Conveyor Equipment Manufacturers Association

2019 CEMA ENGINEERING CONFERENCE

BULK CONVEYOR ACCESSORIES COMMITTEE MEETING

La Playa Hotel, Naples, FL

Tuesday, June 25, 2019 – 1:00 pm

AGENDA

1. Call to order

2. Attendance and Introductions

3. Review and Approval of June 26, 2018 Minutes (attached) – Amendment needed

4. Old Business
   a) Update on review of Belt Mistracking Allowance incorporated in **Skirtboard Sealing Best Practices** (attached)
   b) Emerging Technologies Committee tasked to Accessories Committee to review **Skirtboard and Skirting Pressure Calcs and Resultant Drag** from the Belt Book and to revise and expand as required.
   c) Review submitted "**Tracking and Training Devices**" document – Updates. Training devices pictures received attached, Belt Book Discrepancies (attached)
   d) From Emerging Technologies Committee: Address concerns that Accessories Manufacturers may not be keeping up with **Higher Speed Belts**. (Std. 575-2013).
   e) **Errata fixes and minor revisions are being incorporated into 2nd printing of 7th Edition of the Belt Book**. The 2nd printing will reflect the newer methods of impact bed energy calcs discussed in CEMA Std. 575-2013. Therefore, CEMA Std. 575 -2013 needs to be reviewed for accuracy. Discuss recommended changes and make decision regarding appropriate W_e formula. (See Std. 575 attached and Figure 11.48 from Belt Book)
   f) **CEMA No. 576** – Review updates. See New Business.
   g) **Discrepancies in the 7th Edition Belt Book when recommending training idler spacing** – Updates.

5. New Business
   a) **CEMA White Paper** – Volunteers needed
   b) **CEMA Std. 575 (2013)** – ANSI Revision due 2019 (CEMA Std 575-2019 - Draft 2 attached)
   c) **CEMA Std. 576 (2013)** – ANSI Revision due 2019 (CEMA Std. 576-2019 - Draft 1 attached)

6. Next Meeting – June 16, 2020, La Playa Hotel, Naples, FL

7. Adjourn

Greg Westphall, Chair
Lee Williams, Vice Chair

MINUTES OF THE CEMA ENGINEERING CONFERENCE

BULK CONVEYOR ACCESSORIES COMMITTEE MEETING

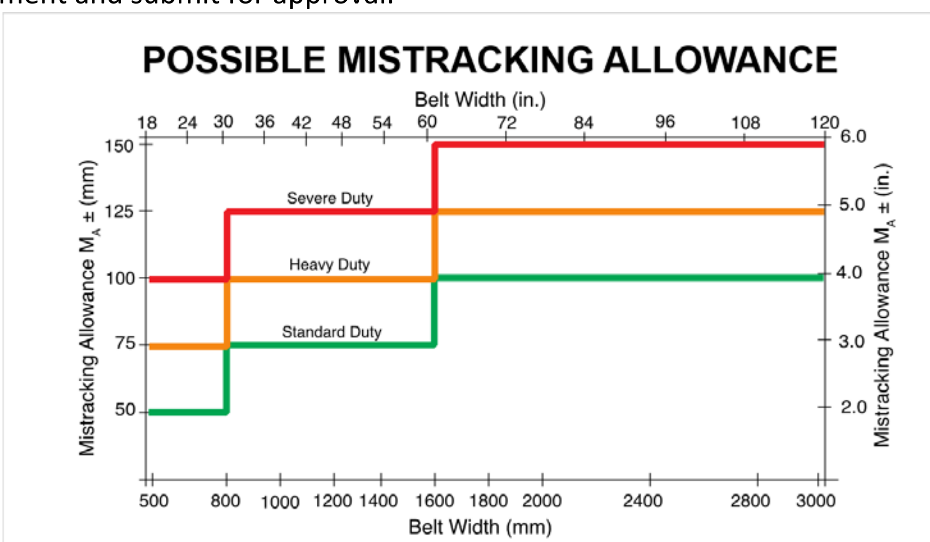
Tuesday, June 26, 2018

1. Call to Order
   Committee Chair Greg Westphall, FLEXCO; and Bruce Antonioli, ASGCO; Acting Vice Chair, called the meeting to order at 1:00 pm.

2. Roll call and introductions – Forty-nine (49) attendees (attached).

3. Minutes from the June 27, 2017 were reviewed and approved.

4. Old Business
   a) Update on review of Belt Mistracking Allowance incorporated in **Skirtboard Sealing Best Practices**.
      Sub-Committee: Lee Williams, ASGCO (Chair). Members: Matt Koca & Brett DeVries, FLEXCO; Scott Smith, Richwood; Robin Steven, ContiTech North America, Inc.; Todd Swinderman, RToddS Engineering, LLC.; Akiko Wakatsuki, Fenner Dunlop.
      - Discussed belt mistracking as it relates to the Skirtboard Best Practices Document. Consensus on 2/3 Belt Width is a good baseline for setting skirting width but Duty Rating as present in Todd's Power Point, slide #10, which graphically shows mis-tracking allowance by duty (standard, heavy, severe), is a good 'go-by' for those not familiar with CEMA. Sub-Committee will incorporate this into the Best Practices Document and submit for approval.



b) Emerging Technologies Committee tasked to Accessories Committee to review **Skirtboard and Skirting Pressure Calcs and Resultant Drag** from the Belt Book and to revise and expand as required.

Sub-Committee: Andrew Hustrulid, Shaw Almex Industries; Edward Sunseri, Applied Conveyor Technology, Inc.; Scott Smith, Richwood; Todd Swinderman, RToddS Engineering, LLC.; Brett DeVries, FLEXCO.

- Skirtboard Resistance. Ref. page 539 in the CEMA belt book. It was mentioned that a default pressure of **6 psi** has been used in place of using the equation for Hydrostatic pressure on skirtboards (Eq. 12.78). Other members use 2-3 psi.
- Sub-Committee formed to investigate the validity of using the SB Resistance and Seal 'drag' equations.

c) Consider implication of **High Speed and High Tonnage Belts** as it pertains to CEMA Std. 575-2013.

- Discussed CEMA Std. 575-2013 as it relates to high speed belts. The main issue with high speed belts is the buildup of heat, which creates problems for some of the materials used in the impact bed and slider bed construction. Discussions took place regarding whether a recommendation should be written into the standard to call a CEMA member for assistance above a certain speed. Consensus was that "NO STATEMENT IS REQUIRED".

d) Review submitted "**Tracking and Training Devices**" document.

- A request for images of Belt Tracking Devices (i.e. Pivot Trainers, Tru-Trainers, etc). Attendees from ASGCO, Richwood, and FLEXCO indicated they could send additional images.

e) A discussion took place regarding concerns that the Accessories Manufacturers may not be keeping up with **Higher Speed Belts.**

- The committee feels the Accessories Manufacturers need to provide solutions for higher speed belts. Duly Noted.

5. New Business

a) **CEMA Whitepaper – Volunteers needed**.

- Safety & Maintenance…. done by Todd Swinderman, RToddS Engineering, LLC.
- Lock out/ tag out…. No volunteer at this time!

b) Errata fixes and minor revisions are being incorporated into 2nd printing of 7th Edition of the Belt Book. The 2nd printing will reflect the newer methods of impact bed energy calcs discussed in CEMA 575-2013. Therefore, **CEMA 575 -2013 needs to be reviewed for accuracy**.

- Naylu has asked for consistency in verbiage between printings.
- Richwood attendees (Geoff Stoll, Blaine Stoll, Joshua Stoll, Scott Smith, Cecil Ferguson, Judd Roseberry) volunteered to review CEMA Std's 575 & 576 for inconsistencies per Naylu's request.

c) **CEMA No. 576** – Proposal Review for same reason as 6b above.

- Same answer above.

d) Discrepancies in the 7th Edition Belt Book when recommending **Training Idler Spacing** (Chapter 5, page 96).

- There have been some inconsistencies regarding spacing of Training Idlers.

- Jim Masek, Precision Pulley and Idler Co. (PPI); from the Idler Committee volunteered to review Belt Book and offer suggestion of rewording.

e) **TIR Classification**

- A discussion took place regarding the CEMA class pulley and what specification should follow.
- Rick Tschantz, Imperial Technologies, Inc. volunteered to investigate this.

6. The next scheduled meeting will be on June 25, 2019 at La Playa Hotel, Naples, FL.

7. Meeting was adjourned at 2:15 pm.

Respectfully submitted,
Greg Westphall, Chair
Bruce Antonioli, Acting Vice Chair

Skirtboard Sealing

Best Practices Approach

05/30/2019 Draft 1

Scope/Purpose: The purpose of this document is to provide instruction for specifying skirtboard systems for new conveyors during the design process. For those applications where dust and spillage are of primary concern, wider belt widths must be employed to provide ample working clearance for all components to function as intended and still maintain throughput. Retrofitting skirtboard systems into existing designs brings about special challenges. Depending upon belt and pulley widths, trade-offs may need to be made between load zone throughput and sealing efficiency. Please consult a CEMA member company for assistance in specifying systems where applications may not be able to accommodate the recommendations listed in this document. References to allowances for mistracking are for load zone areas only and not to be used for other sections of the conveyor.

The primary purpose of a skirtboard is to keep the load on the conveyor, preventing material spillage over the belt edge, while the load is settling onto the belt and material has reached belt speed. Best practices in chute and skirtboard design now provide the opportunity for much cleaner and more efficient material handling system.

The skirtboard and the wear liner placed inside the skirtboard combine with an elastomer sealing system to form a multiple-layer seal. The elastomer seal should not be expected to withstand material side pressures or pieces of material larger than small fines. The skirtboard and wear liner form the first line of defense intended to contain fugitive material and prevent material head pressure from contacting the sealing system. To avoid entrapment of material between skirtboards, wear liner, and belt, skirtboards should be installed so they taper upwards providing increased clearance from the belt (vertical).

Inadequately sized skirtboard always leads to poor conveyor performance in form of material spillage, excessive dust, and higher operating cost by the end user.

Proper Skirtboard Size:

Length- Refers to additional length of steel beyond the impact zone. Skirtboard should extend past point where material fully settles onto the profile. The length needed for the bulk material to reach receiving belt speed and settle into the surcharge profile is calculated in the equation below (Eq. 12.45 p.513 Belt Book).

$$L_a = \frac{V_b^2 - V_{ey}^2}{2g\ (\mu_b - \tan(\Theta))}$$

L_a = distance to accelerate bulk material to receiving belt speed

g = acceleration due to gravity

μ_b = effective coefficient of friction between bulk solids, skirtboards and belt

Θ = angle of inclination of receiving conveyor

V_b = velocity of receiving belt

V_{ey} = vertical velocity of bulk material as it leaves discharge chute

If difference between V_b and V_{ey} is small and receiving belt flat, La= 2 ft. per 100 ft./min belt speed, with minimum 3 feet past loading chute

It is good practice to terminate skirtboards above an idler rather than between idlers to prevent spillage or belt damage.

Width- The CEMA 7th Edition Belt Book recommends the distance between skirtboards to be 2/3 width of troughed belt. There are some circumstances where this recommendation is impractical. Ideally, the skirting system width must be sized to allow for proper function under all normal operating conditions. The designer must use a systems design approach, sizing all of the components in the load zone to work in harmony with each other. Belt width, pulley width, load zone requirements, throughput and belt mistracking allowances are all considerations in this decision. To assist the designer CEMA has developed guidelines to determine belt mistracking allowances based upon Duty class and Belt Width. Using Table in Figure 1 below select the Duty Class based upon Application Description. The Mistracking Allowance can then be determined by using the Graph in Figure 2 along with the Belt Width and Duty Class. Reducing belt width to save money when spillage and sealing are of primary concern will end up costing more in the end.

MISTRACKING ALLOWANCE CLASSES

Mistracking Allowance Class	Description
Standard Duty	• 90% Fines, BW≦ 1600, $V_b \leqq 2.5$ m/s • Free Flowing Bulk Materials • Central & Consistent Loading, Ambient Temperatures • Grains, Clean Coal Packaging Conveyors, Reject Conveyors • Good Maintenance
Heavy Duty	• All Lumps ≤ 20 degree surcharge, BW 800 to 1600, $V_b \leqq$ 5m/s • Sticky, Wet or Interlocking Bulk Materials • Central loading, variable throughput, -20 to + 40 ∘C • Main process conveyors, Quarries, Power, Cement, Steel, Fertilizer, Wood Chips, Hog Fuel, Clay, Secondary Crushers • Average Maintenance
Severe Duty	• All Lumps ≤ 30 degree surcharge, BW ≥ 2000, V_b > 5m/s • Difficult Materials, Run of Mine, Primary Crushers • Off-Center Loading, Tropical or Artic Conditions • Portable Conveyors, Open Cast Mining, Underground Mining, Overland Conveyors, Hard Rock Mining, Stackers/Reclaimers/Trippers • Poor Maintenance

Figure 1

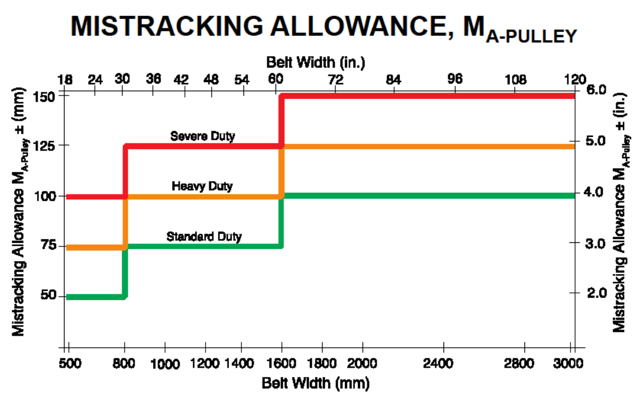


Figure 2

Under no circumstances should the belt be allowed to mistrack under the skirtboards or beyond the edge of the pulley face or severe damage to the system may occur. Belts that mistrack under the skirtboard may not be able to re-establish sealing. Wear liner thickness, skirtboard structure thickness, and seal thickness need to be taken into consideration as these items increase the overall sealing system width and reduce the actual mistracking allowance further. If upon commissioning the belt mistracks beyond the allowance, training devices or adjustments in pulley, idlers and structure alignment must be taken. If conditions exist where the mistracking allowance cannot be maintained special accommodations in the skirtboard sealing system must be made to allow for disengagement and reengagement. May be more effective to recommend amount of free belt edge distance minimum required for belt edge seal and belt mistracking; acceptable amount of belt mistracking is 1.00” (25mm).

Height- Contributing factors effecting height of skirtboard include belt width and speed, material lumps and air speed at discharge. Skirtboard should be tall enough to contain the material load when belt is operating at normal capacity and to pass two of largest lumps stacked on top of each other without jamming. CEMA has published a table specifying minimum height for uncovered skirtboards (Table 12.47 p.515 Belt Book). For dusty materials, it is a good practice to increase height of skirted area to create an added space to reduce positive air pressure. This area serves to "still" dust laden air so particles can fall back onto the cargo of the conveyor. To control dust, the cross-sectional area of the chute should be sized to keep the exit air velocity below 200-250 fpm. If this maximum exit velocity cannot be achieved, then mechanical dust suppression or collection is necessary.

Purpose of Wear Liner

A. Provides sacrificial, easily replaceable wear surface protecting wall of the chute and skirtboard
B. Helps center the material load
C. Prevents material load from applying high side forces to sealing strips
D. Can reduce friction, impact, noise, and degradation of bulk material

Wear Liners-4 styles: straight, spaced, deflector, tapered

Straight Wear Liner- Real benefit is it provides improved life and improved sealing effectiveness without closing down the effective load area. Best for belts with multiple load points.

Spaced Wear Liner- Variation of straight where a space is created between the skirtboard and liner used as a negative pressure area. Fines and dust can be pulled from this space by a dust collection system.

Defector Wear Liner- Bend inward at bottom half of liner- provides free area between elastomer seal and liner for collecting fines for the outer seal to handle without the outward forces of material load. Reduces effective cross-sectional area of the skirtboard area.

Tapered Wear Liner- Cast from Molybdenum steel for use in heavy-duty applications. The cross section is trapezoidal to reduce the gap where the bottom edge meets the belt, skirtboard, and skirting seal. They are heavy and supplied in short lengths, therefore difficult to keep bottom edges in a smooth straight line.

Edge Sealing Systems

Effective sealing at the edge of a belt requires a properly supported belt, wear liners, skirtboards, and an edge seal. A number of engineered sealing systems are now commercially available. These systems consist of a strip of elastomer attached to the lower portion of the skirtboard by an arrangement of clamps. Effective sealing requires an adequate amount of free belt distance. Free belt distance, amount of belt outside the skirtboard on both sides of the conveyor, provides space for the sealing system and belt mistracking. A good practice is to use a minimum of 3.50" (90mm) for the sealing system and 1.00" (25mm) for belt mistracking. The seal should start in the loading area and continue to the end of the settling zone.

There are a number of different approaches to skirtboard sealing. The best way to define these systems is to describe where each contacts the belt.

Vertical Sealing- This type of sealing arrangement uses a single rubber or elastomer sealing strip attached to the skirtboard with some type of clamp.

Advantages:

1. Low in cost
2. Minimal free belt edge required
3. Can be self-adjusting

Disadvantages:

1. Difficult to adjust accurately
2. Easily over adjusted causing premature wear
3. Prone to material entrapment
4. Susceptible to leakage of dust and fines

Inward Sealing- This type of seal contains an elastomer seal clamped to the outside of the skirtboard with the lower portion curled back under the steel.

Advantages:

1. Self-adjusting
2. Require limited free belt edge distance
3. Handle light fluffy and fine non-abrasive materials
4. Handle high internal chute pressure
5. Handle severely mistracking belts

Disadvantages:

1. Shorter seal life due to being in material flow
2. Prone to material entrapment under sealing strip-leads to premature belt wear
3. Reduced carrying capacity due to space taken up by the seal where the load could be carried

Outward Sealing- Type of system that seals on the outside of skirtboard. The most effective is a multi-layered seal containing a primary strip which contains most of the material escaping past wear liner and secondary seal containing fines and dust.

Advantages:

1. Long lasting- positioned away from material flow and protected by skirtboard and wear liner
2. Can be self-adjusting
3. Low required sealing pressure due to multiple layered sealing design
4. Adapt to existing clamp system

Disadvantages:

1. Require greater free belt edge distance
2. Susceptible to damage if belt mistracks underneath seal

The skirtboard seal should not be the first line of defense in preventing material spillage, but rather a last chance to contain fugitive material and prevent its release. The better job done by the belt support and wear liner systems to contain material and keep it away from the belt edge, the better the performance will be of the belt's edge sealing system. A multi-layer flexible seal incorporating some self- adjustment will provide effective material containment for a transfer point. Maintenance and periodic inspection are also important to extend the life of the conveyor's sealing system.

BELT TRACKING AND TRAINING DEVICES

All conveyor belts in a conveyor system may have a nominal amount of wander during normal operation. Material spillage and/or damage to the belt, structure, and conveyor components may occur when the belt wanders beyond its design limits. Proper belt tracking is critical to maintain the safe and efficient operation of any conveyor system. Following the guidelines detailed in Chapter 5 on belt alignment and Chapter 12 on proper belt loading to determine the root cause of the belt misalignment should correct many issues with belt tracking.

In some instances the belt may still wander beyond design limits despite any efforts at belt alignment and proper loading. In these instances, a belt tracking or training device may be used.

Definition

A belt tracking or training device is an accessory or system used to center the belt on the structure when the belt has a tendency to wander beyond its design limits

CEMA Recommendations

- Before installing a tracking or training device or system, attempt to properly align the belt using the guidelines detailed in Chapter 5 on belt alignment and Chapter 12 on proper loading.
- Before installing a tracking or training device or system, the main rotating components of the conveyor system (idlers, pulleys) should be returned to their neutral position. That is, these components should be squared to the structure and centered within the structure within the tolerances as specified in Appendix D.
- Each one direction conveyor should have a minimum of one tracking or training device or system installed on the return belt prior to entering the tail pulley.
- Each reversing conveyor should have a minimum of two reversing tracking or training devices or systems installed on the return belt, one prior to entering the tail pulley and one after exit of the discharge pulley.
- Allowance should be made for one return belt tracker or trainer and one carry side tracker or trainer for every 50 ft of conveyor or in accordance with the manufacturer’s specific recommendations.

Types of Devices

There are many types of tracking and training devices available from CEMA member companies. They can be divided into three main types: active devices, passive tension devices, and brute force devices. Active devices detect when the belt has wandered beyond design limits and respond in some manner to correct the misalignment. These devices include Return Belt Center Pivot Trainers, Carrying Side Belt Center Pivot Trainers, and Powered Automatic Belt Training Systems. Passive devices use belt tension to maintain the belt in alignment. These devices include Hold Down Rollers, Biased Idlers, V Return Idlers, Crown Pulleys, and Inverted Arc Return Belt Trackers. Brute force devices apply pressure to the edge of the belt to force it into alignment. These devices include Edge Guide Rollers and Brute Force Tracking Systems. Devices applying direct pressure on the edge of the belt, such as Brute Force Devices and Edge Guide Rollers, should be used as a last resort as they may cause damage to the belt edges.

Final Notes

The root cause of the belt wander should be determined first and all methods of correcting the root cause should be attempted before alternate solutions are used. Skewing or “knocking” carrying and return idlers is a common practice and can be used to correct minor variations in belt tracking, however, when the belt wanders beyond design limits, skewing idlers is not an effective method of alignment. Skewing idlers creates additional tension and drag on the conveyor system and can reduce component life. Belt tracking and training devices can be used to correct belt wander when other methods have failed.

To function properly, belt tracking and training devices need to be properly maintained according to the manufactures recommendation. Active devices with unlubricated or frozen pivots cannot properly respond to belt misalignments. Active devices should never be “tied off” as they will no longer be able to respond to variations in belt wander and may create excessive drag on the conveyor system. Worn or frozen rotating components should be replaced to maintain proper function of the device.

Inverted Arc Return Belt Trainer

Return Side Center Pivot Trainer

Carry Side Center Pivot Trainer

Carry Side Center Pivot Trainer

Carry Side Center Pivot Tracker

Return Side Trainer

Q = 2,500 tph (2268mtph) 8-inch (200 mm) minus ore 120 lbf/ft^3 (1,922 kgf/m^3)

h = 12.0 ft (3.7 m) k = 5,833 lbf/in CEMA D6 idlers used

$\therefore$ Largest lump could equal a slab 3 x nominal size: $\dfrac{8\text{ in} \times 8\text{ in} \times 24\text{ in}}{1728 \frac{\text{in}^3}{\text{ft}^3}} = 0.89\text{ ft}^3$

$W = 0.89\text{ ft}^3 \times 120 \dfrac{\text{lbf}}{\text{ft}^3} = 106.8\text{ lbf}$

$W_e = \dfrac{Q^2}{k} = 8.03 \times 10^{-4} \dfrac{h^2 \times \text{lbf}^2}{t^2 \times s^2} \times \dfrac{(2500\text{ tph})^2}{5833\text{ lbf-ft}} = 0.86\text{ lbf}$

Impact energy from the homogenous stream, IE = $W_e \times h$ = 0.86 lbf $\times$ 12.0 ft = 10.3 lbf-ft

Impact energy from single lump, IE = W $\times$ h = 106.8 lbf $\times$ 12.0 ft = 1282 lbf-ft

$\therefore$ Rating based on lump impact 1282 lbf-ft (1739 N-m) or "H-D6" for Heavy Duty & use CEMA D6 idler dimensions

Note: Conversion factors for Equation 11.47 $8.03 \times 10^{-4} \dfrac{h^2 \text{ x lbf}^2}{t^2 \text{ x } s^2}$ $\left(0.1457 \dfrac{h^2 \text{ x kg}^2}{t^2 \text{ x } s^2}\right)$

Figure 11.48
Example impact bed/cradle rating

Slider Beds

Slider beds are similar in design to impact beds but do not have the built in ability to absorb impact. They are typically used in applications where impact, as defined in CEMA Standard 575-2013 or the latest version, is considered light-duty. There are some applications where the nature of the bulk material and the environment makes the use of impact cradles less desirable than a heavy-duty slider bed. A very common adaptation of the slider bed is for belt edge support to facilitate sealing of the belt at the skirtboard by eliminating belt sag.

Definition

A slider bed is a support under the carrying side of the conveyor belt that is designed to handle the sliding load of the belt and the bulk solid.

CEMA Recommendation

- Contact a CEMA member for a review of your application to see if a slider bed is an appropriate option.
- When using slider beds consider the additional power that may be required.

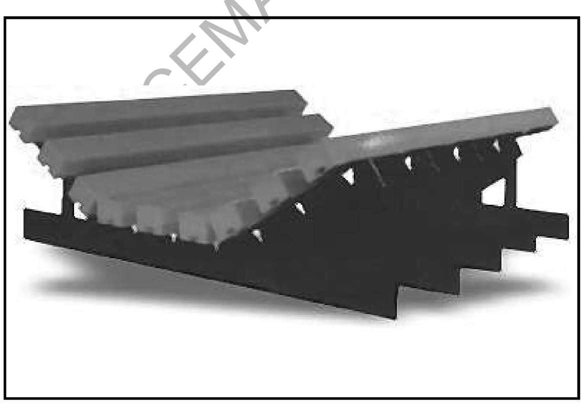


Figure 11.49
Slider bed

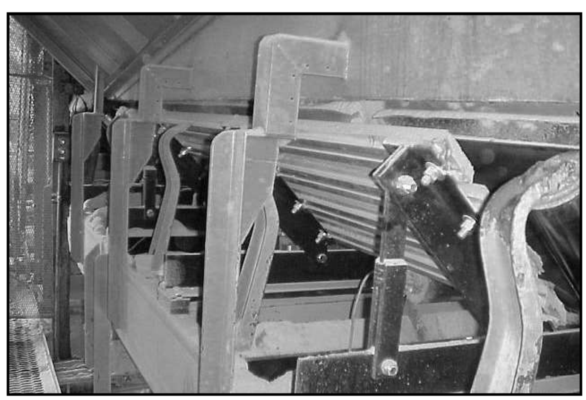


Figure 11.50
Slider bed in use

CEMA Standard No. 575-2019

Bulk Material Belt Conveyor
Impact Bed/Cradle

Selection and Dimensions

Conveyor Equipment Manufacturers Association

DISCLAIMER

The information provided herein is advisory only.

These recommendations provided by CEMA are general in nature and are not intended as a substitute for professional advice. Users should seek the advice, supervision and/or consultation of qualified engineers, safety consultants, and other qualified professionals.

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FOREWORD

Impact Beds/Cradles are used to reduce premature idler failure and reduce belt damage in the load zone of bulk material handling conveyor systems. This standard has been established to provide a uniform method of rating and dimensioning among the various manufacturers of conveyor belt Impact Beds/Cradles.

This standard assures that an Impact Bed/Cradle is dimensionally compatible with conveyor idlers manufactured to the CEMA Standard No. 502. The CEMA standard 575 establishes impact energy ratings to assure the Impact Bed/Cradle is structurally suitable for the application. This standard does not restrict the manufacturer, who has complete freedom to design all parts of the Impact Bed/Cradle according to its best engineering judgment based upon the information supplied by the end-user.

There are three classes of Impact Beds/Cradles rated according to the weight and height of fall of the bulk material and conveyor idler class. Manufacturers voluntarily specify into which class their particular designs fall.

This standard will assist in specifying an Impact Bed/Cradle, which is structurally suitable for the specified conditions and reduce the misapplication of Impact Beds/Cradles.

The capacity of the conveyor belt to absorb impact varies according to belt construction. Contact the belt supplier for information regarding the ability of a specific conveyor belt to absorb impact.

SUMMARY OF CHANGES

On the past versions of this publication:

1. Definitions and Power Requirements:

- Changed N (length of impact zone) to L_n to maintain consistency with the belt book
- Changed T_e(IB) to ΔT_{sbn}, T_{em}(IB) to ΔT_{sbn} to maintain consistency with universal method in belt book
- Changed f (coefficient if friction value – dimensionless) to C_{sb} to maintain consistency with the belt book
- Removed T_e(TI), T_{em}(TI) from power loss calculations. Calculating the effects of the small amount of idlers removed and replaced with impact beds can be very time consuming under the universal method as detailed in belt book. Equations for ΔT_{isn} (change in tension from idler seal friction), ΔT_{iwn} (Change in tension from idler load friction), ΔT_{imn} (tension loss from idler misalignment), and ΔT_{mzn} (tension change due to bulk material moving between idlers) would need to be added. Removing the tension effects of the small amount of idlers results in a power loss calculation typically 10% to 15% higher than when the idlers are accounted for. This difference errs on the side of caution and greatly simplifies the calculations.
- Changed Table 2 to match belt book (Table 6.84) coefficient of friction values for various materials
- Added R_{rsb} (friction modifying factor) to power loss calculation to maintain consistency with the belt book

On this 2019 version, imperial and metric examples were reviewed and updated for ease understanding. Impact force formulas were changed in order to be consistent with ANSI/CEMA Std. 502 and Belt Book.

DEFINITIONS

A Base width mounting holes center to center distance

B Mounting foot mounting holes center to center distance

C Overall width of the Bed/Cradle

C_{sb} Sliding friction factor (dimensionless)

D Overall length of the mounting foot

E Maximum height of the outer edge of the Bed/Cradle

F Impact Force

H Height of the drop [ft (m)]

IE Impact Energy [lbf-ft (N-m)]

k Spring constant for specific idler type [lbs/in (N/m)]. Consult idler manufacturer/

L Mounting bolt diameter.

L_n Length of the impact zone [ft (m)]

M Clearance between the belt and the center sliding surface.

R_{rsb} Coefficient of friction modifying factor.

ΔT_{Sbn} Slider bed resistance [lbs (N)]

V Belt speed [fpm (m/s)].

Q Capacity of the bulk solid [tph (mtph)]

W Mass of single lump [lbs (kg)]

W_b Weight of belt in [lbs/ft (N/m)] of belt length

W_m Weight of material in [lbs/ft (N/m)] of belt length

W_e Equivalent mass of flowing bulk material [lbm (kg)]

Impact Bed/Cradle: A conveyor component that is located underneath the belt in the impact or loading zone of a bulk material handling conveyor belt transfer point. Designed to support the belt and help absorb the impact of falling material.

Outbound Idler: The idler immediately after the Impact Bed/Cradle in the direction of belt travel.

Inbound Idler: The idler immediately preceding the Impact Bed/Cradle in the direction of belt travel.

Transition Distance: The distance between where the belt leaves a terminal pulley of a conveyor and the point where the belt is fully troughed.

Adjustable Transition Idler: An idler with metal rollers and adjustable wing angles to help support the belt in the transition from a terminal pulley to a troughed configuration.

Fixed Transition Idler: A fixed idler with metal rollers and a trough configuration less than the full belt trough. Designed to help support the belt in the transition from a terminal pulley to a troughed configuration.

Slider Bed: A support under the carrying side of a conveyor belt that is designed to handle the sliding load of the belt and the bulk solid.

Loading Zone: The area where material is received on the conveyor belt.

IMPACT BEDS/CRADLES

Impact Beds/Cradles are rated according to their structural capacity to absorb the force of impact from a falling lump or stream of bulk solid. There are three simplified ratings based upon the weight of the bulk solid or equivalent mass of homogeneous stream multiplied by the height of the fall (W × h).

The impact energy from a falling single lump is significantly more than that from a homogeneous stream of bulk material so in most applications the weight of the largest lump that can be expected is the critical variable. Table 1 gives the impact energy rating ranges for Impact Beds/Cradles. Contact a CEMA member for impact energies over 2000 lbf-ft, as the impact may exceed the impact ratings of most fabric ply belts.

Table 1. Impact Bed/Cradle Duty Rating

Duty Rating	Description	Impact Energy lbf/ft (N/m)
L	Light Duty	< 200 (271)
M	Medium Duty	200 to 1,000 (272 to 1,356)
H	Heavy Duty	1,001 to 2,000 (1,357 to 2,712)
Consult CEMA Member Company for Impact Energies > 2,000 lbf-ft (2712 N/m)		

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IMPACT BED/CRADLE DIMENSIONS

The CEMA Idler Class for the idlers used in the load zone determines the dimensional class of the Impact Bed/Cradle. The dimensions for the different idler classes (A through K) can be found in the CEMA Standard No. 502 Bulk Material Belt Conveyor Troughing and Return Idlers. (See Figure 1). The designation for an Impact Bed/Cradle shall be the duty rating followed by the Idler class. For example a Heavy-Duty Impact Bed/Cradle which is dimensionally compatible with CEMA D6 idlers in the load zone shall be designated as H-D6.

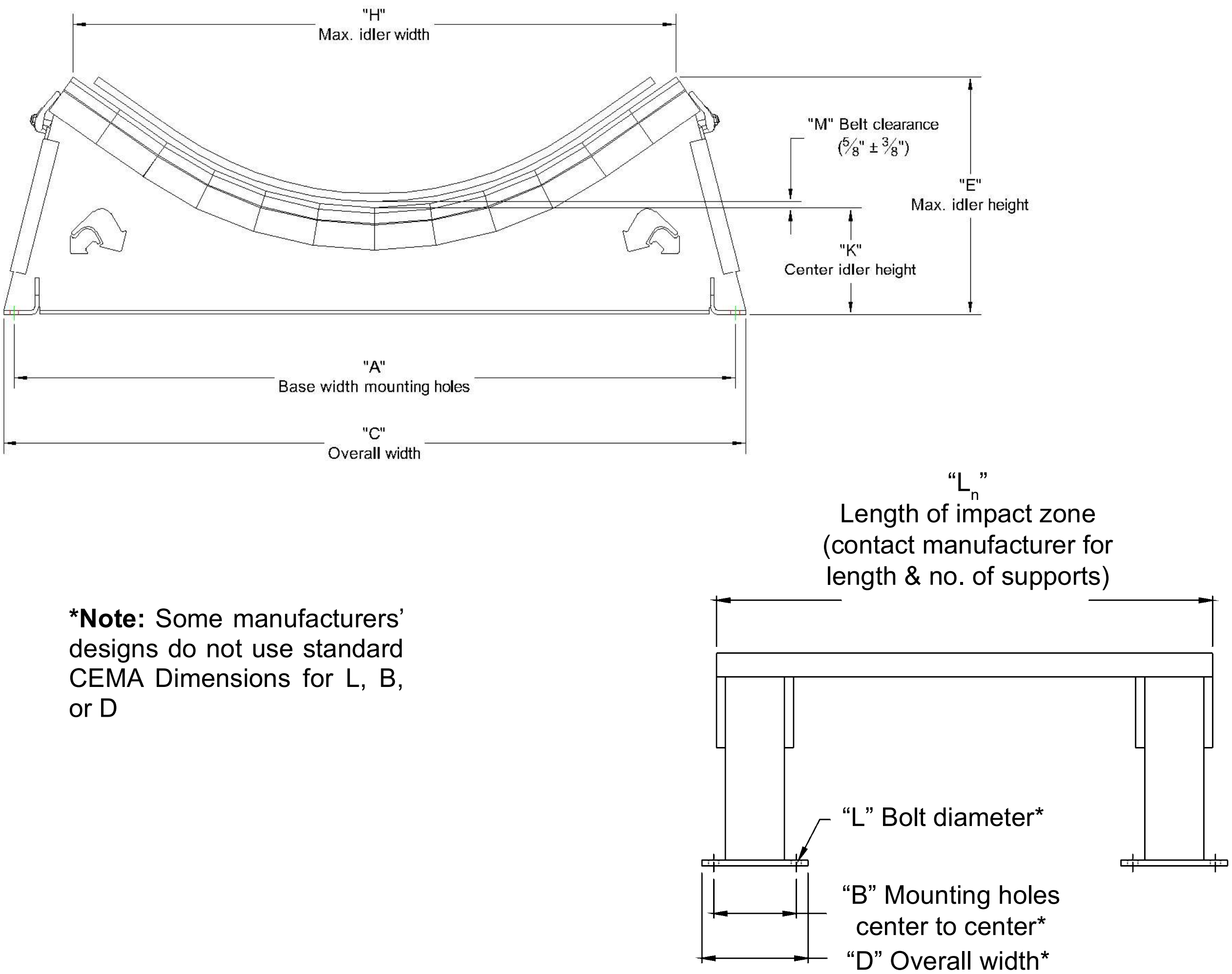

Figure 1. Typical Impact Bed / Cradle

LOCATION OF IMPACT BEDS/CRADLES

Impact Beds/Cradles are placed in load zone under the area of direct impact from the falling lumps or stream of material. The Impact Bed/Cradle should be positioned so the impact is striking the impact bars or pads at the center. The belt must be fully transitioned with properly fitted metal transition idlers before the entry into the Impact Bed/Cradle. A suitable idler which is dimensionally compatible may be used as the inbound idler just preceding the first Impact Bed/Cradle. When the impact area is long or there are multiple load points, intermediate idlers which are dimensionally compatible may be used to separate Impact Bed/Cradle sections (see Figure 2).

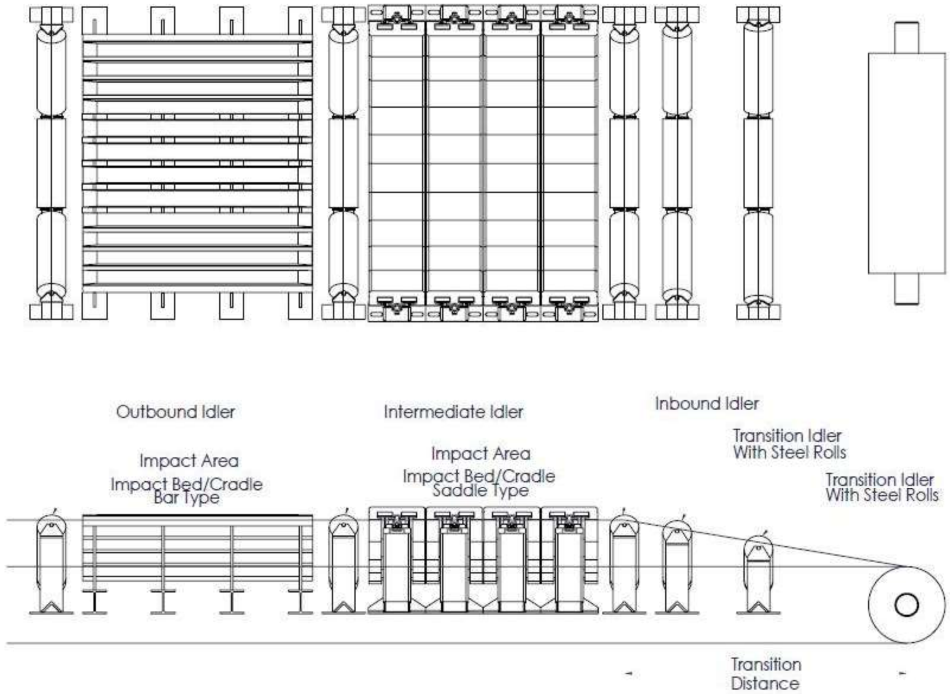

Figure 2. Transition Distance, Inbound and Outbound Idler Positions

The belt must be fully troughed according to CEMA “Belt Conveyors for Bulk Materials” 7th edition, and the transition idlers must be constructed with metal rollers. A suitable idler which is dimensionally compatible may be used as the outbound idler just following the last Impact Bed/Cradle.

IMPACT BED/CRADLE SELECTION

1) <u>Determine the dimensional class</u>: The dimensional class of the Impact Bed/Cradle is the same as the CEMA class of the idlers in the load zone. All of the idlers in the load zone must be from the same manufacturer, have the same trough angle, be of the same CEMA class and be in good working condition or the Impact Bed/Cradle will not fit or function properly. Contact a CEMA member if your load zone is not fitted with idlers all from the same manufacturer, of the same trough angle or all of the same CEMA class. Example: The idlers in the impact zone are CEMA D6. The dimensional class of the Impact Bed/Cradle is therefore D6.

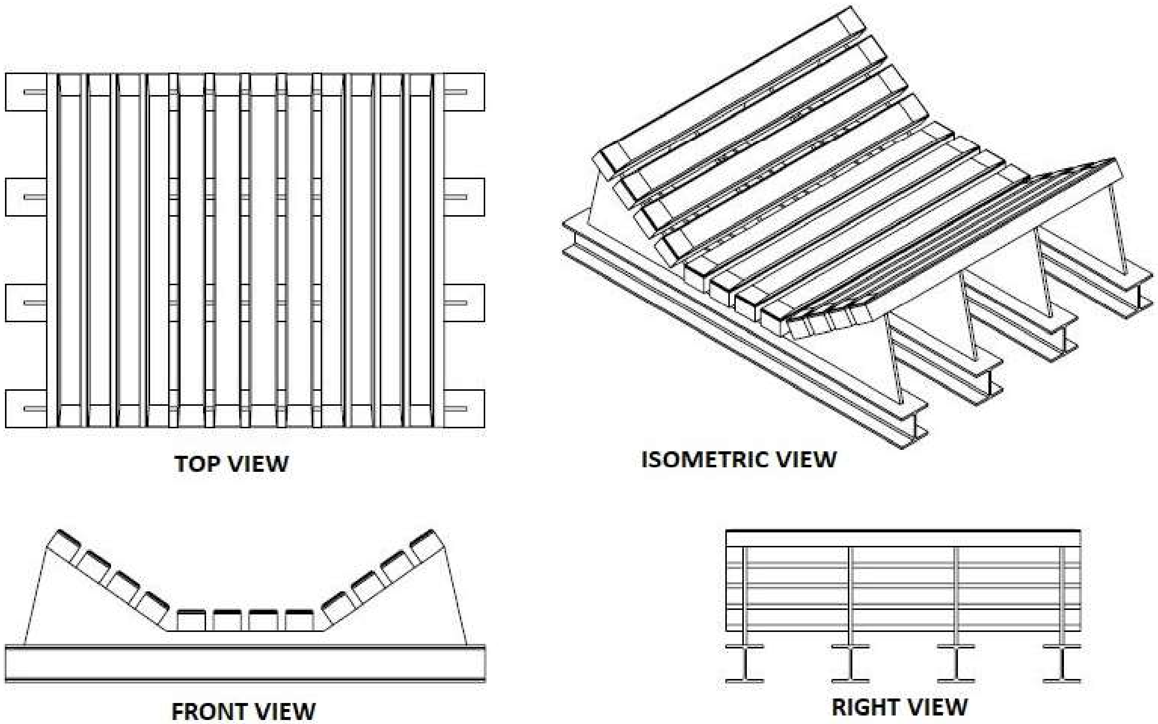

Figure 3. Impact Bed/Cradle - Bar Type

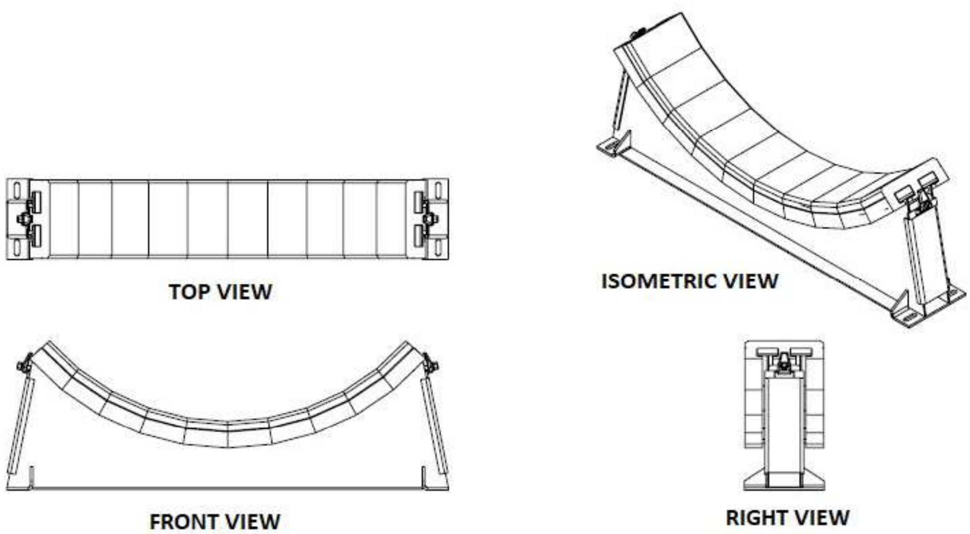

Figure 4. Impact Bed/Cradle - Saddle Type

2) Determine the Duty Rating: The duty rating of a CEMA Impact Bed/Cradle is determined by the maximum impact energy that will be created by the falling lump or stream of material. A simplified formula of the weight of the largest lump, W, or the capacity, Q, of the material and the vertical height of fall, h, is used to determine the rating. Calculate both quantities and select the larger of the two values for determining the appropriate duty rating.

IE (Impact Energy from single lump) = W x h

IE (Impact Energy from the homogeneous stream) = W_e x h

For flow rates below 3,000 tph [2,722 mtph], it is not necessary to calculate the equivalent mass of a homogeneous stream since it will be negligible.

Material containing large lumps

Determine the maximum lump size that will be conveyed. Calculate the weight, W [lbs (N)], of the lump. If slabs of material are likely to pass through the system use the maximum size slab to determine the maximum lump weight. Determine the maximum Height of the Drop, H [ft (m)]. The impact force is given by Equation 1.

Equation 1: Impact Force, $(F) = W + \sqrt{2} \times k \times W \times H$ [lbf (N)], (see Figure 5)

Where:
W = Weight of lump [lbs (N)]
H = Height of the drop [ft (m)]
k = Spring constant for specific idler type [lbs/ft (N/m)]. Consult idler manufacturer.

Consult Table 1 to determine the appropriate duty rating.

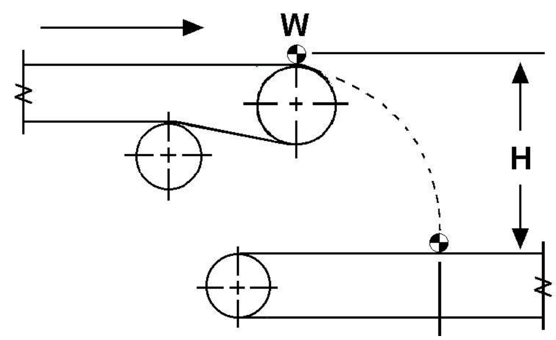

Figure 5. Impact force for material containing large lumps

Homogeneous stream of material without large lumps - (For Q> 3,000 tph, or Q_m> 2,722 mtph)

Determine the maximum Transfer Drop Height, H [ft (m)]. Determine the Capacity, Q [tph (mtph)], of conveyed material. In order to use the lump energy equation, an equivalent mass of the flowing stream needs to be calculated.

Equation 2: Impact Force, $(F) = (0.1389) \times Q \times \sqrt{H}$ (lbf), (see Figure 6)

$$= (1.234) \times Q \times \sqrt{H} \text{ (N), (see Figure 6)}$$

Where:
Q = Capacity [tph (mtph)]
H = Transfer drop height [ft (m)]

Consult Table 1 to determine the appropriate duty rating.

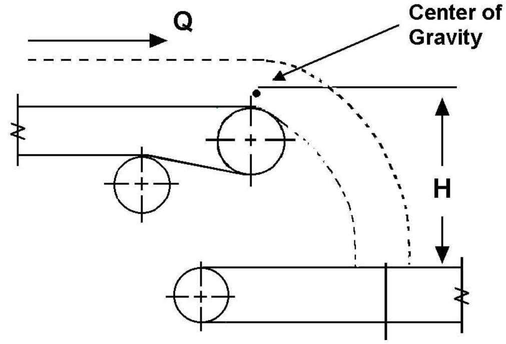

Figure 6. Impact force for homogeneous material without lumps

POWER REQUIREMENTS

Impact Beds/Cradles can have a significant effect on the power requirements of a conveyor, particularly for short conveyors. It is advisable to calculate the theoretical power requirements for an Impact Bed/Cradle and check the available power of the drive.

The power requirement is determined by the formulas:

$$\Delta T_{sbn} = C_{sb} \times (W_b + W_m) \times L_n \times R_{rsb}$$

$$\text{Horsepower} = (\Delta T_{sbn} \times V) \div 33{,}000 \text{ (hp)}$$
$$= (\Delta T_{sbn} \times V) \div 1{,}000 \text{ (kW)}$$

Where:

ΔT_{sbn} = Slider bed resistance

C_{sb} = Sliding friction factor (dimensionless). See Table 2.

R_{rsb} = Modifying factor

The default value for R_{rsb} is 1.0 but when starting under full load use R_{rsb} = 1.50

Table 2. Sliding Bed Sliding Friction Factor (dimensionless)

Sliding Surface	C_{sb}
Steel	0.64 to 0.84
Polyethylene	0.56
Urethane	0.60 to 0.67

Example: Imperial Units

A 60-inch conveyor traveling at 750 fpm is conveying 8 in minus ore, which weighs 120 lb/ft³ at the rate of 2500 tph. The conveyor is equipped with CEMA D6 impact rollers in the load zone. The vertical drop at the transfer point is 12 ft and the impact is confined to an area approximately 4 ft long. Determine the rating and class for an Impact Bed/Cradle for this application. Determine the horsepower requirements for the Impact Bed/Cradle.

Data

Belt size = 60 in

Belt speed (V) = 750 fpm

Bulk density (γ_m) = 120 lb/ft³

Bulk material flow rate / Design capacity (Q) = 2500 tph

Vertical drop (h) = 12 ft

Largest lump slab size = 8 in thick x 8 in wide x 24 in long

Length of impact zone (L_n) = 4 ft

Lump size = 8 in minus ore

k = 70,000 lb/ft

Rating

Since the lump size is large in this application it is material from a primary crusher that has passed through a grizzly with 8 in² openings. It is accepted practice to assume the largest slab that could pass through the grizzly would be 8-inch thick by 8-inch wide by 24 in long.

To calculate the impact energy from the homogeneous stream it will be necessary to obtain a value of k from a CEMA member manufacturer. For this example use 70,000 lb/ft.

The volume of the largest lump that could be expected to impact the receiving belt would be:

$$Volume = \frac{8\ in \times 8\ in \times 24\ in}{1728 \frac{in^3}{ft^3}} = 0.89\ ft^3$$

The weight of the lump (W) would be:

$$W = 0.89\ ft^3 \times 120 \frac{lb}{ft^3} = 106.8\ \text{lb}$$

From equation for the impact force for material containing large lumps (Equation 1):

$$F = W + \sqrt{2 \times k \times W \times h}$$

$$F = 106.8\ \text{lb} + \sqrt{2 \times (70{,}000\ \text{lb/ft}) \times (106.8\ \text{lb}) \times (12\ \text{ft})}$$

$$F = 13{,}501.7\ \text{lbs}$$

From equation for the impact force for homogeneous material without lumps (Equation 2):

$$F = (0.1389) \times Q \times \sqrt{h}$$
$$F = (0.1389) \times 2{,}500 \text{ tph} \times \sqrt{12 \text{ ft}} = 1{,}202.9 \text{ lbs}$$

The equivalent weight from homogeneous stream of material without large lumps (W_e)

$$W_e = 8.03x10^{-4} \times \frac{Q^2}{k}$$
$$W_e = 8.03x10^{-4} \times \left(\frac{(2{,}500 \text{ tph})^2}{70{,}000 \text{ lb/ft}} \right) = 0.072 \text{ lb}$$

From step 2 of impact bed/cradle selection, the impact energy from the single lump is:

$$IE = W \times h = 106.8 \text{ lb} \times 12 \text{ ft} = 1{,}282 \text{ lb-ft}$$

The impact energy from the homogeneous stream is:

$$IE = W_e \times h = 0.072 \text{ lb} \times 12 \text{ ft} = 0.864 \text{ lb-ft}$$

Using the largest impact energy (IE) use, referencing Table 1 the rating for this application would be H (Heavy Duty) because the largest calculated impact energy value falls between 1,000 and 2,000 lbf/ft.

Rating and Class

Since CEMA D6 idlers are used in the impact zone the dimensional class for this application is D6. The correct Impact Bed/Cradle designation for rating and class for this example is H-D6.

Power Requirements

In order to calculate the power requirements you need the values of W_b and W_m. These values can be obtained from the design calculations of the conveyor or from a CEMA member manufacturer. Estimates of these values can be made by referring to the latest revision of the CEMA publication “Belt Conveyors for Bulk Materials”.

For this example use the weight per foot of the belt, W_b, as 22 lbf/ft. The weight of material per foot of belt is 111.11 lbf/ft. To estimate the dynamic power requirement use C_b= 0.56 for a UHMW cover material on the Impact Bed/Cradle. The length of impact zone, L_n, is 4 ft. R_{rsb} = 1 (default value).

$$\Delta T_{sbn} = C_b \times (W_m + W_b) \times L_n \times R_{rsb}$$
$$\Delta T_{sbn} = 0.56 \times (111.11 \text{ lbf/ft} + 22 \text{ lbf/ft}) \times 4 \text{ ft} \times 1 = 298.17 \text{ lbf}$$

$$Horsepower\,(HP) = \frac{(\Delta T_{sbn} \times V)}{33{,}000} = \frac{(298.17 \text{ lbf} \times 750 \text{ fpm})}{33{,}000} = 6.78 \text{ hp}$$

Example: Metric Units

A 1,524 mm conveyor traveling at 3.81 m/s is conveying 203 mm minus ore, which weighs 1,922 kg/m^3 at the rate of 2,268 mtph. The conveyor is equipped with CEMA D6 impact rollers in the load zone. The vertical drop at the transfer point is 3.66 m and the impact is confined to an area approximately 1.22 m long. Determine the rating and class for an Impact Bed/Cradle for this application. Determine the horsepower requirements for the Impact Bed/Cradle.

Data

Belt size = 1,524 mm

Belt speed (V) = 3.81 m/s

Bulk density (γ_m) = 1,922 kg/m^3

Bulk material flow rate / Design capacity (Q) = 2,268 mtph

Vertical drop (h) = 3.66 m

Largest lump slab size = 203 mm thick x 203 mm wide x 610 mm long

Length of impact zone (L_n) = 1.22 m

Lump size = 203 mm minus ore

k = 94,907 N/m

Rating

Since the lump size is large in this application it is material from a primary crusher that has passed through a grizzly with 5,161.3 mm^2 openings. It is accepted practice to assume the largest slab that could pass through the grizzly would be 203 mm thick by 203 mm wide by 610 mm long.

To calculate the impact energy from the homogeneous stream it will be necessary to obtain a value of k from a CEMA member manufacturer. For this example, use 94,907 N/m.

The weight of the largest lump that could be expected to impact the receiving belt would be:

$$Volume = \frac{203\ mm \times 203\ mm \times 610\ mm}{1{,}000{,}000{,}000 \frac{mm^3}{m^3}} = 0.025\ m^3$$

The weight of the lump (W) would be:

$$W = 0.025\ m^3 \times 1{,}922 \frac{kg}{m^3} = 48.05\ kg$$

From equation for the impact force for material containing large lumps (Equation 1):

$$F = W + \sqrt{2 \times k \times W \times h}$$
$$F = 48.05\text{ kg} + \sqrt{2 \times (94{,}907\text{ N/m}) \times (48.05\text{ kg}) \times (3.66\text{ m})}$$
$$F = 5{,}825.70\text{ N}$$

From equation for the impact force for homogeneous material without lumps (Equation 2):

$$F = (1.234) \times Q \times \sqrt{h}$$
$$F = (1.234) \times 2{,}268 \text{ mtph} \times \sqrt{3.66 \text{ m}} = 5353.94 \text{ N/m}$$

The equivalent weight from homogeneous stream of material without large lumps (W_e)

$$W_e = 7.72x10^{-2} \times \frac{Q^2}{k}$$
$$W_e = 7.72x10^{-2} \times \left(\frac{(2{,}268 \; mtph)^2}{94{,}907 \text{ N/m}} \right) = 4.184 \text{ N/m}$$

From step 2 of impact bed/cradle selection, the impact energy from the single lump is:

$$IE = W \times h = 48.05 \text{ kg} \times 3.66 \text{ m} = 175.863 \text{ kg-m}$$

The impact energy from the homogeneous stream is:

$$IE = W_e \times h = 4.184 \text{ N/m} \times 3.66 \text{ m} = 15.313 \text{ N}$$

Using the largest impact energy (IE) use, referencing Table 1 the rating for this application would be H (Heavy Duty) because the largest calculated impact energy value falls between 1,000 and 2,000 lbf-ft.

Rating and Class

Since CEMA D6 idlers are used in the impact zone the dimensional class for this application is D6. The correct Impact Bed/Cradle designation for rating and class for this example is H-D6.

Power Requirements

In order to calculate the power requirements you need the values of W_b and W_m. These values can be obtained from the design calculations of the conveyor or from a CEMA member manufacturer. Estimates of these values can be made by referring to the latest revision of the CEMA publication “Belt Conveyors for Bulk Materials”.

For this example use the weight per foot of the belt, W_b, as 22 lbf/ft. The weight of material per foot of belt is 111.11 lbf/ft. To estimate the dynamic power requirement use C_b= 0.56 for a UHMW cover material on the Impact Bed/Cradle. The length of impact zone, L_n, is 4 ft. R_{rsb} = 1 (default value).

$$\Delta T_{sbn} = C_b \times (W_m + W_b) \times L_n \times R_{rsb}$$
$$\Delta T_{sbn} = 0.56 \times (1621.53 \text{ N/m} + 321.06 \text{ N/m}) \times 1.22 \text{ m} \times 1 = 1{,}327.177 \text{ N}$$

$$Horsepower\,(HP) = \frac{(\Delta T_{sbn} \times V)}{1{,}000} = \frac{(1{,}327.177 \text{ N} \times 3.81 \text{ m/s})}{1{,}000} = 5.06 \text{ kW}$$

Conclusion

The proper rating and class of Impact Bed/Cradle for this example is H-D6. The running power requirement for the Impact Bed/Cradle is 6.78 hp (5.06 kW). The maximum impact energy expected to be transmitted to the conveyor structure is 1,282 lb-ft (175.863 kg-m).

Comments

It is important to determine the maximum lump size that can be expected to pass through the transfer point as the single impact from a single lump almost always produces the greatest impact force. A round 8 in^2 (5,161.28 mm^2) lump in this example would weight 106.8 lb (48.05 kg) and create an impact energy of 1,282 lbf-ft (175.863 kg-m) for a medium-duty rating. In this example an 8-inch (203 mm) × 8-inch (203 mm) × 24-inch (610 mm) slab merits a heavy-duty rating with an impact energy of 1,282 lb-ft.

Even though 8 in (203 mm) minus material does not fit the definition of a homogeneous stream of material it is good to check both impact energies. It is important to check the structure that will support the Impact Bed/Cradle to make sure it can handle the load.

Special Applications

Consult a CEMA member for applications involving explosive bulk solids or for other applications with unique requirements such as food grade construction, corrosion or chemical resistant applications, extreme temperature or belt speeds over 1,000 fpm (5 m/s).

Typical Specification: Impact Bed/Cradle

The Impact Bed/Cradle shall be designed to withstand the maximum impact force as determined by the greater of the two calculations:

- Impact Energy = W x h [lb-ft (N-m)]
- Equivalent Weight (W_e) = $8.03 \times 10^{-4} \times (Q^2/k)$ (imperial)

  = $7.72 \times 10^{-2} \times (Q^2/k)$ (metric)

The manufacturer shall use the information supplied by the end user to establish which rating and class of Impact Bed/Cradle is to be provided. The Impact Bed/Cradle shall be designed to withstand the force of a single maximum impact with a design factor of 1.5.

The manufacturer shall specify:

a. Any exceptions to the standard contained in their design.

b. The duty rating and class of the Impact Bed/Cradle using the CEMA rating and class system.

c. Any limitations resulting from the application as specified by the end user.

The end user shall specify:

a. The maximum lump or slab weight [lb (kg)] that will pass through the load zone.

b. The maximum bulk density [lb/ft^3 (kg/m^3)] of the bulk solid being handled.

c. The maximum drop height [ft (m)].

d. The maximum flow rate of the bulk solid [stph (tph)].

e. The CEMA class and trough angle of the idlers in the load zone and the manufacturer's product number designation.

f. Belt speed [ft/min (m/s)].

g. Certification based on product specifications supplied by the manufacturer, that the existing structure is capable of supporting the weight of and the impact force transmitted by the Impact

Bed/Cradle to the structure.

h. Whether or not the bulk solid being conveyed is flammable or explosive.

i. Special construction requirements for corrosion resistance or process compatibility.

j. Length of load zone.

The transition idler(s) shall be a metal idler(s) and the inbound idler(s), if present, must be from the same manufacturer, have the same trough angle, be of the same CEMA class, be in good working condition, and the belt shall be fully troughed before entering the Impact Bed/Cradle and upon leaving the Impact Bed Cradle.

If more than one load zone is used intermediate idlers of the same CEMA class will be used between Impact Beds/Cradles.

Disclaimers

This standard implies no representation that a particular belt is suitable to be used in combination with a particular Impact Bed/Cradle. Contact the belt supplier for information on the impact capacity of the belt.

Each manufacturer is responsible for the design of their product including the suitability for use in applications where fire retardant Impact Beds/Cradles may be required by statute or application.

The replacement of idlers with an Impact Bed/Cradle may increase the horsepower requirements of the conveyor drive. Contact a CEMA member for information.

Impact Beds/Cradles may be required to meet additional industry or government standards or requirements such as for use in underground mines, hazardous locations or for food handling that are not spelled out in this standard. Contact a CEMA member for information.

Units

Imperial	Metric
1 inch (in)	25.4 millimeters (mm)
1 foot (ft)	0.3048 meters (m)
1 pound (lb)	0.454 kilograms (kg)
1 pound force (lbf)	4.4482 Newton (N)
1 foot per minute (fpm)	0.005 meters per second (m/s)
1 short ton per hour (stph)	907.18 kilogram per hour (kg/hr)
1 cubic feet (ft^3)	1,728 cubic inches (in^3)

CEMA Guide 576-2019
Revision of CEMA Guide 576-2013
Approved: XXXXX

CEMA Guide 576 – Draft 1

Classification of Applications for Bulk Material Conveyor Belt Cleaning

Conveyor Equipment Manufacturers Association

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FOREWORD

Conveyor belt cleaners are used to remove fugitive material, otherwise known as carryback, from the return side of the conveyor belt after the bulk material has been discharged. Ideally, this will be accomplished from within the chute works so that the removed carryback will pass onto the next system element. However, other locations may also be suitable. It is understood that the methods and designs for cleaning belts are numerous.

This guide has been established to provide a uniform method for determining the application class of any individual belt conveyor. This application class will assist in the selection of an appropriate conveyor belt cleaner or conveyor belt cleaner system for the application. By ranking the application, guidance concerning the needed ruggedness and durability of the applicable conveyor belt cleaner will be available. Manufacturers voluntarily specify into which class their particular designs fall.

Belt cleaner designs vary significantly, and it is each manufacturer's responsibility to provide equipment that is suitable for the application as rated and the intended use.

The degree of cleanliness resulting from a properly specified installed and maintained belt cleaner or multiple belt cleaner system is not covered by this guide. It is the end user's responsibility to define the desired level of cleaning that is required for their application. It is the responsibility of the belt cleaner supplier to provide a system and maintenance requirements that can meet the end user's expectation of cleaning results.

This guide assumes the application class ranking will consider the conveyor belt to be in “new” or “as new” condition.

This guide makes no statement regarding the cleaning performance or life of any conveyor belt cleaner. Contact a CEMA member for information.

SUMMARY OF CHANGES

On 2014, it was added ANSI/CEMA Standard No. 550 Material Classification Code Chart as an Appendix for reference. Added Material Description from CEMA 550 for the two materials used as examples.

Additionally, a material was changed – Coal, Mined. As opposed to Coal, Bituminous, Mined, 50 Mesh & Under to better match the Metric Example.

On 2019, after a review of ANSI/CEMA std. 550, this guide was reviewed for consistency.

INTRODUCTION

The proper selection of a belt cleaner must consider the environment in which the belt cleaner must operate. Several factors will play significant roles in deciding the appropriate selection.

This guide provides a method to condense a complex operating environment into a single classification number to be used when selecting belt cleaners.

RANKING AND CLASS SYSTEM

The application class is determined using the following factors.

1. Belt width
2. Belt speed
3. Quantity and type of belt splices
4. Abrasiveness of the material
5. Stickiness/moisture content of the material

For the purposes of this classification, conveyor belts must be new or in "as new" condition.

METHOD

The environment in which the conveyor belt cleaner must operate is divided into two main categories, the conveyor belt itself and the material carried. There are three factors describing the conveyor belt (belt width, belt speed, quantity and type of belt slices) and two factors describing the material (abrasiveness of the material, stickiness/moisture content of the material) for a sum of five. Each of the five factors is rated individually. The final application score is the sum of all five factors.

The final score is divided into five application class levels and should be specified when conveyor belt cleaners are being selected. The selected conveyor belt cleaner should have a rating that meets or exceeds the calculated application class score. (Note: ANSI/CEMA Standard 550 is a valuable tool for assigning values to the material categories. A copy of its Material Classification Chart is included here as an appendix.) An explanation of the factors appears below.

CONVEYOR BELT CHARACTERISTICS

Belt Width Chart

Score	*Description*
0	<24 in (<610 mm) width
1	24 in – 42 in (610 mm – 1067 mm) width
2	>42 in – 60 in (1067 mm – 1524 mm) width
4	>60 in – 96 in (1524 mm – 2438 mm) width
8	>96 in (>2438 mm) width

Belt Speed Chart

Score	*Description*
1	<300 fpm (<1.5 m/s)
2	300 – 600 fpm (1.5 – 3 m/s)
4	601 – 1000 fpm (3.1 – 5 m/s)
8	>1000 fpm (>5 m/s)

Splice Type Chart (Consider that the splice condition may change with time. Use a higher score when in doubt.)

Score	*Description*
0	Vulcanized (for the entire life of the belt)
2	Mechanical splices with belt speed below 500 fpm (2.5 m/s)
4	Mechanical splices with belt speed 500 fpm (2.5 m/s) or greater

MATERIAL CHARACTERISTICS

Abrasiveness (Choose the worst case expected conditions in situations where the conditions will vary)

Score	*Description*
1	Mildly Abrasive (ANSI/CEMA Standard 550 code designation 5, Abrasive index 1-17)
2	Moderately Abrasive (ANSI/CEMA Standard 550 code designation 6, Abrasive index 18-67)
3	Extremely Abrasive (ANSI/CEMA Standard 550 code designation 7, Abrasive index 68-416)

Stickiness/Moisture Content Chart (Choose the worst case expected conditions in situations where the conditions will vary)

Score	*Description*
1	Mild/Dry (<2% moisture by weight)
2	Medium/Moist (2-8% moisture by weight)
4	Heavy/Wet (>8% moisture by weight)
8	Severe/Wet/Sticky slurry with fines

The sum of the individual scores is broken down into the following ratings.

APPLICATION SEVERITY RANKING CHART

Score	*Description*
≤ 6	Class 1
7-10	Class 2
11-15	Class 3
16-23	Class 4
≥24	Class 5

EXAMPLES – Imperial Units

From Table of Materials (ANSI/CEMA Std. 550)

- Material: Limestone
- Loose Bulk Density: 55-95 lbf/ft^3
- CEMA Material Code: 75A_{40}46MY

A conveyor designer needs to choose belt cleaners for a conveyor carrying limestone from the quarry pit. The conveyor width is 36 in and the belt speed is 420 fpm. The belt will be installed with a vulcanized splice but will be spliced mechanically during its life.

Referring to the Belt Width chart, a score of **1** for the 36" width is assigned.

From the Belt Speed chart, a score of **2** is assigned.

From the Splice Type chart, a score of **2** is assigned since this belt will typically have mechanical splices in it even though it is vulcanized at commissioning.

Referring to ANSI/CEMA Standard 550, the CEMA material code is 75A_{40}46MY which contains designation code **6** as the abrasiveness rating for limestone. From this, a score of **2** is assigned.

From the Stickiness/Moisture Content Chart, a score of **4** is assigned. Even though the majority of the time this material will run fairly dry, groundwater or heavy rain can make the pit very wet. A conservative ranking would assume wet conditions.

The total score would be 1+2+2+2+4=11. From the Application Severity Ranking Chart, the designer would select conveyor belt cleaners rated for at least Class 3 applications.

EXAMPLES – Metric Units

From Table of Materials (ANSI/CEMA Std. 550)

- Material: Coal, Bituminous, Mined
- Loose Bulk Density: 641-961 kgf/m^3
- CEMA Material Code: 50D$_3$35LNXY

A designer needs to choose belt cleaners for a new conveyor in a terminal expansion. The material conveyed will be Coal, Bituminous, Mined on an 1800 mm wide belt at 4.1 m/s. The site specified a vulcanized splice for all belts.

Referring to the Belt Width chart a score of "**4**" for the 1800 mm width is assigned.

From the Belt Speed chart, a score of "**4**" is assigned.

From the Splice Type chart, a score of "**0**" is assigned since this belt will be vulcanized throughout its life.

Referring to ANSI/CEMA Standard 550, the CEMA material code is 50D$_3$35LNXY which contains **5** as the abrasiveness rating for bituminous coal. From this, a score of **1** is assigned.

From the Stickiness/Moisture Content Chart, a score of **2** is assigned. Rain and anti-dust measures could result in extra moisture in the coal. A conservative ranking would assume moist conditions.

The total score would be 4+4+0+1+2=11. From the Application Severity Ranking Chart, the designer would select conveyor belt cleaners that rated for at least Class 3 applications.

APPENDIX I. Material Classification Code Chart (ANSI/CEMA Std. 550)

Major Class	Material Characteristics Included		Definition and Test Reference	Code Designation
Density	Bulk Density, Loose		A-8	Actual lbs/ft^3
Size	Very Fine	No. 200 Sieve (0.0029") and under	A-17	A_{200}
		No. 100 Sieve (0.0059") and under		A_{100}
		No. 40 Sieve (0.016") and under		A_{40}
	Fine	No. 6 Sieve (0.132") and under		B_6
	Granular	1/2" and under		$C_{1/2}$
		3" and under		D_3
		7" and under		D_7
	Lumpy	16" and under		D_{16}
		Over 16" to be specified		
		X = Actual Maximum Size		D_X
	Irregular	Stringy, Fibrous, Cylindrical, Slabs, etc.		E
Flowability	Very free flowing -- Flow Function > 10		A-12	1
	Free flowing -- Flow Function > 4 but < 10			2
	Average flowability -- Flow Function >2 but < 4			3
	Sluggish -- Flow Function < 2			4
Abrasiveness	Mildly Abrasive	-- Index 1 - 17	A-1	5
	Moderately Abrasive	-- Index 18 - 67		6
	Extremely Abrasive	-- Index 68 - 416		7
Miscellaneous Properties or Hazards	Builds up and hardens		B-3	F
	Generates Static Electricity		B-5	G
	Decomposition - Deteriorates in storage		B-7	H
	Flammability		B-11	J
	Becomes plastic or tends to soften		B-2	K
	Very dusty		B-8	L
	Aeration - Fluidity		B-1	M
	Explosiveness		B-10	N
	Stickiness - Adhesion		B-18	O
	Contaminable		B-19	P
	Degradable - Size breakdown		B-6	Q
	Gives off harmful or toxic gas or fumes		B-12	R
	Highly corrosive		B-4	S
	Mildly corrosive		B-4	T
	Hygroscopic		B-13	U
	Interlocks, mats or agglomerates		B-14	V
	Oils present		B-15	W
	Packs under pressure		B-16	X
	Very light and fluffy - May be windswept		B-20	Y
	Elevated temperature		A-11	Z

Material Classification Code Chart (ANSI/CEMA Std. 550) – Cont.

Major Class	Material Characteristics Included	Definition and Test Reference	Code Designation
Angle of Repose	Loose	A-5	
Angle of Maximum Inclination (of a Belt)	Conveyor	A-4	