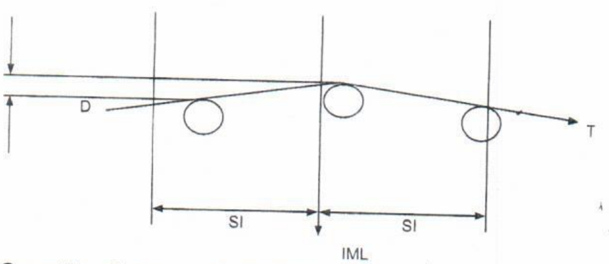
Idler Selection Procedure

Initial Selection; Steps 1, 2, and 3:
Select idler class by comparing calculated idler load with idler load ratings (CIL and CILR) from Tables 2-11 through 2-14. Select impact idler class, if necessary, as shown in Step 3. CEMA idler manufacturers have standard designs meeting these load ratings and dimensional standards shown in tables listed in this publication.

Bearing L10 Life Correction; Steps 4, 5, and 6:
Factors K2 (Fig. 2.5) and K3A (Fig. 2.6) are multiplying factors used to adjust basic L10 life rating of idler class selected. Factor K2 is based on percent of idler load and K3A is factor of actual roll speed (RPM). Factor K3B (Fig. 2.7), step 5 is an optional step showing advantage of using larger diameter rolls. It can be used as a multiplier to save repeating step 5 if a larger diameter roll is used.

Determine Potential Idler Life; Step 7:
Factors K4A (Fig. 2.8), K4B (Fig. 2.9), and K4C (Fig. 2.10) show conditions which will affect idler life and are independent of bearing L10 life, idler load and idler class. Use these figures to evaluate the potential expected idler life.

Step No.1 Troughing Idlers Series Selection
Calculated Idler Load (lbs.) = CIL =
((WB + (WM x K1)) x SI) + IML
Where:
WB= Belt weight (lbs./ft.) use actual or estimate from Table 2-1
WM= Material weight (lbs./ft.) = (Q x 2000) / (60 x V)



Q= Quantity of material conveyed (Tons per hour)
V= Design belt speed (FPM)

SI= Spacing of idlers (ft.)

K1= Lump adjustment factor (see Table 2-2)
Note: Actual weight of lump should be compared with WM value. In situations it may be necessary to use actual lump weight as WM.
IML= Idler misalignment load (lbs.) due to idler height deviation and belt tension = (D x T) / (6 x SI)
Where:
D= Misalignment (inches)
T= Belt Tension (lbs.)
SI= Idler Spacing (feet)
When an idler is higher than the adjacent idler, a component of belt tension will add load to that idler. The amount of height deviation can vary with the installation and type of idler. CEMA publication on "Conveyor Installation Standards" (Appendix D, "Belt Conveyors for Bulk Material," Fifth Edition or later) lists recommendations on structure misalignment.

Use CIL and select proper series of idler from Tables 2-11 through 2-14. CIL value should be equal to or less than idler rating.

This troughing idler selection procedure for calculating idler load does not include the following:
1. Impact force on idler at loading points.
2. Effect of belt transitions (head and tail pulley) on idler load.

Table 2-1 WB Estimated avarage belt weight multiple and reduced ply belts. lbs / ft

BELT WIDTH (inches (b))	MATERIAL CARRIED, lbs./cu. ft.		
	30-74	75-129	130-200
18	3.5	4	4.5
24	4.5	5.5	6
30	6	7	8
36	9	10	12
42	11	12	14
48	14	15	17
54	16	17	19
60	18	20	22
72	21	24	26
84	25	30	33
96	30	35	38

1. Steel cable belts increase above value by 50%.
2. Actual belt weights may vary with different constructions, manufacturers, cover gauges, etc. Use the above values for estimating. Obtain actual values from the belt manufacturer whenever possible.

Table 2-2 K_1 Lump Adjustment Factor

Material Lump Size (inches)	Material Weight, lbs./cu. ft.						
	50	75	100	125	150	175	200
4	1.0	1.0	1.0	1.0	1.1	1.1	1.1
6	1.0	1.0	1.0	1.1	1.1	1.1	1.1
8	1.0	1.0	1.1	1.1	1.2	1.2	1.2
10	1.0	1.1	1.1	1.1	1.2	1.2	1.2
12	1.0	1.1	1.1	1.2	1.2	1.2	1.3
14	1.1	1.1	1.1	1.2	1.2	1.3	1.3
16	1.1	1.1	1.2	1.2	1.3	1.3	1.3
18	1.1	1.1	1.2	1.2	1.3	1.3	1.4

Step No. 2 Return idler Series Selection
Calculated Idler Load (lbs.) = CILR = (WB x SI) + IML
Use CILR and select proper series of idler form Tables 2-11 through 2-14. CILR should be equal to or less than return idler rating.

Step No. 3 Impact Idler Series Selection
For homogeneous material without lumps:
Impact Force (lbs.) = $F = (0.1389)Q\sqrt{H}$
Where:
Q= Rate of flow (ST/hr)
H= Height of fall (ft.)

The calculated impact force is then multiplied by an impact idler spacing factor, f (Table 2-3), to determine the impact force on one idler. Unit Impact Force (lbs.) = Fu = F(f)

Table 2-3 Impact Idler Spacing Factor

SI impact	Factor f
1' 0"	0.5
1' 6"	0.7
2' 0"	0.9
>2' 0"	1

Idler Selection Procedure

Use this unit impact force, Fu, and select proper series of impact idler from Tables 2-11 through 2-14. Fu should be equal to or less than idler rating.

For material containing large lumps:

Impact Force (lbs.) = $F = W + (2kWH)^{1/2}$

Where:

W= Weight of lump (lbs.)

H= Height of fall (ft.)

K= Spring constant for specific idler type (lbs./ft.)

Use calculated energy rating, WH, and maximum lump size to select proper series of impact idler from Table 2-4. Both WH and lump size should be equal to or less than energy rating and maximum lump size.

Note: Both cases (material without lumps and material containing large lumps) should always be considered and the heavier duty idler selected to insure adequate impact resistance capabilities.

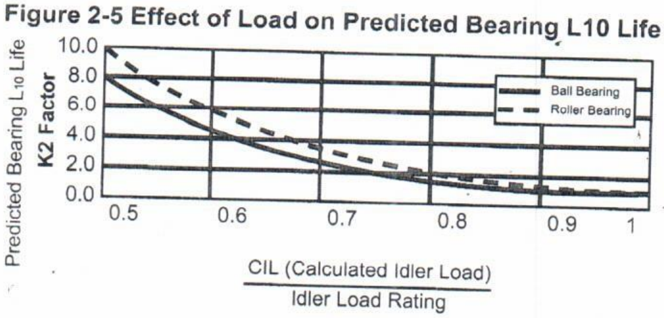
Table 2-4 Minimum Energy Ratings for Impact Idlers

3-Roll Rubber Impact Idlers (Equal Length Rolls)		
CEMA Series	WH (lbs.-ft.)	Maximum Lump Size (in.)
B	40	4
C	160	6
D	240	8
E	460	12

Step No. 4 K2 = Effect of load on predicted bearing L10 life.

When Calculated Idler Load (CIL) is less than CEMA load rating of series idler selected, the bearing L10 life will increase.

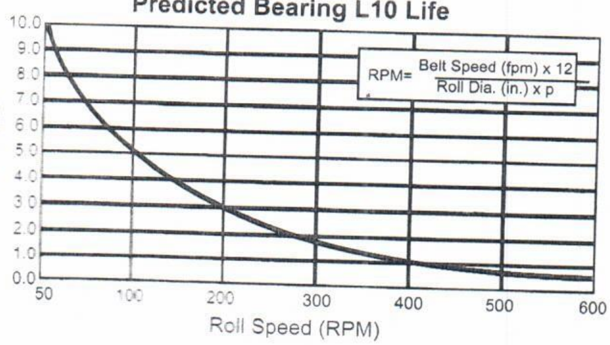
Figure 2-5 Effect of Load on Predicted Bearing L10 Life



Step No. 5 K3A = Effect of belt speed on predicted bearing L10 life

CEMA L10 life ratings are based on 500 rpm. Slower speeds increase life and faster speeds decrease life. Figure 2-6 shows this relationship.

Figure 2-6 Effect of Belt Speed on Predicted Bearing L10 Life



Step No. 6 K3B= Effect of roll diameter on predicted bearing L10 life

For a given belt speed, using larger diameter rolls will increase idler L10 life adjustments for various roll diameters using 4" diameter as a value of 1.0. Percent life increase can be calculated for each roll diameter increase.

Example: 1.5 for 6" dia.÷1.25 for 5" dia.= 1.20 or 20% increase in L10 life.

Figure 2-7 K3B= Effect of Roll Diameter on Predicted Bearing L10 Life (Based on the same belt speed)

Note: In addition to increased predicted bearing L10 life, larger diameter rolls can increase idler wear life.

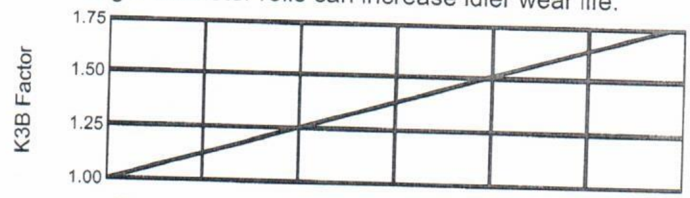


Figure 2-8 K4A= Effect of maintenance on potential idler life

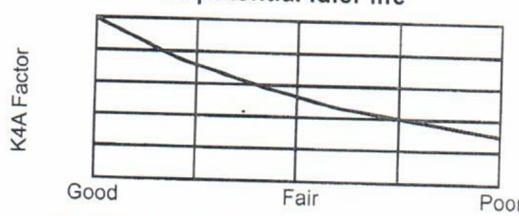


Figure 2-9 K4B= Effect of enviroment on potential idler life

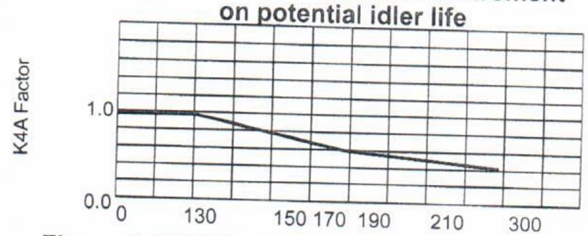
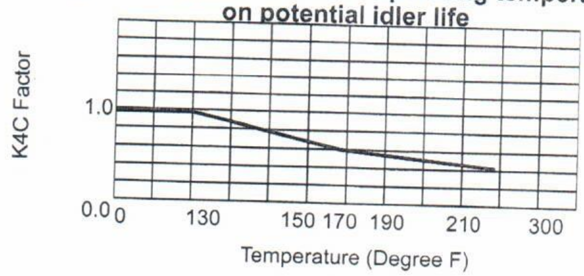


Figure 2-10 K4C= Effect of operating temperature on potential idler life



Based on collective application experience by CEMA idler manufacturers these conditions are very important in determining potential idler life. However, the exact mathematical basis is very subjective so contact your CEMA idler manufacturer for assistance or for any unusual conditions not listed.

Figure 2-11 Load ratings for CEMA B Idlers, LBS

BELT WIDTH (inches)	Troughed Angle			Single Roll Return
	20°	35°	45°	
18	410	410	410	220
24	410	410	410	190
30	410	410	410	165
36	410	410	396	155
42	390	363	351	140
48	381	353	342	130

Idler Selection Procedure

Figure 2-12 Load ratings for CEMA C Idlers, LBS

BELT WIDTH (inches)	Troughed Angle			Single Roll Return	Two Roll Vee Return
	20°	35°	45°		
18	900	900	900	475	
24	900	900	900	325	500
30	900	900	900	250	500
36	900	837	810	200	500
42	850	791	765	150	500
48	800	744	720	125	500
54	750	698	675	*	500
60	700	650	630	*	500
66				*	500

Ratings based on Min. L10 of 30,000 hours at 500 RPM - *CEMA D Return Idler

Figure 2-13 Load ratings for CEMA D Idlers, LBS

BELT WIDTH (inches)	Troughed Angle			Single Roll Return	Two Roll Vee Return
	20°	35°	45°		
24	1200	1200	1200	600	
30	1200	1200	1200	600	
36	1200	1200	1200	600	850
42	1200	1200	1200	500	850
48	1200	1200	1200	425	850
54	1200	1116	1035	375	850
60	1150	1070	1035	281	850
66				215	850
72	1050	977	945	155	850
78				125	850

Ratings based on Min. L10 of 60,000 hours at 500 RPM - *CEMA D Return Idler

Figure 2-14 Load ratings for CEMA E Idlers, LBS

BELT WIDTH (inches)	Troughed Angle			Single Roll Return	BELT WIDTH (inches)	Troughed Angle			Single Roll Return
	20°	35°	45°			20°	35°	45°	
36	1800	1800	1800	1000	72	1800	1800	1800	700
42	1800	1800	1800	1000	78				625
48	1800	1800	1800	1000	84	1674	1674	1620	550
54	1800	1800	1800	925	90				475
60	1800	1800	1800	850	96	1750	1628	1575	400
66				775	102				250

CEMA D & E ratings based on Min. L10 of 60,000 hours at 500 RPM

Notes for tables 2-11 through 2-16

1. Troughing idler load ratings are for three equal length rolls.
2. Load ratings also apply for impact rolls.
3. Troughing idler load ratings are based on a load distribution of 70% on center roll and 15% on each end roll for all trough angles.

Figure 2-15 Load ratings for CEMA Picking Idlers, LBS

Belt Width	CEMA C	CEMA D
24	475	600
30	475	600
36	325	600
42	250	600
48	200	530
54	150	440
60	125	400
72	-	280

CEMA D & E ratings based on Min. L10 of 60,000 hours at 500 RPM

Figure 2-16 Load ratings for CEMA Live Shaft Idlers, LBS

Belt Width	CEMA C	CEMA D
18	1200	-
24	1200	1400
30	1200	1400
36	1200	1400
42	1100	1400
48	1000	1275
54	875	1150
60	780	1000
72	-	850
84	-	-
96	-	-

Belt Carrying Capacity

The carrying capacity of a belt conveyor depends upon belt width, belt speed, and idler troughing configuration. The following information and charts will help you in selecting the proper size and style of idler.

A. Define the material and its characteristics: Refer to Table 1 for weights in Lbs per Cu. Ft. and surcharge angles for some bulk materials.
B. Select belt speed: Refer to Table 2 for maximum recommended belt speeds. The most economical selection usually dictates the use of maximum belt speeds.
C. Select required belt width: Using Table 3 and the correct surcharge angle for the material being handled, select a belt width. Table 3 gives theoretical carrying capacities with various belt widths and idler troughing angles. Table 3 is based on a belt speed of 100 FPM and a material weight of 100 lbs. Per Cu. Ft. Footnote 1 tells how to calculate the capacities for other belt speeds and material weights. When determining belt width, belt speed, and troughing configuration, select the narrowest belt that will handle the largest material lumps and transport the required capacity without exceeding the maximum recommended belt speed.

Troughing Training

Self-aligning idlers operate effectively when empty belt tensions are 200-lbs./in. or less. When empty belt tensions exceed this range, the belt becomes too stiff and makes training difficult. Belt loaded at high tensions and which generate detraining forces due to off-loading cannot be re-aligned with self-aligning idlers. Self-aligning idlers work effectively at low belt tensions to overcome small amounts of idler skew, which make narrow belts easier to train. Self-aligning idlers are especially needed on low tension reversible belts. Conveyor belts that are 48" and wider usually do not need self-aligning idlers even at low belt tensions because the weight of the belt has more training force than is obtainable with a trainer.

Return Training

When self-aligning return idlers are used, they should be no closer than 12 belt widths from terminals and should not be located on vertical curves.

	Indoor	For wind and rain
In line at standard spacing	200 ft.	150 ft.
*Returns removed to obtain maximum training	150 ft.	75-100 ft.

* The removal of one return idler on each side of a self-aligning return to increase conveyor belt wrap on the idler will increase its self-aligning capacity. An alterative in removing the return idlers is to raise the self-aligner above the return belt line.

Idler Selection Procedure

IDLER SELECTION

Table 1 - Characteristics of Common Bulk Materials

Material	Wt. in Lbs. per Cu. Ft.	Surcharge Angle in °	Maximum Conveying Angle in °
Ashes, Coal, Dry - 3"	35-40	25-30	22
Cement, Portland	90-100	25	20
Cement, Clinker	75-80	20	18
Coal, Anthracite, Sized, 3/8"- 6"	55	12	16
Coal, Bitum., Slack	50	22	22
Coal, Bitum., ROM	50	20	18
Coke, Loose	25-30	15	20
Earth, Common, Loam, Dry	70-80	15-30	20
Earth, Clay, Dry	100-120	10-30	20
Earth, Moist	80-100	30	22
Gravel, Average, Blended	90-100	15-20	18
Gravel, Sharp	90-100	25	20
Gravel, Rounded	90-100	15	15
Iron Ore	135	20	22
Limestone, Crushed	85-90	25-30	20
Phosphate Rock	75-85	25	20
Salt, Coarse, Dry	40-45	10	20
Salt, Fine, Dry	70-80	15	22
Sand, Bank, Damp	110-120	20-30	22
Sand, Bank, Dry	90-110	10-20	15
Sand, Foundry, Shakeout	90	25	20
Sand, Silica, Dry	90-100	10-20	15
Sand, Saterated	110-130	0-15	15
Shale, Crushed	85-90	25	20
Slag, Furnace, Crushed	85-90	12	18
Slate, Crushed, - 1/2"	80-90	15	20
Soda Ash, Light	25-35	22	20
Soda Ash, Heavy	55-65	17	20
Sulphur, Crushed, - 1/2"	50-65	20	20
Sulphur, Lumpy, - 3"	80-85	25	20
Wheat	45-48	8-15	16
Wood Chips	15-25	30	25

Table 2 - Max Recommended Belt Speeds

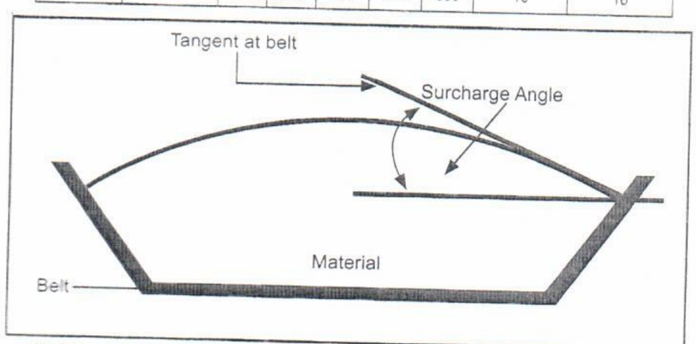
Material Being Conveyed	Belt Speeds (FPM)	Belt Width (in.)
Grain or other free-flowing, nonabrasive material	400	18
	600	24-30
	800	36-42
	1000	48-96
Coal, damp clay, soft ores, overburden and earth, fine-crushed stone	600	18
	800	24-36
	1000	42-60
	1200	72-96
Heavy, hard, sharp-edged ore, coarse-crushed stone	400	18
	600	24-36
	800	Over 36
Foundry sand, prepared or damp; shakeout sand with small cores, with or without small castings (not not enough to harm belting)	350	Any Width
Prepared foundry sand and similar damp (or dry abrasive) materials discharged from belt by rubber-edged plows	200	Any Width
Nonabrasive materials discharged from belt by means of plows -except wood pulp, where 300 to 400 preferable	200	Any Width
Feeder belts, flat or troughed, for feeding fine, nonabrasive, or mildly abrasive materials from hoppers and bins.	50 to 100	Any Width

Suggested Spacing of Troughing Idlers

Belt Width (inches)	Weight of Material Handled, lbs./cu. ft. 30	50	75	100	150	200	Return Idlers
18	5.5	5.0	5.0	5.0	4.5	4.5	10.0
24	5.0	4.5	4.5	4.0	4.0	4.0	10.0
30	5.0	4.5	4.5	4.0	4.0	4.0	10.0
36	5.0	4.5	4.0	4.0	3.5	3.5	10.0
42	4.5	4.5	4.0	3.5	3.0	3.0	10.0
48	4.5	4.0	4.0	3.5	3.0	3.0	10.0
54	4.5	4.0	3.5	3.5	3.0	3.0	10.0
60	4.0	4.0	3.5	3.0	3.0	3.0	10.0
72	4.0	3.5	3.5	3.0	2.5	2.5	8.0
84	3.5	3.5	3.0	2.5	2.5	2.0	8.0
96	3.5	3.5	3.0	2.5	2.0	2.0	8.0

Table 3 Maximum Belt Capacities

BELT WIDTH (inches)	Troughed Angle	Max Belt Capacity (TPH) Surcharge Angle 5°	10°	20°	25°	30°	Max Material (inches) for 20° Surcharge: All lumps uniform size	Mixed 10% lumps 90% fines
18	20°	-	-	50	56	63	4	4
	35°	Not Recommended						
	45°	Not Recommended						
24	20°	-	-	96	108	120	5	7
	35°	-	102	122	132	142	5	7
	45°	106	115	132	140	170	5	7
30	20°	-	-	157	175	195	6	10
	35°	-	167	200	215	232	6	10
	45°	175	187	215	230	244	6	10
36	20°	-	-	230	260	290	7	12
	35°	-	248	295	318	343	7	12
	45°	258	278	318	340	360	7	12
42	20°	-	-	320	360	400	8	14
	35°	-	344	408	442	475	8	14
	45°	358	386	440	470	500	8	14
48	20°	-	-	430	480	530	10	16
	35°	-	457	540	645	630	10	16
	45°	475	510	584	623	660	10	16



(1) All capacities shown are for material weighing 100 lbs. per cu. ft. and moving on belt 100fpm. For other weights, capacity equals table capacity.

$$\times \frac{\text{Wt./Cu. Ft.}}{100}$$

For other belt speeds, capacity equals table capacity (or calculated capacity).

$$\times \frac{\text{fpm}}{100}$$

(2) The surcharge angle is the angle formed between a horizontal line and a tangent to the material slope, both of which pass through the point where the slope meets the belt. Usually the surcharge angle is 10°-15° less than the angle of repose.

(3) "Mixed with 50% fines" means at least half of the material must be less than one half the maximum material size.