RISK ENGINEERING GUIDELINE

FIRE AND EXPLOSION PROTECTION IN THE WOODWORKING INDUSTRY
Fire and explosion hazards in woodworking operations are manifold because of the different processes employed. Based on many years of practical experience by HDI, we introduce various protective measures and point out important particular specific characteristics to be observed in planning, execution and subsequent operation.

General.

Woodworking operations constitute an important sector of our industry, e.g. for building materials, furniture and in the energy field.

Various production processes are used for cutting, drying and chemical processing of wood, for glueing wooden parts together, for planing, grinding, painting, pressing or other ways of processing.

1 Risk situation and examples.

1.1 Risk situation

The fire behaviour of wood materials depends on different criteria such as the type of material, the dimensions and the wood moisture.

Solid wood material, depending on its dimensions, may be classified e.g. as a building material with low ignitability building material. A fire resistance of up to 90 minutes may be achieved as a function of the static design.

Wooden boards, however, are usually much easier to ignite. For example, trash is sufficient for igniting this type of wood.

When dimensions are even smaller or the specific wood surface is larger (= surface per unit of weight), wooden material such as planing chips may even be ignited with a lighter.

Industrial processes frequently produce even tinier wood dust particles. When reaching a critical dust concentration in the air, dust explosions must be expected if the material is sufficiently dry. In these cases, the ignition sources may be varied.

Apart from fires, wood dust explosions without adequate protective measures, such as explosion isolations or pressure relief openings, also represent a big hazard for the employees, in addition to the high property damage potential.

Very slow smouldering fires, e.g. in silos, may also constitute a major hazard because these fires may be
detected only at a very late stage. Smouldering fires may be caused by wood dust or wood chips deposits in contact with hot surfaces for an extended period of time, e.g. on machines or lights, or even by self-ignition, especially during extended storage periods.

The entire production process deals with combustible materials by definition, including the resulting fire and explosion hazards.

Fires or dust explosions frequently have their origin in production areas where increased temperatures or sparks must be expected, e.g. in cutting operations, size reduction, drying or pressing processes.

Ignition hazards must also be expected in conveying systems, e.g. when defective fans produce sparks in pneumatic conveyors or when bearings overheat in mechanical conveyors.

Besides the standard production areas such as cutting, drying, planing, grinding and pressing, other woodworking industry equipment also produces fire and/or explosion hazards, e.g.:
- thermal oil and hydraulic systems,
- coating systems with flammable liquids,
- compressed-air stations,
- film shrinking units,
- filter systems,
- heating systems and heating power stations.

In many cases, sparks enter filter and/or silo facilities via the wood dust and sawdust extraction systems, causing a fire and/or an explosion there.

The transport of smouldering fires on mechanical conveyors into areas not directly affected by the fire is also a frequent cause. In many cases, several operations sections are affected by a fire or an explosion.

Electric energy represents another and essential high-level ignition source. Electric switchgear systems in woodworking operations are sometimes exposed to rough ambient conditions, e.g. sawdust deposits, increased air humidity, increased temperatures, etc. Frequently large amounts of dust penetrate even structurally separated electric rooms and their false floors, e.g. through non-plugged openings or leaky doors. Sawdust and wood chips deposits on cable routes may cause dangerous heat accumulations. Moreover, these deposits constitute an unnecessary and additional fire load.

In addition to technical origins of losses, hazards also exist due to human errors such as in hot works being performed in an improper way or due to smokers’ behaviour that is not adequate to the risk.

When storing combustible material outdoors, an increased arson risk must be taken into account. This involves the danger of an outdoor fire spreading quickly to a nearby building.

High fire loads frequently exist outdoors in the form of timber logs, boards, wood chips, sawdust (also in silo units) and other combustible finished products.

### 1.2 Examples

The consequences are particularly severe if the area affected by the loss assumes a key function in production operations, if sufficient alternatives are not available and restoration within a short time is not possible.

In this situation, even if only partial areas are affected, woodworking companies may quickly suffer losses amounting to several millions of Euros when production operations can continue only with serious restrictions or must be discontinued altogether for several weeks or months. Such a scenario may have far-reaching effects for a company.

<table>
<thead>
<tr>
<th>No.</th>
<th>Origin of loss / ignition source</th>
<th>Extent of loss</th>
<th>Loss amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Electric fault caused by loose cable connections</td>
<td>Full-scale fire in an electric room of a sawmill/planing mill separated with a fire rating</td>
<td>€ 2.5 million</td>
</tr>
<tr>
<td>2</td>
<td>Introduction of ignition sources into a wood chips low-temperature belt dryer (see sketch in chapter 2.3.3)</td>
<td>Total loss of several belt dryers with fire spread to the adjoining chips storage hall and dry chips silos. Fire spread, supported by an explosion in a downstream screening unit</td>
<td>€ 30.0 million</td>
</tr>
<tr>
<td>3</td>
<td>Thermal oil leak in the heater of a ORC combined biomass heating and power station</td>
<td>Total loss of central boiler installation and of thermal oil circuit as well as several months of unavailability of wood drying capacities</td>
<td>Approx. € 65.0 million</td>
</tr>
<tr>
<td>4</td>
<td>Bearing of a pellet elevator running hot</td>
<td>Sawdust explosion due to ignition of a sawdust/air mixture in a pellet elevator</td>
<td>€ 0.5 million</td>
</tr>
<tr>
<td>5</td>
<td>Fan running hot</td>
<td>Introduction of sparks into the screening area of a chipboard factory with big subsequent explosion</td>
<td>Several million Euros</td>
</tr>
</tbody>
</table>

Table 1: Examples of loss events
2 Protective measures.

Suitable and usefully coordinated fire and explosion protection measures clearly reduce the probability of a loss and reduce the loss extent substantially. It is important that the operating company discusses and agrees the protection goal and the protection concept tailored to that purpose with HDI Risk Consulting (HRC). Various fire and explosion protection measures are explained below.

2.1 Structural fire protection

2.1.1 Spatial and structural separation

The first useful measure consists in providing structural or spatial separation between production and storage areas. In an optimum configuration, separation results in different complexes with a distance of at least 20 m between them. This reduces the danger of fire spread. To achieve this condition, the space between the buildings must be kept free of combustible material.

If such a spatial complex separation cannot be realized, production and storage areas must be sub-divided into different fire compartments by fire walls.

Fire walls must have a fire rating of at least 120 minutes, must usually be solid (concrete or masonry) and must extend beyond the roof by at least 30 – 50 cm. Fire doors, fire gates and fire barriers along track-bound conveying systems must also offer a 120-minute fire rating.

In view of the increased fire hazards described above, storage and production areas must generally be sub-divided into fire compartments of the smallest possible size. Larger fire compartments of up to 10,000 m² are acceptable if a sprinkler system is installed. In case of single unprotected fire compartment areas exceeding 5,000 m², coordination with HRC is required in any case.

The location of electric components such as switchgear cabinets, relays, frequency converters, transformer systems as well as medium-voltage and low-voltage distribution boards (HVAC/MVAC) in separate rooms is urgently recommended.

Moreover, technical and electric rooms including control rooms as well as rooms and facilities presenting particularly high fire and explosion hazards must always be separated from adjoining areas with a fire rating.

Both the design of fire walls and the separations with a fire rating must ensure that openings and penetrations in walls, floors and ceilings are also provided with approved fire stoppings. Ventilation ducts going through separating walls with a fire rating must be equipped with approved fire protection dampers; these fire protection dampers must be automatically closed, with smoke detectors being the optimum equipment for this purpose.

2.1.2 Building materials

When erecting new buildings or when refurbishing buildings, the use of non-combustible insulation materials must be focused on. The share of combustible building materials used should generally be minimized.

Combustible outer wall and roof materials can greatly increase the danger of fire spread from the outside, e. g. when an adjacent storage is on fire.

As far as the use of load-bearing roof structures made of glued laminated beams is concerned, there are no objections from a safety engineering point of view if these components are dimensioned so that a fire rating of at least 30 minutes is guaranteed.

Unnecessary additional fire loads such as combustible false floors in electric rooms, combustible noise cancelling materials or combustible ceiling facings should be avoided inside of buildings as well. Drying chambers should also be insulated using non-combustible building materials.

In general, we recommend that you discuss the building materials to be used as well as the sub-division into complexes and fire compartments with HRC in good time during the planning phase.

2.1.3 Type of construction

An optimum building design will avoid horizontal surfaces where sawdust can deposit easily and cleaning requires high efforts; see fig. 3 – 5.

Cable routes must also be fitted with a sloping dust protection in order to reduce the amount of deposits.
2.2 Fixed fire and explosion protection

Fixed fire and explosion protection is an essential issue in woodworking operations and is indispensable because of the risks described above.

The proper combination of different protective measures is important; these measures include:
- sprinkler and water spray systems as full-scale room protection,
- spark extinguishing and water spray systems as object protection,
- special fire protection systems, e.g. gas extinguishing systems,
- automatic fire detection systems,
- explosion protection measures such as explosion relief, suppression and isolation etc.,
- smoke and heat release systems.

The configuration of protective measures must be discussed with HRC during the project planning phase and prior to installation.

Professional project planning must provide detailed flow diagrams containing the following information:
- a) representation of the complete production sequence including conveyor and dedusting systems, filter and silo facilities as well as representation of residual product flows, product return routes and possible bypasses,
- b) representation of all fire protection measures,
- c) representation of all measures for technological fire protection such as off-track monitoring, speed monitoring, level monitoring etc.,
- d) representation of all explosion protection equipment and representation of dust explosion zones.

Overviews showing the equipment actuation in case of fire/explosion must also be provided, e.g. as a matrix. A fire or an explosion may require conveyor systems, fans, rotary valves etc. to be stopped automatically in order to suppress fire spread.

Simultaneous activation of several fixed fire protection systems in different fire fighting areas may be necessary. Also simultaneous fire water withdrawal by the fire brigade must be taken into account in order to guarantee sufficient extinguishing agent and duration in a worst-case consideration. The available hydraulic calculations must correspond with the actually installed pipework.

The fire water stored must be permanently clean and free of pollutions so that the sprinkler or water spray nozzles will not clog in case of fire. Refill of storage tanks with drinking water-quality is recommended. The construction company must sufficiently flush underground pipework before putting them into operation. Prior to initial filling of water storage tanks foreign objects must be removed.

Installation of fire protection systems based on internationally accepted guidelines approved by HRC such as VdS, NFPA and FM is essential. System design and installation being 100% based on regulations including the certified components used is essential. Mixing different guidelines is not permitted. We recommend that you involve an expert approved by HRC as early as in the design phase in order to avoid shortcomings appearing at a later date or major problems in the acceptance/revision process. Completion of the fire protection systems must be followed by an acceptance test. Also an expert's inspection at least once per year is necessary, with type and scope having to be agreed with HRC in advance. The operating personnel must be sufficiently familiar with the fire and explosion protection systems. Inspection, testing and maintenance must be carried out in accordance with regulations.
2.2.1 Room protection

Automatic sprinkler, water spray or gas extinguishing systems are necessary in the following areas:

- production buildings where the entire building must be protected, e.g. sawmills, planing mills, chipboard production buildings etc.,
- operation areas where high fire loads exist and/or where quick fire spread must be expected,
- operation areas with a high concentration of values,
- operation areas where a loss may cause a long business interruption, e.g. of important bottleneck equipment such as technical and electric rooms, important switchgear and control rooms, IT centres etc.

From a loss prevention point of view, the consequence is that all wood production and storage areas must be protected by automatic sprinkler systems.

2.2.2 Local protection of equipment and machinery

2.2.2.1 Spark detection and spark extinguishing systems

Spark extinguishing systems enable detecting and extinguishing sparks automatically while the plant is in operation. The advantage: Production plants do not have to be shut down immediately because of single, short-term sparks occurring in the normal production process.

Installation of spark extinguishing systems is essential in the areas below:

- wherever smouldering fires/sparks may occur, e.g. on saws, chipper lines, planing units, grinding machines, dryers, mills, presses and spark-producing fans,
- wherever smouldering fires/sparks may be introduced into the systems from the outside, e.g. at material feed points,
- where sensitive downstream systems such as vessels, silos, screening systems and elevators must be protected.

In a standard application, spark extinguishing systems are used in pneumatic conveying lines for protecting downstream sawdust filters and silos.

As early as in the design phase of spark extinguishing systems, sufficient falling and detection paths must be ensured not only in pneumatic conveyor lines, but also in mechanical conveyors, e.g. at material transfer points.

Proper insulation and heating of outdoor spark extinguishing pipework exposed to weather conditions is particularly important. Heating must be monitored, installed as specified by the manufacturer and adapted to ambient conditions in winter. A so-called winter check is very useful just before the winter season.

2.2.2.2 Water spray protection systems

Water spray protection systems are often required in closed production plants when high fire loads exist and/or high rates of fire spread must be expected. In that case, water spray protection systems can feed larger amounts of fire water into the closed production equipment affected by the fire. The advantage is that this can be achieved quickly and safely without having to open production units manually. Manual opening of units, e.g. conveying systems, dryers, coolers, screening units, filter units, silos etc., can lead to an increased explosion hazard, therefore endangering fire fighters seriously.

Reliable fire detection systems with a very low risk of false alarms must be selected for automatic actuation of water spray protection systems, see chapter 2.2.3. In addition to automatic actuation, it makes sense to enable local manual system activation by the system operators from a safe position.

A specific number of the nozzles must be removed and tested by an expert according to FM and NFPA standards once a year for ensuring the proper function of the water spray protection systems, for checking their spraying patterns and if nozzles are clogged. If more than one nozzle does not work properly, some more must be removed and tested etc.
In some areas, other fire protection methods should be considered as alternatives to water-based fire protection systems. These include e.g. inertising (oxygen reduction) of wood chips or wood pellets silos with carbon dioxide (CO2) or nitrogen (N2). In this subject-matter, we refer you to our separate HRC Risk Engineering Guideline “Fire protection and fire fighting in silo and bin installations”.

In addition, the installation of gas extinguishing systems may make sense in other areas as well, e.g. in painting and paint drying facilities, in flammable liquids stores or for protecting important bottleneck equipment such as technical and electric rooms, important switchgear and control rooms, IT centres etc.

### Table 2: Comparison of special extinguishing methods for selected processes and special hazards

<table>
<thead>
<tr>
<th>Process or special hazard</th>
<th>Special fire protection system</th>
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<tbody>
<tr>
<td>Chipboard presses</td>
<td>Use of fine-spray protection systems</td>
</tr>
<tr>
<td>Wood chips belt dryers</td>
<td>Water spray protection systems including direct extinguishing even beneath the conveyor belt and inside the waste air collecting ducts, see also chapter 2.3.3.</td>
</tr>
<tr>
<td>Wood chips drum dryer</td>
<td>Combination of spark extinguishing system and water spray protection system in the dryer plus downstream cyclones and flue gas recirculation</td>
</tr>
<tr>
<td>Dry hammer mills</td>
<td>Spark extinguishing system upstream and downstream of the mills</td>
</tr>
<tr>
<td>Thermal oil systems</td>
<td>Use of foam-type fire protection systems, see separate HRC Risk Engineering Guideline</td>
</tr>
</tbody>
</table>

Fig. 7: Firefighting areas 1 – 5 of a chipboard form and press station

Fig. 8: Chipboard form and press station incl. fixed fire protection system (see highlighted areas)
2.2.3 Automatic fire detection

From a loss prevention point of view, all operations areas and rooms must be equipped with an automatic fire detection system. This is realized either by the fire detection part of the fixed fire protection system or by separate fire detectors.

All technical and electric rooms must be equipped with automatic smoke detectors. Smoke aspiration or air-sampling systems are recommended because they respond much faster than conventional point-type detectors.

Automatic fire detection within closed production facilities such as conveying systems, silo facilities etc. is also necessary, either as the actuating element for a fixed fire protection system or as a separate unit.

In this context, the fire detection elements within the production facilities have the task to detect fires not only during operation, but also during standstill periods (standstill monitoring).

Available fire detection systems are:
- smoke detectors (point-type detectors),
- optical beam smoke detectors (IR transmitter/receiver unit),
- smoke aspiration systems,
- heat detectors (point-type detectors),
- linear heat cables,
- CO and multi-criteria detectors,
- hotspot detectors (infrared sensors),
- flame detectors (UV sensors),
- dry pilot sprinkler lines (usually as a hydraulic actuation for deluge systems).

The detectors must be carefully selected and installed so that they detect a fire quickly, without false alarms and allow quick and easy maintenance and cleaning with a reasonable effort. Before starting installation, different boundary conditions such as high temperature differences, condensed water, increased air humidity in general, natural wood degassing products (“noise background”), adhesion of sawdust, conglutination and/or resinification etc. must be considered.

The lens systems of detectors may have to be equipped with purge air units. At any rate, deposits must be removed from lens systems and sensors at regular intervals. This is particularly important with UV flame detectors or IR heat sensors which react to a certain light spectrum. However, even relatively robust temperature sensors may quickly get covered with sawdust accumulation so that a fire alarm would be given only after a long delay.

Any occurring alarms from automatic fire detection and fire protection systems must be transmitted to the control station of the public fire service without delay.

2.3 Operating equipment and systems deserving particular protection

2.3.1 Filter systems

The hazard potential of filter systems is that sparks from the production process can be introduced into the filters through the dedusting systems. This situation may easily cause fires and/or explosions there.

The different protective measures are shown in Fig. 10.

2.3.2 Protection of silo and conveying systems

Sparks or glowing nests may have their origin not only in the production equipment, but also in pneumatic and mechanical conveying systems, e.g. due to bearings running hot, spark generation etc.

Transporting sparks or glowing nests into dry chips or wood pellet silos by means of conveying systems may cause serious fires or explosions. Silo fires are difficult to fight by the fire brigade unless precautions for manual and automatic fire fighting were taken in advance.

The fire loads inside the conveyors consist not only of the conveyed material, but also of fine sawdust deposits and of a possibly combustible conveyor structure, e.g. conveyor belts made of rubber or catches, rails or buckets made of plastic etc.

For this reason, flame-retardant materials should be used for belt conveyors wherever possible.

Well-aimed positioning of dust extraction units can reduce sawdust accumulations in conveying systems in an effective way.

As far as the technological degree of protection of mechanical conveying systems is concerned, elevators (vertical conveyors) deserve particular attention. Recommended safety measures (especially for bottleneck conveyors) such as off-track monitoring, speed monitoring, bearing temperature monitoring, earthing etc. are described in detail in VDI 2263 EN, „Dust fires and dust explosion“ elevators.

Fig. 9: Spark detector with unpermitted sawdust deposits. The IR sensors are seriously impeded. Fire detection is possible only with a long delay or will fail altogether. The right IR sensor type needs to be chosen depending on the actual conditions. As a basic rule, the darker the place of use and the less extraneous light/scattered light is available, the more powerful IR sensors can be used.
Basic filter protection layout

1. Spark detection and extinguishing system
2. Automatic or manual fire protection system
3. Explosion pressure relief opening
4. Smoke or CO detector / opacity meter
5. Temperature monitoring
6. Ex-proofed rotary valve
7. Fire protection damper
8. Seback flap

Fig. 10: Example for filter system, showing the different fire and explosion protection units
Moreover, in pneumatic conveyors, the flow velocities must be selected so that hazardous dust deposits are avoided.

The different protective measures are shown in fig. 11:

**Protection layout for basic silo and conveying systems**

1. Spark detection and extinguishing
2. Manual water spray protection system
3. Explosion pressure relief opening
4. Inertization with nitrogen or carbon dioxide
5. Emergency discharge into a safe area for manual extinguishing
6. Product cooling fan
7. Automatic water spray protection system
8. Rotary valve
9. Bearing temperature monitoring
10. Temperature monitoring
11. Opening for measuring the oxygen content during inertization
12. Minimum filling level monitoring
13. Product temperature monitoring

*Fig. 11: Example sketch for silo protection including the connected conveying systems. Visualisation of the different fire and explosion protection units.*
2.3.3 Protection of belt dryer

As demonstrated by a high number of losses, low-temperature dryers also present an increased loss potential despite their low temperature profile. The different protective measures are shown in fig. 12.

2.3.4 Boiler houses and power stations

Wood residues produced at woodworking industry locations are frequently re-used there for energy generation in biomass boiler houses or biomass heating power stations. From a loss prevention point of view, the protective measures below are necessary for this application:

- automatic backfiring safeguard from the firing space to the upstream fuel bin/silo in the form of automatic water injection points in the material feed line if the fuel consists of wood chips and/or bark,
- option of mechanical fuel lock by means of a flap or a gate valve,
- fire separations for different power station areas such as fuel bin, boiler house, powerhouse, hydraulic systems, control centre, electric and technical rooms etc.,
- power stations must be completely monitored by automatic fire detectors. In some cases/areas, installation of fixed fire protection systems is necessary. This applies in particular to electric rooms and control centres including any existing false floors.

Equipment with a clearly increased hazard potential such as ORC heating power stations require additional fire protection measures. The scope and type of measures depends on the specific plant type.

For example it may be necessary to protect the thermal oil pumps of the thermal oil circuit and the structurally separated ORC turbine by special fire protection systems. Further measures may be required.

In case of conventional steam turbines, the installation of low-pressure fine spray equipment for the turbogenerator oil systems makes sense, see the Risk Engineering Guideline „Fire protection measures relating to industrial power plants turbine oil systems“.

2.4 Explosion protection

Regardless of the grain size of the material to be transported, the conveying and production process constantly produces fine abraded wood dust that may accumulate and deposit inside the units and cause explosions, see loss example 4 in chapter 1.2.

When losses occurred in the woodworking industry, HRC quite often observed that fires were followed by explosions or vice versa. Very often the losses are characterized both by thermal fire effects and smoke contamination and by mechanical, thermal effects due to explosions.
The main task is therefore to ensure intense cleaning in all production and storage areas so that dust deposits will never exceed a layer thickness of 1 mm. This applies to all horizontal surfaces such as flooring, intermediate platforms, roofing, load-carrying structures of buildings etc.

Otherwise, whirled-up wood dust in combination with possible ignition sources involves an increased explosion hazard. In case of an initial explosion, the shock wave whirls up even more dust which can in turn be ignited by the flame front of the initial explosion. These so-called secondary explosions frequently cause even more serious consequences than the initial explosion.

In general, explosions and/or shock waves and flame fronts have the potential of travelling a great distance through buildings and/or through closed production equipment in a very short time.

For this reason, all woodworking operations absolutely must carry out detailed hazard analyses (fire and explosion hazards) in order to derive the necessary explosion protective measures.

These measures include:

- preparation of an explosion protection document by an expert, taking personal and property protection aspects into account. This includes:
  - definition of explosion-hazardous zones
  - description of required protective measures
  - definition of an inspection, maintenance and cleaning concept including check lists
  - preparation of process flow diagrams showing the explosion-hazardous zones and all explosion protection measures
- introduction of a management of change (MOC) system applicable e.g. in case of changes of temperature, wood moisture, air velocities, production methods, speed of operation etc.

- measures for avoiding explosions
  - avoiding explosible dust/air mixtures by regular cleaning and operation of production equipment as specified by the manufacturer
  - avoiding additional ignition sources, e.g. by bonding and grounding temperature monitoring for bearings and drives, off-track monitoring in elevators and documented checks of all safety devices at regular intervals
- measures for explosion pressure relief on silos, filters, mills, elevators, screening units, drum dryers etc.
- measures for explosion protection isolation where required, e.g. by using flame-proof rotary valves, pressure relief openings, quick-acting gate valves, installation of extinguishing agent barriers, non-return flaps etc. The plant sections below must be isolated from one another as an example of explosion protection: dryers, screening units, mills, silos, presses, elevators, filter systems etc.

The risk-adequate explosion protection isolation of the different operations and plant sections is an essential issue. Maintenance of isolation equipment must ensure the following:

- regular inspection of gap dimensions of flame-proof rotary valves,
- regular cleaning of non-return flaps in conveying lines,
- regular cleaning and checks of sensors of extinguishing agent barriers.

Checks of pressure relief flaps must ensure that actuation and/or opening of the flaps results in automatic activation of equipment, e.g. immediate stop of rotary valves at the filter output so that the explosion or a following fire cannot pass.

Electric systems and equipment must be designed for the operation in explosion hazard zones. Employees must be sufficiently trained for working in explosion hazard zones.

Local acceptance tests by recognized explosion protection experts including local tests at regular intervals are useful.
2.5 Organisational fire and explosion protection

High standard organisational fire and explosion protection is the basic pre-condition for the protection concept of a woodworking company.

The minimum requirements include:
- annual inspection of fixed electrical equipment by electric experts and inspection of mobile equipment by a specialist electrician at regular intervals,
- housekeeping in the entire operations, based on a defined cleaning schedule,
- no storage of combustible materials next to outer walls of buildings (otherwise the danger of arson is increased),
- appointment of a fire officer and his representative and documented fire protection surveys of the operations at least every three months, e.g. based on check lists,
- strict compliance with non-smoking rules,
- compliance with written hot works permit procedure for in-house and external employees, see also Risk Engineering Guideline „Hot works“ by HRC,
- a radius of 2.50 m around battery charging stations, especially those used for fork lift trucks, must be kept free of combustible material,
- tank facilities for propane gas, diesel fuel etc. must be checked at regular intervals,
- maintenance, testing and revision of all fire protection equipment by operating company, installation company and by recognized experts, in accordance to accepted guidelines,
- notification of impairment of fire protection equipment to HDI Global SE, see also Risk Engineering Guideline „Impairment of fire protection systems“ by HRC including the impairment notification form,
- maintenance of systems, machinery and conveying systems according to manufacturer’s specifications and/or ambient conditions and state of wear,
- regular employee trainings regarding fire and explosion protection,
- implementation of internal fire regulations,
- representing the current situation fire brigade operations plan,
- preparation of an emergency plan and a Business Continuity Management (BCM) for reducing business interruption periods.

During cleaning work, secondary sawmill products must be removed from the machinery area once per day as a basic rule. Accumulations of dust and wood chips must be removed from electric systems, motors and drives as well as from equipment using thermal processes or generating heat at least once a week.

Free-standing cabinets must be opened on a regular basis and the presence of unpermitted dust contamination and other unnecessary combustible materials must be checked. The same applies to any false floors that may exist.

A general cleaning must be scheduled at least once a year.

When removing wood dust manually, blowing the dust off with compressed air and sweeping off manually is strictly forbidden. Explosion-protected vacuum cleaners must be used.

Beyond the sawdust produced, fire loads must be minimized in general. The production areas may therefore contain only daily amounts of combustible raw materials or other combustible materials. Electric and technical rooms must always be kept free of unnecessary fire loads.

Outdoor stores of combustible materials must be located at a distance of at least 20 m from production and storage buildings.

2.6 Fire fighting

Effective fire fighting requires a qualified and sufficiently equipped fire brigade with professional fire-fighters and a short intervention time, fire brigade alarming without delay as well as a sufficient amount of fire water.

In larger companies and in locations having only a small volunteer fire brigade, it makes sense to set up an own non-public works fire brigade. Selected employees must be specially trained and instructed so they can wear respiratory equipment. In addition to at least one fire fighting vehicle, an early response team (ERT) with 6 persons from present employees per shift must be quickly available.

The fire water demand depends on the size of the fire compartments and on the availability of a full-scale fire protection system.

For example areas in excess of 3200 m² require 192 m³/h with sprinkler protection and 288 m³/h without sprinkler protection.

If fire protection systems are available, the amount of fire water must be available to the fire brigade for a period of 2 hours minimum, otherwise for 3 hours.
This fire water supply must be ensured independent from the water demand by automatic fire protection systems. Fire water withdrawal points must be freely accessible at all times, i.e. never be blocked by stored materials or vehicles parked outdoors. In an ideal configuration, the distance between the individual access points is 50 – 80 m max.

The fire fighting water hydrants must be clearly marked in the fire brigade plans to enable quick orientation for the fire brigade in case of fire-fighting operations.

Fire brigade exercises should be carried out every 1 – 2 years. On these occasions, the actual fire water amounts available and the proper function of the hydrants should be checked.
3 References.

The safety measures described above will not touch any provisions made by law and issued by authorities. Reference is especially made to the regulations in force, the occupational safety requirements in force and the building permit applying to the location in question including the current fire protection concept.

International:

1. NFPA 664 Standard for the Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities
2. FM Global Property Loss Prevention Data Sheets 7-10, Wood processing and Woodworking facilities
3. FM Global Property Loss Prevention Data Sheets 7-17, Explosion protection systems
4. NFPA 13, 15, 20, 25, 68, 69 70, 70B, 72, 664
5. DIN EN 12779 Safety of woodworking machines – chip and dust extraction systems with fixed installation
6. VDI 2263 EN Dust fires and dust explosions
7. Risk Engineering Guidelines, forms and check lists of HDI Risk Consulting GmbH are available for downloading on the homepage of HDI Global SE at the link below: https://www.hdi.global/de/en/infocentre/download
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