

**Conveyor Equipment Manufacturers Association
(CEMA)**

Safety Best Practices Recommendation

CEMA SBP-003 (2018)

**Design and Application of Spill Guarding
for Unit Handling Conveyors**



**Provided as a service to the Conveying Industry by the
CEMA Engineering Conference**

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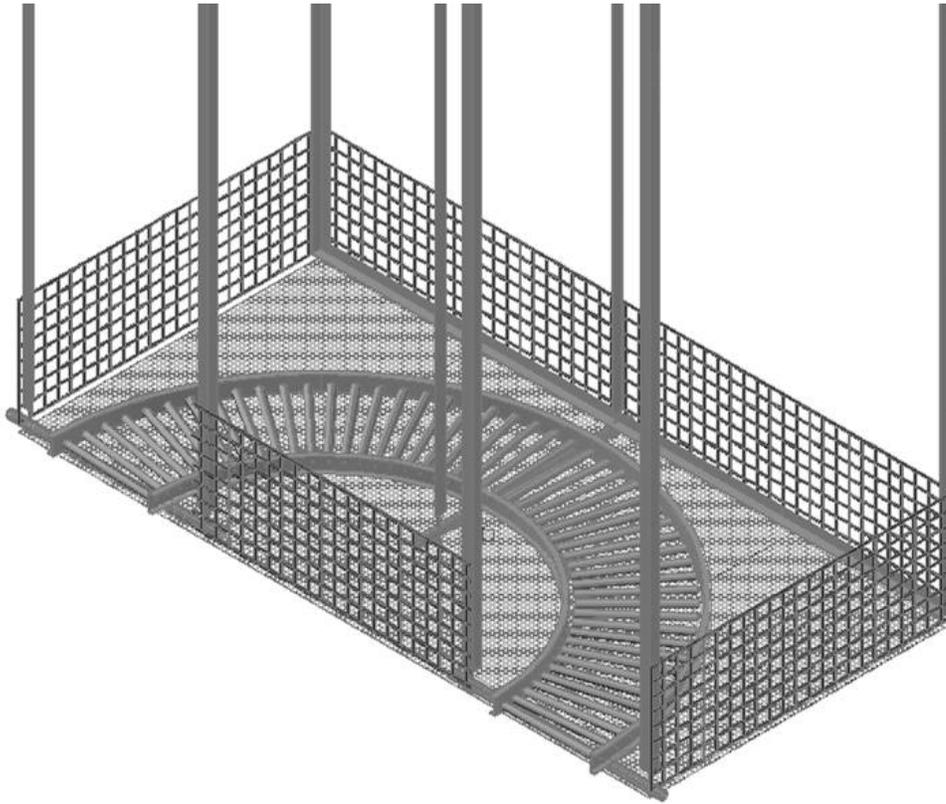
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Best Practices for Spill Guarding for Unit Handling Conveyors

1. Purpose

The purpose of this document is to outline a standardized approach to the selection and application of common guard rail, safety netting, and accessories used to contain loads (cartons and totes excluding stacked loads) transported on unit handling conveyors.

These approaches flow from the collective experience of the member companies of the Unit Handling Section of the Conveyor Equipment Manufacturers Association (CEMA). Their recommendations have been compiled herein to help ensure a safe operating environment for personnel working next to or below unit handling conveyors.



Figure 1 – Plastic Tote Pan

The types of loads being handled, and location of the conveyor equipment will affect the selection of containment devices. Particular attention must be given to overhead conveyors that pass over aisle ways and work zones. These areas usually require additional safe guards to protect personnel from falling objects caused by jamming loads. Plastic tote pans commonly used to transport loose items are especially vulnerable to jam induced ejection from the conveyor because of their tapered sides and low coefficient of friction.

Safety should always be the primary concern when determining the necessary precautions for any situation.

2. Definitions

The definitions of terms used within this standard will conform to those identified in ANSI/CEMA Standard No.102 “Conveyor Terms and Definitions” except as redefined within this section. Additional terms not currently found in ANSI/CEMA Standard No. 102 are defined here. The term guide or guard rail represents the same meaning in this document.

2/3 Rule – Rule of thumb adopted by the unit handling industry requires the height of *guard rail* to be at least 2/3 the height of the tallest load on the conveyor. This applies to conveying surfaces 8’ and higher above the floor except as determined by risk assessment.

Note: during the risk assessment, the height of the center-of-gravity must be taken into consideration to ensure 2/3rds is adequate

Factors that influence load stability and should be considered during a risk assessment:

- Center of gravity - In center of load or lower
- Weight
- Load form factor (shape)
- Loose straps, cord, tape, labels, excess glue, open flaps, irregular sides and bottoms
- Totes, cartons, trays draft and lips

Content spillage and minimum load height should be considered when a space is required between the bottom of the guard rail and the top of the side rail

2.1 *Adjustable Guard Rail* - Guard rail attached to the conveyor frame with adjustable mounting brackets that allow horizontal and vertical adjustment. Typically, available in single (one rail) or double high (two rail) configurations. (Figure 2)



Figure 2 – Adjustable Guard Rail

2.2 *Fixed Guard Rail* - Guard rail attached directly to the conveyor frame (no adjustment). Can be spaced up for photo eyes or load viewing. Available in high (channel) or low (angle) configurations. (Figures 3 and 4)



Figure 3 – High (Channel) Fixed Guard Rail (shown without spacers)



Figure 4 – Low (Angle) Fixed Guard Rail (shown with spacers)

2.3 *Safety Netting* - Nylon or wire mesh used to construct a screen guard for overhead conveyors. Can be hung from conveyor or overhead building structure.

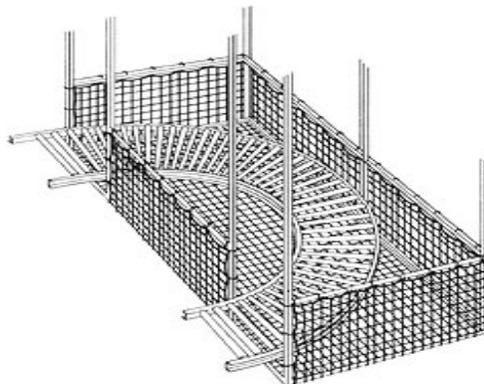


Figure 5 – Safety Netting

3. Human Factor Considerations

People and their observed tendencies are the reasons that CEMA has found it necessary to address this topic when dealing with netting. In operations areas where personnel are familiar with the conveying equipment, their duties and designated routes of travel have a propensity to shortcut the designated routes into non-designated areas. There is a great potential for abuse of the most basic safety rules. Temptations for personnel to shortcut designated routes often occur when traveling to or from break rooms, restrooms, ingress and egress to work stations, and adjacent work areas. Continuous analysis of worker requirements for movement and access in the conveyor operating areas is necessary. Proper application and training concerning the use of designated pathways throughout the operations areas is essential. Whenever changes or movement of equipment are made, an evaluation of the overhead equipment and whether safety netting is required, should be made. The application of netting at the needed locations, along with proper training in the use of designated pathways, can go a long way toward promoting workplace safety.

4. Design

The two most commonly used items to contain product on unit handling conveyors are guard rail and safety netting

- 4.1 *Guard Rail* - Guard rail is generally attached directly to the conveyor side frame and can be fixed position or adjustable
- 4.2 *Fixed Guard Rail* - Fixed guard rail can be low (angle type) or high (channel type). Low guard rail is generally used in loading or picking areas and is not recommended for overhead applications except in the case of inner lanes of multi-lane conveyor where safety netting is also used. High guard rail is recommended for all conveying surfaces 8'-0" and higher above the floor or platform. The guard rail height should be at least two thirds the height of the tallest load on the conveyor. This rule of thumb is commonly referred to as the 2/3 Rule. Loads with a high center of gravity may require higher guard rail to prevent spillage

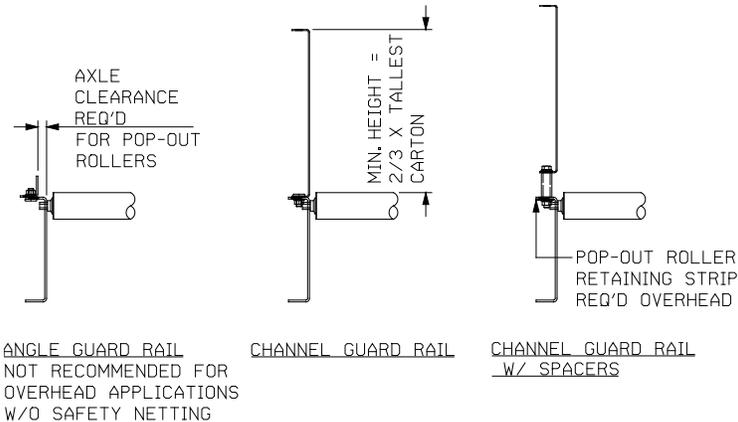


Figure 6 – Fixed Guard Rail

- 4.3 *Adjustable Guard Rail* - Adjustable guard rail can be adjusted both horizontally and vertically from the conveyor side frame for varying load widths and heights. Typically, the guard rail is clamped to support rods that in turn are clamped to the conveyor side frame. Adjustments are made by loosening the clamps, repositioning the guard rail or

support rods, and then re-tightening the clamps. Small channels in a single or double high configuration are generally used for adjustable guard rail. The guard rail(s) must be vertically positioned to contain the shortest and tallest loads on the conveyor. In some cases, it may be necessary to add a center guard rail to prevent certain loads from passing between the top and bottom guard rails

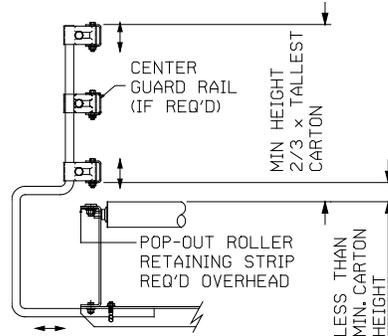


Figure 7 – Adjustable Guard Rail

4.4 *Safety Netting* - The application of safety netting must be evaluated for each specific area of a conveyor system. Careful consideration should be given for conveyors over worker access areas and walkways. A combination of high guard rail and safety netting may be required in these areas, particularly when there is a possibility for load jams on the conveyor. Spillage from load jams generally occurs when loads continue to be driven into a jammed or stopped condition downstream. Curves, spurs, transfers, and merge areas downstream of belt conveyors are particularly vulnerable to load jams and should be appropriately safeguarded against spillage (Figure 8). Load spillage presents a particular hazard to personnel around and below the affected area.

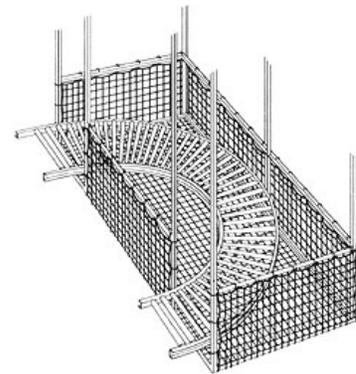


Figure 8 – Safety Netting

Netting systems should be designed with fireproof materials whenever possible. Common netting materials often used by manufacturers are as follows:

- Braided Nylon
- Polyethylene
- Wire
- Heavy gage construction grade plastic woven into a mesh pattern. Light gage plastic is not acceptable

Mesh Size	Material	Capacity	Cord Strength	Fire Retardant
1" x 1"	Nylon	1,000 ft-lb	190 lbs	X

4.5 *Load Size and Weight* - Netting must be able to withstand impact of the maximum load weight falling from the top of the guard rail to the netting elevation. Capacity value from catalog must be greater than the impact generated by the maximum load falling the maximum distance to the netting

$$\text{Capacity} > \text{Maximum Carton Weight} \times \text{Maximum Fall Distance}$$

4.6 *Netting Height* - The design must allow for sufficient space for several loads collecting in netting area. The height of the netting needs to be 2/3 the height of the tallest load which is often higher than the height of the guard rail.

4.7 *Mesh Size* – Net mesh size determined by the smallest item to be contained

Netting mesh size should be small enough not to allow loads or conveyor rollers to pass through the netting. Recommended mesh size is typically 1" x 1". This size will not allow any loose 1.9" diameter rollers to pass through the netting. Small items in totes or cartons need to be reviewed for ability to pass through netting mesh.

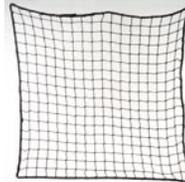


Figure 9 – Netting Mesh

4.8 *Spacing of Supports* – Spacing of supports for netting should minimize sag when loaded and allow for ample number of connection points to prevent failure of netting at maximum loading. Aircraft cable style mounting is recommended to distribute loading of netting at connection points. Connections should be made with snap hooks. The number and spacing of connections should be reviewed with netting manufacturers to obtain full strength of the netting

4.9 *Signage* – The safety netting system, including the netting and related hardware, is not designed to support personnel. Installations should provide signage warning personnel to keep off the safety netting. (Figure 10)



Figure 10 – Safety Sign Used in Netting Systems

4.10 *Design Considerations*

- Design the netting to support the heaviest product loads.
- Vertical netting can be used above the guard rail as an alternative to sheet metal
- Netting must be removable for cleanout
- Solid pans can be used for underguarding
- Avoid the sharp edge commonly produced by cutting plastic net
- When using plastic netting as under guarding as well a spill guarding consider that the plastic material can be deflected, allowing access to moving machinery. Minimize deflection by using fasteners at shorter intervals

5. Example Spill Guarding Configurations

These are not intended to exclude other methods

5.1 Single Line

- The space between conveyor side frame and netting must be equal to or greater than the conveyor between-frame (B.F.) dimension
- The vertical netting must extend above conveyor guard rail a minimum of $\frac{2}{3}$ the maximum load height

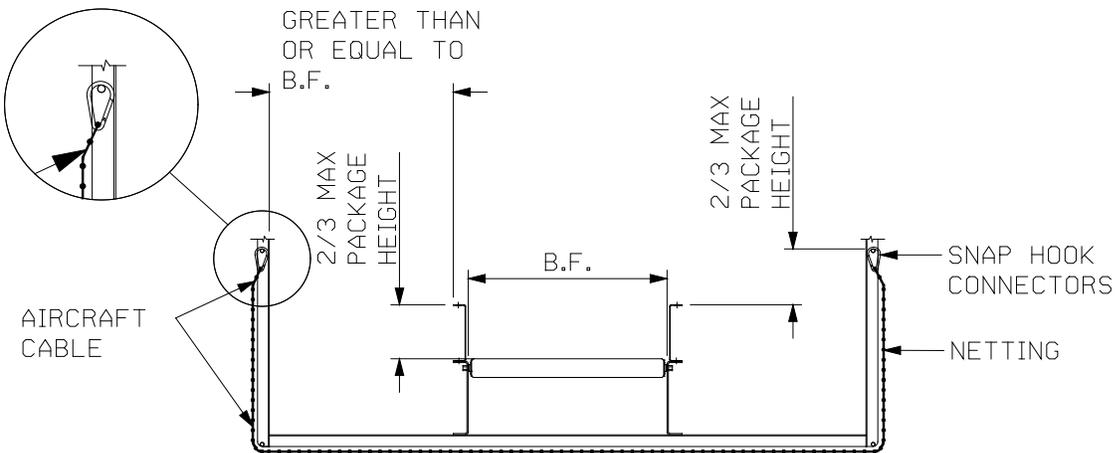


Figure 11 – Single Line Spill Guarding Configuration

5.2 Multiple Lines

- The spacing between parallel lines should be less than minimum load size
- The space between the conveyor outer side frame and the netting must be equal to or greater than the conveyor between-frame (B.F.) dimension
- The vertical netting must extend above the conveyor guard rail a minimum of $\frac{2}{3}$ the maximum load height

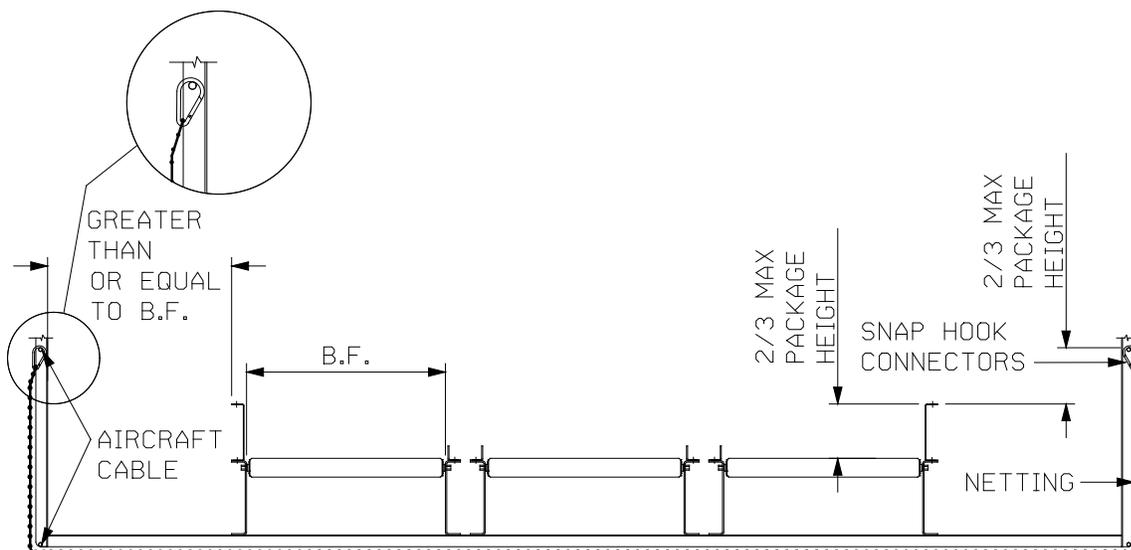


Figure 12 – Multiple Line Spill Guarding Configuration

5.3 *Lines Supported of Platforms* - A platform may serve as spill guarding if it properly protects areas below. Netting may be installed on the handrail to contain spilled loads

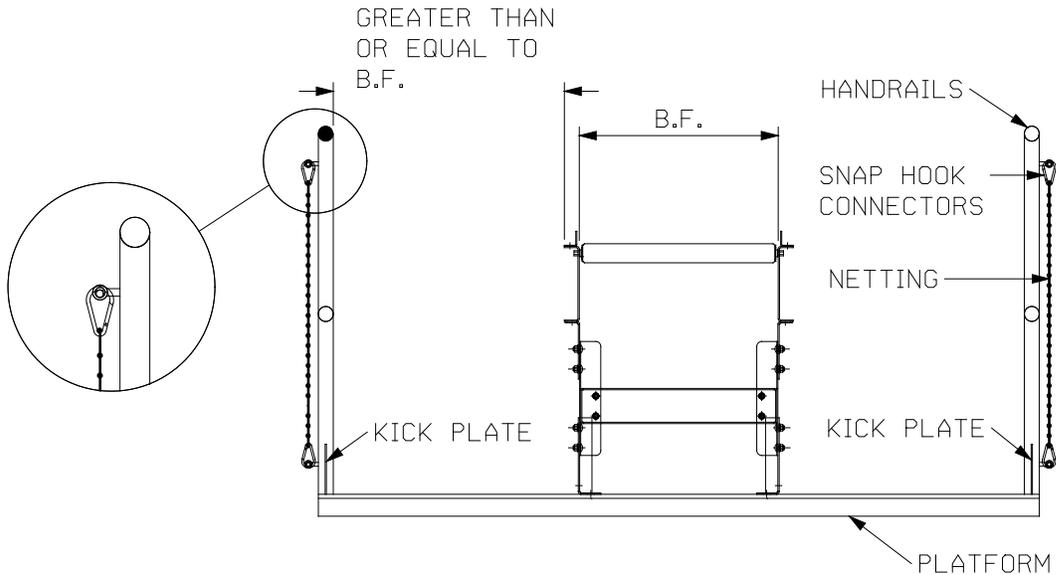


Figure 13 – Lines Supported on Platforms

5.4 *Lines Parallel to Catwalk* - A catwalk may serve as spill guarding if it properly protects areas below. Netting may be installed on the handrail to contain spilled loads

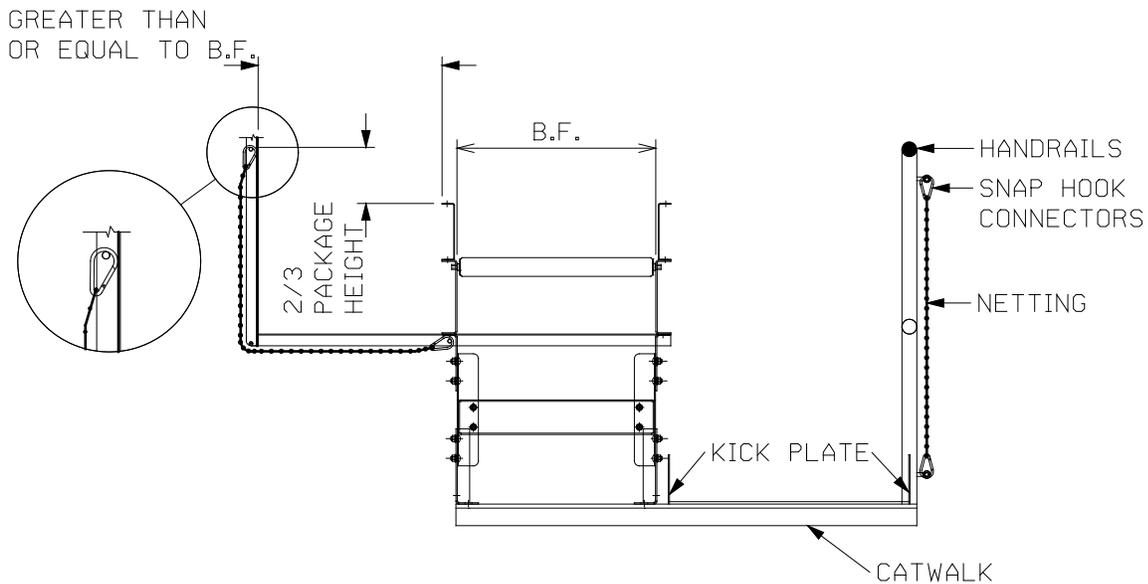


Figure 14 – Lines Parallel to Catwalks

5.5 *90° Transfers and Merges*

- Transfers and merges are more susceptible to load jams due to causes such as variation in load integrity, changes in direction of travel, and timing of conveyor equipment

- The volume of loads that can be collected in these areas must be considered in the design of the netting system. Use of jam detection devices in such areas is recommended in addition to spill guarding

5.6 *Testing*

1. Determine where the weakest area(s) of the spill guarding is located. (There may be several such points in the netting system.)
2. Assemble a test load that simulates the maximum carton or load to be handled by the conveyor equipment
3. Drop the load from the maximum height. Inspect the netting and connection points. The netting should return to its original shape. There must be no tears or fretting

6. Inspection/Maintenance

To avoid overloading the netting system, remove spilled product immediately and inspect for damage to the netting system. Yearly inspections are necessary. Inspect all cabling and fasteners to make sure they are tight and secure. Inspections are also required any time work is performed in the area that requires removing or modifying the netting. Particular attention is required if welding or grinding is performed in the area.