

Conveyor Equipment Manufacturers Association

(CEMA)

Safety Best Practices Recommendation

CEMA SBP-002 (2008)

E-Stop Application Guide

For

UNIT HANDLING CONVEYORS



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

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1.1 CEMA Emergency Stop (E-Stop) Application

1.1.1 Definitions

The following definitions are both specific to this document and generic to the material handling industry where such definitions can be found.

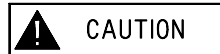
- E-Stop Purpose: To disable or stop any motion hazardous to personnel, equipment or product as quickly as is safe and practical.
- E-Stop Application Criteria: Required on equipment on which there is a reasonable potential for injury to personnel moving components or conveyables. The potential for injury from falling conveyables must also be considered.
- E-Stop Access: The rapid visual contact, recognition and physical accessibility of an E-Stop device for actuation.
- E-Stop Device: Any mushroom switch, cable-operated switch or other component that is an actuation point for the E-Stop function.
- E-Stop Panel: This is an independently powered relay cabinet that will not shut down if one or more of the interlocked control cabinets are shut down.
- Guarded by Location: Remoteness from regular or frequent presence of public or employed personnel. Also when hazards or other items are 8'- 0" or more vertically removed from a walking working surface.
- Lock-Out Device: Any approved device that can be used to lock out or block any or all potential energy sources, such as electrical, air, or kinetic, that might cause unexpected movement of machine components.
- E-Stop Interlocking: Where an E-Stop associated with one control cabinet will be required to initiate an E-Stop condition in another control cabinet/E-Stop zone, such as when two independent control areas have transportation conveyors running adjacent to each other en-route to a central merge.

NOTE For the purpose of this document, the term "conveyor" applies to all powered material handling equipment.

1.1.2 Objectives

The four bullet points following indicate objectives toward which we must strive in E-Stop application. Occasionally, these objectives must be tempered with the realities of practical application such as equipment density, equipment interfaces, and customer operational preferences. The first bullet point is the only one that must be achieved when specific situations are known to result in injury accidents.

- Prevent accidents that might result in injury to personnel, damage to equipment or damage to conveyables.
- Stop the motion quickly in the event that an accident has occurred.
- Stop all motion that may be observed from the point of actuation.
- Create as little disruption to system throughput as possible while providing a reasonable degree of protection from conveying anomalies.



Do not apply E-Stop equipment in a manner that might entice, encourage or otherwise facilitate unsafe practices.



Do not deviate from the established guidelines or standards without evaluating the safety of those changes in the specific situations considered.

1.1.3 General Application Rules for E-Stops

- An E-Stop must be provided at reasonable intervals consistent with equipment type and density, expected operational parameters, reasonable foreseeable misuse and training levels of personnel expected to be in the area.
- E-Stops are not properly configured to function as lockout devices, and must never be used for that purpose.
- E-Stop circuits must be hard wired and not depend on any solid state or logic devices to function. Approved networking systems may be employed provided any programming changes are indelibly recorded.
- E-Stop circuits, when activated, shall remove electrical energy directly from the power source or from the power source switching device.
- E-Stop circuits shall stop air or hydraulic powered devices by interrupting the power source in such a manner that subsequent motion due to kinetic energy or other means does not occur.
- E-Stop electrical devices and systems must be designed such that they require manual reset at the point of electrical actuation before a restart sequence can begin.
- Resetting the activated E-Stop device must not automatically restart the equipment. Equipment restart must be initiated by start controls of the associated control cabinet only after the activated E-Stop device has been manually reset, and begin only after the normal startup sequence including delays and warnings has occurred. Equipment interlocked with the associated cabinet will also restart (or not) per the

sequence of operation. No equipment will restart without appropriate warning and delay.

- Apply only those E-Stop devices and systems that meet accepted company, industry, engineering, and government standards for performance, appearance, and electrical design.
- E-Stop switches must be recognizable and distinct from any other controls:
 - The actuator of a pushbutton-operated device shall be of the palm or mushroom head type.
 - E-Stop pushbutton actuators shall be colored red.
 - Pull cords for pull cord switches should be provided in a high visibility color which allows rapid identification.
- E-Stop devices and systems, regardless of type, will effectively stop all motion in the controlled E-Stop zone.

1.1.4 Placement Rules for E-Stops

- Apply an approved E-Stop device mounted to or available nearby to all control cabinets on which there are external controls that stop, start or monitor conveyor operation.
- Apply E-Stops so that they control all conveyors viewable from where that E-Stop can be actuated, where practical.
- E-Stop devices are not required to be readily available to conveyors that are guarded by location, provided such or additional guarding can reasonably prevent contact with the conveyor and injury to personnel from falling conveyables.
- Apply an E-Stop at hazards that cannot otherwise be protected in a practical manner and are accessible by operators.
- Extend E-Stop cords to accessible areas where practical, unless additional electrical devices would be needed.
- Maintain consistency when determining the functions, locations, arrangements, labeling, and appearance of emergency stop system cords and switches within the same installation wherever possible.
- Apply an E-Stop within an unobstructed travel distance of 100 ft. of any portion of a conveyor where access is restricted to maintenance personnel or operators with special training for functions that require them to be there. An exception to this requirement is if the conveyors and conveyables likely to be present do not have the capacity to produce injury as installed or are guarded by location.
- Apply an E-Stop within reach of any designated work station that directly interfaces with powered conveyors.

- Apply an E-Stop within 25 feet for any general duty powered conveyor with general operator access.
- For Bulk Conveyors apply pull cord E-Stops on all sides of belt feeders and belt conveyors normally accessible from walkways, floors, or platforms.

1.1.5 E-Stop Interlocking

E-Stop interlocking applies to situations where an E-Stop device associated with one control cabinet will be required to initiate an E-Stop condition in another control cabinet/E-Stop zone. For example, this occurs when two independent control areas have transportation conveyors running adjacent to each other en route to the central merge.

- Provide interlocks between independent control sections as specified in 1.1.4, last two bullet points.
- Provide E-Stop interlock capability for third party equipment expected to be in the area.
- Interlocks should be provided between independent OEM equipment controls as specified in paragraph 1.1.4, last two bullet points.

E-Stop interlocking is typically accomplished via one of the methods listed below:

- One or more E-Stop relays in each cabinet with contacts wired to other cabinets for interlocking on a zone-to-zone basis.
- Single E-Stop device: A single E-Stop device being interlocked to another area can be equipped with a double set of isolated contacts: one set for each control cabinet/E-Stop zone.
- Multiple E-Stop devices: When one or more independently powered E-Stop devices must be interlocked to one or more additional cabinets, an E-Stop panel may be employed to avoid an unnecessary shutdown of interlocked cabinets.

Operation of interlocked E-Stop zones is as follows:

- The cabinet associated with the actuated E-Stop device will comply with all rules specified in paragraph 1.1.3.
- The interlocked cabinet E-Stopped zone works as follows:
 - When the remote E-Stop device is actuated, the interlocked cabinet/E-Stop zone immediately goes into an E-Stopped condition.
 - Recommend that the E-Stop indicator on the interlocked control cabinet will blink, indicating that

the E-Stop condition is remote from that controlled area.

- When the E-Stop device is reset and the associated control cabinet is restarted, the interlocked cabinet/E-Stop zone may restart after a five- second audible alarm. No physical reset in the interlocked cabinet is required.

1.1.6 Typical Areas for E-Stop Application

Here are some typical areas and types of equipment where E-Stops would or could be applied. This section is not intended to be a complete listing of where E-Stops are to be applied, nor does it mandate that E-Stops be applied in all the situations listed.

- Pick modules, picking conveyors
 - Conveyor: Cords along the entire accessible length.
 - Gates: None if non-powered or fall under the low power exception as described in ASME B-15.1.
 - Accessible feed and take away conveyors unless they are within 25' of an E-Stop actuating device.
- General duty conveyors with operator access: Follow distance requirements in paragraph 1.1.4 for the following:
 - Belt conveyor
 - Live roller conveyor (including lineshaft driven and accumulation conveyors)
 - Transfers
 - Transportation corridors
- Merges:
 - Central (large): Pull cord protection where generally accessible
 - Remote (mini): Mushroom switch or pull cord within 25 feet
 - Alligators (pivot belts): Mushroom switch or pull cord where readily accessible
- Induction: Cord along accessible length
- Sorters:
 - Slat: Cord along accessible length
 - Tube: Cord along accessible length

- Pop-up wheel or roller: Cord along accessible length
 - Isolated diverters: Require individual evaluation based on access
- Trailer loaders and unloaders:
 - Control station mushroom switch at the end of a decline or incline
 - Interlock loader/unloader to feed/takeaway conveyor and other visible conveyors
- Pallet Conveyor:
 - Roller transport: or accumulation conveyors. Cord protection or within 25 ft if generally accessible
 - Chain: Cord protection on all generally accessible areas
 - Lifts: Cord protected if generally accessible; button or cord protection within sight if not accessible
 - Transfers: Cord protected if generally accessible; button or cord protection within sight if not accessible
- Automatic Storage and Retrieval Cranes: At control station
- Transfer Cars: At control station and accessible area within 25 ft. of any accessible location where motion could occur
- Robots, Overhead cranes: Per manufacturer's and RIA Recommendations
- Miscellaneous, "Third-party", such as those components listed below, the denser coverage of: manufacturer's recommendations or per these specifications if the supplier integrates the equipment. Individual installations are to be evaluated for additional needs.
 - Scales
 - Label print & appliers
 - Stretch wrappers
 - Depalletizers
 - Palletizers
 - Strappers/tapers
 - Compacters
 - Those conveyors where moving surfaces and general arrangements qualify under the low energy exception in ASME B-15.1 para 1.3.1 need not be provided with access to E-Stop devices. A risk assessment (formal or otherwise) must verify that

the application creates no hazard from falling products.

1.1.7 Special Applications or Areas

In areas and applications where the preceding rules do not appear to apply, such as the following, the situation should be analyzed and qualified by an appropriate risk analysis:

- Hazardous special equipment
- Unusual controls configurations
- Special operational factors
- Sub-standard training levels of personnel with access to the area

1.1.8 References

- ASME B-15.1 Safety Standard for Mechanical Power Transmission Apparatus
- ASME B-20.1 Safety Standard for Conveyors and Related Equipment
- ASME B-30.13 Storage/Retrieval (SR) Machines and Associated Equipment
- RIA R15.06 Industrial Robots and Robot Systems
- OSHA 29CFR 1910.147 Lockout/Tagout

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