

Industrial Vibrator Sizing Guide

Sizing Guide for Air and Electric Powered Vibrators for Hoppers, Bins and Chutes

I. Air Vibrator Selection

A single vibrator will normally provide the necessary force to move materials from most hoppers and bins. The single vibrator installation requires that the force of vibration be transmitted to full 180° right and left of the vibrator mounting location. However, due to the special configurations of some hoppers, their construction or wall thickness or the characteristics of the material itself (sticky, lightweight, large particles, moisture, etc.), consideration should be given to the use of multiple smaller vibrators that are evenly arranged around the hopper in place of one large vibrator.

The maximum number of multiples is three vibrators mounted 120° apart, or two vibrators mounted 180° apart. Greater distribution of vibration will result and assurance that all areas will be vibrated equally. This arrangement is of particular importance when attempting to move material from long rectangular shaped hoppers or from hoppers with a very shallow taper at the discharge.

AIR VIBRATOR SIZING CHART FOR BINS AND HOPPERS			
Bin Capacity lbs/kg or ton/MT	Approximate Skin Thickness of Bin in/mm	Impact Vibrator Size	Non-Impact Vibrator Size
100 lbs 45 kg	1/8" or less 3.2 mm	VM-25	CVT-P-1
200 lbs 90 kg	1/8" or less 3.2 mm	VM-38	CVT-P-10
300 lbs 136 kg	1/8" or less 3.2 mm	1/2" SA-EP	CVT-P-30, CVT-P-22 or 3/4" ACM
500 lbs 226 kg	1/8" 3.2 mm	1" SA-EP	CVT-P-30, CVT-P-22 or 1125 VMSAC
700 lbs 317 kg	1/8" 3.2 mm	1125 VMS/VMR	CVT-P-50, CVT-30 or 1150 VMSAC
1 ton 0.9 MT	1/8"-3/16" 3.2 mm-4.8 mm	1150 VMS	CVT-P-60, CVT-40 or 1200 VMSAC
3 ton 2.7 MT	3/16"-1/4" 4.8 mm-6.4 mm	1200 VMS/VMR	CVT-80 or 1300 VMSAC
20 ton 18 MT	5/16"-3/8" 7.9 mm-9.5 mm	1300 VMS	1350 VMSAC
50 ton 45 MT	3/8" 9.5 mm	1350 VMS	1400 VMSAC
100 ton 90 MT	3/8" 9.5 mm-12.7 mm	1400 VMS	1500 VMSAC
100 ton and up 90 MT and up	3/4"-1" 19.1 mm-25.4 mm	1500 VMS	1700 VMSAC

A. Installation

The mounting of a vibrator on a length of channel which is stitch welded vertically to the side of a hopper will provide a transmission line above and below the vibrator and will also reinforce the hopper wall as well. The width of the channel should be to suit the base dimensions of the vibrator. The length will also vary with the hopper size, however, a good rule to follow is that the channel be one-third the length of the sloping section of the hopper.

B. Moisture Content

Moisture content of the material to be moved is also important in the sizing of a vibrator. If the moisture content is 6% or more, it is advisable to use the next size vibrator or two vibrators.

C. Force Output Adjustment

All vibrators provide a range of adjustability in their force output. Air vibrators can be adjusted with a simpler air regulator; electric vibrators with adjustable eccentrics; or others with SCR controls. In selecting a vibrator, remember that it can be adjusted due to changes in material make-up, lower hopper contents, or vibrator over sizing.

D. Non-Impact Adjustments

There is a reduction in vibration intensity in the non-impacting type vibrators (air-cushioned piston, rotary electric, turbine and ball) over the impacting piston vibrator. For piston vibrators, to achieve comparable results, the next size non-impacting vibrator should be used.

E. Operation Effectiveness

A short burst of vibration is normally more effective than continuous vibration. Do not operate vibrators against closed hopper gates or valves.

F. Noise Levels

Noise level of vibrators varies with the type. A general ranking from loudest to quietest is as follows: impact, ball, air-cushioned, rotary electric and turbine.

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II. Rotary Electric Selection

The sizing of rotary electric vibrators is based on the ratio of material weight in the sloped wall section to the force output of the vibrator. For the majority of applications, the ratio should be one pound of vibratory force for every ten pounds of material in the sloped wall section of the hopper.

The 3600 RPM rotary electric vibrator units are used for the majority of applications and are well suited for materials which are in the "free flowing" to "difficult to flow" range. For particularly stubborn materials, the 1800 RPM units will provide greater amplitude than a 3600 RPM unit of the same force output. When selecting an 1800 RPM rotary electric vibrator, use the chart to determine the proper size 3600 RPM vibrator, then select the 1800 RPM unit which develops the same force output.

To determine the weight of material in the sloped wall section, multiply the bulk density of the product by the volume (in cubic feet) of the hopper section.

To calculate the volume of a conical hopper:
 $1.0472 \times \text{vertical height} \times [R^2 + (R \times r) + r^2] = \text{Volume}$,
 where R is the radius of the cone at the transition point and r is the radius of the cone at the discharge.

To calculate the volume of a rectangular or square hopper:
 $\text{Vertical height} / 3 \times (B + (B \times b)^{1/2} + b) = \text{volume}$ where B is the area at the transition point and b is the area at the discharge.

Most bin or hopper applications will require only one RE rotary electric vibrator. Cleveland Vibrator Company recommends mounting the single drive, locating the unit at a point on the sloped wall section that is 1/3 the height of the wall.

Applications involved with particularly stubborn material or hoppers larger than 100 ton capacity may require two or more vibrators. The recommended mounting is shown in figures 2 and 3. Normally, not more than three rotary electric vibrators would ever be required on a hopper or bin.

ROTARY ELECTRIC SIZING CHART FOR BINS AND HOPPERS		
Maximum Material in Sloped Wall Section	Cleveland Vibrator Company Model	Normal Wall Thickness
1,100 lbs 498 kg	RE 0.5-2	16 to 20 gauge 1.31 to 0.52 mm ²
2,200 lbs 997 kg	RE 1-2	1/8 to 3/16" 3.17 to 4.76 mm
4,400 lbs 1995 kg	RE 2-2	3/16 to 1/4" 4.76 to 6.35 mm
7,700 lbs 3,492 kg	RE 3.5-2	3/16 to 1/4" 4.76 to 6.35 mm
13,200 lbs 5,987 kg	RE 6-2	1/4 to 3/8" 6.35 to 9.52 mm
22,000 lbs 9,979 kg	RE 10-2	3/8 to 1/2" 9.52 to 12.7 mm
35,200 lbs 15,966 kg	RE 16-2	1/2 to 3/4" 12.7 to 19 mm
50,600 lbs 22,951 kg	RE 23-2	3/4 to 1" 19 to 25.4 mm
66,000 lbs 29,937 kg	RE 30-2	1 to 1-1/4" 25.4 to 31.7 mm
88,000 lbs 39,916 kg	RE 40-2	1-1/4 to 1-1/2" 31.7 to 38 mm

The information contained in the charts in this sizing guide is the result of decades of field experience. It is a reasonably accurate approach to giving you quick information to vibrator sizing on a hopper, bin or chute. Recommended vibrator sizes are predicated on a dry granular material weighing 100 lbs. per cubic ft. Considerations to other characteristics are mentioned previously.