How to Select and Size an Industrial Vibrator

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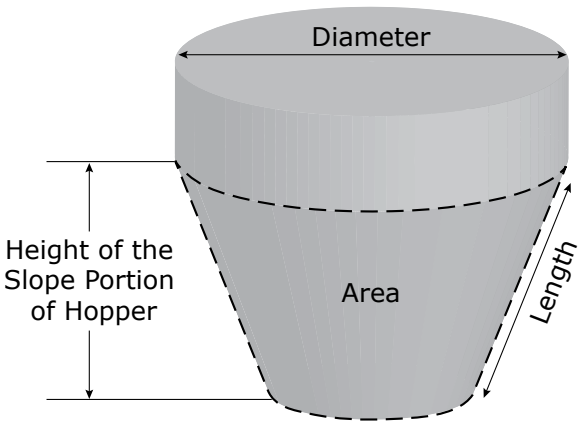
How to Select and Size an Industrial Vibrator

Rotary Vibrators or Linear Force Vibrators are widely used to initiate or restore the flow of stored bulk materials, and have proven to be effective in most situations. Industrial vibrators are available in many types and sizes. The key factors in using them effectively are to select the proper type and size of vibrator for your specific application, and to ensure that the vibrator is properly mounted.

Selecting an Industrial Vibrator for Your Application

The first consideration in selecting an Industrial Vibrator is to determine the mass of the bulk material that must be vibrated. To do this, first determine the volume and weight of the material **in the sloped portion of the hopper** (Note: If optimum flow is achieved with the material in the sloped portion of a properly designed hopper, the remaining materials will flow properly.)



A Five-Step Approach to Selecting an Industrial Vibrator:

1. Using the **"Global Calculators"** select the style of the hopper and enter the dimensions of the sloped portion of the hopper as indicated.

2. Enter the density of the bulk solid stored in the hopper.

3. Select the appropriate weight to force ratio:

   a. If the bulk material is less than 90 lb/ft^3 or flows freely in normal conditions, select a ratio of 1 lb force/10 lb material.

   b. If the bulk material is greater than 90 lb/ft^3 or is sticky, has high moisture content, or bridges easily, select a ratio of 1 lb force/5 lb material.

   c. If the bulk material has characteristics of both a and b, e.g., bulk material that is heavier than 90 lb/ft^3, but tends to flow easily, or materials that are lighter and often bridge or cling in normal conditions, use a ratio of 1 lb force/8 lb material.

Note: *These ratios are approximations based on field experience. While not an absolute rule, they have been proven effective in properly selecting the vibrator size.*

4. To select the most effective vibrator, you should match the characteristics of the stored materials with the appropriate style vibrators. Bulk materials respond to the energy produced by Industrial Vibrators. This energy is comprised of Frequency (how rapidly the waves of energy cycle) and Amplitude (the height of the waves). The combination of these factors is calculated as ***force*** and typically expressed (in the USA) in pounds (or force-pound or pound-force). Generally speaking, finer materials respond more favorably to higher frequency vibration, while higher force is more effective on coarser materials.

Examples of Fine Materials	Examples of Coarse Materials
Cement	Wood Chips
Flour	Gravel
Sand	Coal
Powders	Ores

5. Select your preferred Power Source (pneumatic, hydraulic, or electric) and refer to the **Product Performance Data** to select one or more well-matched vibrators with a force output equal to or slightly greater than the force as determined using the appropriate Weight-to-Force Ratio. Or you may use the **Rotary Vibrator Selection Guide** (starts on page 6), based on 10 : 1 Weight-to-Force Ratio, to choose a vibrator as indicated in the guide.

Other Important Factors to consider when selecting vibrators:

- If your stored material is best categorized as coarse, you may achieve the best results using a Linear Vibrator (pneumatic piston) or a higher force Rotary Vibrator (motor-driven hydraulic, pneumatic or electric).
- Finer materials are more likely to respond to higher frequency Rotary Vibrators (pneumatic turbines or ball vibrators).

• Follow all recommended mounting instructions. A properly-mounted vibrator will effectively transfer the energy to the bulk material and will provide better performance, longer vibrator service life and minimize stress on the hopper. The calculated vibrator force does not need to exactly match the output of the selected vibrator. For example, if the calculated force requirement is 1,000 force-pounds (4.45 kN), you can use a vibrator with 1,200 force-pounds (5.34 kN) rating. In addition, the speed of hydraulic and pneumatic vibrators can be adjusted by reducing the flow of hydraulic fluid or compressed air. This reduction of speed will reduce the force the vibrator produces, allowing for additional "fine-tuning" of the vibrator's frequency and force.

• If a Linear Vibrator (piston) is selected, additional important considerations are bin wall thickness and bin capacity. Piston Vibrators restore material flow by producing a linear shock wave that reduces friction and forces the bulk material away from the hopper wall. To avoid damage to the hopper, do not use a larger piston vibrator than the bin wall thickness recommendations.

Piston Vibrators are available as:

1. Impacting Pistons (IM) - where the moving piston directly strikes the vibrator anvil.

2. Air-Cushioned Pistons (AC) - where a small amount of residual air remains in the space between the piston and the anvil.

Impacting Pistons produce significantly more force than similar-sized Air-Cushioned models, but Air-Cushioned models are much quieter during operation. Typically, select one size larger Air-Cushioned model than the Impacting Piston if a quieter vibrator is preferred.

Use the Piston Vibrator Selection Guide on page 5 to determine which Piston Vibrator will work best in your application.

Refer to the Rotary Vibrator Selection Guide, on pages 6 & 7, for a quick recommendation on the vibrator size. Find the material weight and move across the chart horizontally to the recommended vibrator size.

When to Use More Than One Vibrator

Occasionally, two or more industrial vibrators may be required if:

1. Either the diameter of a hopper or the longest side of a hopper exceeds 10 feet (3.05 m).
2. When the amount of force needed to restore material flow exceeds the capacity of the preferred vibrator.
   a. Example – if the force required is 5,000 force-pounds (22.24 kN), two vibrators, each with a minimum of 2,500 force-pounds (11.12 kN) rating may be used.

The following are a couple examples on how to select and size an Industrial Vibrator.

Example A

Round Hopper

Diameter at Top – 8 ft (2.44 m)

Diameter at Discharge – 2 ft (.61 m)

Height of Sloped Portion of Hopper – 5 ft (1.52 m)

Bulk Material-Granulated Sugar – 45 lb per cubic foot

- Using the Global Calculator, we determine that there are 110 ft^3 of volume in the Sloped Portion of the Hopper, and that the bulk material weight is 4,948 pounds (2,244 kg).
- Since Granulated Sugar weighs less than 90 pounds per cubic foot and tends to flow freely, we will require only one pound of force per ten pounds of sugar (4,948 divided by 10 equals 495 pounds of force [2.20 kN]).
- Granulated Sugar is a relatively "fine material", so higher frequency vibration will be most effective.
- The hopper dimensions are not excessive, so one vibrator will be sufficient.
- Because High Frequency Vibration will be required, a Pneumatic Vibrator is preferred.
  - ◇ Ball Vibrator Options – US-38 or DS-51
  - ◇ Turbine Vibrator Options – SST-25

Example B

Square Hopper

Dimension at Top – 8 ft x 16 ft (2.44 m x 4.88 m)

Dimension at Discharge – 2 ft x 3 ft (.61 m x .91 m)

Height of Sloped Portion of Hopper – 10 ft (3.05 m)

Bulk Material-Gravel – 110 lb per cubic foot

- Using the Global Calculator, we determine that there are 539 ft^3 of volume in the Sloped Portion of the Hopper, and that the bulk material weight is 59,295 pounds (26,895 kg).
- Since Gravel weighs more than 90 pounds per cubic foot but tends to flow freely, we will require only one pound of force per eight pounds of gravel (59,295 divided by 8 equals 7,412 pounds of force [33 kN]).
- Gravel is a relatively "coarse material", so higher amplitude vibration will be most effective.
- The hopper dimensions are greater than the one vibrator capability, so more than one vibrator will be required.
- If a Hydraulic Vibrator is preferred:
  - ◇ Two Design Series C3-6-5HC (each producing up to 4,260 pounds of force [19 kN]).
- If a Pneumatic Vibrator is preferred:
  - ◇ Two Design Series C3-6-4AC (each producing up to 4,350 pounds of force [19 kN]).
  - ◇ Two TurboViber TV-7X (each producing up to 4,175 pounds of force [19 kN]).
- If an Electric Vibrator is preferred:
  - ◇ Three Quiet Thunder Electric DEG-2500 (each producing up to 2,630 pounds of force [12 kN]).

Customer Service

If you have questions or need more help please contact us. An experienced member of our Customer Service Team will be more than happy to assist you in selecting the best vibrator for your application.

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PISTON VIBRATOR SELECTION GUIDE

Bin Capacity	Bin Wall Thickness	Piston Size Recommendation			
lb	inches	Yellow Jacket®	Findeva	P-Series	Lube-Free
kg	mm				
200	1/16 - 1/8		FP-12*		FPLF-12-M
91	1.6 - 3.2				
400	1/16 - 1/8	YJ-1.00-AC	FP-18*	P1 AC	FPLF-18-M
182	1.6 - 3.2				
700	1/16 - 1/8	YJ-1.00-IM YJ-1.25-AC	FP-25-S	P1 IM P1 1/4 AC	
318	1.6 - 3.2				
1,000	1/16 - 1/8		FP-25-M FP-25-L		FPLF-25-M
455	1.6 - 3.2				
2,000	1/16 - 1/8	YJ-1.25-IM	FP-35*	P1 1/4 IM TMD 1 1/4 IM	FPLF-35-M
908	1.6 - 3.2				
2,000	3/16 - 1/4	YJ-1.50-AC	FP-50-M	P1 5/8 AC	FPLF-50-M
908	4.7 - 6.3				
4,600	3/16 - 1/4		FP-60-M		FPLF-60-M
2,091	4.7 - 6.3				
6,000	3/16 - 1/4	YJ-1.50-IM YJ-2.00-AC		P1 5/8 IM P2 AC	
2,724	4.7 - 6.3				
20,000	3/16 - 1/4	YJ-2.00-IM		P2 IM P2 IM TMD 2 IM	
9,080	4.7 - 6.3				
20,000	1/4 - 3/8	YJ-3.00-AC	FP-95-M	P3 AC	FPLF-95-M
9,080	6.3 - 9.5				
40,000	1/4 - 3/8	YJ-3.00-IM		P3 IM TMD 3 IM	
18,160	6.3 - 9.5				
40,000	3/8 - 1/2			P4 IM TMD 4 IM	
18,160	9.5 - 12.7				

* If there is a * next to a FP model (Findeva model) it means any variation of that particular size will work. For example you can use a FP-12-S, or FP-12-M, or a FP-12-L. The "S", "M", and "L" refers to the stroke or speed of the piston.

ROTARY VIBRATOR SELECTION GUIDE

Weight of Material in Sloped Portion of Hopper		PNEUMATIC ROTARY VIBRATORS						HYDRAULIC ROTARY VIBRATORS	ELECTRIC ROTARY VIBRATORS		
Pounds	Kilo-grams	Ball Vibrator	SILVER SONIC TURBINE	*TurboViber*® Turbine Vibrator		High Frequency Dual-Roller Vibrator	Motor-Driven Design Series Vibrator	Motor-Driven Design Series Vibrator	Single Phase	3 Phase	12V / 24V DC
350	159	BS-10	SST-12						QT2-80		
500	227	BS-13, US-13	SST-12						QT2-80		
750	340	BS-16, US-13	SST-12						DEG-161	DEG-161	
1,000	454	BS-19, US-19, CS-19	SST-12, SST-16						DEG-161	DEG-161	
1,500	680	BS-19, US-19, CS-19	SST-12, SST-16					C2-0.5-2HC	QT2-250	QT2-250	
2,000	907	BS-25, US-25, CS-25	SST-12, SST-16					C2-0.5-2HC	QT2-250	QT2-250	
2,500	1,134	US-25, CS-25	SST-16, SST-25					C2-0.5-2HC	QT2-500, DEG-451	QT2-500, DEG-451	
3,000	1,361	US-38, CS-35	SST-16, SST-25					C2-0.5-2HC	QT2-500, DEG-451	QT2-500, DEG-451	CEG-400
3,500	1,588	US-38, DS-41	SST-25					C2-1.0-2HC	QT2-500, DEG-901	QT2-500, DEG-901	CEG-400
4,000	1,814	US-38, DS-41	SST-25					C2-1.0-2HC	QT2-1000, DEG-901	QT2-1000, DEG-901	CEG-400
4,500	2,041	US-38, DS-51	SST-25					C2-1.0-2HC	QT2-1000, DEG-901	QT2-1000, DEG-901	CEG-800
5,000	2,268	US-44, DS-51	SST-25				C3-1.5-4AC	C2-1.4-2HC	QT2-1000, DEG-901	QT2-1000, DEG-901	CEG-800
6,000	2,722	DS-51	SST-25				C3-1.5-4AC	C2-1.4-2HC	QT2-1000, DEG-901	QT2-1000, DEG-901	CEG-800
7,000	3,175	Use more than one vibrator to achieve total force required.	SST-25				C3-1.5-4AC	C2-1.5-2HC	QT2-1000	QT2-1000	CEG-800
8,000	3,629		SST-35	TV-3X			C3-2.0-4AC	C3-2.0-2HC	Use more than one vibrator to achieve total force required.	DEG-1300	CEG-800
9,000	4,082		SST-35	TV-3X			C3-2.0-4AC	C3-2.0-2HC		DEG-1300	CEG-1200
10,000	4,536		SST-35	TV-3X			C3-2.5-4AC	C3-2.5-2HC		DEG-1300	CEG-1200
12,500	5,670		SST-35	TV-3X			C3-2.5-4AC	C3-2.5-2HC		DEG-2000	CEG-1800
15,000	6,804		SST-35	TV-5X	TCL-2500		C3-3.0-4AC	C3-3.0-2HC		DEG-2000	CEG-1800
17,500	7,938		Use more than one vibrator to achieve total force required.	TV-5X	TCL-2500	GCL-4400, GCD-4400	C3-4.0-4AC	C3-4.0-2HC		DEG-2500	CEG-2200
20,000	9,072			TV-5X	TCL-2500	GCL-4400, GCD-4400	C3-4.0-4AC	C3-4.0-2HC		DEG-2500	CEG-2800
22,500	10,206			TV-5X	TCL-2500	GCL-4400, GCD-4400	C3-5.0-4AC	C3-5.0-2HC		DEG-3000	CEG-2800
25,000	11,340			TV-7X	TCL-4000	GCL-4400, GCD-4400	C3-5.0-4AC	C3-5.0-2HC		DEG-3000	CEG-3600
27,500	12,474			TV-7X	TCL-4000	GCL-5000, GCD-5000	C3-6.0-4AC, D4.5-6-4AC	C3-6.0-2HC, D4.5-6-5HC		DEG-3500	CEG-3600
30,000	13,608			TV-7X	TCL-4000	GCL-5000, GCD-5000	C3-6.0-4AC, D4.5-6-4AC	C3-6.0-2HC, D4.5-6-5HC		DEG-3500	CEG-3600
32,500	14,742			TV-7X	TCL-4000	GCL-5000, GCD-5000	C3-6.0-4AC, D4.5-6-4AC	C3-6.0-2HC, D4.5-6-5HC		DEG-3500	CEG-4200
35,000	15,876			TV-7X	TCL-4000	GCL-5000, GCD-5000	C3-6.0-4AC, D4.5-6-4AC	C3-6.0-2HC, D4.5-6-5HC		DEG-3500	CEG-4200
Frequency (rpm) Range		3,100 - 22,000	8,500 - 40,000	9,000 - 14,000	10,500 - 14,500	7,600 - 15,400	2,700 - 5,650	Up to 5,000	3,450	3,450	3,450
		HIGH	VERY HIGH	HIGH	HIGH	HIGH	LOW - MEDIUM	LOW - MEDIUM	MEDIUM	MEDIUM	MEDIUM

The recommended vibrator shown in the Selection Guide is one of several vibrators that can be used. The force created by Pneumatic Vibrators or Hydraulic Vibrators can be adjusted by reducing or increasing the flow. Electric Vibrators have adjustable weight settings. Additional vibrators may be used if more force is required.

C3 Hydraulic Vibrators are available with 2HC (High Pressure - Low Flow) or 5HC (Low Pressure - High Flow) Hydraulic Motors. D4.5 and D7 Pneumatic or Hydraulic Vibrators are available with Clamp-type Mounting System (CC4.5 & CC7).
Single Phase Electric Vibrators are available in 115V and 230V models. Three Phase Electric Vibrators are available in 230V and 460V models. AC Electric Vibrators are available in 12V and 24V models.

ROTARY VIBRATOR SELECTION GUIDE

Weight of Material in Sloped Portion of Hopper		PNEUMATIC ROTARY VIBRATORS						HYDRAULIC ROTARY VIBRATORS	ELECTRIC ROTARY VIBRATORS		
Pounds	Kilo-Grams	Ball Vibrator	Silver Sonic Turbine	TurboViber® Turbine Vibrator		High Frequency Dual-Roller Vibrator	Motor-Driven Design Series Vibrator	Motor-Driven Design Series Vibrator	Single Phase	3 Phase	12V / 24V DC
37,500	17,010			TV-7X	TCL-6500	GCL-5500, GCD-5500	D4.5-8.0-4AC	D4.5-8.0-5HC	Use more than one vibrator.	Use more than one vibrator to achieve total force required.	CEG-4200
40,000	18,144			TV-7X	TCL-6500	GCL-5500, GCD-5500	D4.5-8.0-4AC	D4.5-8.0-5HC			CEG-4200
42,500	19,278			TV-7X	TCL-6500	GCL-5500, GCD-5500	D4.5-8.0-4AC	D4.5-8.0-5HC			Use more than one vibrator to achieve total force required.
45,000	20,412			Use more than one vibrator to achieve total force required.	TCL-6500	GCL-5500, GCD-5500	D4.5-10.0-4AC	D4.5-10.0-5HC			
47,500	21,546				TCL-6500	GCL-5500, GCD-5500	D4.5-10.0-4AC	D4.5-10.0-5HC			
50,000	22,680				TCL-6500	GCL-6500, GCD-6500	D4.5-10.0-4AC	D4.5-10.0-5HC			
52,500	23,814				TCL-6500	GCL-6500, GCD-6500	D4.5-10.0-4AC	D4.5-10.0-5HC			
55,000	24,948				TCL-6500	GCL-6500, GCD-6500	D4.5-10.0-4AC	D4.5-10.0-5HC			
57,500	26,082				Use more than one vibrator to achieve total force required.	GCL-6500, GCD-6500	D7-12-6AC	D7-12-8HC			
60,000	27,216					GCL-6500, GCD-6500	D7-12-6AC	D7-12-8HC			
62,500	28,350					GCL-6500, GCD-6500	D7-12-6AC	D7-12-8HC			
65,000	29,484					GCL-6500, GCD-6500	D7-12-6AC	D7-12-8HC			
67,500	30,617					GCL-6500, GCD-6500	D7-12-6AC	D7-12-8HC			
70,000	31,751					GCL-6500, GCD-6500	D7-12-6AC	D7-12-8HC			
72,500	32,885					GCL-6500, GCD-6500	D7-12-6AC	D7-12-8HC			
75,000	34,019					GCL-6500, GCD-6500	D7-12-6AC	D7-12-8HC			
77,500	35,153					Use more than one vibrator to achieve total force required.	D7-25-6AC	D7-25-8HC			
80,000	36,287						D7-25-6AC	D7-25-8HC			
82,500	37,421						D7-25-6AC	D7-25-8HC			
85,000	38,555						D7-25-6AC	D7-25-8HC			
87,500	39,689						D7-25-6AC	D7-25-8HC			
90,000	40,823						D7-25-6AC	D7-25-8HC			
92,500	41,957						D7-25-6AC	D7-25-8HC			
95,000	43,091						D7-25-6AC	D7-25-8HC			
97,500	44,225						D7-25-6AC	D7-25-8HC			
100,000	45,359						D7-25-6AC	D7-25-8HC			
110,000	49,895						D7-25-6AC	D7-25-8HC			
120,000	54,431						D7-50-6AC	D7-50-8HC			
130,000	58,967						D7-50-6AC	D7-50-8HC			
Frequency (rpm) Range		3,100 - 22,000	8,500 - 40,000	9,000 - 14,000	10,500 - 14,500	7,600 - 15,400	2,700 - 5,650	Up to 5,000	3,450	3,450	3,450
		HIGH	VERY HIGH	HIGH	HIGH	HIGH	LOW - MEDIUM	LOW - MEDIUM	MEDIUM	MEDIUM	MEDIUM

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