

Australian/New Zealand Standard™

Safety of machinery

**Part 3612: Conveyors—Chain
conveyors and unit handling conveyors**



AS/NZS 4024.3612:2015

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Australian/New Zealand Standard™

Safety of machinery

Part 3612: Conveyors—Chain conveyors and unit handling conveyors

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee SF-041, Safety of Machinery, to supersede (in part) AS 1755—2000, *Conveyors—Safety requirements*.

The objective of this Standard is to provide guidance and clarity in applying the principles articulated in the AS 4024.1 series of Standards to conveyors and to protect workers and other persons against harm to their health, safety and welfare through the elimination or minimisation of lifecycle risks associated with conveyor systems.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the appendices to which they apply. A ‘normative’ appendix is an integral part of a Standard, whereas an ‘informative’ appendix is for information and guidance only.

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Australian/New Zealand Standard
Safety of machinery**Part 3612: Conveyors—Chain conveyors and unit handling conveyors**

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard sets out minimum lifecycle safety requirements for chain conveyors and unit handling conveyors, which are in addition to the general requirements of AS/NZS 4024.3610. It also contains requirements for systems comprising multiple conveyors. It specifies requirements for people who design/modify, manufacture, supply, install, commission, operate, maintain or dismantle chain conveyors and unit handling conveyors.

This Standard does not apply to bulk materials handling belt conveyors, which are covered by AS/NZS 4024.3611.

This Standard includes requirements for users and providers of inspection, maintenance, training and the implementation of safe work practices for such equipment. Particular emphasis is given to operational safety and the protection afforded to operators, maintenance personnel or other persons who may be exposed to risks to health and safety associated with conveyors.

The following types of conveyors are covered:

- (a) Apron.
- (b) Barrel or drum.
- (c) Bucket.
- (d) Chain.
- (e) Cross-bar.
- (f) Pocket.
- (g) Plate.
- (h) Truck towing.
- (i) Powered roller.
- (j) Slat.
- (k) Twin flat top.
- (l) Trolley.

This Standard excludes the following:

- (i) Platform elevators/lifts.
- (ii) Moving stairways.
- (iii) Moving walkways.
- (iv) Conveyors specifically designed for the conveyance of people.

- (v) Materials hoists.
- (vi) Conveying of material by fluids, e.g. slurries, powder.

1.2 APPLICATION

This Standard specifies additional requirements for chain conveyors and unit handling conveyors that supplement and shall be applied in conjunction with the general requirements of AS/NZS 4024.3610. Where this Standard and AS/NZS 4024.3610 cover the same scope, this Standard shall take precedence.

Conveyors shall comply with relevant parts of each section. For example, unit handling chain conveyors shall comply with the relevant clauses from Sections 1, 2 and 4.

1.3 REFERENCED DOCUMENTS

A list of the documents referred to in this Standard is given in Appendix A.

1.4 DEFINITIONS

For the purpose of this Standard, the definitions given in AS/NZS 4024.3610 and the following apply.

1.4.1 Accessible area

Any area which is accessible or reachable without opening a guard or activating a protective device.

NOTE: A person may reach up to 2.7 m.

1.4.2 Backstop

A mechanical device to prevent reversal of a loaded conveyor under action of gravity when forward travel is interrupted.

NOTE: A backstop is a type of anti-runaway device.

1.4.3 Carrying element

Parts of a conveyor that carry the loads.

NOTE: Carrying elements can also be driving elements, e.g. the chain of a drag chain conveyor.

1.4.4 Conveyor types

Refer to examples of conveyors in Appendix B.

1.4.4.1 *Apron, slat conveyor, roller flight conveyor*

A conveyor with chains as driving elements and rods, battens, plates, or troughs as carrying elements for loads.

1.4.4.2 *Belt conveyor*

A conveyor with an endless belt acting as a carrying medium.

1.4.4.3 *Chain conveyor*

A conveyor that utilizes a powered continuous endless chain with either single or multiple strands.

1.4.4.4 *Chain-driven roller conveyor*

Conveyors which use a set of rollers for the carrying surface. The unit loads ride directly upon the roller surfaces, and the rollers are driven by chains and sprockets.

1.4.4.4.1 *Roller-to-roller conveyor*

A chain-driven roller conveyor in which power is transmitted from roller to adjacent roller via chain loops which are attached to the adjacent rollers, causing each to rotate. Two sprockets are required for each driven roller.

1.4.4.4.2 *Continuous chain conveyor*

A chain-driven roller conveyor driven by one continuous strand of chain, engaging a sprocket attached to each driven roller, causing the roller to rotate. One sprocket is required for each driven roller.

1.4.4.5 *Light duty belt conveyor*

A belt conveyor used for—

- (a) transport of unit loads (e.g. parcels, boxes, cans, containers, luggage, industrial goods of all kinds and foodstuffs); and
- (b) bulk materials applications indoors typically found in chemical, pharmaceutical, cosmetic, food and tobacco industry (see ISO 21183 series).

1.4.4.6 *Overhead conveyor*

A conveyor in which carrying elements are suspended overhead.

1.4.4.7 *Roller conveyor*

A series of rollers supported in a frame over which objects are advanced manually, by gravity, or by power.

1.4.4.8 *Self-propelled overhead conveyor*

An overhead conveyor with individually driven carrying elements.

1.4.4.9 *Slat conveyor*

A conveyor employing one or more endless chains to which slats are attached.

1.4.4.10 *Swing tray conveyor, fixed tray conveyor, bucket conveyor*

A conveyor in which the carrying element is attached to one or more chain strands that run in parallel or other driving elements.

1.4.5 *Curve (roller conveyor)*

A section of conveyor in the shape of an arc to change the horizontal direction.

NOTE: Curves may have either—

- (a) straight face rollers;
- (b) differential rollers; or
- (c) tapered rollers.

1.4.6 *Driven element*

Power driven parts of a conveyor which move the loads directly or indirectly.

1.4.7 *Drop section*

A diversion system for de-coupling trolleys from the driving chain.

1.4.8 *Grade (slope)*

- (a) The rate of incline or decline in terms of degrees from the horizontal.
- (b) Percent of rise to the horizontal distance.

1.4.9 Hold down

A wear-member located over the driving (top) side of chain and sprockets to prevent chain disengagement from the sprocket teeth.

1.4.10 Horizontal transfer device (diverter, sorter)

A unit positioned in the path of conveyors which diverts the unit loads at the same conveying level in a direction deviating from the original conveying direction, e.g. turntable.

1.4.11 Nose-over

Curved or segmented frame sections having rollers properly spaced to provide a transition from incline to horizontal or from horizontal to decline.

1.4.12 Pulleys

1.4.12.1 Pulley

A rotating element with tension applied which changes direction of the belt, chain or cable.

1.4.12.2 Snub (*snub roller*)

A pulley used to change the direction of the belt, chain or cable, usually less than 90°.

1.4.13 Reasonably practicable

That which is, or was at a particular time, reasonably able to be done to ensure health and safety, taking into account and weighing up all relevant matters including—

- (a) the likelihood of the hazard or the risk concerned occurring;
- (b) the degree of harm that might result from the hazard or the risk;
- (c) what the person concerned knows, or ought reasonably to know, about the hazard or risk, and ways of eliminating or minimizing the risk;
- (d) the availability and suitability of ways to eliminate or minimize the risk; and
- (e) after assessing the extent of the risk and the available ways of eliminating or minimizing the risk, the cost associated with available ways of eliminating or minimizing the risk, including whether the cost is grossly disproportionate to the risk.

NOTE: There are two elements to what is 'reasonably practicable'. First, consider what can be done, i.e. what is possible in the circumstances for ensuring health and safety. Then consider whether it is reasonable, in the circumstances to do all that is possible. This means that what can be done should be done unless it is reasonable in the circumstances to do something less.

For a full explanation of 'reasonably practicable', refer to 'Interpretive Guideline—Model Work Health and Safety Act—The Meaning of 'Reasonably Practicable' by SafeWork Australia.

1.4.14 Rollers

1.4.14.1 Carrying roller (*carrier roller*)

A series of rollers used to support a conveyed load.

1.4.14.2 Idler

A rotating element which provides support or guidance to belt, chain or cable.

1.4.14.3 Pressure roller

A series of rollers used for holding the driving belt in contact with the load carrier rollers in a belt driven live roller conveyor (see Figure 4.10).

1.4.14.4 Pop-out roller

A load-carrying roller mounted in such a manner as to pop out when foreign objects are introduced between the belt and the roller; usually located adjacent to the drive or tail pulleys (see Figure 1.1).

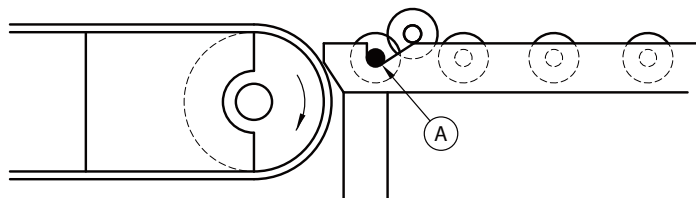


FIGURE 1.1 EXAMPLE OF POP-OUT ROLLER

1.4.14.5 Return roller

A roller supporting the return run of the conveyor drive belt.

1.4.14.6 Roller

A cylindrical member that rotates about its axis.

1.4.14.7 Static roller

Undriven roller used to carry a load on a unit handling conveyor.

1.4.15 Sprocket

A wheel with suitably shaped and spaced cogs, pockets or teeth to engage with the links of a chain.

1.4.16 Transfer car

A mechanically guided car for transferring unit loads, that moves laterally (Figure 4.15).

NOTE: Sometimes referred to as 'shuttle car'.

1.4.17 Transport area

An area or space required by the moving element of a conveyor and its load.

1.4.18 Vertical transfer device

A device that is integrated into a conveyor system and transfers loads between defined levels.

1.4.19 Working area (work station)

Area, as intended by the manufacturer, where persons work at or operate conveyors under normal conditions (inspection, maintenance and cleaning are excluded).

NOTE: Sometimes referred to as 'work station'.

SECTION 2 TYPICAL HAZARDS, RISK ASSESSMENT AND DESIGN

2.1 APPLICATION

This Section applies to both chain conveyors and unit handling conveyors.

2.2 TYPICAL HAZARDS ASSOCIATED WITH CHAIN AND UNIT HANDLING CONVEYORS

Table 2.1 provides a list of typical hazards involving conveyors. More than one hazard can be present in one conveyor.

TABLE 2.1
TYPICAL HAZARDS ASSOCIATED WITH CHAIN
CONVEYORS AND UNIT HANDLING CONVEYORS

Energy source/Hazards	Description
Mechanical hazards	
Crushing and shearing hazards	Hazards may occur where parts can move against or past one another or against fixed parts or past one another or past other fixed parts so that persons or parts of their bodies can be crushed or sheared.
Entanglement hazards	Hazards may occur where projecting sharp edges, teeth, wedges, screws, lubricating nipples, shafts, shaft ends or the like move so that persons, parts of their bodies or their clothing can be caught and carried along.
Drawing-in hazards (nip points)	Hazards may occur where parts move so that a constriction is formed in which persons, parts of their bodies or their clothing can be drawn in. Examples of drawing in points or nip points are as follows: (a) Between the traction or carrying elements or attached pushers and fixed parts of the conveyor or of the surroundings. (b) At the traction or carrying elements in the area of direction changing points. (c) Between the traction or carrying elements and supporting rollers. (d) At contact points of pushers on slide ways. (e) At transfer points of conveyors as well as at chutes, roller and gravity tables.
Impact hazards	Hazards may occur where parts move in relation to persons so that injury of persons or parts of their bodies is caused by impact.
Falling objects	Hazards may occur as a result of falling of the conveyor or parts of the conveyor or unit loads.
Slip, trip and fall hazards	Hazards may occur, e.g. depending on design of gangway and platforms.
Electrical hazards	
Contact with electricity	Direct or indirect contact with live parts as a result of damage to insulation.
Electrostatic discharge	Source of ignition from electrostatic charging (due to the nature of the material).

(continued)

TABLE 2.1 (continued)

Energy source/Hazards	Description
Thermal hazards	
Contact with heat source	Burns may arise from touching heat sources.
Hot or cold work environment	Health-damaging effects may result from a hot or cold working environment.
Bio-mechanical hazards	
Ergonomic hazards can arise from neglecting ergonomic principles in conveyor design.	
Poor ergonomic design	Poor design of control devices and working places. Overstress of personnel with regard to speed and effort due to poor height of conveyor in relation to lifting zones. Back and other strain injuries. Repetitive strain injury.
Conveyor failure hazards	
Hazards can arise from failure of energy supply, failure of conveyor parts or other functional disorders.	
Gravitational potential energy	Hazards can occur in the case of failure of energy supply if conveyors or loads overrun unintentionally. Hazards due to component failure may occur, e.g. breakage of roller on a self-propelled overhead conveyor, the trolley can derail or fall. Failure of conveyor or drive mechanism itself causing spillage of conveyed media.
Impact from ejected parts or fluids	Hazards may arise as a result of unexpected ejection of conveyor parts or fluids, e.g. failure of hydraulic or pneumatic components.

2.3 RISK ASSESSMENT

2.3.1 General

Any known incidents in relation to chain conveyors and unit handling conveyors should be considered in the design and operational risk management process.

2.3.2 Environmental lifecycle considerations

Risk assessments shall consider appropriate control measures when unit handling conveyors are operated in severe conditions.

For example, severe conditions may include—

- (a) freezer applications;
- (b) high temperatures;
- (c) corrosive environments;
- (d) strong magnetic fields;
- (e) potentially explosive atmospheres;
- (f) radioactive conditions;
- (g) loads the nature of which could lead to a dangerous situation (e.g. molten metal, acids/bases, specially brittle loads, explosives);
- (h) movement of the base (e.g. operation on ships or earthquake effects); or
- (i) contact with foodstuff.

2.4 DESIGN

2.4.1 General

For enclosed chains and unit handling conveyors, a protective device shall be provided to detect any stoppage of the driven elements where this stoppage creates a risk while the drive motor is still running.

2.4.2 Hinged sections

2.4.2.1 General

Hinged sections of a conveyor or conveyor system used for the purpose of creating a passageway shall be designed so that when the hinged section is opened while the conveyor is in operation, control measures shall be provided to prevent a risk to people, e.g. automatic stopping of conveyors. The conveyor may be restarted automatically upon closure of the hinged section provided that automatic stop controls are in accordance with AS/NZS 4024.3610.

2.4.2.2 Manually operated

Manually-operated hinged sections shall be held in the open position by counterbalance or other means and shall be designed so that the maximum effort required to open or close the hinged section does not exceed 120 N.

2.4.2.3 Power operated

Power-operated hinged sections shall be provided with mechanical safety devices which restrict their closing to a safe speed and prevent them from falling in the event of a power failure.

2.4.3 Nose overs

Nose-overs or vertical bends shall be used for slopes over 15° and should be used for slopes over 10°.

NOTE: See Figure C3(b) for a typical side elevation view of an inclined belt conveyor with a nose-over.

2.4.4 Anti-runaway

The design shall consider the potential for runaway of the conveyor under the following conditions:

- (a) Failure of power supply.
NOTE: Reverse operation can exist in reverse or fall-back under the effects of gravity.
- (b) Hazards during maintenance activities.
- (c) Functional disorders such as excessive wear.
- (d) If derailing occurs and the trolley can derail in reverse direction.
- (e) Component failure, i.e. breakage of a roller on a self-propelled overhead conveyor which can cause the trolley to fail.

The design shall also consider potential for harm to people in the vicinity from ejection of carried loads or failed machine parts, (e.g. couplings, pulleys) in the event of a runaway condition.

NOTES:

- 1 Refer to AS/NZS 4024.3610 for further guidance on anti-runaway.
- 2 Refer to Appendix B, Figure B31 and Figure B32 which illustrate typical means of anti-runback and anti-runaway.
- 3 Hazardous reverse movement can occur with the following:
 - (a) Swing tray conveyors, fixed tray conveyors.
 - (b) Belt, chain belt, and slat conveyors with a grade.
 - (c) Overhead conveyors.

SECTION 3 CHAIN CONVEYORS

3.1 APPLICATION

This Section applies to chain conveyors, including the following:

- (a) Slat and apron.
- (b) Chain driven roller conveyors.
- (c) Overhead chain, overhead cable and towing conveyors.
- (d) Chain conveyors.
- (e) Vertical elevators, swing tray conveyors and vertical chain conveyors.

Chain conveyors which carry unit loads shall also comply with Sections 1 and 4.

3.2 DESIGN RISK ASSESSMENT

3.2.1 Characteristics of chain conveyors

Chain conveyors typically have unique characteristics which impose additional hazards. These characteristics shall be considered in the design risk assessment and may typically include the following:

- (a) Power source (including energy type—electric, diesel, hydraulic, pneumatic).
- (b) Rotational drive sprocket.
- (c) Tensioner system.
- (d) Change in elevations.
- (e) Load transfer between chains.
- (f) Exposed moving parts (e.g. chain, flight bars and similar).
- (g) Wide range of chain sizes (mass) and associated handling mechanisms.
- (h) Operating environment (e.g. ambient, freezers, ovens, manufacturing, mining, food).
- (i) Noise of conveyors during operation.

3.2.2 Specific lifecycle hazards associated with chain conveyors

Specific hazards which should be considered in the design stage include but are not limited to the following:

- (a) Handling of large masses (e.g. masses that cannot generally be handled by people).
- (b) Physical damage.
- (c) Wear of components (e.g. chain, guides, sprockets, strippers, and similar).
- (d) Rotating elements.
- (e) Corrosion.
- (f) Chain failure suddenly releasing stored energy within the chain.
- (g) Stored energy within the tensioner.
- (h) Chain elongation.
- (i) Suspended components and loads.
- (j) Difficulty in carrying out inspections on enclosed chain.

3.2.3 Chain conveyor design information

The following information shall be included in the plant safety file:

- (a) Rated capacity.
- (b) Specification of the chain, including minimum break load (in kN).
- (c) Specification of anti-runaway protective devices.

3.3 DESIGN OF SPECIFIC TYPES OF CHAIN CONVEYORS

3.3.1 General

The requirements in Clause 3.3 shall be included in the design and construction relevant to specific types of chain conveyors.

3.3.2 Overhead chain or cable conveyors

3.3.2.1 Guarding

Conveyor under-guards shall be provided where there is a risk to people from either the load or carrier falling. Under-guards shall be designed to capture any item that may fall.

Dimensions of guards are determined by the size of loaded carriers. 150 mm minimum clearance on each side should be provided. Vertical height should permit loaded carriers to clear a fallen part lying on the bottom of the guard.

If several runs of loaded conveyors can be routed close together, a single wide guard may serve more than one conveyor.

Figures 3.1 and 3.2 provide examples of under-guards.

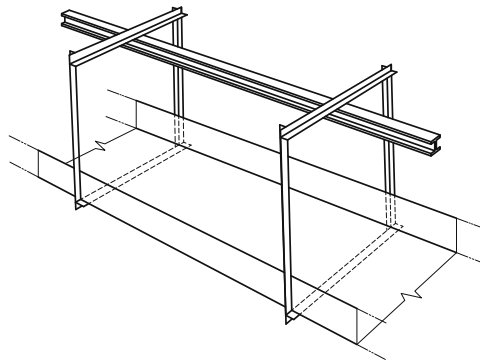


FIGURE 3.1 SHEET METAL GUARD

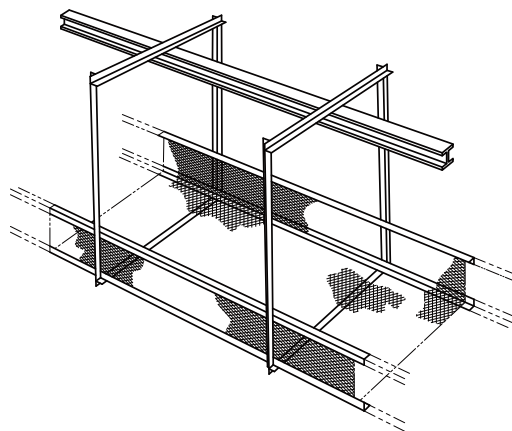


FIGURE 3.2 EXPANDED METAL OR WIRE MESH GUARD

3.3.2.2 *Guarding yokes*

Where the underside of the free track of an overhead chain or cable conveyor is within 2.7 m of the floor level, nip and shear points shall be suitably guarded where they pass through the yokes.

Where access to the trolley is from walkways provided for maintenance, yokes need not be specifically guarded provided that the clearance between the trolley bracket and the yoke is not less than 30 mm (distance x as shown in Figure 3.3).

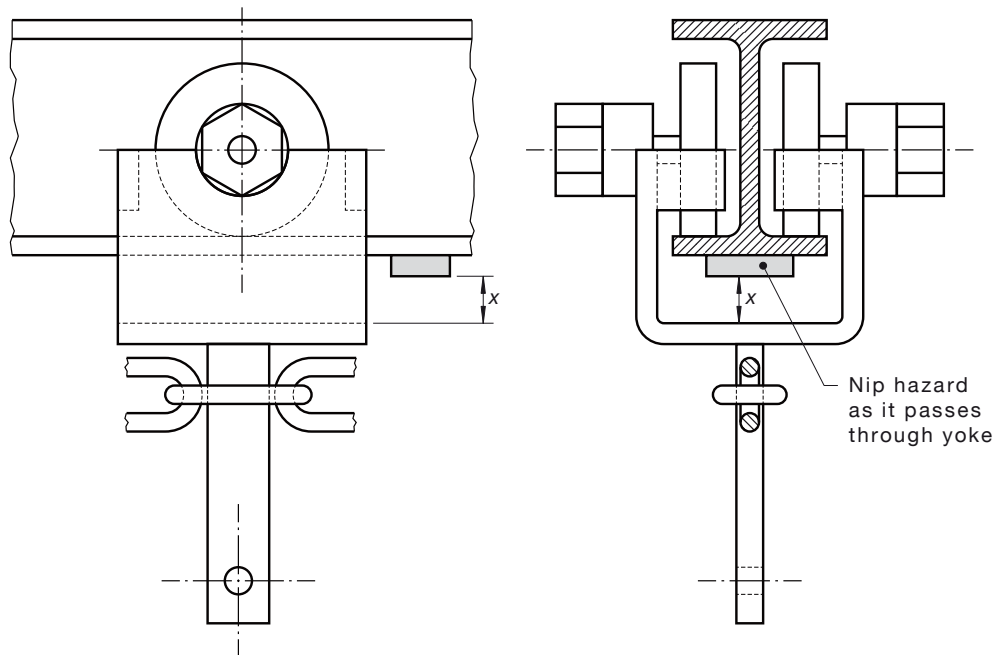


FIGURE 3.3 TROLLEY AND YOKE

3.3.2.3 Drop sections

Where drop sections are used, suitable means shall be provided to prevent crush hazards in the open section of track. Where required, the free trolley(s) in the drop section shall be positively retained on the track.

Means shall be provided to stop the descent of any drop section or to control its speed to not more than 125% of its normal operating speed; in any event its speed shall not exceed 0.5 m/s.

3.3.2.4 Anti-runaway and anti-drop devices

Anti-runaway protective devices should be provided at one device per 1500 mm of elevation change.

Traction wheels, turns and other similar components should be fitted with an anti-drop device to prevent the component from falling to an accessible area in the event of a failure.

3.3.3 Slat conveyors—Spacing between slats and aprons

The distance between slats and aprons when travelling in a straight line along a slat conveyor shall not create a risk to people due to shearing or crushing hazards from—

- (a) objects underneath the slats (see Figure 3.4); or
- (b) going over a curve (see Figure 3.5).

NOTES:

- 1 See Appendix B, Paragraphs B1 and B10 for descriptions of apron and slat conveyors.
- 2 One means to achieve this may be to provide a smooth bed underneath the slats.

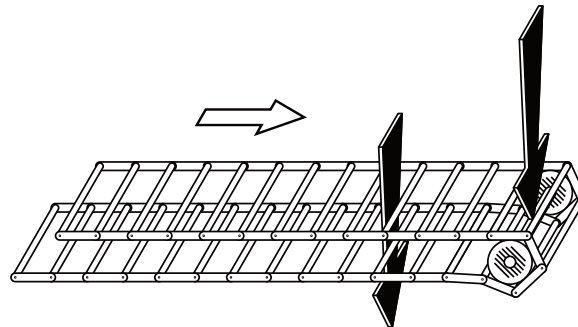


FIGURE 3.4 SLAT CONVEYORS AND OBJECTS UNDERNEATH

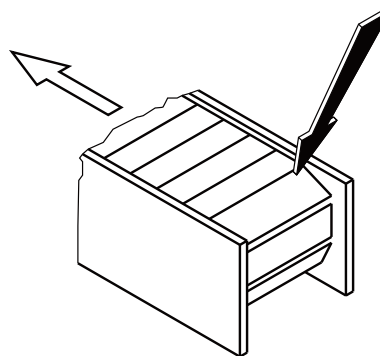


FIGURE 3.5 SLAT CONVEYORS GOING OVER A CURVE

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3.3.4 Roller flight conveyors

The distance between rollers of a roller flight conveyor shall not create a risk to people due to shearing or crushing hazards from objects underneath the rollers.

See Appendix B, Paragraph B4.9 and Figure B15 for a description.

NOTE: One means to achieve this may be to provide a smooth bed underneath the rollers.

3.3.5 Drag chain conveyors

3.3.5.1 General

Typical designs and descriptions are given in Appendix B, Paragraphs B8 and B9.

3.3.5.2 Inspection panels

Where inspection panels are used in the top of a casing structure which encloses a drag chain and can be opened when the system is in motion, a safeguarded system shall be provided to prevent access. Where inspection is required during operation, this may be a mesh screen behind the door or panel. See further requirements specified in AS/NZS 4024.3610 for inspection and access doors.

3.3.5.3 Guarding of flights

The flights and chain of a drag chain conveyor which create a risk to health or safety shall be safeguarded or fully enclosed, except for applications where it has been established that it is not reasonably practicable and alternative risk controls that reduce the risk to an acceptable level are implemented.

3.3.5.4 Anti-runback

A backstop shall be provided in the system where there is potential for reverse travel on a loaded inclined conveyor or the load has potential to rotate the conveyor and chains.

Such conditions may include:

- (a) Reverse rotation of loaded portion exceeds internal friction for the system and has potential for reverse travel when loaded to rated load conditions.
- (b) Maintenance is performed and the system has stopped while in a loaded condition and friction of the chain and blades on the supporting plate is lower than loaded forces of rotation for the system.

3.3.6 Swing tray conveyors

Where there is a manual loading or unloading point in a swing tray conveyor, the conveyor or its controls shall be designed to prevent injury from moving parts.

3.3.7 Bucket elevators

3.3.7.1 General

Consideration shall be given to the hazards arising from the movement of loose materials with buckets as the carrying medium. Such hazards may include the following:

- (a) Accumulation of spillage.
- (b) Oversize product.
- (c) Sticky product.
- (d) Flammable product.
- (e) Overfilling.
- (f) Explosive dust atmospheres.

3.3.7.2 *Design for maintenance*

Bucket elevators shall be provided with an energy isolation device. An additional means to prevent free rotation due to gravity or other stored energy systems shall be provided. This means shall be capable of preventing unrestrained movement or rotation of the buckets and chain/belt medium resulting from a state of imbalance between each side of the elevator during maintenance or if the motor, backstop or brake is removed.

The design shall provide for the safe installation, replacement and maintenance of the bucket conveyors. This should include the following:

- (a) A means for releasing chain tension safely, e.g. counterweight, spring, torsion arm, hydraulic pressure.
- (b) Raising and removing the buckets.
- (c) Replacement of chain.

3.4 MAINTENANCE

3.4.1 General

Chains shall be periodically inspected for wear, corrosion, fatigue (cracking), elongation and physical damage to provide assurance the chain conveyor is safe to use. Inspections shall be documented.

3.4.2 Anti-runaway

During maintenance activities, potential for runaway shall be considered and shall include the following:

- (a) Ensure correct assembly and adequate erection. Errors can influence operation of hydraulic, pneumatic, electrical, mechanical components which could then function incorrectly.
- (b) Removal of driveline components.
- (c) Disassembly of chain.
- (d) Imbalance caused by removal of attachments such as buckets, flight bars and similar.

SECTION 4 UNIT HANDLING CONVEYORS

4.1 APPLICATION

This Section applies to unit handling conveyors, including the following:

- (a) Slat and apron conveyors.
- (b) Light duty belt conveyors.
- (c) Powered/unpowered roller conveyors.
- (d) Chain conveyors.

Unit handling conveyors which use chain drives shall also comply with Section 1 and Section 2 of this Standard.

NOTES:

- 1 For information on specific types of unit handling conveyors see Appendix B and Appendix C.
- 2 EN 619 provides further guidance.

4.2 DESIGN RISK ASSESSMENT

4.2.1 General

Design risk assessments for unit handling equipment should consider the information and guidance in EN 619.

4.2.2 Characteristics of unit handling conveyors

Unit handling conveyors typically have unique characteristics which impose additional hazards. These characteristics shall be considered in the design risk assessment.

These characteristics typically include the following:

- (a) Power source (including energy type—electric, diesel, hydraulic).
- (b) Handling of unit/package loads.
- (c) Proximity of people while loading and unloading.
- (d) Unrestrained loads on static rollers (e.g. movement under gravity).
- (e) Range of styles and designs and the potential for an installation that is not fit-for-purpose.
- (f) Intermittent operation.
- (g) Proximity to the public and unskilled operators.
- (h) Mostly in controlled environments (e.g. enclosed buildings).
- (i) Range of environments (freezers, ovens, potentially explosive atmospheres).

4.2.3 Specific lifecycle hazards associated with unit handling conveyors

Specific hazards which should be considered in the design stage include but are not limited to the following:

- (a) Uncontrolled movement of conveyed load (e.g. due to gravity).
- (b) Lack of maintenance.
- (c) Exposed nip/shear points due to foreseeable removal/overriding of safeguards.
- (d) Unexpected start-up (e.g. auto-start, conveyor sequencing).