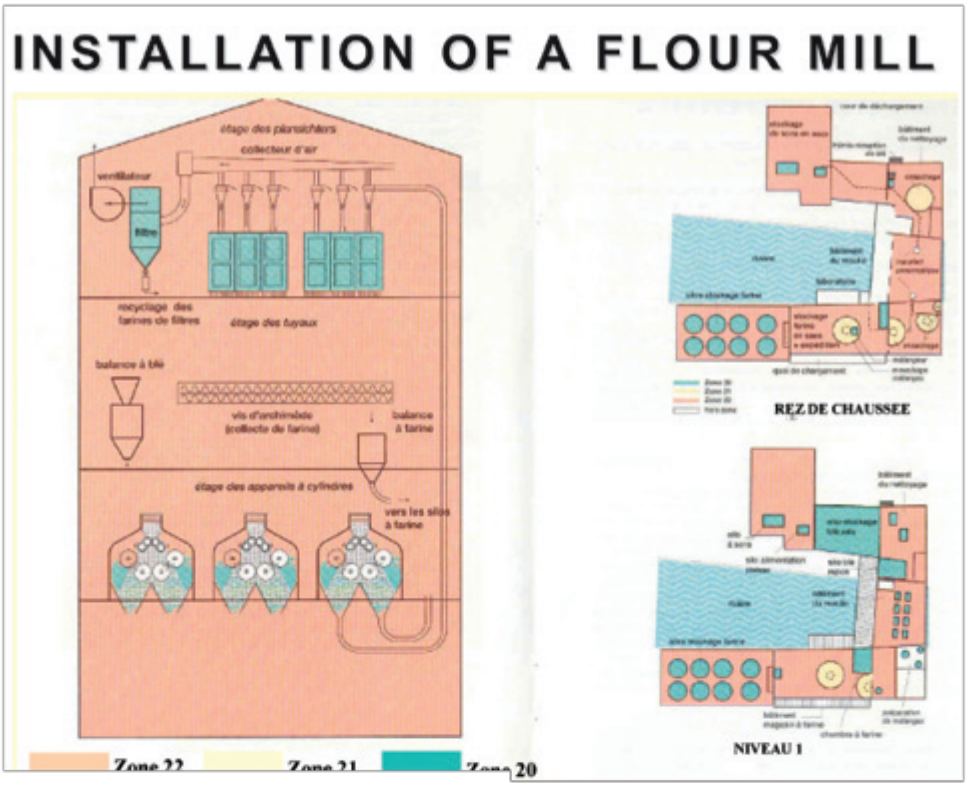
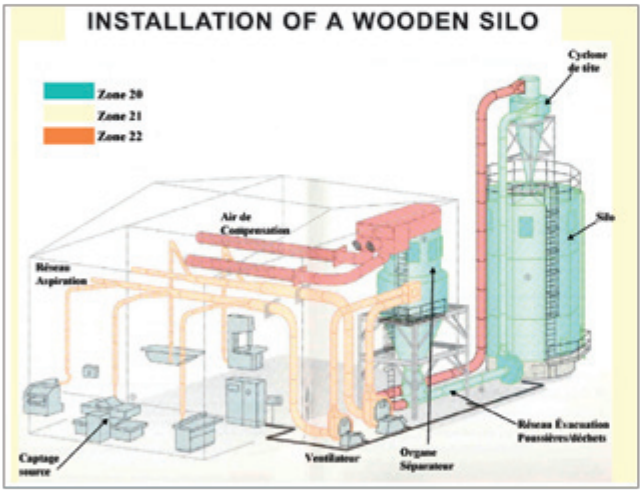
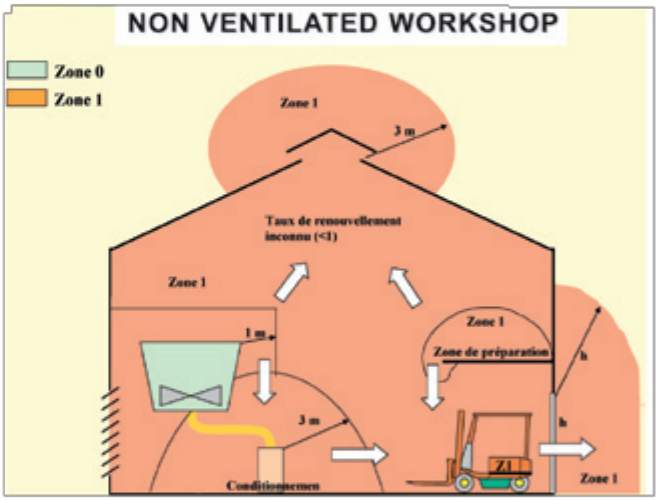
INSTALLATION OF A FLOUR MILL



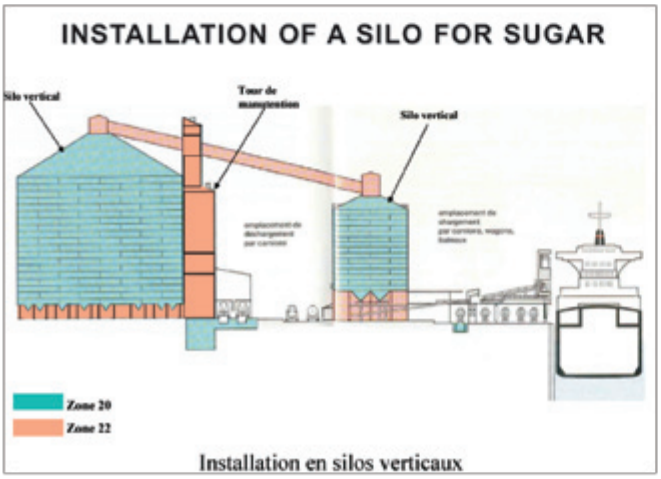
INSTALLATION OF A WOODEN SILO



NON VENTILATED WORKSHOP

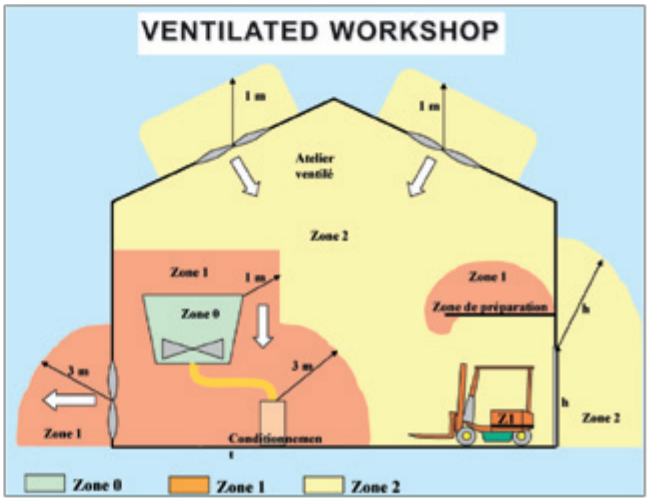


INSTALLATION OF A SILO FOR SUGAR



Installation en silos verticaux

VENTILATED WORKSHOP



Which product use to provide the safety?
The EX category and areas

According to the Guideline 94/ 9/EC, an explosive atmosphere is defined as a mixture:
- of flammable substances in the form of gases, vapours, mists or dusts,
- with air,
- under atmospheric conditions,
- in which, after ignition, the combustion spreads to the entire unburned mixture.

An atmosphere becoming explosive due to local and/or operational conditions, is called a potentially explosive atmosphere. The electrical equipment used in these areas must be designed as not to create sources of ignition capable of igniting these mixtures.

The table 1 shows us the repartition of the dangerous area, considering their environment, their risk category, and the components requirements. It gives the help to determine which product must be used in accordance with the environment. Of course, a product which complies in the most restrictive area applies also in the less restrictive area (e.g. ANATOM78S-EEX PL).

TABLE 1

ATm.EXpl.	risk	zone	category	equipment to be used
Gas, steam and fog	permanent or frequent	0	II 1 G	Very high level of protection (2 independent means in order to ensure the protection and the safety)
Gas, steam and fog	occasional	1	II 2G	High level of protection (safe even in case of unusual conditions of functioning)
Gas, steam and fog	occasional or for a short time	2	II 3 G	Normal level of safety (safe in case of usual conditions of functioning)
Dust	permanent or frequent	20	II 1 D	Very high level of safety (2 independent means in order to ensure the protection and the safety)
Dust	occasional	21	II 2 D	High level of safety (safe even in case of unusual conditions of functioning)
Dust	occasional or for a short time	22 conductive dust / non-conductive dust	II 2 D	High level of safety
			II 3 D	Normal level of safety

Synthesis of the table 1

A) Gas

Zone 0 : Frequent risk
Zone 1 : Occasional risk
Zone 2 : Low probability of risk and for short time

As the area can not be always defined precisely, exemples will be provided afterward.

B) Dust

Zone 20 : Frequent risk
Zone 21 : Occasional risk
Zone 22 : Low probability of risk and for short time

C) Our solution

We provide an economical and reliable ATEX solution which can reach the highest protection level for explosive area : zone 0 for gas and zone 20 for dust

- ANATOM78S-EEX : Coded, double channel (process acotom ® 2) with 12 M cable length
- AWAX26XXL : with integrated Zener Barrier , cat 4 acc. to EN954-1

E) CONCLUSION

The solution ANATOM78S-EEX + AWAX26XXL allows to meet the requirements of these standards :

- ATEX ➔94/9/CE
- MACHINE ➔2006/42/CE
- CEM ➔2004/108/CE

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How to avoid the explosion?

The risk in potentially explosive atmospheres is due to mixtures of gas/air, vapour/air, dust/air or other flammable combinations.
We can avoid the explosion by eliminating sources of ignition such as sparks, hot surfaces or static electricity.

Preventing an explosive atmosphere

The used protective systems for electrical equipments in an atmosphere of gas, vapour or mist are detailed in table 2. Several protective measures may be combined.

Within explosive dust atmosphere, the protective measures mainly concern the waterproof surface (protection class IP)

New protective systems applied to non electrical materials used in potentially explosive atmosphere are detailed in the new European standard EN 13343-1.

Reliable measures eliminating all potential sources of ignition is dependent on the category of the used equipment. You should first consider the materials, alloys, electro-static charges, electric arc and overheating due to frictions.

TABLE 2

MODES OF PROTECTION AGAINST THE IGNITION	THIS IDENTIFICATION CAN BE USED IN ZONE	PRINCIPLE OF SAFETY
Increased safety	EEx e 1	no electric arcs, sparks or hot surfaces
Anti-spark equipment	EEx nA 2	
Antiexplosive covering	EEx d 1	controls the internal explosions but not the spreading of the flame
Encapsulation of sand	EEx q 1	
Device for protected commutation	EEx nC 2	
Intrinsic safety (specific demands)	EEx ia 0	limits the energy of a spark and the temperature of the surface
Intrinsic safety	EEx ib 1	
Equipment for limiting energy	EEx nL 2	
Encapsulation	EEx m 1	distinguishes the source of ignition and the ATm.EXpl.
Encapsulation of oil	EEx o 1	
Pressurisation	EEx p 1	
Simplified pressurisation	EEx nP 2	
Protective covering against the vapour	EEx nR 2	

Groups of gas

Various substances may be flammable due to occuring energy . Weaker sufficient energy is, the more the subtance is dangerous. The directive divides equipment into two groups. Group I is applied for mining, and Group II for surface industries. Group II is divided in subgroup (from the leak risk level IIA to the high level IIC). Our ATEX solution ANATOM78SEEx and AWAX26XXLEEx complies with the highest risk level groupe IIC.

Temperature classes

Various substances may ignite in different temperatures. These substances are considered as the most dangerous ones when they may ignite under very low temperature. The temperature class is indicated by a marking on the equipment. The maximum surface temperature of apparatus must be lower than this of self-ignitable mixtures being present in the dangerous area. Materials used in explosive atmosphere are classified from T1 to T6 according to their generated maximum surface temperature. (See table 3). Materials in class T6 (the lowest temperature) are the most dangerous and may be obviously used for other classes (T1 to T5). The equipment marked with EEx...IICT6 can be used for any mixture of atmospheres existing. In explosive dust atmosphere, the maximum surface temperature is mentionned in °C.

TABLE 3

GROUPS OF DANGEROUS ZONES	TEMPERATURE CLASSES					
	T1	T2	T3	T4	T5	T6
MAXIMUM TEMPERATURE OF SURFACE	450°C	300°C	200°C	135°C	100°C	85°C
II A	Acetone Ammoniac Benzene Acetic acid Ethane Acetate of ethyl Ethyl chloride Methanol Naphthalene Phenol Propane	I-Amyl acetate Butane Alcool Butyl	Petrol Gazoil Hot oil Hexane	Acetaldehyde		
II B	City gas Gas for lighting	Ethylene	Hydrogen sulfide	Diethyl ether		
II C	Hydrogen	Acetylene				Carbon bisulphide
	ANATOM78SEEXPL+AWAX26XXLEEX APPLICATION ZONE					

ANATOM 78S-PL-EEx in polyamid housing
II 1GD-EEx ia IIC T4

Benefits

- What's T4 ?

T4 is the maximum temperature on the surface of the product (135°C). It covers almost all gases. As the unit ANATOM78S PL-EEX can be used in T4 condition (the most dangerous), it means that it can be appllied in T1, T2 and T3 condition which are less dangerous.

ANATOM78X-OX-EEX in stainless steel
II 2 GD-EEx ia IIc T4

The unit is designed for application in hard environment where agressive materials are used for cleaning and mechanical wear occurs, but the risk category decreases to 1.

AWAX26XXL-EEx

Benefits

This safety module provides a high safety category in EX as well as machine safety.
A dual channel and category «a» Zener barrer is embedded.

The safety module

This safety module provides safety contacts rated up to 8A/250V. The plug-in terminal offers an easy maintenance. A dip-switch allows also to choose the reset mode (auto/manual) when the module is energized or when it has detected a failure. The front LED (V1 and V2) gives a display status of the both channels.

		GROUP	II A																										II B			II C		
		GAS AND VAPOURS	Acetone	Industrial methane	Acetate of ethylene	Methanol	Butane	Propane	Hexane	Ammoniac	Oxidized carbonne	Pentane	Heptane	Iso-octane	Decane	Benzene	Xylene	Cyclohexane	Ethyl/MethylKetone	Acetate of methyl	Acetate of propyl	Acetate of butyl	Acetate of amyl	Butanol	Nitrite of ethyl	Ethylene	Butadiène 1,3	Oxydized ethylene	Hydrogen	Carbon bisulphide	Acethylene
APPLICATION FIELDS	Ignition temperature	Group of Gas	465°C	535°C	425°C	385°C	287°C	450°C	223°C	650°C	605°C	260°C	204°C	530°C	205°C	498°C	460°C	245°C	510°C	454°C	450°C	420°C	360°C	343°C	90°C	450°C	420°C	425°C	500°C	90°C	300°C
Industry of cleaning products	245°C	II or IIB	X		X											X	X	X	X	X						X					
Pharmaceutical industry	90°C	II or IIC		X	X	X															X	X			X				X		
Industry of colouring agents	385°C	II or IIA		X		X										X	X		X	X											
Industry of artificial rubber	300°C	II or IIC		X	X											X						X				X	X				X
Perfumery	375°C	II or IIA	X		X	X										X	X						X								
Alcohols	375°C	II or IIA				X																	X								
Artificial essences of fruits	90°C	II or IIA			X																		X		X						
Manufacture of artificial textile	90°C	II or IIC			X						X					X		X								X		X		X	X
Painting industry	343°C	II or IIB	X		X											X			X	X		X	X	X				X			
Manufacture of fats	343°C	II or IIB	X		X											X			X	X		X	X	X				X			
Fat solvents	465°C	II or IIA	X							X						X															
Resin solvents	465°C	II or IIA	X			X													X	X				X							
Manufacture of plastic matters	300°C	II or IIC	X	X																		X		X		X			X		X
Hydrocarbons	90°C	II or IIC		X			X	X	X			X	X	X	X	X	X	X												X	
Gas used as fuel	300°C	II or IIC		X		X	X	X																					X		X
Agricultural fertilizers industry	500°C	II or IIC																											X		

Note: The mixtures of gas are mentionned as information only.

ANATOM78S-PL-EEX+AWAX26XXL-EEX:
GAS Ex ia IIC T4
DUST : II 1 GD IP6X-T135 °C

ANATOM78S-OX-EEX+AWAX26XXL-EEX:
GAS : EEx ia IIC T4
DUST : II 2 GD IP6X-T135 °C

USE OF TABLE:
Example of “manufacture of plastic matters”. The “X” in the table show the presence of the gas. For the gas that has the lowest temperature of self-ignition (300°C), the electrical equipment which is installed must have a temperature less than 300°C, so be classed T3, T4, T5 and T6.
the most explosive gas is the acethylene (Group II C). The equipment must be classed at least IIC T3.
Our equipment is not designed to be used with the following gas: Nitrite of ethyl and carbon bisulphide (red boxes)

Technical characteristics	AWAX26XXL-EEX
Power supply (Un)	24VAC 50Hz/60Hz or 24VDC
Tolerance of Un	-15% / +10%
Consumption DC/AC	More than 2W (DC); More than 5VA (AC)
Electrical protection	DLC: Electrical circuit-breaker with a current limiting system
Safety contacts	8A / 250VAC resistive
Minimum switching capacity	Less than 50 mW
Response time	More than 20ms
Protection class	IP20
Temperature	-20°C / +40°C
Life expectancy	10 million mechanical operations
Dimensions L*l*h	45*100*111 mm
Weight	250 g

Technical characteristics	ANATOM 78S-EEX	
Power supply	12V DC	
Consumption	30mA DC	
Safety contacts	2NO static isolated	
Auxiliary line	1 NC static PNP 15 mA	
Protection class	IP67	
Temperature	-20°C/+40°C	
detection distance / hysteresis	10mm/4mm (typical)	
dimensions Lxlxh	Transmitter 92x23x18 mm	Receiver 92x23x23
Weight	Transmitter 80g Polyamide 6	Receiver 620g Polyamide 6

3 NO safety contacts and

1 NC auxiliary contact of 8A/250V

Category 4 acc. to EN954-1

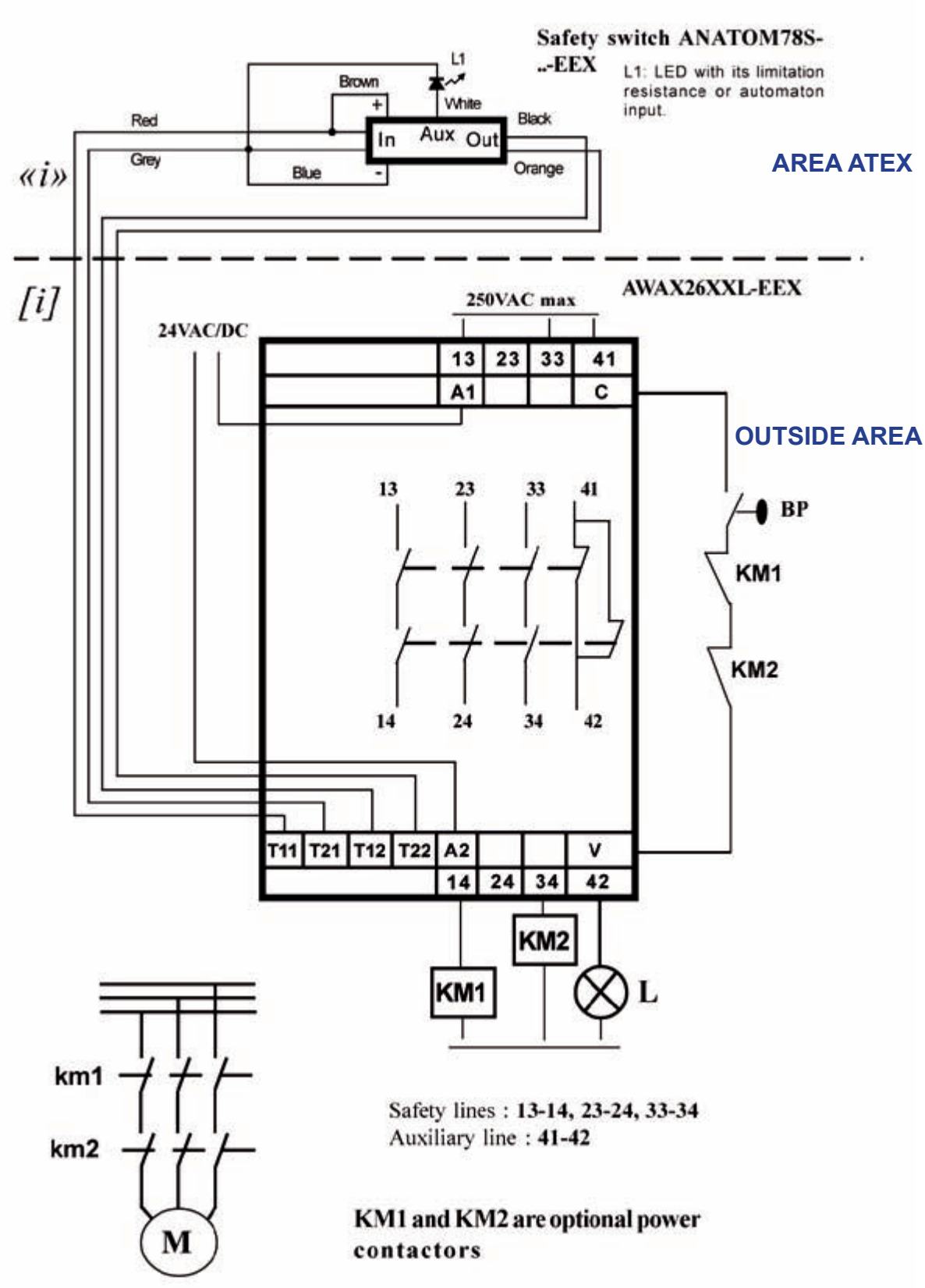
Zener barrier incorporated

High tolerance of misalignment : 10 mm

Embedded Led / mounting brackets

Equipped with ACOTOM ® 2 Process

ELECTRICAL WIRING



Machine safety in explosive atmosphere

EX area 2 and 22

IMPORTANT : **AWAX26XXL-EEx3 can monitor up to 30 switches RDX8 in serial**

CATEGORY OF THE SOLUTION : EX II3GD
PROTECTION EX : EExnc IIc T6X

RDX8 safety switch

Application field

The RDX8 safety switch controls the opening of movable guard doors. It is manipulation free thanks to the coded process. It is suitable for area ATEX 2 and 22. It meets the requirements of the standard 94/9/CE and for which a conformity declaration from the manufacturer is asked. As the overheating is very low, the magnetic switches RDX8 are particularly adapted for high room temperature, because they never reach the ignition temperature of the gas or the dust, even when energized. When they are monitored by the safety relay AWAX26XXL-EEX3, which integrates a zener barrier with dual channel, one can connect up to 30 switches in serie.

Writing

Reference : Safety switch RDX8
Category : II 3GD
Ex Protection : EEx nC IIC T6 X
Protection class : IP67-T80°C
Operating temperature : -25°C à +70°C

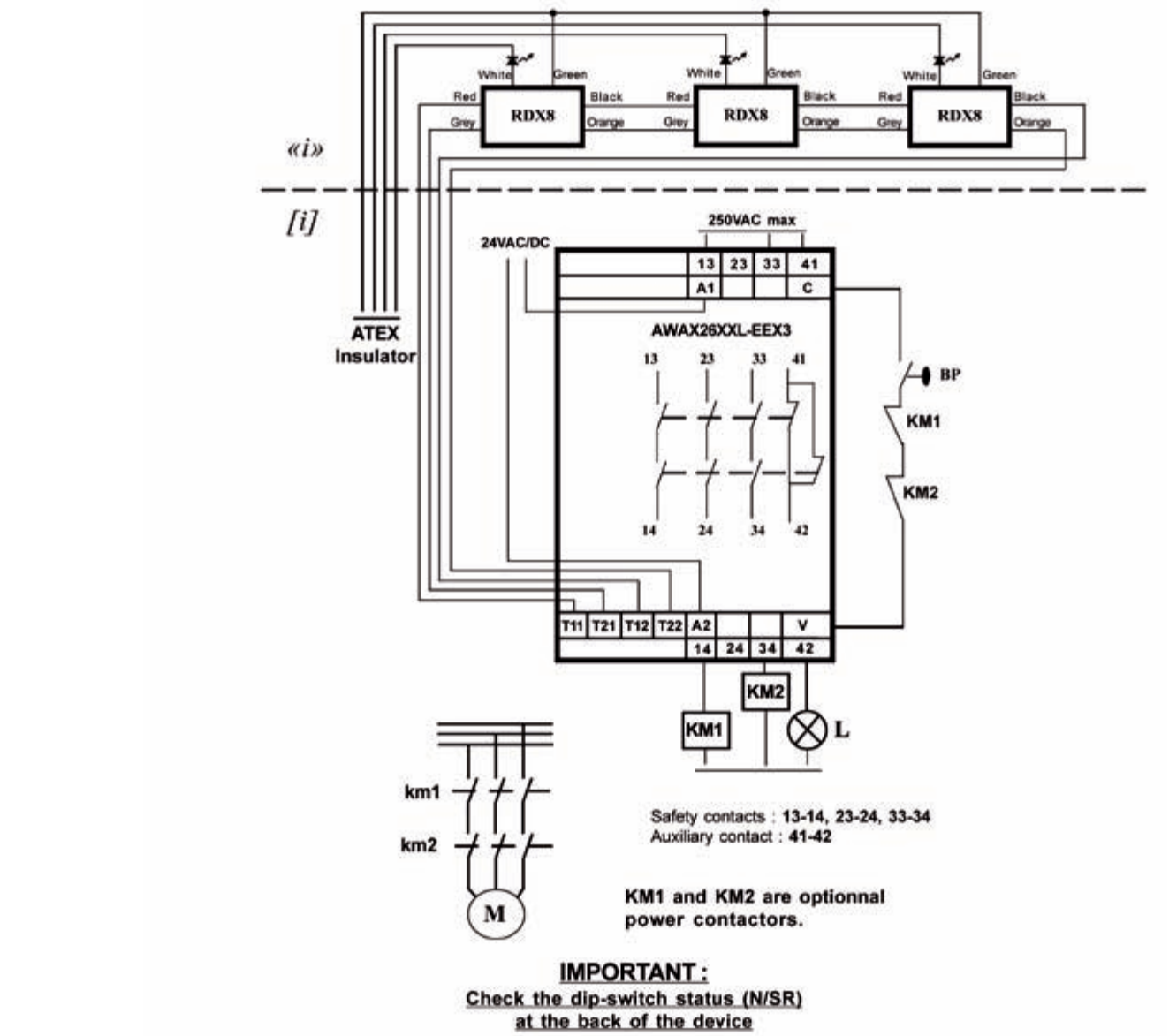
Operating mode

This non-contact safety switch provides 2 NO safety outputs and 1 NC auxiliary output potential free. To comply with the ATEX requirements (94/9/CE), the RDX8 must be connected to an intrinsic zener barrier with dual channel such as our ZRX8. But to be in compliance with the ATEX and machine safety standards (guideline 2006/42/CE), the RDX8 must be connected to a safety relay such as the AWAX26XXL-EEX3 in which the zener barrier is embedded.

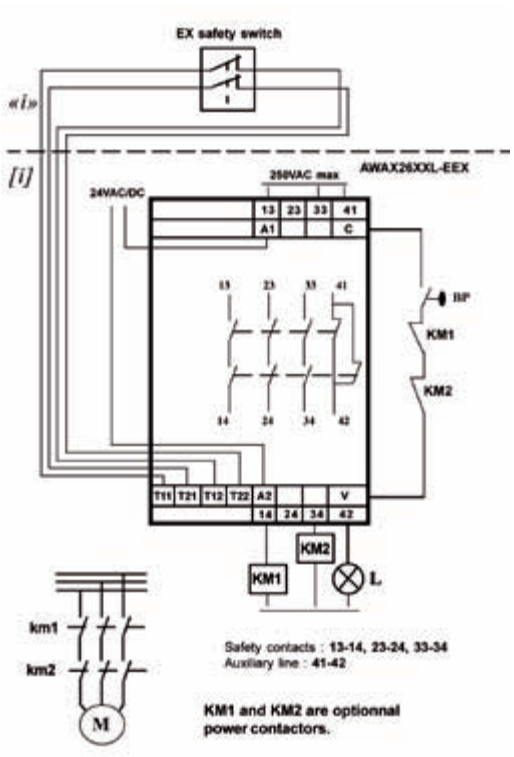
Technical features

Ex	RDX8
Nominal voltage (Vac/dc)	24 V
Static nominal current	150 mA on the 3 lines
Max. nominal current/contact	50 mA
Peak nominal intensity	500 mA during 2 s
Cable max. capacitance	Contact = 300 mΩ / cable= 78 mΩ/m
Cable inductance	Ls = 0,39 µH/m
Cable capacitance	Cs = 270 pF/m + 3pF
Switch insulation resistance	10^9 Ω
Cable operating voltage	300 V
Switching distance ON	17 mm
Switching distance OFF	22 mm
Axial misalignment	+/- 4 mm
Vertical misalignment	+/- 12 mm
Operating temperature	-5 °C / +80 °C
Protection class	IP 67
Resistance to vibration	(50-2000 Hz) 30 g
Resistance to shock	(1/2 sin 11 ms) 50 g
Dimensions L x H x W receiver	92 x 25 x 25 mm
Dimensions L x H x W emitter	92 x 25 x 18 mm
Weight of receiver/emitter	250 g

Electrical wiring with RDX8



Electrical wiring with atex safety switch



AWAX26XXL-EEX3

Application field

The safety relay AWAX26XXL-EEX3 is intended to monitor any type of sensor in explosive atmospheres. It provides redundant channel, a zener barrier and the whole solution meets the EN954-1 / ISO13849-1 standard.

Writing

Reference : AWAX26XXL-EEX3
Category : II 3 G EX
Protection class : IP20
Operation temperature : -20°C to +40°C

Operating mode

This product is equipped with a dual channel ATEX barrier (conformity EN50020) as well as a processing logic conform to the requirements of the machine safety EN954-1 (category 4). It is intended to control mechanical sensors, ANATOM78S-EEX, RDX8 or EPB which are EEX certified with at least 2 NC contacts powered at 12Vdc (consult us). This module has three NO safety lines and one NC auxiliary lines with each a switching capacity of 8A/250Vac. This product is energized with 24Vac/dc and can be used in all applications that require the highest safety and / or a high switching power. This module is easily installed on DIN-rail enclosure.

Technical features

	AWAX26XXL-EEX3
Power supply (Un)	24VAC 50Hz/60Hz ou 24VDC
Tolérance sur Un	-15 % / +10 %
Power consumption DC/AC	< 2W (DC) ; < 5VA (AC)
Electrical surge protection	DLC : electronic circuit-breaker with a current limiting system
Safety contacts	8A / 250VAC resistive
Minimum switching current	> 50 mW
Life expectancy	10 millions mechanical operations
Response time	< 20ms
Operating temperature	-20 °C / +40 °C
Protection class	IP20
Dimensions W x H x L	45 x 100 x 111mm
Weight	250 g
Max. output voltage	Uzm = 15,75v (T11=+ and T21=0)
Courant de sortie impulsionnel	Izp = 166mA (T11=+ and T21=0)
Output voltage	Us = 12v (T11=+ andT21=0) pour Is=0
Output current	50 mA (T11=+ andT21=0)
Output capacitance	0,35µF
Output inductance	0,69 mH
Output contact resistance	100 ohms

ATEX BARRIER ZRX8
WITH HIGH SWICHING POWER
AND REDUNDANT CHANNEL

Application field

The ZRX8 intrinsic safety barrier is used to isolate 2 independant electrical information to more beyond a ATEX zone 2 or 22 outer the area. The ZRX8 meets the essential requirements for the guideline 94/9/CE and for which a declaration of conformity is necessary. The ZRX8 provides 2 NO outputs and 2 NC outputs 8A/250V. An input for PLC is available as a NO or NC contact, potential free. The ZRX8 is well suited to magnetic switches RDX8.

Writing

Category : II 3GD
Ex Protection : [EEx ia IIC]
Operating temperature : -25°C to +40°C

Operation

ZRX8 : The two T11/T12 and T21/T22 inputs are connected to the switch in the ATEX area thanks to a specific cable. The output contacts of the barrier are potential free and their switching power is 8A/250V.

Technical features

	ZRX8
Switching power of the contacts 13/14, 23/24, 31/32, 41/42	8A / 250Vac or 30Vdc general use
Minimal switching power of the contacts	10mA / 5Vdc
Capacitance of the contacts	Rs = 30 mΩ
Reaction time of the contacts	10 ms
Bounce time of the contacts	5 ms
Switching power of the Y1/Y2 contact	400 mA/60 Vdc
Optocoupled E input for X1/X2 contact	3 to 30 Vdc
Input insulation	100 ohms
Input inductance	Ls = X mH
Input capacitance	Cs = X nF
Impuls insulation 50 µs	6000 V
Operating temperature	-25 °C / +70 °C
Protection class	IP 67
Dimensions L x H x P	45 x 100 x 111mm
Weight	100 g

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RISK ASSESSMENT

Our experiences

Chemical / petrochemical industry
BTI is certified INERIS 08ATEXQ404

Agrofood industry/pharmaceuticals/cosmetics
BTI produces 316L St. Steel products

BTI has a worldwide network of distributors.
BTI R&D designs some products to meet your needs in our factory in Marne la vallée

Our technical knowledge with your service

Founded in 1988 in the machine safety field.

BTI is the designer of the first multicoded, non contact and stand-alone safety switch with the original ACOTOM Process. Since 1993, Bti is offering you his collaboration, his expertise and engineering to:

– Determine and assess the risks of your machines
– Define together the risk assessment acc. to ISO 14121.
– Find together the best solution, the products, and the machines best practices.

Choose the right partner:

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ISO 9001:2008 AB Certification cofrac N° 4-0023 PORTEE DISPONIBLE SUR www.cofrac.fr

The traceability is mandatory to fullfil the safety standards requirements

TÜV

RoHS Compliant

CE

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