CONVEYORS

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1.0 SCOPE

This data sheet covers fire, collapse and equipment breakdown hazards to vertical, horizontal, and inclined indoor and outdoor conveyors.

For guidance on the explosion hazards associated with conveying combustible materials, see FM Property Loss Prevention Data Sheet 7-76, *Combustible Dusts*.

1.1 Changes

April 2025. Interim revision. Significant changes include:

A. Clarified the Scope in Section 1.0.

B. Consolidated and revised belt width guidance in Section 2.2.3.5, requiring sprinklers be installed beneath.

C. Clarified fire protection recommendations in Section 2.1.7 for conveyors entering a building or passing through a fire wall.

D. Added and highlighted guidance in Sections 2.3.1 and 2.3.2 for avoiding combustibles under outdoor conveyor systems.

E. Expanded housekeeping guidance in Section 2.3.2 to address the structural loading posed by conveyed material accumulations.

F. Clarified in Section 2.3 when fire protection is necessary for outdoor conveyors.

G. Removed captive conveyor terminology throughout.

H. Added inspection, testing and maintenance guidance in Section 2.7 for elevated conveyor and gallery structures.

I. Added guidance in Section 2.7 regarding process changes for elevated conveyor and gallery structures.

J. Defined different conveyor types in Appendix A.

1.2 Hazards

A fire involving a rubber, plastic or synthetic material conveyor may be difficult to ignite; but once ignited, the fire will have a high heat-release rate and generate large amounts of toxic black smoke. Depending on the orientation of the conveyor, the fire can be slow to propagate, allowing time to attack the fire manually. However, the thick smoke will cause poor visibility, hindering firefighting efforts. The presence of automatic sprinklers will ensure smoke is kept to a minimum and that a fire involving a combustible conveyor will be quickly controlled.

The hazard presented by combustible indoor conveyors or noncombustible conveyors carrying combustible materials is similar to the fire hazards associated with outdoor conveyors. A key difference is the potential for the indoor conveyor to be shielded from ceiling sprinklers. If the shielded conveyor is unprotected, factors such as length and width of the conveyor, whether conveyors are horizontal or inclined, and whether they are stacked (either parallel or crossing over each other) will affect how far and fast the fire will spread and how much smoke will be generated.

The hazard of outdoor conveyors depends on whether the conveyor is protected with automatic sprinklers (wet, dry, pre-action) or a water-spray system. The hazard of an unprotected conveyor depends on detection, response time and access to the conveyor. If the conveyor is located in a tunnel, a totally enclosed surface, elevated gallery or partially enclosed elevated gallery, a fire on the conveyor might be inaccessible for manual firefighting. A fire in an enclosed conveyor structure could result in structural damage or collapse of the conveyor support structure.

2.0 LOSS PREVENTION RECOMMENDATIONS

2.1 General

2.1.1 Use FM Approved equipment, materials, and services whenever they are applicable and available. For a list of products and services that are FM Approved, see the *Approval Guide*, an online resource of FM Approvals.

2.1.2 Use noncombustible conveyor belt material when possible.

2.1.3 Use noncombustible construction for enclosures, insulation, and structural supports of conveying systems.

2.1.3.1 Cover exposed, combustible insulation on interiors of conveyor galleries, tunnels or buildings with FM Approved fire-retardant coating; or replace with noncombustible insulation. Refer to Data Sheet 1-57, *Plastics in Construction*, for recommendations on the protection of foamed plastic insulation.

2.1.4 Design conveyor transfer points to minimize the generation of dust. Provide the following at transfer points:

A. A hood discharge chute designed so the material transferred does not impinge directly against the side of the chute.

B. A spoon loading chute so material is discharged onto the lower conveyor in the same direction and at the same speed as the conveyor.

C. A settling enclosure with a passive dust-control system over the lower conveyor.

2.1.5 Where conveyor transfer points are not in accordance with Section 2.1.4, tightly enclose conveyors handling combustible dust and/or provide collection systems to exhaust dust fines.

2.1.6 Refer to Data Sheet 7-76, *Combustible Dusts*, for recommendations on the arrangement of explosion protection for combustible dusts.

2.1.7 Do not run conveyors through fire walls when that can be avoided. Refer to Data Sheet 1-42, *Maximum Foreseeable Loss Limiting Factors*, for conveyor belts that pass through MFL walls.

2.2 Indoor Conveyors.

2.2.1 Construction and Location

Fire will propagate along combustible conveyors, including those made from plastic, rubber, or composite materials made from a combination of PVC, polyester, nylon, and/or cotton with or without a steel core.

2.2.1.1 Provide noncombustible covers if an enclosure over the conveyor is needed for quality control or other purposes.

2.2.1.2 Do not position one conveyor above another (either parallel or crossing over). Doing so will create areas that are shielded from automatic sprinklers at the ceiling.

Where positioning one conveyor over another (either parallel to or crossing over each other) cannot be avoided, provide sprinkler protection per Section 2.2.3.

2.2.2 Occupancy

2.2.2.1 Do not store combustible material under indoor conveyors. If such storage cannot be avoided, provide automatic sprinkler protection in accordance with the recommendations for obstructed ceiling construction in Data Sheet 2-0, *Installation Guidelines for Automatic Sprinklers*.

2.2.2.2 Conduct regular weekly inspections around conveyors to ensure there is no buildup of debris beside or under the conveyor. Keep motor cooling fins clean, and bearings clear of debris.

Good housekeeping will help reduce the possibility of an overload of the structure and ignition due to friction from a buildup of debris underneath or beside the conveyor.

2.2.3 Protection

2.2.3.1 Provide automatic ceiling sprinkler protection over open combustible conveyors or conveyors transporting combustible material. Design the system for the surrounding occupancy.

2.2.3.1.1 If the surrounding occupancy and construction do not require sprinkler protection, provide sprinkler protection over the conveyor using the guidance in Table 2.2.3.1.1-1, treating the conveyor as if it was enclosed or partially enclosed.

2.2.3.2 Provide automatic sprinkler protection for enclosed or partially enclosed conveyors shielded from overhead automatic ceiling sprinkler systems in accordance with Table 2.2.3.1.1-1 and Table 2.2.3.2.1-1.

For these conveyors the demand in Table 2.2.3.2.1-1 does not need to be hydraulically balanced with the ceiling system demand.

Table 2.2.3.1.1-1. Automatic Sprinkler Spacing for Enclosed and Partially Enclosed Indoor Conveyors

Belt Width	*Style of Sprinkler*	*Sprinkler Spacing*	*Sprinkler Location*
2 ft (0.6 m) to 6 ft (1.8 m)	Pendant or Upright[1]	12 ft (3.7 m)	Along the center line of the belt
	Sidewall[2]	12 ft (3.7 m)	Along one side of the belt
> 6 ft (1.8 m)	Pendant or Upright[1]	12 ft (3.7 m)	Along the center line of the belt
	Sidewall[2]	12 ft (3.7 m)	Staggered along both sides of the belt (i.e., sprinkler heads on one side are spaced 24 ft [7.4 m] apart)

Note 1. The use of upright sprinklers is acceptable if they can be installed in accordance with Data Sheet 2-0, *Installation Guidelines for Automatic Sprinklers*. Pendent sprinklers should only be used in wet systems.
Note 2. Sidewall sprinklers are only acceptable for enclosed or partially enclosed conveyors. Unenclosed conveyors can be protected by sidewalls if the installation guidelines of the FM Approved sprinkler are satisfied (e.g., distance between sprinkler deflector and ceiling, spacing, etc.).
Note 3. See Section 2.1.3.2.3 for conveyors more than 10 ft (3 m) wide.

2.2.3.2.1 Design the sprinkler system to protect indoor conveyor systems per Table 2.2.3.2.1-1.

Table 2.2.3.2.1-1. Sprinkler Protection Options for Enclosed and Partially Enclosed Indoor Conveyors

Belt Orientation	*Sprinkler System Type*	*Sprinkler Demand*		*Water Duration*	*Hose Demand*
		Number of Sprinklers Operating	Flow per Sprinkler, Sprinkler Density		
< 10°	Wet, dry, pre-action	10	25 gpm (95 L/min) per sprinkler	60 min	250 gpm (946 L/min)
10° - 30°	Wet, dry, pre-action	15	25 gpm (95 L/min) per sprinkler		
> 30°	Deluge	All sprinklers on a single system	0.3 gpm/ft^2 (12 mm/min) along the length of conveyor the system covers		
Two or more parallel conveyors < 30°	Wet, dry, pre-action		0.3 gpm/ft^2 (12 mm/min) along the length of conveyor the system covers		

2.2.3.2.2 Install FM Approved quick-response sprinklers with a minimum K factor of 8.0 (115) and a temperature rating of 165°F (74°C). Use 212°F (100°C) nominal temperature rated sprinklers when the ambient temperature will exceed 100°F (38°C).

2.2.3.2.3 For conveyors more than 10 ft (3.0 m) wide, ensure the maximum sprinkler coverage does not exceed 100 ft^2 (9 m^2) with sprinklers no more than 12 ft (3.7 m) apart.

2.2.3.2.4 If flexible sprinkler hoses are used, ensure they are FM Approved.

2.2.3.2.5 Where multiple parallel enclosed or partially enclosed conveyors are less than 2 ft (0.6 m) apart horizontally and are less than 2 ft (0.6 m) in width, provide sprinkler protection in accordance with Table 2.2.3.1.1-1 assuming each conveyor is 2 ft (0.6 m) wide.

2.2.3.2.6 Sprinkler protection can be waived if all of the following criteria are met:

A. The conveyor belt is noncombustible or FM Approved.

B. The material being conveyed is noncombustible.

C. The enclosure housing the conveyor is of noncombustible construction.

2.2.3.3 Where dry-type or pre-action systems are installed, design the system so the maximum water delivery time does not exceed 60 seconds.

2.2.3.4 Interlock conveyors to shut down automatically on detection of fire. Refer to Data Sheet 5-48, *Automatic Fire Detection, for more information*.

Failure to shut down the conveyor system once the conveyor or combustible products on the conveyor are ignited can allow fire to spread to other areas.

2.2.3.5 Provide automatic sprinkler protection underneath conveyors in accordance with Data Sheet 2-0, *Installation Guidelines for Automatic Sprinklers*, when the conveyor is considered an obstruction to ceiling sprinklers.

2.3 Outdoor Conveyors

2.3.1 Construction and Location

2.3.1.1 To prevent impact to exposed structural supports, place warning markers and clearance signs on elevated conveyors and galleries in high-traffic areas or areas under which large mobile equipment might pass.

2.3.1.2 Minimize the potential for collapse due to overloading from debris accumulation, rain, snow, etc. by designing the conveyor system in accordance with Data Sheet 1-54, *Roof Loads and Drainage*.

2.3.1.3 Provide employee training to help staff recognize and facilitate the removal of unusual accumulations of spilled materials, snow, or ice inside or on roofs of galleries and buildings.

2.3.1.4 Protect conveyor galleries against natural hazards such as landslide, flood, surface water runoff, and ground subsidence. See Data Sheet 1-40, *Flood.*

2.3.1.5 Provide separation distance between conveyors and exposing fire hazards.

2.3.1.5.1 For belt conveyors in wood yards at pulp mills or wood processing plants, refer to FM Data Sheets 8-27, *Storage of Wood Chips* and 8-28, *Pulpwood and Outdoor Log Storage*, for protection guidance.

2.3.1.5.2 Separate the conveyor from combustible yard storage and unsprinklered combustible buildings in accordance with Data Sheet 1-20, *Protection Against Exterior Fire Exposure*.

2.3.1.5.3 Separate ignitable liquid, flammable gas, and liquefied flammable gas operations (such as storage tanks, pumping stations, and tanker truck unloading or loading facilities) in accordance with the appropriate data sheet.

2.3.2 Occupancy

2.3.2.1 Conduct weekly inspections of conveyor systems.

2.3.2.1.1 Document the inspection results and corrective actions.

2.3.2.1.2 Include the following in the scope of the inspections:

A. Material accumulations, combustible or noncombustible, are not present beside or under the belt.

B. If conveyors are elevated or in a gallery, material accumulations are not present on walkways, belt enclosures, gallery enclosures and structural members.

C. Conveyor drive and pulleys, motors, and motor and pully bearings are clean and free of material accumulations.

D. Any fire protection sprinklers and nozzles are free of material accumulations, undamaged from impact and oriented in the appropriate direction.

2.3.2.2 Remove vegetation (weeds, brush, and trees) from underneath and at least 25 ft (7.6 m) from both sides of a conveyor. Refer to Data Sheet 9-19, *Wildland Fire*, for additional guidance when conveyors are located in a wildfire zone.

2.3.2.3 Prevent fueled vehicles from being staged or parked under conveyors.

2.3.3 Protection

2.3.3.1 Provide automatic sprinkler protection for outdoor conveyors under any of the following conditions in accordance with Figure 2.3.3.1-1 and Section 2.3.3.2. See Section 2.3.4 and 2.3.5 for overland conveyors.

A. The conveyor is totally enclosed by a gallery or cover (i.e., not open or partially enclosed).

B. Combustible construction is used to support or enclose the conveyor.

C. Multiple conveyors are stacked vertically in a tiered arrangement.

D. The conveyor has a slope of 30° or greater.

E. Any portion of the open or partially enclosed conveyor extends more than 40 ft (12 m) above grade (such as a conveyor passing over a building or on a steep hillside), is below grade (i.e., in a tunnel), or is otherwise routed in a manner that obstructs fire service access for hose stream application.

F. Any portion of the conveyor is inaccessible to the fire service.

2.3.3.2 Design and install automatic sprinkler protection per Figures 2.3.3.2-1 and 2.3.3.2-2, and Tables 2.3.3.2-1 and 2.3.3.2-2.

2.3.3.2.1 Follow automatic sprinkler installation guidance in Data Sheet 2-0.

2.3.3.2.2 Install FM Approved quick-response sprinklers with a K-factor of 8.0 (115) and a temperature rating of 165°F (74°C).

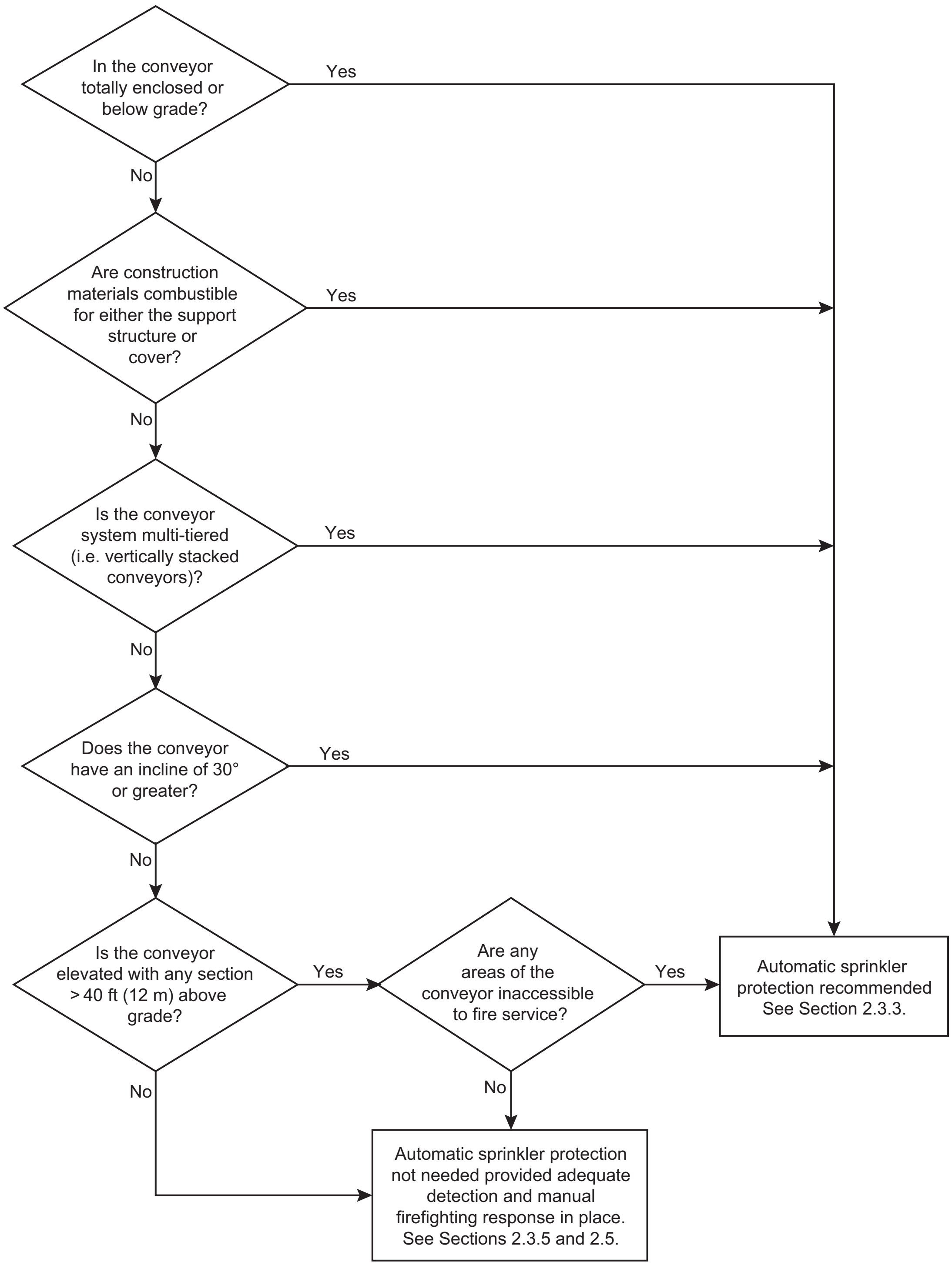

Fig. 2.3.3.1-1. Flowchart for outdoor conveyor automatic sprinkler protection

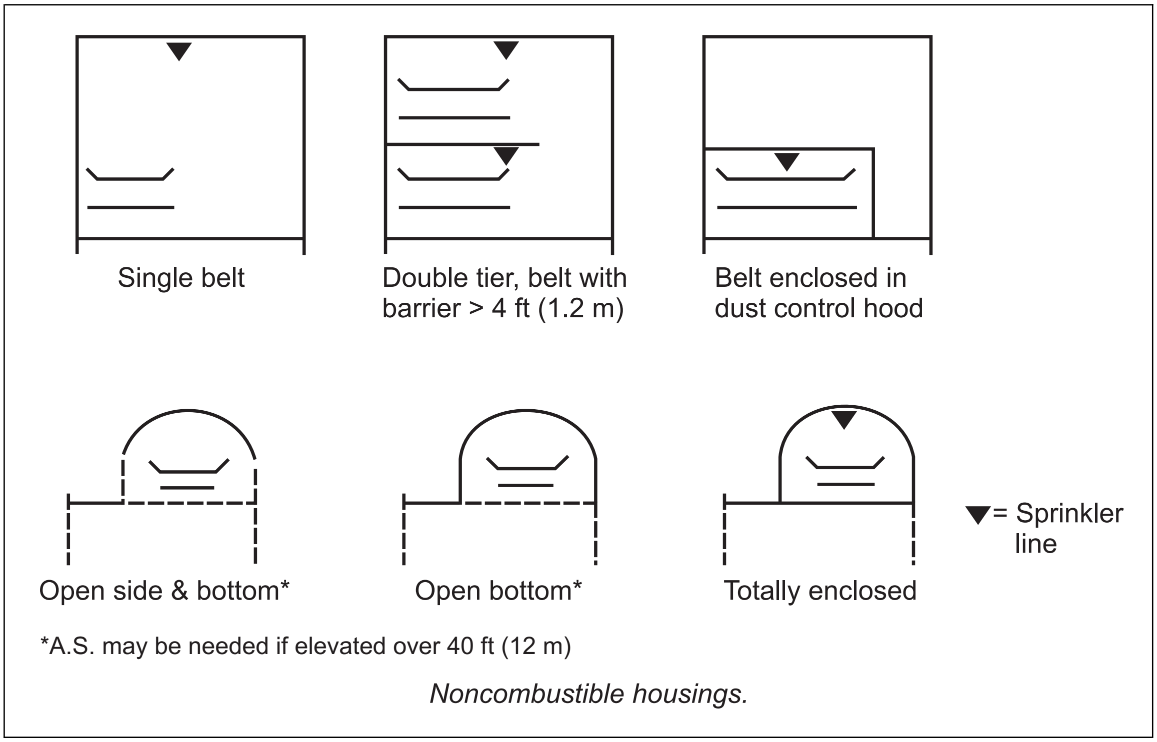

Fig. 2.3.3.2-1. Suggested locations for automatic sprinklers in various outdoor conveyor arrangements of noncombustible construction (the occupancy is assumed to be noncombustible, apart from the conveyor or conveyed product)

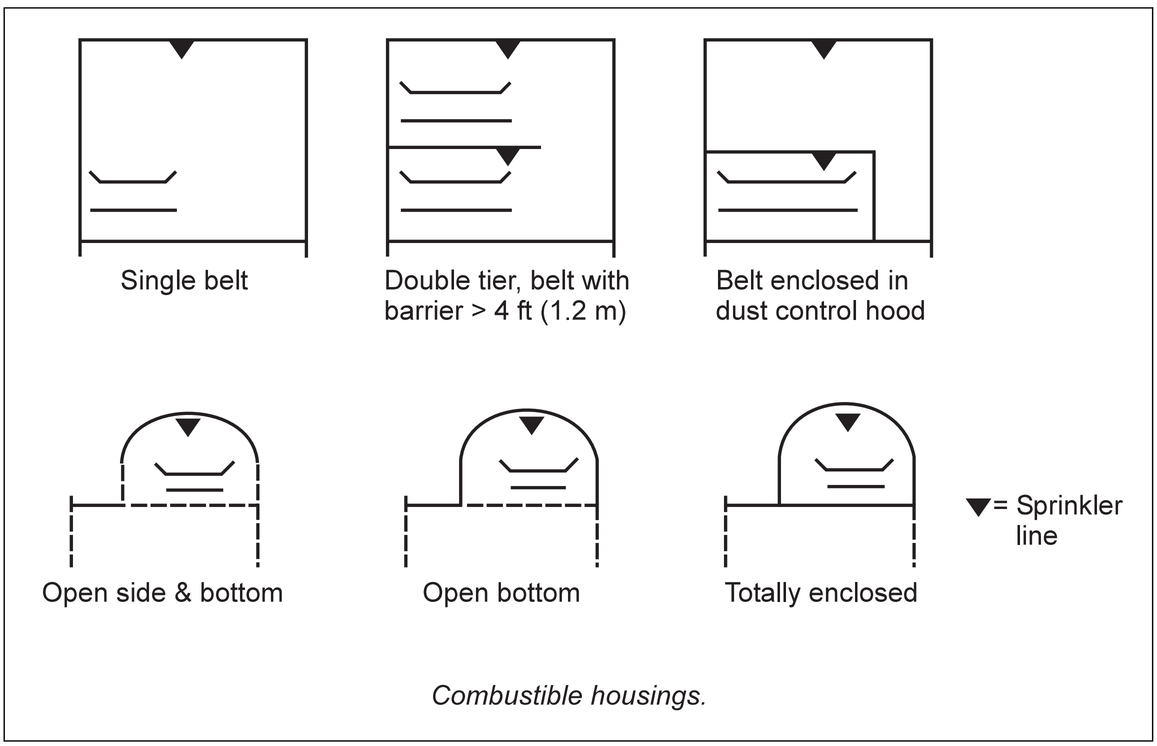

Fig. 2.3.3.2-2. Suggested locations for automatic sprinklers in various outdoor conveyor arrangements of combustible construction (the occupancy is assumed to be noncombustible, apart from the conveyor or conveyed product)

Table 2.3.3.2-1. Automatic Sprinkler Spacing for Outdoor Conveyors

Belt Width	*Style of Sprinkler*	*Sprinkler Spacing*	*Sprinkler Location*
2 ft (0.6 m) to 6 ft (1.8 m)	Pendant or Upright[1]	20 ft (6.0 m)	Along the center line of the belt
	Sidewall[2]	20 ft (6.0 m)	Along one side of the belt
> 6 ft (1.8 m)	Pendant or Upright[1]	20 ft (6.0 m)	Along the center line of the belt
	Sidewall[2]	20 ft (6.0 m)	Staggered along both sides of the belt (i.e., sprinkler on one side are spaced 40 ft [12.2 m] apart)

Note 1. The use of upright sprinklers is acceptable if they can be installed in accordance with Data Sheet 2-0, *Installation Guidelines for Automatic Sprinklers*. Pendent sprinklers should only be used in wet systems.
Note 2. Sidewall sprinklers are only acceptable for enclosed or partially enclosed conveyors.

Table 2.3.3.2-2. Sprinkler Protection Options for Outdoor Conveyors

Belt Orientation	*Sprinkler System Type*	*Sprinkler Demand*		*Water Duration*	*Hose Demand*
		Number of Sprinklers Operating	Flow per Sprinkler, Sprinkler Density		
< 10°	Wet, dry, pre-action	5	25 gpm (95 L/min) per sprinkler	60 min	250 gpm (946 L/min)
10° - 30°	Wet, dry, pre-action	7	25 gpm (95 L/min) per sprinkler		
> 30°	Deluge	All sprinklers on a single system	0.3 gpm/ft^2 (12 mm/min) along the length of conveyor the system covers		

2.3.3.3 Use wet automatic sprinkler systems.

2.3.3.3.1 Use a single-interlock, pre-action, automatic or dry sprinkler system in locations exposed to a 100-year return period daily minimum temperature (DMT) of 20°F (-6.7°C) or colder, based on the FM Worldwide Freeze Map available on www.fm.com.

Table 2.3.3.3.1-1. Maximum Water Delivery Times

Conveyor Arrangement	*Maximum Water Delivery Time, sec*
Incline ≤ 30 degrees	300
Inclined > 30 degrees	60

Note: Maximum water delivery times are based on the following assumptions:
A. Interlocks are present to stop the conveyor in the event of a fire.
B. The conveyor system (enclosure and associated equipment) is noncombustible.
C. The conveyor is not an indoor conveyor.
If any of these assumptions is not true, the maximum water deliver time is 60 seconds.

2.3.3.4 Provide fire detection to actuate pre-action sprinklers, deluge sprinklers, or fixed water spray systems in accordance with Data Sheet 5-48 and Section 2.3.4.1.

2.3.3.5 Provide automatic sprinklers throughout all floors of intermediate transfer, splice or junction buildings that have combustible construction.

2.3.3.6 Where space inside the enclosures is limited, arrange piping on the exterior; and extend sprinklers through sealed openings. Use FM Approved flexible hoses to plumb sprinklers inside the enclosure, or provide inspection and maintenance hatches for each sprinkler.

2.3.3.7 Protect automatic sprinklers or nozzles, piping and fire detectors against impact damage from oversized pieces of conveyed material.

2.3.3.8 Provide adequate drainage via floor openings or conveyor pitch to prevent elevated conveyor or gallery collapse due to pooling sprinkler discharge.

2.3.3.9 Provide yard hydrant protection for outdoor conveyor systems that is consistent with the planned manual firefighting response.

2.3.3.10 Where conveyors enter a building or pass through a fire wall, provide automatic sprinkler protection per Section 2.2.

2.3.3.11 Provide additional sprinklers at the ceiling of a tunnel or gallery housing an enclosed conveyor only if construction is combustible or if other combustibles, such as grouped electrical cables, are present.

2.3.4 Cross-Country (Overland) Conveyors

2.3.4.1 For totally enclosed cross-country conveyor systems, provide automatic sprinklers per Figure 2.3.3.1-1 and protect in accordance with Section 2.3.3 as an enclosed outdoor conveyor.

An alternative would be to partially or completely remove the enclosure and protect as outlined below for open or partially enclosed cross country conveyor systems.

2.3.4.2 For open or partially enclosed cross-country conveyor systems, protect as follows:

A. Provide and maintain fire access roads that run parallel to the conveyor system.

B. Maintain a mobile water truck with a pump and hose attached. Ensure the water tank has a minimum capacity of 7,500 gal (28,400 L). This will provide approximately a one-hour supply for manual firefighting response.

Alternatively, provide fire hydrants at intervals that allow the fire service to reach all sections of the conveyor system (typically, at 350 to 500 ft [91 to 152 m] intervals along the system).

C. Replace combustible weather hoods and intermediate buildings with noncombustible or fire-resistant alternatives.

2.3.5 Fire Detection

2.3.5.1 Provide detection coverage that spans the entire length of the belt. For overland conveyors, in lieu of detection over the entire length, provide detection at all drive ends and transfer houses.

2.3.5.2 Position heat detection directly above the belt and in accordance with Figure 2.3.5.2-1. Refer to Data Sheet 5-48, *Automatic Fire Detection for other design and installation guidelines*.

2.3.5.3 Arrange the alarm to sound in a constantly attended location.

2.3.5.4 Provide a belt interlock for all indoor, outdoor and overland conveyors to automatically shut down the drive system upon fire detection.

2.4 Specialty Conveyors

2.4.1 Vertical Bucket Elevators

2.4.1.1 Provide fire protection for bucket elevators with rubber belts, plastic buckets or combustible construction using automatic sprinkler as specified in Data Sheet 7-76, *Combustible Dusts*.

2.4.1.1.1 If the bucket elevator transports grain or other combustible products that may present an explosion hazard, refer to Data Sheet 7-76, *Combustible Dusts*.

2.4.2 Pipe Conveyors

2.4.2.1 Protect pipe conveyor systems in accordance with Section 2.3.4, Cross-Country Conveyors.

2.4.3 Air-Supported Conveyors

2.4.3.1 Provide an interlock to stop the conveyor if one or more compressors are lost.

2.4.3.2 Provide automatic sprinkler protection for air-supported conveyors in accordance with Section 2.2.3.3, Cross-Country Conveyors.

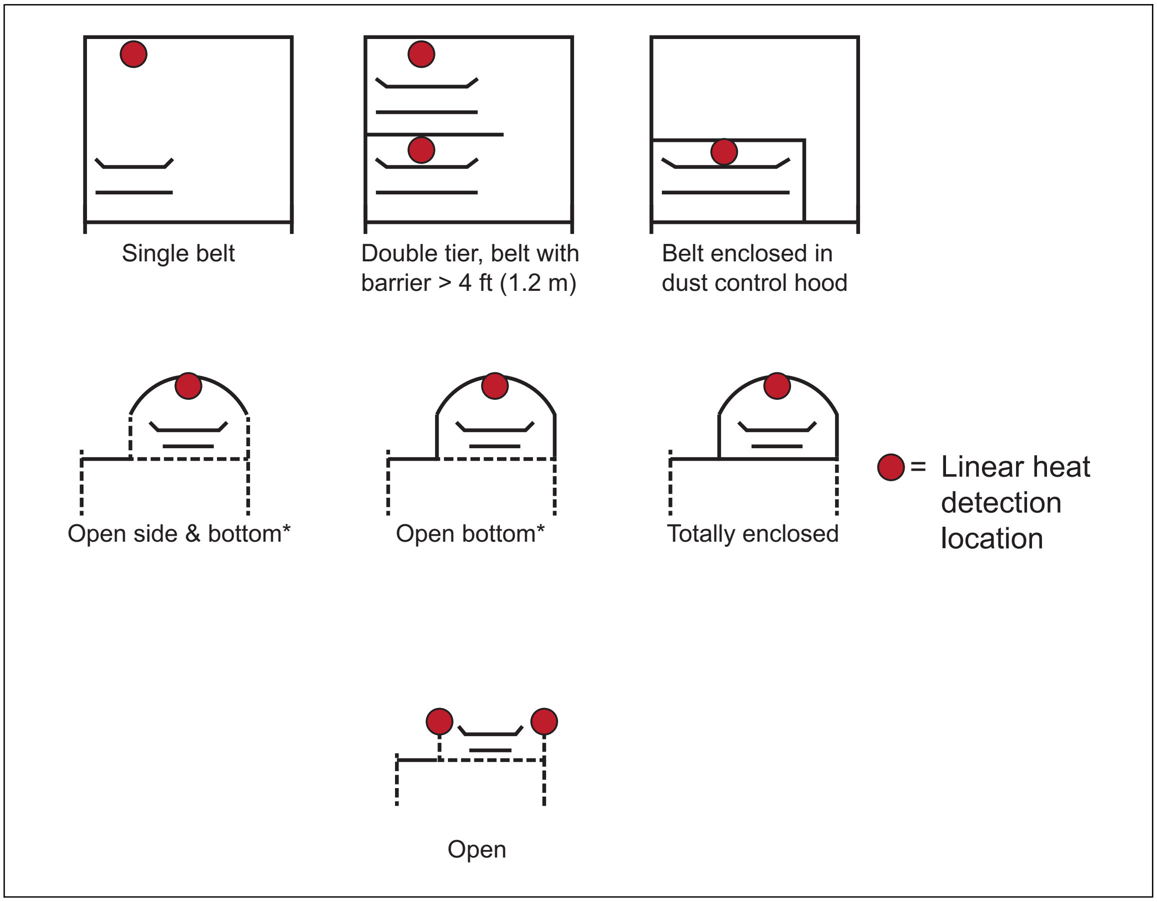

Fig. 2.3.5.2-1. Suggested locations for fire detection in various outdoor conveyor arrangements

2.4.3.3 Do not install grouped electrical cables, gas piping, or similar combustibles within the conveyor framework.

2.5 Manual Firefighting for Outdoor Conveyors

2.5.1 Establish a pre-incident plan in cooperation with the local fire service. See Data Sheet 10-1, *Pre-incident and Emergency Response Planning*, for guidance related to a pre-incident and emergency response plan.

2.5.2 Include manual firefighting response in the emergency response plan for unsprinklered conveyors. Account for all of the following:

A. Alarms and interlocks installed in accordance with Sections 2.3.5 and 2.7

B. Access lanes that are clearly marked and maintained for fire service vehicles

C. Access for personnel with hoses along the full length of at least one side of the conveyor

D. Fire hydrants provided along the full length of at least one side of the conveyor

E. Emergency response team staffed 24/7, 365 days a year.

F. Onsite fire brigade, or public fire service response time to the conveyor section is:

1. Less than 20 minutes for conveyors with a slope less than or equal to 10°
2. Less than 10 minutes for conveyors with a slope greater than 10°, but less than 30°

2.5.3 Maintain mobile fire protection equipment, fixed fire protection equipment, and any associated firefighting equipment such as hoses and nozzles in accordance with appropriate data sheets or local authority having jurisdiction.

2.6 Utilities

2.6.1 Do not use conveying systems to transport utilities such as grouped electric cables, flammable gases, and ignitable liquids. If unavoidable, protect cables as recommended in Data Sheet 5-31, *Cables and Bus Bars*.

2.7 Operation and Maintenance

2.7.1 Develop an inspection, testing and maintenance (ITM) program to verify the structural integrity of support structures and galleries for elevated conveyors.

2.7.1.1 Develop the inspection program based on input from a licensed structural engineer.

2.7.1.2 Provide a baseline inspection report performed by a structural engineer.

2.7.1.3 Perform visual inspections every 5 years (initially) to verify structure integrity.

2.7.1.3.1 Revise the frequency of the inspections as needed based on the results. More frequent follow-up inspections by a structural engineer or plant personnel may be warranted.

Degradation of structural members due to corrosion or impact damage can reduce load bearing capacity, potentially leading to collapse, especially when degradation is paired with conveyed material accumulations and natural hazards such as wind, earthquake or snow.

2.7.2 Evaluate process changes that may increase the total load on the conveyor system, such as:

- Increase in feeder speed
- Decrease in conveyor speed
- Change in conveyed material
- Installation of equipment on the structure for elevated conveyors or galleries
- Installation of cabling, piping and other equipment runs in elevated conveyors or galleries

2.7.3 Develop an asset integrity program. See Data Sheet 9-0, *Asset Integrity*.

2.7.4 Inspect, test and maintain areas of the conveyor system considered to be common ignition sources due to friction and overheating, including bearings, motors and/or drive system components, belt or driver alignment, etc.

2.7.5 Where a history of longitudinal conveyor ripping exists, provide anti-rip detection devices to automatically de-energize drives and minimize further damage. An alternative is to use high tear-resistant conveyors.

2.7.6 Maintain idler and pulley bearings per the original equipment manufacturer's guidelines, including lubrication schedule, and keep them free of dust, product and buildup of lubrication residues.

2.7.7 Have regular thermographic scans conducted on known or frequent hot zones, such as conveyor drive pulleys and bearings.

2.8 Ignition Source Control

2.8.1 Where heated materials are discharged onto the conveyor, provide interlocks to automatically shut down the feed system if the material exceeds a safe temperature or if the conveyor or cooling system shuts down.

2.8.2 Interlock drive motors to shut down on detection of overload, over-current condition, or if the conveyor slows down more than 20%. Interlock contributing conveyors so no operating conveyor can discharge material to a stopped downstream conveyor.

2.8.3 Provide a conveyor belt alignment interlock for all styles of conveyors (horizontal, inclined, vertical bucket conveyors, etc.) to automatically shut down the conveyor upon misalignment detection.

2.8.4 Use the FM Hot Work Permit System for all hot work activities near conveyors. Refer to 10-3, *Hot Work Management*, for further details.

2.8.5 Prohibit smoking around all combustible conveyors or conveyors that transport combustible material.

2.8.6 Protect and arrange gas-fired space heaters in conveyor systems.

2.8.7 Arrange electrical equipment in conveyor systems handling combustible dusts as recommended in Data Sheet 5-1, *Electrical Equipment in Hazardous Locations*, or appropriate jurisdictional electrical codes for hazardous locations.

2.8.8 When the material being conveyed is combustible, install magnetic tramp metal separators at rail car and truck dump hoppers and on conveyors ahead of grinding or pulverizing operations.

2.9 Contingency Planning

2.9.1 Equipment Contingency Planning

When a conveyor breakdown would result in an unplanned outage to site processes and systems considered key to the continuity of operations, develop and maintain a documented, viable equipment contingency plan per Operating Standard 9-0, *Asset Integrity*. See Appendix C of that data sheet for guidance on the process of developing and maintaining a viable equipment contingency plan. Also refer to sparing, rental, and redundant equipment mitigation strategy guidance in that data sheet.

In addition, include repair of the longest conveyor on site in the conveyor contingency planning process, taking into consideration the availability of belting to restore the conveyor to service in the event of a breakdown.

2.9.2 Sparing

Sparing can be a mitigation strategy to reduce the downtime caused by a conveyor breakdown depending on the type, compatibility, availability, fitness for the intended service, and viability of the sparing. For general sparing guidance, see Data Sheet 9-0, *Asset Integrity*.

2.9.2.1 Routine Spares

Routine conveyor spares are spares that are considered to be consumables. These spares are expected to be put into service under normal operating conditions over the course of the life of the conveyor, but not reduce equipment downtime in the event of a breakdown. This can include sparing recommended by the original equipment manufacturer. See Section 3.4 for routine spare guidance.

3.0 SUPPORT FOR RECOMMENDATIONS

3.1 Belt Flammability

3.1.1 General

Although the conveyed product and the structure may be noncombustible, loss history demonstrates that the conveyor itself presents sufficient combustible loading to spread the fire without other fuel contributions.

Conveyors are manufactured of natural and synthetic rubber or plastic, such as polyvinyl chloride (PVC), acetyl, polyethylene, polypropylene, and nylon. They are often reinforced with fibers for strength. Outdoor conveyors usually are formed in laminated layers and may have, for example, a PVC base for flexibility with a rubber top layer to allow for product adhesion under incline conditions.

Conveyors, whether made of natural or synthetic rubber or plastics, are generally assumed to be capable of self-sustained fire propagation whether or not other combustibles are present. For this reason, automatic sprinkler protection has been recommended for most installations regardless of the conveyor material's claimed fire or flame retardancy, or of the combustibility of the materials conveyed. The use of fire-retardant conveyors is encouraged. They are typically harder to ignite when exposed to a low-energy ignition source, thereby reducing the frequency of fire.

3.2 Major Factors Affecting the Need for Fire Protection

Major factors influencing the need for special fire protection for conveyors are as follows:

A. The conveyor itself provides sufficient combustible loading to spread a fire. Major fires have spread on conveyors as narrow as 2 ft (0.6 m) wide and on systems carrying noncombustible materials such as limestone, iron ore, and metal cans.

B. While not as common as single-tier systems, multiple-tier arrangements present greater vertical combustible loading as well as a more favorable burning configuration than single-tier systems. A tier is defined as the feed and return layers of the conveyor. A single-tier system has two horizontal layers of belting stacked vertically; a two-tier system has four horizontal layers of belting stacked vertically.

C. Conveyors emit dense, black, toxic smoke when ignited. This smoke can severely hamper manual firefighting in underground or totally enclosed systems where entry and means of heat venting are limited.

D. Ventilation (air flow) within a sprinklered tunnel or gallery does not appear to influence fire spread to a great degree. FM conducted air-flow studies over conveyors in coal mines to test detector sensitivity. These tests were correlated to sprinkler operation after detection by computer simulation.

E. Fire service response may be delayed because many conveyors are in unoccupied areas. Fires occurring without automatic fire protection can be expected to be well-developed by the time they are detected and the fire service arrives.

F. Accessibility and openness of the system directly influence fire spread, severity, ease of manual response, and damage. A fully enclosed system will not allow heat to be released or hose streams to be introduced from outside the conveyor system. Firefighters cannot physically fight the fire except from the ends of the conveyor, and often dense smoke prevents effective response. A firefighting team will rarely enter an enclosed conveyor system. All of these factors combine to permit a free-burn fire that will spread rapidly with very high heat release and expose the steel structure. If this occurs, the entire structure can sag, cantilever, or collapse. Alternatively, an open or partially enclosed system will allow heat to escape and hose streams to penetrate the fire plume. Damage can be significantly less, with structural collapse much less likely.

G. Height of the conveyor above grade influences accessibility; incline influences the rate of fire spread. In general, galleries or towers more than 40 ft (12.2 m) above grade should be considered inaccessible for manual firefighting, even with substantial openings for hose stream penetration. Inclines of more than 30% allow for a faster spreading flame front.

H. Unprotected interior exposed steel or combustible support framing on an elevated, totally enclosed structure can lead to collapse of the entire elevated portion during a fire.

I. Intermediate buildings, such as transfer, splice, and tensioner houses, present the same hazard as tunnels or elevated galleries of similar construction and accessibility. The presence of motorized drive equipment and more frequent personnel activities in these buildings creates more frequent ignition sources.

An explosion hazard may also exist in a conveyor system used to handle materials that can generate combustible dust (e.g., sulfur, coal, various grains). A small initial dust explosion can trigger secondary dust explosions that can propagate the entire length of tunnels or galleries. Fires originating at conveyors have been the ignition sources for dust explosions in the grain industry and at coal-mining facilities.

Other exposures to conveyors include impact damage from mobile equipment, collapse, and longitudinal ripping from sharp objects. Conveyors that have become separated have been known to slide down elevated galleries or tunnels, causing impact damage and presenting a challenge to cleanup operations.

3.3 Importance of Housekeeping

Conveyed material accumulation may occur due to spillage, carryback or airborne suspension of dust. Conducting frequent inspections helps to identify what and how much material is accumulating over time, so that the accumulation can be addressed before it becomes a problem. A proper housekeeping program reduces the likelihood of ignition and limits the potential for structural overload of elevated conveyors or conveyor galleries that could lead to collapse.

3.4 Manual Firefighting

Manual firefighting can be challenging when it comes to conveyor systems. That is why the best form of protection is automatic sprinklers with interlocks to shut the conveyor system down. If automatic sprinklers and interlocks are not installed, the following challenges must be overcome:

- Fully enclosed conveyors
- Elevated conveyors

- Access to water supply
- Conveyors moving the fire to other locations

Enclosures limit fire service response and their ability to get hose streams on burning surfaces such as belts and combustible conveyed materials. Enclosures also collect heat, increasing the potential for fire spread and structural damage.

Elevated conveyors and galleries present a challenge for fire service response, as an external attack or defensive action from grade becomes more difficult as height increases, especially in wind-prone areas. Additionally, responders are often advised not to conduct an internal attack on an elevated conveyor or gallery structure that has the belt intact, given the belt failure potential and release of stored energy in the tensioned belt (take-up pulley), as well as heat, smoke and collapse concerns.

Access to water to fight the fire is another challenge especially, for long overland conveyors or conveyors located in remote locations. Having a plan for how to provide the water can make a difference in manual firefighting efforts.

Conveyors are designed to transport materials and may be moving when a fire occurs. Various forms of detection are available, including linear heat detection, point detectors (both heat and smoke) and optical detectors, as well as sprinkler water flow that can be used to trigger an interlock to stop the conveyor belt. The longer a burning conveyor keeps moving, the more likely the fire will ignite combustibles located near the conveyor.

3.5 Loss History

A recent 10-year study of FM conveyor losses was reviewed. Details are provided in the following sections.

3.5.1 Indoor Conveyors

Table 3.5.1-1 shows indoor conveyor losses broken down by peril. It is clear that the majority of losses involving indoor conveyors are caused by fire: 78% by number and 98% by loss cost.

Table 3.5.1-1. Indoor Conveyor Losses by Peril

Peril	*Percentage by Frequency*	*Percentage by Loss Cost*
Fire	78%	98.5%
Mechanical breakdown	10%	0.7%
Miscellaneous	4%	0.6%
Water, liquid damage	2%	0.0%
Sprinkler leakage	2%	0.0%
Explosion	2%	0.2%
Smoke	2%	0.0%
Total	100%	100.0%

3.5.2 Illustrative Losses

3.5.2.1 Unsprinklered Can Plant with Combustible Plastic Dust Covers Over the Conveyor

The fire occurred in a plant that manufactures cans for the beverage industry. Equipment for can manufacture, such as the cupper, bodymaker, necker, washer, coater, and spray operations, as well as the palletizers for can packaging, were located on the ground floor. Transfer from one part of the process to another was by polypropylene, open grid conveyor. The conveyors were located on a mezzanine over the equipment. In some areas, the conveyors were stacked over one another due to the convergence of multiple production lines and processes. Due to customer requirements, plastic covers were installed over the conveyors to keep dust and other debris out of cans during production. The plastic covers increased the combustible loading.

Smoke detection was provided, but there was no automatic sprinkler protection. The practice for other divisions within this company was provision of automatic sprinkler protection at ceiling level and below mezzanines. In addition, metal covers were provided over conveyors.

It is believed the fire started on a conveyor from an overheated drive motor for the conveyor. Operators working on the main floor heard the alarm, shut down their equipment, and proceeded to the mezzanine to attempt to fight the fire with small hose and portable extinguishers. They were not able to get close enough to the conveyor to be effective due to the intense heat. Fire spread the length of the conveyor to other conveyors in the building and through unprotected wall openings. Conveyors in five buildings were involved before the fire was brought under control by the fire service.

3.5.2.2 Hot Work Above a Polypropylene Can Conveyor

A contractor was conducting hot work on a mezzanine above a polypropylene can conveyor that had a rigid plastic cover. He was using a welding blanket to catch sparks. A plant supervisor walking below the conveyor noticed a burning hole on the return side of the conveyor. He sounded an alarm and he and other plant personnel attacked the fire with extinguishers and small hoses. The fire spread to an adjacent conveyor that crossed over the conveyor of origin. Sprinklers at ceiling level operated; and after the fire service arrived, they were able to extinguish the fire using hose streams.

Thirty-two ceiling sprinklers operated. The conveyors initially involved suffered heavy damage, while much of the plastic belting and covers, aluminum framework, plastic guides and rollers, sprockets, and wiring was consumed or melted. Adjacent control panels suffered thermal damage. The surrounding area suffered nonthermal damage, requiring cleanup

The first two can lines initially involved were down for approximately three weeks. The next line was down for five days, with the two lines further away were down for three days.

3.5.2.3 Fire During Maintenance Outage

During a maintenance outage for one of two can lines, a torch was used to remove a bearing collar from a vertical transition conveyor. The heat from the torch ignited combustible deposits in the vacuum chamber that spread to the plastic vacuum conveyor. The fire watch spotted smoke from the blower discharge duct. The only access to the fire was from the top of the discharge duct. By the time the fire watch attempted to extinguish the fire from the top of the discharge duct with an extinguisher, flames were evident. The fire service was summoned and the plant was evacuated. After exhausting seven extinguishers, a water hose was directed into the top of the discharge duct. The fire service arrived and completed extinguishing the fire. No sprinklers operated. Smoke spread to the adjacent finished can warehouse, resulting in contamination of most of the stock. The plant production line was shut down for 8 hours and the restart of the line undergoing maintenance was down for an additional 9 hours.

3.5.2.4 Conveyor Shielded from Automatic Sprinkler Protection

The formation department of a battery manufacturing plant had 15 conveyor lines running parallel to each other. Each line was made up of four 100 ft (30.5 m) long conveyors, two conveyors vertically stacked above the other two, effectively shielding the two lower conveyors from sprinkler discharge. The conveyors supplied an “end” conveyor that ran perpendicular to the formation line conveyors. The fire occurred during an off shift period and was detected by a security guard, who called the fire service. The fire apparently started at the end of one of the formation line conveyors near the end conveyor.

Automatic sprinkler protection was provided at the 30 ft (9.1 m) high ceiling over the fire area. No sprinkler protection was provided below the upper conveyors. Twenty-four sprinklers opened during the fire, resulting in extensive water damage.

Both building and equipment were damaged. Equipment damage was over four times the building damage. It is believed the conveyors were a substantial part of the equipment damage. The end conveyor and 8 ft (2.4 m) sections of 12 of the 15 formation line conveyors required replacement. There was also damage to a mezzanine above the end conveyor and to motors and blowers on the mezzanine used to supply cooling air for battery manufacture. In addition, there was water damage to a number of hydraulic lift tables.

3.5.3 Outdoor Conveyors

Table 3.5.3-1 shows outdoor conveyor losses by peril. The majority of losses involving outdoor conveyors are caused by fire: 34% by frequency and 27% by loss cost.

Table 3.5.3-1. Outdoor Conveyor Losses by Peril

Peril	*Percentage by Frequency*	*Percentage by Loss Cost*
Collapse	11%	4%
Earthquake	2%	0%
Fire	34%	27%
Flood	4%	26%
Impact	2%	0.5%
Mechanical breakdown	14%	27%
Miscellaneous	9%	0.8%
Rigging	2%	0.3%
Wind and hail	23%	13%
Total	100%	100.0%

3.5.4 Illustrative Losses

3.5.4.1 Uncontrolled Fire in a Woodchip Conveyor

A fire began in a bark pile, probably due to spontaneous heating, at a large paper mill. The fire then spread over a large portion of the outside storage area, involving several wood chip piles. Several conveyor systems ran above the wood chip piles. With the aid of strong winds, the conveyors became involved in the fire and helped spread the blaze to several nearby buildings.

The conveyor system was protected by a manual deluge system, which personal activated once the alarm was raised. However, the conveyor systems were not interlocked to shut down on activation of the deluge system and continued to operate until manually shut down.

One of the buildings involved was the fresh-water treatment building. The loss of this building halted production until alternative arrangements could be put into place.

3.5.4.2 Unsprinklered Limestone Conveyor

Fire severely damaged 2400 ft (731 m) of a 3500 ft (1067 m) long inclined limestone conveyor at a copper refinery. The 48 in. (1.2 m) wide rubber conveyor ran in 8 X 8 ft (2.4 X 2.4 m) subgrade concrete tunnels and plank-on-steel frame elevated galleries supported on steel towers. Transfer and splice houses were present along the system, allowing for limited access every 400 to 500 ft (122 to 152 m). Sprinkler protection was not provided and hydrants were lacking along portions of the conveyor.

The fire originated at the lowest portion of the system and spread unchecked until a bulldozer was used to sever the conveyor housing immediately prior to its entrance into an unsprinklered, high-value concentrator building. The fire was so intense that concrete was spalled in tunnels and elevated housings, and their support towers collapsed. Production interruption was minimized by trucking product at extra expense.

3.5.4.3 Unsprinklered Iron Ore Conveyor

At an iron mine, iron ore was transported from a crusher building to a pelletizing building on a 1000 ft (304 m) long, 72 in. (1.8 m) wide rubber conveyor in a totally enclosed housing. The conveyor had a 27% pitch and, at its highest, was 90 ft (27.7 m) above grade. The initial 330 ft (100 m) was in a concrete subgrade tunnel, and the remaining elevated steel tube portion was supported on steel towers. Access to the conveyor tube was at either end or via a splice house near the center. The conveyor lacked internal sprinkler protection.

A fire caused by friction originated near the center of the elevated steel tube and spread unchecked up the remaining 300 ft (91 m), where it was finally stopped by manual efforts. Damage to the structure and conveyor was severe. The entire pelletizing operation was shut down for about five weeks.

3.5.4.4 Unsprinklered Grain Elevator

Horizontal-and bucket-elevated conveyors were used to transport corn from trucks to cleaning facilities and then to storage silos. Major horizontal systems were located in concrete rooms above (gallery) and below (tunnel) the silos, and in various levels on the head house.

During an unattended period, an arsonist started multiple fires in the conveyor systems. Fires consumed many conveyors, and manual firefighting efforts were hampered by dense smoke, poor accessibility, and the potential of exploding dust. Although minor “puffs” were reported, a major explosion did not occur. Automatic sprinklers were recommended in key conveyor areas following the fire.

3.5.4.5 Belt-Ripping Loss

A sharp tool similar to a crowbar accidentally entered a conveying system feeding coal to an electric generating station. It lodged in a transfer chute and jammed against the center of a 48 in. (1.2 m) wide rubber conveyor. More than 23,000 linear feet (7,010 m) of belting was split in two. Major interruption to production was averted by trucking coal to the plant.

3.6 Routine Spares

The following are common routine spares for conveyors (depending on the type of conveyor). Store and maintain the routine spares per original equipment manufacturer recommendations to maintain viability. Refer to Data Sheet 9-0 for additional guidance.

- Sections of belting for repairs
- Drive motors and drive system components
- Drive pulleys and drums
- Gears and bearings
- Rollers
- Buckets
- Specialty cleating and fixtures

4.0 REFERENCES

4.1 FM

Data Sheet 1-44, *Damage-Limiting Construction*
Data Sheet 1-54, *Roof Loads and Drainage*
Data Sheet 1-57, *Plastics in Construction*
Data Sheet 4-5, *Portable Extinguishers*
Data Sheet 5-1, *Electrical Equipment in Hazardous Locations*
Data Sheet 5-31, *Cables and Bus Bars*
Data Sheet 7-12, *Mining and Mineral Processing*
Data Sheet 7-76, *Combustible Dusts*
Data Sheet 9-0, *Asset Integrity*
Data Sheet 10-1, *Pre-Incident and Emergency Response Planning*
Data Sheet 10-3, *Hot Work Management*

4.2 Other

ASTM International. *Standard Test Methods for Measurements of Synthetic Polymer Material Flammability Using a Fire Propagation Apparatus (FPA)*. ASTM E2058.

APPENDIX A GLOSSARY OF TERMS

Conveyor: A medium to transport goods or products, including rubber belts, plastic meshes, and synthetic materials.

Conveyor assembly: The structure that supports the conveyor (e.g., the frame or gallery of an elevated conveyor).

Conveyor cover: The structure covering the conveyor, forming either a partial or total enclosure around the conveyor.

Conveyor gallery: A structure surrounding an elevated conveyor (or conveyors) and any accompanying walkway. Galleries are either of truss or tubular construction, and they may be open, partially enclosed or totally enclosed.

Conveyor system: The combined components, including the conveyor, conveyor assembly, and conveyor housing.

Critical conveyor: A conveyor that moves essential material for production where an alternative means to transport the material does not exist. A critical conveyor is typically responsible for a significant percentage of site production.

Elevated conveyor: A conveyor system with a structure supporting the conveyor frame stands and idlers, as well as any associated pulleys and drive. Galleries are elevated conveyor structures, but not all elevated conveyors are galleries. A non-gallery overhead conveyor structure runs underneath the conveyor frame in the form of a channel, I-beam, or truss construction while also supporting an optional adjacent walkway.

FM Approved: Products and services that have satisfied the criteria for FM Approval. Refer to the *Approval Guide* for a complete listing of products and services that are FM Approved.

Ignitable liquid: Any liquid or liquid mixture that is capable of fueling a fire, including flammable liquids, combustible liquids, inflammable liquids, or any other term for a liquid that will burn. An ignitable liquid is one that has a fire point.

Indoor conveyor: A conveyor system that is located within a building, excluding conveyor galleries. Indoor conveyors can be open, partially enclosed or totally enclosed.

Open conveyor: A conveyor with no housing or hood. An example is a cross-country system conveying products not susceptible to weather conditions, such as raw coal or limestone.

Outdoor conveyor: A conveyor system that is located outside and may be located sub-grade, at grade or above-grade. Outdoor conveyors can be open, partially enclosed or totally enclosed (i.e. a conveyor gallery).

Overland conveyor: A conveyor that transports material great distances (often miles) between loading and uloading stations.

Partially enclosed conveyor: Continuous openings exist along the sides or bottom of the gallery. A conveyor with a weather hood or one with no floor qualifies as partially enclosed. Rate of fire spread is less in a partially enclosed conveyor system because venting allows heat and dense smoke to escape. Continuous openings also allow for water penetration from external hoses, which limits fire spread and supplements internal sprinkler flow.

Plant conveyor: A conveyor that transports material onsite between buildings, process structures, silos or bins, bulk receiving or loadout stations, or piles. These conveyors may be several thousand feet long (several hundred meters).

Totally enclosed conveyor: A conveyor where the belt and any conveyed combustible material are completely surrounded by a cover, hood or gallery building envelop. The floor may or may not be open, but the other sides of the enclosure offer insufficient openings to allow hose streams to reach the belt and any other combustibles within. Enclosures can be a cover, hood or gallery with roof and full-height walls. Sub-grade tunnels and elevated or grade-level steel tubes are examples of totally enclosed systems.

APPENDIX B DOCUMENT REVISION HISTORY

The purpose of this appendix is to capture the changes that were made to this document each time it was published. Please note that section numbers refer specifically to those in the version published on the date shown (i.e., the section numbers are not always the same from version to version).

April 2025. Interim revision. Significant changes include:

A. Clarified the Scope in Section 1.0.

B. Consolidated and revised belt width guidance in Section 2.2.3.5, requiring sprinklers be installed beneath.

C. Clarified fire protection recommendations in Section 2.1.7 for conveyors entering a building or passing through a fire wall.

D. Added and highlighted guidance in Sections 2.3.1 and 2.3.2 for avoiding combustibles under outdoor conveyor systems.

E. Expanded housekeeping guidance in Section 2.3.2 to address the structural loading posed by conveyed material accumulations.

F. Clarified in Section 2.3 when fire protection is necessary for outdoor conveyors.

G. Removed captive conveyor terminology throughout.

H. Added inspection, testing and maintenance guidance in Section 2.7 for elevated conveyor and gallery structures.

I. Added guidance in Section 2.7 regarding process changes for elevated conveyor and gallery structures.

J. Defined different conveyor types in Appendix A.

January 2024. Interim revision. Minor editorial changes were made.

July 2023. Interim revision. Updated housekeeping guidance in Section 2.2.2.1.

July 2020. Interim revision. Updated contingency planning and sparing guidance.

July 2019. Interim revision. Major changes include the following:

A. Updated sprinkler protection guidelines for outdoor covered conveyors to reflect large-scale testing. This updated guidance is now contained in a new Table 3.

B. Clarified guidance relating to the appropriate use of sidewall and upright sprinklers.

C. Reinforced the importance of interlocking conveyors to shut down automatically (for all conveyor types).

D. Clarified guidance on obstructions to ceiling sprinklers caused by conveyors.

January 2017. Interim revision. Fire protection guidance for bucket elevators has been modified to refer to Data Sheet 7-76.

October 2015. The following changes have been made:

A. Reformatted document to group together recommendations on indoor conveyors and outdoor conveyors.

B. Clarified the recommendations for indoor conveyor protection (Section 2.1.3).

C. Revised Figure 1 to remove potential conflicts with recommendations in Section 2.2.3.1 regarding outdoor conveyor protection. The two key changes are the following:

1. Protection is recommended for all conveyors that are single tier and fully enclosed in a noncombustible enclosure.

2. Protection is recommended for multi-tier conveyors that are partially enclosed in noncombustible enclosures that are not elevated.

D. Added protection criteria for a single line of sprinklers protecting a conveyor in terms of minimum flow per sprinkler. The flow recommendation has increased from 18 gpm (67 L/min) to 25 gpm (95 L/min) to better address the surface fire hazard associated with conveyors.

E. Restructured the conveyor protection options into a table format. Table 2 lists protection options for indoor conveyors, and Table 3 lists options for outdoor and captive conveyors.

January 2012. Terminology related to ignitable liquids has been revised to provide increased clarity and consistency with regard to FM Global's loss prevention recommendations for ignitable liquid hazards.

October 2009. The following changes were made:

1. Added protection recommendations for indoor conveyor belts in manufacturing and warehouse settings.

2. Added protection requirements for serpentine (also called pipe) conveyors and air-supported conveyors.

3. Removed requirements for underground mines; these are covered in Data Sheet 7-12, *Mining and Ore Processing*.

4. Added protection recommendations for vertical bucket elevators.

January 2005. Clarification of protection needed for single conveyor systems, where barriers are located between supply and return belts, was made (Section 2.3.1.1).

September 2004. Minor editorial changes were done for this version.

Clarification was made in Section 3.2, Conveyor Belt Flammability.

January 2003. Minor editorial changes were done for this version.

January 2000. This revision of the document was reorganized to provide a consistent format.