Recycled Materials Association

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Fire Safety Guidelines for Tire Processors

Recycled Materials Association (ReMA)
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Contents

Preamble

ReMA has prepared this guidance document to encourage tire recyclers to operate their facilities safely, as safety is one of ReMA's core values. Not every section of this document will apply to every tire recycling facility as each facility is unique in its design, layout, and operation, etc. Readers should review this document in its entirety in order to determine which sections are applicable. The document examines each phase of a typical tire recycling facility and outlines approaches for practices and procedures associated with that particular phase of the recycling process.

The sections within this document are intended to build upon each other. When training employees on fire safety procedures, care should be taken to ensure that steps in previous sections are considered even when focusing on a particular processing stage or general area of concern. Use of this document should not take the place of in-person safety trainings.

This document is to be used for general educational purposes only and to promote increased overall safety awareness. The information provided herein is intended to be accurate and helpful, but it is not exhaustive. ReMA expressly disclaims all liability related to any inaccuracies or omissions herein. Further, this document is not intended to be legal advice and should not be used in place of consultation with local, state, and/or federal authorities or legal counsel to ensure compliance with applicable laws and regulations. All companies are responsible for determining what laws and regulations apply to their operations and facilities and what such regulations require. Each facility using this guidance document bears its own risk. No liability is assumed by ReMA or its member companies or agents.

Definitions and Additional References

Product Definitions

Size Category Definitions

Rough Shred	Chip	Nugget	Crumb	Fines
Single pass shred	5" to 1"	3/4" to 1/4"	1/4" & below	30 mesh & below

- Screened (excluding fines)
- Unscreened (including fines). Unscreened material, particularly from single pass shred and chips, poses much greater risk of fires and must be handled with additional safety precautions (see sections on Screening, Storage Methods, Dust Control Methods).
- Rough shred and chip material retains greater amounts of wire and can pose greater risks of sparking during processing.

"Whole Tire" is defined as a tire that has not been reduced in size. This includes but is not limited to tires that contain rims.

"Rough Shred" is defined as a tire that has gone through a shredding process once with no further reduction in size.

"Chip" is defined as tire material that has been processed to a uniform size, shape and consistency that generally ranges between 1 and 5 inches in any two dimensions.

"Nugget" is defined as tire material processed to a uniform size, shape, and consistency that is between 3/4 inch and 1/4 inch in any two dimensions.

"Crumb" is defined as tire material processed to a uniform size, shape, and consistency that is at or below 1/4 inch in any two dimensions.

"Fines" are defined as materials that pass a 30 mesh; these materials may include rubber, fiber, inorganic and organic matter, dirt, and other non-tire materials. Fines may be further processed into fine grinds for specific purposes.

Other Product / Processing Definitions

"Cryogenic" (cryo) systems introduce liquid nitrogen to rubber through a high-speed milling system.

"Dust" is any type of particulate matter released during the entire tire recycling process.

"Granulation" systems consist of rotating blades cutting material against fixed blades where the material must pass a sizing screen to exit.

“Fiber” is non-metallic reinforcing cords used in tire manufacturing with loose rubber included.

“Finished Product” is defined as any non-whole tire material that has been sized and classified as a specification grade material.

"Halo Sprinklers" are zone-specific secondary sprinkler systems used in second-stage processing and beyond. These sprinklers may be located above specific equipment, conveyance areas, ductwork, screening, etc.

"Mag-off" is magnetic separation of high wire content rough shred and chip materials. Mag-off typically requires further processing to create finished rubber and wire products.

"Mesh" is a steel sortation screen defined by holes per square inch. For example, a 10-mesh screen will have 10 holes per square inch; a 20 mesh will have 20 holes per square inch.

"Milling" systems consist of counter-rotating rolls used to further reduce the size of particles.

"Tire Shredder Residue" is defined as material that has fallen loose from the shredding process.

“Wire” is metallic reinforcement used in tire manufacturing with attached rubber included.

Safety Definitions

“Arcing” is defined as a luminous discharge of electric current that is formed when a strong current jumps a gap in a circuit or between two electrodes.

"Incipient Stage Fire" A fire which is in the initial or beginning stage, and which can be controlled or extinguished by portable fire extinguishers, Class II standpipe, or small hose systems (no greater than 1.5 inches in diameter) without the need for protective clothing or breathing apparatus.

“Inspection” is defined as a detailed and documented analysis of all operating components of the processing equipment, components, systems, processes, and materials.

“Monitor” is defined as observing the operation and condition of the processing equipment and components needed to operate the equipment. It also means observing the feedstock material from a safe distance to prevent a hazardous situation from developing.

Additional References

ReMA Resources

- ReMA Fire Management Resources: https://www.isri.org/fire-management-resources
- ReMA Guide to Creating a Fire Prevention and Management Plan: latest version is available to ReMA members on the Fire Management Resources page.

NFPA Codes and Standards (free access to the NFPA Codes is available)

- NFPA 1, Fire Code,
  - Chapter 33 – Outside Storage of Tires
  - Chapter 34 General Storage, 34.9 Protection of Rubber Tires
- NFPA 68, Standard on Explosion Protection by Deflagration Venting
- NFPA 654, Standard for the Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids
- NFPA 600, Standard on Facility Fire Brigades
- NFPA 1081, Standard for Facility Fire Brigade Member Professional Qualifications

OSHA Standard Number 1910

- 29 CFR 1910.38 Emergency action plans.
- 29 CFR 1910.106 Flammable liquids.
- 29 CFR 1910.137 Electrical Protective Equipment.
- 29 CFR 1910.146 Permit-required confined spaces.
- 29 CFR 1910.147 The control of hazardous energy (lockout/tagout).
- 29 CFR 1910 Subpart L - Fire Protection: 1910.155 to 1910.165; particularly:
  - 1910.155 Scope, application and definitions applicable to this subpart.
  - 1910.156 Fire brigades.
  - 1910.157 Portable fire extinguishers.
  - 1910.158 Standpipe and hose systems.
  - 1910.159 Automatic sprinkler systems.
  - 1910.160 Fixed extinguishing systems, general.
  - 1910.163 Fixed extinguishing systems, water spray and foam.
  - 1910.164 Fire detection systems.
- 29 CFR 1910.252 Welding, Cutting and Brazing - General requirements.
- 29 CFR 1910.301 Electrical - Introduction.
- 29 CFR 1910.305 Electrical - Wiring methods, components, and equipment for general use.
- 29 CFR 1910.307 Electrical - Hazardous (classified) locations.
- 29 CFR 1910.308 Electrical - Special systems.
- 29 CFR 1910.331 Electrical - Scope (note: electrical safety-related work practices)
- 29 CFR 1910.332 Electrical - Training.
- 29 CFR 1910.333 Electrical - Selection and use of work practices.
- 29 CFR 1910.334 Electrical - Use of equipment.
- 29 CFR 1910.335 Electrical - Safeguards for personnel protection.

- 29 CFR 1910.399 Definitions applicable to this subpart.

State and Local zoning ordinances should always be referenced.

Emergency Response and Action Plan

ReMA's Guide to Creating a Fire Prevention and Management Plan is available to all ReMA members on the Fire Management Resources page, providing guidance to U.S. and Canadian recyclers in creating a fire prevention and management plan.

External Components of an Emergency Action Plan

Ensure local emergency management agencies have schematics, descriptions, layouts, etc., of equipment, material, and other important information related to the facility as required by federal, state, and local statutes, regulations, and ordinances.

Familiarize your local EMS and fire department with your site layout and building layout and design. Have site maps showing the location of equipment and buildings, safety data sheets (SDSs), and fire suppression systems. Share these plans with the fire department during their site visit. Discuss hazards and common incidents in the industry. Get their assistance in testing the 911 response system to ensure a 911 call from your facility will provide the right address for emergency services to respond.

Internal Components of an Emergency Action Plan

Each facility should develop and keep on file an Emergency Action Plan that is specific to the facility's layout, equipment, processes and location.

A facility owner should designate an Emergency Response Coordinator to coordinate the appropriate response during an incident, to ensure all employees are accounted for and appropriate agencies are notified. A designated person should be the only one to speak with the media during and after an event.

It is important that employees be trained to understand what they should or should not do during an emergency event. Training should be focused on prevention, material and processing equipment monitoring, detection, and **incipient** fire response. Any training beyond incipient fire response requires the establishment of a fire brigade with training, PPE, and procedural requirements mandated by OSHA and NFPA standards.

Fire suppression equipment, such as sprinkler systems, fire extinguishers, water supply pumps, infrared detection systems, deluge equipment, etc., should be inspected and tested on a periodic basis to ensure proper operation and must be inspected at least annually by a professional. Consideration should be given to monthly inspections of all systems. Follow all applicable NFPA, federal, state, and local requirements and manufacturer's recommendations regarding periodic testing of fire suppression equipment. Fire hoses should be no more than 1.5 inches in diameter.

Facility maps showing the location and types of fire suppression equipment should be posted and available for both employees and fire response personnel. An emergency response drill should be conducted on a regular basis and, to the extent possible, coordinated with all units and shifts of local fire response personnel that may respond to your location.

All of the above items should be documented and available to responsible parties.

Visitor and Facility Control

The perimeter of the facility should be controlled by use of fencing, motion detectors, alarm systems, security guards or onsite personnel to minimize the possibility of unauthorized personnel gaining access. Security / thermal cameras inside and outside of the facility can also provide valuable records in case of a fire.

In lieu of a manned checkpoint, it is recommended to direct all visitors to a safe and secure location for check in.

All visitors should be aware of the fire safety hazard potentials in areas of the facilities.

- All visitors should be made aware that no smoking or vaping is permitted or where the permitted areas for such are located.

It is important to know the location of all visitors to the facility to ensure they do not pose a hazard to themselves or to others.

- Sign in / sign out procedures should be implemented.
- Any retail or public areas should be separated from processing areas, with clear signage for retail customers not to leave the public area without an employee accompanying them.
- All temporary visitors allowed past the retail or public areas should receive a safety briefing and be accompanied by an employee at all times.
- Vendors or other visitors who will be on site for an extended period should attend a safety orientation and adhere to all site safety guidelines.

Any safety signage, markings, or other indicators used in the facility should be clearly explained to visitors before entry to processing areas.

PPE should be provided to all visitors beyond retail or public areas. Different colored hard hats, vests, and/or other PPE can be a visual cue to employees that visitors are present and should be monitored.

Common Issues / General Safety & Maintenance

Employee Training

A robust employee training program should be established, documented, and routinely reviewed and updated to ensure employees understand good housekeeping, safe maintenance procedures, and any hazards associated with the procedures or materials to be operated and handled. The employee training program should include:

- A reporting process for employees to communicate any potential fire concerns.
- An emphasis on observing proper lockout/tagout procedures prior to inspecting or performing any maintenance on these items.
- An employee checklist and shift / daily checklists for operations personnel.
- Training for all employees on what hazards require an equipment shutdown; who to contact; and how to intervene in case of potential larger fire risks.
- An emphasis on the use of all senses when employees are judging issues and risk, with particular emphasis on an employee's sense of smell.
- Reference to the manufacturer's recommendations for proper installation and maintenance procedures for different equipment.
- A prohibition on smoking at all times in the processing and storage areas.
- Care should be taken that, if possible, no flashlights or other tools containing lithium-ion batteries are used when inspecting machinery due to the danger of thermal events if those batteries are dropped.
- A prohibition on cellphones out anywhere near machinery.
- Requirement to follow appropriate confined space practices as outlined by OSHA.

Housekeeping

No Fuel, No Fire.

At its heart, this entire document deals with good housekeeping. Each of the following sections incorporates aspects of housekeeping for different safety, maintenance, storage, and processing activities, both inside and outside the facility.

Good housekeeping is imperative to reduce potential fuel loads and/or friction elements. Regular cleaning of processing and storage areas need to be performed throughout the workday and before a shutdown period of extended length. It is necessary that housekeeping activities are sufficient to prevent buildup of material or contaminants in the facility.

Processing / production lines should be started empty and run until empty before stopping.

Independent blow down fans can be used throughout the processing area to avoid buildup of materials in difficult to reach areas, such as upper levels, rafters, etc., and set to run regularly. Fans should be integrated into emergency stop systems.

Moving Components / Mechanical Maintenance

- Observe proper lockout/tagout procedures prior to performing any maintenance on these items.
- Scheduled and periodic cleaning to prevent accumulation of fines, fiber, dust, or wire on the various components is essential to prevent heat buildup from friction or the wire penetrating electrical components and causing sparks.
- Inspect all moving components, such as belts, clutches, gear boxes, rollers, and bearings to ensure proper maintenance has been performed and equipment can be operated without causing excessive heat buildup or other failure which could cause a fire.
- Repair or replace as necessary any defects that are noted and record this information.
- Employees should be trained to identify and report any required repairs. Temporary fixes may become their own fire risk.

Electrical Maintenance

Refer to the appropriate National Electrical Code and local building codes as applicable. It is advised that you consult with a licensed electrician or electrical engineer for advice and/or guidance.

- Electrical connections, switch gear systems, and other components should be checked on a regular basis by trained personnel and repaired or replaced as necessary.
- Loose, worn or broken electrical components may heat up or arc, thereby creating an ignition source.
- Any electrical gear or motors should be free of dust.
- Any electric motors should be rated TEFC (Totally Enclosed Fan Cooled) or better.
- Any electrical panels or other enclosures must be closed securely before and after maintenance.
- Consider using thermal imaging inspection of all electrical control systems and panels on an annual basis.
- A separate climate-controlled electrical room can minimize many of the housekeeping concerns for electrical maintenance.

Mobile equipment

Particular care should be given to removal of dust and oily residue buildup and inspection of components to reduce the potential of equipment starting a fire. Any material lying on hot sections or components of equipment is dangerous. Good

housekeeping can be the difference between an incipient stage fire in mobile equipment and a total loss of the equipment.

Ensure that all mobile equipment has a fire extinguisher on board in good working condition.

Equipment that contains fuels or oils should have a spill kit readily accessible.

Daily, weekly, and monthly inspections should be recorded, with special note of items that are defective or in need of repair. Any items that are repaired or replaced should also be documented.

An employee should not operate any piece of equipment until they have been trained in the proper and safe use of that equipment. This includes, but is not limited to:

- Pre- and post-operation inspection and maintenance checklists conducted with each change in operator;
- Sense awareness of any indicators of fire risks (particularly distinctive smells and sounds);
- Safe operations around other equipment and employees; and
- The safe operation on a given site.

All training must be documented as required by your federal, state, and local agencies.

Heavy mobile equipment should be stored at least 25 feet away from material and other flammable substances, such as fuels, oils, chemicals, processing equipment, grass and weeds, or other items that might easily ignite or spread a fire. Parked equipment should be electrically disconnected and fuel shut off as appropriate. Equipment that is shut down for extended periods should have any batteries removed and be drained of all fuel sources and oils.

Tire Shredder Residue

Tire Shredder Residue should not be allowed to mingle with other processed materials. Residue may be able to be re-run through the processing stages and be separated properly into crumbs, fines, wire, and fiber, but if not properly removed from the processing areas and processed materials, it will pose an increased fire risk as it dries or falls to the bottom of storage areas.

Water Supply and Delivery Systems

Adequate water supplies and delivery systems for all areas of the facility should be inspected and tested regularly with documentation of completion. These systems include sprinklers, misting systems, spark detection and deluge, fire hydrants, etc. It may be necessary to conduct additional inspections during cold weather operations to prevent freezing, clogging, and other issues.

- Water supply and delivery systems should be designed and installed by fire suppression specialists.
- If you add any new equipment or change the configuration of the facility, the water delivery system should be reinspected.
- Flow and trip checks must be performed and systems inspected on an annual basis or otherwise according to NFPA, federal, state, and local regulations.
- Having a water delivery system present on processing equipment allows for rapid response to an event.
- The water supply, whether private well or city supplied, should be checked periodically or include a detection and alert system to ensure sufficient pressure is present for the water system.
- Use of a boost pump, secondary water supply, and/or water storage system may be necessary if the water pressure is not adequate.
- Deluge systems should be located at the feed and discharge systems for the processing equipment.
- Automatic detection and notification systems are critical to the initial fire suppression process. These systems should initiate processing system shutdowns.
    - Systems should include manual bypasses where appropriate in the event that automatic detection systems fail.
    - Battery backups should be included for automatic detection systems.
- Periodic checks of spray nozzles should be conducted to ensure sufficient flow and proper spray patterns.
- If a water mist system is installed, it should be monitored and inspected periodically to ensure proper flow and spray pattern is maintained to minimize heat buildup and dust.
- Ensure water supply lines are constructed of material appropriate for use in fire suppression systems.
- Water supply lines should be inspected regularly for damage or restrictions which may affect proper operation.

Screening

Screening of processed rubber is common practice and in many facilities products are screened multiple times. There are many different types of screens used such as trommels, disc screens, shaker screens and gyratory / reciprocating type screens. The volume and quality of products and the desired size generally determine the appropriate equipment for a given operation. Regardless, the potential hazards associated with this equipment will be similar and should be monitored and managed in a similar manner.

During screening, rubber and fiber dust is released into the surrounding areas. Sufficient dust control and housekeeping in the screening area is important to reduce potential fuel loads and/or friction elements.

- Special attention should be paid to smaller size category processing.

- Temperature checking and/or regular maintenance should be conducted to ensure that drive systems and moving parts do not overheat.
- Refer to the Dust Control section of this document for more recommendations.

Ferrous Separation

Tire Wire is a Significant Ignition Source.

Primary ferrous separation occurs immediately after the initial shredding and is repeated throughout the tire processing. The most common method of separating ferrous material is to utilize magnets. The potential risks associated with processing and handling these materials requires continued maintenance of systems and equipment to encourage optimal performance at all times.

Wire buildup will start with one piece and inevitably grow. Proper conveying, handling, storage and disposal of these materials can significantly reduce the exposure of a fire hazard.

- Wire buildup is of particular concern during the separation process because of its ability to create sparks, static electricity & friction, and the ability to conduct and retain heat.
- Magnet bearings and chambers, grinder cutting chamber and screens, and conveyer pulley shafts and other shafts, are particularly susceptible to wire buildup and should be part of daily inspections and walkthroughs.
- Wire buildup can erode processing components and lead to mechanical failures.

Fiber and Other Material Separation

Fiber and Dust are Significant Fuel Sources. No Fuel, No Fire.

Fiber, non-magnetic material, dust, and other material separation is an integral part of tire processing plants that perform rubber granulating or grinding activities. Fiber and other material separation usually involves a large air source that allows lighter, undesirable material to be removed from the denser product material.

The largest fire risk for non-magnetic materials is from fiber and dust. Due to its light weight, dust and fiber can pose significant control issues. **Dust and Fiber are highly flammable.**

- Moving these materials by air through ducting and equipment may generate a static charge and/or produce sparks that could lead to a fire or explosion. Ducting and equipment should be grounded.
- Ensure that spark or fire suppression systems are incorporated into equipment and are functioning properly.
- Note and resolve any instances where static electricity has been observed.
- Proper, permanent repairs should be made to any air-handling component.
- Refer to the Dust Control section of this manual for more details on fiber and dust collection.

Conveying

Conveying material throughout the processing system is essential to the proper operation of a facility.

- For earlier processing applications, rubber belt conveyors or screw conveyors are often used.
- Airflow is used to convey smaller size products, as it allows a more compact and simpler system to be utilized. Such systems should include a pressure or temperature detection system that can detect a system fault.
- Conveying systems should include interlocks as a safeguard if downstream equipment stops, systems before that also stop to avoid causing a fire risk due to a blockage or other issue.
- Operators should be particularly aware of rundown periods for equipment before it can be safely stopped and:
    - The potential need to offload materials from conveying systems; and
    - The need to promptly clear equipment if stopped without a rundown period.

Dust Control

Dust control is an integral part of tire processing, especially when performing Second Stage and Third Stage processing. Large quantities of fines and fiber are generated during processing and need to be managed.

Extreme caution should be exercised when working in a dust control area due to the extremely explosive nature of the material. The equipment, as well as the dust, can pose an extreme explosive hazard and individuals should be cautious and follow applicable company safety policies and procedures when working in and around this equipment.

Dust Control Housekeeping

A housekeeping program should be implemented to minimize dust buildup. Employees need to be trained in proper cleaning procedures. Housekeeping activities should be sufficient to prevent the buildup of material or contaminants in the area.

- Accumulations of fugitive dust on surfaces should be removed on a regular basis in a manner that minimizes the generation of dust layers.
- Vacuuming is a preferred method of dust removal. Personnel should be aware that vacuuming a hot ember into vacuum may create a high explosion risk.
- Compressed air should not be used to blow down equipment as it can create a dust cloud and an explosive condition.
- When moving dust or fiber with a broom or scrapers, it is advisable to use non-sparking tools to minimize the potential of creating a spark.

Dust Collectors Containing Filtration Media

Dust collectors on grinders serve the dual purposes of removing excess dust from the grinder and providing airflow to help reduce heat buildup in the grinder. The dust collector should be of sufficient size to provide the proper airflow for heat extraction and dust collection.

Dust and other undesirable materials are collected and transported to a central location for reprocessing or disposal using various techniques. It is not uncommon to pick up sparks or embers at the dust source and transport them along with the dust through the system. Proper installation and operation of the dust collection system may significantly reduce the potential for fires. A fire or explosion in a filter system can occur due to sparks or burning material (fluff or dust) that is transported from the process area to the dust collector through exhaust (pneumatic) ducting.

Safety Precautions

- Cyclones and filter systems should be located outside the building whenever possible.
- Dust control systems must be properly vented for explosions as per NFPA 68.
- The use of a backdraft damper, abort gates, or other isolation device upstream of the dust collector is critical to prevent explosion propagation back into the plant.
- Utilize a spark &/or thermal detection and suppression system in the duct work, filters, and other enclosed equipment.
- Consider installing manually activated deluge valves and nozzles for cyclones, duct work, and filters.
- Cyclones, filters, and duct work should be tested and inspected regularly for proper air flow or buildup of dust material that could impact air volume and conveying velocities.
- Dust control fire suppression systems should be tested regularly.
- A program should be established for periodic monitoring of pressure gauges.

Dust Control-Specific Electrical Maintenance

- Ensure that filters, cyclones, fans, duct work and associated equipment are properly grounded to eliminate the buildup of static electricity from non-metallic equipment.
- If a section of duct is connected via plastic or rubber hose, ensure that grounding is accomplished on both sides of the connection.
- Note instances where static electricity has been observed and develop a program to eliminate as much static as possible.

Hot Work

Use when performing torch cutting, welding, grinding, or plasma cutting or any process that generates sparks, heat, or other ignition sources.

- A documented program in compliance with any federal, state, or local requirements is required whenever hot work operations are performed.

- Programs should include a written hot work authorization for any employees / contractors who are performing hot work.
- Establish a written procedure for the use, handling, and storage of compressed gases in compliance with any federal, state, or local requirements.
- When possible, avoid hot work 2-4 hours before the end of the day.

Pre-Hot Work

Before undertaking any hot work procedure, the following should be done:

Identify potential fire safety hazards, including but not limited to:

- Airborne particles
- Confined spaces
- Flammable gases or vapors
- Hazardous fumes
- Hot environment
- Oil and hydraulic fluids

Prepare Area

- Housekeeping: Clean area and equipment of any processed material, dust, fiber, or other debris.
- Pay specific attention to inaccessible areas near the hot work where sparks and heat may reach that are out of immediate sight of the operators.
- Turn off equipment and follow lockout-tagout procedures - particularly dust control equipment and fans - in the area to avoid dispersion of sparks.
- If appropriate, wet the area down and/or use fire blankets.
- Ensure employees / contractors performing hot work wear appropriate PPE.

During Hot Work

- Any hot work should be performed with a hot work trained spotter.
- Ensure the spotter has appropriate fire suppression equipment, including:
    - Properly functioning water supplies.
    - Fire extinguishers that have suppression ability for rubber and fiber.
- The hot work area cannot be unattended until the hot work is completed and post hot work has begun.

Post Hot Work

After undertaking any hot work, the following procedures should be done:

- Inspect and clean the hot work area.
- Any hot work equipment used should be inspected, maintained, and properly stored.
- A fire watch should be scheduled that is appropriate for the hot work that has been performed.
- Depending on the hot work performed, thermal sensors such as infrared, temp guns, or thermal imaging cameras can be used to identify combustion or hot spots.

Tire Recycling Processes

Storage: inbound, production, and outbound materials

Tire processing introduces several potentially significant fire hazards. These hazards may exist during all phases of storage, processing and transportation. History has proven that once a pile of rubber products reaches a certain internal temperature, it becomes progressively more difficult to cool it. Once the threshold temperature is reached, runaway heating begins and a fire becomes likely, if not inevitable. Once a pile ignites, the fire can grow dramatically, with tremendous speed and with potentially devastating results.

A critical component of fire prevention involves emergency preparedness. Procedures should be implemented that incorporate adequate space between piles to ensure a fire in one pile cannot propagate to adjacent piles. Similarly, adequate space should be maintained between piles and operating facilities to minimize any life hazard in the event a fire occurs. Criteria should be established for the height and area of piles for different materials and/or stages of processing to reflect the potential hazards of each type.

The following suggestions are based on common industry procedures. As state and local fire codes and other statutes may impact a facility's layout and storage requirements regarding pile heights and areas, it is important to consult with your state and local regulatory bodies and legal counsel to ensure compliance. Additionally, consultation with the local fire department is also important.

General Guidelines
All storage areas will want to consider the three basic sources of fire: fuel sources, ignition sources, and oxygen sources.

Each facility should have a policy for what inbound material is accepted and how inbound material will be inspected, evaluated, and documented. Separation of non-tire materials should occur at this stage before materials are stored.

Tire piles should range between 2,500 to 3,500 square feet in area and up to 15 feet high, but maximum pile areas, heights, weights, and/or volumes may vary greatly between states and localities.

All material should be spaced at least 25 feet away from buildings, additional piles, equipment, property lines, etc.

Fire lanes or roads should be at least 25 feet wide and maintained to provide sufficient access in the event of an emergency.

- If this distance cannot be met, the facility operator should work with state and local regulatory bodies to find a suitable alternative that ensures all appropriate safety standards are met.

Sufficient storage capacity should be available to provide safe storage even during maximum production demands triggered by market fluctuations, delays in shipment, etc.

Suggested storage methods include, but are not limited to:

- Bulk Storage Piles – It is common industry practice to store finished products in rows prior to shipment.
- Trailers – Storage of finished product in trailers prior to shipment should be managed appropriately.
- Bins, Sacks or Totes – Although this method of storage may be considered the least threatening, hazards may still be present. Storage of material prior to shipment should be managed appropriately.

Risk Assessment

Consider whether all material is sized and stored in like groups. Any crumb or fine material is a greater hazard, including materials stored with larger grades which can lead to oxygen pockets, uneven temperature gradients, and other issues.

Fiber in particular can serve as an accelerant if it remains mixed with other materials.

Rubber products should be stored in a manner that reduces adverse weather impacts, such as employing lightning suppression protocols and being aware of the effects of moisture and wind.

All material should be stored in an area away from objects that can attract lighting or energy sources. Storage areas should also consider – and be checked more regularly during – conditions of greater temperature changes and/or increased moisture.

Materials such as lighters, electronic cigarettes, batteries, chemicals, oils, etc. should not be in or near piles.

Separation and segregation techniques and procedures should be put in place to ensure foreign materials are filtered out before processing.

Fire Response Considerations

Fire department personnel should have adequate access to water supplies.

Fire suppression equipment such as extinguishers, hoses, on-site fire extinguisher carts, water supplies, etc. should be readily and easily accessible.

Consider the use of a water "wetting agent" or other additives to enhance the fire suppression capabilities of water for extinguishing fires.

Temperature Monitoring

The internal temperatures of piles will often be different from the external temperatures. As material will generally produce heat from the interior to the exterior

of a pile, internal temperature monitoring with a suitable device, i.e. a six foot thermal probe or other appropriate device, is necessary for safe storage.

In general practice, the internal temperature of stored material should not exceed 40ºF over the maximum ambient temperature for the day at a depth of six feet, and should be carefully watched at any temperature over 120ºF regardless of ambient temperatures. However, it is important to note that internal temperature recommendations will vary based on the climate and location of a facility and facility safety policies should be adjusted accordingly.

Any changes in color or odor of steam coming from stored material should trigger heat reduction strategies.

Suggested cooling strategies include agitating, spreading, and/or turning material as needed to reduce temperature and allow heat to escape. Having an empty location or storage bin available in the event of temperature increases allows material to be separated while cooling.

The monitoring of the pile should be recorded **on a regular basis and properly documented**.
A rise in temperature in either the interior or exterior of the pile should be noted, especially in the context of variances in ambient temperature.

Processed Materials (Shred, Chip, Nugget, Crumb, Fines, Fiber)
For any processed materials stored in a pile, the smaller the size, the greater the risk of spontaneous combustion.

Any materials stored with other materials that are not like-sized pose an increased risk and should not be compacted. The more fines, the greater the risk.

Tire Wire
Clean, processed tire wire, if stored in a pile, should be stored in an area that has minimal exposure to lightning strikes. Piles of tire wire need to be kept at a lower height due to acting as a lightning rod.

Tire wire will generate heat as it begins to oxidize. Temperature monitoring as outlined above should be done on this material daily to ensure that there is not excessive heat buildup due to oxidation.

Fiber
Fiber is an inherently mixed product with residual rubber and wire; because of this, it is a much higher fire risk. Fiber should never be stored in large piles to ensure that it is not compacted, and should be temperature monitored as outlined above.

Stage One Processing: Shredding

There are two different types of shredders: Primary and Secondary. Primary shredders reduce whole tires to a Chip or a Rough Shred while secondary shredders further shred and reduce the particle size of the material produced by the primary shredder. Both primary and secondary shredding is generally accomplished using low speed, high torque machines utilizing multiple, counter rotating shaft/blade arrangements. Occasionally single shaft or medium to high-speed units are utilized for this part of the operation, and although this is acceptable, it is not as common. In operating either a primary or secondary shredder, potentially significant fire safety hazards exist and care should be exercised while the machinery is being utilized.

Major points of consideration for fire risk include:

- Good housekeeping to reduce fuel loads and/or friction elements.
- Inspection of the shredder feedstock for any non-tire material, which can include remnants of the wheel assembly or other vehicle parts, loose lithium-ion batteries, small pressurized containers, road debris, etc.
- Monitoring of cutting chamber and bearing temperatures.
- Buildups of material in the grinding chamber.
- Conveyer belts tracked off / other potential friction points.
- Mobile equipment driven near the shredding area.
- Finer grades of processed materials.
- Unmanaged Tire Shredder Residue.
- Hot work.
- Potentially increased risk during secondary shredding from smaller materials and/or heat accumulation.

The shredder cutting chamber and bearing temperatures need to be monitored regularly throughout the workday to ensure that material does not accumulate in these areas to prevent excessive heat buildup due to friction or sparks. An automated temperature monitoring system is recommended. Material accumulation can be a fuel source for a fire. If buildup of material is observed, clean or repair the affected equipment as necessary and appropriate.

Proper maintenance of the shredder head is important to reduce the potential of fire from worn or improperly adjusted components. Blades should be inspected and re-torqued as appropriate to minimize friction created during processing. Depending on how the shredder heads are driven, employees should inspect:

- Electrical connections for loose or damaged components;
- Hydraulic components for leaks and excessive wear;
- Combustion engines for fuel sources, engine heat, and exhaust;
- Belts, clutches, gear boxes and other mechanical components.

Mag-off

Mag-off occurs after the primary shedding in order to separate high wire content rough shred and chip materials before secondary shredding.

- Mag-off separated materials should be sent for further processing as soon as possible; any stored materials should be carefully temperature monitored as outlined in the Storage section.
- During the mag-off process, loose wire can accumulate in processing machinery or material handling equipment, creating a fire hazard.
- Malfunctioning electromagnets can also pose a fire risk.

Stage Two Processing: Rasping / Wire Liberation

This stage is routinely considered to be the greatest fire risk area in the processing of tires. Keeping the processing area clean is of utmost importance. With the high possibility of sparks or a fire, observing the motto **"No fuel, no fire"** may be the difference between a relatively minor flash event and the complete loss of the facility to a fire.

These recommendations also apply to subsequent processing stages.

Fire Detection / Suppression

A typical wire liberation process should be designed to include multiple levels of fire detection/suppression; the more equipment that has integrated fire suppression systems, the better. These may include building sprinklers, halo sprinkler systems, deluge systems internal to the machine, nearby fire extinguisher carts having an encapsulating agent, traditional fire extinguishers, and connected water hoses.

- The use of optical, thermal, spark, or other heat / fire detection devices integrated with additional sprinklers / nozzles is strongly recommended.
- Processing equipment temperatures should be monitored and documented, including the grinder housings, bearings, and other potential points of heat generation.
- Temperature monitoring of discharged materials should be integrated with the conveyance system to regulate the rate of feed in order to control the temperatures of the discharge material and processing equipment.
- The use of water misting to assist with material temperature control is suggested.
- Dust collection systems should have fire detection / suppression nozzles in the ducts and thermal detection integrated with flood nozzles in the filter.
- Fire suppression systems should be inspected, tested, and maintained as required by your local Authority Having Jurisdiction (AHJ).

In Case of a Rapid Stop

In the case of a hard stop of processing equipment, clearing the remaining material in the equipment and allowing it to exit the confined processing area allows fire sprinklers to reach hot material and reduce the risk of a fire.

- In the event of a power outage or other situation where processing equipment cannot be operated, material will have to be manually removed from the equipment.

- Operators should also adhere to the recommendations under the Conveying section related to the movement or clearing of material.
- Elevated temperature material should not be left in hoppers. Material can reach high temperatures in this process and should be brought back down to safe temperatures prior to storing in a bin or packaging the material.

Dust Collection
The application of dust collection typically starts in Stage Two processing to capture separated fiber and dust. The air also assists in reducing product temperature. Refer to the Dust Collection section for specific operational practices.

Stage Three Processing: Granulation

Granulation is typically considered Stage Three processing. Material produced at this stage starts out smaller than 1 inch in size and is reduced to ¼ inch or less. Significant amounts of fiber and residual wire are removed at this stage. Stage Three processing is usually accomplished with medium to high-speed equipment. Fire hazards at this stage can be caused by friction and sparks that are generated from remaining wire contained in the material.

In addition to Stage Two processing recommendations on Fire Detection / Suppression and considerations during a Rapid Stop, the following should be considered:

- The use of air as a pneumatic conveyor introduces further risks inside ductwork. The use of spark detection / suppression is critical in the ductwork.
- The spark detector in the ductwork can also be interlocked with a deluge valve to extinguish the fire in and around the granulation system.
- As with Stage Two materials, packaging of products should only occur once material has returned to a safe temperature.

Processing equipment temperature monitoring is especially important during Stage Three. Special attention should be paid to:

- Monitoring of temperatures inside the processing equipment as well as bearings, grinding heads, and the materials being processed.
- Buildups of material in the grinding chamber.
- Conveyer belts tracked off / other potential friction points.
- If a water mist system is applicable to the equipment used in Stage Three, they should be inspected and maintained for proper functioning.
- Suggested cooling strategies for processed material include pneumatic conveying and auguring before storage or further processing.

Stage Four Processing: Milling / High Speed Granulation / Cryogenics

At this stage the processed material is nearly steel free so fiber and contamination are your greatest threats for a fire. In these areas, optical fire sensors can assist, duct spark detection and suppression is needed, and filter detection is required.

In addition to recommendations in Stages Two and Three, the following should be considered:

Milling

- In mills there may be a need to elevate material temperatures for optimum performance; care must be taken to ensure that the material being processed does not exceed dangerous temperatures.
- Sparking can occur if mill rolls are damaged by wire or any contaminants.

High Speed Granulation

- It is necessary to make sure in-feed materials are contaminant free before entering the system.
- Care should be taken to ensure that materials are cleared from the equipment using air evacuation.
- Vacuum sensors in air systems can be used to shut down the system if vacuum is lost.
- Due to the inherent speeds involved, high speed granulation systems present additional concerns with rapid temperature change. Operators must continually monitor equipment and material temperature.

Cryogenics

- Dryers, usually gas-fired, are used to remove moisture from cryogenically processed material before it is screened. Special care must be taken that the dryer does not become an ignition source.
- The use of flood valves with nozzles in the cryogenic system and ducts are recommended.

As with previous stages, packaging of product should only occur once material reaches a safe temperature.