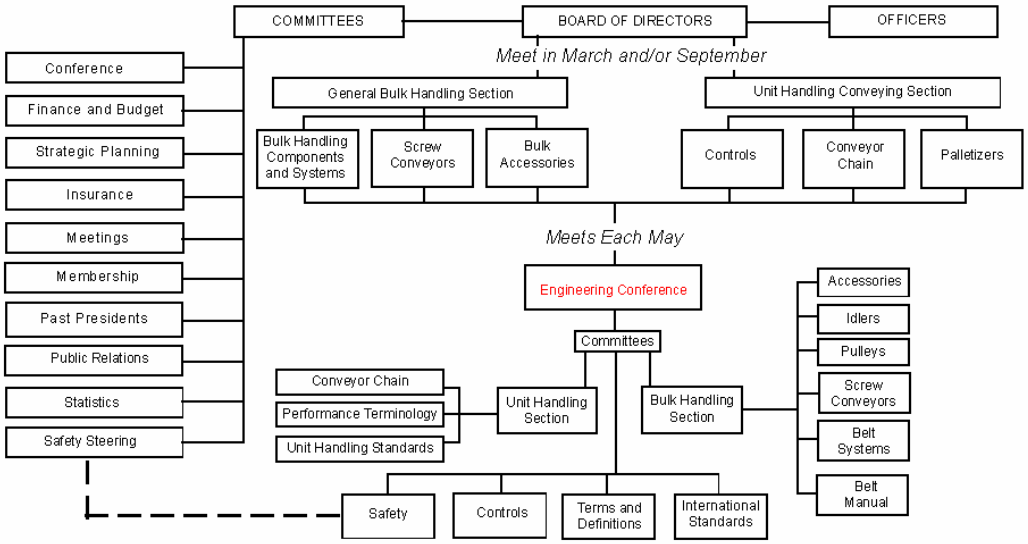
Conveyor Equipment Manufacturers Association (CEMA)

Safety Best Practices Recommendation CEMA SBP-001 (2004)

Design and Safe Application of Conveyor Crossovers for Unit Handling Conveyors

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

CEMA ORGANIZATIONAL CHART



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SAFETY NOTICE

The Conveyor Equipment Manufacturers Association has developed Industry Standard Safety Labels for use on the conveying equipment of its member companies.

The purpose of the labels is to identify common and uncommon hazards, conditions, and unsafe practices which can injure, or cause the death of, the unwary or inattentive person who is working at or around conveying equipment.

The labels are available for sale to member companies and non-member companies.

A full description of the labels, their purpose, and guidelines on where to place the labels on typical equipment, has been published in CEMA's *Safety Label Brochure* No. 201. The Brochure is available for purchase by members and non-members of the Association. Safety Labels and Safety Label Placement Guidelines, originally published in the Brochure, are also available free on the CEMA Web Site at http://www.cemanet.org/safety/

PLEASE NOTE: Should any of the safety labels supplied by the equipment manufacturer become unreadable for any reason, the equipment USER is then responsible for replacement and location of these safety labels.

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Design and Safe Application of Conveyor Crossovers for Unit Handling Conveyors

A. PURPOSE

The purpose of this document is to outline a standardized approach to the devices and items routinely provided to allow personnel to cross unit handling material handling conveyors used in a typical warehouse or manufacturing facility.

These approaches flow from the collective experience of the member companies of the Unit Handling Section of the Conveyor Equipment Manufactures Association (CEMA). They have been collected herein in to offer considerations for selection and use of crossovers as one means of creating a safer operating environment for people working with unit handling conveyor systems.

Specific conditions will vary from application to application, as will the purposes and experience level of the personnel expected to use the crossovers. These varying conditions, purposes, and experience levels will affect the selection of the type and design of the equipment provided in any given situation.

The interests of practicality, utility, and safety are of prime concern in evaluating any proposed design.

B. DEFINITIONS

The definitions of terms used within this standard will conform to those identified in *CEMA Standard #102* "Conveyor Terms and Definitions", except as re-defined within this section. Additional terms not currently found in *CEMA 102* are be defined here.

Conveyor Crossover - A device used to allow personnel to cross conveyors at designated and approved locations.

Fill in Plates - Closely fitted plates positioned between the rollers, wheels or chains of powered or non-powered conveyors. These plates may be intended to be used as portions of a walk way, to provide a "steadying"/"resting" place, and or to prevent access to potential injury producing catch points.

Ladder Crossover - A conveyor crossing device consisting of one or more ladders with support railings and, possibly, a platform that traverses the conveyor path. (See types 1 & 3)

Landing - A step or platform intended to allow someone to stand at that location while resting or waiting for a passage way to clear.

Ship's Stair - A stairway equipped with treads and stair rails with a slope of 50 to 70 degrees. It is sometimes referred to as a "ship's ladder".

Stair Crossover - A conveyor crossing device, with a slope of less than 50 degrees, consisting of one or more stair step assemblies which may be joined together across the conveying surface by railings or railings and a platform or walkway. (Type 2 and 4)

Step – to – Step Distance - The distance between two steps measured from trailing edge of the departure step to the leading edge of the arrival step.

Stile - A generic term used to denote any crossing or "passing" device, sometimes used to denote a conveyor crossover.

C. HUMAN FACTOR CONSIDERATIONS

People and their observed tendencies are the reason that CEMA has found it necessary to address the need for crossovers. In operations areas where personnel are familiar with the conveying equipment, and their duties or routes of travel can require movement across conveyor paths, there is a great potential for abuse of the most basic safety rules. Temptations for these personnel to cross running and/or temporarily stopped conveyors are very strong. Experience has shown that accidents are inevitable under these conditions. Continuous analysis of worker requirements for movement and access in the conveyor operating areas is necessary. Proper application of crossovers at the "most needed" locations can go a long way towards promoting workplace safety when conditions would otherwise present the temptation to cross the conveyors in an unsafe manner.

D. GENERAL DESIGN PARAMETERS

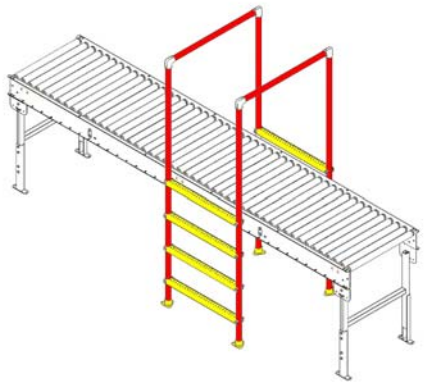
There are two different types of elevated conveyor crossovers commonly used in industrial applications. These are the ladder and stair types. Each of these can be sub categorized by whether they allow crossing at conveyor height, or provide for crossing at an elevation which clears both the conveying surface and the highest item expected to be conveyed. All four designs should be lagged to the floor for safety and stability.

When designing these crossovers, reference should be made, among others, to the following documents:

- *ANSI Standard A1264.1* - "Safety Requirements for Workplace Floor and Wall Openings, Stairs and Railing Systems" http://www.ansi.org
- *OSHA's 29 CFR Part 1910.24* - *"Fixed Industrial Stairs"* http://www.osha.gov
- *OSHA's 29CFR Part 29CFR Part 1910.*27 - "Fixed Ladders" http://www.osha.gov

CROSSOVERS AT CONVEYOR HEIGHT

Ladder - At conveying height (Type 1 Access Method)



This crossover typically uses vertical ladders on both sides of the conveyor, and hand rails (without middle rail) traversing the conveyor. An angled ships ladder may also be used. This type requires the least floor and over the conveyor space. It is also the easiest to install. The use of both hands is required while climbing the ladder and while crossing the conveyor. This type of crossover is typically used by trained personnel for access to maintenance and for other operational purposes.

Stair - At conveyor height (Type 2 Access Method)

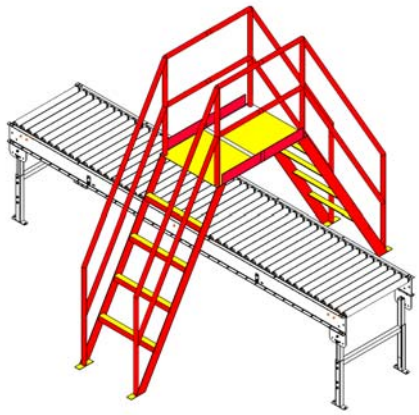
This type of stair crossover brings the walking surface height only up to the conveying surface height, or slightly above. There are routinely hand rails on one or both sides of both the stairs and the conveyor crossing area. The crossing area will usually not have an intermediate rail, allowing for clearance for the conveyable to pass under the hand rail.

This type of stair crossover improves on the vertical space requirements of the Type 3 (see below), but may not meet fire code egress requirements in all areas. These units can be applied in lower ceiling heights and head clearance areas than is possible with full decked crossovers. They are easier to build and apply, and can be more easily moved when there are changes in conveyor or personnel travel paths. This is the most convenient type of crossover to use, since often a package can easily be carried in one hand, and there are few steps to negotiate.

Personnel should be cautioned to cross only when conveyables are not present or immediately approaching on the conveyor. This is not unlike crossing the street or fork truck aisle, except the "traffic" is much slower, comes from only one direction, and the "pedestrian" has one or more hand rails available the entire way across. In some instances, there will be no opportunity to step on the conveyor surface. In these instances it will be necessary to step completely across the conveyor. On the wider (and some narrow) applications, surfaces suitable for walking or stepping will be provided. On a wide belt or slat conveyor, this will be accomplished by stopping the conveyor during passage and using the conveying surface itself as a walkway if necessary. In these instances, the control of the conveyor motion must be at the location of the passage. Those controls should be operated only by the person seeking passage.

CROSSOVERS ABOVE THE CONVEYOR

Ladder - Over the conveyable (Type 3 Access Method)



The most elaborate type of ladder crossover clears both the conveyor and the conveyable. This type has a ship's ladder (shown on the drawing) supporting both sides of a standard deck, with standard toe boards and railings. The ladders may be straight or angled as shown. If angled, there should also be hand rails on each side of the ladder for increased stability.

These crossovers save floor space over the stair type unit, while retaining the over the load capability.

The disadvantages of this type of crossover are the same as with the stair Type 4 (see below), except that ladders require both hands to use safely. Both take up a lot of vertical space to provide both adequate package clearance with the crossover deck, and head clearance with the building or other structure. Ladders require that personnel have both hands free. Disabled persons missing a limb or several fingers on the same hand will find it difficult to use this type of crossover.

Stair - Over the conveyable (Type 4 Access Method)

This type of crossover is one method of providing access for the public, and approved access to work stations for operational personnel. Such devices are routinely required to have a solid deck crossover with toe boards, standard stair treads, and standard hand railings on both sides of both the top deck and stairways. When used as part of an approved route of egress in case of fire, the width and strength of the structure must conform to the published requirements for the egress traffic expected for that location. This structure must also be of sufficient strength to support the maximum expected load safely.

The main disadvantages of this type of crossover are the vertical and horizontal space requirements and the limitations it places on the height of packages that can be conveyed beneath it. They are the less portable than the other three types of crossovers.

E. APPLICATION

The application of crossovers must be evaluated on an individual basis. There are many factors which must be considered and weighed against each other. General guidelines for application are these:

Full stairway over the conveyable type crossovers (Type 4) should be used when the general public is expected to be crossing the conveyor, or when operator work stations are using them as part of a primary route of egress. The units should be equipped with standard hand rails, decking, and toe boards. Stair tread and riser design should also conform to accepted standards. Strength and width requirements outlined in the appropriate industrial standards for egress should be observed.

Stair type crossovers at conveyor surface (Type 2) should be used in operations areas (where room permits), where items might be carried and where traffic may be light or occasional.

Ladder type crossovers above conveyor surface (Type 3) are appropriate where horizontal room is at a premium, and traffic is expected to be light. Non fire exit access by anyone who is able bodied is appropriate with this design.

Ladder type crossovers at conveyor surface (Type 1) are useful in operations areas where space is at a premium and traffic is expected to be occasional.

Ladder type crossovers are more appropriate when portability and floor space economy are factors. Personnel using the devices should always be familiar with the area and their use.

Ladder and stair type crossover designs without decking at or near conveyor heights are the most convenient. This is because the climbing requirement is reduced to a minimum. For this reason, they have the greatest capacity to reduce accident potential in many cases. In these situations, the step across distances, railings, conveyor type, and control of the conveyors must be carefully evaluated.

GENERAL APPLICATION GUIDE CHART

The following chart is a general application guideline for types of conveyors and associated crossover designs.

CROSSOVER SELECTION CHART						
Conveyor Type	**BELT**		**ROLLER**		**CHAIN**	
Step to Step Distance	**33" or Less**	**Greater Than 33"**	**33" or Less**	**Greater Than 33"**	**33" or Less**	**Greater Than 33"**
Type 1 Access	O - IAP	O - IAP	O - IAP	O - IAP	O - IAP	O - IAP
Type 1 Method	Step Across	Step on Stopped Belt	Step Across	Step On Plates	Step On Plates or Across	Step On Plates
Type 2 Access	O - E	O - E	O - E	O - E	O - E	O - E
Type 2 Method	Step Across	Step on Stopped Belt	Step Across	Step On Plates	Step Across	Step On Plates
Type 3 Access	P - E	P - E	P - E	P - E	P - E	P - E
Type 3 Method	Walk On Deck	Walk On Deck	Walk On Deck	Walk On Deck	Walk On Deck	Walk On Deck
Type 4 Access	P - E	P - E	P - E	P - E	P - E	P - E
Type 4 Method	Walk On Deck	Walk On Deck	Walk On Deck	Walk On Deck	Walk On Deck	Walk On Deck

Legend

O = Occasional = Not for heavy traffic or the only access to a work station.
P = Primary = Primary route of egress capable
IAP = Informed Authorized Personnel
E = Employee = Employee or others accompanied by an employee

Note – Be sure to consult state and local regulations before applying crossovers.
For instance, as of 2004, California OSHA (CALOSHA) does not allow the use of Type 1 and Type 2 crossovers.

F. MECHANICAL SAFETY CONSIDERATIONS

At conveyor level crossovers where the conveyor is wider than 33" an intermediate step plate or plates of some kind should be considered. This is often possible on roller and chain conveyors, but not on belt or slat type conveyors. The purpose of these step plates is to provide a solid intermediate point for personnel to step while crossing the conveyor. Such plates will necessarily be slightly below the conveying surface. Care should be taken that the top steps on either side of the conveyor are no more than a few inches above the conveyor surface in these instances.

Across the conveyor hand rails should be evaluated on an installation by installation basis when conveyor height crossovers are employed. In most instances a hand rail on each side of the travel path is the best option. When the conveyor is expected to be running when someone is crossing, the size and mass of the potential load should be evaluated with respect to potential injury involving the downstream hand rail. Stopping the conveyor while crossing is in process is also an option.

G. CONTROLS

Certain types of conveyors and conveying situations make it advisable to tie the conveyor control circuit into the conveyor crossing event. High speed conveyors, particularly those conveying heavy packages, should be considered for this option. Although the distance across the conveyor may be an easy step (33" or less) accidentally stepping on a running high speed conveyor may cause someone to loose their balance, even when holding two hand rails. For this reason, it might be advisable to provide a conveyor control switch on each side of the crossover to stop the conveyor prior to personnel crossing.

Other situations which warrant this measure are Belt and slat conveyors over 33" wide. On this equipment, crossing the conveyor requires a step where no step is possible. Stopping the conveyor provides that step.

Other situations which might indicate the need to shut down the conveyor prior to crossing would be solid, heavy bulky loads which might injure personnel. Another instance might be an expected very high number of loads moving on a wide conveyor, making finding a break to pass through "on the fly" difficult or impossible.

In all of these situations, the exact control sequence should be evaluated closely. Unexpected start-up of the conveyor while personnel are crossing is unacceptable. Any control scheme should be closely evaluated under every conceivable situation for this possibility.

To help determine the level of control and reliability for the control system, one should refer to *ISO 13849-1* "Safety of Machinery – 'Safety Related Parts of Control systems" Parts 1 and 100.

H. ADDITIONAL CONFIGURATIONS

Multiple Conveyors and Platforms

Where type 1 and 2 crossovers are utilized to cross multiple conveyors without returning to the walking/working surface, a landing or step of full width and minimum 8" deep will be provided between conveyors. Suitable rails or grab handles will be provided on both sides of the landing, if continuous hand rails across the conveyors and landings are not installed. Multiple conveyors separated by gaps greater than 12" will require that crossover railing systems comply with the kick plate and intermediate rail requirements of *OSHA 29CFR 1910.27* and *ASME A1264.1* if the elevation of the crossing surface exceeds 4'-0". Obviously, this is necessary only at the locations where the deck or step transverses the clear distance between the conveyors.

Ladder ways for ascending or descending to/from the conveyor elevation shall conform to the provisions of *OSHA 29CFR 1910.27* and *ASME A1264.1.*

Crossover ladder ways descending onto platforms which are 4'-0" or more above the next walking working surface shall employ one of the following fall arrest features:

- A landing extending at least 50" past the ladder base at right angles to the ladder rungs.

- An elevated backstop railing system such that a 50" or greater radius from vertical to horizontal radiating from the top step of the ladder will contact the backstop. Such backstop will conform to standard guard rail strength construction and strength requirements, except that there shall be no opening larger than 10" by 10". The backstop shall extend to 1'-6" or more to each side of the ladder width, and have a total width not less than 5'6". Structural members of the backstop shall conform to the 20" vertical by 8' maximum open hole dimensions of the hand rail design. Lesser members of suitable strength may be used to reduce the openings to 10" X 10"or smaller.

- A standard ladder cage as prescribed in *OSHA 29CFR 1910.27*

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