

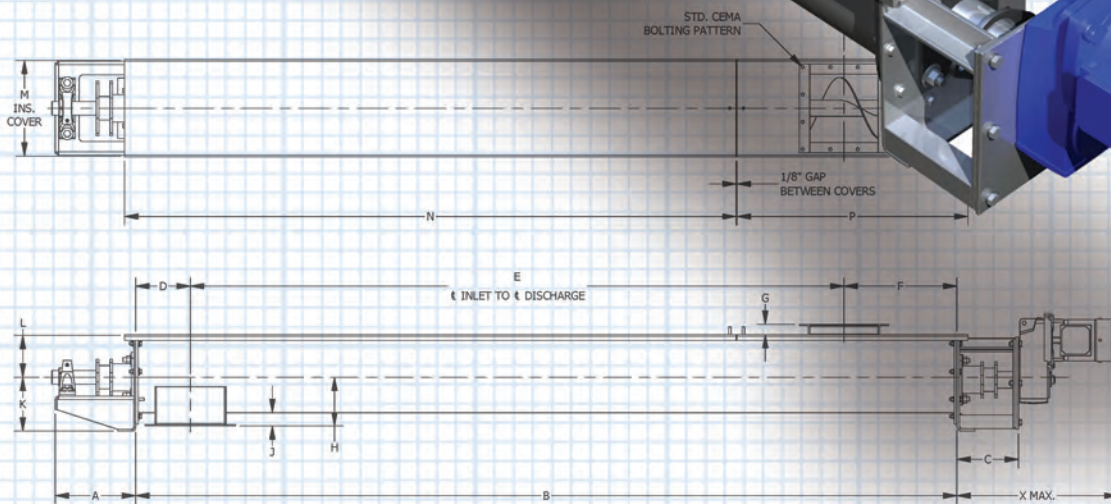
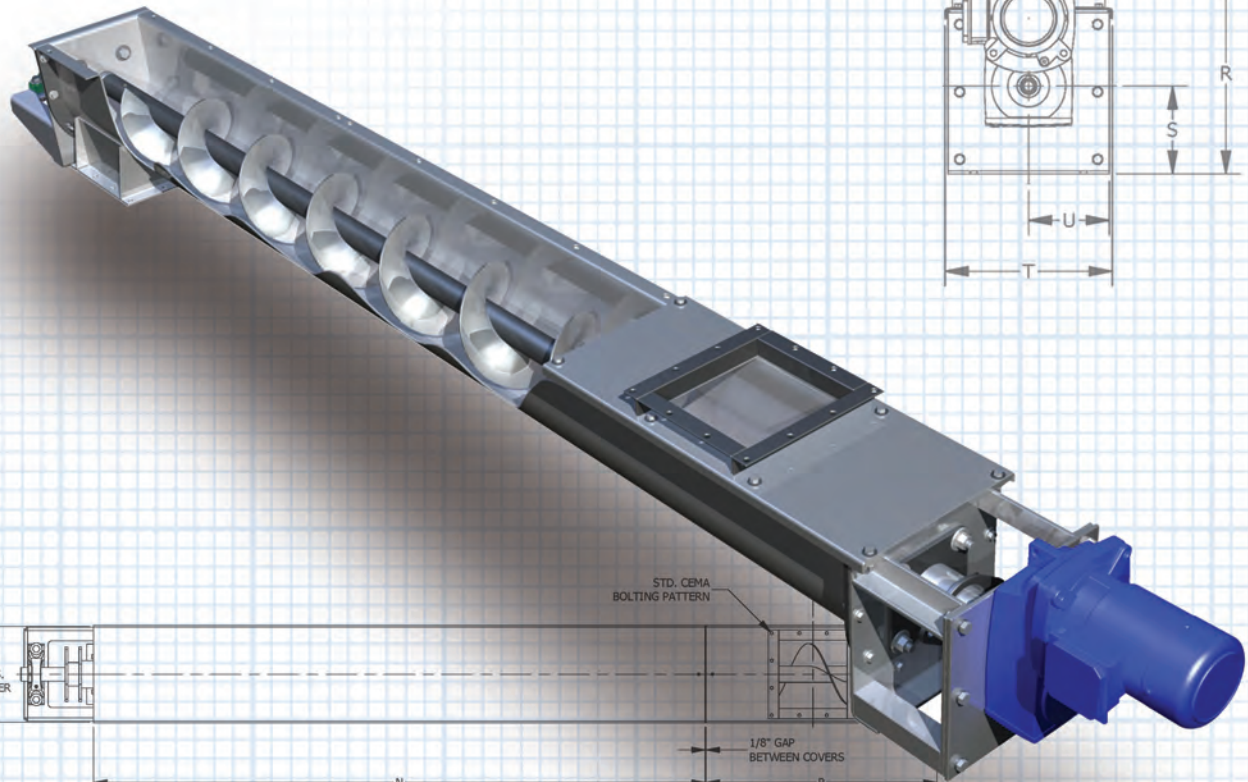


**Design
Engineering
Manufacturing**

Conveying Knowledge, Workmanship, Solutions

ENGINEERING GUIDE

Screw Conveyors



Release Date 4.1.16



**ISO 9001
Certified**



KWS PROFILE

Founded in 1972, KWS Manufacturing Company, Ltd, is the leader in the design and manufacture of conveying equipment for the bulk material handling industry. Our primary Customers are power transmission distributors, end users, engineering firms, system suppliers and original equipment manufacturers (OEMs).

As an ISO 9001 certified manufacturer, KWS provides the highest quality equipment and service to our Customers. The KWS name stands for Knowledge, Workmanship and Solutions. Our large number of repeat Customers shows our commitment to Customer satisfaction. Our quality system ensures that your equipment is designed and manufactured to rigid specifications and validated by exceeding performance expectations.

We also offer complete system design and engineered solutions for our Customers. KWS is one of the largest conveyor manufacturers in North America and continues to grow every year.

KWS SCREW CONVEYOR ENGINEERING GUIDE

Screw conveyors are a cost effective and reliable method of conveying bulk materials. Thousands of bulk materials are conveyed and processed daily utilizing screw conveyors. The KWS Screw Conveyor Engineering Guide is an excellent resource for understanding and designing screw conveyors. The engineering guide is easy to use, with descriptions of many bulk materials and their characteristics. Examples are provided to assist the screw conveyor designer on how to properly select a screw conveyor, determine horsepower and speed as well as choose the proper components for a specific application.

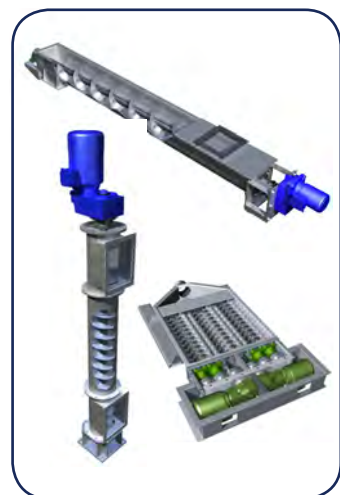




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SCREW CONVEYOR BASICS

The KWS Screw Conveyor Engineering Guide will provide assistance in the design of a screw conveyor or system, yielding optimum performance and efficiency.

Primary considerations for the selection of a screw conveyor are:

1. Type and condition of the bulk material to be conveyed including maximum particle size and specific bulk density
2. Capacity or feed rate of bulk material to be conveyed expressed in pounds per hour, tons per hour, or cubic feet per hour
3. Required distance and incline the bulk material is to be conveyed
4. Design conditions such as materials of construction, inlet feed conditions and operating temperature

The Engineering Guide provides the necessary information for selecting a screw conveyor in a series of five steps. These steps are arranged in logical order and are divided into separate sections for simplicity.

The five steps are:

1. Establish characteristics of the bulk material to be conveyed.
2. Determine conveyor size and speed based on capacity.
3. Calculate horsepower requirements.
4. Verify torque rating of components.
5. Select conveyor components.



Typical KWS Screw Conveyor

TYPES OF SCREW CONVEYORS

Horizontal Screw Conveyors

Horizontal screw conveyors are the most widely used type of screw conveyor. Used to convey bulk materials from one part of a process to another, horizontal screw conveyors are available in a wide range of sizes, lengths, configurations and materials of construction.

Screw conveyors are typically designed to convey bulk materials at 15, 30 or 45-percent trough loading, depending upon material characteristics of the specific bulk material. As a general rule, trough loading of 45-percent can be used for light, free-flowing and non-abrasive bulk materials. Trough loadings of 15 and 30-percent are typically used for denser, sluggish and more abrasive bulk materials.

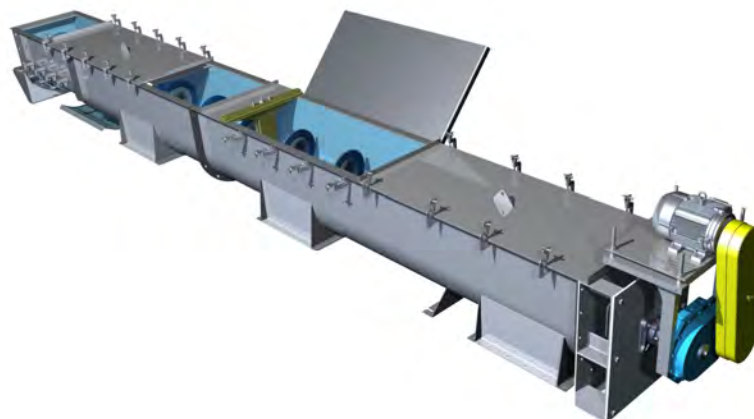
The inlet of a screw conveyor is always control fed by another device such as:

- Screw Conveyor
- Screw Feeder
- Belt Conveyor
- Rotary Airlock
- Volumetric or Gravimetric Feeder

The recommended location for the drive unit is on the discharge end of a screw conveyor which pulls the bulk material to the drive end. With this arrangement, each screw section is put in tension as the bulk material is conveyed toward the discharge of a screw conveyor, reducing wear and fatigue on the conveyor components.

Advantages of Using Screw Conveyors

- Ideal for conveying dry to semi-fluid bulk materials – free flowing to sluggish
- Cost-effective when compared to other conveying devices such as belt, pneumatic or aero-mechanical
- Efficiently distributes bulk materials to various locations using multiple inlet and discharge points
- Totally enclosed for dusty, corrosive or hazardous environments



TYPES OF SCREW CONVEYORS

Inclined Screw Conveyors

Inclined screw conveyors typically operate from slightly above the horizontal position to 45-degrees from the horizontal position. Above 45-degrees an inclined screw conveyor is considered a vertical screw conveyor and must be designed in accordance with the KWS Engineering Guide for Vertical Screw Conveyors. As the degree of incline increases, conveying efficiency is reduced and horsepower requirements increase due to the effects of gravity and bulk material fall back. Conveying efficiency is affected by angle of incline, characteristics of the specific bulk material, type of screw conveyor trough and screw pitch. KWS recommends designing screw conveyors using the lowest possible degree of incline for maximum efficiency.

The following are design and construction features to consider when designing an inclined screw conveyor:

- Incline Up to 10-Degrees – Loss in conveying efficiency is minimal on inclines up to 10-degrees. A screw conveyor with U-trough and full pitch screw is sufficient for most applications. Loss in efficiency can be overcome by increasing the speed of the screw conveyor, increasing the diameter of the screw conveyor or reducing the pitch of the screw.
- Incline Between 10 and 20-Degrees – Loss in conveying efficiency is typically between 10 and 40-percent on inclines up to 20-degrees. A screw conveyor with U-trough and 2/3-pitch screw is sufficient for most applications. Loss in efficiency can also be overcome by increasing the speed or the diameter of the screw conveyor. Additional horsepower is required to overcome gravity and bulk material fall back.
- Incline Between 20 and 30-Degrees – Loss in conveying efficiency is typically between 10 and 70-percent on inclines up to 30-degrees. A screw conveyor with tubular housing and reduced pitch screw (1/2 or 2/3) is recommended for most applications. Loss in efficiency can also be overcome by increasing the speed or the diameter of the screw conveyor. Additional horsepower is required to overcome gravity and bulk material fall back.
- Incline Between 30 and 45-Degrees – Loss in conveying efficiency is typically between 30 and 90-percent on inclines up to 45-degrees. A screw conveyor with tubular housing and reduced pitch screw (1/2 or 2/3) and larger diameter is recommended for most applications. Increasing the speed of the screw conveyor is also required. Additional horsepower is required to overcome gravity and bulk material fall back.

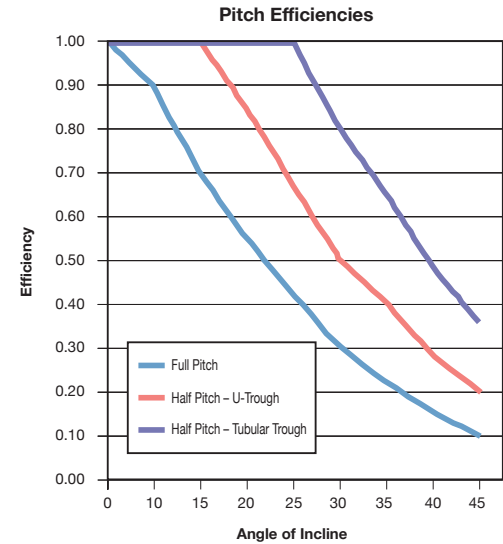




TYPES OF SCREW CONVEYORS

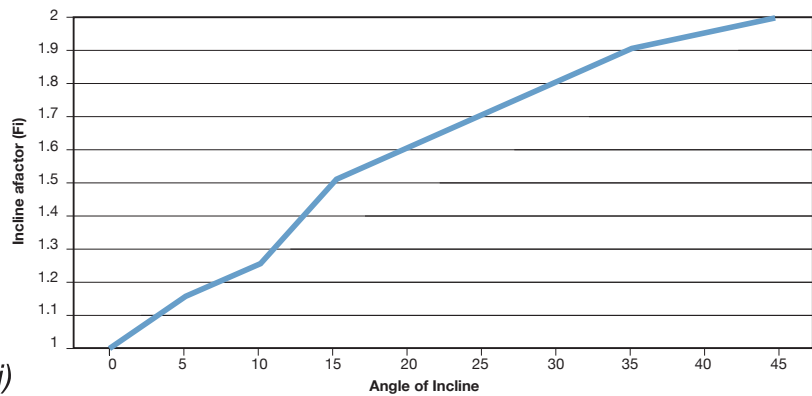
Pitch Efficiency

The Pitch Efficiency chart shows the relative conveying efficiency at different degrees of incline and pitch configurations. As the degree of incline increases, reduced pitch screws (1/2 and 2/3) are more efficient than full pitch screws. The combination of reduced pitch screws (1/2 and 2/3) and tubular housings provide the highest conveying efficiency.



Horsepower Requirements

The horsepower requirements for inclined screw conveyors increase with the degree of incline. The Horsepower Factor (Fi) is incorporated into the standard screw conveyor horsepower calculations to compensate for the additional horsepower required to overcome gravity and bulk material fall back.



$$TSHP(i) = \frac{FHP + (MHP^* \times Fi)}{e}$$

TSHP (i) = Total Shaft HP for Inclined Screw Conveyor

FHP = Friction HP (HP required to drive the conveyor empty)

MHP = Material HP (HP required to move the material)

Fi = Incline Factor

e = Drive Efficiency (Typical value of 0.88 is used for a shaft mount reducer/motor)

* If calculated Material Horsepower is less than 5HP it should be corrected for potential overload. Use the Corrected Material HP Chart.

Upset Conditions

Screw conveyors located on inclines over 10-degrees must be designed to start and operate under upset conditions. An upset condition is caused when normal flow in an inclined screw conveyor is interrupted and the bulk material inside the conveyor slips back to the lower end, filling up the conveyor. Additional horsepower is required to restart and convey the bulk material because the conveyor will temporarily experience 100-percent trough loading. Please consult KWS Engineering for the proper design of inclined screw conveyors for upset conditions.

TYPES OF SCREW CONVEYORS

Shaftless Screw Conveyors

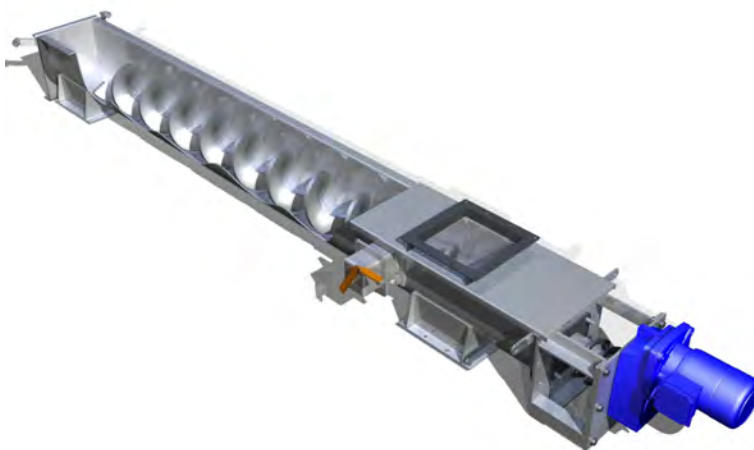
Bulk materials discharged from centrifuges, filter presses or mixers can easily be conveyed using a KWS Shaftless Screw Conveyor. Our shaftless design provides a non-clogging conveying surface that allows difficult-to-convey materials to become easy-to-convey. The perfect solution for handling bulk materials with high moisture content is the KWS Shaftless Screw Conveyor.

Advantages of Shaftless Screw Conveyors

- Ideal for handling sticky and sluggish bulk materials
- Improved conveying efficiency when compared to other types of conveyors
- Allows greater flexibility for plant layout due to configurations available
- Internal bearings are eliminated

KWS Shaftless Screw Conveyors are successfully used throughout the chemical, food, minerals processing and wastewater treatment industries for conveying everything from catalysts to dewatered biosolids.

KWS developed the industry standards for shaftless screw conveyors and continues to create new and improved design standards. Our high strength alloy spirals are the hardest, strongest and toughest in the industry. For more information regarding shaftless screw conveyors consult the *KWS Shaftless Screw Conveyor Engineering Guide* located on our website.



Engineering Guide Available at:
www.KWSMFG.com

TYPES OF SCREW CONVEYORS

Vertical Screw Conveyors

Vertical screw conveyors are a very efficient method for elevating a variety of bulk materials at very steep inclines or completely vertical. KWS considers any screw conveyor located on an incline over 45-degrees to be a vertical screw conveyor. The compact design allows for the vertical screw conveyor to fit into almost any plant layout. With a minimum number of moving parts, the vertical screw conveyor is a cost-effective and dependable component of any bulk material handling process.

Advantages of Vertical Screw Conveyors

- Ideal for handling dry to semi-fluid materials
- Capacities up to 6,000 cubic feet per hour.
- Ability to elevate bulk materials up to 30-feet without use of internal bearings.
- Totally enclosed design for dust and vapor-tight requirements.

KWS designs and supplies vertical screw conveyors to meet the needs of many industries, such as chemical, minerals processing, food, wood products and wastewater treatment. For example, our unique shaftless vertical screw conveyor design is used in many wastewater treatment facilities for elevating dewatered biosolids.

KWS Vertical Screw Conveyors are available in many configurations. Inlet sections can be offset to either side or can be in-line. Horizontal feed conveyors are required to accurately meter bulk materials directly to the vertical conveyor's inlet for maximum efficiency.

For more information regarding vertical screw conveyors, consult the *KWS Vertical Screw Conveyor Engineering Guide* located on our website.



Engineering Guide Available at:
www.KWSMFG.com

TYPES OF SCREW FEEDERS

Screw Feeders

Screw feeders are designed to meter bulk materials and are typically located at the beginning of a process. Capacity or feed rate can be accurately controlled with screw feeders. Variable speed drives improve metering accuracy and can provide a wide range of feed rates. Screw feeders are available in a variety of sizes, lengths, configurations and materials of construction.

The inlet of a screw feeder is always flood loaded (100-percent). A screw feeder is typically mounted directly to a:

- Hopper – Square or rectangular in shape with sloped bottom and limited storage capacity
- Bin – Square or rectangular in shape with sloped bottom and large storage capacity
- Silo – Cylindrical in shape with cone or mass-flow bottom and large storage capacity

Several factors must be considered when designing a screw feeder, including:

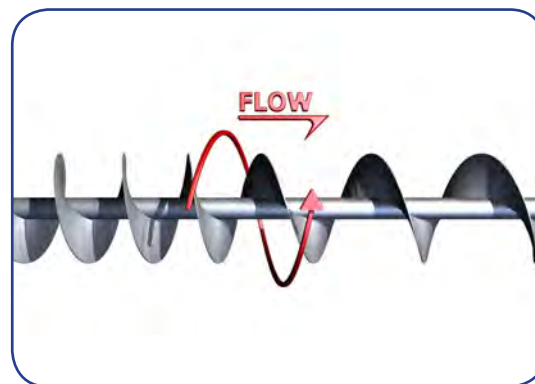
1. Flow characteristics of bulk material being stored and metered
2. Density of bulk material in both stored and metered condition
3. Maximum and minimum capacity or feed rate of process
4. Bulk material size with screen analysis
5. Width and length of screw feeder inlet opening
6. Overall length of screw feeder
7. Height of bulk material in hopper, bin or silo

With the screw feeder inlet flood loaded (100-percent), the design of the screw in the inlet area and the screw speed determine the desired capacity or feed rate.

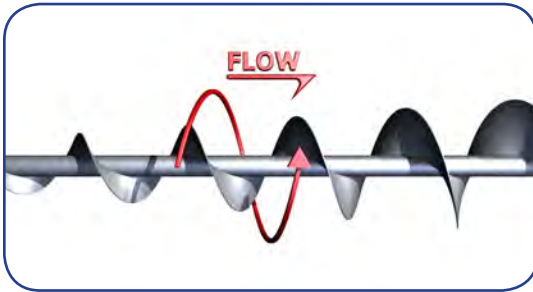
Most screw feeders are less than 20-feet in length because the use of internal hanger bearings is not recommended. In most applications a short screw feeder will meter a bulk material to a screw conveyor for transfer to the next step of the process.

KWS designs and manufactures three types of screw feeders:

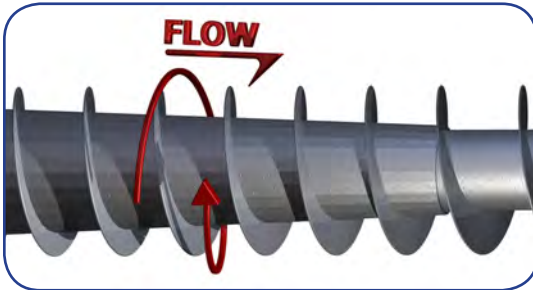
Variable or Stepped Pitch – The pitch of the screw varies from shorter to longer as the screw progresses toward the discharge of the screw feeder. With variable pitch, every pitch increases in length in the inlet section creating more available volume for addition of bulk materials from the hopper. With stepped pitch the flight pitch changes in increments. For example, a stepped pitch screw feeder may have 2-feet of 1/3 pitch, then 2-feet of 2/3 pitch in the inlet section.



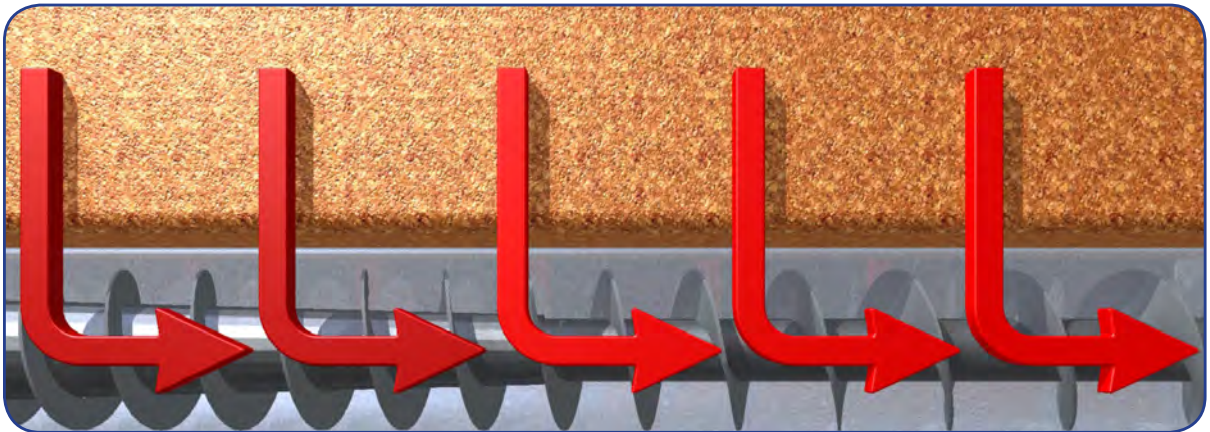
TYPES OF SCREW FEEDERS



Tapered Outside Diameter – The outside diameter of the screw is tapered from the rear of the inlet opening to the shroud creating more available volume for addition of bulk materials from the hopper.



Mass Flow – The mass flow design was developed by Jenike & Johanson and is a combination of variable pitch and tapered inside diameter. A tapered cone is located on the center pipe of the screw from the rear of the inlet opening to approximately the center of the inlet opening. Short pitch flights are mounted on the cone creating available volume for addition of bulk materials from the hopper. Variable pitch is then added to the screw starting where the cone ends and continuing to the discharge.



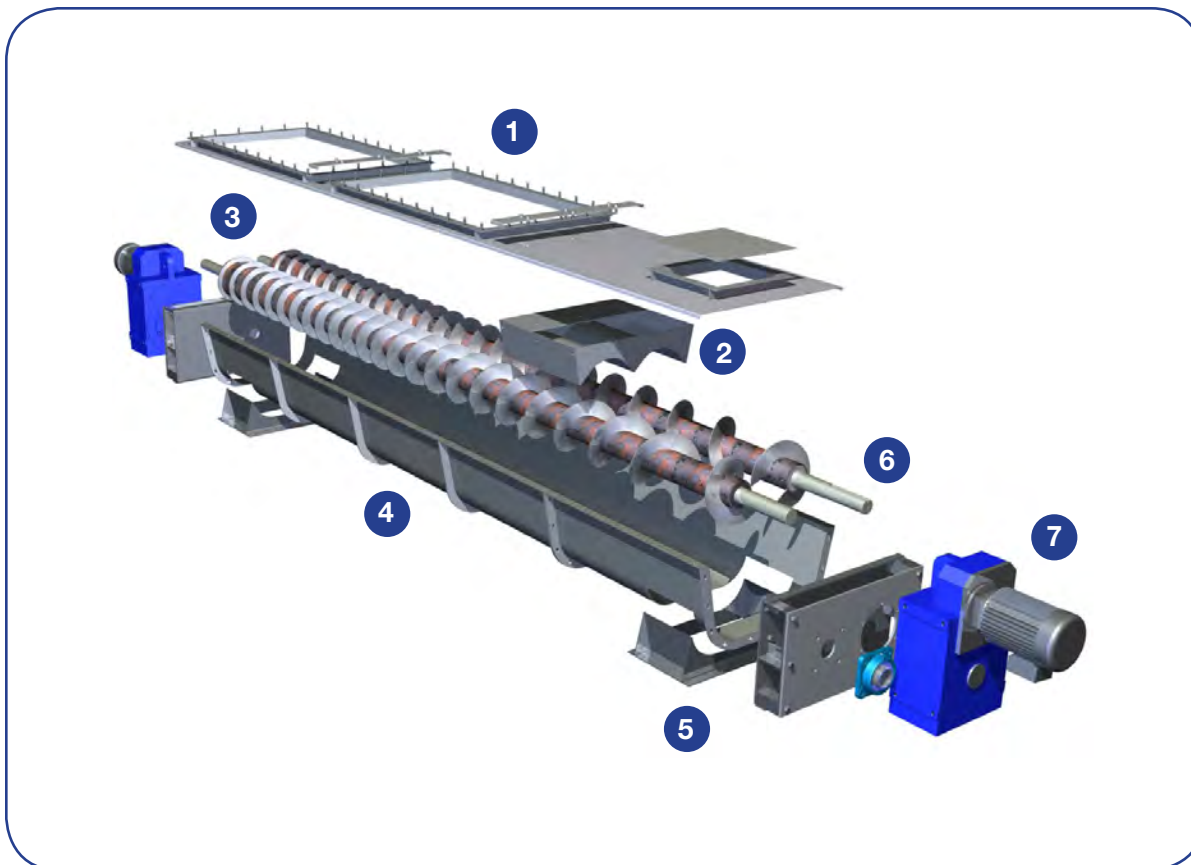
Mass flow in a hopper

Screw feeders can be composed of one, two or virtually any number of screws. A screw feeder with multiple screws is considered a live bottom screw feeder.

TYPES OF SCREW FEEDERS

Basic Screw Feeder Design

It is not recommended to design screw feeders with uniform outside diameter and constant pitch because bulk materials will fill the screw from the rear of the inlet opening first, creating rat-holing, stagnant material and possible bridging of bulk materials above the screw feeder. To draw bulk materials evenly across the full length of the inlet each flight must increase in available volume as the screw progresses towards the discharge of the screw feeder. Variable pitch, tapered outside diameter (OD) or mass flow screw design is required.



1. Inlet opening matches bin or hopper discharge.
2. Feeder Shroud prevents material flooding.
3. Twin mass flow, variable pitch screw feeder permits even draw off of material.
4. Twin screw trough.
5. Discharge opening.
6. Solid shafting transmits rotary motion to gear reducer.
7. Independent gear boxes to drive each screw.



TYPES OF SCREW FEEDERS

Feeder Shroud

Screw feeders must be equipped with a shroud for at least 2 pitches beyond the inlet opening to prevent flooding of the bulk material past the inlet. The shroud is a curved cover that converts a standard U-trough into a tubular housing to prevent bulk materials from flooding past the screw. Extended shrouds, tubular housings or short pitch flights can be utilized for accurate feed rate control when metering very free flowing bulk materials.

Screw Feeder Capacity and Speed

The pitch of the last screw flight going into the shroud determines the feed rate of the screw feeder and is called the Control Pitch. The Control Pitch is typically less than full pitch. The capacity of the Control Pitch is calculated in cubic feet per hour per RPM. The speed of the screw feeder can be determined by dividing the maximum screw feeder capacity in cubic feet per hour by the capacity of the Control Pitch in cubic feet per hour per RPM. Most screw feeder speeds are lower than standard screw conveyor speeds. For example, in heavy industrial applications, screw feeders typically operate at speeds less than 20-RPM. More torque is generated at lower operating speeds ensuring the screw feeder does not stall at start-up.

Screw Feeder Horsepower Requirements

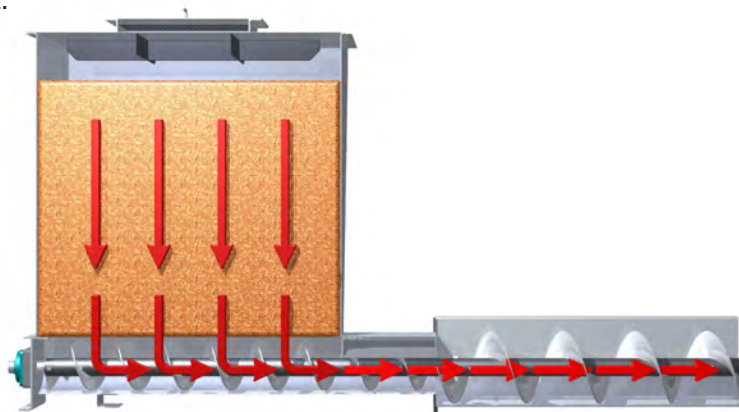
The horsepower and torque requirements for a screw feeder are much higher than a comparable screw conveyor. A screw feeder must start up with a flood loaded inlet and the head load weight of the bulk material in the inlet section. Bulk materials also tend to pack when under pressure in a hopper, bin or silo. As the bulk material density increases, so do the horsepower and torque requirements. The Material Factor or HP Factor (MF) can exceed 4.0 for some bulk materials when under pressure and packed. The start-up horsepower and torque can easily be 2.5 times the normal operating conditions. Please consult the KWS Engineering Department for proper screw feeder design.

TYPES OF SCREW FEEDERS

OTHER TYPES OF SCREW FEEDERS

Multiple Diameter Screw Feeder/Conveyor

Multiple Diameter Screw Feeder/Conveyors consist of a screw feeder with an extension conveyor. A smaller diameter screw feeder is located under a hopper, bin or silo and is flood loaded. The screw feeder meters the bulk material to the larger diameter extension conveyor. When the bulk material reaches the extension conveyor the trough loading decreases and the bulk material is conveyed to the discharge. Hanger bearings are allowed in the extension conveyor as long as the trough loading is below 45-percent.



Live Bottom Screw Feeder

Live bottom screw feeders are designed for use on large silos, bins and hoppers with large discharge openings. The live bottom screw feeder utilizes multiple feeder screws in tandem to create a “live bottom” to prevent bridging. Bulk materials are metered and drawn out equally from the full width and length of the inlet opening. Live bottom screw feeders are used on bulk materials which tend to pack or bridge easily.



When designing a screw feeder, every application is unique. For this reason, please consult KWS Engineering for proper recommendations concerning your particular needs.

TYPES OF SCREW FEEDERS

Inclined Screw Feeders

Inclined screw feeders meter and elevate bulk materials from hoppers, bins or silos and perform the same function as horizontal screw feeders. However, special care is required when designing inclined screw feeders.

Knowledge of the flow characteristics of bulk materials is extremely important for successful inclined screw feeder design. The angle of repose and flowability of a bulk material will determine the design of the screw feeder and the maximum angle of incline. Testing of bulk materials is required for all inclined screw feeders before a proper design can be established. Bulk material samples can be sent to KWS for laboratory and field testing.

Basic Inclined Screw Feeder Design

Inclined screw feeders must be designed to meter a desired capacity or feed rate and elevate a bulk material to a desired height. Screw feeders become less efficient when inclined over 5-degrees from the horizontal position. The loss of efficiency is determined based on the degree of incline of the screw feeder and the angle of repose and flowability of the bulk material. The diameter of the inclined screw feeder can be selected once the incline efficiency factor is determined.

Inclined screw feeders utilizing U-troughs are typically used on inclines up to 15-degrees and tubular housings are recommended for inclines over 15-degrees. Reducing the pitch of the screw increases the incline efficiency factor because the shorter pitch provides a better conveying surface and bulk materials do not fall back when compared to full pitch flights. Full pitch flights are the least efficient at metering and conveying bulk materials on an incline.



TYPES OF SCREW FEEDERS

Inclined Screw Feeder Capacity and Speed

Inclined screw feeders typically operate at higher speeds when compared to horizontal screw feeders because additional speed is required to elevate a bulk material and overcome the forces of gravity and bulk material fall back. The desired capacity is adjusted using the incline efficiency factor calculated from testing of the bulk material. The speed of the inclined screw feeder can then be determined.

Inclined Screw Feeder Horsepower Requirements

Inclined screw feeders require more horsepower and torque when compared to a horizontal screw feeder. Additional horsepower and torque is required to elevate a bulk material and overcome the forces of gravity and bulk material fall back. Bulk materials can become packed inside an inclined screw feeder, causing more demand on the drive unit.

Inlet Length

The inlet length on an inclined screw feeder must be kept to a minimum to prevent the bulk material from falling back over the top of the flights in the inlet section. Typically, the length of the inlet should not exceed 2 times the diameter of the screw for an inclined screw feeder.

Flight Pitch Changes

Inclined screw feeders are typically designed with multiple flight pitch changes. Shorter flight pitches are used in the inlet section to control the capacity or feed rate. Typically, the flight pitch increases beyond the inlet to reduce the trough loading to less than 100-percent. The conveying efficiency must be calculated in the longer flight pitch section to make sure the desired capacity or feed rate is met. Improper design of the flight pitches could result in the inclined screw feeder becoming plugged at the transition from shorter to longer pitch flights.

Inclined screw feeders can be a very important part of your process. Please consult KWS Engineering for proper inclined screw feeder design.



BULK MATERIAL CHARACTERISTICS

Conveyor size, speed and horsepower requirements are directly affected by the following characteristics of the conveyed bulk material. More specific information will be discussed in the ensuing pages clarifying several of the factors listed in the Bulk Material Table.

Maximum Particle Size and Bulk Material Lump Size

Particle size is measured in inches or by a mesh screen gauge. Other material size designations such as irregular, shredded, or % oil have special considerations in the design process. In addition to particle size, lump size is also an important consideration and will be discussed in detail in the next few pages.

Bulk Density

Conveying capacity for screw conveyors and screw feeders is calculated volumetrically in cubic feet per hour (ft³/hr). The bulk density of the bulk material is needed in order to convert capacities given in tons per hour or pounds per hour to cubic feet per hour.

The bulk density column of the Bulk Material Table provides an average bulk density or a range of bulk densities for each bulk material. Accurate bulk density information is needed for selecting the proper screw conveyor or screw feeder.

% Trough Loading

Trough loading is a prime factor in determining conveyor size and is based on the maximum depth at which bulk materials will flow through a screw conveyor without causing undue wear on the conveyor components, such as screws, hanger bearings, couplings shafts and troughs. The recommended trough loading is lower for abrasive bulk materials in comparison to non-abrasive bulk materials.

Material Factor (MF)

Material factor represents the resistance of a bulk material to be conveyed and is used for calculating screw conveyor horsepower. The material factor may vary for screw feeders. Please consult KWS Engineering for screw feeder applications.

Component / Bearing Series

The recommended component series assists in the selection of screw conveyor components for a given bulk material. In general, lighter duty construction is acceptable for free flowing and non-abrasive bulk materials. Heavier duty construction is recommended for sluggish and abrasive bulk materials. The alphabetical code refers to the general component series and the numerical code refers to hanger bearing recommendations.

Abrasiveness, Corrosiveness, Flowability, and Special Characteristics

Each of these characteristics affect how the material reacts to and moves through the conveyor.

The characteristics explanations and the Bulk Material Table on the following pages contain important information for the proper design of screw conveyors and screw feeders. Please contact KWS Engineering for materials not listed in the Bulk Material Table.

BULK MATERIAL CHARACTERISTICS

Bulk Material Lump Size

Bulk material lump size must be considered when designing a screw conveyor. Screw conveyor diameter not only depends on the capacity of the bulk material to be conveyed, but also the size and proportion of lumps in the bulk material. Lump size is determined by the maximum dimension of the largest lumps. If a lump has one dimension much longer than its transverse cross-section, then the longer dimension will be used to determine the lump size.

The character of the lump must also be considered when designing a screw conveyor. Some bulk materials have hard lumps that won't break up when conveyed by a screw conveyor. Other bulk materials may have lumps that are fairly hard but degrade when conveyed causing a reduction in the lump size. Bulk materials that have lumps that are easily broken up when conveyed have no limitations on conveyor size.

The allowable size of a lump in a screw conveyor is a function of the radial clearance between the outside diameter of the center pipe and the radius of the inside of the trough, as well as the proportion of lumps in the mix. The screw conveyor must be able to convey the lumps without impeding bulk material flow or damaging the conveyor. The lumps must be able to fit in the clearance between the center pipe and the inside of the trough. Radial clearance is shown below.

Bulk Material Lump Classification

Bulk materials are classified based on the percentage of lumps in the total mixture.

Class 1

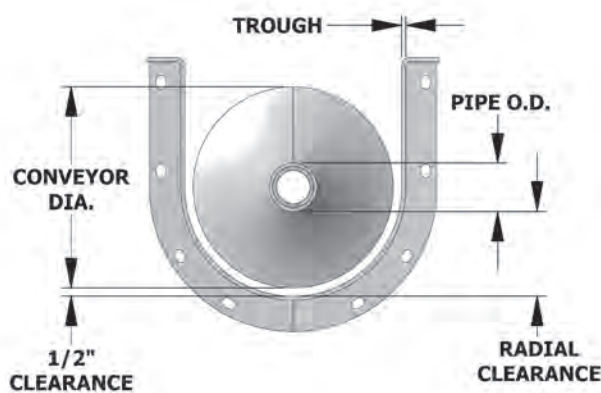
Class 1 bulk materials are a mixture of lumps and fines in which not more than 10-percent are lumps ranging from maximum size to 1/2 of maximum size and 90-percent are lumps smaller than 1/2 of maximum size.

Class 2

Class 2 bulk materials are a mixture of lumps and fines in which not more than 25-percent are lumps ranging from maximum size to 1/2 of maximum size and 75-percent are lumps smaller than 1/2 of maximum size.

Class 3

Class 3 bulk materials are a mixture of lumps and fines in which not more than 95-percent are lumps ranging from maximum size to 1/2 of maximum size and 5-percent are lumps smaller than 1/2 of maximum size.





BULK MATERIAL CHARACTERISTICS

Lump Size Ratio

Lump Size Ratio (R) is a function of screw conveyor radial clearance and lump size. The ratio is used to determine the correct screw conveyor design based on maximum bulk material lump size.

$$\text{Ratio, } R = \frac{\text{Radial Clearance inches}}{\text{Lump Size, inches}}$$

Bulk Material Lump Size Table						
Screw Dia.	Pipe Size	Pipe O.D.	Radial Clearance	Class 1 (R = 1.75)	Class 2 (R = 2.5)	Class 3 (R = 4.5)
4"	1-1/4"	1-5/8"	1-11/16"	3/4"	1/2"	1/4"
6"	2"	2-3/8"	2-5/16"	1-1/4"	3/4"	1/2"
9"	2"	2-3/8"	3-13/16"	2"	1-1/2"	3/4"
	2-1/2"	2-7/8"	3-9/19"	2"	1-1/4"	3/4"
12"	2-1/2"	2-7/8"	5-1/16"	2-3/4"	2"	1"
	"3	3-1/2"	4-3/4"	2-1/2"	1-3/4"	1"
	3-1/2"	4"	4-1/2"	2-1/2"	1-3/4"	3/4"
14"	3"	3-1/2"	5-3/4"	3-1/4"	2-1/4"	1-1/4"
	3-1/2"	4"	5-1/2"	3"	2"	1"
16"	3-1/2"	4"	6-1/2"	3-1/2"	2-1/2"	1-1/4"
	4"	4-1/2"	6-1/4"	3-1/2"	2-1/4"	1-1/4"
18"	3-1/2"	4"	7-1/2"	4-1/4"	2-3/4"	1-1/2"
	4"	4-1/2"	7-1/4"	4"	2-3/4"	1-1/2"
20"	3-1/2"	4"	8-1/2"	4-3/4"	3-1/4"	1-3/4"
	4"	4-1/2"	8-1/4"	4-1/2"	3-1/4"	1-3/4"
24"	4"	4-1/2"	10-1/4"	5-3/4"	4"	2-1/4"
30"	5"	5-9/16"	12-11/16"	7"	5"	2-3/4"
36"	6"	6-5/8"	15-3/16"	8-1/2"	6"	3-1/4"

BULK MATERIAL CHARACTERISTICS

Trough Loading

Trough loading is the depth of a bulk material in the trough of a screw conveyor and is measured in percent when compared to a full trough. A full trough is considered 100-percent full. Recommended trough loadings of 15, 30 and 45-percent were developed based on the characteristics of bulk materials. The recommended trough loading for a screw conveyor is a function of the density, abrasiveness and flowability of a bulk material. For a given capacity, screw conveyor size and speed is determined by trough loading percentage.

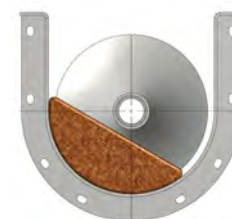
15% Trough Loading

Bulk materials with a density range of 50 to 120 lbs/ft³ that are extremely abrasive and sluggish such as alumina, glass cullet or potash are difficult to convey and do not easily flow through a screw conveyor. The trough loading must be kept well below the center pipe to reduce undue wear on the conveyor components such as screws, hanger bearings, couplings shafts and troughs. The recommended trough loading for bulk materials with similar characteristics is 15-percent.



30%A Trough Loading

Bulk materials with a density range of 15 to 60 lbs/ft³ that are mildly abrasive and free-flowing such as carbon black, fish meal or spent brewers grain will flow through a screw conveyor. The trough loading can be raised to a level below the center pipe without causing undue wear on the conveyor components such as screws, hanger bearings, couplings shafts and troughs. The recommended trough loading for bulk materials with similar characteristics is 30-percent.



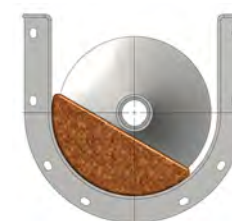
30%B Trough Loading

Bulk materials with a density range of 30 to 80 lbs/ft³ that are very abrasive with average flowability such as crushed bauxite, cement clinker or flue dust are difficult to convey and do not easily flow through a screw conveyor. The trough loading can be raised to a level below the center pipe without causing undue wear on the conveyor components such as screws, hanger bearings, couplings shafts and troughs. The recommended trough loading for bulk materials with similar characteristics is 30-percent. The screw conveyor speed is reduced for bulk materials with 30B trough loading when compared to bulk materials with 30A trough loading.



45% Trough Loading

Bulk materials with a density range of 5 to 40 lbs/ft³ that are non-abrasive and very free-flowing such as alfalfa, baking soda or hulled rice will easily flow through a screw conveyor. The trough loading can be raised to the level of the center pipe without causing undue wear on the conveyor components such as screws, hanger bearings, couplings shafts and troughs. The recommended trough loading for bulk materials with similar characteristics is 45-percent.





COMPONENT/BEARING SERIES

COMPONENT SERIES

The recommended component series for bulk materials are listed in the Bulk Material Table. The alphabetical series codes refer to the minimum construction requirements for a screw conveyor used to convey a specific bulk material. Series A and B construction can be used for most light, non-abrasive and free-flowing bulk materials. Series C and D construction are recommended for dense, abrasive and sluggish bulk materials. Please consult KWS Engineering for further assistance.

Series A

Light Duty Construction – Series A bulk materials such as barley, cocoa beans, fish meal and sawdust are light, non-abrasive and very free-flowing. Light duty construction is very cost-effective and consists of the thinnest gauge materials available for screws, troughs and covers. Helicoid screws and angle flange troughs are recommended for Series A bulk materials.

Series B

Medium Duty Construction – Series B bulk materials such as alfalfa pellets, dry bagasse, activated carbon and crushed ice are slightly higher in bulk density, have some abrasiveness and are slightly less free-flowing when compared to Series A bulk materials. Medium duty construction is cost-effective and consists of slightly heavier gauge materials for screws, troughs and covers. Helicoid screws and angle flange troughs are recommended for Series B bulk materials.

Series C

Heavy Duty Construction – Series C bulk materials such as alumina fines, spent distiller's grain, foundry sand and sodium sulphate are dense, abrasive and sluggish when compared to Series A and B bulk materials. Heavy duty construction is required to prevent excessive maintenance or downtime and consists of heavy duty screws, troughs and covers. Sectional screws and formed flange troughs are recommended for Series C bulk materials.

Series D

Extra Heavy Duty Construction – Series D bulk materials such as adipic acid, blast furnace slag, cement clinker and lignite coal are very dense, extremely abrasive and very sluggish when compared to Series A, B or C bulk materials. Extra heavy duty construction is required to prevent excessive maintenance or downtime and consists of extra heavy duty screws, troughs and covers. Sectional screws with weld-on hardsurfacing and formed flange troughs are recommended for Series D bulk materials.



COMPONENT/BEARING SERIES

Component Series Tables

Screw Dia.	Shaft Dia.	Cover Thickness	Series A			Series B		
			Screw Number		Trough Thickness (Min.)	Screw Number		Trough Thickness (Min.)
			Helicoid	Sectional		Helicoid	Sectional	
4	1"	14 Ga.	4H206	N/A	14 Ga.	4H206*	N/A	14 Ga.
6	1-1/2"	14 Ga.	6H304*	6S309	14 Ga.	6H308*	6S309	14 Ga.
9	1-1/2" 2"	14 Ga.	9H306* 9H406*	9S309 9S409	14 Ga.	9H312* 9H412*	9S312 9S412	10 Ga.
12	2" 2-7/16" 3"	14 Ga.	12H408* 12H508* 12H614*	12S409 12S509 12S612	12 Ga.	12H412* 12H512* 12H614*	12S412 12S512 12S612	3/16"
14	2-7/16" 3"	14 Ga.	14H508* 14H614*	14S509 14S609	12 Ga.	14H508* 14H614*	14S512 14S612	3/16"
16	3"	14 Ga.	16H610*	16S612	12 Ga.	16H614*	16S616	3/16"
18	3" 3-7/16"	12 Ga.	N/A	18S612 18S712	10 Ga.	N/A	18S616 18S716	3/16"
20	3" 3-7/16"	12 Ga.	N/A	20S612 20S712	3/16"	N/A	20S616 20S716	3/16"
24	3-7/16"	12 Ga.	N/A	24S712	3/16"	N/A	24S716	3/16"
30	3-15/16"	10 Ga.	N/A	30S816	3/8"	N/A	30S824	3/8"
36	4-7/16"	3/16"	N/A	36S916	3/8"	N/A	36S924	3/8"
Screw Dia.	Shaft Dia.	Cover Thickness	Series C			Series D		
			Screw Number		Trough Thickness (Min.)	Screw Number		Trough Thickness (Min.)
			Helicoid	Sectional		Helicoid	Sectional	
4	1"	14 Ga.	4H206*	N/A	14 Ga.	4H206*	N/A	10 Ga.
6	1-1/2"	14 Ga.	6H312*	6S312	14 Ga.	6H312*	6S316*	10 Ga.
9	1-1/2" 2"	14 Ga.	9H312* 9H414*	9S316* 9S416	10 Ga.	9H312* 9H414*	9S324* 9S424*	3/16"
12	2" 2-7/16" 3"	14 Ga.	12H412* 12H512* 12H614*	12S416* 12S516 12S616	3/16"	12H412*-H 12H512*-H 12H614*	12S424* 12S524* 12S624*	1/4"
14	2-7/16" 3"	14 Ga.	14H508*-H 14H614	14S524 14S624*	3/16"	14H508*-H 14H614*-H	14S524 14S624*	1/4"
16	3"	14 Ga.	16H614*	16S616	3/16"	16H614*-H	16S624*	1/4"
18	3" 3-7/16"	12 Ga.	N/A	18S624* 18S724	3/16"	N/A	18S624* 18S724	1/4"
20	3" 3-7/16"	12 Ga.	N/A	20S624* 20S724*	3/16"	N/A	20S624* 20S724*	1/4"
24	3-7/16"	12 Ga.	N/A	24S724*	3/16"	N/A	24S724*	1/4"
30	3-15/16"	10 Ga.	N/A	30S832	3/8"	N/A	30S832	3/8"
36	4-7/16"	3/16"	N/A	36S932	3/8"	N/A	36S932	3/8"

*KWS Stock Component (Only Right Hand Screws) -H Hardsurfacing Recommended

COMPONENT/BEARING SERIES

The recommended bearing series for bulk materials are listed in the Bulk Material Table. The numerical series codes refer to the minimum requirements for screw conveyor hanger bearings used for a specific bulk material. Series 1 and 2 bearing materials are used for most non-abrasive bulk materials. Series 3 and 4 bearing materials are recommended for abrasive and extremely abrasive bulk materials. Please consult KWS Engineering for further assistance.

Series 1

Hanger bearings manufactured from engineered plastics such as Nylatron, Plastech and UHMW as well as oil-impregnated wood and ball bearings are recommended for non-abrasive bulk materials.

Series 2

Hanger bearings manufactured from engineered plastics such as Plastech as well as composite materials such as Gatke and ball bearings are recommended for bulk materials that have some abrasiveness when compared to Series A bulk materials.

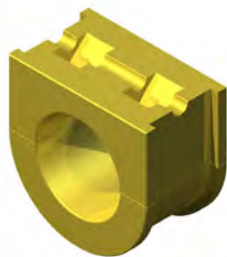
Series 3

Hanger bearings manufactured from bronze and hard iron metals are recommended for bulk materials that are abrasive when compared to Series A and B bulk materials.

Series 4

Hanger bearings manufactured from ceramic, hard iron, stellite, and hardsurfaced metals are recommended for bulk materials that are extremely abrasive when compared to Series A, B or C bulk materials.

Series	Bearing Material
1	Nylatron, Plastech, UHMW, Wood, Ball
2	Plastech, Gatke, Ball
3	Bronze, Hard Iron
4	Hard Iron, Stellite, Hardsurfaced, Ceramic



Style 216 hanger bearing



Style 226 hanger bearing

FACTORS INFLUENCING SCREW CONVEYOR DESIGN

Abrasiveness, Corrosiveness and Flowability

The Bulk Material Table also presents the relative abrasiveness, corrosiveness and flowability of the bulk materials listed. These characteristics, as well as other special aspects of bulk materials, are given further consideration in the Component Selection Section. The nomenclature used in the Bulk Material Table are listed below.

Description	I	II	III	IV
Abrasiveness	Mildly Abrasive	Moderately Abrasive	Extremely Abrasive	—
Corrosiveness	Not Corrosive	Mildly Corrosive	Highly Corrosive	—
Flowability	Very Free Flowing	Free Flowing	Average Flowability	Sluggish
	Angle of Repose			
	To 30°	30° - 45°	30° - 45°	Beyond 45°

NOTE: Some bulk materials, while they are not corrosive under “normal” conditions, may become corrosive when heated or in the presence of moisture.

Special Characteristics Notes

Notable unusual bulk material characteristics are listed by alphabetical codes in the last column of the Bulk Material Table where applicable. An explanation of these numerical codes is shown on the right and in the Bulk Materials Characteristics section.

A	Builds Up and Hardens
B	Generates Static Electricity
C	Decomposes—Deteriorates in Storage
D	Flammability
E	Becomes Plastic or Tends to Soften
F	Very Dusty
G	Aerates and Becomes Fluid
H	Explosiveness
I	Stickiness—Adhesion
J	Contaminable, Affecting Use
K	Degradable, Affecting Use
L	Gives Off Harmful or Toxic Gas or Fumes
M	Hygroscopic
N	Interlocks, Mats, or Agglomerates
O	Oils Present
P	Packs Under Pressure
Q	Very Light and Fluffy—May Be Windswept
R	Elevated Temperature
V	May Be Conveyed In a Vertical Screw Conveyor
•	Consult KWS Engineering Department



FACTORS INFLUENCING SCREW CONVEYOR DESIGN



Quartz

Abrasive Bulk Materials

Abrasive bulk materials may cause excessive wear of screw conveyor components. Screw conveyors must be fabricated from abrasion resistant alloys. Typical materials of construction are AR235, AR400, AR500, TriBrazed or chromium carbide overlay. These materials are harder and tougher than A36 carbon steel for resisting abrasion. The carrying face of the screw may be Hardsurfaced with a weld-on hardsurfacing material. It is also very important to reduce the trough loading and the speed of the screw conveyor when handling abrasive bulk materials.



Copper Sulfate

Highly Corrosive

Highly corrosive bulk materials require the use of corrosion resistant alloys. Screw conveyors must be fabricated from alloys not affected by the corrosive product. Typical materials of construction for highly corrosive products are 304, 310, 316, 410 and 430 stainless steels. Also, high nickel alloys such as Inconel, Monel and Hastalloy may be used.



Drilling Sludge

Mildly Corrosive

Mildly corrosive bulk materials, or bulk materials that have a tendency to become corrosive under certain conditions, may require the use of corrosion resistant alloys. Corrosion is a relative term that is defined by each particular application. Screw conveyors must be fabricated from alloys not affected by the corrosive product. Typical materials of construction for mildly corrosive products are 304 and 316 stainless steels.



Ammonium Sulfate

Builds Up and Hardens (A)

Certain bulk materials build up and harden in the screw conveyor trough. These bulk materials also tend to pack under pressure and absorb moisture. Screw conveyors with close clearance between the screw and trough are required to prevent build up in the trough. Also, high-torque drive units are required to shear through the hardened bulk material and carbide tip teeth can be used as well.

FACTORS INFLUENCING SCREW CONVEYOR DESIGN

Generates Static Electricity (B)

Static electricity can be generated as the rotation of the screw tumbles the bulk material during conveying. Plastic pellets will generate static electricity when conveyed by a screw conveyor. Grounding the screw conveyor trough in several locations will help eliminate static electricity. Low trough loading and reducing operating speeds will also help.



Bentonite

Decomposes – Deteriorates in Storage (C)

Some bulk materials will decompose and deteriorate if stored for long periods of time. Bulk materials stored in hoppers, bins or silos must be discharged and processed before being allowed to decompose or deteriorate. As part of the complete process, screw feeder and conveyor design must take into account the characteristics of specific bulk materials that tend to decompose or deteriorate.



Ground Meat

Flammability (D)

Flammable bulk materials will burn when oxygen and an ignition source are present. Screw conveyors can be designed with non-sparking materials to eliminate a possible ignition source. Pressure tight troughs or housings with mechanical shaft seals will keep oxygen from entering the screw conveyor. The inside of the screw conveyor trough or housing can also be purged with an inert gas such as nitrogen.



Hay

Becomes Plastic or Tends to Soften (E)

Certain bulk materials are sensitive to changes in temperature or pressure. The rotation of the screw may cause friction and heat and cause the bulk material to soften. Many food products must be gently conveyed. Lower trough loading and slower screw speeds are recommended for bulk materials that tend to become plastic or soften.



Silica Gel



FACTORS INFLUENCING SCREW CONVEYOR DESIGN



Hydrated Lime

Very Dusty (F)

Some bulk materials can become very dusty and leak out from screw conveyors. These dusty bulk materials can become a hazard or even be explosive. Screw conveyors must be completely sealed with special shaft seals to contain the dusty bulk material. Design of screw conveyor troughs or housings depends on the severity of the hazard.



Aluminum Oxide

Aerates and Becomes Fluid (G)

Fluidizing bulk materials will aerate and tend to flow like liquids when conveyed. The “as conveyed” bulk density is much lower than the static or packed bulk density. In some cases the fluidized bulk material will flood and “run like water” with the loss of control of capacity or feed rate. Trough loading will increase causing the flooding of downstream equipment. Lower trough loading and slower screw speeds are recommended to reduce the chance of aeration of the bulk material.



Powdered Milk

Explosiveness (H)

Explosive bulk materials will ignite when oxygen and an ignition source are present. Screw conveyors can be designed with non-sparking materials to eliminate a possible ignition source. Pressure tight troughs or housings with mechanical shaft seals will keep oxygen from entering the screw conveyor. The inside of the screw conveyor trough or housing can be purged with an inert gas such as nitrogen. Explosion venting is also an option for relieving pressure due to an explosion.



Rice Grits

Stickiness - Adhesion (I)

Viscous or sticky bulk materials contain a high percentage of moisture or oil and are difficult to convey. Sticky bulk materials tend to stick to the center pipe of a screw conveyor where the flight is welded to the center pipe. Ribbon flighting is an excellent choice for handling sticky bulk materials. Shaftless screw conveyors provide even better performance than shafted conveyors with ribbon flighting.

FACTORS INFLUENCING SCREW CONVEYOR DESIGN

Contaminable, Affecting Use (J)

Contaminable bulk materials lose their value if contaminated by foreign materials. Screw conveyors must be completely sealed with special shaft seals and utilize hanger bearings that will not contaminate the bulk material.



Bread Crumbs

Degradable, Affecting Use (K)

Degradable bulk materials are easily broken down to smaller particles when conveyed and could lose their value. Screw conveyors must be designed for very slow speeds and lower trough loading. Larger screw conveyor sizes are recommended.



Almonds

Gives Off Harmful or Toxic Gas or Fumes (L)

Toxic bulk materials give off vapors or dusts that may be hazardous to personnel. Screw conveyors must be completely sealed with special shaft seals to contain the toxic bulk material. Design of screw conveyor troughs or housings depends on the severity of the hazard. Screw conveyors can be designed to contain internal pressure and even an explosion.



Galena

Hygroscopic (M)

Hygroscopic bulk materials readily absorb moisture and can become contaminated. Screw conveyors with vapor-tight covers are required. It also may be necessary to insulate or provide a jacket for the trough to maintain a consistent product temperature. Purging the troughs with dry gas or air may also be necessary.



Alum

Interlocks, Mats or Agglomerates (N)

Interlocking bulk materials have a tendency to mat together and become resistant to being conveyed. Heavier construction with high torque drives for screw conveyors are required. Intermediate hanger bearings can create an obstruction to flow so may need to be eliminated. Shaftless screw conveyors are a good option for interlocking bulk materials.



Wood Bark

FACTORS INFLUENCING SCREW CONVEYOR DESIGN



Fuller's Earth

Oils Present (O)

Oils contained in the bulk material may cause the bulk material to become sticky and adhere to the flights of the screw as well as the trough. Sticky bulk materials tend to stick to the center pipe of a screw conveyor where the flight is welded to the center pipe. Ribbon flighting is an excellent choice for handling sticky bulk materials. Shaftless screw conveyors provide even better performance than shafted conveyors with ribbon flighting.



Compost

Packs Under Pressure (P)

Compressible materials tend to pack under pressure. Bulk materials will lump or pack together as moisture content increases and pressure is applied. Special screw conveyors with "lump breakers" or "breaker bars" can help break up the lumps and reduce packing. Additional horsepower and torque is required to break up the lumps and convey the bulk material.



Grass

Very Light and Fluffy (Q)

Bulk materials weighing less than 15 lbs. per cubic foot have a tendency to be dusty and aerate when conveyed. A larger diameter screw conveyor with lower trough loading and slower screw speed is recommended to reduce the chance of aeration of the bulk material.



Activated Carbon

Elevated Temperature (R)

Hot bulk materials are encountered in many phases of bulk material processing. Screw conveyors should be designed and manufactured with heavy-duty construction and may require 304, 316 or even high-temperature stainless steel alloys. Hot materials can be cooled with KWS Thermal Processors that utilize jacketed troughs and hollow-flight designs.

May Be Conveyed in a Vertical Screw Conveyor (V)

Many bulk materials can easily be conveyed in a vertical screw conveyor. Bulk materials that are of medium density, free-flowing and non-abrasive are ideal for conveying vertically. Bulk materials that tend to aerate and become fluid, interlock, pack under pressure, are very light and fluffy or are degradable are not recommended for use in a vertical screw conveyor. Please consult KWS Engineering for vertical screw conveyor applications.

BULK MATERIAL TABLE

Bulk Material	Maximum Particle Size (in.)	Bulk Density (lbs/ft ³)	% Trough Loading	Material Factor (MF)	Component /Bearing Series	Abrasive-ness	Corrosive-ness	Flowability	Special Notes
Acetylenogen (Calcium Carbide)	+ 1/2	70-90	30A	2.0	B4	I	I	II	H
Adipic Acid	-100M	45	30A	0.5	D3	I	I	III	H, M, V
Alfalfa Meal	-1/8	14-22	30A	0.6	B4	I	I	IV	O, Q, V
Alfalfa Pellets	-1/2	41-43	45	0.5	B4	I	I	II	
Alfalfa Seed	-1/8	10-15	45	0.4	A1-A2-A3	I	I	I	H
Almonds	-1/2	28-30	30A	0.9	B4	I	I	III	K
Alum, Fines	-1/8	45-50	30A	0.6	A1-A2-A3	I	I	III	M, •
Alum, Lumpy	+ 1/2	50-60	30A	1.4	B1-B2	I	I	II	•
Alumina	-1/8	55-65	15	1.8	C4	III	I	II	G, Q
Alumina, Fines	-100M	35	15	1.6	C4	III	I	II	G, Q
Alumina, Sized or Briquette	-3	65	15	2.0	C4	III	I	III	
Aluminate Gel (Aluminate Hydroxide)	-1/8	45	30A	1.7	B4	I	I	III	V
Aluminum Chips, Dry	-1/2	7-15	30A	1.2	B4	I	I	IV	H, N
Aluminum Chips, Oily	-1/2	7-15	30A	0.8	B4	I	I	IV	N, Q, V
Aluminum Hydrate (Aluminum Hydroxide)	-1/2	13-20	30A	1.4	A1-A2-A3	I	I	III	H, V
Aluminum Oxide	-100M	60-120	15	1.8	C4	III	I	I	G, H
Aluminum Ore (Bauxite)	-3	75-85	15	1.8	D4	III	I	II	
Aluminum Silicate (Andalusite)	-1/2	49	30A	0.8	C1-C2	I	III	III	V
Aluminum Sulfate (Alum)	-1/2	45-58	45	1.0	A1-A2-A3	I	I	II	
Ammonium Chloride, Crystalline	-100M	45-52	30A	0.7	C1-C2	I	III	IV	A, L
Ammonium Nitrate	-1/8	45-62	30A	1.3	C3	I	II	III	H, M, •
Ammonium Sulfate	-1/2	45-58	30A	1.0	A1-A2-A3	I	II	III	A, I, M, •
Antimony Powder	-100M	•	30A	1.6	B4	II	I	II	V, •
Apple Pomace, Dry	-1/2	15	30A	1.0	B4	I	I	IV	Q, V
Arsenate of Lead (Lead Arsenate)	-1/64	72	30A	1.4	A1-A2-A3	I	I	III	G, L
Arsenic Oxide (Arsenolite)	-100M	100-120	30A	•	•	I	•	III	L, •
Arsenic, Pulverized	-100M	30	45	0.8	B4	I	•	II	L, •
Asbestos Rock, Ore	-3	81	15	1.2	C4	III	I	III	L
Asbestos, Shredded	Fibers	20-40	30B	1.0	B4	II	I	IV	L, P, Q
Ash, Black, Ground	-1/8	105	30A	2.0	A1-A2-A3	I	I	III	
Ashes, Coal, Dry	-1/2	35-45	30B	3.0	C4	II	II	IV	Q



BULK MATERIAL TABLE

Bulk Material	Maximum Particle Size (in.)	Bulk Density (lbs/ft ³)	% Trough Loading	Material Factor (MF)	Component /Bearing Series	Abrasive-ness	Corrosive-ness	Flowability	Special Notes
Ashes, Coal, Dry	-3	35-40	30B	2.5	C4	II	II	IV	
Ashes, Coal, Wet	-1/2	45-50	30B	3.0	D4	II	II	IV	P
Ashes, Coal, Wet	-3	45-50	30B	4.0	D4	II	II	IV	P
Asphalt, Crushed	-1/2	45	30A	2.0	A1-A2-A3	I	I	IV	
Bagasse, Dry	Fibers	7-10	30A	1.5	B1-B2-B3	I	I	IV	L, N, P, Q
Bakelite	-1/8	30-45	45	1.4	A1-A2-A3	I	I	II	
Baking Powder	-100M	40-55	30A	0.6	A2	I	I	III	
Baking Soda (Sodium Bicarbonate)	-100M	40-55	45	0.6	A2	I	I	II	
Barite (Barium Sulfate)	+1/2	120-180	30B	2.6	D4	II	I	III	
Barite, Powder	-100M	120-180	30B	2.0	B4	I	I	III	G, P
Barium Carbonate	-100M	72	30B	1.6	B4	I	I	IV	L
Bark, Wood	+1/2	10-20	30B	2.0	C4	I	II	IV	N, Q
Barley, Fine Ground	-1/8	24-38	30B	0.4	A1-A2-A3	I	I	III	
Barley, Malted	-1/2	31	30A	0.4	A1-A2-A3	I	I	III	
Barley, Meal	-1/2	28	30A	0.4	A1-A2-A3	I	I	III	
Barley, Whole	-1/8	36-48	45	0.5	A1-A2-A3	I	I	II	H
Basalt	-1/8	80-105	15	1.8	C4	III	I	II	
Bauxite, Crushed	-3	75-85	30B	2.5	D4	II	I	III	
Bauxite, Dry, Crushed	-1/8	68	15	1.8	C4	I	I	II	
Beans, Castor, Meal	-1/8	35-40	30A	0.8	A1-A2-A3	I	I	III	O
Beans, Castor, Whole, Shelled	-1/2	36	45	0.5	A1-A2-A3	I	I	I	O
Beans, Navy, Dry	-1/2	48	45	0.5	A1-A2-A3	I	I	I	
Beans, Navy, Steeped	-1/2	60	45	0.8	A1-A2-A3	I	I	II	
Beans, Soy	-1/2	45-50	45	0.5	A2	I	I	I	
Beet Pulp, Dry	•	11-16	•	•	•	•	•	•	•
Beet Pulp, Wet	•	25-45	•	•	•	•	•	•	•
Bentonite	-100M	50-60	45	0.7	B4	I	I	II	G, P, Q
Bentonite, Crude	-3	34-40	30A	1.2	B2	I	I	IV	P
Benzene Hexachloride	-100M	56	30A	0.6	A1-A2-A3	I	I	IV	L
Blood, Dried	-3	35-45	30A	2.0	B4	I	I	IV	M
Blood, Dried, Ground	-100M	30	30A	1.0	A1-A2	I	I	III	M
Bluestone (Copper Sulfate)	-1/2	75-95	30A	1.0	B1-B2-B3	I	III	III	•
Bone Ash (Tricalcium Phosphate)	-100M	40-50	30A	1.6	A1-A2	I	I	IV	
Boneblack	-100M	20-25	45	1.5	A1-A2	I	I	II	Q

**BULK MATERIAL TABLE**

Bulk Material	Maximum Particle Size (in.)	Bulk Density (lbs/ft ³)	% Trough Loading	Material Factor (MF)	Component /Bearing Series	Abrasive-ness	Corrosive-ness	Flowability	Special Notes
Bonechar	-1/8	27-40	30A	1.6	A1-A2	I	I	III	
Bonemeal	-1/8	50-60	30A	1.7	B4	I	I	III	
Bones, Crushed	-3	35-50	30A	2.0	B4	I	I	IV	
Bones, Ground	-1/8	50	30A	1.7	B4	I	I	III	
Bones, Whole	Irregular	35-50	30A	3.0	B4	I	I	IV	N
Borate of Lime	-100M	60	30A	0.6	A1-A2-A3	I	I	III	•
Borax Lumps	1 1/2 to 2	55-60	30A	1.8	B4	I	I	III	
Borax Lumps	2 to 3	60-70	30A	2.0	B4	I	I	III	
Borax, Fines	-1/8	45-55	45	0.7	C4	I	II	II	
Borax, Screenings	-1/2	55-60	30A	1.5	B4	I	I	III	
Boric Acid	-1/8	55	45	0.8	C4	I	II	II	
Boron	-100M	75	15	1.0	B4	III	I	III	
Bran, Rice—Rye—Wheat	-1/8	16-20	30A	0.5	A1-A2-A3	I	I	III	H, Q
Braunite (Manganese Oxide)	-100M	120	30B	2.0	B4	II	I	III	
Bread, Crumbs	-1/8	20-25	30A	0.6	A1-A2-A3	I	I	III	J,K
Brewers Grain, Spent, Dry	-1/2	14-30	30A	0.5	A1-A2-A3	I	I	IV	
Brewers Grain, Spent, Wet	-1/2	55-60	30A	0.8	D3	I	II	IV	
Brick, Ground	-1/8	100-120	15	2.2	C4	III	I	III	
Bronze Chips	-1/8	30-50	30A	2.0	B4	I	I	IV	
Buckwheat	-1/8	37-42	45	0.4	A1-A2-A3	I	I	II	H
Calcine, Flour	-100M	75-85	30A	0.7	A1-A2-A3	I	I	III	
Calcium Carbide	-3	70-90	30A	2.0	B4	I	I	II	H
Calcium Lactate	-3	26-29	30A	0.6	B1-B2	I	II	IV	K, L, P
Calcium Magnesium Carbonate	+ 1/2	90-100	30B	2.0	B4	II	I	II	
Calcium Phosphate	-100M	40-50	30A	1.6	A1-A2-A3	I	I	IV	
Carbon, Activated, Dry, Fine	-1/8	8-20	30A	1.2	B4	I	I	II	K, •
Carbon Black, Fine	-100M	4-7	30A	0.4	A2	I	I	III	P, Q, •
Carbon Black, Pelleted	-1/8	20-25	45	•	•	I	•	I	M, P, •
Carborundum*	-3	100	15	3.0	C4	III	I	II	
Casein	-1/8	36	30A	1.6	B4	I	I	III	
Cashew, Nuts	-1/2	32-37	30A	0.7	B4	I	I	IV	
Cast Iron, Chips	-1/2	130-200	30A	4.0	B4	I	I	IV	
Caustic Soda (Sodium Hydroxide)	-1/8	88	30A	1.8	D4	I	III	III	L, M
Caustic Soda, Flakes (Sodium Hydroxide)	-1/2	47	30A	1.5	D4	I	III	IV	K, L, M, P



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Celite (Diatomaceous Earth)	-1/64	11-17	30B	1.6	C4	II	I	III	G, P, Q, •
Cement, Aerated (Portland)	-100M	60-75	30B	1.4	B4	II	I	I	G
Cement, Clinker	-3	75-95	30B	1.8	D4	II	I	III	
Cement, Mortar	-1/8	133	30A	3.0	C4	I	I	III	K
Cement, Portland	-100M	94	30B	1.4	B4	II	I	II	G
Cerrusite (Lead Carbonate)	-1/64	240-260	30A	1.0	B4	I	I	III	G, L
Chalk, Crushed	-3	75-95	30A	1.9	B4	I	I	II	P
Chalk, Ground	-100M	67-75	45	1.4	B4	I	I	II	G, P, Q
Charcoal, Ground	-100M	18-28	30A	1.2	B4	I	I	IV	H
Charcoal, Lumps	-3	18-28	30A	1.4	B4	I	I	IV	H, K
Chips, Pulpwood	+1/2	12-25	30A	1.0	B1	I	I	III	N, Q
Chocolate, Cake, Pressed	-3	40-45	30A	1.5	B2	I	I	II	
Chrome Ore	-3	125-140	30B	2.5	C4	II	I	III	
Cinders, Blast Furnace	-3	57	30B	1.9	D4	II	II	III	
Cinders, Coal	-3	40	30B	1.8	D4	II	II	III	
Clay, Brick, Dry, Fines	-1/2	100-120	30B	2.0	C4	II	I	III	
Clay, Calcined	-1/8	80-100	30B	2.4	C4	II	I	III	
Clay, Ceramic, Dry, Fines	-100M	60-80	30A	1.5	A1-A2-A3	I	I	III	J
Clay, Dry, Lumpy	-3	60-75	30A	1.8	B4	I	I	III	
Clinker, Cement	-3	75-95	30B	1.8	D4	II	I	III	
Clover, Seed	-1/8	45-48	45	0.4	A1-A2-A3	I	I	II	H
Coal, Anthracite (Culm and River)	-1/8	55-61	30A	1.0	B1-B2	I	II	III	
Coal, Anthracite, Sized	-1/2	49-61	45	1.0	B1-B2	I	I	II	
Coal, Bituminous, Mined	-3	40-60	30A	0.9	A1-A2	I	I	III	F, H, P, Q
Coal, Bituminous, Mined, Sized	-3	45-55	30A	1.0	A1-A2	I	I	III	H, K, N
Coal, Bituminous, Mined, Slack	-1/2	43-50	30A	0.9	B1-B2	I	II	IV	H
Coal, Lignite	-3	37-45	30A	1.0	B4	I	II	III	H
Cocoa, Beans	-1/2	30-45	45	0.5	A1-A2	I	I	II	K
Cocoa, Nibs	-1/2	35	45	0.5	B4	I	I	II	
Cocoa, Powdered	-100M	30-35	30A	0.9	A2	I	I	IV	G, P, Q
Coconut	Shredded	20-22	30A	1.5	B2	I	I	IV	
Coffee, Beans, Green	-1/2	25-32	45	0.5	A1-A2	I	I	II	J, K



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Coffee, Beans, Roasted	-1/2	20-30	45	0.4	A2	I	I	II	J, K
Coffee, Chaff	-1/8	20	45	1.0	A1-A2	I	I	II	G, Q
Coffee, Ground, Dry	-1/64	25	30A	0.6	A1-A2	I	I	III	J
Coffee, Ground, Wet	-1/64	35-45	30A	0.6	A1-A2	I	I	IV	P
Coffee, Soluble	-1/64	19	30A	0.4	A2	I	I	III	G,J,K,M,Q
Coke, Breeze	-1/2	25-35	15	1.2	C4	III	I	III	H, Q
Coke, Loose	-7	25-35	15	1.2	D4	III	I	III	H, K, N
Coke, Petrol, Calcined	-7	35-45	15	1.3	D4	III	I	III	N
Compost	-7	30-50	30A	1.0	C1-C2	I	II	IV	N, P, •
Concrete, Pre-Mix, Dry	-1/2	85-120	30B	3.0	C4	II	I	III	M
Copper Ore	+ 1/2	120-150	30B	4.0	D4	II	I	III	
Copper Ore, Crushed	+ 1/2	120-150	30B	4.0	C4	II	I	III	
Copper Sulfate (Bluestone)	-1/2	75-95	30A	1.0	B1-B2-B3	I	III	III	•
Copperas (Ferrous Sulfate)	-1/2	50-75	30A	1.0	B4	I	I	III	M
Copra, Cake, Ground	-1/8	40-45	30A	0.7	A1-A2-A3	I	I	IV	C, O
Copra, Cake, Lumpy	-3	25-30	30A	0.8	B1-B2-B3	I	I	III	C, O
Copra, Lumpy	+ 1/2	22	30A	1.0	B1-B2-B3	I	I	III	C, O
Copra, Meal	-1/8	40-45	30A	0.7	B4	I	I	III	C, O
Cork, Granulated	-1/2	12-15	30A	0.5	A1-A2-A3	I	I	III	D, V, Q
Cork, Ground	-1/8	5-15	30A	0.5	A1-A2-A3	I	I	III	D, V, Q
Corn, Cleanings	-1/8	20-30	30A	0.4	A1-A2-A3	I	I	III	J, Q
Corn, Cracked	-1/8	40-50	45	0.7	A1-A2-A3	I	I	II	H, J
Corn, Grits	-1/8	40-45	30A	0.5	A1-A2-A3	I	I	III	H, J
Corn, Seed	-1/2	45	45	0.4	A1-A2-A3	I	I	II	H, J, K
Corn, Steeped	-3	40-60	•	0.8	•	•	•	•	•
Corn, Shelled	-1/2	45	45	0.4	A1-A2-A3	I	I	II	H, V
Corn Cobs, Ground	-1/2	17	45	0.6	A1-A2-A3	I	I	II	H, Q
Corn Cobs, Whole	Irregular	12-15	30A	•	B1-B2	I	I	II	H, N, •
Corn Ear	-16	56	30A	•	B1-B2	I	I	III	H, N
Corn Fiber Feed	-1/8	15-35	30A	1.5	•	I	I	III	
Corn Fiber, Dewatered	-1/8	10-25	30A	0.6	A1-A2-A3	I	I	III	
Corn Fiber, Wet	-1/8	15-50	30A	0.8	A1-A2-A3	I	I	III	J, M
Corn Filter Aid	-1/8	15-50	15	2.5	C4	III	I	III	
Corn Germ	-1/8	21	30A	0.4	A1-A2-A3	I	I	III	H, J, O, Q



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Corn Germ, Dewatered	-1/8	30-35	30A	0.6	A1-A2-A3	I	I	III	H, J, M
Corn Germ, Dry	-1/8	30-40	30A	0.5	A1-A2-A3	I	I	III	
Corn Germ, Expanded Cake	-1/8	30-40	30A	2.0	A1-A2-A3	I	I	III	
Corn Germ, Oil Meal	-1/8	30-35	30A	0.6	A1-A2-A3	I	I	III	
Corn Oil, Cake	-7	25	30A	0.6	A1-A2	I	I	IV	C, O
Corn Sugar	-1/8	30-35	30A	1.0	A2	I	I	III	H, J, M, V
Corn Sugar, Crystalline, Dry	-1/8	25-60	30A	1.5	A2	I	I	III	
Corn Sugar, Crystalline, Wet	-1/8	30-60	30A	1.5	A2	I	I	III	
Corn Meal	-1/8	32-40	30A	0.5	A1-A2	I	I	III	H, J, O, V
Cottonseed, Cake, Crushed	-1/2	40-45	30A	1.0	A1-A2	I	I	IV	C, O, V
Cottonseed, Cake, Lumpy	-7	40-45	30A	1.0	B1-B2	I	I	IV	C, O, V
Cottonseed, Dry, Delinted	-1/2	22-40	45	0.6	A1-A2	I	I	II	P, V
Cottonseed, Dry, Not Delinted	-1/2	18-25	30A	0.9	A1-A2	I	I	IV	P, Q, V
Cottonseed, Flakes	-1/2	20-25	30A	0.8	A1-A2	I	I	III	C, O, Q, V
Cottonseed, Hulls	-1/8	12	30A	0.9	A1-A2	I	I	III	Q, V
Cottonseed, Meal, Expeller	-1/8	25-30	30A	0.5	C1-C2	I	I	IV	C, O, V
Cottonseed, Meal, Extracted	-1/8	35-40	30A	0.5	A1-A2	I	I	IV	C, O, V
Cottonseed, Meats, Dry	-1/8	40	30A	0.6	A1-A2	I	I	III	C, O, V
Cottonseed, Meals, Rolled	-1/2	35-40	30A	0.6	A1-A2	I	I	IV	C, O, V
Cracklings, Crushed	-3	40-50	30A	1.3	B1-B2-B3	I	I	IV	C, O, V
Cryolite, Dust (Kryalith)	-100M	75-90	30B	2.0	B4	II	I	III	F, G, L, V
Cryolite, Lumpy (Kryalith)	-16	90-110	30B	2.1	B4	II	I	III	L, V
Cullet, Fines	-1/2	80-120	15	2.0	D4	III	I	III	
Cullet, Lumps	-16	80-120	15	2.5	D4	III	I	III	
Cupric Sulfate (Copper Sulfate)	-1/2	75-95	30A	1.0	B1-B2-B3	I	III	III	•
Diatomaceous Earth (Diatomite)	-1/64	11-17	30B	1.6	C4	II	I	III	G, P, Q, •
Dicalcium Phosphate	-1/64	40-50	30A	1.6	A1-A2-A3	I	I	III	V
Disodium Phosphate	-1/64	25-31	30A	0.5	C4	I	I	III	K

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Distiller's Grain, Spent, Dry	-1/8	30	30A	0.5	B4	I	I	III	
Distiller's Grain, Spent, Wet	-1/2	40-60	30A	0.8	C1-C2	I	I	IV	N
Dolomite, Crushed	-1/2	80-100	30B	2.0	B4	II	I	III	
Dolomite, Lumpy	+1/2	90-100	30B	2.0	B4	II	I	III	
Earth, Loam, Dry, Loose	-1/2	76	30B	1.2	B4	II	I	III	
Ebonite	-1/2	63-70	30A	0.8	A1-A2-A3	I	I	III	V
Egg, Powder	-1/64	16	30A	1.0	A2	I	I	III	G, H, J, Q
Epsom Salts (Magnesium Sulfate)	-1/64	40-50	30A	0.8	A1-A2-A3	I	I	III	M, V
Ethanedioic Acid (Oxalic Acid)	-1/8	60	30A	1.0	A1-A2	I	III	III	L, M
Feldspar, Ground	-100M	65-80	15	2.0	B4	III	I	III	
Feldspar, Lumps	-7	90-100	15	2.0	B4	III	I	III	
Feldspar, Powder	-200M	100	30B	2.0	B4	II	I	III	
Feldspar, Screenings	-1/2	75-80	15	2.0	B4	III	I	III	
Ferrous Sulphate	-1/2	50-75	30A	1.0	B4	I	I	III	M
Ferrous Sulfide (Iron Sulfide), Lumps	-1/2	120-135	30B	2.0	A1-A2-A3	II	I	II	V
Ferrous Sulfide (Iron Sulfide), Mesh	-100M	105-120	30B	2.0	A1-A2-A3	II	I	III	V
Fish Meal	-1/2	35-40	30A	1.0	A1-A2-A3	I	I	IV	C, J, V
Fish Scrap	-7	40-50	30A	1.5	B1-B2-B3	I	I	IV	C, •
Flaxseed	-1/8	43-45	30A	0.4	A1-A2-A3	I	I	III	H, P, V
Flaxseed Cake (Linseed Cake)	-7	48-50	30A	0.7	B1-B2	I	I	IV	O
Flaxseed Meal (Linseed Meal)	-1/8	25-45	30A	0.4	A1-A2	I	I	IV	O, V
Flour, Wheat	-1/64	33-40	30A	0.6	A2	I	I	IV	F, H, J, V
Flue Dust, Basic Oxygen Furnace	-1/64	45-60	30B	3.5	C4	II	I	III	F, G
Flue Dust, Blast Furnace	-1/64	110-125	30B	3.5	C4	II	I	III	
Flue Dust, Boiler H, Dry	-1/64	30-45	30B	2.0	C4	II	I	III	F, G
Fluorspar (Calcium Fluoride)	-1/8	80-100	30B	2.0	B4	II	I	III	
Fluorspar, Lumps	-7	90-110	30B	2.0	B4	II	I	III	
Flyash	-1/64	30-45	30B	2.0	C4	II	I	III	G
Flyash, Coal	-1/64	30-60	30B	2.0	C4	II	I	III	G
Flyash, Fluidized Bed	-1/64	60-90	30B	3.0	C4	II	I	III	
Foundry Sand, Dry	-1/8	90-110	15	1.7	C4	III	I	III	



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Fuller's Earth, Oil Filter, Burned	-1/8	40	15	2.0	C4	III	I	II	
Fuller's Earth, Oil Filter, Raw	-1/8	35-40	30B	2.0	B4	II	I	II	
Fuller's Earth, Oil Filter, Spent	35% oil	60-65	15	2.0	D4	III	I	III	I, O
Galena (Lead Sulfide)	-100M	240-260	30A	1.2	B4	II	I	II	G, L, P
Gelatin, Granulated	-1/8	32	30A	0.8	A2	I	I	III	J, K, M, V
Gilsonite	-1/2	37	30B	1.5	D4	II	II	III	H, L
Glass, Batch	-1/2	80-100	15	2.5	D4	III	I	III	
Glue, Ground	-1/8	40	30A	1.7	B4	II	I	IV	M
Glue, Pearl	-1/2	40	30A	0.5	A1-A2-A3	I	I	III	M
Glue, Veg. Powdered	-1/64	40	30A	0.6	A1-A2-A3	I	I	IV	M
Gluten Cake, Wet	-1/2	30-50	30A	2.5	A2	I	I	IV	
Gluten, Meal, Dry	-1/8	30-40	30A	0.6	A2	I	I	III	J
Granite, Broken	+1/2	95-100	15	2.5	D4	III	I	II	
Granite, Fines	-1/2	80-90	15	2.5	C4	III	I	II	
Grape, Pomace	-3	15-20	30A	1.4	B4	I	I	IV	M, Q, V
Graphite Flakes	-1/8	40	45	0.5	A1-A2-A3	I	I	II	F, J, V
Graphite Flour	-100M	28	30A	0.5	A1-A2-A3	I	I	III	F, G, J, V
Graphite Ore	+1/2	65-75	30A	1.0	B4	I	I	III	F
Grass Seed	-1/8	10-32	30A	0.4	A2	I	I	III	H, Q
Guano, Dry	-1/2	70	30A	2.0	C1-C2	I	I	III	•
Gypsum, Calcined	-1/8	55-60	30A	1.6	B4	I	I	III	M
Gypsum, Calcined, Powdered	-100M	60-80	30A	2.0	B4	I	I	III	M
Gypsum, Raw	-3	70-80	30A	2.0	B4	I	I	II	
Green Vitriol (Ferrous Sulfate)	-1/2	50-75	30B	1.0	B4	II	I	II	
Hay, Chopped	-1/2	8-12	30A	1.6	B1-B2	I	I	III	D, Q, •
Hexanedioic Acid (Adipic Acid)	-100M	45	30A	0.5	D3	I	I	III	H, M
Hominy	-1/2	35-50	30A	0.4	A1-A2-A3	I	I	II	J, V
Hops, Spent, Dry	-3	35	30A	1.0	B1-B2-B3	I	I	III	V
Hops, Spent, Wet	-3	50-55	30A	1.5	D3	I	II	IV	N, V
Hydroxybenzoic Acid (Salicylic Acid)	-1/8	29	15	0.6	C4	III	I	III	M
Ice, Crushed	-3	35-45	30A	0.4	B1-B2	I	I	III	K, V
Ice, Cubed	-3	33-35	30A	0.4	A2	I	I	III	K, V
Ice, Flaked	-1/2	40-45	30A	0.6	A2	I	I	III	K, V, •
Ice, Shells	-3	33-35	30A	0.4	A2	I	I	IV	K, V
Ilmenite Ore	-3	140-160	15	2.0	C4	III	I	III	
Iron Ore	-1/64	120-180	15	2.2	C4	III	I	III	
Iron Oxide Pigment	-100M	25	30B	1.0	A1-A2-A3	II	I	III	F, G, J



BULK MATERIAL TABLE

Bulk Material	Maximum Particle Size (in.)	Bulk Density (lbs/ft ³)	% Trough Loading	Material Factor (MF)	Component /Bearing Series	Abrasive-ness	Corrosive-ness	Flowability	Special Notes
Iron Oxide, Millscale	-1/2	75	30B	1.6	B4	I	I	III	
Kafir (Corn)	-1/2	40-45	30A	0.5	C4	I	I	II	V
Kaolin Clay	-3	63	30A	2.0	B4	I	I	II	
Kaolin Talc	-1/64	42-56	30A	2.0	B4	I	I	III	F, G, J
Lactose	-1/64	32	30A	0.6	A2	I	I	III	H, J, M, P
Lead Arsenate	-1/64	72	30A	1.4	A1-A2-A3	I	I	III	G, L
Lead Arsenite	-1/64	72	30A	1.4	A1-A2-A3	I	I	III	G, L
Lead Carbonate	-1/64	240-260	30A	1.0	B4	I	I	III	G, L
Lead Ore	-1/8	200-270	30A	1.4	C4	I	I	III	L
Lead Ore	-1/2	180-230	30B	1.4	C4	II	I	III	L
Lead Oxide, Red Lead	-100M	30-150	30A	1.2	B4	II	I	III	G, J, L
Lead Oxide, Red Lead	-200M	30-180	30A	1.2	B4	II	I	III	F, G, J, L
Lead Sulfide	-100M	240-260	30A	1.0	B4	II	I	III	G, L, P
Lignite, Air Dried	-3	37-45	30A	1.0	B4	I	II	III	H
Lime, Hydrated	-1/8	40	30A	0.8	B4	I	I	III	F, G, P, V
Lime, Hydrated, Pulverized	-1/64	32-40	30A	0.6	A1-A2	I	I	III	F, G, P, V
Lime, Unslaked	-1/8	60	30A	0.6	A2	I	I	III	P, V
Lime, Pebble, Unslaked	-1/2	53-56	45	2.0	B1	I	I	II	C, M
Limestone, Agricultural	-1/8	68	30A	2.0	B4	II	I	III	
Limestone, Crushed	+1/2	85-90	30B	2.0	B4	II	I	III	
Limestone, Dust	-1/64	55-95	30B	1.6-2.0	B4	II	I	IV	G, Q
Limonite, Ore	-1/2	120	15	1.7	C4	III	I	IV	
Lindane (Benzene Hexachloride)	-100M	56	30A	0.6	A1-A2-A3	I	I	IV	L
Litharge (Lead Oxide)	-100M	30-150	30A	1.2	B4	II	I	III	G, J, L
Lithopone	-200M	45-50	30A	1.0	A1-A2	I	I	III	G, L
Magnesium Chloride (Magnesite)	-1/2	33	30A	1.0	A1-A2	I	I	IV	
Magnesium Sulfate (Epsom Salts)	-1/64	40-50	30A	0.8	A1-A2-A3	I	I	III	M
Maize	-1/8	40-45	45	0.4	A1-A2-A3	I	I	I	H
Malt, Dry, Ground	-1/8	20-30	30A	0.5	A1-A2-A3	I	I	III	H, J, L, Q, V
Malt, Dry, Whole	-1/2	20-30	30A	0.5	A1-A2-A3	I	I	III	H, V
Malt, Wet or Green	-1/2	60-65	30A	0.4	A1-A2-A3	I	I	III	
Malt, Meal	-1/8	36-40	30A	0.4	A1-A2-A3	I	I	II	J, V
Malt, Sprouts	-1/2	13-15	30A	0.4	A1-A2-A3	I	I	III	J, V
Manganese Dioxide	-100M	70-85	30A	1.5	B1-B2	I	II	III	H, L, •



BULK MATERIAL TABLE

Bulk Material	Maximum Particle Size (in.)	Bulk Density (lbs/ft ³)	% Trough Loading	Material Factor (MF)	Component / Bearing Series	Abrasive-ness	Corrosive-ness	Flowability	Special Notes
Manganese Ore	+1/2	125-140	15	2.0	C4	III	I	III	
Manganese Oxide	-100M	120	30B	2.0	B4	II	I	III	
Manganese Sulfate	-1/2	70	15	2.4	C4	III	I	III	
Marble, crushed	-1/8	80-95	15	2.0	C4	III	I	III	
Marl (Clay)	+ 1/2	80	30B	1.6	B4	II	I	III	
Meat, Ground	-1/4	50-55	30A	1.5	B1-B2	I	II	IV	C, K, P, •
Meat, Scraps, With Bone	Scraps	40	30B	1.5	D4	II	I	IV	C, N, •
Mica, Flakes	-1/8	17-22	30B	1.0	B4	II	I	I	G, N, Q, V
Mica, Ground	-1/8	13-15	30B	0.9	B4	II	I	III	V
Mica, Pulverized	-100M	13-15	30B	1.0	B4	II	I	III	G, V
Milk, Dried, Flake	-1/8	5-6	30A	0.4	A2	I	I	III	H, J, M, Q
Milk, Malted	-1/64	27-30	30A	0.9	A2	I	I	IV	G, H, J, P
Milk, Powdered	-1/8	20-45	45	0.5	A2	I	I	II	G, H, J
Milk, Powdered, Whole	-1/8	20-36	30A	0.5	A2	I	I	III	J, M, P
Milk, Whole, Dried	-100M	20	30A	0.4	A2	I	I	III	G, J, M, P
Milk Sugar (Lactose)	-100M	32	30A	0.8	A2	I	I	III	H, J, P
Mill Scale (Steel)	Irregular	120-125	30B	3.0	C4	II	II	IV	
Milo, Ground	-1/8	32-36	30A	0.5	A1-A2-A3	I	I	II	V
Milo, Maize (Kafir)	-1/8	40-45	45	0.4	A1-A2-A3	I	I	I	H, V
Molybdenite Powder	-1/8	107	30A	1.5	B4	II	I	II	
Monosodium Phosphate	-1/8	50	30B	0.6	B4	II	I	III	
Mortar, Wet	Irregular	150	30B	3.0	C4	II	II	IV	
Muriate of Potash	-1/8	77	15	1.8	D4	III	III	II	
Mustard Seed	-1/8	45	45	0.4	A1-A2-A3	I	I	I	H, V
Naphtalene, Flakes	-1/8	45	30A	0.7	A1-A2-A3	I	I	III	V
Nicotinic Acid (Niacin)	-1/64	35	30A	0.8	B4	I	I	III	J
Oakite (Trisodium Phosphate)	-1/8	60	30B	1.7	B4	II	I	II	
Oats	-1/2	26	45	0.6	A1-A2-A3	I	I	li	G, H, V
Oats, Crimped	-1/2	19-26	30A	0.5	A1-A2-A3	I	I	III	V
Oats, Crushed	-1/8	22	30A	0.6	A1-A2-A3	I	I	IV	H, Q, V
Oats, Flour	-100M	35	30A	0.5	A1-A2-A3	I	I	III	V
Oats, Hulls	-1/8	8-12	30A	0.5	A1-A2-A3	I	I	III	H, Q, V
Oats, Rolled	-1/2	19-24	30A	0.6	A1-A2-A3	I	I	III	H, Q, V
Oleo (Margarine)	Irregular	59	30A	0.4	B1-B2	I	I	IV	C, E, J, O, P
Oranges, Peels, Dry	Irregular	15	30A	1.5	B1-B2	I	I	IV	
Oxalic Acid, Crystal—Ethane Diacid Crystal	-1/8	60	30A	1.0	A1-A2	I	III	III	K, M

**BULK MATERIAL TABLE**

Bulk Material	Maximum Particle Size (in.)	Bulk Density (lbs/ft ³)	% Trough Loading	Material Factor (MF)	Component /Bearing Series	Abrasive-ness	Corrosive-ness	Flowability	Special Notes
Oyster Shells, Ground	-1/2	50-60	30B	2.0	B4	II	II	III	
Oyster Shells, Whole	-3	80	30B	2.5	B4	II	II	III	N
Paper Pulp, Stock	5%	62	30A	1.5	B1-B2	I	I	IV	N
Paper Pulp, stock	6-15%	60-62	30A	1.7	B1-B2	I	I	IV	N
Paraffin Cake, Broken	-1/2	45	30A	0.6	A1-A2	I	I	IV	E
Peanuts Meal	-1/8	30	30A	0.6	A2	I	I	III	J, V
Peanuts, Clean, Shelled	-3	15-20	30A	0.6	B1-B2	I	I	III	K
Peanuts, Raw, Uncleaned, Unshelled	-3	15-20	30B	0.7	C4	I	I	III	K
Peanuts, Shelled	-1/2	35-45	30A	0.4	A2	I	I	III	K, V
Peas, Dried	-1/2	45-50	45	0.5	A1-A2-A3	I	I	I	H, K, V
Perlite, Expanded	-1/2	8-12	30B	0.6	B4	II	I	III	
Phosphate Disodium	-1/8	50-60	30A	0.9	A1-A2	I	I	III	
Phosphate Acid, Fertilizer	-1/8	60	45	1.4	B1-B2	I	II	II	
Phosphate Rock, Broken	+ 1/2	75-85	30B	2.1	B2	II	I	III	
Phosphate Rock, Pulverized	-1/8	60	30B	1.7	B4	II	I	III	
Phosphate of Soda (Disodium Phosphate)	-1/64	25-31	30A	0.5	C4	I	I	III	K
Phosphate Sand, Granular	-1/8	90-100	15	2.0	C4	III	I	III	
Phosphoprotein (Casein)	-1/8	36	30B	1.6	B4	II	I	II	
Phosphoric Acid (Phosphate Acid)	-100M	60	30A	1.4	A2	I	I	II	
Plaster of Paris (Gypsum)	-200M	60-80	30B	0.9	B4	II	I	III	G
Polyethylene, Pellets	-1/8	35	30A	0.4	A2	I	I	III	J, K
Polystyrene Beads	-1/8	40	30A	0.4	A2	I	I	II	J, K, V
Polyvinyl Chloride, Pellets	Irregular	20-30	30A	0.6	A2	I	II	IV	E, J, K
Polyvinyl Chloride, Powder	-100M	20-30	30A	1.0	A1-A2-A3	I	II	IV	E
Potash, Dry (Muriate of Potash)	-1/8	70	15	2.0	D4	III	III	III	
Potash, Mine Run (Muriate of Potash)	+1/2	75	15	2.2	D4	III	III	III	



BULK MATERIAL TABLE

Bulk Material	Maximum Particle Size (in.)	Bulk Density (lbs/ft ³)	% Trough Loading	Material Factor (MF)	Component /Bearing Series	Abrasive-ness	Corrosive-ness	Flowability	Special Notes
Potassium Carbonate	-1/8	51	30B	1.0	B4	II	II	III	
Potassium Chloride, Pellets	-1/2	120-130	30A	1.6	C4	I	II	II	M
Potassium Nitrate	-1/2	76	30B	1.2	D4	II	II	I	H, V
Potassium Nitrate	-1/8	80	30B	1.2	D4	II	II	II	H, V
Potassium Sulfate	-1/8	42-48	30B	1.0	B4	II	I	IV	P
Potato, Flour	-200M	48	30A	0.5	A1-A2	I	I	III	G, H, J, V
Pumice	-1/8	42-48	30B	1.6	C4	II	I	IV	
Pyrite, pellets	-1/2	120-130	30B	2.0	C4	II	I	II	
Quartz	-1/2	80-90	15	2.5	C4	III	I	II	
Quartz	-100M	70-80	15	1.7	C4	III	I	II	
Quicklime (Lime, unslaked)	-1/8	60	30A	0.6	A2	I	I	III	P
Red Lead (Lead Oxide)	-100M	30-150	30A	1.2	B4	II	I	III	G, J, L
Rice Bran	-1/8	20	30A	0.4	A1-A2-A3	I	I	III	H, Q, V
Rice Grits	-1/8	42-45	30A	0.4	A1-A2-A3	I	I	III	J, V
Rice Hulled	-1/2	45-49	45	0.4	A1-A2-A3	I	I	II	J, V
Rice Hulls	-1/8	20-21	30A	0.4	A1-A2-A3	I	I	III	H, Q
Rice Polished	-1/2	30	45	0.4	A1-A2-A3	I	I	I	J, V
Rice Rough	-1/2	32-36	30A	0.6	A1-A2-A3	I	I	III	H, V
Rosin	-1/2	65-68	30A	1.5	A1-A2-A3	I	I	IV	K, V
Rubber, Pelleted	-3	50-55	30A	1.5	B1-B2-B3	I	I	IV	
Rubber, Reclaimed, Ground	-1/2	23-50	30A	0.8	A1-A2-A3	I	I	IV	V
Rye	-1/8	42-48	45	0.4	A1-A2-A3	I	I	I	H, V
Rye, Bran	-1/8	15-20	30A	0.4	A1-A2-A3	I	I	III	Q, V
Rye, Feed	-1/8	33	30A	0.5	A1-A2-A3	I	I	III	H, V
Rye, Meal	-1/8	35-40	30A	0.5	A1-A2-A3	I	I	III	V
Rye, Middlings	-1/8	42	30A	0.5	A1-A2	I	I	III	V
Rye, Shorts	-1/2	32-33	30A	0.5	B1-B2	I	I	III	V
Safflower, Cake	-3	50	30B	0.6	B4	II	I	II	
Safflower, Meal	-1/8	50	30A	0.6	A1-A2-A3	I	I	III	V
Safflower, Seed (Safflower)	-1/8	45	45	0.4	A1-A2-A3	I	I	I	H, V
Sal Ammoniac (Ammonium Chloride)	-100M	45-52	30A	0.7	C1-C2	I	III	IV	A, L
Salicylic Acid	-1/8	29	15	0.6	C4	III	I	III	M
Salt, Dry Coarse	-1/2	45-60	30B	1.0	C4	II	II	III	M, V
Salt, Dry Fine	-1/8	70-80	30B	1.7	C4	II	II	III	M, V
Salt Cake, Dry, Coarse (Sodium Sulfate)	-1/8	85	30B	2.1	C4	II	II	III	M
Salt Cake, Dry, Pulverized (Sodium Sulfate)	-1/8	65-85	30B	1.7	C4	II	II	III	M

**BULK MATERIAL TABLE**

Bulk Material	Maximum Particle Size (in.)	Bulk Density (lbs/ft ³)	% Trough Loading	Material Factor (MF)	Component /Bearing Series	Abrasive-ness	Corrosive-ness	Flowability	Special Notes
Saltpeter (Potassium Nitrate)	-1/2	76	30B	1.2	C4	II	II	I	H
Sand, Dry Bank, Damp	-1/8	110-130	15	2.8	C4	III	I	IV	
Sand, Dry Bank, Dry	-1/8	90-110	15	1.7	C4	III	I	III	
Sand, Foundry, Prepared	-1/8	90	15	3.0	C4	III	I	III	
Sand, Foundry, Shakeout	-3	90-100	15	3.0	D4	III	I	III	R
Sand, Silica, Dry	-1/8	90-100	15	2.0	C4	III	I	II	
Sand, Silica, Resin Coated	-1/8	104	15	2.0	C4	III	I	II	
Sand, Zircon, Resin Coated	-100M	115	15	2.3	C4	III	I	II	
Sawdust, Dry	-1/8	10-13	30A	1.4	A1-A2-A3	I	I	IV	M, P
Sea-Coal	-1/8	65	30B	1.0	B4	II	I	III	
Sesame Seed	-1/8	27-41	30B	0.6	B4	II	I	II	V
Shale, Crushed	-1/2	85-90	30B	2.0	B4	II	I	III	
Shellac, Powdered or Granulated	-1/8	31	30A	0.6	A2	I	I	III	J, V
Silica Flour	-1/64	80	30B	1.5	B4	II	I	IV	
Silica Gel (Silicic Acid)	-3	45	15	2.0	C4	III	I	III	C, E, K, M
Silicon Dioxide (Quartz)	-1/2	80-90	15	2.5	C4	III	I	II	
Slag, Blast Furnace, Crushed	-3	130-180	15	2.4	D4	III	I	III	Q
Slag, Furnace, Granular, Dry	-1/2	60-65	15	2.2	A1-A2-A3	III	I	III	
Slaked Lime (Lime, Hydrated)	-1/8	40	30A	0.8	B4	I	I	III	F, G, P
Slate, Crushed	-1/2	80-90	30B	2.0	B4	II	I	III	
Slate, Ground	-1/8	82-85	30B	1.6	B4	II	I	III	
Sludge, Sewage, Dry	Irregular	40-50	30B	0.8	D4	II	II	IV	O
Sludge, Sewage, Dry, Ground	-1/8	45-55	30B	0.8	D4	II	II	IV	
Snow, Fresh	-1/8	5-12	30A	0.4	A2	I	I	IV	
Snow, Packed	+1/2	15-35	30A	0.8	B1	I	I	IV	
Soap, Beads or Granules	-1/8	15-35	30A	0.6	A1-A2-A3	I	I	III	K, M
Soap, Chips	-1/2	15-25	30A	0.6	A1-A2-A3	I	I	III	K, M
Soap, Detergent	-1/8	15-50	30A	0.8	A1-A2-A3	I	I	III	A, K
Soap, Flakes	-1/8	5-15	30A	0.6	A1-A2-A3	I	I	III	K, M, P, Q
Soap, Powder	-1/8	20-30	30A	0.9	A1-A2-A3	I	I	II	P
Soapstone (Talc)	-200M	40-50	30A	2.0	A1-A2-A3	I	I	IV	G, P, Q



BULK MATERIAL TABLE

Bulk Material	Maximum Particle Size (in.)	Bulk Density (lbs/ft ³)	% Trough Loading	Material Factor (MF)	Component /Bearing Series	Abrasive-ness	Corrosive-ness	Flowability	Special Notes
Soda Ash, Heavy (Sodium Carbonate)	-1/8	55-65	30B	1.0	B4	II	I	III	
Soda Ash, Light (Sodium Carbonate)	-1/64	20-35	30B	0.8	B4	II	I	III	G, Q, V
Sodium Aluminate (Ground)	-1/8	72	30B	1.0	B4	II	I	III	
Sodium Aluminum Sulphate	-100M	75	30B	1.0	B4	II	I	III	•
Sodium Bicarbonate (Baking Soda)	-100M	40-55	45	0.6	A2	I	I	II	
Sodium Nitrate	-3	70-80	45	1.2	B1-B2	I	III	II	H
Sodium Phosphate	-1/8	50-60	30A	0.9	A1-A2	I	I	III	
Sodium Sulfate, Dry, Coarse	-1/8	85	30B	2.1	C4	II	II	III	M
Sodium Sulfate, Dry, Pulverized	-1/8	65-85	30B	1.7	C4	II	II	III	M
Sodium Sulfit	-1/8	96	30B	1.5	B4	II	I	IV	P
Sorghum Seed (Milo or Kafir)	-1/8	32-36	30A	0.5	A1-A2-A3	I	I	II	
Soybean, Dust	-1/64	25-35	30A	2.0	A1-A2-A3	I	I	III	G, H
Soybean, Cake	-1/2	40-43	30A	1.0	A1-A2-A3	I	I	III	O, V
Soybean, Cracked	-1/2	30-40	30B	0.6	B4	II	I	III	H, O, V
Soybean, Flakes, Raw	-1/2	15-35	30A	0.8	A1-A2-A3	I	I	III	Q, V
Soybean, Flakes, Spent	-1/4	18-20	30A	0.6	A2	I	I	II	Q, V
Soybean, Flour	-1/64	25-35	30A	1.0	A1-A2-A3	I	I	III	G, H, V
Soybean, Meal, Cold	-1/8	35-45	30A	0.6	A1-A2-A3	I	I	III	V
Soybean, Meal, Hot	-1/8	40	30A	0.6	D3	I	II	III	
Soybean, Whole	-1/2	45-50	30B	1.0	B4	II	I	II	H, O
Starch	-1/64	25-50	45	1.0	A1-A2-A3	I	I	I	G, H, V, •
Steel Turnings (Chips), Crushed	-3	100-150	30B	3.0	D4	II	I	IV	N, O
Stibium (Antimony)	-100M	•	30A	1.6	B4	II	I	II	•
Sugar, Powdered	-100M	50-60	30A	0.8	A2	I	I	III	H, J, P, V, •
Sugar, Raw, Cane	-1/8	55-65	30A	1.5	A2	I	I	III	H, J, P
Sugar, Refined, Granulated, Dry	-1/8	50-55	30A	1.0-1.2	A2	I	I	III	H, J, M, V
Sugar, Refined, Granulated, Wet	-1/2	55-65	30A	1.4-2.0	A2	I	I	III	P
Sugar Beet, Pulp, Dry	-1/2	12-15	30B	0.9	B4	II	I	II	H, •

**BULK MATERIAL TABLE**

Bulk Material	Maximum Particle Size (in.)	Bulk Density (lbs/ft ³)	% Trough Loading	Material Factor (MF)	Component / Bearing Series	Abrasive-ness	Corrosive-ness	Flowability	Special Notes
Sugar Beet, Pulp, Wet	-1/2	25-45	30A	1.2	A1-A2-A3	I	I	III	H, P
Sulphur, Crushed	-1/2	50-60	30A	0.8	A1-A2	I	I	III	H
Sulphur, Ground	-1/64	50-60	30A	0.6	A1-A2	I	I	II	G, H
Sulphur, Lumps	-3	80-85	30A	0.8	D4	I	I	III	H
Sunflower Seed	-1/2	19-38	45	0.5	A1-A2-A3	I	I	I	V
Taconite, Pellets	+1/2	116-130	15	2.0	D4	III	I	II	K
Talc	-1/2	80-90	30B	0.9	B4	II	I	III	
Talc, Powder	-200M	50-60	30B	0.8	B4	II	I	III	G, P, V
Tanbark, Ground	-1/8	55	30A	0.7	A1-A2-A3	I	I	IV	•
Timothy Seed	-1/8	36	30A	0.6	B2	I	I	III	H, Q, V
Titanium Dioxide (Ilmenite)	-3	140-160	15	2.0	C4	III	I	III	
Tobacco, Scraps	-3	15-25	30A	0.8	B1-B2	I	I	IV	Q
Tobacco, Snuff	-1/8	30	30A	0.9	A1-A2-A3	I	I	IV	H, G, K, V
Tricalcium Phosphate	-1/64	40-50	30A	1.6	A1-A2	I	I	IV	
Triple Super Phosphate	-1/8	50-55	30B	2.0	C4	II	III	III	L
Trisodium Phosphate	-1/2	60	30B	1.7	B4	II	I	III	
Trisodium Phosphate, Granular	-1/8	60	30B	1.7	B4	II	I	III	
Trisodium Phosphate, Pulverized	-1/64	50	30B	1.6	B4	II	I	III	V
Tung Nuts	-3	25-30	30A	0.7	B1-B2	I	I	I	V
Tung Nut Meats, Crushed	-3	28	30A	0.8	B1-B2	I	I	II	O, V
Uintaitite (Bentonite)	-100M	50-60	45	0.7	B4	I	I	II	G, P, Q
Urea Prills, Coated	-1/8	43-46	45	1.2	A1-A2-A3	I	I	II	
Vermiculite, Expanded	-1/2	16	30A	0.5	A1-A2	I	I	III	Q
Vermiculite, Ore	-3	80	30B	1.0	B4	II	I	III	
Vetch	-1/8	48	30B	0.4	A1-A2-A3	II	I	I	H, V
Vulcanite (Ebonite)	-1/2	63-70	30A	0.8	A1-A2-A3	I	I	III	
Walnut Shells, Crushed	-1/8	35-45	30B	1.0	B4	II	I	III	V
Wheat	-1/2	45-48	45	0.4	A1-A2-A3	I	I	II	H, V
Wheat, Cracked	-1/8	40-45	45	0.4	A1-A2-A3	I	I	II	H, V
Wheat, Germ	-1/8	18-28	45	0.4	A1-A2-A3	I	I	II	V
White Lead, Dry	-1/64	75-100	30B	1.0	B4	II	I	III	G, L, V
Wood Bark	+1/2	8-16	30B	1.5	B1-B2	I	I	IV	N, Q
Wood Chips, Screened	-3	10-30	30A	0.6	B1-B2	I	I	IV	N, Q
Wood, Flour	-1/8	16-36	30A	0.4	A1-A2	I	I	III	H, P, Q, V
Zinc Concentrate Residue	-1/8	75-80	15	1.0	C4	III	I	III	
Zinc Oxide, Heavy	-100M	30-35	30A	1.0	A1-A2	I	I	IV	G, P
Zinc Oxide, Light	-100M	10-15	30A	1.0	A1-A2	I	I	IV	G, P, Q, V



SCREW CONVEYOR CAPACITY

Capacity is defined as the weight or volume per hour of a bulk material that can be safely and feasibly conveyed using a screw conveyor. Screw conveyor diameter is determined by multiple factors including capacity.

The following steps are required for proper screw conveyor selection –

1. Calculate required capacity in cubic feet per hour (ft³/hr).
2. Select the recommended trough loading percentage from the Bulk Material Table for the specific bulk material to be conveyed.
3. Select the screw conveyor diameter that corresponds with the recommended trough loading and is less than the capacity at maximum RPM from the Capacity Table.
4. Calculate actual conveyor speed by dividing the required capacity by the capacity at 1-RPM from the Capacity Table.

NOTE: Maximum speeds shown in the Capacity Table are not intended for every application and were developed for non-abrasive, free-flowing bulk materials. KWS recommends lower screw conveyor speeds for most industrial applications. A larger screw conveyor diameter will be required for lower screw conveyor speeds.

Maximum lump size must also be considered when designing a screw conveyor. Please refer to the Bulk Material Lump Size section for further information.

The Capacity Table is only intended for designing control fed screw conveyors. Conversely, screw feeders are flood loaded at the inlet and require special design considerations. Please refer to the Screw Feeder section for further information.

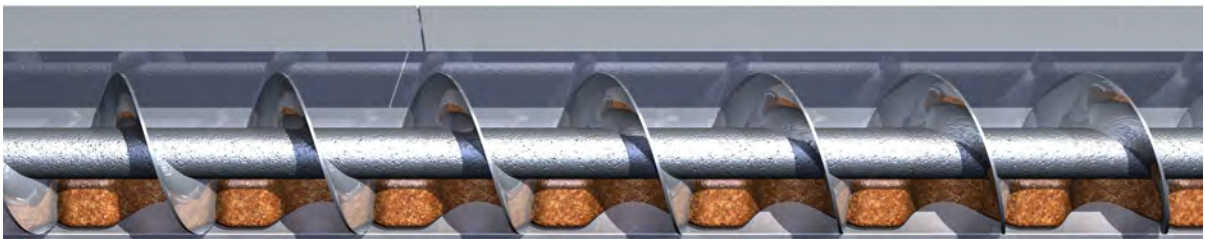
Calculation Of Conveyor Speed

The maximum recommended capacity for each screw diameter is listed in the Capacity Table for reference and should not be exceeded. Using the formula below, the exact conveyor speed (S) can be calculated:

$$S = \frac{CFH}{CFH \text{ AT } 1 \text{ RPM}}$$

Nomenclature: S = Conveyor Speed

CFH = Capacity in Cubic Feet per Hour (ft³/hr)



SCREW CONVEYOR CAPACITY

Capacity Factors for Special Pitches

Screw conveyors transfer bulk materials volumetrically and capacity is calculated in cubic feet per hour. Screw conveyor capacity is affected when the flight pitch is reduced from standard full pitch. Reducing the flight pitch reduces the capacity. For example, a 1/2 pitch screw carries 1/2 the capacity of a full pitch screw at the same level of trough loading and speed. Capacity Factors for Special Pitches are shown below.

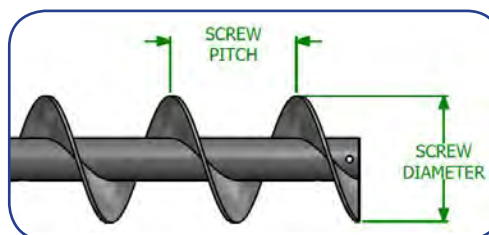
Selection Capacity (SC) is the capacity adjusted for special pitch or modified flights used in the process of selecting the screw conveyor diameter for the application.

Calculation of special screw conveyor capacities is as follows:

$$SC = CFH \times CF$$

Nomenclature: SC = Selection Capacity
 CFH = Required Capacity in Cubic Feet per Hour (ft³/hr)
 CF = Capacity Factor

Capacity Factors for Special Pitches		
Pitch	Description	Capacity Factor
Standard	Pitch = Diameter	1.00
Short	Pitch = 2/3 Diameter	1.50
Half	Pitch = 1/2 Diameter	2.00
Long	Pitch = 1-1/2 Diameters	0.67



Capacity Factors for Modified Flight

Screw conveyor capacity is also affected by using modified flight types such as cut flight, cut-and-folded flight, ribbon and paddles. The use of modified flights reduces conveying capacity. Capacity Factors for Modified Flights are shown below for various flight types and trough loading

Capacity Factors for Cut or Cut and Fold Flights			
Flight Type	Conveyor Loading		
	15%	30%	45%
Cut flight	1.92	1.57	1.43
Cut & folded flight	X	3.75	2.54



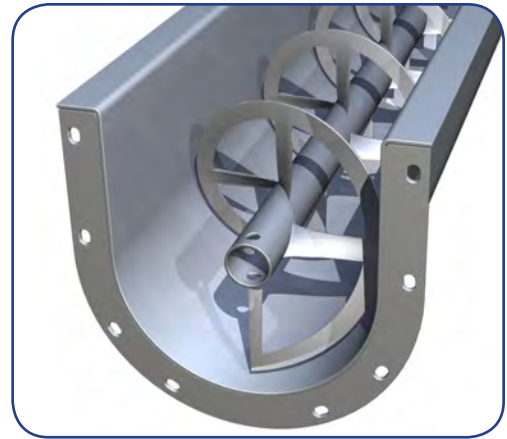
Capacity Factors for Paddles				
Paddles Per Pitch	1	2	3	4
Factor	1.08	1.16	1.24	1.32





SCREW CONVEYOR CAPACITY

Capacity Factors for Ribbon Flights			
Ribbon Screw Dia.	Conveyor Loading		
	15%	30%	45%
4	X	X	X
6	1.32	1.52	1.79
9	1.34	1.54	1.81
12	1.11	1.27	1.50
14	1.27	1.45	1.71
16	1.55	1.69	1.90
18	1.33	1.53	1.80
20	1.60	1.75	1.96
24	2.02	2.14	2.28
30	2.16	2.29	2.44
36	3.27	3.37	3.70



Example

A screw conveyor is required to transport 10 tons per hour of unslaked lime with a bulk density of 60 lbs/ft³. The unslaked lime also needs to be mixed in transit using cut and folded flights. The conveying distance is 15-feet, so short (2/3) pitch screws will be used to ensure proper mixing. The recommended trough loading percentage from the Bulk Material Table is 30A.

Actual calculated capacity is:

$$CHF = \frac{20,000 \text{ lbs/hr}}{60 \text{ lbs/ft}^3} = 333 \text{ ft}^3/\text{hr}$$

For proper selection of screw conveyor diameter and speed, the actual capacity must be adjusted for the cut and folded flights and short pitch using the Capacity Factors for Special Pitches and Modified Flights. As stated above, the adjusted capacity is defined as Selection Capacity (SC).

The Capacity Factor for short (2/3) pitch is 1.50.

Capacity Factors for Special Pitches		
Pitch	Description	Capacity Factor
Standard	Pitch = Diameter	1.00
Short	Pitch = 2/3 Diameter	1.50
Half	Pitch = 1/2 Diameter	2.00
Long	Pitch = 1-1/2 Diameters	0.67

SCREW CONVEYOR CAPACITY

The Capacity Factor for cut and folded flights with 30-percent trough loading is 3.75.

Capacity Factors for Cut or Cut and Fold Flights			
Flight Type	Conveyor Loading		
	15%	30%	45%
Cut flight	1.92	1.57	1.43
Cut & folded flight	X	3.75	2.54

Therefore:

$$SC = 1.50 \times 3.75 \times 333 \text{ ft}^3/\text{hr}$$

$$SC = 1,873 \text{ ft}^3/\text{hr}$$


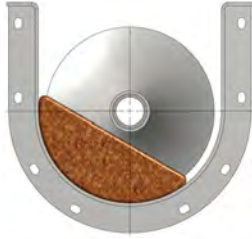

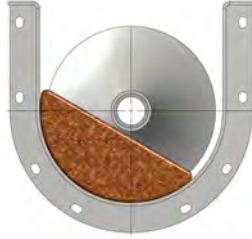
The Selection Capacity will be used to select the proper screw conveyor diameter and speed from the Capacity Table. With a recommended trough loading of 30A, the Selection Capacity must be less than the maximum capacity given in the Capacity Table. A 16-inch diameter screw conveyor will convey 2,496 cubic feet per hour at the maximum recommended speed of 80-rpm.

The actual screw conveyor speed is calculated by dividing the Selection Capacity by the capacity at 1-rpm.

$$1,873/31.2 = 60\text{-rpm}$$

60-rpm is the correct speed for a 16-inch diameter screw conveyor with cut and folded flights and short pitch for conveying and mixing 333 cubic feet per hour.

SCREW CONVEYOR CAPACITY

Capacity Table				
Trough Loading	Screw Dia. (in.)	Max. RPM *	Capacity in ft ³ /hr	
			At Max. RPM	At 1 RPM
 15%	4	69	14.5	0.2
	6	60	45	0.8
	9	55	150	2.7
	12	50	323	6.5
	14	50	520	10.4
	16	45	702	15.6
	18	45	1,012	22.5
	20	40	1,248	31.2
	24	40	2,184	54.6
	30	35	3,728	106.5
 30% A	4	139	57	0.4
	6	120	179	1.5
	9	100	545	5.5
	12	90	1,161	12.9
	14	85	1,768	20.8
	16	80	2,496	31.2
	18	75	3,375	45.0
	20	70	4,375	62.5
	24	65	7,085	109.0
	30	60	12,798	213.3
 30% B	4	69	28	0.4
	6	60	90	1.5
	9	55	305	5.5
	12	50	645	12.9
	14	50	1,040	20.8
	16	45	1,404	31.2
	18	45	2,025	45.0
	20	40	2,500	62.5
	24	40	4,360	109.0
	30	35	7,465	213.3
 45%	4	190	116	0.61
	6	165	368	2.2
	9	155	1,271	8.2
	12	145	2,813	19.4
	14	140	4,368	31.2
	16	130	6,071	46.7
	18	120	8,112	67.6
	20	110	10,307	93.7
	24	100	16,400	164.0
	30	90	28,800	320.0
	36	75	41,490	553.2

NOTE: Maximum speeds shown in the Capacity Table are not intended for every application and were developed for non-abrasive, free-flowing bulk materials. KWS recommends lower screw conveyor speeds for most industrial applications. A larger screw conveyor diameter will be required for lower screw conveyor speeds.

SCREW CONVEYOR HORSEPOWER

The calculations included in the KWS Screw Conveyor Engineering Guide are for control fed screw conveyors only. The horsepower calculations for screw feeders require additional considerations. Please consult KWS Engineering for screw feeder applications.

Horsepower is defined as the power required to safely and feasibly convey a bulk material a fixed distance in a screw conveyor. The horsepower required to drive a screw conveyor is called Total Shaft Horsepower, or TSHP. TSHP is a function of the characteristics of the bulk material being conveyed and the friction inherent in the screw conveyor. It is very important to design a screw conveyor with sufficient horsepower in order to prevent downtime and loss of production.

Properly defining the bulk material to be conveyed is very important because material characteristics such as bulk density, abrasiveness and flowability all play a role in determining the proper horsepower for a screw conveyor. TSHP is the sum of Friction Horsepower and Material Horsepower divided by the drive efficiency. Friction Horsepower is the horsepower required to turn a screw conveyor when empty. Friction from the bearings, seals and other moving components create resistance. Sufficient horsepower is required to overcome the friction. Material Horsepower is the horsepower required to convey the bulk material the full length of the screw conveyor. The Friction and Material Horsepower calculations are shown below:

Friction HP Calculation:

$$FHP = \frac{DF \times HBF \times L \times S}{1,000,000}$$

Material HP Calculation:

$$MHP^* = \frac{CFH \times W \times MF \times L}{1,000,000} \quad \text{OR:} \quad MHP = \frac{CP \times MF \times L}{1,000,000}$$

Total Shaft HP Calculation:

$$TSHP = \frac{FHP + MHP^*}{e}$$

* If calculated Material Horsepower is less than 5HP it should be corrected for potential overload. Use the Corrected Material HP Chart.

Equation Nomenclature:

FHP = Friction HP (HP required to drive conveyor empty)

DF = Conveyor Diameter Factor

HBF = Hanger Bearing Factor

L = Conveyor Length (feet)

S = Conveyor Speed (RPM)

MHP = Material HP (HP required to convey bulk material)

CFH = Conveyor Capacity (ft³/hr)

W = Bulk Density (lbs/ft³)

MF = Material Factor (From Bulk Material Table)

CP = Capacity (lbs/hr)

TSHP = Total Shaft HP

e = Drive Efficiency (Typical value of 0.88 is used for a shaft mount reducer/motor)



SCREW CONVEYOR HORSEPOWER

The Diameter Factor (DF) is an empirical value determined over many years of testing and represents the frictional resistance of the weight of the screw for various screw diameters.

Diameter Factor Table (DF)	
Dia.	Factor
4	12
6	18
9	31
12	55
14	78
16	106
18	135
20	165
24	235
30	377
36	549

The Hanger Bearing Factor (HBF) is an empirical value determined over many years of testing and represents the frictional resistance of the hanger bearing for various types of hanger bearing materials.

Hanger Bearing Factor Table (HBF)	
Bearing Type	Bearing Factor
Ball, Roller, or none	1.0
Bronze, or Wood	1.7
Plastic, Nylon, UHMW, or Teflon	2.0
Hard Iron, or Stellite	4.4



The Material Factor (MF) is an empirical value determined over many years of testing and represents the frictional resistance of the bulk material being conveyed. Please note that as the bulk density increases, typically the Material Factor increases because denser bulk materials are more difficult to convey. Material Factors for many materials can be found in the Bulk Material Table.

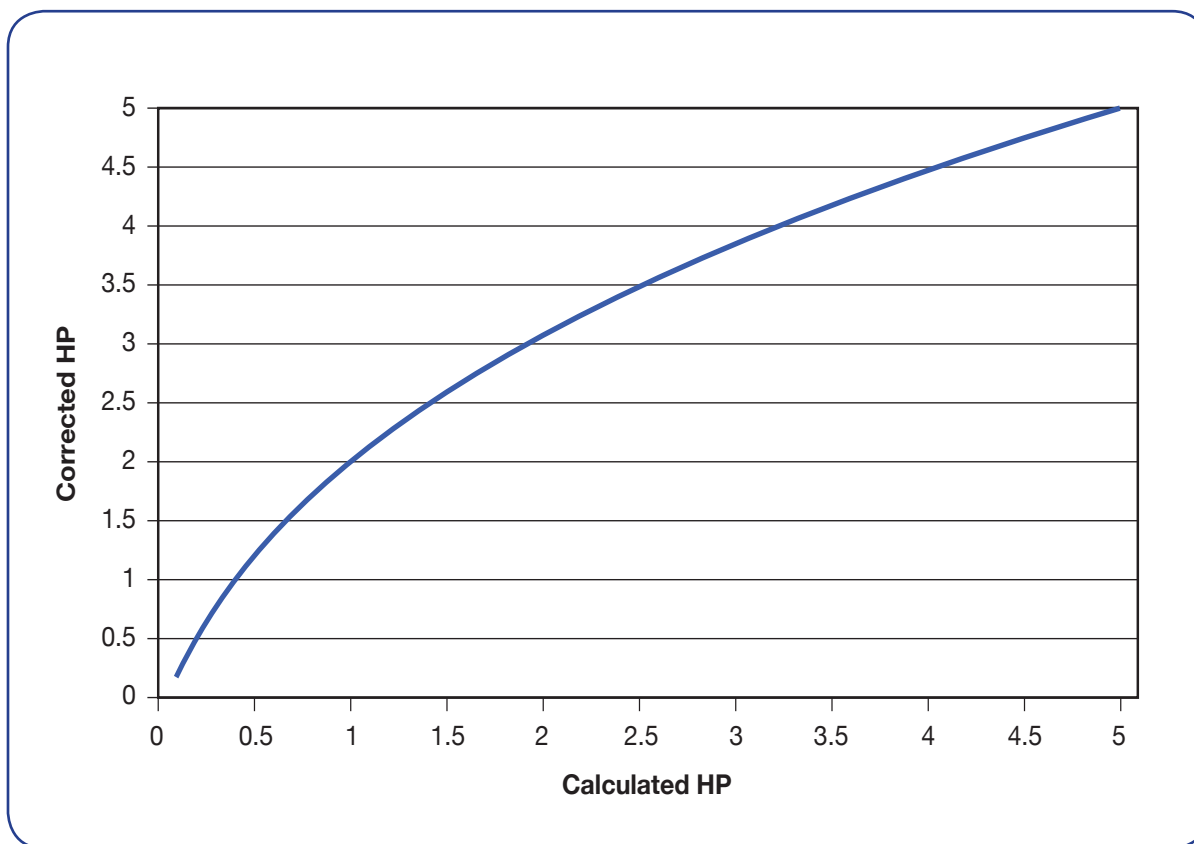
The drive unit for a screw conveyor is typically designed with a gear reducer and motor. The drive unit for a screw conveyor is not 100-percent efficient. There are frictional losses in the gear reducer and belt/chain reduction. Drive efficiency (e) is typically between 85 and 95-percent.

SCREW CONVEYOR HORSEPOWER

Corrected Material Horsepower

The calculated horsepower of a screw conveyor may need to be adjusted so the drive unit will have more horsepower and torque available to overcome an upset condition such as a minor choke in the inlet or a large lump being conveyed. The Corrected Material Horsepower Factor, sometimes called the Overload Factor, is used to increase the Total Shaft Horsepower (TSHP) of a screw conveyor when the calculated Material Horsepower (MHP) is less than 5-HP. Increasing the TSHP allows the screw conveyor to overcome most upset conditions, reducing downtime and loss of production.

Corrected Material HP Chart





SCREW CONVEYOR HORSEPOWER

Conveyors With Special Flights

The procedure for calculating Total Shaft Horsepower (TSHP) for screw conveyors with special flights is identical to that used for standard flights except the Material Horsepower (MHP) must be multiplied by one or more of the Special Flight Factors (SF). Special Flight Factors are used to account for the additional horsepower needed to overcome the resistance of the special flights to the bulk material being conveyed. Special flights are used for chopping up or mixing bulk materials and additional horsepower is required to perform these functions.

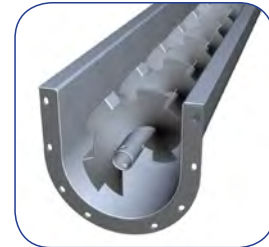
Total Shaft Horsepower

$$TSHP = \frac{FHP + (MHP * SF)}{e}$$

* If calculated Material Horsepower is less than 5HP it should be corrected for potential overload. Use the Corrected Material HP Chart.

Special Flight Factors:

Type	Conveyor Loading		
	15%	30%	45%
Cut flight	1.10	1.15	1.2
Cut & folded flight	X	1.50	1.7
Ribbon flight	1.05	1.14	1.20



Paddles Per Pitch	1	2	3	4
Factor	1.29	1.58	1.87	2.16



Note: Trough loading must not exceed 45-percent when using special flights.

Example

Using the previous example, a screw conveyor is required to transport 10 tons per hour of unslaked lime with a bulk density of 60 lbs. per cubic foot. The unslaked lime also needs to be mixed in transit using cut and folded flights. The conveying distance is 15-feet so short (2/3) pitch screws will be used to ensure proper mixing. The recommended trough loading percentage from the Bulk Material Table is 30A. The Special Flight Factor for cut-and-folded flights at 30-percent trough loading is 1.50.

Type	Conveyor Loading		
	15%	30%	45%
Cut flight	1.10	1.15	1.2
Cut & folded flight	X	1.50	1.7
Ribbon flight	1.05	1.14	1.20

The Material Horsepower (MHP) will be multiplied by 1.50 to account for the additional horsepower needed to overcome the resistance of the special flights to the unslaked lime being conveyed and mixed.

SCREW CONVEYOR TORQUE

Torque is defined as the twisting force exerted by the drive unit on the conveyor screw. Torque is transmitted through the drive shaft of the drive unit to the screw and converted to force to convey the bulk material. Properly selecting screw conveyor components is important to minimizing downtime and maintenance.

Full Motor Torque is the maximum torque generated by the drive unit. The equation for Full Motor Torque is shown below:

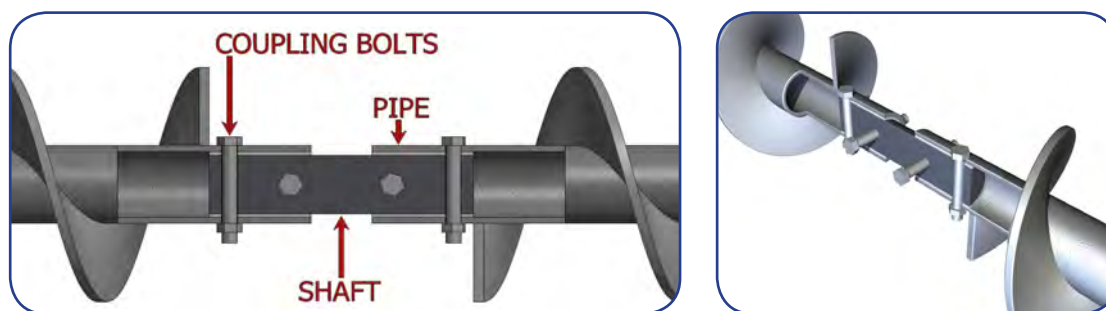
$$\text{Full Motor Torque} = \frac{HP \times 63,025}{S}$$

HP = Nameplate Horsepower of the motor on the screw conveyor

S = Conveyor Speed

Torque is measured in inch-lbs. for screw conveyor components. The torque rating of the drive shaft, coupling shafts, coupling bolts and conveyor screw must be able to withstand Full Motor Torque without failing. Every KWS screw conveyor is designed to this criteria with a minimum safety factor of 5 to 1. The motor on the screw conveyor will stall out before there is a mechanical failure of a screw conveyor component.

Maximum torque ratings for each screw conveyor component are shown in the Torque Tables. Maximum torque ratings are based on a safe stress value for the specific material of construction. The screw conveyor components will have an infinite life under normal operating conditions.

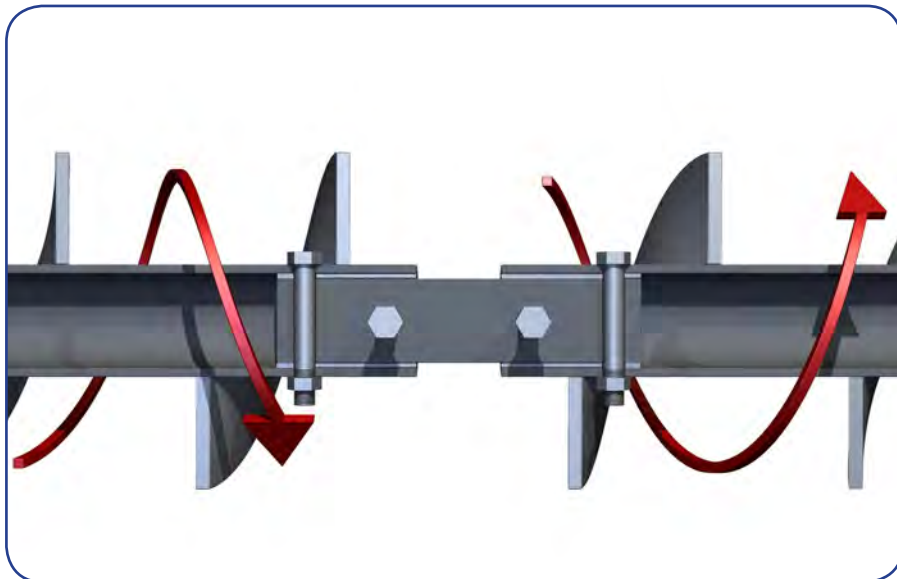


Standard Screw Construction (by Shaft Size)								
Shaft Diameter (In.)	1	1-1/2	2	2-7/16	3	3-7/16	3-15/16	4-7/16
Nominal Pipe Size	1-1/4	2	2-1/2	3	3-1/2	4	5	6
Coupling Bolt Dia. (In.)	3/8	1/2	5/8	5/8	3/4	7/8	1-1/8	1-1/4

SCREW CONVEYOR TORQUE

Torque Table – Carbon Steel

Shaft Dia.	Carbon Steel Torque Values							
	Shaft		Coupling Bolts (2-Bolt)		Pipe – Schedule 40			
	C-1045		Grade 5		A-53			
	Torsion		Bolts in Shear		Pipe in Shear		Pipe in Bearing	
	Safe Stress	Torque Rating	Safe Stress	Torque Rating	Safe Stress	Torque Rating	Safe Stress	Torque Rating
	PSI	In-Lbs	PSI	In-Lbs	PSI	In-Lbs	PSI	In-Lbs
1	8,750	1,000	15,500	3,400	6,700	3,100	6,700	2,200
1-1/2	8,750	3,800	15,500	9,100	6,700	7,600	6,700	5,600
2	8,750	9,500	15,500	19,000	6,700	14,200	6,700	8,900
2-7/16	8,750	18,700	15,500	23,000	6,700	23,000	6,700	13,200
3	8,750	35,400	15,500	41,000	6,700	31,900	6,700	17,500
3-7/16	8,750	53,000	15,500	64,000	6,700	42,700	6,700	24,700
3-15/16	8,750	76,400	15,500	121,300	6,700	72,600	6,700	58,200
4-7/16	8,750	110,200	15,500	168,800	6,700	112,900	6,700	101,300

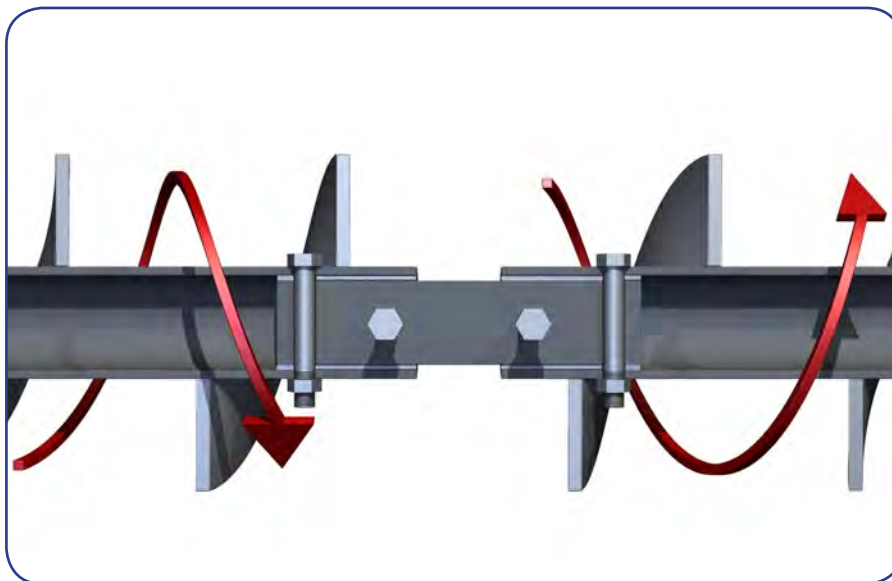


Torque On Shaft, Coupling Bolts and Pipe

SCREW CONVEYOR TORQUE

Torque Table – Stainless Steel

Shaft Dia.	Stainless Steel Torque Values							
	Shaft		Coupling Bolts (2-Bolt)		Pipe – Schedule 40			
	304 & 316		18-8		A-312			
	Torsion		Bolts in Shear		Pipe in Shear		Pipe in Bearing	
	Safe Stress	Torque Rating	Safe Stress	Torque Rating	Safe Stress	Torque Rating	Safe Stress	Torque Rating
	PSI	In-Lbs	PSI	In-Lbs	PSI	In-Lbs	PSI	In-Lbs
1	6,000	700	6,000	1,300	6,000	2,800	6,000	1,900
1-1/2	6,000	2,600	6,000	3,500	6,000	6,800	6,000	5,000
2	6,000	6,500	6,000	7,300	6,000	12,700	6,000	7,900
2-7/16	6,000	12,800	6,000	8,900	6,000	20,600	6,000	11,800
3	6,000	24,300	6,000	15,900	6,000	28,600	6,000	15,700
3-7/16	6,000	36,400	6,000	24,800	6,000	38,300	6,000	22,100
3-15/16	6,000	52,400	6,000	46,900	6,000	65,000	6,000	52,100
4-7/16	6,000	75,600	6,000	65,300	6,000	101,100	6,000	90,700



Torque On Shaft, Coupling Bolts and Pipe



SCREW CONVEYOR EXAMPLE

There are many different factors to consider when designing a screw conveyor. The purpose of this example is to provide a step-by-step process that a KWS engineer would follow when designing a screw conveyor. It is important for the person designing the screw conveyor to understand how each factor affects the final screw conveyor design.

The following information will be used for the example –

- Bulk Material: Corn Meal
- Capacity: 25,600 lbs/hr
- Screw Conveyor Length: 16-feet, 0-inches from centerline of inlet to centerline of discharge
- Screw Conveyor Degree of Incline: 0° Horizontal

The screw conveyor for the example is control fed at the inlet by another screw conveyor.

SCREW CONVEYOR EXAMPLE - STEP 1: ESTABLISH CHARACTERISTICS OF BULK MATERIAL

The first step is to look up corn meal in the Bulk Material Table and write down the following information –

Bulk Material: Corn Meal

Maximum Particle Size: minus 1/8-inch and smaller

Bulk Density: 32 to 40 lbs/ft³

Trough Loading: 30A (30-percent)

HP Factor: 0.5

Component Series: A1-A2

Abrasiveness: I

Corrosiveness: I

Flowability: III



Note – For the example, the additional characteristics provided in the “Note” column of the bulk material will not be considered in order to simplify the solution. Please refer to the Bulk Material Factors section for more detailed information.



SCREW CONVEYOR EXAMPLE

SCREW CONVEYOR EXAMPLE - STEP 2: DETERMINE CONVEYOR SIZE AND SPEED BASED ON CAPACITY

Information Given for Example:

- Bulk Material: Corn Meal
- Length: 16'-0" from centerline of inlet to centerline of discharge
- Capacity: 25,600 lbs per hour
- Conveyor Type: Horizontal

Information Provided from Bulk Material Table:

Bulk Material	Maximum Particle Size (in.)	Bulk Density (lbs/ft ³)	% Loading	HP Factor	Component Series	Abrasiveness	Corrosiveness	Flowability
Corn Meal	-1/8	32-40	30A	0.5	A1-A2	I	I	III

Now that the characteristics of the bulk material to be conveyed have been determined, the next step is to calculate the capacity in cubic feet per hour. Always use the lowest bulk density when calculating capacity in order to get the highest potential volumetric capacity.

The recommended trough loading percentage according to the Bulk Material Table is 30A, or 30-percent.

Fill in the blanks and calculate the Capacity:

$$\text{Capacity (ft}^3\text{/hr)} = \frac{\text{Capacity (lbs/hr)}}{\text{Bulk Density (lbs/ft}^3\text{)}} = \frac{25,600 \text{ lbs/hr}}{32 \text{ lbs/ft}^3} = \underline{800} \text{ ft}^3\text{/hr}$$

Using standard full pitch, fill in the blank to calculate the Selection Capacity:

$$\text{SC} = \text{CFH} \times \text{CF} = \underline{800} \text{ ft}^3\text{/hr} \times \underline{1} = \underline{800} \text{ ft}^3\text{/hr}$$

Nomenclature:

SC = Selection Capacity (ft³/hr)

CFH = Required Capacity in Cubic Feet Per Hour (ft³/hr)

CF = Capacity Factor

The Selection Capacity will be used to select the proper screw conveyor diameter and speed from the Capacity Table. Using the Recommended Trough % Loading and calculated Selection Capacity, select the proper conveyor diameter. The Selection Capacity must be less than the maximum capacity given in the Capacity Table. Fill in the blanks below based on your previous calculations:

Conveyor Diameter: 12" Capacity at Max RPM: 1,161 Capacity at 1 RPM: 12.9



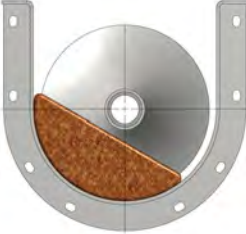
SCREW CONVEYOR EXAMPLE

SCREW CONVEYOR EXAMPLE - STEP 2:

DETERMINE CONVEYOR SIZE AND SPEED BASED ON CAPACITY (CONTINUED)

The Actual Conveyor Speed is calculated by dividing the Selection Capacity by the Capacity at 1-RPM. Fill in the blanks below:

$$\text{Actual Conveyor Speed (S)} = \frac{\text{SC (ft}^3\text{/hr)}}{\text{Capacity at 1 RPM}} = \frac{800 \text{ ft}^3\text{/hr}}{12.9 \text{ ft}^3\text{/hr at 1 RPM}} = 62 \text{ RPM}$$

Capacity Table				
Trough Loading	Screw Dia. (in.)	Max. RPM *	Capacity in ft ³ /hr	
			At Max. RPM	At 1 RPM
 <p>30% A</p>	4	139	57	0.4
	6	120	179	1.5
	9	100	545	5.5
	12	90	1,161	12.9
	14	85	1,768	20.8
	16	80	2,496	31.2
	18	75	3,375	45.0
	20	70	4,375	62.5
	24	65	7,085	109.0
	30	60	12,798	213.3
	36	50	18,440	368.8

SCREW CONVEYOR EXAMPLE - STEP 3:

CALCULATE HORSEPOWER REQUIREMENTS

Information Given for Example:

- Bulk Material: Corn Meal
- Length (L): 16'-0" from centerline of inlet to centerline of discharge
- Capacity (CP): 25,600 lbs/hr
- Conveyor Type: Horizontal

Information Provided from Bulk Material Table:

Bulk Material	Maximum Particle Size (in.)	Bulk Density (lbs/ft ³)	% Loading	HP Factor	Component Series	Abrasiveness	Corrosiveness	Flowability
Corn Meal	-1/8	32-40	30A	0.5	A1-A2	I	I	III

SCREW CONVEYOR EXAMPLE

SCREW CONVEYOR EXAMPLE - STEP 3: CALCULATE HORSEPOWER REQUIREMENTS (CONTINUED)

Calculating Horsepower

Friction Horsepower

A 12-inch diameter screw conveyor was selected in Step 2 of the example. The Diameter Factor (DF) selected from the Diameter Factor Chart (HP Section) is 55 for a 12-inch diameter screw conveyor.

Diameter Factor Chart (DF)							
Dia.	Factor	Dia.	Factor	Dia.	Factor	Dia.	Factor
4	12	12	55	18	135	30	377
6	18	14	78	20	165	36	549
9	31	16	106	24	235		

Since the bulk material to be conveyed is corn meal, a wood hanger bearing is selected for the application. The Hanger Bearing Factor (HBF) selected from the Hanger Bearing Factor Chart (HP Section) is 1.7 for a wood hanger bearing.

Hanger Bearing Factor Chart (HBF)		
Bearing Type	Bearing Factor	Bearing* Class
Ball, Roller, or none	1.0	2
Bronze, or Wood	1.7	2
Plastic, Nylon, UHMW, or Teflon	2.0	3
Hard Iron, or Stellite	4.4	4



The screw conveyor speed calculated in Step 2 is 62-rpm.

Fill in the blanks and calculate the Friction Horsepower (FHP):

$$FHP = \frac{DF \times HBF \times L \times S}{1,000,000} = \frac{55 \times 1.7 \times 16 \times 62}{1,000,000} = 0.09HP$$

Nomenclature:

DF = Conveyor Diameter Factor HBF = Hanger Bearing Factor
L = Conveyor Length (ft) S = Conveyor Speed

Material Horsepower

The capacity (CP) given in the example is 25,600 lbs. per hour. Please note: Do not use Selection Capacity (SC) to calculate horsepower. The screw conveyor length is 16-feet.

The Material Factor (MF) or HP Factor for corn meal is 0.5 from the Bulk Material Table.

$$MHP^* = \frac{CP \times MF \times L}{1,000,000} = \frac{25,600 \times 0.5 \times 16}{1,000,000} = 0.21HP$$

Nomenclature:

MF = Material Factor CP = Capacity (lbs/hr)

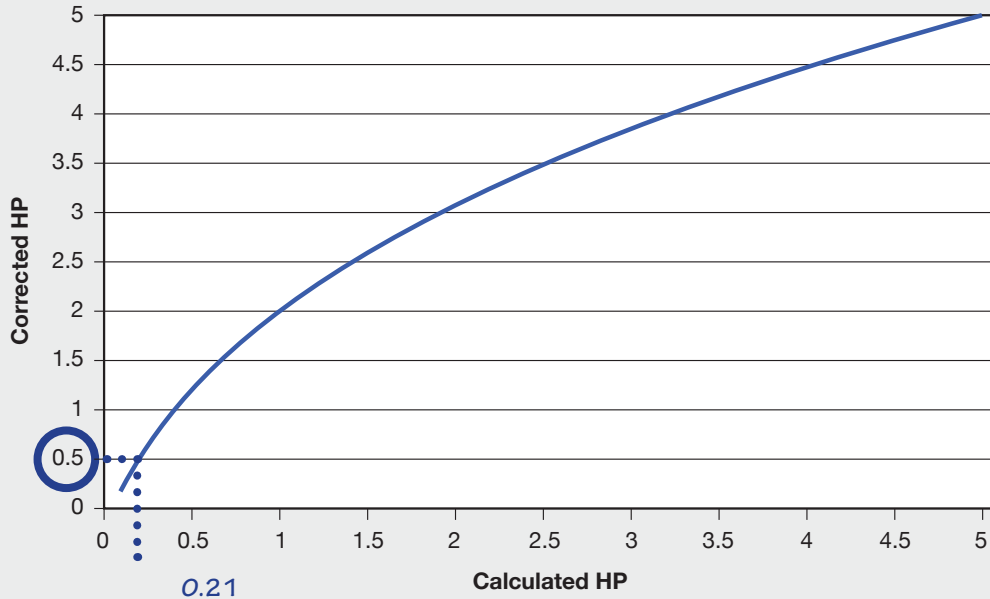
The calculated Material Horsepower (MHP) is 0.21-HP and must be corrected since it is less than 5-HP. Using the Corrected Material HP Chart below, locate 0.21-HP on the horizontal axis of the chart, draw a line vertically until it intersects the curved line, then move horizontally to determine the Corrected Material Horsepower of 0.5-HP.



SCREW CONVEYOR EXAMPLE

SCREW CONVEYOR EXAMPLE - STEP 3: CALCULATE HORSEPOWER REQUIREMENTS (CONTINUED)

Corrected Material HP Chart



Fill in the blanks and calculate Total Shaft Horsepower (TSHP) by summing the Friction Horsepower (FHP) and the Corrected Material Horsepower (MHP) as follows:

$$TSHP = \frac{FHP + MHP^*}{e} = \frac{0.09 + 0.50}{0.88} = 0.67 \text{ HP}$$

Drive efficiency (e) for a typical screw conveyor drive unit with shaft-mounted reducer and V-belt drive is 88-percent, or 0.88.



Total Shaft Horsepower (TSHP) is typically rounded up to the next commonly available motor size. The most commonly available motor size for the example would be 1-HP. The drive unit selected for the example is 1-HP at 60-rpm. The speed of the drive unit is typically rounded to the closest 5-rpm increment.

SCREW CONVEYOR EXAMPLE

SCREW CONVEYOR EXAMPLE - STEP 4: CALCULATE TORQUE REQUIREMENTS

Information Given for Example:

- Bulk Material: Corn Meal
- Length: 16'-0" from centerline of inlet to centerline of discharge
- Capacity: 25,600 lbs/hr
- Conveyor Type: Horizontal

Information Provided from Bulk Material Table:

Bulk Material	Maximum Particle Size (in.)	Bulk Density (lbs/ft ³)	% Loading	HP Factor	Component Series	Abrasiveness	Corrosiveness	Flowability
Corn Meal	-1/8	32-40	30A	0.5	A1-A2	I	I	III

Calculating Full Motor Torque

A 1-HP at 60-rpm drive unit was selected for the example screw conveyor. Full Motor Torque is calculated with the following equation below:

$$\text{Full Motor Torque} = \frac{\text{HP} \times 63,025}{S} = \frac{1 \times 63,025}{60} = 1,050 \text{ inch-lbs.}$$

HP = Nameplate Horsepower of the motor on the screw conveyor

S = Screw Conveyor Speed.

The torque rating of the drive shaft, coupling shafts, coupling bolts and conveyor screw must be greater than Full Motor Torque for proper design.

A 12-inch diameter screw conveyor was selected for the example. The minimum standard shaft size for a 12-inch diameter screw conveyor is 2-inch diameter. The corresponding pipe size is 2-1/2-inch schedule 40 pipe with 5/8-inch diameter coupling bolts. The materials of construction of the screw conveyor is carbon steel.



Standard Screw Construction (by Shaft Size)

Shaft Diameter (In.)	1	1-1/2	2	2-7/16	3	3-7/16	3-15/16	4-7/16
Nominal Pipe Size	1-1/4	2	2-1/2	3	3-1/2	4	5	6
Coupling Bolt Dia. (In.)	3/8	1/2	5/8	5/8	3/4	7/8	1-1/8	1-1/4



SCREW CONVEYOR EXAMPLE

SCREW CONVEYOR EXAMPLE - STEP 4: CALCULATE TORQUE REQUIREMENTS (CONTINUED)

Maximum torque ratings for each screw conveyor component are shown in the Torque Tables below. Maximum torque ratings are based on a safe stress value for the specific material of construction. The screw conveyor components will have an infinite life under normal operating conditions.

Shaft Dia.	Carbon Steel Torque Values							
	Shaft		Coupling Bolts (2-Bolt)		Pipe – Schedule 40			
	C-1045		Grade 5		A-53			
	Shaft in Torsion		Bolts in Shear		Pipe in Shear		Pipe in Bearing	
	Safe Stress	Torque Rating	Safe Stress	Torque Rating	Safe Stress	Torque Rating	Safe Stress	Torque Rating
	PSI	In-Lbs	PSI	In-Lbs	PSI	In-Lbs	PSI	In-Lbs
1	8,750	1,000	15,500	3,400	6,700	3,100	6,700	2,200
1-1/2	8,750	3,800	15,500	9,100	6,700	7,600	6,700	5,600
2	8,750	9,500	15,500	19,000	6,700	14,200	6,700	8,900
2-7/16	8,750	18,700	15,500	23,000	6,700	23,000	6,700	13,200
3	8,750	35,400	15,500	41,000	6,700	31,900	6,700	17,500
3-7/16	8,750	53,000	15,500	64,000	6,700	42,700	6,700	24,700
3-15/16	8,750	76,400	15,500	121,300	6,700	72,600	6,700	58,200
4-7/16	8,750	110,200	15,500	168,800	6,700	112,900	6,700	101,300

The torque rating of the screw conveyor components from the Torque Tables:

Drive and Coupling Shafts = 9,500 inch-lbs.

Coupling Bolts = 19,000 inch-lbs.

Pipe in Shear = 14,200 inch-lbs.

Pipe in Bearing = 8,900 inch-lbs.

The torque rating of each screw conveyor component is much higher than the Full Motor Torque generated by the drive unit. The screw conveyor in the example is designed properly and will function many years with minimal maintenance or downtime.



SCREW CONVEYOR EXAMPLE

SCREW CONVEYOR EXAMPLE - STEP 5: COMPONENT SERIES SELECTION

Information Given for Example:

- Bulk Material: Corn Meal
- Length: 16'-0" from centerline of inlet to centerline of discharge
- Capacity: 25,600 lbs/hr
- Conveyor Type: Horizontal

Information Provided from Bulk Material Table:

Bulk Material	Maximum Particle Size (in.)	Bulk Density (lbs/ft ³)	% Loading	HP Factor	Component Series	Abrasiveness	Corrosiveness	Flowability
Corn Meal	-1/8	32-40	30A	0.5	A1-A2	I	I	III

The recommended Component Series for corn meal is A as listed in the Bulk Material Table. Corn meal is a light, non-abrasive and free-flowing bulk material.

The 12-inch diameter by 16-foot long screw conveyor for the example is constructed from carbon steel with the following construction as selected from the Component Series Table:

Screw Dia.	Shaft Dia.	Cover Thickness	Series A		Trough Thickness (Min.)
			Screw Number		
			Helicoid	Sectional	
4	1"	14 Ga.	4H206	N/A	14 Ga.
6	1-1/2"	14 Ga.	6H304*	6S309	14 Ga.
9	1-1/2 " 2"	14 Ga.	9H306* 9H406*	9S309 9S409	14 Ga.
12	2" 2-7/16" 3"	14 Ga.	12H408* 12H508* 12H614*	12S409 12S509 12S612	12 Ga.
14	2-7/16" 3"	14 Ga.	14H508* 14H614*	14S509 14S609	12 Ga.
16	3"	14 Ga.	16H610*	16S612	12 Ga.
18	3" 3-7/16"	12 Ga.	N/A	18S612 18S712	10 Ga.
20	3" 3-7/16"	12 Ga.	N/A	20S612 20S712	3/16"
24	3-7/16"	12 Ga.	N/A	24S712	3/16"
30	3-15/16"	10 Ga.	N/A	30S816	3/8"
36	4-7/16"	3/16"	N/A	36S916	3/8"

Screw: 12H408 helicoid screws with 1/8-inch nominal flight thickness and 2-inch shaft diameter

Trough: TUA1212 angle flange trough with 12-gauge trough thickness

Cover: COV1214UFL flanged cover with 14-gauge cover thickness



SCREW CONVEYOR EXAMPLE

SCREW CONVEYOR EXAMPLE - STEP 5: COMPONENT SERIES SELECTION (CONTINUED)

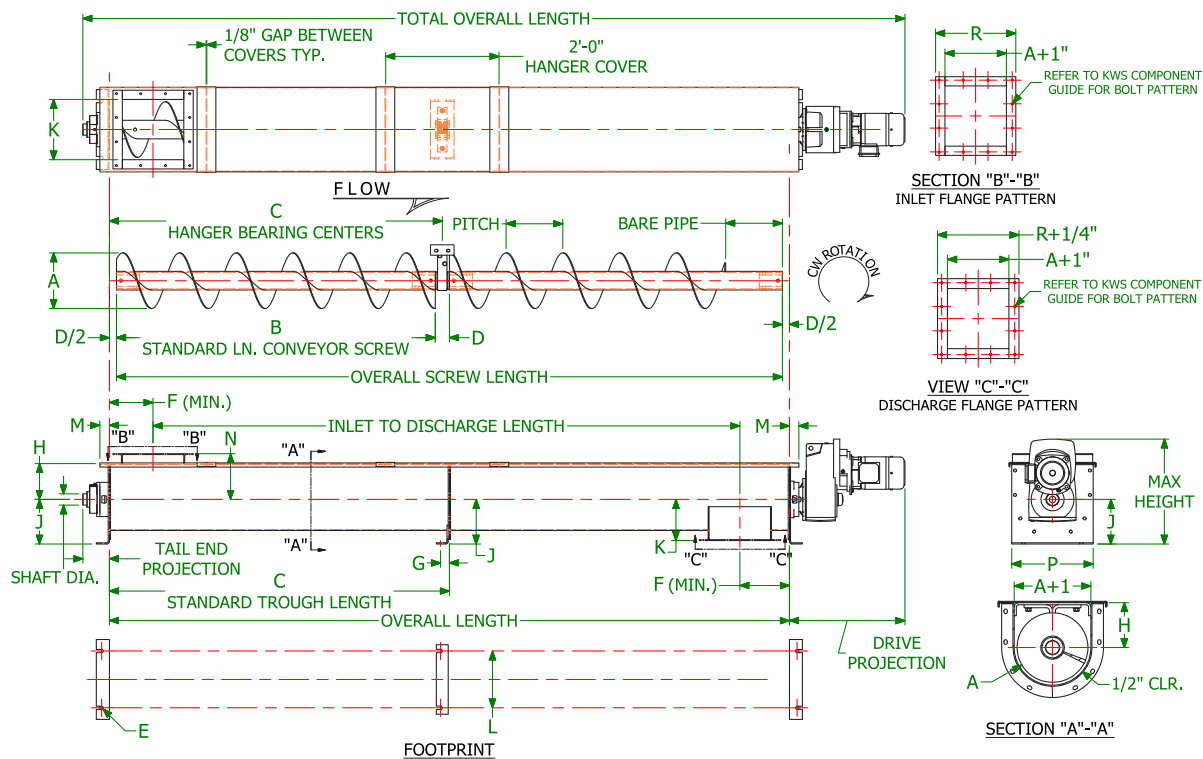
The recommended Bearing Material Series is 1-2 as listed in the Bulk Material Table.

The 12-inch diameter by 16-feet long screw conveyor for the example can utilize several different hanger bearing materials as selected from the Component Series Table:

Series	Bearing Material
1	Nylatron, Plastech, UHMW, Wood, Ball
2	Plastech, Gatke, Ball
3	Bronze, Hard Iron
4	Hard Iron, Hardsurface, Stellite, Ceramic

Based on a Bearing Material Series of 1-2, the hanger bearings can be Nylatron, Plastech, UHMW, Wood, Gatke or ball bearing. We are selecting wood for the example because wood hanger bearings are very cost-effective and durable.

DIMENSIONAL LAYOUT OF CONVEYOR



A Screw Dia.	Shaft Dia.	B	C	D	E Bolts	F (Min.)	G	H	J	K	L	M	N	P	R
4	1	9' - 10-1/2"	10	1-1/2	3/8	4-1/2	1	3-5/8	4-5/8	3-3/4	5-3/4	1-7/16	4-7/8	7-3/4	7-1/2
6	1-1/2	9' - 10"	10	2	3/8	6	1	4-1/2	5-5/8	5	8-1/8	1-1/2	6	9-3/4	10
9	1-1/2 2	9' - 10"	10	2	1/2	8	1-1/2	6-1/8	7-7/8	7-1/8	9-3/8	1-5/8	7-5/8	13-3/4	13
12	2 2-7/16 3	11' - 10" 11' - 9" 11' - 9"	12	2 3 3	5/8	10-1/2	1-5/8	7-3/4	9-5/8	8-7/8	12-1/4	2	9-3/4	17-1/4	17
14	2-7/16 3	11' - 9"	12	3	5/8	11-1/2	1-5/8	9-1/4	10-7/8	10-1/8	13-1/2	2	11-1/4	19-1/4	19
16	3	11' - 9"	12	3	5/8	13-1/2	2	10-5/8	12	11-1/8	14-7/8	2-1/2	12-5/8	21-1/1	21
18	3 3-7/16	11' - 9" 11' - 8"	12	3 4	5/8	14-1/2	2	12-1/8	13-3/8	12-3/8	16	2-1/2	14-5/8	24-1/4	24
20	3 3-7/16	11' - 9" 11' - 8"	12	3 4	3/4	15-1/2	2-1/4	13-1/2	15	13-3/8	19-1/4	2-1/2	16	26-1/4	26
24	3-7/16	11' - 8"	12	4	3/4	17-1/2	2-1/4	16-1/2	18-1/8	15-3/8	20	2-1/2	19	30-1/4	30
30	3-15/16	11' - 8"	12	4	3/4	20-1/2	2-1/2	19-1/2	21-1/2	18-3/8	30	3	22-1/2	38	36
36	4-7/16	11' - 7"	12	5	3/4	23-1/2	2-1/2	22-1/2	24	21-3/8	36	3	25-1/2	44	43



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