

Electrical Equipment in Hazardous Areas

Mobile Offshore Drilling units carry the hazard of explosions and fire. The most probable source of ignition is in the electrical equipment. To avoid the hazard, the equipment in such areas must be selected with special consideration to their certification for hazardous area. This information sheet identifies the typical hazardous locations in a MODU and how to identify the equipment acceptable for those locations.

In addition to the adequate selection of equipment, the quality of cables and routing are also part of the safe practice in hazardous locations.

Definition

From the ABS Rules Part 4 Ch. 3 Sec.1:

3.7 Hazardous Area (Hazardous Location)

An area where flammable or explosive vapor, gas, or dust or explosives may normally be expected to accumulate.

This includes all the areas that contain "active" drilling fluid (mud), the vicinity of openings such as doors and vents leading to such areas, battery rooms, and helicopter refueling stations. The following is a list of the most typical locations on a MODU and some that are not

Hazardous Areas

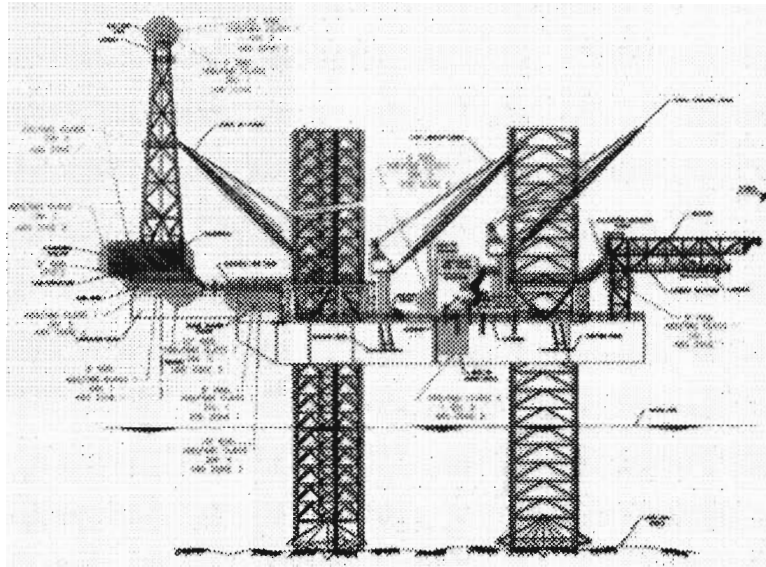
- 1 Top opening of drill pipe, usually just below drill floor. Diverter or Bell Nipple. The hazardous area will usually extend upward to include the drill floor.
- 2 On column stabilized units, the top opening of the drill pipe will usually be within the boundaries of the moon pool, therefore the moon pool will be a hazardous area to the extent of the enclosure.
- 3 Mud return trough (if open)
- 4 Shale Shakers and Shale Shaker Pit
- 5 Degasser
- 6 Gas Vent Line Outlet, usually at the top of the derrick.
- 7 Desilter
- 8 Mud Tanks or Mud Pits
- 9 Enclosed spaces containing part of the mud circulation system (as mentioned above).
- 10 Ventilation outlets from enclosed hazardous spaces
- 11 Helicopter Refueling equipment & storage tank
- 12 Large Battery Installations (when battery charger is more than 2 KW), usually in a battery room.
- 13 Paint Storeroom or Locker
- 14 Oxygen-acetylene storage room
- 15 Enclosed spaces that are adjacent to an enclosed hazardous space and that have direct access (such as a door) to an enclosed hazardous space.

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Non Hazardous Areas

- 1 Mud Pumps
- 2 Inactive Mud Tanks or Mud Pits (contain new mud that has not gone down the hole)

During the design of an offshore unit, the hazardous areas are identified and a Hazardous Area Plan is produced: This plan is used to select the electrical equipment to be fitted in that area during construction and a copy is placed in the Operations Manual for reference for maintenance and repair.



Part of a MODU Hazardous Area Plan

Areas Classification and equipment certification

The hazardous areas are classified in two ways:

1. Zone or Class; governed by the probability of the presence of a significant amount of an explosive atmosphere
2. Nature of the substance that creates the explosive atmosphere

The electrical equipment suitable for installation in hazardous areas are categorized and certified under the following aspects:

1. Area classification where it can be installed (only NEC)
2. The nature of the explosive atmosphere or type of gas in the area where it can be installed
3. The protection of the device to prevent ignition (IEC only)
4. The surface temperature of the equipment

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Codes

The classification of hazardous areas and certification of the equipment for those areas has been standardized by several organizations. The most frequent codes are the ones by NEC and IEC. The areas are identified in the Hazardous area Plan (see documents to be submitted below). The equipment installed is identified by a nameplate that must be attached to electrical components for that application. The interpretation of the nameplates is as follows:

Class I Div1: location in which as ignitable concentration of flammable gas or vapors may exit under normal operating conditions or such concentrations may exist frequently because of repairs, maintenance or leakage - for example, inside tanks, 1.5 m from the tank vent, 1.5 m rotary table, 1.5 m from shale shakers.

Class I Div 2: locations in which ignitable concentration of flammable gases or vapors would occur only as a result of accidental rupture or breakdown of systems, or in which concentrations are normally prevented by mechanical ventilation - for example, 1.5m from the hazardous area Class I-Div1, outdoors or semi-enclosed spaces on the drill floor.

3.2.- ABS Rules and International Electrotechnical Commission (IEC), which defines:

Zone 0 where an explosive gas/air mixture is continuously present or is present for long periods - for example, inside pipes of the mud circulating systems, inside tanks, 1.5m from tank vents, etc

Zone 1 where an explosive gas air, mixture is likely to occur in normal operation - for example, 1.5m from the Zone 0, or semi-enclosed spaces in drill floor

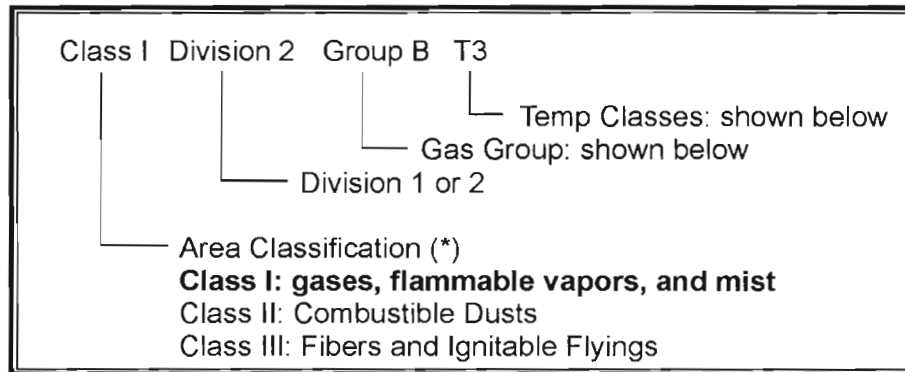
Zone 2, where an explosive gas/air mixture is not likely to occur in normal operation, and if it occurs will exist for only a short period - for example, 1.5m from the Zone1, semi-enclosed spaces in drill floor, etc.

For more specific examples, see ABS MODU Rules 4-1-3/3

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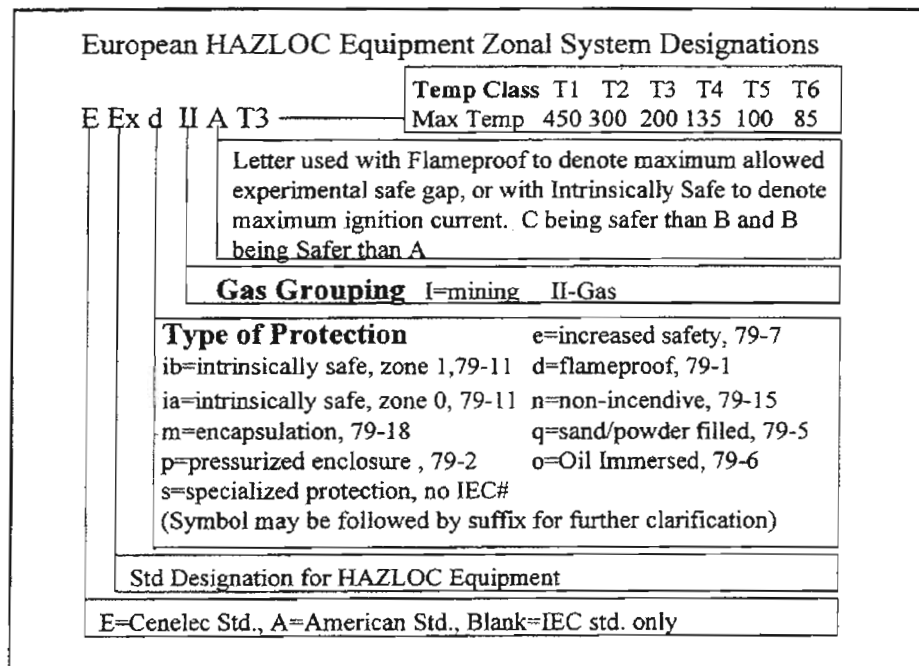
4. - Typical designation (as shown in the nameplate) for equipment for use in hazardous area:

NEC



(*)Class I is the most common in MODUs

IEC



(*) Numbers next to the type of protection is the Std number, i.e. IEC 79-1: Construction and verification test of flame-proof enclosures of electrical apparatus.

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4.1.- Type protection

Zone 0:

Intrinsically safe ia: Apparatus with this protection are contained in intrinsically safe circuits only. An intrinsically safe barrier is a device designed to avoid sparks by limiting the energy (voltage and current) available to a protected circuit installed in hazardous area.

Zone 1:

Intrinsically safe ib: see definition on intrinsically safe "ia". "ib" is not allowed for Zone 0.

Encapsulation m: Parts which may ignite a potentially explosive atmosphere are embedded in a sealing compound.

Pressurized enclosure p: The formation of a potentially explosive atmosphere inside a casing is prevented by maintaining a positive internal pressure of gas in relation to the surrounding atmosphere and, where necessary, by supplying the inside of the casing with a constant flow of gas which acts to dilute any combustible mixtures. The most common gas used is air.

Increased safety e: Additional measures are taken to increase the level of safety, thus preventing the possibility of unacceptably high temperatures and creation of sparks or electric arcs within the enclosure or exposed parts of electrical apparatus parts, where such ignition sources would not occur under normal operation.

Flameproof d: parts which can ignite a potentially explosive atmosphere are surrounded by an enclosure which withstands the pressure of an explosive mixture exploding inside the enclosure and prevents the propagation of the explosion to the atmosphere surrounding the enclosure

Zone 2:

Nonsparking/Nonincendive n: Electrical apparatus not capable of igniting a potentially explosive atmosphere.

Sand power filler q: Filling the casing of an electrical apparatus with a fine granular packing material avoids the creation of an electric arc.

Oil immersed o: Electrical apparatus are immersed in a protective fluid such a potentially explosive atmosphere existing over the surface or outside of the apparatus cannot be ignited.

4.2.- Gas Grouping

The drilling fluid (mud) returning from the well is often mixed with the gas in the reservoir. Despite the "degassing" process, some gas returns and can be released onboard. Equipment must be selected and tested for a specific flammable material involved. The following are the different classification of gases as per the different standards.

Gas	Group IEC	Group NEC	
		500	505
Acetylene	IIC	A	IIC
Hydrogen	IIC	B	B+H2
Ethylene	IIB	C	IIB
Propane	IIA	D	IIA

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Note in the table that while the letter grouping in the IEC Code decreases the order is reversed in the NEC Grouping

4.3.- Temperature Class (surface Temperature)

The ignition temperature of a flammable gas is the lowest temperature of a surface at which the gas/air or vapor/air mixture ignites. The maximum surface temperature of electrical apparatus must be lower than the ignition temperature of the gas/air or vapor/air mixture in which is used.

Surface Temperature °C	450	300	280	260	230	215	200	180	165	160	135	120	100	85
NEC 500	T1	T2	T2A	T2B	T2C	T2D	T3	T3A	T3B	T3C	T4	T4A	T5	T6
IEC & NEC 505	T1	T2	N/A	N/A	N/A	N/A	T3	N/A	N/A	N/A	T4	N/A	T5	T6

Note that the surface temperature decreases as the T rating increases. Therefore, the higher the T rating is for cooler and safer equipment. While the MODU Rules specify the maximum operating temperature and not the "T" rating, a T3 rating or T2 rating maybe acceptable depending on the composition of the well gas likely to be present. While this is true for most hazardous locations in a MODU, paint lockers require not less than a T3 rating, battery rooms T1 rating and helicopter refueling facilities require not less than T2 rating.

Examples for the Classification of Gases and vapors into the Explosion Groups and Temperatures Classes:

	T1	T2	T3	T4	T5	T6
IIA	Acetone Ethane Ethyl Ethanoate Ammonia Benzol Ethanoic acid Carbon oxide Methane Methanol Propane Tuolene	Ethanol i-Amyl acetate n-Butane n-Butyl alcohol	Benzine Diesel fuel Aircraft fuel Heating oils n-Hexane	Acetaldehyde Ethylether		
IIB	Coal gas (lighting gas)	Ethylene				
IIC	Hydrogen	Acetylene				Carbon disulphide

Equivalence across standards

There is no standard that establishes equivalency of equipment certified, for installation in classified hazardous areas, in accordance with the differing NEC & IEC standards/requirements. Guidelines in this regard:

1. Generally equipment certified as suitable for either Div 2 or Zone 2 is acceptable for installation in areas classified per either of the two methods/requirements.
2. However, equipment certified as suitable for Zone 1 areas is not always acceptable for installation in areas classified as Div 1, and will be considered on a case by case basis.
3. Equipment certified for Zone 0 is acceptable for use in areas classified as Div 1.

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5.- Documents Required to be submitted

1. Hazardous Area Plan,

All hazardous areas are identified and defined as Zone 0/ 1/ 2, or Class I, Div 1/Div2. Dimensions of the hazardous areas must be shown in the plan.

2. List of the electrical equipment

Required by the ABS MODU rules 4-3-3/1.5 and ABS SV Rules 4-8-1/5.3.2 the list should include a brief description of the equipment, the manufacturer's name, model number, laboratory's name, the certification number, and the hazardous area rating.

Item #	Description	Manufacturer/ Model	Hazardous Area	Testing Lab	Cert No
1	Volume Analyzer	WELKER / AVA-1	Class I Div 1 group B T3	UL	E59810
2	Pressure Switch	Grainger/ PS-500	E Ex d II A T3	BASSEFA	BAS. Ex 80004
3	Gas Detector	General Monitors / SC 4000	Class I div 2	FM	Ex 7788256

Typical list of electrical equipment in hazardous areas.

3. Certificates of compliance

The ABS MODU rules 4-3-3/1.5, require a certificate for each item in the list of electrical equipment from an independent testing laboratory such as, UL, CSA, or PTB. The documentation must indicate that the item has been certified for use in hazardous areas.

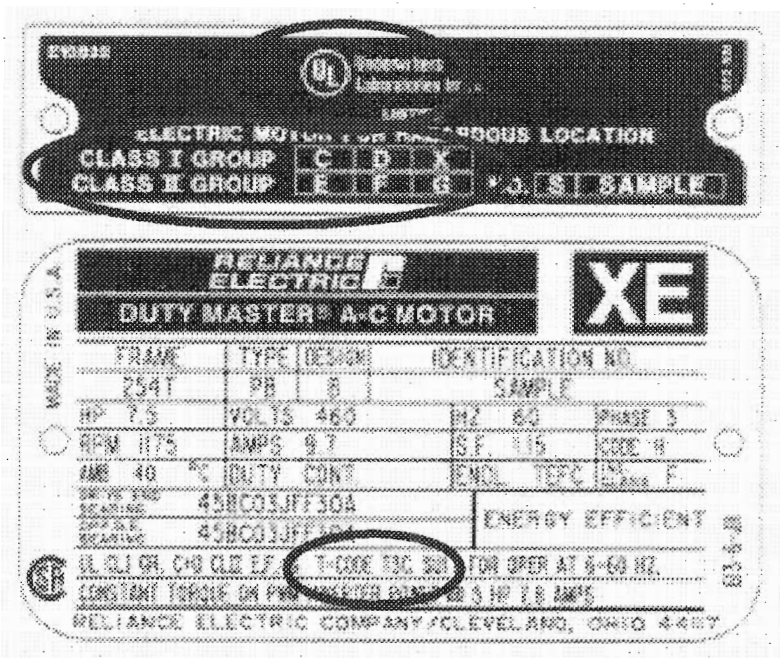
The certificates must indicate:

- manufacturer's name,
- testing lab name
- model number, and
- hazardous area rating shown in the list.

Catalog cut sheets are not adequate, however they can be considered as supporting documentation.

If a certificate has not been provided, the attending Surveyor, can check and verify that in the nameplate on the components, shows the hazardous area rate, the testing lab's name, model number, and manufacturer's name.

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Typical motor's NEC nameplate showing testing lab UL, hazardous areas rating Class I Group C, D, manufacturer's name Reliance Electric, type of motor, frame, design, T rating, etc.

Note that the Class is shown without a division; it means that is acceptable for division 1 and 2. Also for Class I, it show a non-existing group X. The marking is placed to indicate that only group C and D are acceptable.

6.- Alternative to certified equipment

If a room or enclosure is installed in hazardous area and the electrical equipment has not been certified, the room or enclosure needs to be purged, presenting a positive internal pressure in relation to the surrounded atmosphere. The purge system must be in accordance with IEC 79-2, & 9-13 or NFPA 496, and documentation including type of pressurization, the purge system flow rate (CFM), number of air changes and total time to accomplish the air changes for the panel must be approved. Further, arrangements for alarm/shutdowns upon loss of pressurization must be approved.