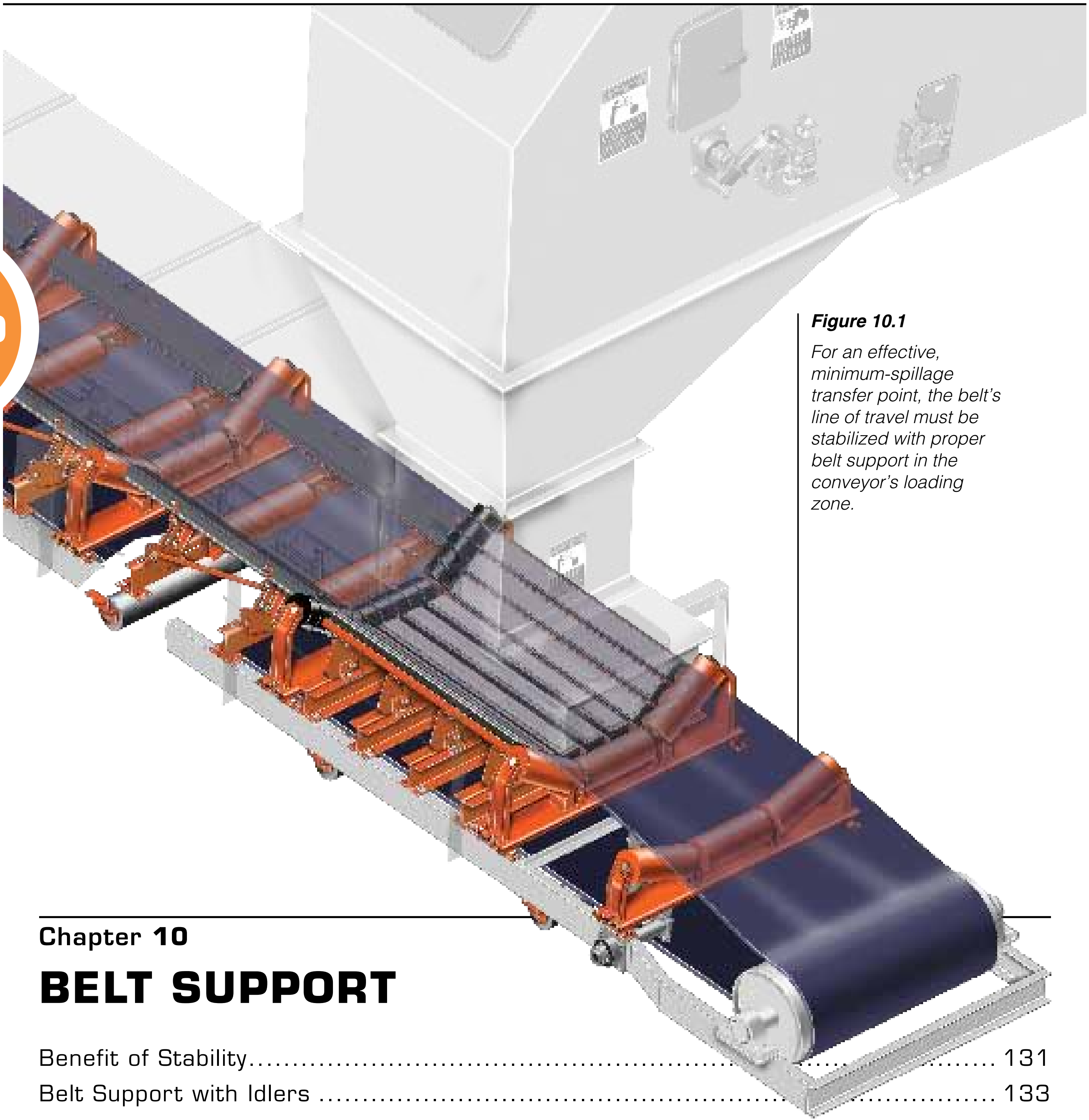


Figure 10.1

For an effective, minimum-spillage transfer point, the belt's line of travel must be stabilized with proper belt support in the conveyor's loading zone.

Chapter 10

BELT SUPPORT

In this Chapter...

This chapter focuses on belt support in the conveyor load zone to prevent the escape of fugitive materials and to prevent damage to the belt and other components. Topics covered include idlers, slider beds, and impact cradles, as well as several alternative methods for maintaining a stable belt line. Equations to calculate power requirements needed for belt support are provided.

The building of an efficient conveyor load zone is like the construction of a house: It starts with a good foundation. For a house, the foundation consists of the footings and/or walls of the basement; in a conveyor belt system, the foundation is a stable, sag-free belt line.

For a conveyor to control dust and spillage, the design engineer must do whatever is practical to keep the belt's line of travel consistently steady and straight. While there are many factors that influence the belt's running line both inside and outside the loading zone, a key ingredient is the provision of proper belt support.

For an effective, minimum-spillage transfer point, it is essential that the belt's line of travel be stabilized with proper belt support in the loading zone (**Figure 10.1**).

BENEFIT OF STABILITY

A flat, sag-free belt line in the skirted area is essential to successfully sealing the load zone (**Figure 10.2**). Ideally, the belting should be kept flat, as if it were running over a table that prevented movement in any direction except in the direction the cargo needed to travel; it would eliminate sag and be easier to seal.

Belt sag, when viewed from the side of the transfer point, is the vertical deflection of the belt from a straight line as drawn across the top of the two adjacent idlers (**Figure 10.3**). The shape of the sagging belt is assumed to be a catenary curve, a natural curve formed when a cable is suspended by its endpoints.

If the belt sags between idlers below the loading zone or flexes under the stress of loading, fines and lumps will work their way out the sides of the conveyor, dropping onto the floor as spillage or becoming airborne as a cloud of dust. Worse, these materials can wedge into entrapment points where they can gouge the belt or damage the sealing system and other components, worsening the spillage problem. A small amount of belt sag—sag that is barely apparent to the naked eye—is enough to permit fines to become entrapped, leading to abrasive wear on the skirtboard-sealing system and the belt surface. A groove cut into the belt cover along the entire length of the belt in the skirted area can usually be attributed to material captured in entrapment points (**Figure 10.4**). When belt sag is prevented, the number and size of

Figure 10.2

A flat, sag-free belt line in the skirted area is essential to successfully sealing the load zone.

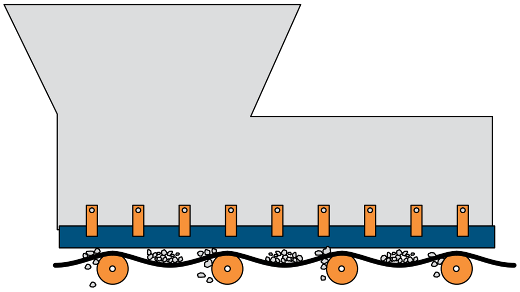


Figure 10.3

Belt sag is a vertical deflection of the belt from a straight line as drawn across the top of the two adjacent idlers.

Figure 10.4

A groove cut into the belt cover along the entire length of the belt in the skirted area can usually be attributed to material captured in entrapment points.

entrapment points are reduced, therefore reducing the possibility of belt damage.

In order to prevent spillage and reduce the escape of dust particles, belt sag must be eliminated wherever practical to the extent possible. It is particularly important to control sag in the conveyor's loading zone, where the cargo constantly undergoes changes in weight. These changes in load carry fines and dust out of the sealing system and push particles into entrapment points between the wear liner or skirt seal and the belt.

Methods to Control Sag

One method for reducing belt sag along the entire length of the conveyor is to increase the belt tension. There are drawbacks to this, however, such as increased drive power consumption and additional stress on the belt, splice(s), and other components. When utilizing additional tension to reduce sag, the maximum rated tension of the belting should never be exceeded.

After achieving the belt tension required by the conveyor belt and the load on the system, the recommended method for reducing belt sag is to improve the conveyor's belt-support system (**Figure 10.5**).

Proper Belt Support

The key to a stable, sag-free line of belt travel is proper support. The amount of support needed is determined by the unique characteristics of each individual conveyor, its loading zone(s), and its material load. The factors to be assessed include the trough angle and speed of travel of the conveyor being loaded, the weight of the material, the largest lump size, the material drop height, and the angle and speed of material movement during loading.

Figure 10.5

To reduce belt sag, improve the conveyor's belt-support system.

It is essential that the belt be stabilized throughout the entire length of the load zone. Support systems extended beyond what is minimally required will provide little harm other than an incidental increase in conveyor power requirements. A belt-support system that is left shorter than required can lead to fluctuations in the belt's stability at the end of the support system, potentially creating spillage problems that will render the installed belt-support system almost pointless. Belt support is like money: It is much better to have a little extra than to fall a little short.

Basics of Building Belt Support

It is essential that the stringers—the conveyor's support structure upon which all other components are installed—are straight and parallel for proper belt support. If not, they should be straightened or replaced. Laser surveying is the preferred method for checking stringer alignment. *(See Chapter 16: Belt Alignment.)*

Footings must provide a rigid support structure to prevent stringer deflection. The amount of material being loaded and the level of impact forces must be considered to prevent excessive deflection under load. Properly spaced stringers tied to rigid footings ensure a good base for the remaining structure.

Conveyor Equipment Manufacturers Association (CEMA) provides a valuable resource for construction standards for conveyors and loading zones: "Conveyor Installation Standards for Belt Conveyors Handling Bulk Materials" *(Reference 10.1)*.

There are a number of techniques and components that can be used, independently or in combination, to control belt sag by improving belt support in the loading zone. They include idlers, belt-support cradles, and impact cradles.

BELT SUPPORT WITH IDLERS

The basic means of support for a conveyor belt is idlers. An idler consists of one or more rollers—with each roller containing one or more bearings to ensure it is free rolling. The rollers are supported by, or suspended from, a framework installed across the conveyor stringers (**Figure 10.6**). Idlers are the most numerous of conveyor components, in terms of both the number used on a particular conveyor and the number of styles and choices available. There are many types, but they all share the same responsibilities: to shape and support the belt and cargo, while minimizing the power needed to transport the materials.

The Idler Family

Idlers are classified according to roll diameter, type of service, operating condition, belt load, and belt speed; they are rated on their load-carrying capacity based on calculated bearing life. CEMA uses a two-character code that expresses the idler classification and implied load rating, with a letter-based code followed by idler diameter in inches, resulting in classes from B4 to F8 (**Table 10.1**). Other regions may have different classification systems.

Regardless of the codes and classifications, the key is to make sure each conveyor is consistent throughout—that all idlers on a given conveyor conform to the same standards and, ideally, are supplied by the same manufacturer.

There is a wide variety of general categories of idlers, depending on their intended application.

Carrying Idlers

Carrying idlers provide support for the belt while it carries the material. They are available in flat or troughed designs. The flat design usually consists of a single horizontal roll for use on flat belts, such as belt feeders.

Figure 10.6

An idler consists of one or more rollers, each with one or more bearings. The rollers are supported by, or suspended from, a framework installed across the conveyor stringers.

Table 10.1

Idler Classifications (Based on CEMA Standards)

CEMA Idler Classification	Roll Diameter		Belt Width		Description
	mm	in.	mm	in.	
B4	102	4	450-1200	18-48	Light Duty
B5	127	5	450-1200	18-48	
C4	102	4	450-1500	18-60	Medium Duty
C5	127	5	450-1500	18-60	
C6	152	6	600-1500	24-60	
D5	127	5	600-1800	24-72	
D6	152	6	600-1800	24-72	
E6	152	6	900-2400	36-96	Heavy Duty
E7	178	7	900-2400	36-96	
F6	152	6	1500-2400	60-96	
F7	178	7	1500-2400	60-96	
F8	203	8	1500-2400	60-96	

Metric dimensions are conversions by Martin Engineering; belt widths may not be actual metric belt sizes.

Figure 10.7

The troughed idler set usually consists of three rolls—one horizontal roll in the center with inclined (or wing) rolls on either side.

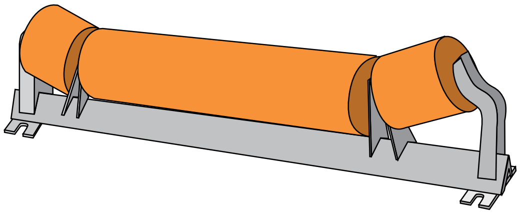


Figure 10.8

"Picking" idlers incorporate a longer center roll and shorter inclined rollers to supply a large cargo area.

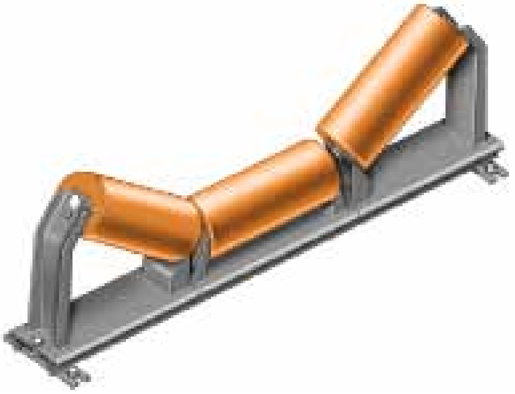


Figure 10.9

With in-line idlers, the centerlines of the three rolls are aligned.

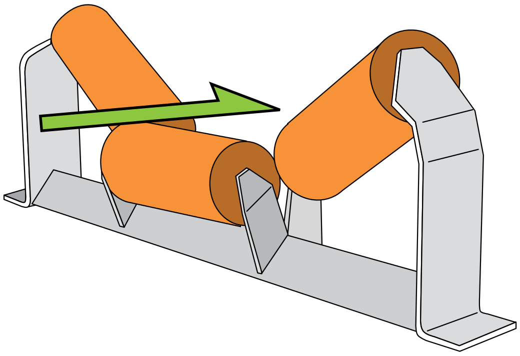


Figure 10.10

Offset idlers, with the center roller placed on a centerline different from the wing rolls, can reduce the overall height of the idler set.

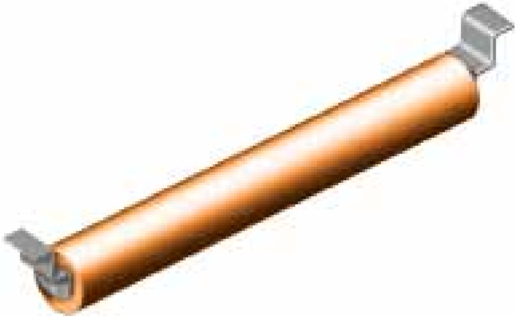


Figure 10.11

Used to support the belt on its way back to the loading zone, return idlers normally consist of a single horizontal roll hung from the underside of the conveyor stringers.

The troughed idler usually consists of three rolls—one horizontal roll in the center with inclined (or wing) rolls on either side (**Figure 10.7**). The angle of the inclined rollers from horizontal is called the trough angle. Typically, all three rolls are the same length, although there are sets that incorporate a longer center roll and shorter inclined rollers called "picking" idlers. This design supplies a larger flat area to carry material while allowing inspection or "picking" of the cargo (**Figure 10.8**).

Troughed idler sets are available as in-line idlers (**Figure 10.9**)—the centerlines of the three rolls are aligned—and offset idlers—the center roll has a centerline different from the wing rollers, usually with the belt passing over the center roller in advance of the wing rollers (**Figure 10.10**). Offsetting the idlers can reduce the overall height of the idler set and, accordingly, is popular in underground mining applications, where headroom is at a premium. Offset idlers eliminate the gap between the rollers, reducing the chance of a type of belt damage called junction-joint failure.

Return Idlers

Return idlers provide support for the belt on its way back to the loading zone after unloading the cargo. These idlers normally consist of a single horizontal roll hung from the underside of the conveyor stringers (**Figure 10.11**). V-return idlers, incorporating two smaller rolls, are sometimes installed to improve belt tracking (**Figure 10.12**).

Training Idlers

There are a number of designs for training idlers that work to keep the belt running in the center of the conveyor structure. Typically, these idlers are self-aligning: They react to any mistracking of the belt to move into a position that will attempt to steer the belt back into the center (**Figure 10.13**). They are available for both carrying side and return side application. *(See Chapter 16: Belt Alignment.)*

Belt-training idlers should never be installed under the carrying side of the belt in the load zone, as they sit higher than the adjacent regular carrying idlers and raise the belt as they swivel.

Impact Idlers

Rubber-cushioned impact idlers are one solution for absorbing impact in the belt's loading zone (**Figure 10.14**). These idlers use rollers composed of resilient rubber disks to cushion the force of loading. Impact idlers typically have the same load rating as standard idlers, because they utilize the same shafts and bearings. The rubber covers absorb some of the energy to provide the benefit of shock absorption.

One disadvantage of using impact rollers in the load zone is that each idler supports the belt only at the top of the roller. No matter how closely spaced, the rounded shape of the roller and the ability of the rubber to deflect under the load will allow the conveyor belt to oscillate or sag away from the ideal flat profile (**Figure 10.15**). This sag allows and encourages the escape or entrapment of fugitive material. The space interval between impact rollers offers little protection from tramp materials dropping from above and penetrating the belt.

Even impact idlers are subject to impact damage, suffering damaged bearings and rollers from "too large" lumps or unusual impacts (**Figure 10.16**). Idlers with worn or seized bearings cause the belt to run erratically, allowing mistracking and spillage over the sides of the belt. Idlers damaged from severe impact or seized due to fugitive material increase the conveyor's power consumption significantly. In many cases, it becomes more effective to absorb impact with impact cradles, as discussed below.

Idler Spacing

The spacing between the rolling components has a dramatic effect on the idlers' support and shaping missions. Idlers placed too far apart will not properly support the belt nor enable it to maintain the desired profile. Placing idlers too close together will

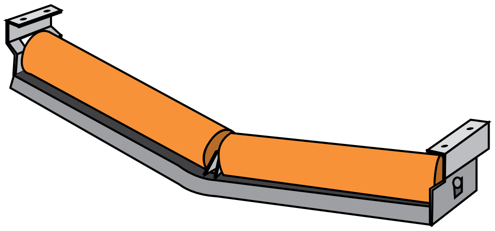


Figure 10.12

V-return idlers, incorporating two smaller rolls, are sometimes installed to improve belt tracking.

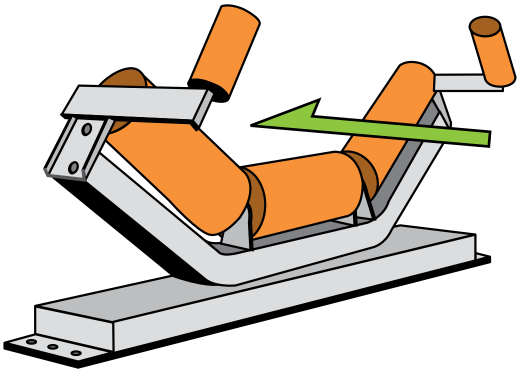


Figure 10.13

Available for both the carrying side and return side of the conveyor, training idlers self-align to steer the belt back into the proper path.

Figure 10.14

Impact idlers use rollers composed of resilient rubber disks to cushion the force of loading.

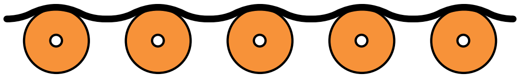


Figure 10.15

The rounded shape of the roller and the ability of the rubber to deflect under the load will allow the conveyor belt to oscillate or sag away from the ideal flat profile.

Figure 10.16

Although designed to cushion loading forces, impact idlers are subject to impact damage, suffering damaged bearings, rollers, or bent frames from "too large" lumps or unusual impacts.

improve belt support and profile, but will increase conveyor construction costs and may lead to an increase in the conveyor's power consumption.

Normally, idlers are placed close enough to support a fully loaded belt so it will not sag excessively between them. If the belt is allowed too much sag, the load shifts as it is carried up and over each idler and down into the valley between. This shifting of the load increases belt wear and power consumption. The sag also encourages material spillage. CEMA has published tables of recommended idler spacing for applications outside the loading zone (**Table 10.2**).

The spacing of return idlers is determined by belt weight, because no other load is supported by these idlers and sag-related spillage is not a problem on this side of the conveyor. Typical return idler spacing is 3 meters (10 ft).

Idlers in the Skirted Area

The basic and traditional way to improve belt support, and so reduce belt sag under a loading zone or anywhere else along the conveyor, is to increase the number of idlers. By increasing the number of idlers in a given space—and consequently decreasing the space between the idlers—the potential for belt sag is reduced (**Figure 10.17**). Idlers can usually be positioned so that their rolls are within 25 millimeters (1 in.) of each other (**Figure 10.18**).

However, this method is not without drawbacks. As the idlers are packed more tightly, it becomes more difficult to service them. Idler sets are typically maintained by laying the framework over on its side to allow the rolls to be lubricated or replaced. If the idlers are closely spaced, there is no room available for the idler set to be laid on its side to allow the maintenance to be performed (**Figure 10.19**). To reach one set of idlers, one or more adjacent sets must be removed, creating a "falling domino" chain reaction.

Figure 10.17

The traditional method to reduce belt sag under a loading zone is to increase the number of idlers in a given space, consequently decreasing the space between the idlers.

Table 10.2

Recommended Idler Spacing for Applications Outside the Loading Zone as Published by CEMA

Return Idler Spacing	Belt Width	Carrying Side Idler Spacing Outside the Loading Zone					
		Weight of Material Handled in Kilograms per Cubic Meter (lb_m/ft^3)					
		480 (30)	800 (50)	1200 (75)	1600 (100)	2400 (150)	3200 (200)
m (ft)	m (in.)	m (ft)	m (ft)	m (ft)	m (ft)	m (ft)	m (ft)
3,0 (10.0)	457 (18)	1,7 (5.5)	1,5 (5.0)	1,5 (5.0)	1,5 (5.0)	1,4 (4.5)	1,4 (4.5)
3,0 (10.0)	610 (24)	1,5 (5.0)	1,4 (4.5)	1,4 (4.5)	1,2 (4.0)	1,2 (4.0)	1,2 (4.0)
3,0 (10.0)	762 (30)	1,5 (5.0)	1,4 (4.5)	1,4 (4.5)	1,2 (4.0)	1,2 (4.0)	1,2 (4.0)
3,0 (10.0)	914 (36)	1,5 (5.0)	1,4 (4.5)	1,2 (4.0)	1,2 (4.0)	1,1 (3.5)	1,1 (3.5)
3,0 (10.0)	1067 (42)	1,4 (4.5)	1,4 (4.5)	1,2 (4.0)	1,1 (3.5)	0,9 (3.0)	0,9 (3.0)
3,0 (10.0)	1219 (48)	1,4 (4.5)	1,2 (4.0)	1,2 (4.0)	1,1 (3.5)	0,9 (3.0)	0,9 (3.0)
3,0 (10.0)	1372 (54)	1,4 (4.5)	1,2 (4.0)	1,1 (3.5)	1,1 (3.5)	0,9 (3.0)	0,9 (3.0)
3,0 (10.0)	1524 (60)	1,2 (4.0)	1,2 (4.0)	1,1 (3.5)	0,9 (3.0)	0,9 (3.0)	0,9 (3.0)
2,4 (8.0)	1829 (72)	1,2 (4.0)	1,1 (3.5)	1,1 (3.5)	0,9 (3.0)	0,8 (2.5)	0,8 (2.5)
2,4 (8.0)	2134 (84)	1,1 (3.5)	1,1 (3.5)	0,9 (3.0)	0,8 (2.5)	0,8 (2.5)	0,6 (2.0)
2,4 (8.0)	2438 (96)	1,1 (3.5)	1,1 (3.5)	0,9 (3.0)	0,8 (2.5)	0,6 (2.0)	0,6 (2.0)

Metric conversions added by Martin Engineering; belt widths may not be actual metric belt sizes.

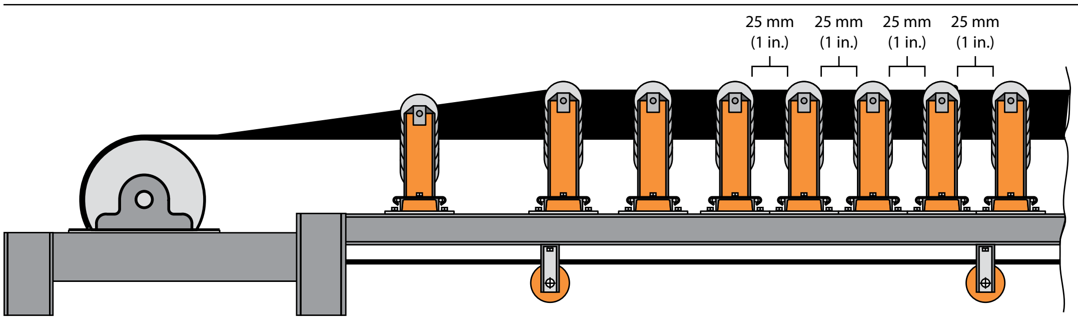


Figure 10.18

Idlers can usually be positioned so that their rolls are within 25 millimeters (1 in.) of each other.

Track-Mounted Idlers

Track-mounted idlers that slide into position are a solution to the problems in servicing closely-spaced idlers. These idlers are mounted on a steel beam that forms a track, allowing the individual rollers to be installed or removed with a slide-in/slide-out movement perpendicular to the path of the conveyor (**Figure 10.17** and **Figure 10.20**). Idlers used in track-mounted configurations can be steel rollers or rubber ring impact-style rollers. With track-mounted idlers, each individual roller, or each set, can be serviced without laying the frame on its side or raising the belt.

The track upon which idlers (and/or other belt-support components) slide provides a supplement to the conveyor structure. This track could be incorporated into the design of the conveyor as part of the structure (**Figure 10.21**). Incorporating a slide-in-place system during the conveyor's design stage allows the use of modular belt-support structures, idlers, cradles, or combination units and simplifies component installation. This is particularly beneficial on wide belts, where large components might otherwise require cranes or other heavy equipment for installation.

Tips for Idler Installation

When installing idlers in a transfer point, they should be square with the stringers and aligned horizontally and vertically across the conveyor. Variations will cause entrapment points, capturing material that will lead to belt damage and spillage. Laser surveying can be used to ensure the alignment of all rolling components. *(See Chapter 16: Belt Alignment.)*

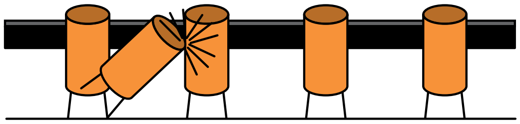


Figure 10.19

If the idlers are closely spaced, there is no room available for the idler set to be laid on its side for maintenance.

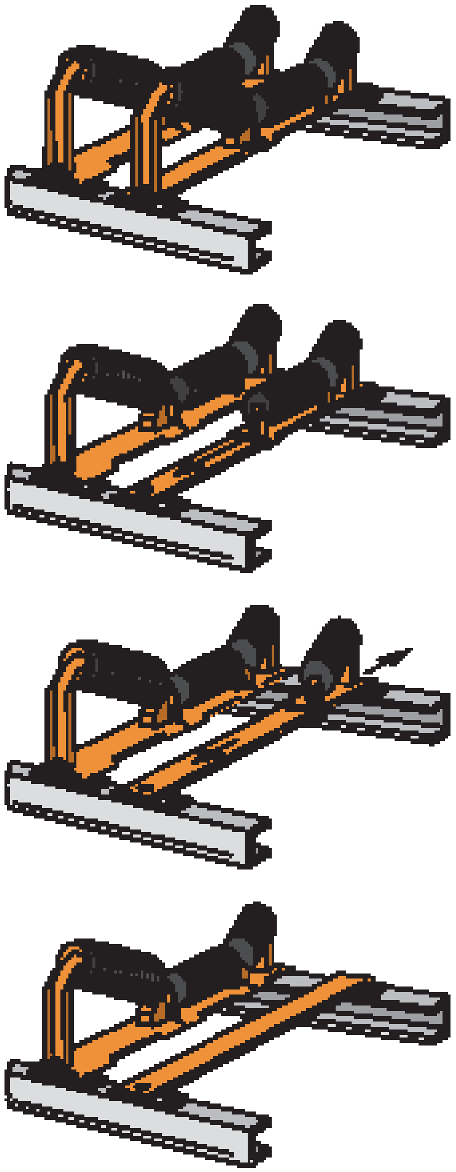


Figure 10.20

Track-mounted idlers solve the problems in servicing closely-spaced idlers by allowing the individual rollers to be installed or removed with a slide-in/slide-out movement.

Idler standards have tolerances for roll diameter, roundness (or "run out"), center roll height, and trough angle. Even a slight difference in an idler's dimensions—the difference from one manufacturer to another—can create highs and lows in the belt line, making it impossible to provide effective sealing. Idlers must be aligned with care and matched so as not to produce humps or valleys in the belt. Idlers should be checked for concentricity; the more they are out of round, the greater is the tendency for the belt to flap or bounce. Only idlers supplied by the same manufacturer and of the same roll diameter, class, and trough angle should be used in the skirted area of a conveyor.

Figure 10.21

The track upon which idlers slide can be incorporated into the design of the conveyor as part of the structure.

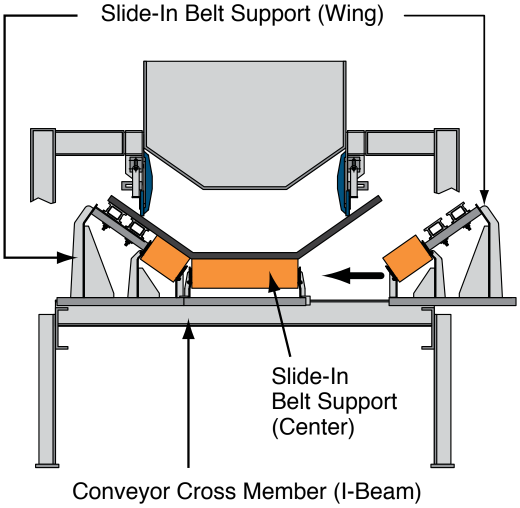


Figure 10.22

To provide the flat table that allows effective sealing, many conveyors use cradles instead of idlers in the conveyor loading zone.

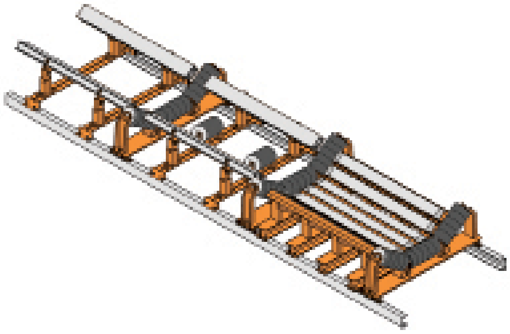


Figure 10.23

"Side rail" edge support places one or more low-friction bars on both sides of the conveyor directly under the skirtboard seal.

BELT-SUPPORT CRADLES

So important is the "flat table" concept to good sealing that many designers now use cradles in place of idlers under conveyor loading zones (**Figure 10.22**). Instead of using an idler's rolling "cans," cradles use some variety of low-friction bars to support the belt profile.

In this discussion of belt-support systems, the terms cradle, bed, or saddle should be considered synonymous.

All belt-support cradles perform two functions—controlling belt sag in the load zone to curtail spillage and providing a slick surface upon which the belt can ride. In addition, impact cradles reduce belt damage by absorbing the forces from the landing of material on the belt. Other benefits of the use of cradles under the transfer point include a reduction in moving parts and elimination of required lubrication. The modular design of the typical cradle system allows the belt support to be extended as far as the circumstances require.

Edge-Seal-Support Cradles

Edge-sealing-support systems are designed to provide continuous support of the belt and maintain a straight belt profile at the belt edges.

One form of edge-seal support is a "side rail" configuration. This system places one or more low-friction bars on both sides of the conveyor directly under the skirtboard seal (**Figure 10.23**). The bars function to support the sides of the belt, allowing effective sealing of the belt edge.

Each edge-seal cradle installation may be one or more cradles long, depending on the length of the transfer point, the speed of the belt, and other conveyor characteristics.

The top of these bars should be installed in line with the top of the entry and exit idlers, to avoid the creation of entrapment points (**Figure 10.24**). When multiple edge-sealing cradles are used, idlers should be placed between the cradles.

On faster, wider, more heavily loaded belts, the edge-seal cradles may need more than one bar on each side to support the belt edge. On wider belts, it is often necessary to add a center support roll or an additional low-friction bar under the middle of the belt (**Figure 10.25**).

Edge-support slider bars can be manufactured from low-friction plastics such as Ultra-High Molecular Weight (UHMW) polyethylene. These materials provide a low-drag, self-lubricating surface that reduces heat accumulation and undue wear on either the belt or the bar. One proprietary design features bars formed in an "H" or "box" configuration, allowing for the use of both the top and bottom surfaces (**Figure 10.26**).

At conveyor speeds above 3,8 meters per second (750 ft/min), the heat created by the friction of the belt can reduce the performance of the plastic bars. Consequently, the use of stainless steel support bars has found acceptance in these applications. Stainless steel bars should also be incorporated in applications with service temperatures above 82 degrees Celsius (180º F).

Safety regulations may limit the choice of materials used in bar support systems. Most countries have regulations requiring anti-static and/or fire–resistant materials used in contact with the belt in underground applications. Other regional or plant requirements may govern materials to be used.

The low-friction bars should be supported in a mounting frame that is adjustable, to allow easy installation, alignment, and maintenance. This frame should accommodate various idler combinations and chutewall widths and allow for adjustment due to wear.

The bars should be held in the support position without the risk of the mounting hardware and fasteners coming into contact with the belt. For example, the bolts holding the bars in place should be installed parallel rather than perpendicular to the belt (**Figure 10.27**).

An edge-support cradle may add incrementally to the friction of the belt and to the conveyor's power requirements. However, this marginal increase in energy consumption is more than offset by the elimination of the expenses for cleanup of skirt leakage, entrapment-point damage to the belt, and unexpected downtime necessary for idler maintenance or belt replacement.

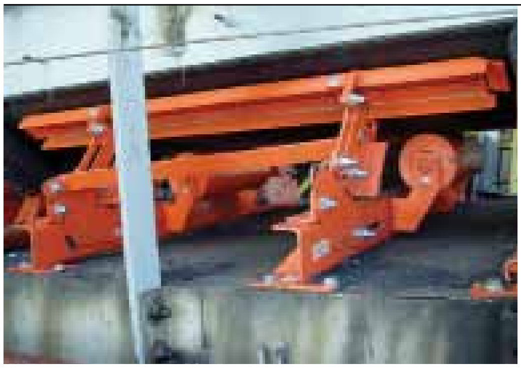


Figure 10.24

To avoid the creation of entrapment points, the top of the belt-support bars should be installed in line with the top of the entry and exit idlers.

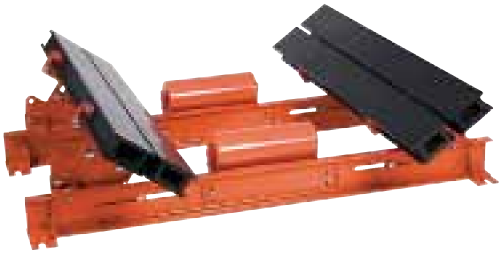


Figure 10.25

On wider belts, it may be necessary to add additional support rolls or low-friction bars in the center of the support cradle.

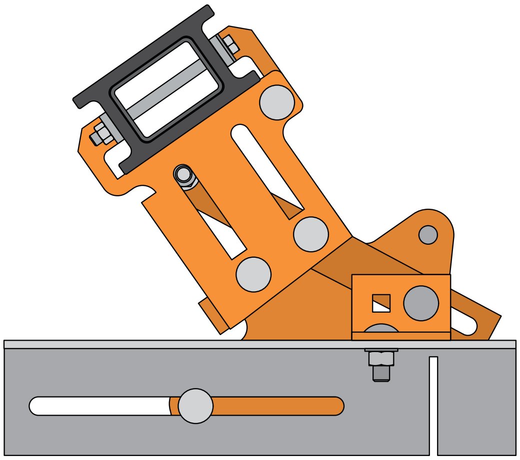


Figure 10.26

One proprietary cradle features bars formed in an "H" or "box" configuration, allowing the use of both the top and bottom surfaces.

Impact Cradles

Nothing can damage a conveyor's belting and transfer-point components and create material leakage as rapidly and dramatically as impact in the loading zone from heavy objects or lumps with sharp edges (**Figure 10.28**). Whether arising from long material drops or large lumps—or boulders, timber, or scrap metal—these impacts will damage components like idlers and sealing strips. Impact can also create a "ripple" effect on the belt, de-stabilizing its line of travel and increasing the spillage of material. Heavy or repeated impacts can also damage the belt cover and weaken its carcass. Consequently, system engineers do a variety of things to reduce impact levels in loading zones, including the inclusion of engineered chutes, rock boxes, or designs that load fines before lumps.

Figure 10.27

The bars should be held in the support position without the risk of the mounting hardware and fasteners coming into contact with the belt.

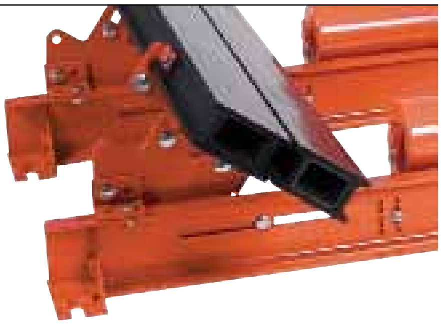


Figure 10.28

Impact in the loading zone from long material drops or large lumps can damage components and create spillage.

Figure 10.29

Impact cradles are installed directly under the material drop zone to bear the brunt of the shock of the material hitting the belt.

Figure 10.30

Impact cradles are composed of a steel framework holding a set of impact-absorbing bars. The bars combine a slick top surface and one or more sponge-like secondary layers to absorb the energy of impact.

However, in many cases, it is not possible to totally eliminate impact, so it becomes necessary to install some sort of energy-absorbing system under the loading zone. If one were to lay a belt on a concrete floor and strike it with an ax or a hammer, the belt would be damaged. However, if one would place layers of foam between the belt and the floor, the belt would be somewhat protected. This is the way an impact belt-support system protects the belt under severe impact loading conditions.

Impact cradles are installed directly under the material-drop zone to bear the brunt of the shock of the material hitting the belt as it loads (**Figure 10.29**). These cradles are usually composed of a set of individual impact-absorbing bars assembled into a steel support framework. The bars are composed of durable elastomeric materials that combine a slick top surface—allowing the belt to skim over it to minimize friction—and one or more sponge-like secondary layers to absorb the energy of impact (**Figure 10.30**).

Some manufacturers align a group of long bars—typically 1,2 meters (4 ft) in length—into a cradle, with the bars running parallel to the direction of belt travel. Other manufacturers use shorter modular segments that align to form a saddle that is perpendicular to belt travel. These saddles are typically 300 millimeters (12 in.) in width. The number of cradles and saddles required is determined by the length of the impact zone. The number of bars required in a given cradle or saddle is determined by the width of the conveyor belt.

Some systems feature a slick top surface and a cushioned lower layer permanently attached; others feature separate components that are put together at the application. Impact cradles are available in a track-mounted design, which simplifies replacement of bars when required (**Figure 10.31**).

The limit to the amount of impact that can be absorbed by the belt in combination with an impact cradle is based on the belt's ability to resist crushing energy. For loading zones with the highest levels of impact, the entire impact-cradle installation can be mounted on a shock-absorbing structure, such as springs or air cushions. While this does reduce the stiffness of the entire loading zone and so absorbs impact force, it has the drawback of allowing some vertical deflection of the belt in the skirted area, making it harder to seal the load zone.

Standard for Impact Cradles

CEMA STANDARD 575–2000 provides an easy-to-use rating system for impact cradles utilized in bulk-materials handling applications. This system gives manufacturers and users a common rating system to reduce the chance for misapplication.

The cradle-classification system is based on the impact energy created by the bulk material to establish a duty rating for the given application. The impact-force requirement is determined for each application by calculating the worst-case impact. For a given application, the impact from both the single largest lump (**Equation 10.1**) (**Figure 10.32**) and a continuous homogeneous flow (**Equation 10.2**) (**Figure 10.33**) should be calculated. Most applications will use the larger of these two forces. The reference numbers for impact force are then used to select one of the three ratings from a chart (**Table 10.3**).

The equations used by CEMA are generally accepted as reasonable approximations of impact forces. The CEMA

Figure 10.31

Impact cradles are available in a track-mounted design, which simplifies replacement of bars when required.

$$F_I = W + \sqrt{2 \cdot k \cdot W \cdot h_d}$$

Given: *A lump of material with a weight (force) of 475 newtons (100 lb$_f$) drops 4 meters (13 ft) onto an impact cradle with an overall spring constant of 1000000 newtons per meter (70000 lb$_f$/ft).* ***Find:*** *The impact force created by the lump of material.*

Variables		Metric Units	Imperial Units
F_I	Impact Force	newtons	pounds-force
k	Spring Constant of System that is Absorbing the Impact	1000000 N/m	70000 lb$_f$/ft
W	Weight (Force) of the Largest Lump of Material	475 N	100 lb$_f$
h_d	Drop Height	4 m	13 ft
Metric: $F_I = 475 + \sqrt{2 \cdot 1000000 \cdot 475 \cdot 4} = 62119$			
Imperial: $F_I = 100 + \sqrt{2 \cdot 70000 \cdot 100 \cdot 13} = 13591$			
F_I	Impact Force	62119 N	13591 lb$_f$

Equation 10.1

Calculating Impact Force from a Single Lump of Material (CEMA STANDARD 575-2000)

STANDARD notes that the impact from a maximum lump size almost always yields the highest impact force and, therefore, should govern the impact rating specified for a given application. A completely thorough analysis would involve adding the force absorbed by the lump with the force absorbed by a stream and cross referencing the force value.

The dimensions for cradle construction are based on CEMA's long-established idler-classification system. They include the ratings: B, C, D, E, or F, followed by the nominal idler diameter as measured in inches (e.g., 5, 6, or 7).

Cradles with Bars and Rollers

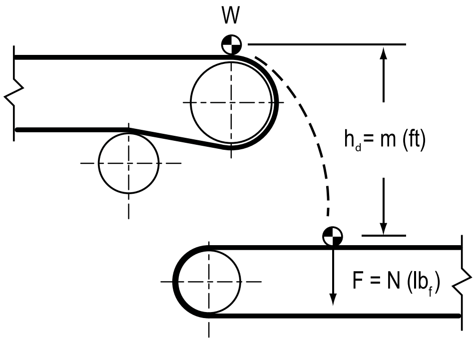
A number of "combination cradle" designs are available, which use bars for a continuous seal at the belt edge but also incorporate rollers under the center of the belt (**Figure 10.34**). These hybrid designs are popular as a way of combining the low power consumption of rollers with the flat sealing surface of impact or slider bars. With a hybrid design, the running friction is kept low by supporting the center of the belt with conventional rollers. This reduces the power consumption of the conveyor. The belt edge is continuously supported, eliminating belt sag between the idlers. This reduces spillage to a mini-

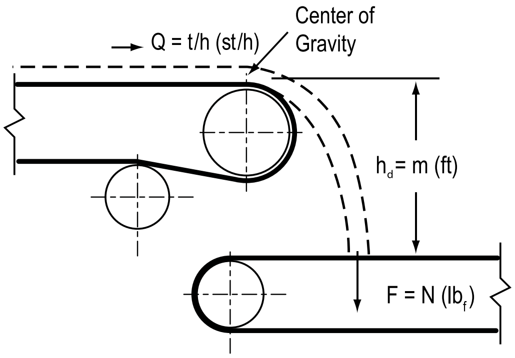
Figure 10.32 (left)

Impact Calculation from the Single Largest Lump

Figure 10.33 (right)

Impact Calculation from a Continuous Homogeneous Flow





Equation 10.2

Calculating Impact Force from a Stream of Material (CEMA STANDARD 575-2000)

$$F_s = k \cdot Q \cdot \sqrt{h_d}$$

Given: *A stream of material drops 4 meters (13 ft) onto an impact cradle at the rate of 2100 tons per hour (2300 st/h).* ***Find:*** *The impact force created by the stream of material.*

Variables		Metric Units	Imperial Units
F_s	Impact Force	newtons	pounds-force
Q	Material Flow	2100 t/h	2300 st/h
h_d	Drop Height	4 m	13 ft
k	Conversion Factor	1,234	0.1389
Metric: $F_s = 1{,}234 \cdot 2100 \cdot \sqrt{4} = 5183$ **Imperial:** $F_s = 0.1389 \cdot 2300 \cdot \sqrt{13} = 1152$			
F_s	Impact Force	5183 N	1152 lb_f

Table 10.3

CEMA STANDARD 575-2000 Impact Bed/Cradle Rating System

Code	Rating	Impact Force (N)	Impact Force (lb_f)
L	Light Duty	<37800	<8500
M	Medium Duty	37800-53400	8500-12000
H	Heavy Duty	53400-75600	12000-17000

Metric conversions added by Martin Engineering.

mum. Since the central rollers operate in a virtually dust-free environment, the life of idler bearings and seals is extended, thus reducing long-term maintenance costs. These designs are most commonly seen on high-speed conveyors operating above 3,8 meters per second (750 ft/min) or applications where there is a heavy material load that would create high levels of friction in the center of the conveyor.

Another possibility is to use cradles incorporating impact bars in the center with short picking idlers closely spaced on the wings. Here the design intention is to provide superior impact cushioning in the center of the belt, while reducing friction on the belt edges.

CRADLE INSTALLATION

Multiple-Cradle Systems

It is often appropriate to install combination systems, incorporating both impact-absorbing cradles and seal-support cradles (**Figure 10.35**). As many impact cradles as necessary should be installed to support the belt to the end of the impact zone. Side-seal-support cradles then complete the system over the distance required to stabilize the load in the skirted area.

These systems provide an efficient way to combine optimum belt support with maximum cost-efficiency in system construction and power consumption.

Cradle Alignment

The impact cradle is usually installed so that the bars in the center of the cradle are set slightly—12 to 25 millimeters (0.5 to 1 in.)— below the normal unloaded line of the belt (**Figure 10.36**). This allows the belt to absorb some of the force of impact when the material loading deflects it down onto the cradle, while avoiding continuous friction and wear on the bars. The wing bars—the bars on the sides of the cradle—should be installed in line with the entry, exit, and intermediate idlers to prevent belt sag and entrapment points (**Figure 10.37**). It is important that the bar directly under the steel chute or skirtboard wall be precisely aligned with the wing idlers.

Cradles can be welded or bolted to the stringers; it may be better to bolt the systems in place, as this will allow more efficient maintenance. Some impact cradles are available in a track-mounted design, which simplifies cradle installation or the replacement of bars when required.

Figure 10.34

"Combination cradles" use bars for a continuous seal at the belt edge and rollers under the center of the belt.

Figure 10.35

Combination systems, incorporating both impact-absorbing cradles and seal-support cradles, can be installed to provide a stable belt line.

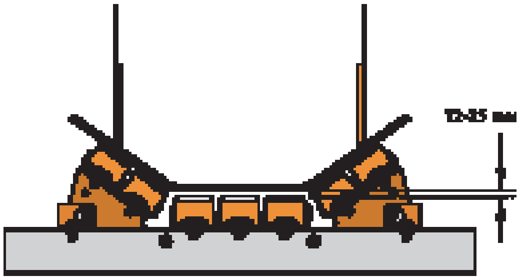


Figure 10.36

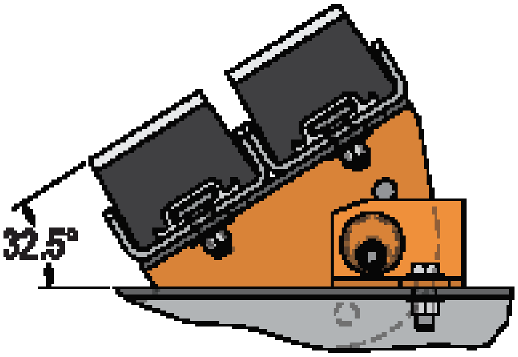
Impact cradles are usually installed so that the bars in the center of the cradle are set 12 to 25 millimeters (0.5 to 1 in.) below the normal unloaded line of the belt.

Figure 10.37

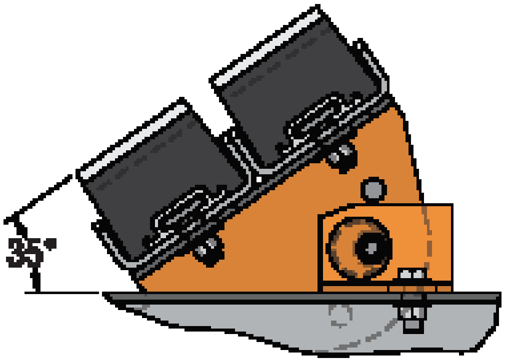
The wing bars of an impact cradle should be installed in line with the entry, exit, and intermediate idlers to prevent belt sag and entrapment points.

Figure 10.38

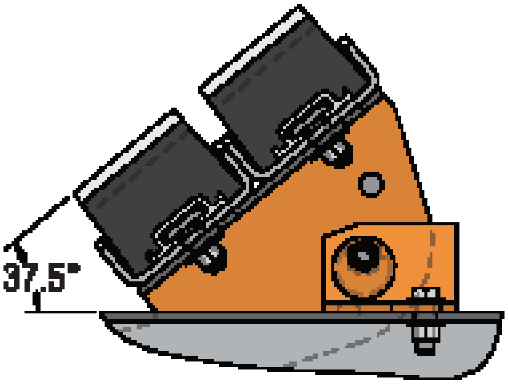
A well-designed impact cradle will simplify installation with the use of adjustable wing supports, which allow the cradle to be placed under the belt before its sides are raised to the appropriate trough angle. Note: adjustment range for a 35° troughing angle is ± 2.5°.



Adjustment Detail 32.5°



Adjustment Detail 35°



Adjustment Detail 37.5°

Figure 10.39

When two or more cradles are installed, the use of intermediate idlers—idlers placed between the adjacent cradles—is recommended.

Installation of impact cradles is simplified through the use of adjustable wing supports, which allow the cradle to be slid under the belt in a flat form; the sides are then raised to the appropriate trough angle (**Figure 10.38**). It is important that the cradle be designed to allow some simple means of adjustment of bar height and angle. This will enable the cradle to work with idlers of varying manufacturers and allow compensation for wear.

Idlers Between Cradles

When two or more cradles are installed, the use of intermediate idlers—that is, idlers placed between the adjacent cradles—is recommended (**Figure 10.39**). Installing an idler set between two cradles (or putting each cradle between two idlers) will reduce the drag of the conveyor belt over the bars. This reduces the conveyor's power consumption. In addition, the heat buildup in the bars will be reduced, giving the bars and belt longer life expectancies.

Idlers should be specified before and after each 1200 millimeter (4 ft) cradle; the number of idler sets required for a given transfer point is the same as the number of cradles required plus one. To ensure uniformity for a stable belt line, all of these idlers should be of the same manufacturer with the same size roller. Impact idlers should be used between cradles under the loading zone; conventional idlers can be used outside the impact area. Track-mounted idlers should be used between cradles to allow for ease of maintenance.

In some impact areas, it may be acceptable to go as far as 2,4 meters (8 ft) between intermediate idlers. These applications might include long loading zones where it is difficult to predict the location of the impact and where rollers might be damaged by point-impact loading. These would also include transfer points under quarry and mine dump hoppers, at pulp and paper mills where logs are dropped onto belts, or at recycling facilities that see heavy objects ranging from car batteries to truck engines dropped on conveyors.

ALTERNATIVE METHODS OF BELT SUPPORT

This book discusses several methods of alternative conveying systems. *(See Chapter 33: Considerations for Specialty Conveyors.)* In addition, there are other methods of supporting conventional belting on more-or-less conventional conveyor structures.

Catenary Idlers

Catenary idlers, sometimes called garland idlers, are sets of rollers—typically, three or five—linked together on a cable, chain, or other flexible connection and suspended from the conveyor structure below the belt (**Figure 10.40**). These idler sets swing freely under the forces of loading material, acting to absorb impact and centralize the load. Their flexible mounting allows the idlers to be quickly moved or serviced and provides some amount of self-centering.

Catenary idlers are typically seen in very heavy-duty applications such as conveyors seeing high impact levels and large volumes of material. Typical installations would include conveyors under the discharge of bucket wheel excavators and under the loading zones of long overland conveyors carrying run-of-mine material (**Figure 10.41**). Catenary idlers are also commonly used in the metalcasting industry.

However, the "bounce" and swing of catenary idlers and the changes this motion can add to the belt path, particularly when the material is loaded off-center, must be considered when engineering a conveyor system (**Figure 10.42**). As the catenary idler swings, the belt moves from side to side. This allows the escape of fugitive material out the sides of the loading zone and creates mistracking that exposes belt edges to damage from the conveyor structure (**Figure 10.43**). Consequently, greater edge distance must be left outside the skirtboard to allow for sealing.

Air-Supported Conveyors

Another concept for stabilizing the belt path is the air-supported belt conveyor. These conveyors replace carrying-side idlers and cradles with a trough-shaped plenum below the belt. The belt is supported by a film of air that is released from the plenum (**Figure 10.44**). *(See Chapter 23: Air-Supported Conveyors.)*

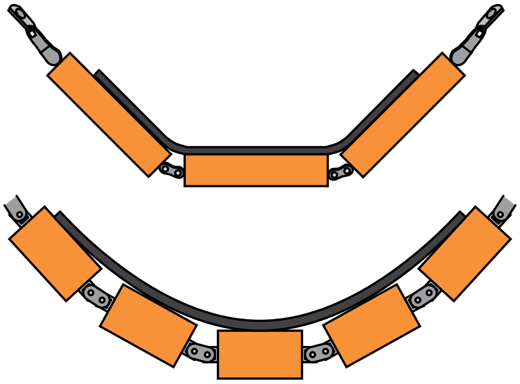


Figure 10.40

Catenary idlers, sometimes called garland idlers, are sets of rollers—typically, three or five—linked together on a cable, chain, or other flexible connection and suspended from the conveyor structure below the belt.

Figure 10.41

Typical installation of catenary idlers include conveyors under the discharge of bucket wheel excavators and under the loading zones of long overland conveyors carrying run-of-mine material.

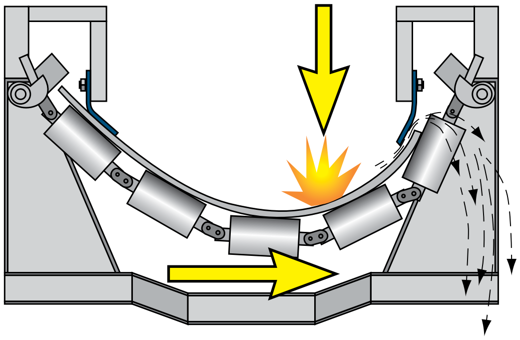


Figure 10.42

Their suspension allows catenary idlers to bounce and swing under loading impact, changing the belt path and making sealing difficult.

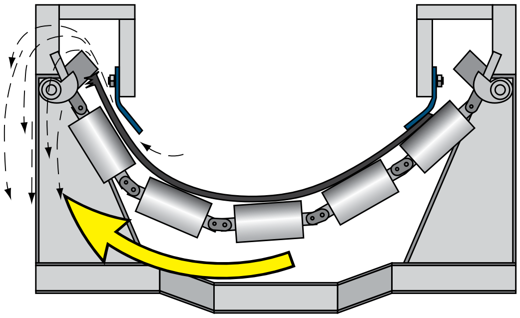


Figure 10.43

As the catenary idler swings, the belt moves from side to side, allowing the escape of fugitive material out the sides of the loading zone and creating mistracking.

SYSTEM MAINTENANCE

A key to providing the proper line and stability for a conveyor is the maintenance on the belt-support systems. Proper maintenance of these components will keep the belt from developing unwanted dynamic action that would defeat the belt-support system's ability to control fugitive materials.

The maintenance procedures required for a conveyor belt-support system will vary by the construction and components of the particular system, but should include the following:

A. Inspection of rolling components—including pulleys and idler "cans" (rollers)—for wear and operation (Do they still roll?)

B. Replacement of "stalled," "seized," damaged, or worn rollers

C. Lubrication of bearings in rolling components as appropriate—some idlers are manufactured as "sealed for life," so no lubrication would be required

D. Inspection of belt-support cradles

E. Adjustment of cradles to compensate for wear

F. Realignment and/or replacement of bars showing abuse or wear

G. Removal of material accumulations from rollers, frames, cradle structure, and support bars as required

It is important to refer to the manufacturer's instructions for the required maintenance for any specific component.

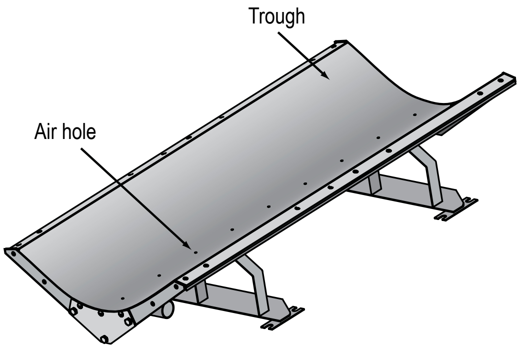


Figure 10.44

Air-supported conveyors stabilize the belt line by supporting the belt with a film of air rising from a trough-shaped pan.

Idlers should not be over-lubricated. This can damage the bearing seals, allowing fugitive materials to enter the bearing, increasing the friction while decreasing life. Excess oil and grease can spill onto the belt where it can attach to the cover, decreasing life. Excess grease can also escape onto handrails, walkways, or floors, making them slippery or hazardous. Idlers equipped with sealed "greased for life" bearings should not be lubricated.

It may be best to select the components of the belt-support system with ease of maintenance in mind. Otherwise, the time required to perform maintenance and/or the difficulty in executing these chores will reduce the likelihood that this essential maintenance will actually be performed.

TYPICAL SPECIFICATIONS

A perfectly flat and straight belt line in the skirted area is essential to successfully seal a transfer point. Belt sag should be minimized to no more than 3 millimeters (0.125 or 1/8 in.) through the load zone. Specifications include the following:

A. Impact cradles in load area

To absorb the shock of loading impact and to stabilize the belt line, full impact cradles should be used under the belt in the direct load area. The impact cradle section should be no longer than 1,2 meters (4 ft.) with an idler installed a minimum of every 1,2 meters.

B. Cradle installation in load area

The cradles should be designed to match the profile of the troughed belt and should be installed so that the bars in the center of the cradle are 12 to 25 millimeters (0.5 to 1 in.) below the normal unloaded track of the belt.

C. Track-mounted cradles

The bars should be installed in a cradle form designed for ease of installation and service without requiring the raising of the belt or the removal of adjacent idlers or the cradle itself. The cradle should be constructed in three track-mounted sections for ease of access and maintenance.

D. Edge-support bars and center-support rollers

In the skirted stabilization area directly after the loading point, seal-support cradles with low friction edge-support bars and center-support rollers should be used.

E. In line with idlers

The cradles should be designed in line with the entry and exit idlers, as well as any intermediate idlers.

F. Method for adjustment

The design should include a method for vertical and radial adjustment of the bar to the belt.

In all cases, the equipment selected must not only provide adequate belt support but must also be able to maintain the belt in constant contact with the skirting system to assure sealing efficiency.

ADVANCED TOPICS

Idler Spacing and Belt Sag

In *BELT CONVEYORS for BULK MATERIALS, Sixth Edition*, CEMA recommends that conveyor belt sag between idlers be limited to 2 percent for 35-degree idlers and 3 percent for 20-degree idlers *(Reference 10.2)*. The CEMA method refers to limiting sag outside the load zone to prevent spillage.

In the load zone, the sag must be much less than that recommended by CEMA to

SAFETY CONCERNS

Workers must be aware of the following hazards specific to the loading zone and trained to perform inspections, cleaning, and maintenance in a safe manner:

A. Pinch Points

A moving belt creates pinch or nip point hazards between the rotating and stationary components of the load zone.

B. Heavy Components

Many of the belt-support and load-zone components are heavy, creating lifting hazards.

C. Tight Quarters

Load zones are often in tight quarters with limited access, areas that are sometimes considered confined spaces.

D. Water, Snow, or Ice

Load zones are often in locations exposed to weather, so they are subject to accumulations of water, snow, or ice, creating additional slip, trip, and fall hazards.

E. Storage Area

The open area around the tail end of the conveyor and the load zone often becomes a storage area for spare and replaced equipment. This practice creates trip and fall hazards around load zones.

F. Auxiliary Equipment

Auxiliary equipment is often automated and can start without warning, creating potentially dangerous situations.

Established lockout /tagout / blockout / testout procedures must be followed before adjusting or maintaining any belt-support system. It is important to ensure the area is clear of obstructions and to follow all confined-space entry requirements.

prevent spillage; dusting; and wear of the belt, wear liner, and skirt seal. For example (**Equation 10.3**), using the CEMA method results in recommended maximum sag between idlers of 12,5 millimeters (0.5 in.) for 35-degree idlers and 19 millimeters (0.75 in.) for 20-degree idlers. This is clearly unacceptable sag for control of fugitive materials in the load zone.

Sag (ΔY_s) is proportional to the weight (force) of the belt and bulk material (W_b + W_m) [newtons (lb_f)] and the idler spacing (S_i) [millimeters (in.)], and it is inversely proportional to the minimum belt tension in the load zone (T_m) [newtons (lb_f)] (**Equation 10.3**). To control fugitive materials, it is recommended that the designer manage the belt tension and idler spacing in the load zone to keep belt sag at no more than 3 millimeters (0.12 in.) and preferably 0.0. Even with very little sag, if belt support is not continuous, fugitive materials can escape and cause wear.

The example (**Equation 10.3**) shows that with idler spacing of 600 millimeters (24 in.), there is 3,37 millimeter (0.135 in.) of sag. If the idler spacing in the example is reduced to 178 millimeters (7 in.), belt sag drops to 1,0 millimeter (0.039 in.).

If a belt-support system such as an impact cradle or air-supported conveyor section is used, idler spacing (S_i) can be assumed to be 0.0; the calculation then yields belt sag of 0.0, because there should be no sag when the belt is a continuous, flat surface.

Cradles and Power Requirements

Belt-support systems have a significant effect on the power requirements of a conveyor. Changes in belt support will have a particularly noticeable effect on short or under-powered systems. It is recommended that the theoretical power requirements of proposed changes in belt-support systems be calculated to ensure there is adequate conveyor drive power available to compensate for the additional friction placed on the conveyor.

Added kilowatts (hp) consumption can be calculated by determining the added belt tension, using the standard methods

Equation 10.3

Calculating Belt Sag

$$\Delta Y_s = \frac{(W_b + W_m) \cdot S_i \cdot k}{T_m}$$

Given: A belt that weighs 550 newtons per meter (38 lb_f/ft) is carrying 3000 newtons per meter (205 lb_f/ft) of material. The idlers are spaced at 600 millimeters (2 ft) and the tension in the area is 24000 newtons (5400 lb_f). Find: The belt sag.

Variables		Metric Units	Imperial Units
ΔY_s	Belt Sag	millimeters	inches
W_b	Weight (Force) of the Belt per Length of Belt	550 N/m	38 lb_f/ft
W_m	Weight (Force) of the Material per Length of Belt	3000 N/m	205 lb_f/ft
S_i	Idler Spacing	600 mm	2 ft
T_m	Belt Tension	24000 N	5400 lb_f
k	Conversion Factor	0,038	1.5

$$\text{Metric: } \Delta Y_s = \frac{(550 + 3000) \cdot 600 \cdot 0{,}038}{24000} = 3{,}37$$

$$\text{Imperial: } \Delta Y_s = \frac{(38 + 205) \cdot 2 \cdot 1.5}{5400} = 0.135$$

ΔY_s	Belt Sag	3,37 mm	0.135 in.

recommended by CEMA. The coefficient of friction of the new (or proposed) support systems, multiplied by the load placed on the belt support from belt weight, material load, and sealing system, equals the tension. There is no need to allow for the removal of idlers, the incline of the conveyor, or other possible factors, as estimates provided by this method will in most cases produce results higher than the power consumption experienced in actual use. In applications where there is a lubricant, such as water, consistently present, the actual power requirements may be one-half, or even less, of the amount estimated through these calculations.

The tension added by a skirtboard sealing-support system can be calculated (**Equation 10.4**).

The tension added by an impact bed can be calculated (**Equation 10.5**).

The tensions due to the impact bed and the support bed can be related to the power requirements added to the drive on a conveyor belt (**Equation 10.6**).

PAY NOW, OR PAY (MORE) LATER

In Closing...

Seemingly simple changes in a conveyor system such as changing the belt specification or adding belt support can result in dramatic changes in the drive power required.

In its sixth edition of *BELT CONVEYORS for BULK MATERIALS*, CEMA details a relatively complex formula for determining conveyor belt tension and power requirements. Current conveyor engineering computer software offers similar equations and, given the proper data, will perform the calculation.

The installation of improved belt-support systems can increase the conveyor's drive power requirements. However, the true implications of improved belt-support systems are seen when they are compared to the power consumption of a conveyor where idler bearings drag or the idlers themselves build up with material due to transfer-point spillage induced by belt sag.

As demonstrated by R. Todd Swinderman in the paper "The Conveyor Drive Power Consumption of Belt Cleaners" *(Reference 10.3)*, "Fugitive material can also impair the operation of conveyor systems, increasing power consumption significantly." For example, Swinderman calculated that a single frozen impact idler set would require approximately 1,2 kilowatt additional power (1.6 hp), while a seized steel idler set can demand as much as 0,27

$$\Delta T_s = (W_b \cdot L_b \cdot 0.1) + (F_{ss} \cdot 2 \cdot L_b)$$

Given: *A conveyor belt weighing 130 newtons per meter (9 lb_f/ft) is supported under the seal for 6 meters (20 ft). The seal presses on the belt with a force of 45 newtons per meter (3 lb_f/ft).*
Find: *Tension added to the belt due to the sealing support.*

Variables		Metric Units	Imperial Units
ΔT_s	Tension Added to the Belt due to the Sealing Support	newtons	pounds-force
W_b	Weight (Force) of the Belt per Length of Belt	130 N/m	9 lb_f/ft
F_{ss}	Rubber Strip Sealing Load	45 N/m	3 lb_f/ft
L_b	Length Belt Support	6 m	20 ft

Metric: $\Delta T_s = (130 \cdot 6 \cdot 0,1) + (45 \cdot 2 \cdot 6) = 618$

Imperial: $\Delta T_s = (9 \cdot 20 \cdot 0.1) + (3 \cdot 2 \cdot 20) = 138$

ΔT_s	Tension Added to the Belt due to the Sealing Support	618 N	138 lb_f

Equation 10.4

Calculating the Tension Added to the Belt due to Sealing Support

Equation 10.5

Calculating Tension Added to the Belt due to the Impact Bed

$$\Delta T_{IB} = (W_b \cdot L_b) + (F_{ss} \cdot 2 \cdot L_b) + \left(\frac{Q \cdot L_b \cdot k}{V} \right)$$

Given: *A conveyor belt weighing 130 newtons per meter (9 lb_f/ft) is supported by an impact bed for 1,5 meters (5 ft). The seal presses on the belt with a force of 45 newtons per meter (3 lb_f/ft). The belt carries 275 tons per hour (300 st/h) and travels at 1,25 meters per second (250 ft/min).* ***Find:*** *Tension added to the belt due to the impact bed.*

Variables		Metric	Imperial
ΔT_{IB}	Tension Added to the Belt due to the Impact Bed	newtons	pounds-force
W_b	Weight (Force) of the Belt per Length of Belt	130 N/m	9 lb_f/ft
L_b	Length Belt Support	1,5 m	5 ft
F_{ss}	Rubber Strip Sealing Load	45 N/m	3 lb_f/ft
Q	Material Flow	275 t/h	300 st/h
V	Belt Speed	1,25 m/s	250 ft/min
k	Conversion Factor	2,725	33.33

$$\text{Metric: } \Delta T_{IB} = (130 \cdot 1{,}5) + (45 \cdot 2 \cdot 1{,}5) + \left(\frac{275 \cdot 1{,}5 \cdot 2{,}725}{1{,}25} \right) = 1230$$

$$\text{Imperial: } \Delta T_{IB} = (9 \cdot 5) + (3 \cdot 2 \cdot 5) + \left(\frac{300 \cdot 5 \cdot 33.33}{250} \right) = 275$$

ΔT_{IB}	Tension Added to the Belt due to the Impact Bed	1230 N	275 lb_f

Equation 10.6

Calculating the Power Consumption Added to the Belt Drive due to Sealing and Impact Support

$$P = (\Delta T_S + \Delta T_{IB}) \cdot V \cdot \mu_{ss} \cdot k$$

Given: *A conveyor belt traveling 1,25 meters per second (250 ft/min) is supported by an impact bed and a seal-support system that add 1230 newtons (275 lb_f) and 618 newtons (138 lb_f) respectively. The support systems use a UHMW sliding surface.* ***Find:*** *The power consumption added to the drive due to the sealing and impact support.*

Variables		Metric Units	Imperial Units
P	Power Consumption Added to Belt Drive	kilowatts	horsepower
ΔT_S	Tension Added to the Belt due to the Sealing Support *(Calculated in Equation 10.4)*	618 N	138 lb_f
ΔT_{IB}	Tension Added to the Belt due to the Impact Bed *(Calculated in Equation 10.5)*	1230 N	275 lb_f
V	Belt Speed	1,25 m/s	250 ft/min
μ_{ss}	Friction Coefficient Per CEMA 575-2000	0,5 – UHMW 1,0 – Polyurethane 1,0 – Rubber	0.5 – UHMW 1.0 – Polyurethane 1.0 – Rubber
k	Conversion Factor	1/1000	1/33000

$$\text{Metric: } P = \frac{(618 + 1230) \cdot 1{,}25 \cdot 0{,}5}{1000} = 1{,}15$$

$$\text{Imperial: } P = \frac{(138 + 275) \cdot 250 \cdot 0.5}{33000} = 1.56$$

P	Power Consumption Added to Belt Drive	1,15 kW	1.56 hp

kilowatts (0.36 hp). One idler with a 25 millimeter (1 in.) accumulation of material would add 0,32 kilowatt additional power (0.43 hp) to the conveyor's drive requirements. These additional requirements would be multiplied by the number of idlers affected.

The use of improved belt support and sealing techniques places additional requirements on conveyor drive systems. However, these additional requirements and costs will seem minor when compared to the power consumed by operating with one "frozen" idler or several idlers operating with a material accumulation. By implementing the proper belt-support systems, a plant can prevent the many and more costly problems that arise from the escape of fugitive material.

It would be better to design a system that incorporates the slightly elevated power consumption required to prevent spillage, rather than suffer the much higher power consumption and greater consequences that arise from fugitive material. The costs for installation and operation of proper belt-support systems represent an investment in efficiency.

Looking Ahead...

This chapter about Belt Support, the fifth chapter in the section Loading the Belt, discussed the importance of proper belt-support systems to maintain a stable belt line to prevent fugitive material and dust. The following three chapters continue this section and discuss additional ways to prevent spillage, focusing on Skirtboards, Wear Liners, and Edge-Sealing Systems.

REFERENCES

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