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## Hazardous areas with risk of explosion and fire: the carpentries

Carpentries are plants of the wood processing, usually consisting of industrial buildings, in which a series of machine tools process the wood, through some different operations such as cutting, drilling, planing, milling and turning.

Such operations, produce both shavings and powders because of the wood features. These scraps are normally carried by the air and can form clouds or layers of powder on the ground.

Therefore, the production of shavings and powders, during normal working operations, requires the assessment of the possible presence of an explosive atmosphere.

For regulatory issues relating to the health of the workers, all the processing machines should be equipped with air intake systems which, favouring the removal of the most volatile dust from the environment, decreases the danger of explosion in the environment.

Moreover, if in carpentry shops are carried out also the products coating through flammable paints, will be presents the danger of formation of an explosive atmosphere due to flammable vapours.

### 1. Risk of explosion from combustible dusts

The presence of combustible dust involves other fire and explosion hazards.

As in all the environments in which there is the presence of combustible dust, the danger is represented by:

- Dust clouds
- Dust layers.

#### *Dangers from dust clouds*

The combustible dusts dispersed in the air, as a result of the processing operations, form clouds of mixtures of fuel (wood powder) and oxidizing agent (oxygen). These clouds, if triggered, are able to cause an explosion. The danger is represented by the size of the dust particles that, in general, are dangerous if they have a diameter lower than 500 µm.

In addition, a cloud is considered potentially when the dust concentration (g/m<sup>3</sup>) is within the the LEL (lower explosive limit) and the UEL (upper explosive limit), which are expressed in grams of powder in air volume (g/m<sup>3</sup>).

#### *Dangers of dust layers*

If they are not properly aspirated, the powders form layers on the ground that can be of variable thickness depending on the frequency of cleaning of the workplace.

The layers are dangerous because they can be raised, by the action of air currents, forming clouds again.

In any case, the layers that are not raised to form potentially explosive clouds, however, generate fire hazard.

## 2. Reference Standards

The EN 60079-10-2: 2016 standard is the reference for the classification of hazardous areas in a carpentry considering all hazards due to the presence of dust clouds or layers.

## 3. Areas Classification

As we saw above, the processes carried out with the machine tools produce powder particles that form clouds. If the particles have average sizes less than 500  $\mu\text{m}$ , the machines which generate dust must be considered sources of emission.

In order to proceed with the classification, you need to verify the concentrations of dust next to the sources of emission identified. If the concentration of dust detected is below the LEL of the wood, the danger of explosion is negligible.

If the concentration of dust in the air does not exceed 10  $\text{g}/\text{m}^3$ , the LEL will not be reached. Depending on the type of wood or composition of the material being processed, the LEL can vary from 15 to 200  $\text{g}/\text{m}^3$ .

For this verification is used the weight difference of the processed material and of the sawdust compared to the volume of air where the processing takes place.

A machine that produces dust concentration above the LEL is considered Emission Source of First Instance.

At this point, it's necessary to assess the degree of ventilation and cleaning practiced by aspirators obligatorily present on the machine. If the dust extraction system guarantees a "High" degree of aspiration means that it reduces the concentration of dust immediately below the LEL, both closed to the processing, and in the intake duct. The aspiration system is equipped with safety mechanism which stop the machine in case the aspiration is interrupted. In this case, the area is considered not dangerous.

If the aspiration system has a "Middle" degree of efficiency, does not reduce the concentration of dust immediately below the LEL, but captures all dust produced by the processing and the availability of aspiration is good, you will have a Zone 21 in the area extending from the tool up to the suction hood (suction cone).

If the degree of aspiration efficiency is "Middle" and there are no security systems that block the tool if the aspiration is not working, will be two types of zones:

- Zone 21 from the tool until the suction hood;
- Zone 22 surrounding for a distance around the source of ignition projected vertically up to the ground.

If there are barriers such as walls or other structures that prevent the spread of dust, these are generally considered as the extension limit of the zone.

Whereas the suction system works in depression and the losses are very unlikely, other possible source of emission may be:

- layers of dust in the vicinity of a machine that could be raised.
- discharge filters of the intake system may originate surrounding Zone 21 and 22 depending on the environmental conditions in which they are positioned.
- dust losses during filling/emptying/transportation operations of sawdust containment bags can cause Zone 21 and Zone 22, depending on the environmental conditions.

As we have seen, the probability of the formation of hazardous areas depends on the characteristics of the dust extraction system and the degree of emission of the sources of emission. In fact, in the absence of an extraction system, there is a strong chance of formation of explosive atmospheres.

The following table (Guide of Italian CEI 31-56, table GC. 3.2-A) shows a system for determining the danger zones, depending on the characteristics of the extraction system and the degree of emission of the emission source.

This explanatory table cannot be exhaustive, however, referring directly to the Standard for a correct classification.

Degree of emission	Degree of uptake and removal of dust						
	HIGH			MIDDLE			LOW
	Availability of the powder uptake						
	GOOD	ADEQUATE	POOR	GOOD	ADEQUATE	POOR	GOOD ADEQUATE OR POOR
<b>CONTINUOUS</b>	(ZONE 20 NE)  NOT DANGEROUS AREA (1)	(ZONE 20 NE)  ZONE 22  (1) (3)	(ZONE 20 NE)  ZONE 21  (1) (4)	ZONE 20	ZONE 20 +  ZONE 22  (3)	ZONE 20 +  ZONE 21  (4)	UNCONSIDERED
<b>FIRST</b>	(ZONE 21 NE)  NOT DANGEROUS AREA (1)	(ZONE 21 NE)  ZONE 22  (1) (3)	(ZONE 21 NE)  ZONE 22  (1) (4)	ZONE 21	ZONE 21+  ZONE 22  (3)	ZONE 21+  ZONE 22  (4)	UNCONSIDERED
<b>SECOND</b>	(ZONE 22 NE)	(ZONE 22 NE)	ZONE 22	ZONE 22	ZONE 22	ZONE 22	UNCONSIDERED

	NOT DANGEROUS AREA (1)	NOT DANGEROUS AREA (1) (3)	(4)		(3)	(4)	
(1) Zone 20 NE, 21 NE o 22 NE indicates a theoretical zone where, under normal conditions, the extension is negligible..							
(2) LOW degree has not been considered since, under these conditions, the danger zones must be defined considering the absence of the dust removal system.							
(3) It's expected the formation of dust layers typically of a thickness of 5 mm.							
(4) ) It's expected the formation of dust layers typically of a thickness greater than 5 mm, to be assessed case by case.							

## 4. Maximum surface temperature

It's necessary, finally, to calculate the maximum surface temperature (Tmax) which may not be exceeded in order not to trigger the cloud or the layer of dust.

The Tmax is necessary for the choice of the electrical equipment and it's determined as a function of the ignition temperature of the cloud and of the layer.

## 5. Fire Hazard

Even without explosion risk, the presence of wooden material processed and stored makes necessary the assessment of the fire risk in order to realize the electrical system, but this discussion is not the aim of this article.

## 6. Suitable equipment

The components of the electrical system, when installed in classified areas with risk of explosion, must comply with the ATEX Directive and must be CE marked.

Depending on the Zone, different equipment categories can be used:

- In Zone 20 are allowed Group II Category 1D products
- In Zone 21 are allowed Group II Category 1D and 2D products
- In Zone 22 are allowed Group II Category 1D, 2D and 3D products

The choice of the system components must also take account of the maximum surface temperature stated on the device label, which must be less than (or equal) to Tmax. The electrical system in the danger zones must be installed according to EN 60079-14 standard.