ON-LINE MANUAL
Introduction

Note: This manual was created to assist Findeva's agents, representatives and end users in the installation and use of Findeva external vibrators. Since there is an enormous variety of applications and installation procedures, this manual can only show some basic concepts and does not claim to be complete nor free of errors.
We will attempt to update it regularly. We do appreciate any criticism, comments and suggestions.

IMPORTANT INFORMATION

The installation and initial operation of pneumatic motors such as pneumatic vibrators must be carried out by trained personnel only.

Danger of Injury

Units such as vibrators, filters, lubricators and the air supply lines may be under extremely high pressure. Before carrying out maintenance or installations first **DISCONNECT THE LINE** from the main air supply and bleed off all pressure. Air power may create excessive noise levels. Wear **EAR PROTECTION** in the operation field of pneumatic vibrators.

Observe Local Laws and Regulations

Make sure your installations and operations of pneumatic systems are in accordance with national and local laws and prescriptions.

ON-LINE MANUAL
General Information

1. General information on pneumatic external vibrators

1.1. Introduction
This manual contains information on the two main types of vibrators:

- **Rotary vibratord** (ball, roller and turbine vibrators)
- **Linear piston vibrators**

Historical Background...
Even today in some areas of the globe, just as it was centuries ago, the hand driven stamper still is very common as a tool to compact concrete in molds. Similarly, the sledge hammer is the tool used to support the material flow.

Screens to separate chaff from corn are known to be the first vibrating application "industrialized", i.e. the first vibrating element driven by non-human energies such as water and wind.

Pneumatic driven vibrators were introduced early this century as linear piston vibrators or pneumatic hammers. Only years later was the simpler rotary vibrator with a ball or a roller running circle born. For decades this design has not been changed. The body was and still is made by many manufacturers of cast iron and the outside surface is not machined.

At the end of the sixties, the first experiments with aluminum bodies were conducted. Aluminum is very simple and clean to machine, with no black casting dust that covers machines and the hands of the end users. Aluminum has the strength required but is not too stiff to allow cracks to form. It can be coated with paint so that modern industrial designs can be created. For applications in special environments such as pharmaceutical installations bodies are machined from stainless steel.

Today, a vast amount of work is done by vibrators. The main applications are emptying bins and hoppers, screening materials, and compacting concrete as well as feeding sand, clay, or any kind of powder or small parts such as screws. Vibration is also used in the electronics industry to detect cold joints on printed circuit boards.

In silo and bin applications air blasters are used to loosen bulky materials. Most of our agents and representatives sell air blasters as well as vibrators since the products complement each other.

1.1.1. Classification of vibrators
Vibrators can be classified in general according to the type of energy they use and the vibration technology :

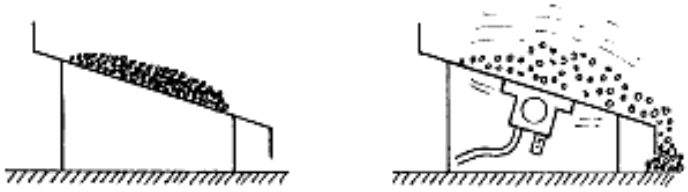
Energy Type	Technology
Electricity	Rotary / Linear / Magnetic
Pneumatic	Rotary / Linear
Hydraulic	Rotary

1.2. Basic Information On Pneumatically Driven Vibrators
1.2.1. What is a vibrator good for?

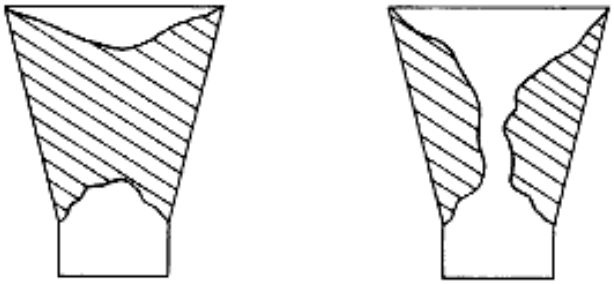
As previously stated, with the help of vibration any kind of bulky material can be fed, compacted or separated. In most cases vibration supports the force of gravity. For instance, bulky material may "hang" and clog in a hopper because of moisture. Vibration can loosen the material so the force of gravity can continue to move material through the hopper.

Another application for vibrators is their use with concrete. Vibrating concrete means to shake the sand and gravel particles so that they find the most compact volume possible, with no space available for air. Gravity is responsible for the first line in compacting but the vibration supports and improves it very much.

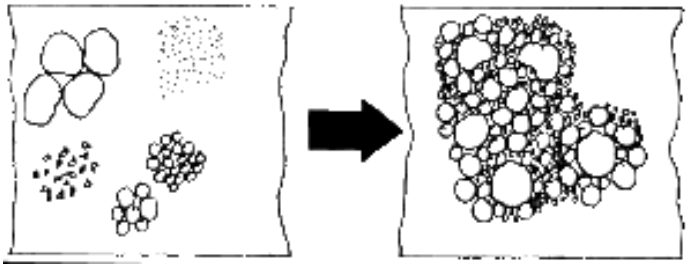
In both the cases vibration will reduce friction of the material.



Vibrating and gravity

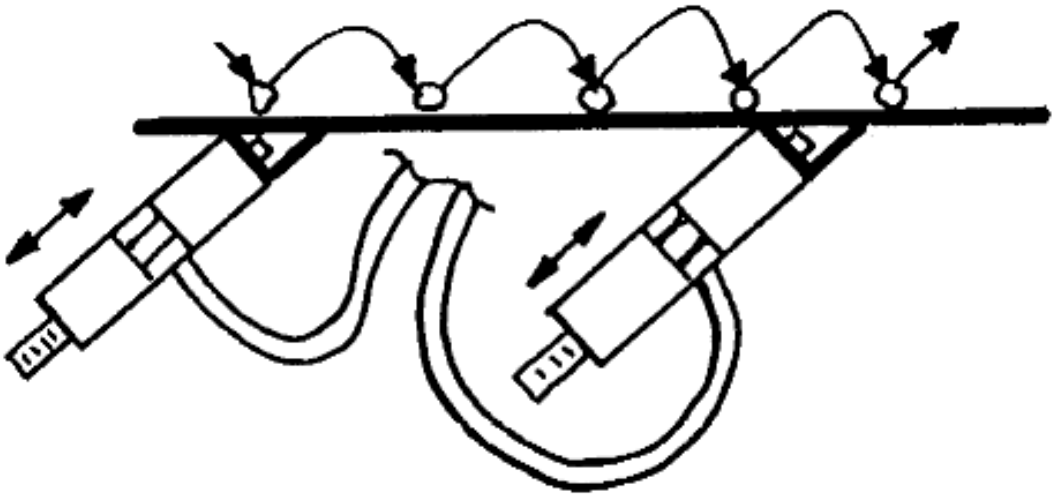


Bridging and ratholing



Compacting of concrete

Vibration does not necessarily suppor the force of gravity. Vibration makes material "jump" and gravity brings it back to the channel or chute. With the help of linear vibrators the direction of the material jump can be defined, and by adjusting the amplitude the length of the jump can be varied. When the chute slopes downward, rotary vibrators can be used as well.



Feeding of materials

1.2.2. Basic information

One thing is most important to know when dealing with any kind of vibrators: You can certainly calculate natural frequencies of materials, silos, chutes, etc., but in reality your results will never be exactly as calculated.

There are tables and even calculation schemes available to correctly select and position vibrators with respect to a wide range of force and frequency. However, the "fine tuning", that is, the optimal adjustment of the vibrator, is a matter of practical trials and tests. Field engineers with some experience may immediately select the best type of vibrator as well as the optimal mounting site.

There are some rules of thumb and tables given under "Selection of the Optimal Vibrator Type".

To be able to perform optimal tuning of the vibrator, it is recommended that you put an air line regulator or a needle valve in the air pressure line so the air flow and the air pressure can be controlled.

Finding the natural frequency of the material that is to be fed, compacted or separated is the best way to tune or adjust the vibrator.

The operational frequency range of pneumatic external vibrators is from 2,000 r.p.m. up to about 20,000 r.p.m. or about 35 to 350 Hz. The values given in the technical data sheet were obtained when the vibrator is mounted to a heavy lab test block, when the vibrator is not actually working, that is, the amplitude is zero, but the frequeny speeds 2 to 3 times higher than when mounted to an object.

Often the natural frequency of the material is out of the operational frequency range of a vibrator. Thus, a more powerful vibrator has to be used to do the job.

It is not necessary for the vibrator to run at full power to perform at its best. It is recommended that you operate a new vibrator at ¾ of its maximum power so that if power is lost over time due to abrasion, aging, etc., the frequency can be increased to compensate properly.

NOTE:

The pneumatic rotary and linear vibrator must not be operated with more than 7 bar (100 PSI) operating pressure.

ON-LINE MANUAL
Pneumatic Requirements

2. Pneumatic Requirements

2.1. Air Consumption and Air Compressors

The air consumption, especially the average air consumption, of a vibrator system is the basis for calculating the size of the air compressor needed.

In the following table the air consumption in liters per minute for 2 and 6 bar air operating pressure are given. The values may vary about 10 % due manufacturing tolerances.

Fig. 2.1. Air consumption [liters per minute] of the FINDEVA vibrators

Type	2 bar	6 bar	*	Type	2 bar	6 bar	*	Type	2 bar	6 bar
K-8	83	195	*	R-50	100	195	*	DAR-2	70	200
K-10	92	200	*	R-65	200	400	*	DAR-3	100	300
K-13	94	225	*	R-80	290	570	*	DAR-4	120	360
K-16	122	280	*	R-100	370	730	*	DAR-5	130	390
K-20	130	340	*	R-120	500	970	*	DAR-6	170	470
K-25	160	425	*				*	DAR-7	180	500
K-30	215	570	*				*			
K-36	260	675	*				*			

Type	2 bar	6 bar	*	Type	2 bar	6 bar	*	Type	2 bar	6 bar
GT-4/6	33	83	*	T-50-LP	70	165	*	FP-12-S	1	25
GT-8/10	46	112	*	T-50-HP	80	190	*	FP-12-M	1	20
GT-13/16	120	390	*	T-65-LP	90	240	*	FP-12-L	1	20
GT-20/25	185	455	*	T-65-HP	110	290	*	FP-18-S	5	57
GT-30/36	330	745	*	T-80-LP	150	290	*	FP-18-M	4	25

GT-40/48	425	970	*	T-80-HP	150	390	*	FP-18-L	5	46
			*	T-100-HP	200	390	*	FP-25-S	13	93
								FP-25-M	23	87
								FP-25-L	18	93
								FP-35-S	23	162
								FP-35-M	24	141
								FP-35-L	38	135

2.1.1. Calculation of the average air consumption

FORMULAS	1. Air Consumption according to table 2.1. : CONS. = ... liters / minute
	2. Operating Factor (On/Off) x 100% : OPF = ... %
	3. Average Air Consumption = CONS x OPF : ACON = ... liters / minute
	4. Total Average Consumption = ACON x NUMBER OF UNITS DRIVEN

To get the average consumption of several vibrators and/or other air consumers connected to the same supply pipe, multiply the Average Air Consumption by the number of units if the air consumption is the same. If the air comsumption is not the same, do the calculation for every consumer separately and add the results.

To determine the size of the air compressor required it is recommended to add about 20 % as a safety figure to the above calculated demand since the values given may vary. Also, leaks or additional installations may require a larger compressor. Extra power for future installations may also be necessary.

To define the air compressor size required another figure is necessary. It is the highest consumption at any given time. This figure can be estimated taking the air consumption of all units that may be in operation at the same time and the length of this period :

Highest Air Consumption =Number of units x CONS for .... minutes

= ..... liters / minute during ..... minutes

Both the volume of the highest air consumption as well as the average consumption of the system should be used to determine the proper compressor.

2.2. Lubrication

Dry or not dry ? This is an important question. Generally speaking, lubrication always increases the lifetime of moving parts since it significantly reduces friction. But, lubricating ball vibrators is a waste of lubricants because it will not visibly increase the vibrator’s lifetime whereas dry running T-turbine ball bearings will fail quickly.

Thanks to special material and treatments (teflon-coating, etc.) the operating friction can be minimized so that piston vibrators (FP-series) and DAR-vibrators alike have very good emergency running properties. Still, after time, lubrication becomes necessary to avoid increased abrasion..

The question of how many drops of oil per minute are sufficient or how many are too much cannot be answered in general. It is possible that a reciprocating or piston air compressor supplies sufficient oil in the air so that the use of a lubricator is not necessary. Unfortunately, the same compressor type may supply too much machinery oil if the leakage is too great which causes the DAR-series to decrease in frequency and force due to oil gumming. On the other hand, air compressors with built-in air dryers require a line lubricator to keep T-turbine, DAR- and FP-vibrators from wearing out quickly.

IMPORTANT: For lubrication of FINDEVA vibrators use oil with the viscosity:
ISO VG 5 with 5cSt/40°C (5 centistokes or approx. 42.4 Susec or 5 cm2 sec2)

The oil needs to be non gumming. Some examples are listed below :

- Shell Tellus Oil C5
- Esso Nuto H5
- Mobil Velocite No.4
- BP Energol HP 5
- For food applications : Mobil Whiterex 304 (vegetable base)

NOTE: Oil with viscosity other than recommended will reduce frequency and power! For FP-piston vibrators only, distilled water may be used instead of oil with the same lubrication effect. Adjust the lubricator to 10 drops per minute at minimum.

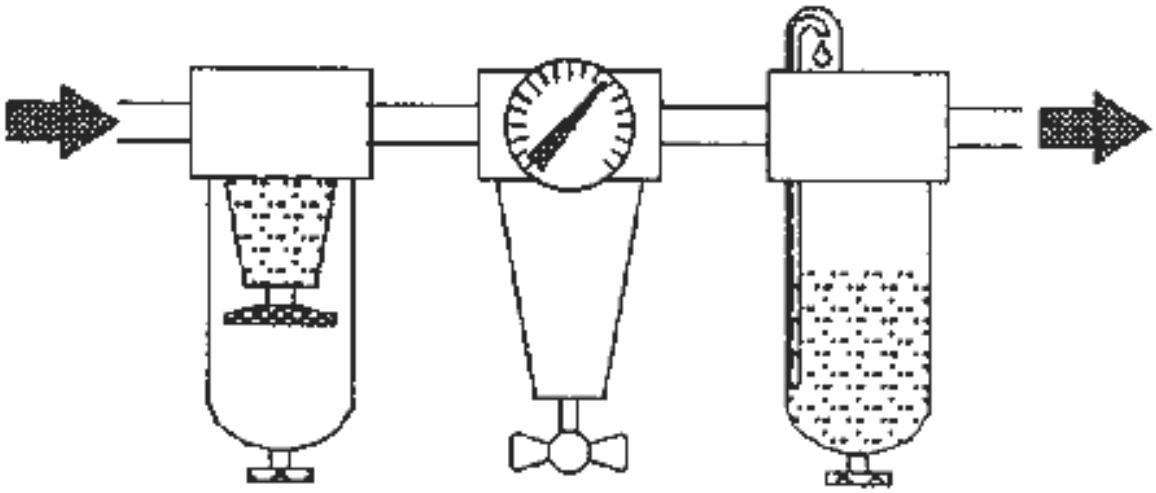
As line oilers, "drip feed" lubricators provide better results than "wick oilers". Check the silencer for oil trace and adjust the lubricator for minimal, but not completely without, trace. Too much lubrication will lead pistons and rollers to clog and should therefore be avoided.

2.3. Air Filters and Pressure Regulators

All air compressors are equipped with air filters to protect the compressor valves. This compressed air is clean enough to be used in all of our rotative vibrators. Small dirt particles will be blown through, but we strongly recommend the use of an air line filter of 5 micrometers or less. This will help to prolong the lifetime of the vibrator.

NOTE: For FP-piston vibrators the use of 5 micrometer filters is strongly recommended due to the small tolerance between piston and bore.

The air filter must be installed close to the vibrator to avoid rust particles from iron pipes reaching vibrator. It is advisable to connect the filter, air pressure regulator and lubricator in line as shown.



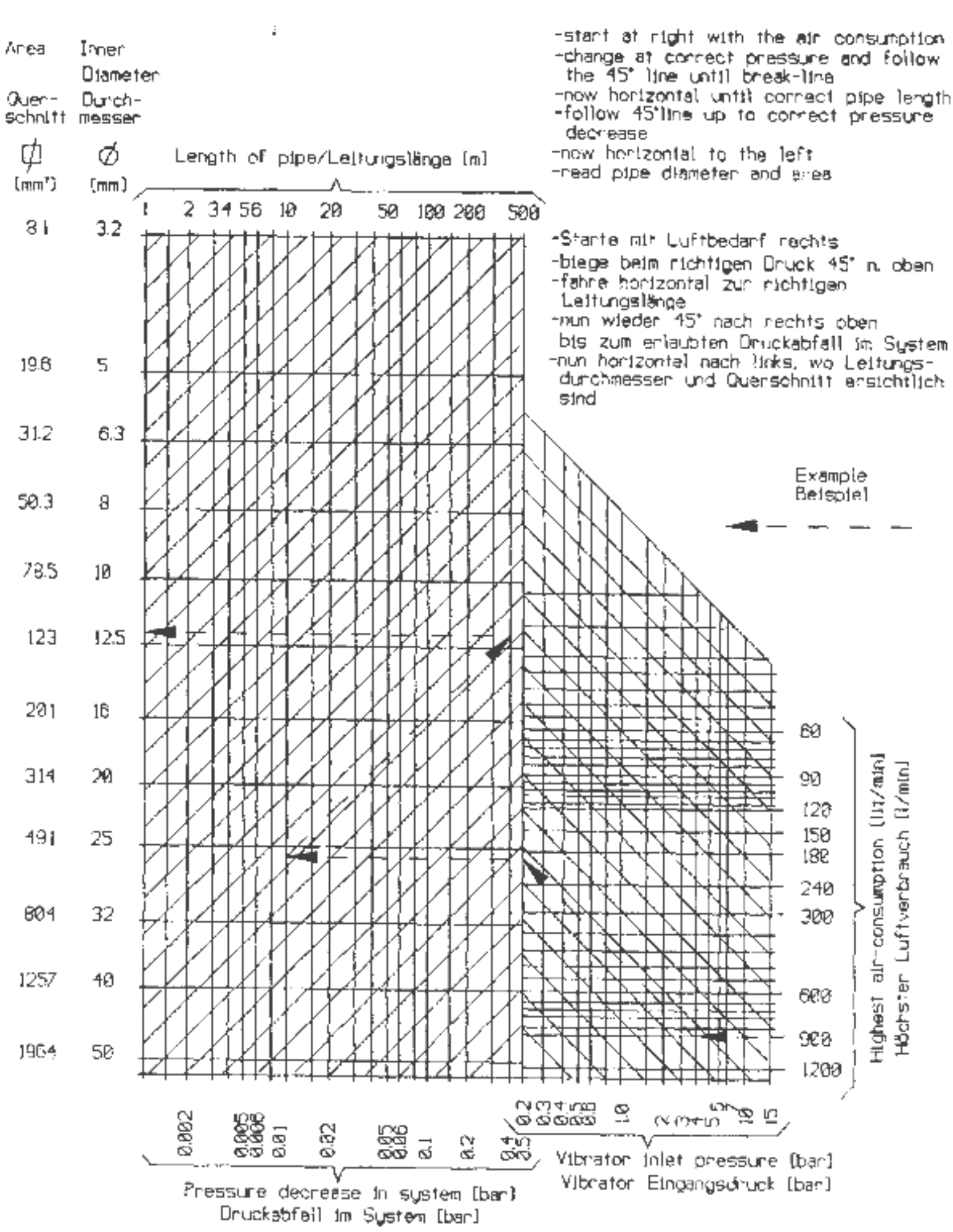
Correct installation : filter, then regulator and lubricator.

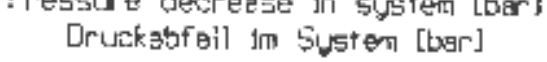
2.4. Air Pressure Pipes

It is of course possible to adjust the vibrator by decreasing or increasing the air pressure or the air volume. However the supply and the exhaust-pipes have to be dimensioned correctly. If the ratio of these tubes is too small, the vibrator will not be able to run at full power.

The exhaust pipe should be as short as possible because the volume of the exhausted air (expanded) is many times greater than the pressure difference.

The respective formula is V(in) x P(in) = V(out) x P(out) where P is the absolute pressure and not only the overpressure. Therefore, it can be shown easily that when running a vibrator at 6 bar (overpressure) the exhaust air volume is 6 times the air pressure inlet volume.


Area
Inner Diameter
Quer-schnitt
Durch-messer
Length of pipe/Leitungslänge [m]
1 2 3 4 5 6 10 20 50 100 200 500
(mm²)
(mm)
8
3.2
19.6
5
31.2
6.3
50.3
8
78.5
10
123
12.5
201
16
314
20
491
25
804
32
1257
40
1964
50
-start at right with the air consumption
-change at correct pressure and follow the 45° line until break-line
-now horizontal until correct pipe length
-follow 45°line up to correct pressure decrease
-now horizontal to the left
-read pipe diameter and area
-Starte mit Luftbedarf rechts
-biege beim richtigen Druck 45° n. oben
-fahre horizontal zur richtigen Leitungslänge
-nun wieder 45° nach rechts oben bis zum erlaubten Druckabfall im System
-nun horizontal nach links, wo Leitungs-durchmesser und Querschnitt ersichtlich sind
Example
Beispiel
60
90
120
150
180
240
300
600
900
1200
Highest air-consumption [lit/min]
Höchster Luftverbrauch [l/min]
0.002
0.005
0.008
0.01
0.02
0.05
0.06
0.1
0.2
0.4
0.5
0.2
0.3
0.5
0.6
0.8
1.0
2
3
4
5
6
10
15
Pressure decrease in system [bar]
Druckabfall im System [bar]
Vibrator inlet pressure [bar]
Vibrator Eingangsdruck [bar]



Graph to determine diameter and area of air pipes

An exhaust pipe that is too long or too short will hinder the air movemnt in such a way that all of the air pressure cannot be transformed in the vibrator into vibrating energy.

Using the silencer mounted directly onto the vibrator is the best way to gain as much power as possible. Since the question of correct pipe diameter is of importance, the above graph can be used to determine the required value.

EXAMPLE The air consumption is 900 liters per minute at 4 bar pressure.
The pipe length is 10 meters.
So start at the right side with 900 to the left until 4 bar line. Now follow 45° up until the break line. Then go straight to the left until 10 meter line, then 45° up to the right until the desired line of maximum pressure loss allowed in the system. The inner diameter and the area can be seen at the left now.

NOTE: The pressure loss in the pipe should not be more than 0.5 bar; however, it does not make sense to minimize this value too much since this will increase the size and the cost of the pipes required. A value between 0.1 and 0.5 bar will be OK.

The required size of the exhaust pipes can be determined the same way. Use the vibrator inlet pressure nomogram lines but instead of inlet pressure use exhaust pressure that is about 0.2 to 0.5 bar.

2.5. Air Valves and Pressure Regulators

2.5.1. Pressure regulators

With the help of a pressure regulator (a needle valve, for example), the vibrator can be adjusted to its best working conditions. The adjustable flow volume influences vibration frequency and energy.

We recommend installing the pressure regulator between air filter and lubricator to get best results.

2.5.2. Air valves

For some applications like emptying bins and hoppers it is advisable to use the vibrator intermittently. To do so you may place a solenoid valve after the lubricator. Do not put the solenoid valve in line before the regulator and lubricator because then the regulator has to upstart every time and the air pressure is not available immediately. This could cause the vibrator to malfunction. It also is recommended that you place the valve as close as possible to the vibrator.

NOTE: Do not place supporting devices such as air filters, pressure regulators, lubricators, etc. on a vibrating mount. This will cause devices to malfunction.

CAUTION: Make sure the inner width of the valve is large enough. (See Nomogram to determine diameter and

area of air pipes.) Otherwise, the vibrator will not run at full vibrating energy, and piston vibrators eventually experience difficulty starting properly.

It is also possible that piston vibrators will not start when the valve is manually driven because for a proper start the piston needs to be supplied with full pressure right from the beginning. When manually driven try to open the valve as quickly as possible or make use of solenoid valves.

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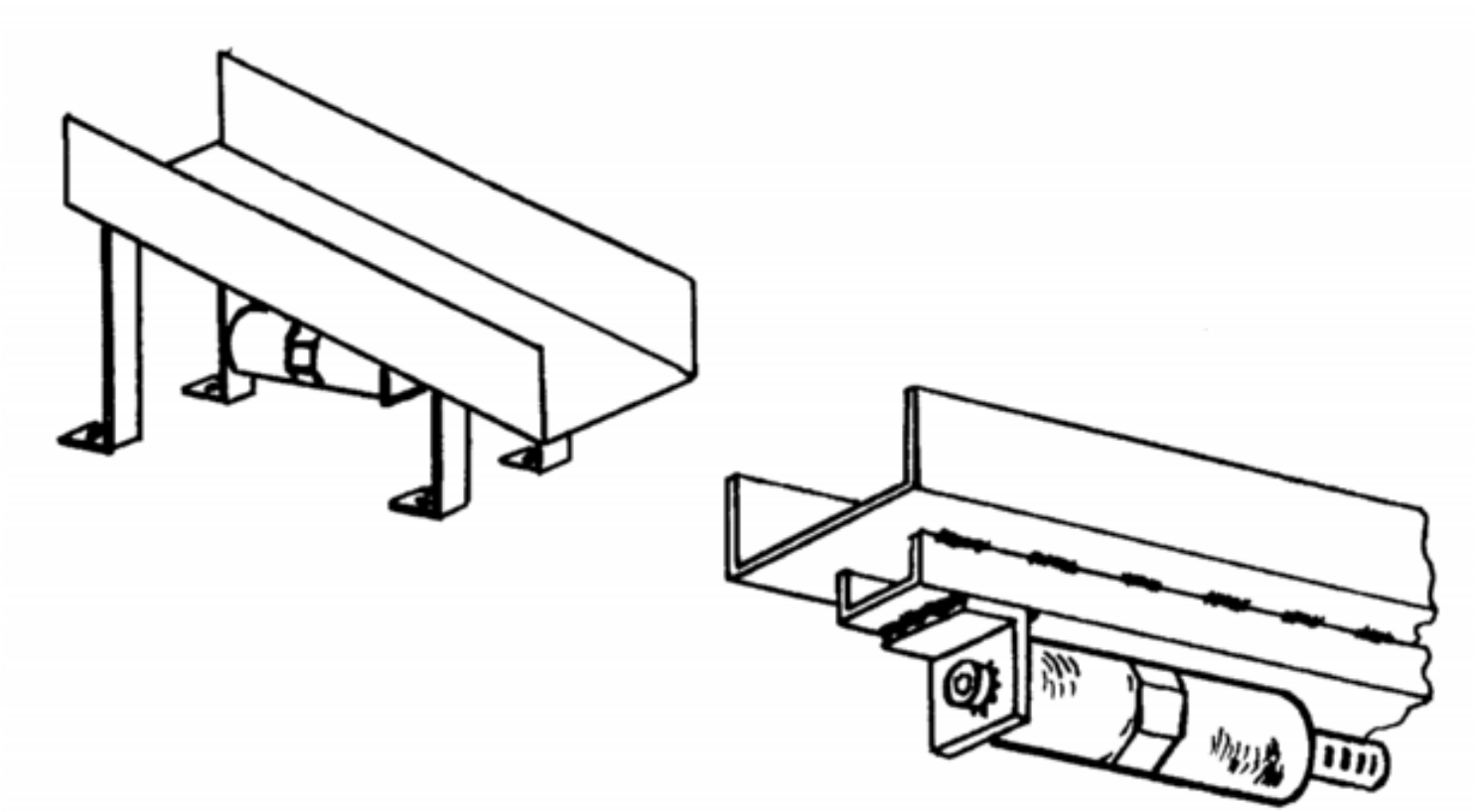
ON-LINE MANUAL
Mounting

3. Where and how to attach the vibrator

3.1. Linear Piston Vibrators

These vibrators are used mainly for feeding applications. The most common feeder forms are channels, chutes and spiral chute feed hoppers. Piston vibrators are not recommended for emptying bins and hoppers since they produce impacting energy that moves bin walls back and forth which can cause oil canning problems as greater force is needed to make material flow. The impact and the force may cause structural damage to the bin also. The FP-series are non-impacting.

3.3.1. Chutes



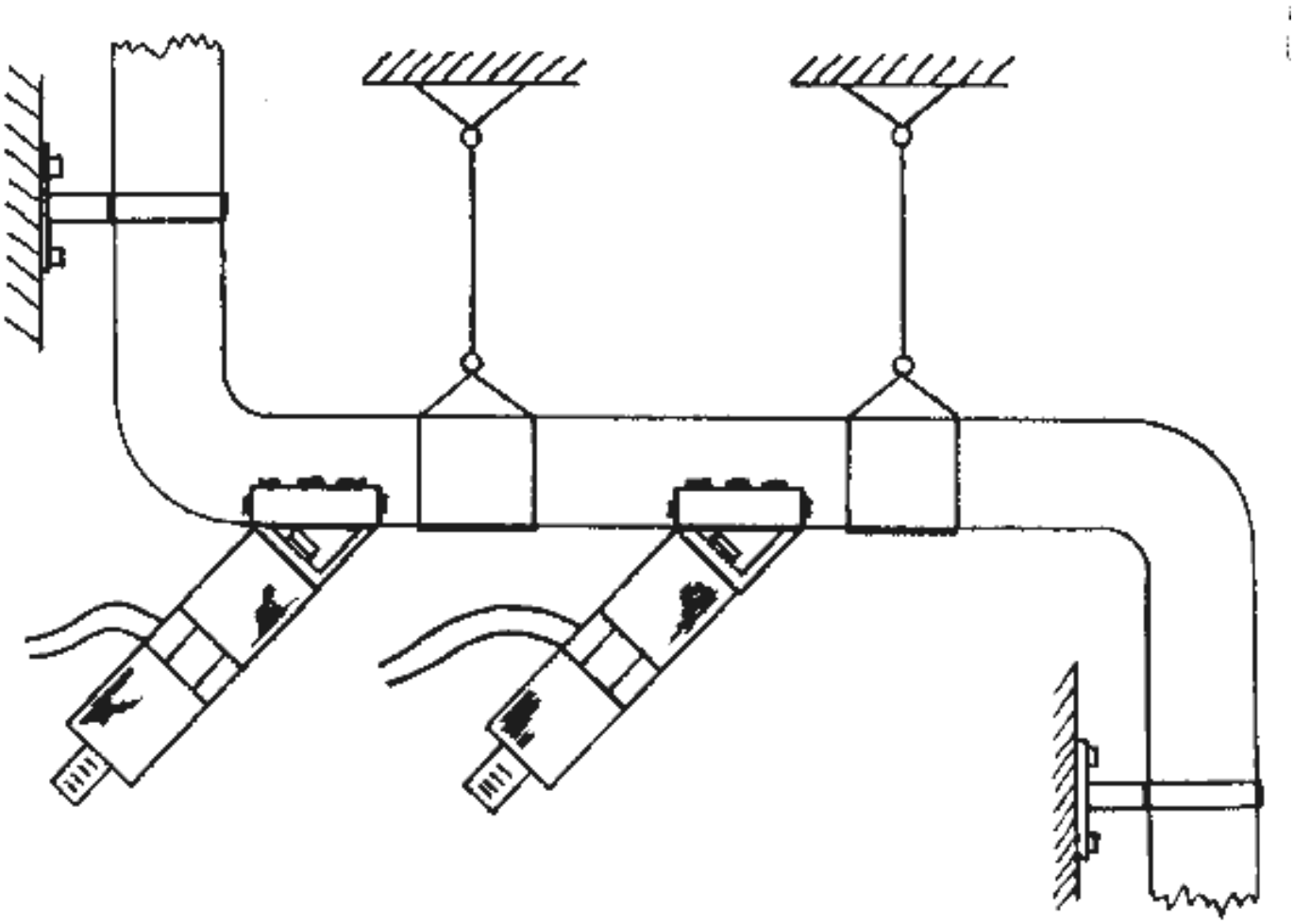
Chutes

Feeding materials in chutes consists mainly of aiding gravity's natural force, since chutes, in most cases, are mounted with a downward slope. To allow the vibrator to function properly, the chute should be suspended on laminated iron springs, fiber springs or rubber elements. The vibration direction should be horizontal only.

Make sure the vibrator is mounted rigidly to the chute. If the chute base is not stiff enough the vibrator should be mounted

on a stiffening channel or U-shaped iron running the full length of the chute.

3.1.2. Channels and tubes



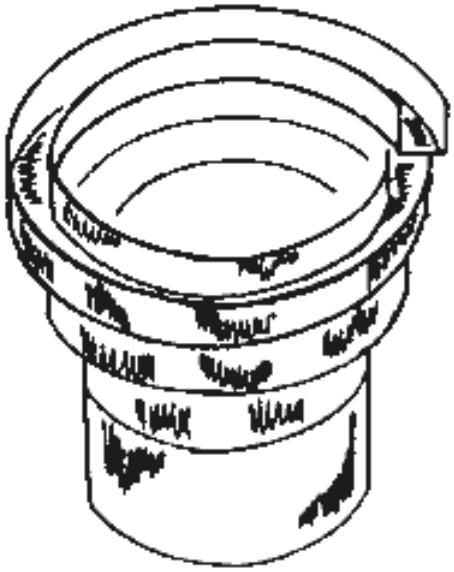
Channel

Channels or tubes like the one shown above are used to feed fine materials such as chemical powder, flour, or sugar between silos and production machines. The advantage is that the material does not come in contact with anything other than the channel which can be made out of chemical resistant material. This satisfied regulations regarding cleanliness and non-contamination in food and pharmaceutical industries.

The vibrators are mounted with a 45° angle which causes the powder material to be pushed forward. If necessary additional transversal rib elements can be fixed in the channel, so even upward slope does not hinder the feeding.

It is important to insure that the channel is stiff but not mounted too rigidly. It is possible to use several piston vibrators in line if the channel is long, but they have to be of the same type and model so that they will operate at the same frequency and phase assuming the channel is stiff. The channel itself can be stiffened by welding a small channel with heavy wall thickness to the outside of the channel or tube. Please note that the ends of such stiffener channels must not be welded for the first 3mm.

3.1.3. Spiral chute feed hoppers



Spiral chute feed hopper

Spiral chute feed hoppers are used whenever small bulky parts have to be feed automatically into machines. They often include a system to position parts in a certain way when they are fed into the machine.

Normally, spiral chute feed hoppers are driven by electrical, rotary or electromagnetic vibrators. Pneumatic piston vibrators are advantageous for saving space while keeping high vibration power.

The spiral chute should be mounted on laminated springs or rubber elements. Two vibrators should be mounted opposite each other to get an imaginary vertical fulcrum. The exact mounting angle of the vibrators must be obtained by practical tests, but an angle of 45° to the chute base line is normally a good value.

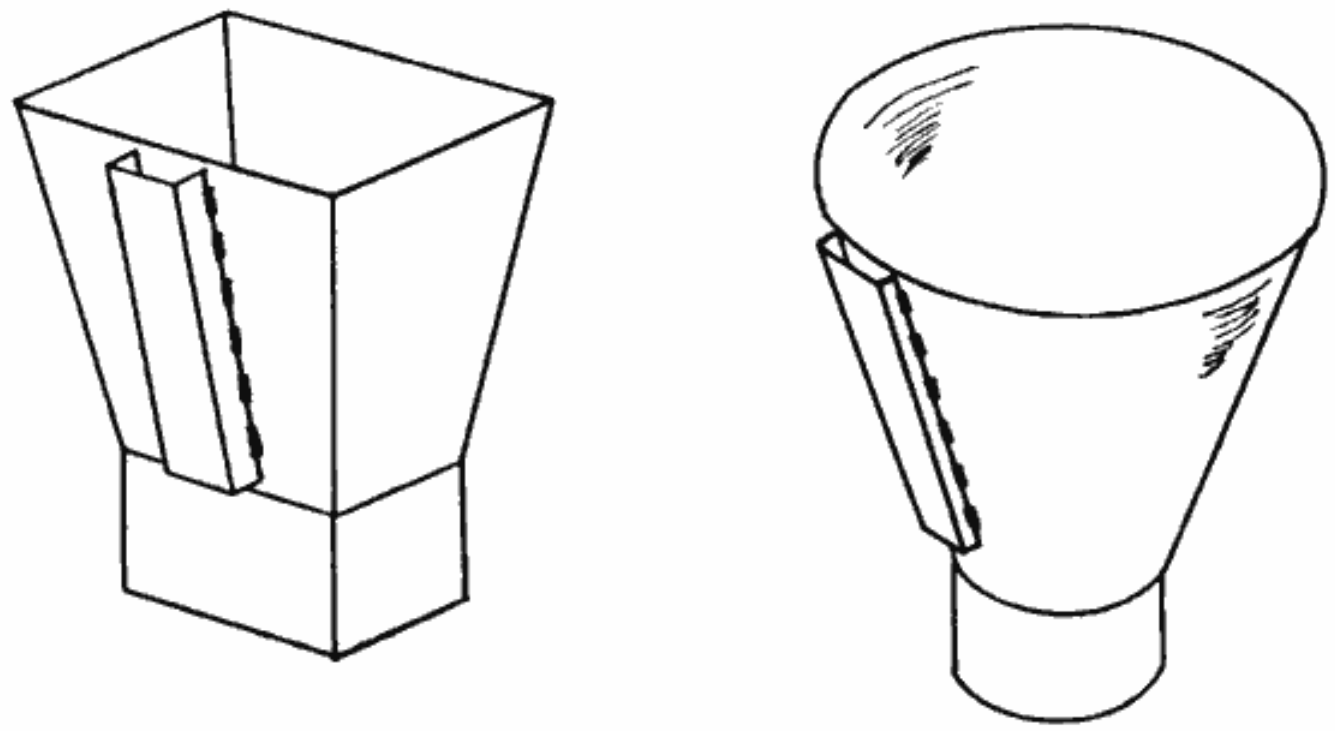
3.2. Rotary Vibrators

Rotary vibrators produce a sinusoidal vibration. This type of vibrator is much more efficient in bringing materials into resonance than the linear vibrators. The frequency of a rotary vibrator can be adjusted in a wide range by using a pressure or flow regulator.

Rotary vibrators are used mainly to separate or compact materials. One common application is emptying bins, silos, and hoppers. The function of the vibrator in separation applications is to separate clogged material to free it. Once it is freed it moves downward by the force of gravity.

Rotary vibrators can be used for feeding materials similarly to linear ones. Since piston vibrators do not create strong forces, larger rotary vibrators are commonly used for feeding heavier materials like gravel in chutes and for screening materials which respond better to sinusoidal vibrations than impact vibrations.

Linear vibrators are not effective in compacting concrete. The unidirection motion will compact when moving forward and separate while moving backwards. To compact concrete two types of rotary vibrators are used, namely, internal and external vibrators. Internal vibrators are sometimes called poker vibrators. That are dipped into concrete, and a needle containing a rotary mass is driven electrically, pneumatically or with a flexible shaft by an engine into the concrete. These poker vibrators are used for building or bridge construction wherever larger areas are to be compacted. They may also be used in wall, pilon, or tunnel construction, but external vibrators placed on the outside moulding form are recommended for these situations.



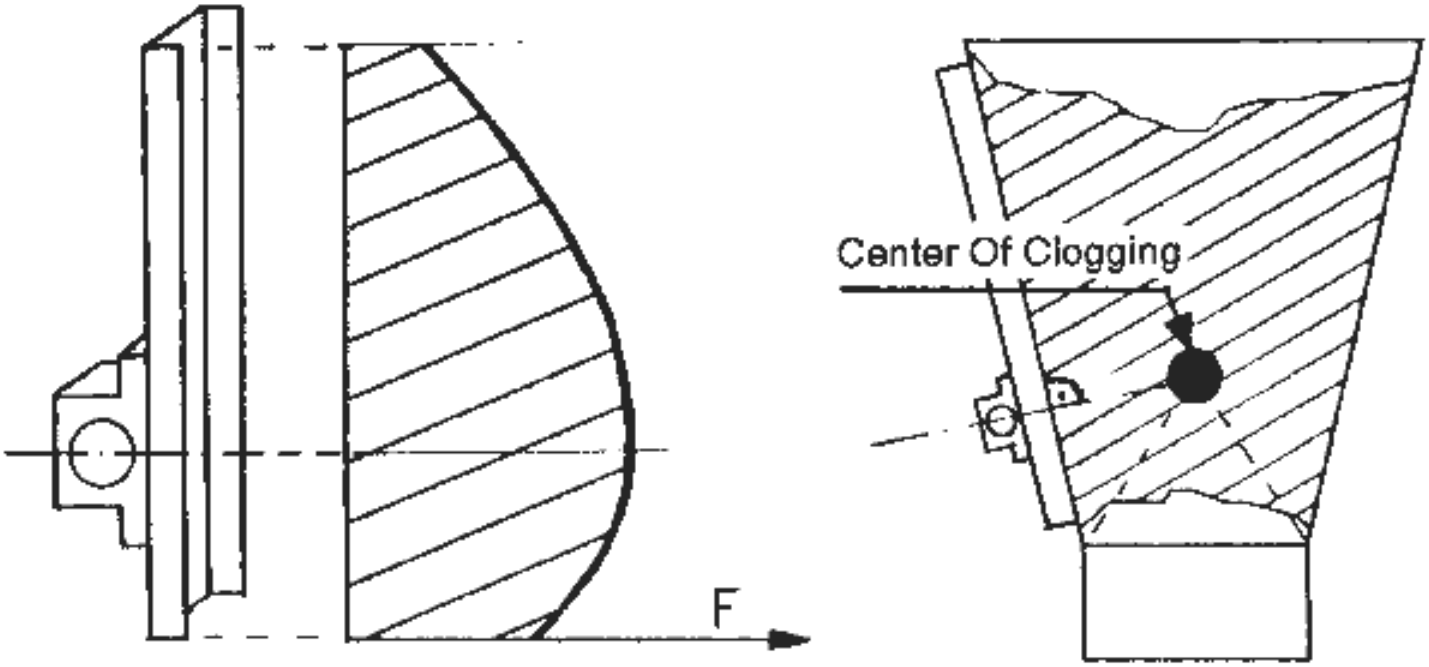
Using a channel iron

3.2.1. Mounting on bins and hoppers

Using a channel iron that is stich welded vertically is the best way to transfer as much as possible vibration energy into the material inside the bin. The channel should be placed on the symmetrical axis of the larger side of a four-cornered bin. Take care that no frame structure moves closer than half of the length of the channel iron to the channel iron because it would absorb most of the vibration energy and could also lead to damage of the frame structure.

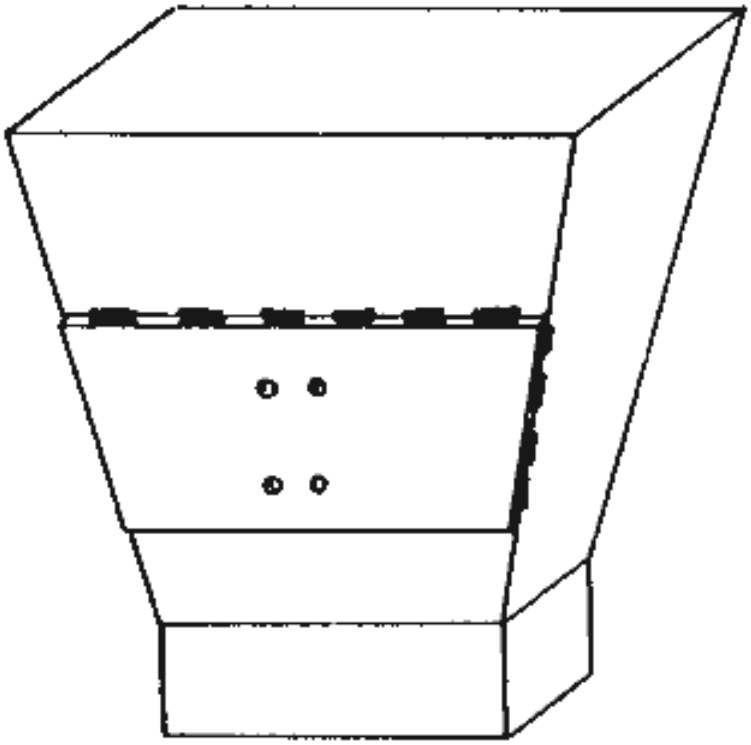
The channel works as stiffener so that the vibrating power is spread over the full length of the channel. Of course the vibrating power at the ends of the channel is less than the power near the vibrator. The vibration waves are pushed away in a 90° angle to the channel's length, so the optimal place for the vibrator is on the imaginary line connecting the channel iron to the center of clogging.

If the center of clogging is unknown, practical experiences indicated that a good mounting site is at about 1/3 of the height of the bin or hopper.



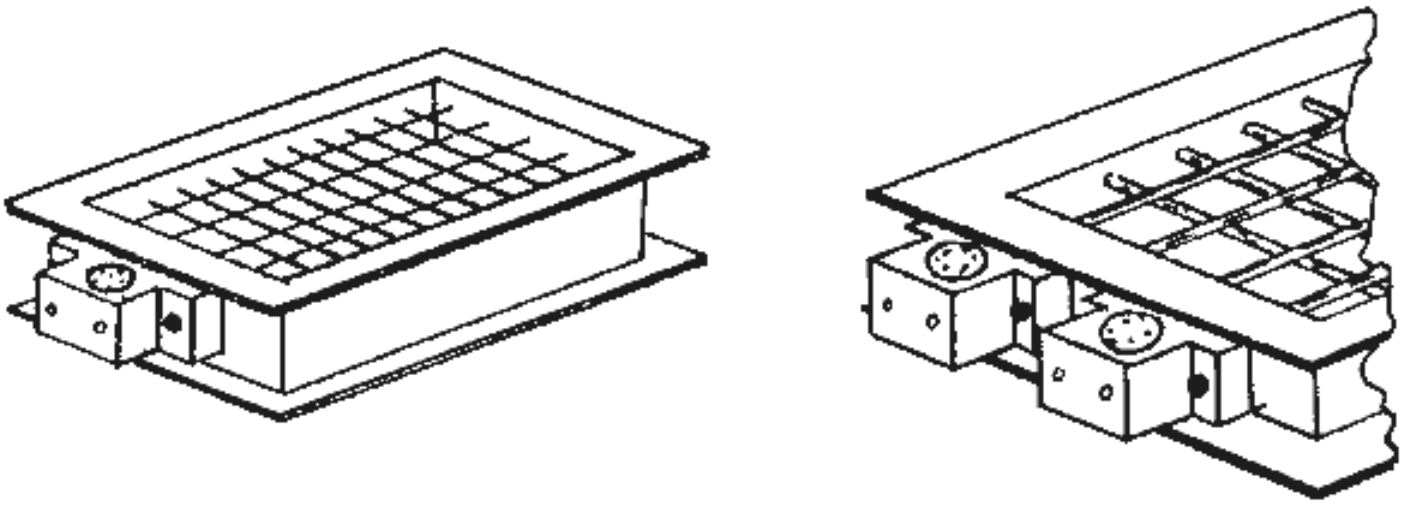
Vibrating power on a channel / center of clogging

Instead of a channel iron a plate can be welded to the bin to assure enough stiffness to spread the vibrating energy throughout the bin or hopper. Because of their thickness, area and weight a certain amount of vibrating energy is therefore wasted to vibrate the plate itself.



Using a plate

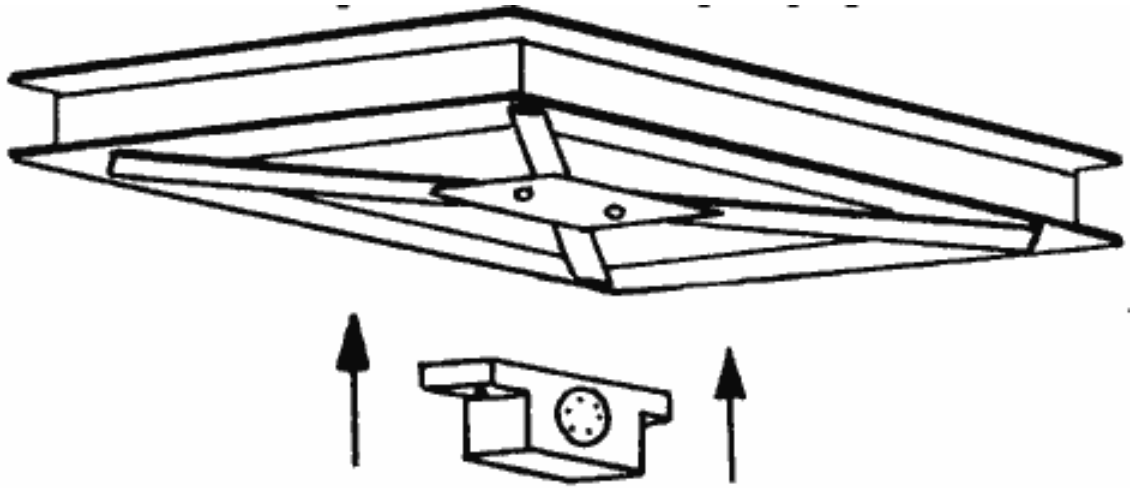
3.2.2. Mounting on screens



Mounting on a screen

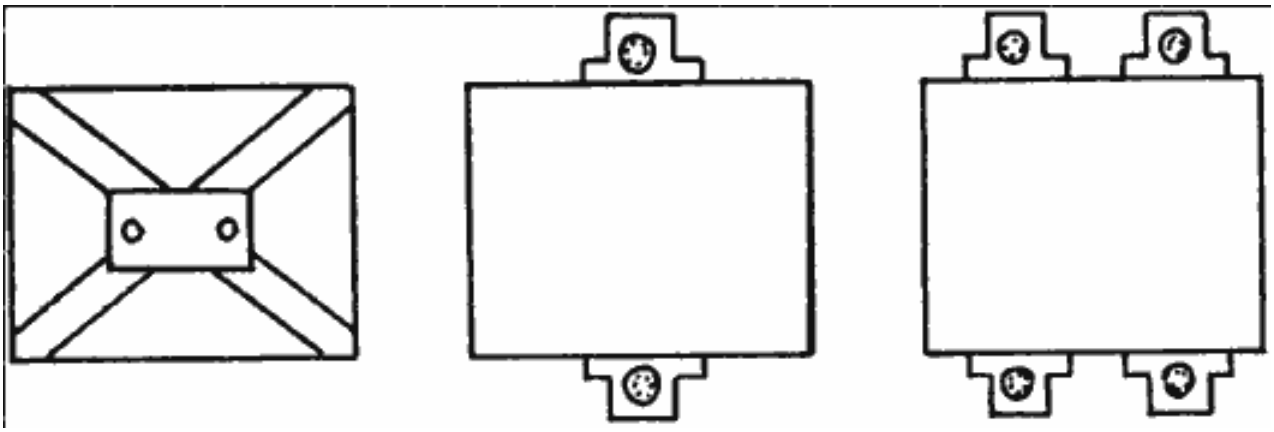
As mentioned earlier, screens are very similar to chutes. Screens may be activated by a vibrator mounted on the smaller edge or in the center. Often, when screening heavier material like gravel one single vibrator is not powerful enough. Under such circumstances two units can be mounted very close to each other. They will immediately synchronize and double the vibrating power. Take care that the frame is stiff enough. If it is not, the rigidity can be increased by using channel (U- or H-type) irons and a vibrator mounted in the center as in the following figure.

The screen must be mounted on springs or rubber elements so that the vibration energy is not absorbed by the screening machinery's structure. Make sure the air pressure tube and connection to the vibrator cannot be mechanically harmed. When mounted outdoors, please refer to paragraph 6.1.4.



Increasing the rigidity of a screen (bottom view)

3.2.3. Mounting on a concrete mold

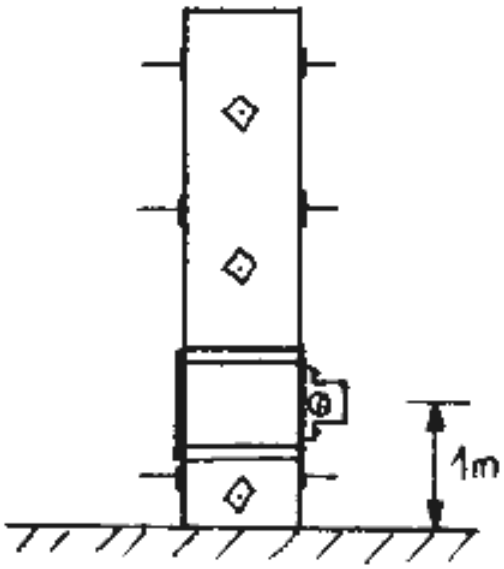


Mounting on a concrete mold (bottom view)

As with bins, the use of a channel iron or plate is recommended to spread the vibration energy when mounting on a concrete mold. If the mold is extremely small (less than 50 by 50 cm / 20 by 20 inches) the vibrator may be placed in the center under the mold. If it is larger, one of three configuration is recommended: one vibrator only, two vibrators mounted opposite each other on the longer sides of the mold, or four vibrators with two mounted opposite each other on the longer sides of the mold.

Like the screens, pneumatic vibrators mounted on molds will synchronize immediately after they begin to vibrate. The mold should be mounted on rubber elements or laminated springs, but also fixed in a fairly rigid position so the mold will not continue to swing or vibrate after the vibrator's energy is cut.

3.2.4. Mounting on a concrete form



Mounting on a pilon form

Under normal circumstances the wooden or iron form plates of concrete pilons are sufficiently stiff to mount a vibrator since the square area is relatively small. It is best to place the vibrator relatively close to the bottom of the pilon, around a height of 1 m. This guarantees that the lower portion of the pilon will be vibrated correctly. The upper part can move relatively freely, and the reinforcing steel in the pilon will transfer the vibration energy upwards. Even for pilons of up to 4 m in height, one single vibrator is absolutely sufficient. It can be attached with clamps.

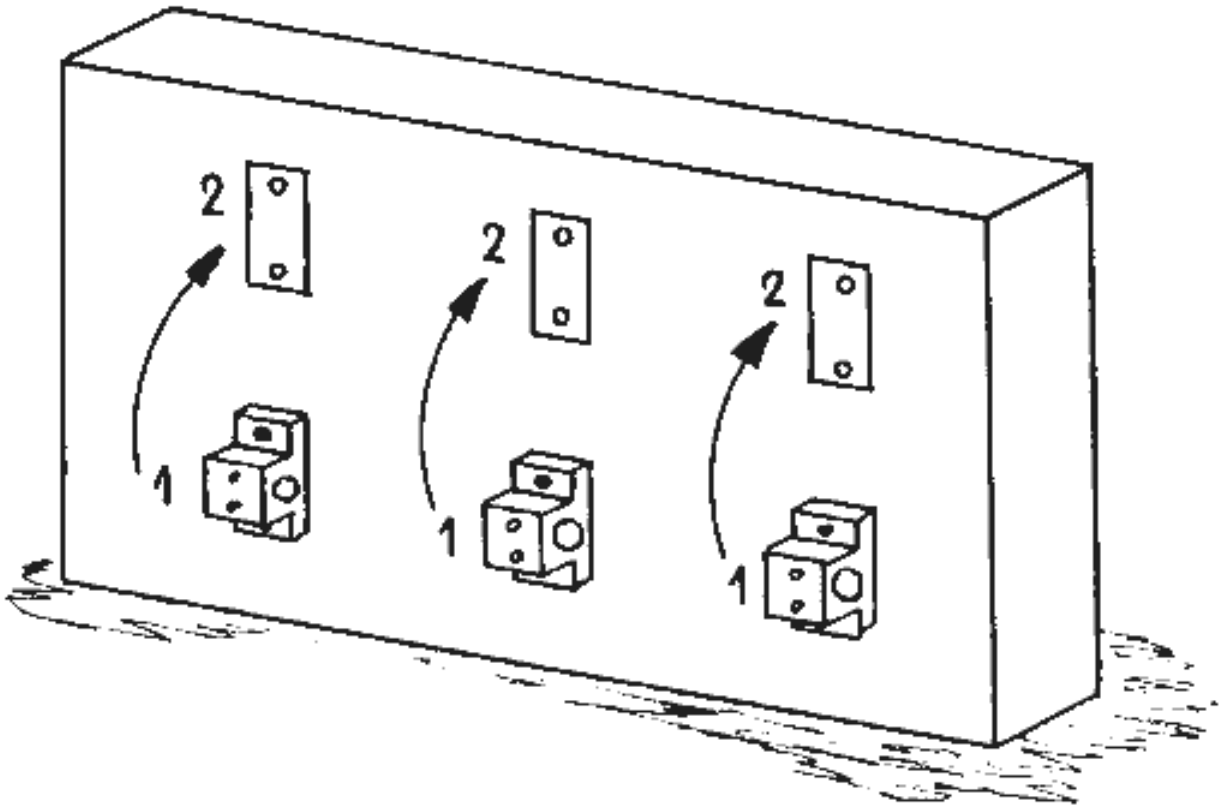
For longer pilons, instead of using two or more vibrators, the first few meters should be vibrated as it is poured.

Subsquently, every few meters, the poured concrete should be vibrated separately until the pilon is completed.

The time of vibration varies according to the viscosity of the concrete and the additives used .

Unlike pilon forms, concrete forms for walls are generally not very stiff. Hence, the vibrating energy may not be spread very well using only one vibrator. Instead of using only one vibrator to cover a given area, several have to be used. They may be smaller accordingly.

The wall should be vibrated piece by piece (portions of 1 to 2 m in height at maximum).



Mounting on a wall form

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ON-LINE MANUAL
Vibrator Selection

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4. Selection of the optimal vibrator type

4.1. General Information

In this section you will find some suggestions on how to select vibrators, but selection of the optimal vibrator cannot be done soely by using a calculator, some graphs and tables. Every single application is to be treated in a different way. Very often the free vibration is hindered by structural reinforcements, stiffeners, or other impediments. The following tables may give you an approximate idea to come close to the optimum, but in the end the final adjustment has to be done by varying the air pressure and tuning in to the object's natural frequency or a frequency that provides good working conditions.

There are many applications where three or more types of vibrators will do the job. In these cases the decision on which vibrator to use needs to be made according to noise and cost, both initial and long-term.

Generally speaking there are 7 factors to be taken into consideration :

- air consumption
- noise
- space of the unit / mounting area
- frequency required
- amplitude / vibrating energy
- cost / maintenance cost
- air supply / lubrication necessary

You will find different types of vibrator listed in the following tables, listed according to their force and amplitude. Other factors which are important are cost, noise and air consumption. For example, it might sometimes be important to use a Golden Turbine Vibrator, which is less noisy and consumes less than half the air that a ball vibrator with similar characteristics. For other applications there are no noise restrictions and a ball vibrator will be sufficient and save money as well.

How to proceed :

1. Select all the possible vibrator types and models according to the force needed in the following tables.
2. If silent operation is required, then do not use noisy types.

3. If oil-free running is required, then do not use T-, DAR-, and FP-vibrators.
4. If low air consumption is required, do not use Ball- and Roller-Vibrators (K-, R- and DAR-vibrators). For air consumption data please refer to Section 10--Technical Data.
5. Check for the mounting space needed.
6. Compare the costs. Take into consideration that one single GT-vibrator may do the job of two ball vibrators and that it might be less expensive in the long run.

4.2. Bins And Hoppers

4.2.1. Formula

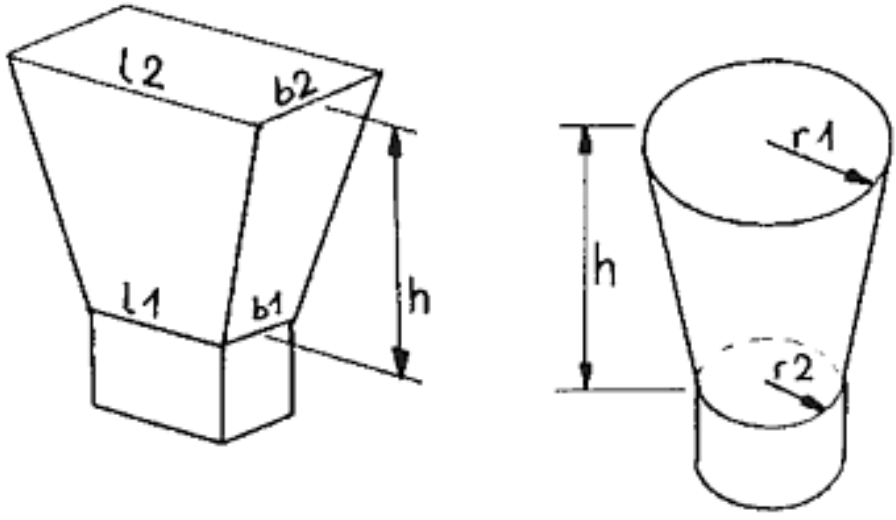
The most important factor in selecting the optimal vibrator model is the weight of the good that has to be vibrated. Where bins and hoppers are concerned, only the material in the sloped part of the bin or hopper is of interest.

Weight of the content :

W(cont) = Volume x Volume Weight of the Material

$$W(cont) = \frac{(b1 \times L1 + b2 \times L2)}{2} \times h \times VW \text{ for square bins}$$

$$W(cont) = \frac{(r12 \times p + r22 \times p)}{2} \times h \times VW \text{ for conical bins}$$



Calculation of the material weight of bins and hoppers

4.2.2. Vibrator table

Very often it is better to run two smaller vibrators instead of a large one. The units should be placed opposite each other on the bin or hopper so the structure is not stressed toomuch at one single point.

	Materials					
Weight of the content in kg	dry/loose grain, corn, coffee dry powders, flours			humid/wet/bulky cement, concrete, sugar salt, chemicals		
	Ball Vibrator K-Type	Roller Vibrator R-Type	Golden Turbine GT-Type	(Ball) Roller Vibrator R-Type	DAR Vibrator	Golden Turbine GT-Type
	noisy	noisy	silent	noisy	noisy	silent
50	K-8		GT-8	K-10		GT-8
100	K-8		GT-8	K-13		GT-8
200	K-10		GT-8	K-16		GT-8
300	K-13		GT-8	K-20		GT-8
500	K-16		GT-8	R-50		GT-8
800	K-20	R-50	GT-8	R-50	DAR-2	GT-10
1,000	K-25	R-50	GT-13	R-50	DAR-2	GT-16
1,500	K-30	R-50	GT-16	R-65	DAR-3	GT-20
2,000	K-36	R-65	GT-20	R-80	DAR-4	GT-25
3,000	K-36	R-65	GT-25	R-100	DAR-5	GT-36
5,000		R-80	GT-30	R-120	DAR-6	GT-40
8,000		R-100	GT-40		DAR-7	GT-78
10,000		R-100	GT-48		DAR-7	GT-48-S

Selection table for bins and hoppers

4.3. Chutes And Screens

To select the correct vibrator, first determine the weight of the material and the volume to be moved. For smaller chutes and screens, up to a total of about 120 kg, piston vibrators can be used but for larger chutes and screens, rotary vibrators, especially turbines, are a better choice.

Where two vibrators have to be used make sure both are fixed to the same stiffening iron so they will immediately run in resonance and amplify their forces.

4.3.1. Formula

Total weight to be vibrated :

W(vib) = Weight of chute or screen (moving part) + weight of the material inside

4.3.2. Vibrator table

Total weight in kg	Ball vibrator K-type noisy SA/HF	Roller vibrator R-type noisy MA/HF	Roller vibrator DAR-type noisy HA/LF	Turbine vibrator GT-type silent LA/MF	Piston vibrator FP-type silent 1/LF
5					FP-12
10					FP-18
15					FP-18
20	K-8				FP-25
30	K-8				FP-25
40	K-10				FP-25
50	K-13				FP-35
75	K-16				FP-35
100	K-20				2xFP-35
150	K-25	R-50	DAR-2	GT-16	
200	K-30	R-50	DAR-3	GT-16	
300	K-36	R-65	DAR-4	GT-25	
400	2x K-36	R-80	DAR-5	GT-36	
500		R-100	DAR-6	GT-36-S	
750		R-120	DAR-7	GT-48	
1,000		R-120	DAR-7	GT-48-S	
2,000		2xR-120	2xDAR-7	2xGT-48-S	

Selection table for chutes and screens

The FP-vibrators are available as S(mall), M(edium) and L(arge) amplitude types

SA = small amplitude	LF = low frequency
MA = medium amplitude	MF = medium frequency
HA = high amplitude	HF = high frequency

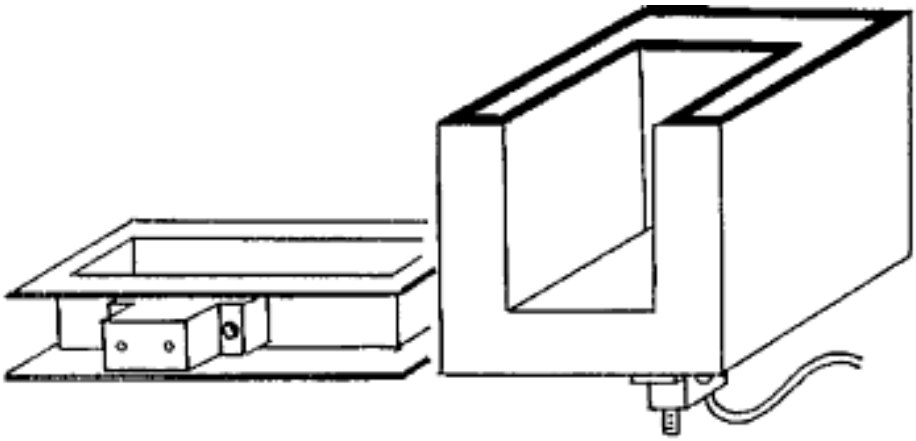
4.4. Molding Forms For Concrete and Iron Cast Applications

The important factors in selecting a vibrator for concrete molds are the mold weight and the condition of hte concrete, either dry, medium, or wet.

NOTE : Whatever vibrator you choose from the table, you will always have to perform practical tests to determine its best working conditions. Especially for concrete, the time of vibration is of significant importance to insure that the concrete is vibrated throughout. The table only provides a rough estimate.

	Condition		
Weight of filled mold in kg	WET	MEDIUM	DRY
20	R-50 DAR-2 GT-10-S	R-50 DAR-3 GT-10-S	R-65 DAR-4 GT-10-S
50	R-50 DAR-2 GT-10-S	R-65 DAR-3 GT-16-S	R-65 DAR-4 GT-16-S
100	R-65 DAR-5 GT-16-S	R-65 DAR-5 GT-16-S	R-80 DAR-6 GT-25-S
200	R-65 DAR-5 GT-25-S	R-80 DAR-6 GT-25-S	R-100 DAR-6 GT-36-S
500	R-80 DAR-6 GT-36-S	R-100 DAR-6 GT-48-S	R-120 DAR-7 2x GT-36-S
750	R-120 DAR-6 GT-48-S	R-120 DAR-7 2x GT-36-S	2x R-120 2x DAR-6 2x GT-48-S
1'000	2x R-120 DAR-7	2x R-120 2x DAR-6	2x DAR-7

Selection table for concrete molds



Fixation of the Vibrators depending on molding form

When more than 10 cm (4 inches) of concrete are to be compacted, DAR-vibrators (above, on the right) are recommended. The DAR-vibrators produce very large amplitudes which penetrate deeply into the concrete material.

For flat molding forms (above, on the left), DAR-vibrators should be used if the total width is more than 20 cm (8 inches) or 40 cm (16 inches) if two vibrators are used. If the width is less than 20cm, roller R-series or turbine GT-vibrators will produce good results.

To get a very compact and bubblefree surface, a GT-vibrator should be run for about ten seconds. Due to its higher frequency, it compacts sand material closely around gravel stones.

4.5. Foundry Molding Forms

To determine the correct vibrator to separate the silica sand of molding forms use the DRY column on the table. The use of GT-turbines is recommended since they can be operated without lubrication and their ball bearings are shielded so the silica sand dust can not harm the bearings. The vibrator should always be supplied with about 0.5 bar in standby operation so that no silica sand enters the exhaust port during the filling of the mold. Higher pressure is necessary to start the vibrator.

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ON-LINE MANUAL
Vibrator Description

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5. Description of FINDEVA vibrators

5.2. The Vibrator's Design

The FINDEVA vibrator housings are machined out of extruded aluminum alloy. There are two standard forms, one for the FP-Piston Vibrator series and the other for the Ball-, Roller- and Turbine-Vibrator series.

The FP-Piston Vibrator series are available in four different piston diameters (12, 18, 25 and 35 mm) and three force levels (small, medium and large).

The other vibrator series are available in five different profile sizes: P-50, P-65, P-80, P-100 and P120 where the number indicates the main body dimensions in millimeters. The Golden Turbine Black Beauties GT-4 and -6 are machined out of a P-40 profile. Like the FP-series some other vibrators types are available in two or three force levels . For example the Golden Turbine profile type 80 is available with one brass unbalance weight (named GT-30), with two brass unbalance weights (named GT-36) or with two heavy metal unbalance weights, which has the best weight to force ratio, (named GT-36-S).

5.3. The Ball Vibrator K-Series

Click here for dimensions and performance specifications

This is the simplest version of all vibrators and has been used for half a century. A steel ball driven by air rotates on hardened steel races and creates unbalance and vibration in a sinusoidal energy wave.

The rotating frequency varyies from 7,000 to 35,000 r.p.m. depending on the model and pressure supplied. The centrifugal force varies from 130 N up to 4,000 N, and the air consumption changes accordingly.

5.3.1. Description

The body is made out of extruded aluminum alloy fitted with hardened steel races. The steel ball is extremely durable. Nylon end plates are located on either side to keep dust and water out and to contain the ball.

Air pressure inlet and exhaust ports have standard pipe threads, allowing the exhaust air to be piped away, ensuring that no restriction is imposed on exhaust air.

The pipe thread is BSP (British Standard Pipe) but will accept the US NPT (National Pipe Thread).

Four mounting holes are provided, two vertically and two horizontally, for handling difficult mounting positions.

The K indicates the ball series and the number stands for the diameter of the ball in millimeters.

The maximum ambient operating temperature is 100°C (220°F).

The noise level range is 75 to 95 dBA with silencer.

5.3.2. Applications

The K-Series Ball Vibrators can be used in various applications including the following:

- Assisting the flow of material from bins, chutes and hoppers
- Excellent performance in packing machinery industries
- Preventing bottles and similar objects from locking together and blocking conveyor systems
- Compacting materials in containers or molds
- Separating various sizes of materials on screens

5.3.3. Installation / Operation

Please refer also to Chapter 6 for general information.

You can place the vibrator in any mounting position. The centrifugal force created when the air pressure is applied will cause the ball toimmediately find its correct path on the race.

NOTE: If the vibrator is mounted with its rotary axle in a vertical position, the lower end cap will hold the ball as long as no air pressure is applied. As soon as air pressure is applied the ball will rotate on its races and not move along the end plate any more.

The ball vibrators can be operated intermittently without losing their effectiveness or causing other difficulties since the vibration stops immediately after pressure is cut. Therefore, it is very useful in packing machinery industries.

Lubrication is not required, but only clean (filtered) air should be used because dirt will cause the ball to jump and dent the ball's race.

5.3.4. Keywords

Type:	Ball vibrator
Frequency :	Medium to high

Unbalance Weight:	Ball (Type number is diameter in mm)
Lubrication :	Not necessary
Air Supply :	2 to 6 bar (30 to 90 PSI)
Air Type :	Clean, use of filter (40 µm) recommended
Body :	Aluminum, stove-enamelled cream-grey
End Caps :	black Nylon, self retaining
Ambient Temperature :	100°C = 220°F
Noise Level Range :	75 to 95 dBA with silencer

5.4. The Roller Vibrator R-Series

Click here for dimensions and performance specifications

This version is as simple as the ball vibrator. A steel alloy roller rotates on a cast iron liner delivering very high centrifugal forces.

The rotating frequency varies from 10,000 to 36,000 r.p.m. depending on model and air pressure supply. The centrifugal force varies from 1,070 N up to 12,500 N with an increase of air consumption accordingly.

5.4.1. Description

The vibrator body is machined from an extruded aluminum alloy section, inside of which a precision steel roller rotates. It is retained by two special high impact plastic end plates.

For easy mounting the housing has four holes, two horizontal and two vertical.

Air is introduced through one of the two inlet ports on top or on the right hand side of the housing. These inlet ports are tapped with standard pipe thread, and a sealing screw is provided for sealing the one not used.

The pipe thread is BSP (British Standard Pipe) but will also accept US NPT (National Pipe Thread).

The air is pressed through an air compression groove and exits into the roller chamber through a number of jets spread over the liner. This guarantees a silent, continuous and economic operation.

The air is exhausted through the special high impact plastic end plates, designed with an air silencer.

The R indicates roller series and the number is the dimension of the square body (without legs) in millimeters.

The maximum ambient operating temperature is 140°C (280°F)

The noise level range is 75 to 100 dBA.

5.4.2. Applications

The R-Series Roller Vibrators are to be used in the following application areas :

- Emptying bins, chutes and hoppers with very fine materials, such as powder, or humidified materials, such as hummus or jelly
- Moving of fine powders
- Agitation of small particles
- Compacting plastic cast and concrete in molds

5.4.3. Installation / Operation

Please refer also to Chapter 6 for general information.

You can place the vibrator in any mounting position, but we do recommend that you place the vibrator so that its rotative axle is horizontal because otherwise the roller moves along one of the end plates and will wear out relatively quickly.

The roller vibrators can be operated intermittently without losing effectiveness or causing other difficulties since the vibration stops immediately after air pressure is cut. Therefore, it is very useful in the concrete industry to calculate accurate compaction times.

Lubrication is required. One drop per five minutes is sufficient. Only filtered, clean air only (40 µm Filter is sufficient) should be used because dirt will cause the roller to jump and dents or cracks in the cast iron liner will result.

Please make sure that hydraulic oil ISO VG5 with 5 cSt/40¡C is used. Any other viscosity will cause the unit to clog or reduce the vibrating frequency and power.

5.4.4. Keywords

Type :	Roller vibrator
Frequency :	Medium to high
Unbalance Weight :	Steel alloy roller
Lubrication :	Necessary, approx. 1 drop/5 minutes
Air Supply :	2 to 6 bar (30 to 90 PSI)

Air Type :	Clean, use of filter (40µm) recommended
Body :	Aluminum, stove-enamelled blue
End Caps :	Threaded high impact Grastin end caps One left, the other right hand thread
Ambient Temperature :	140°C = 280°F
Noise Level Range :	75 to 100 dBA

5.5. The Roller Vibrator DAR-Series

Click here for dimensions and performance specifications

The DAR-series roller vibrators complement our existing range of roller vibrators and are especially suited for concrete applications. The new design features provide a more robust vibrator, suitable for use under the most arduous conditions.

The rotating frequency varies from 8,000 to 38,000 r.p.m. depending on model and air supply pressure. The centrifugal force variies from 1,700 N up to 12,000 N. The vibration amplitude is extremly large compared to the other series.

5.5.1. Description

The vibrator housing is machined from an aluminum alloy profile ,inside of which a precision cast iron roller rotates in high tensile steel races. It is retained by two high impact special bronze end plates.

The housing has two mounting holes.

The air inlet port and the exhaust port are tapped with standard pipe thread. The pipe thread is BSP (British Standard Pipe) but will accept US NPT(National Pipe Thread) .

For optimal performance, silencers of sintered bronze should be used to improve exhausting.

The DAR indicates the heavy roller series and the number (2 to 7) is a running number.

The maximum ambient operating temperature is 200°C (400°F).

The noise level range is 75 to 100 dBA with silencers.

5.5.2. Applications

The DAR-series roller vibrators provide a new approach in compacting and moving fine heavy materials. Examples of their uses include:

- Compacting concrete and plastic in molds
- Assisting the flow of material from chutes and hoppers
- Separation of various sizes of material on screens

5.5.3 Installation / Operation

Please refer also to Chapter 6 for general information.

The vibrator should be placed so that its rotative axle is horizontal in order to avoid friction between roller and end plates that would prematurely wear out the end plates.

The DAR-vibrator can be operated intermittently without losing efficiency or causing other difficulties since the vibration stops immediately after air pressure is cut. Therefore, it is very useful in the concrete industry to calculate accurate compaction times.

Lubrication is required. One drop per five minutes is sufficient. In addition, only filtered, clean air (40 µm filter is sufficient) should be used. Dirt will cause the roller to jump and dents or cracks in the steel races will result.

Please make sure that hydraulic oil ISO VG5 with 5 cSt/40°C is used. Any other viscosity may cause the unit to clog or reduce the vibrating frequency and power.

5.5.4. Keywords

Type :	DAR-roller vibrator
Frequency (Object) :	Low to medium
Unbalance Weight :	Cast iron roller
Lubrication :	Necessary (Oil ISO VG5 = 5cSt/40°C)
Air Supply :	2 to 6 bar (30 to 90 PSI)
Air Type :	Clean, use of filter (40µm) recommended
Body :	Aluminum, stove-enamelled orange
End Caps :	Bronze, threaded (Left and right hand)
Ambient Temperature :	200°C = 400°F
Noise Level Range :	75 to 100 dBA with silencer

5.6. The Golden Turbine Vibrator GT-Series

Click here for dimensions and performance specifications

A low to high speed range and eccentric working moments are combined in this vibrator series to produce a powerful vibration.

The rotating frequency varies from 5,600 to 46,000 r.p.m. depending on model and air supply pressure. The centrifugal force varies from 1,000 up to 12,000 N.

5.6.1. Description

The vibrator body is made from an extruded aluminum alloy profile , and the threaded end plates are hard coated so that the vibrator can be used in the food and pharmaceutical industries.

The GT-Turbine vibrators conform to current international noise regulations under factory test conditions.

The vibration is produced by the centrifugal force of the positive and negative unbalance weights in the rotor. The rotor is supported on two heavy duty, prelubricated, matching shielded ball bearings. A special long life grease ensures a long working life.

Air pressure inlets and exhaust ports have BSP thread (British Standard Pipe) but will accept US NPT (National Pipe Thread).

The inner and outer raceways of the bearings are designed so that the bearings can be easily replaced using only a pin-wrench.

The end-plates are fitted with right- and left-hand threads and are self-locking.

5.6.2. Applications

The GT-series Golden Turbine Vibrators are used for a wide range of applications including the following:

- Assisting the flow of material from bins, hoppers and chutes
- Compaction of silica sand in moulds of foundries

Due to its low noise level it may be used instead of all other vibrator types where there are low noise requirements. It can also be used wherever no lubricated air pressure is available .

5.6.3. Installation / Operation

Please refer also to Chapter 6 for general information.

The Golden Turbine Vibrator can be placed in any position, but in order to increase its lifetime the vibrator should be operated ,whenever possible, with the rotor axle horizontal so that the ball bearings do not get side pressure.

Intermittent operation is not suggested since when air pressure is cut down, the rotor will continue running for about ten seconds. Thus, it should only be operated intermittently if the off time is more than 10-20 seconds.

Lubrication is not required, but an air line filter should be used to prevent dirt from clogging the silencer.

5.6.4. Keywords

Type :	GT - Golden-Turbine vibrator
Frequency :	Low, Medium, High
Unbalance Weight :	Aluminium Rotor with positive and negative unbalance (brass or heavy metal)
Lubrication :	not necessary
Air Supply :	2 to 6 bar (30 to 90 PSI)
Air Type :	Clean, use of filter (40 µm) recommended
Body :	Aluminum, stove-enamelled yellow
End Caps :	Aluminum, black anodized, threaded
Ambient Temperature :	120°C = 250°F
Noise Level Range :	60 to 75 dBA with silencer

5.7. The Turbine Vibrator T-Series

Click here for dimensions and performance specifications

A low speed range and large working moments are combined in these vibrators to produce a powerful vibration with a high amplitude.

The rotating frequency varies from 6,500 to 23,000 r.p.m. depending on model and air supply pressure. The centrifugal force varies from 600 N to 6,000 N.

5.7.1. Description

The vibrator housing is machined from an aluminum alloy profile which is tempered and hard anodized. It is chemically resistant and suitable for use in the food and pharmaceutical industries.

The LP-vibrators (Low Pressure) work most economically between 2 and 4 bar (30 to 60 PSI) while the HP-vibrators (High Pressure) show best results between 4 and 6 bar (60 to 90 PSI). In this range the frequency of vibration can be varied by regulation of the air pressure, thus enabling the vibrator to be tuned to suit the application.

The housing has two mounting holes.

The air inlet port and the exhaust port are tapped with BSP thread (British Standard Pipe) but will accept US NPT (National Pipe Thread) as well.

The maximum ambient operating temperature is 140°C = 280°F.

These pneumatic turbine vibrators have a relatively low noise level range of 65 to 80 dBA. The noise level measured in the proximity of the silencer may be reduced in half when an exhaust hose is used.

5.7.2. Applications

The T-series turbine vibrators are used in a wide field of applications including the following:

- Emptying bins and hoppers
- Compacting materials in molds
- Separation of materials

5.7.3. Installation / Operation

Please refer also to Chapter 6 for general information.

The vibrator should be mounted so that its rotative axle is horizontal to avoid side pressure to ball bearings, thus increasing its lifetime.

Intermittent operation is not suggested since when the air pressure is cut down, the rotor will continue running for about ten seconds. Only when the OFF-time is more than about 20 seconds is it advisable to operate intermittently.

5.7.4. Keywords

Type :	T-Turbine vibrator
Frequency :	Low to Medium

Unbalance Weight :	Aluminum/Brass Rotor
Lubrication :	Necessary (Oil ISO VG5 = 5 cSt / 40°C)
Air Supply :	2 to 6 bar (30 to 90 PSI)
Air Type :	Clean, use of filter (40 µm) recommended
Body :	Aluminum, black anodized
End Caps :	Plastic endcap with thread on one side and nylon endplate
Ambient Temperature :	140°C = 280°F
Noise Level Range :	65 to 80 dBA with silencer

5.8. The Piston Vibrator FP-Series

Click here for dimensions and performance specifications

The FP-series pneumatic piston vibrators produce a linear vibration with an infinitely variable amplitude and frequency. The frequency is controlled by the air pressure.

The frequency varies from 2,400 to 9,300 v.p.m. depending on model and air supply pressure. The linear force varies from 34 N to 1,060 N.

The FP-series vibrators are non impacting so the piston does not hit the socket, but rather stops on an air cushion formed in the respective chamber (socket or end cap side). The force/time curve is therefore relatively sinusoidal without peaks. This feature is excellent whenever parts have to be moved.

5.8.1. Description

The aluminum body is hard coated and corrosion resistant. The power-to-weight ratio of the unit makes it particularly efficient for feeder applications. Explosion proof, light weight, compact, quiet and efficient, these units are ideal for most applications. They are easy to install and designed to work continuously under the most arduous conditions. Servicing requirements are minimal.

The housing has a metric thread in the aluminum socket so the vibrator can be easily mounted. The air inlet port in the body as well as the exhaust port in the end cap are tapped with BSP thread (British Standard Pipe)

but will accept US NPT (National Pipe Thread) as well.

The maximum ambient operating temperature is 50°C = 120°F

Piston vibrators with aluminum end cap may be operated at higher temperatures, but the vibration power will decrease due to increased leakage.

The noise level is extremely low, from 57 to 74 dBA.

5.8.2. Applications

The FP-series piston vibrators are used mainly for feeding materials mounted on chutes, spiral chutes and channels :

- Feeding of chemical powder in tube channels
- Feeding of flour, sugar, etc. in the food industry
- Feeding of small parts into machines
- Feeding of seed and grain in the flower and vegetables industries

5.8.3 Installation / Operation

Please refer also to Chapter 6 for general information.

The FP-piston vibrator can be placed in any position.

An air line filter with five micron (5 µm) is required to keep dirt from entering and blocking the piston.

A lubricator filled with oil (ISO VG5 = 5 cSt/40°C) or distilled water should be used to avoid abrasion.

Although intermittent operation is possible without lubrication if the operation factor is less than 20%, we do strongly recommend that you always lubricate.

Please note that when mounted in upright position it will take up to two seconds for the piston to move back to its end position after the air pressure is cut down because the piston has to move air out of the housing with the help of the starter spring. If the vibrator will be operated intermittently, the starter spring should be turned to the upper side so that gravity supports the spring.

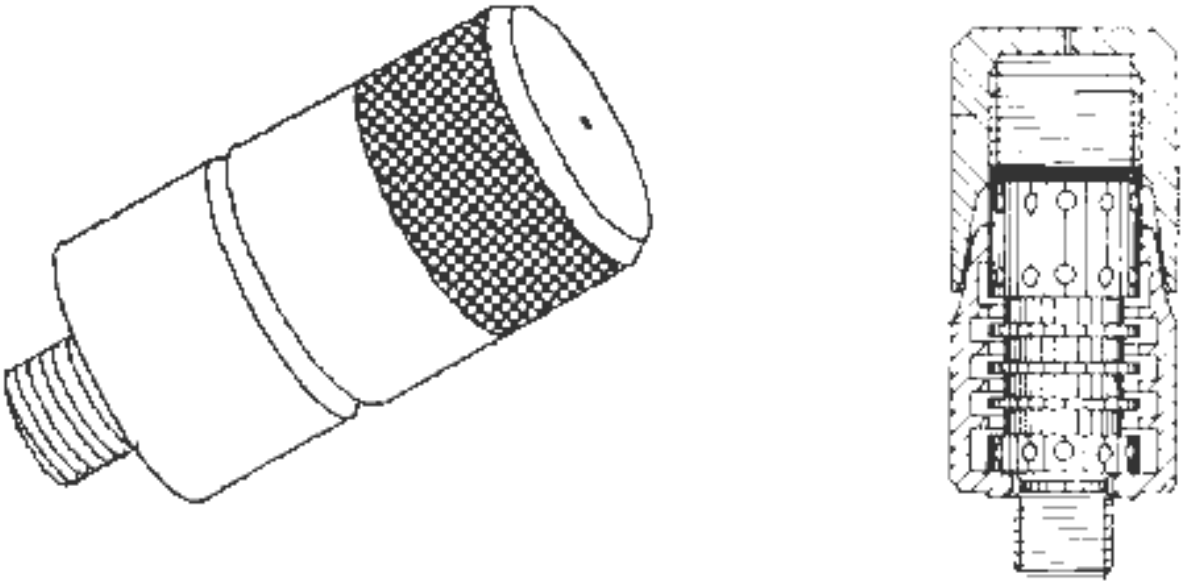
Please also refer to Chapter 7.2 section 1 and 7.3.6.

5.8.4. Keywords

Type:	Piston vibrator
Frequency:	Low
Unbalance Weight:	Bronze Piston

Lubrication:	Necessary (Oil ISO VG5 = 5 cSt/40°C or distilled water)
Air Supply:	2 to 6 bar (30 to 90 PSI)
Air Type:	Clean, 5 µm filter required
Body:	Aluminum, block anodized and teflonized
End Cap :	Aluminum socket with metric mounting thread plastic or aluminum end cap
Ambient Temperature:	50° C = 120° F
Noise Level Range:	57 to 74 dBA with silencer (FF-type)

5.8.5. Silencer / Flow Restrictor



Free Flow silencer FF-type

The exhaust air flow of rotary vibrators is continous, and ordinary filter type silencers may be used. Due to the operating principle, the air is exhausted in waves.

The exhaust from piston vibators is given off in pulsating puffs. The principle of the FF-silencer suits the need for a special silencer by regulating the flow of exhaust.

The FF-type silencer (FF = Free Flow) employs the principle of diffusion using a flow labyrinth and eliminates the clogging problems encountered with conventional filter type silencers.

The silencer also incorporates a flow restrictor which makes it possible to select and hold a given amplitude.

The 1/4" Free-Flow silencer can be fitted either on the vibrator or positioned as remote control device.

The FF-silencer fits the FP-25 and FP-35 series. For FP-12 and FP-18 series standard silencers can be used.

By correct adjustment of the flow restrictor the dB value can be reduced by up to 50%.

The Free-Flow silencers are machined from black acetal resin POM.

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ON-LINE MANUAL
Operation

6. Installation and operation of the vibrator

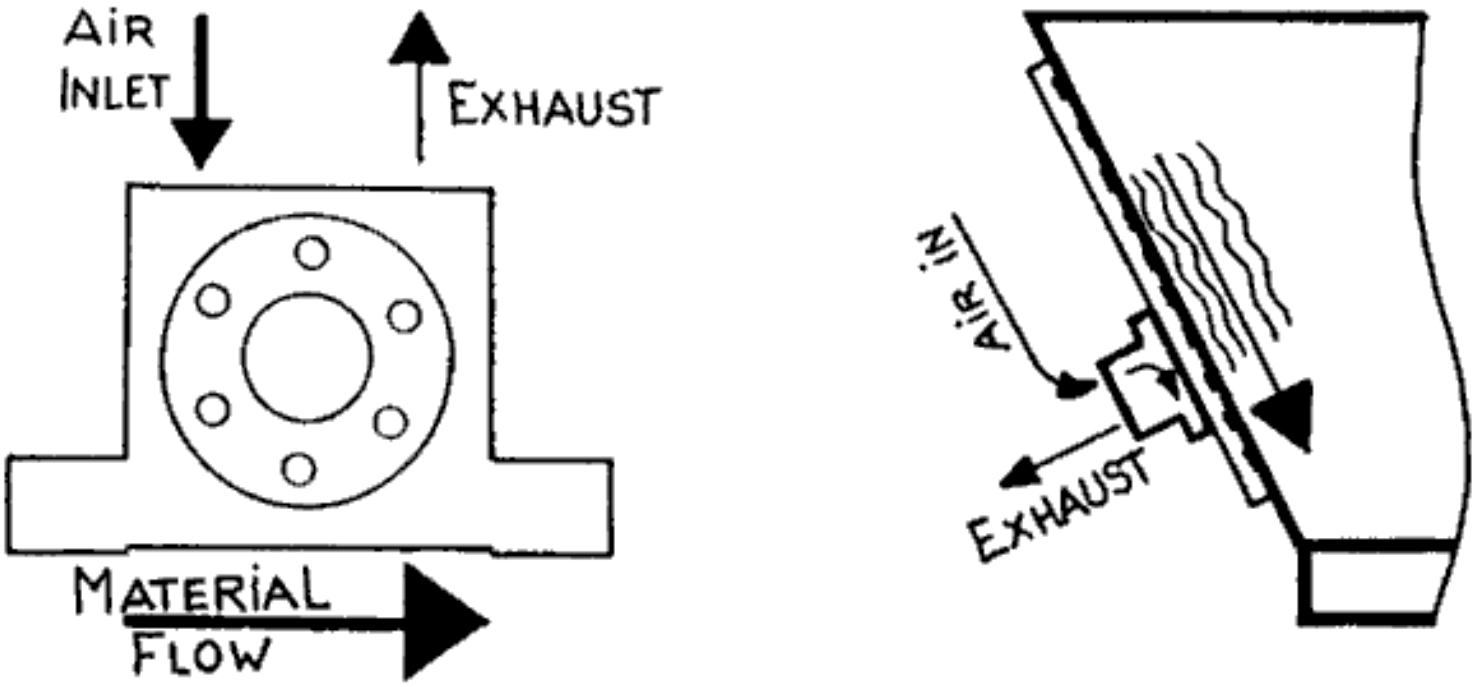
6.1 Mounting

Before mounting the vibrator make sure the location has been carefully selected to insure the best working results (refer to Chapter 3).

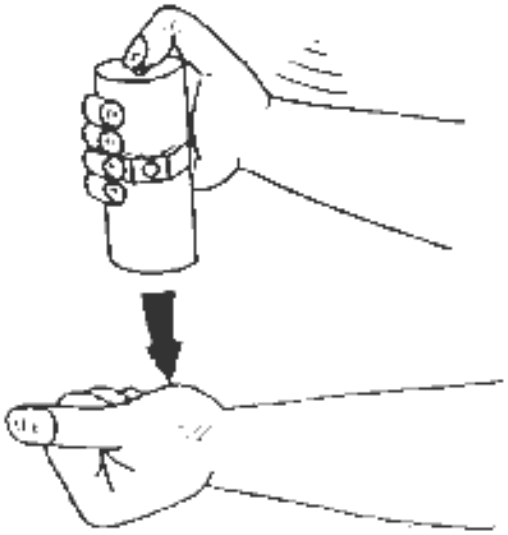
The mounting area must be clean and even. Please note that an uneven mounting area may cause the vibrator to malfunction due to torsion in the vibrator's body.

The vibrator should be placed, whenever possible, so that the rotation of the ball, roller or turbine supports the direction of material flow.

It is easy to verify the correct placement with the help of the air inlet as shown in figure 6.1.



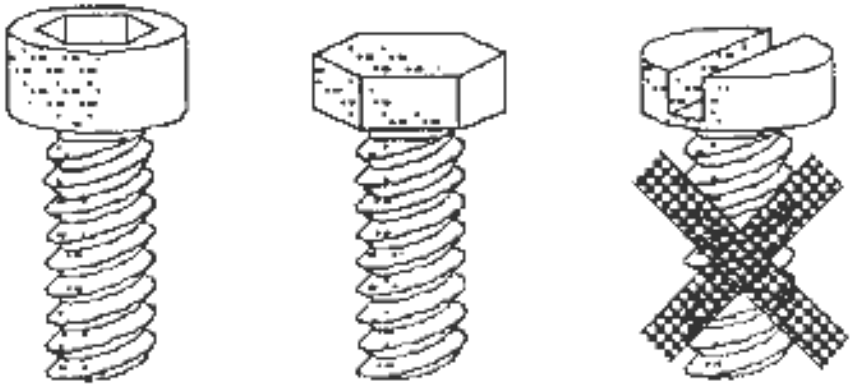
Support of flow and correct placement on a bin



Check free movement of the piston

Before mounting the Piston Vibrator FP-series, check to make sure that the piston is moving freely. Hit the vibrator against the ball of the thumb. You will hear a metallic "clack" of the piston when knocking the end cap. If the piston is not moving freely, add some drops of petroleum (kerosene) into the air inlet. It will loosen the clog of the piston which is probably caused by the congealed oil we use in manufacturing.

6.1.1. Screws and nuts



Allen Screws / Hexagon Screw / Slotted Screw

The following screw sizes have to be used:

Model	8/10	13/16	20/25	30/36	40/48	60/70
K-series	M6	M8	M8	M10	----	----
GT-series	M6	M8	M8	M10	M16	M16
Model	50	65	80	100	120	
R-series	M6	M8	M8	M10	M16	

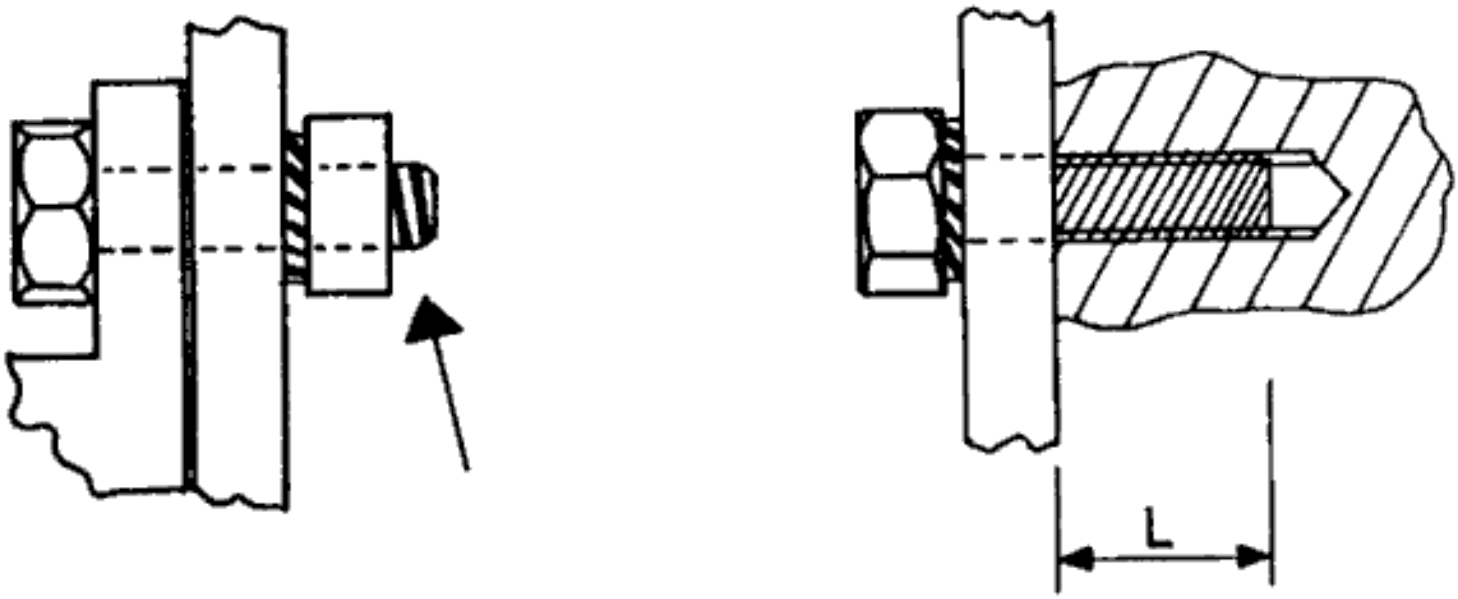
T-series	M6	M8	M10	M12	----	
Model	2	3	4	5	6	7
DAR-series	M6	M8	M10	M12	M16	M16
Model	12	18	25	35		
FP-series	M8	M10	M12	M12		

Allen Screws or Hexagon Screws with a minimum quality of 8.8 are recommended. Similarly, the nuts should conform to 8.8 quality.

Slotted Screws or other types of screws with less tensile strength should be avoided.

The screws should be long enough so that at least one full thread is out of the nut.

If a threaded hole in the object is used for mounting, the screw should be torn in at least 1.5 times the screw diameter.



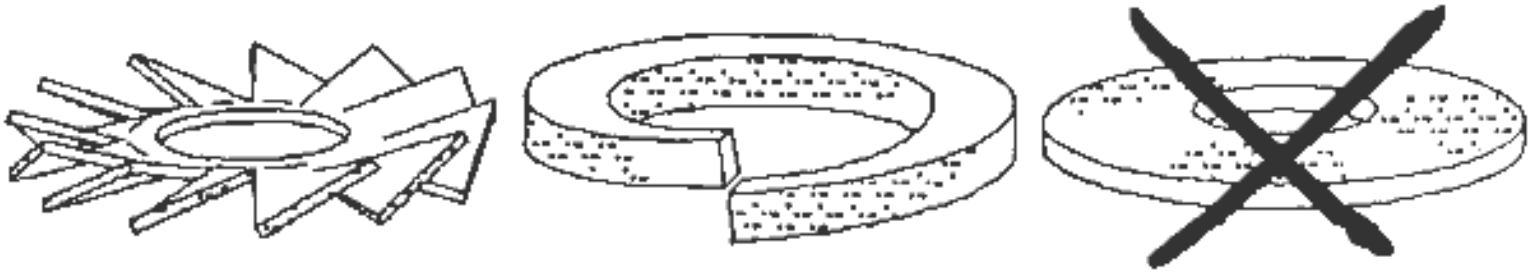
Lengths of the screw in the thread

For FP-series the length of the screw in the vibrator thread should be as follows:

FP-Type	12	18	25	35
Minimum (mm)	10	10	12	12
Maximum (mm)	13	13	15	15

CAUTION: Always use a Tooth Lock Washer or a Spring Lock Washer.
The use of an adhesive sealant (LOCTITE 270 for instance) is suggested. Please follow the manufacturer's instructions.

Never use an ordinary Flat Washer or a Curved Washer because these washers do not stop movement, and loosening of the screw during vibration may occur.



Tooth Lock Washer / Spring Lock Washer / Curved Washer

The washer should be placed between mounting plate and nut, and between mounting plate and screw for FP-vibrators.

The tightening torque must not exceed the following values :

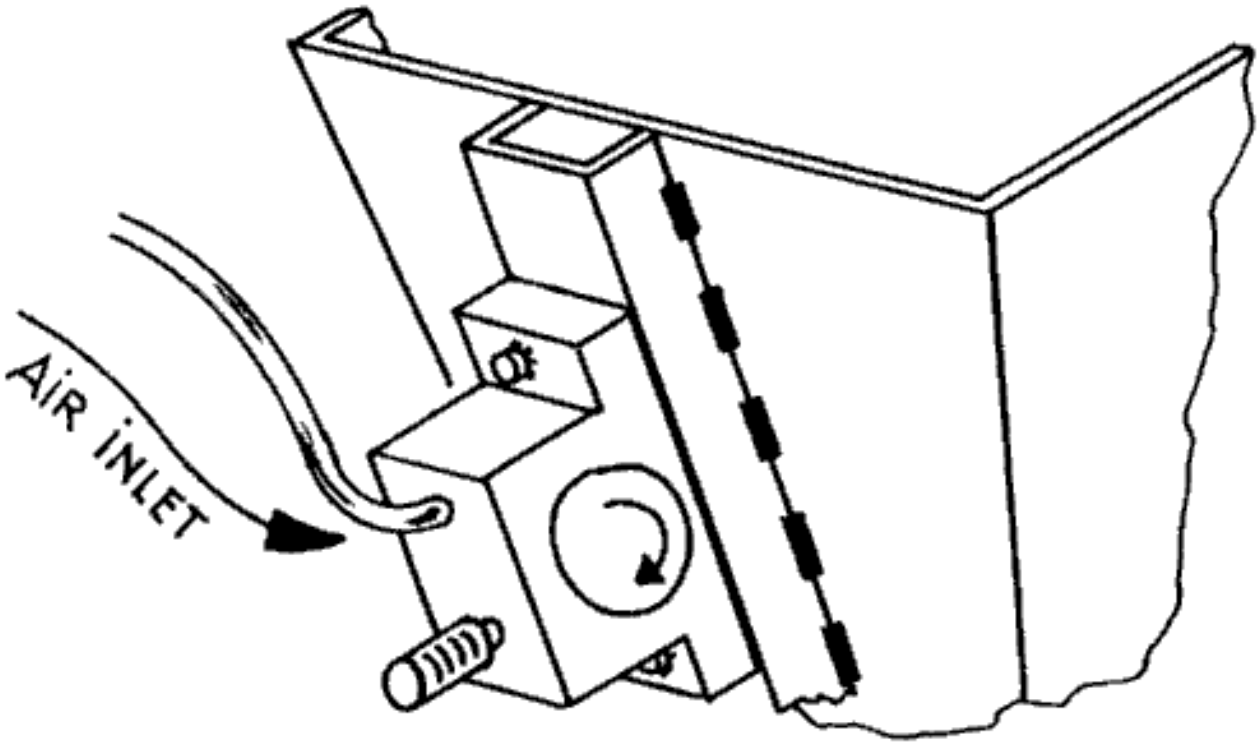
Thread	Minimum	Maximum
M6	6 N	10 N
M8	15 N	21 N
M10	30 N	42 N
M12	50 N	72 N
M16	150 N	174 N

Fig. 6.7. : Minimum / maximum torque

NOTE: FP-series : The socket with the mounting thread is the end cap with the smaller diameter. The thread in the other end cap (air exhaust port) is not metric!

The vibrator is to be placed, whenever possible, so that the rotation of the ball, roller or turbine supports the direction of material flow.

It is easy to verify the correct placement with the help of the air inlet as shown in figure 6.8.



Support of flow and correct placement on a bin

CAUTION: Make sure the vibrator is securely fixed! We strongly recommend that you retighten the screws after a few minutes of operation. A loose vibrator may fall down and harm people or machinery.

6.1.2. Air connection

The air pressure tube should be wide enough to allow a good air flow. The main air line should be dimensioned according to paragraph 2.4.. The connection from the main line to the vibrator is made with a short flexible tube. Make sure the inner span of this flexible connecting tube conforms to figure 6.9.

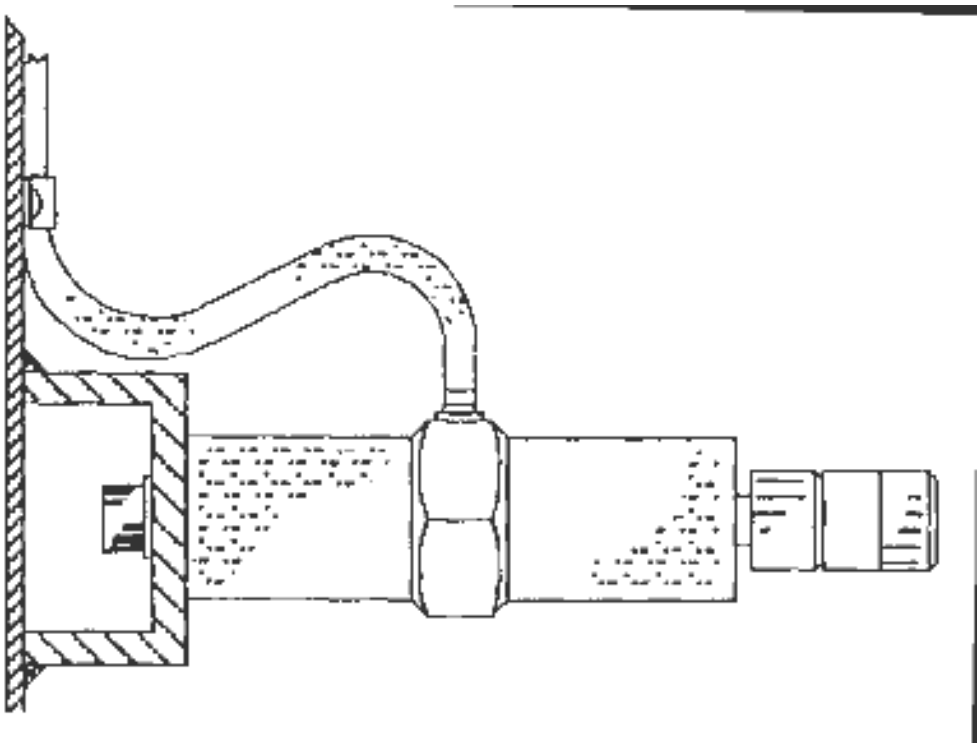
Profile Type	50	65	80	100	120	180
Inner Span (mm)	8	8	12	16	16	20

Fig. 6.9. : Minimum requirements of inner span of connecting tube

Make sure the air pressure tube at the air inlet port is flexible and freely movable so that vibration does not harm the tube at the transition piece. The tube is to be securely fixed at the object side, so that the tube may not come in resonance. You can let the tube hang from a structure point directly to the inlet port, but make sure that it does not create a safety hazard.

Make sure that the tube can never be buckled.

NOTE: The pipe thread is BSP type (British Standard Pipe) but will accept US NPT (National Pipe Thread) that is conical and has one extra turn per inch. Tighten very closely using Teflon-tape



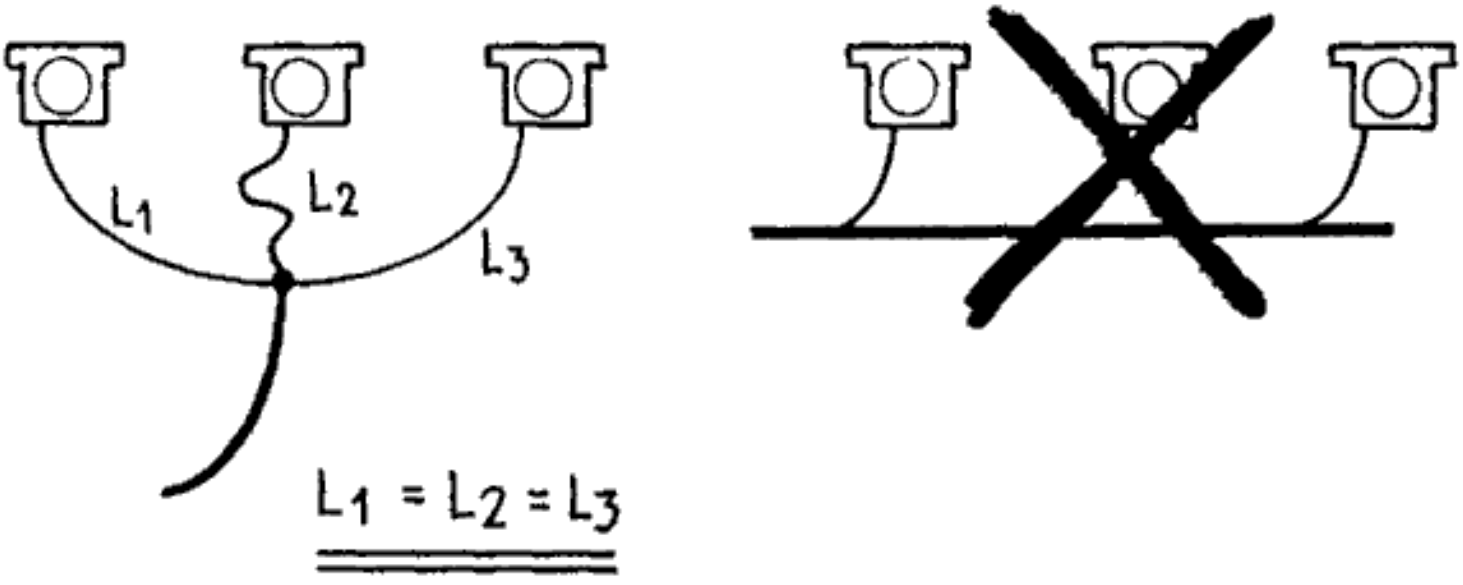
Fixation of the air pressure tube

The filter, regulator and lubricator unit should be placed as close as possible to the vibrator (less than 2 m).

If an electromagnetic valve is connected into the air line for intermittent operation of the vibrator, the distance between vibrator and valve should be less than 50 cm. This will guarantee a proper and immediate start and stop.

Only one lubricator unit needs to be used for a maximum of three vibrators. The lines from the junction to every vibrator should be of the same length to ensure that all vibrators are supplied with same pressure and flow through.

Again, when using electromagnetic valves, place each one within 50 cm of every vibrator so it is guaranteed that all vibrators will start and stop at the same time.



Connection of three vibrators to one lubricator unit

If a lubricator is used, the oil must be ISO VG5 as explained in paragraph 2.2.

Please note that suppliers of servicing units (filter-regulator-lubricator) sell their own oil for lubrication. Please verify it conforms to ISO VG5!

We recommend that you add a few drops of kerosene into the vibrator's air inlet before mounting the air tube. Kerosene will dispel the corrosion protective additive inside new vibrators during the first few seconds of operation.

6.1.3. Silencer

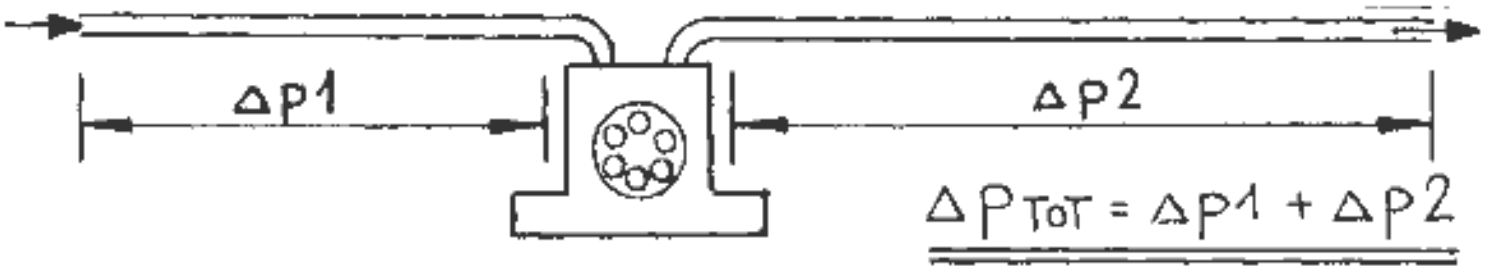
All vibrators except the R-series may be equipped with silencers or an exhaust hose. The use of the following silencers is recommended.

Vibrator Types/Models	Silencer	Size	Order-No.
GT-8 /-10, R-50, FP-12 / -18	Filter Type	1/8"	44025
K-8 to 25, GT-13 to 25, T-50 to 65, R-65 / -80	Filter Type	1/4"	44026
K-30 / -36, GT-30 to 48, T-80 to 100, R-100 / -120	Filter Type	3/8"	44027
DAR-2	Sintered	1/8"	39371
DAR-3 / -4	Sintered	1/4"	39372
DAR-5 / -6 / -7	Sintered	3/8"	39373
FP-25 / 35	Free Flow	1/4"	44029

Fig. 6.12. : Silencer cross reference

Silencers may clog due to dirt in air; hence, the use of air line filters is strongly recommended, but clogged silencers (filter types and sintered types) may be washed out with petroleum (kerosene). FF-types (Free-Flow 1/4") can be unscrewed, and both parts can be blown through with air pressure.

Instead of using silencers the exhaust air may be blown through a hose. Make sure that the hose inner span is about double the size of the air pressure tube, otherwise the full pressure (difference from air inlet port to the end of the exhaust hose) is not transformed into mechanical energy. As mentioned in Chapter 2.4. pressure loss in pipes (whether supplying nor exhausting) must not exceed 0.5 bar in total.



Pressure Loss

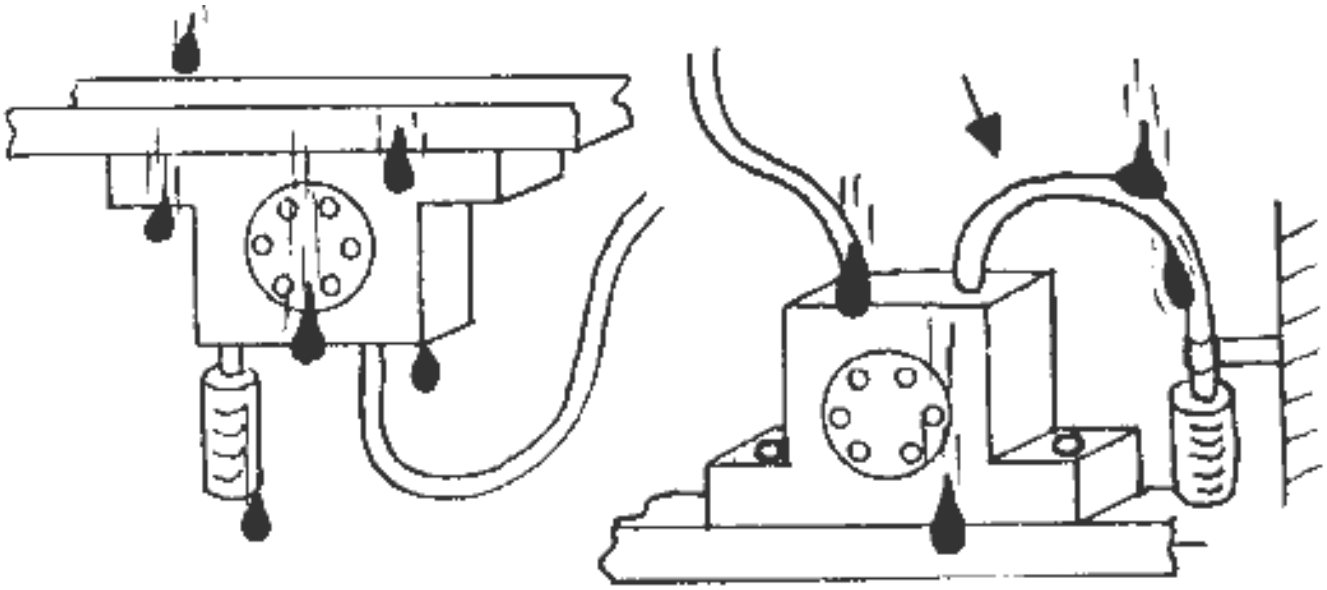
The exhaust pipe should not exceed 2 m.

6.1.4. Outdoor application

All FINDEVA vibrators may be used outdoors when operated under the following conditions :

The vibrator is to be installed so that no fluid may reach it. If the vibrator is exposed to fluids (rain drops or other moisture), one of the following steps must be taken:

- The vibrator should be mounted so that the exhaust port with silencer is turned against the ground or the exhaust port should be connected to a hose that is mounted so its end is against the ground, not allowing liquid or dirt to enter.



Mounting outdoors or exposed to liquids, dirt, etc.

- If the vibrator is exposed to fluids but above the measures can not be followed, use a silencer and have a continuous flow of about 0.5 to 1 bar (15 to 30 PSI) so that no fluids may enter.

CAUTION: Never operate vibrators without a silencer or exhaust hose if dirt, liquids or other particles (concrete powder, caustic solution, etc.) can enter the exhaust port.

6.2. Operation

After having successfully installed the vibrator, it can be set into operation.

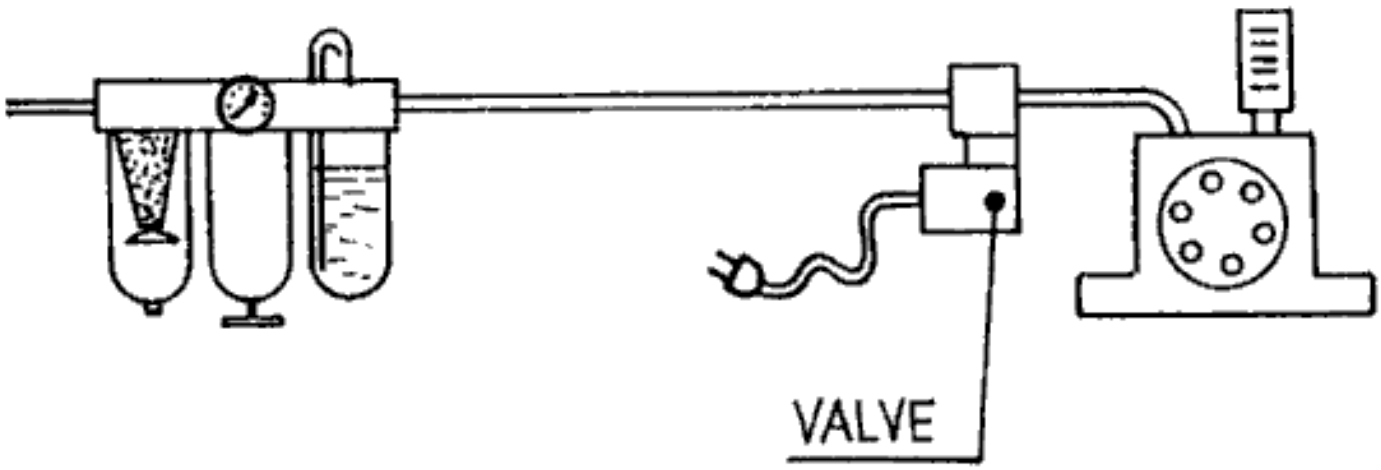
WARNINGS:

- Wear ear protection around pneumatic vibrators!
- Operation without a silencer should be avoided to keep the noise level (and possibility of ear damage) reduced as much as possible!
- Make sure the lubricator (if any) is filled.
- Make sure that the maximum air pressure to the vibrator is 7 bar!
- Check again that mounting screws are tightly fastened.
- Make sure the air pressure tube is connected to the inlet port.
- Vibrators mounted on bins and hoppers should not be operated if bin or hopper is empty since this may cause structural damage.

When starting the first time, the vibrator might reach its nominal frequency and force after only a few minutes. This is because the moving parts are covered with grease and the temperature is low so that the grease is stiff. All vibrators are run during the final inspection in the plant for some minutes but because of stocking the grease may have a chance to clog again.

We recommend that you operate vibrators intermittently for several reasons:

- the lifetime of the vibrator is extended
- costly air pressure energy is conserved
- operate only when material flow is required and shutters and gates are open to prevent material from packing in the bin, hopper or chute.
- an Operating Factor of 10 to 30 seconds ON and 1 to 5 minutes OFF has been found to be most efficient for most applications.



Intermittent operation

For intermittent operation, we recommend the use of electromechanical valves driven by timers or the machinery control system. The valve has to be set in line between the lubricator and the vibrator. The closer the valve is set to the vibrator the stronger start- and stop-intervals are. When the valve is set farther from the vibrator, the air pressure volume remaining in the air pressure tube has to be emptied and refilled.

Very often there is no need to run the vibrator at full power. Air power energy can be saved using a pressure regulator. Adjusting to the resonant frequency of the system extends the life time as well.

The frequency of all vibrators can be controlled with the help of pressure regulators in the supply pressure line. The FF-silencer connected to the piston vibrator's exhaust also allows adjustment of the vibration amplitude.

WARNING: For the following inspection wear ear protection !

When operating a vibrator for the first time, disconnect the exhaust hose and run the vibrator and measure its frequency and force. Do the same again with the exhaust hose mounted. Any difference in the values obtained show pressure and energy loss in the exhaust hose. If this occurs, increase diameter of the hose or cut the length of the hose.

The same procedure can be done with a silencer to verify the air flow is sufficient or to detect clogging.

If the vibrator cannot be set into operation or the desired operation power cannot be obtained please refer to Chapter 7.2.1. Fault Detection.

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ON-LINE MANUAL
Maintenance

7. Maintenance and repair

7.1. Maintenance

Under normal circumstances, the pneumatic vibrator units themselves do not require any kind of maintenance if they are operated in a proper way.

We suggest checking the vibrating system at regular intervals to insure that it is functioning properly. The frequency of the system can be measured with the help of a Vibrometer. A change in frequency is always the first indication for a loss in vibrating power.

> **NOTE:** The frequency of a vibrator may vary depending on the size of the air compressor and the air reservoir. Make sure frequency and power measurements are obtained only when the reservoir is filled.

Required regular maintenance for the air pressure supply includes checking the following at regular intervals :

- The air filter for accumulation of dirt (clogging). This may lead to a loss in vibration energy.
  If clogged, wash out or replace.
- The silencer for accumulation of dirt (clogging). This may lead to a loss in vibration energy.
  If clogged, wash or replace. The FF-silencer (FOR piston vibrators) can be unscrewed into two pieces and blown out with compressed air.
- The lubricator for sufficient oil in the container.

> **NOTE: Very often vibrators are damaged because the lubricator runs out of oil. Therefore, make one person responsible either to keep the lubricators filled or to check the lubricators at regular intervals.**

> **NOTE: For Piston Vibrators only !**
> The air lubricator may be filled with distilled water for the operation of piston vibrators. The materials (teflonized aluminum and leaded bronze) may be operated oilfree with only distilled water with excellent results. Operation with distilled water requires a 5 to 10 times higher flow rate than operation with oil becasue water is blown away very quickly, while oil adheres longer to the moving parts and the walls.

7.2. Troubleshooting

7.2.1. Vibrator does not start

- Piston Vibrator only: Remove it from the mount and hold it vertically in your hand. Turn it on. If it runs, check starter spring inside.

- Gumming of oil may keep the parts stuck together (mainly for FP- and DAR-Vibrators). Add ten drops of Kerosene (Petroleum) into the air pressure inlet to dissolve the gumming oil.
- If you suspect air pressure supply blockage:
    - Unscrew silencer or exhaust hose and run the vibrator. If it operates properly, then check the silencer or hose for clogging. If clogged, wash out (kerosene) or replace
    - Check air pressure to localize the blockage
      - at the compressor's site
      - at the maintenance unit (filter-regulator-lubricator)
      - at the end of the flexible tube

7.2.2. Vibrator does not always start

- Occurs in Piston Vibrators because they require a few seconds OFF- time before supplying again. Starter problems usually occur if the OFF-time cycle is extremely short.

    - The piston may need a few seconds to be pushed by the spring into the start position. This time depends on the manner of installation, with a longer supply pipe between valve and vibrator extending the OFF-time needed. Also, a clogged silencer will hinder the exhaust. To test this possibility, remove the silencer and run the vibrator. If it runs, then wash silencer out or replace it.
    - If the OFF-time required is short (less than 4 seconds), it is advantageous to use a 3-way valve so that the supply pipe to the vibrator is bled when switching OFF.
    - Using a hand-driven valve may sometimes cause starting problems if the air pressure is not moved through quickly enough. Electrically or pneumatically driven valves are recommended.
    - Insufficiently large tube or valve diameters may cause similar problems.

7.2.3. Vibrator runs too slow / Vibration power too low

New Installations

- Vibrators need up to 15 minutes to reach full power since excessive grease and anticorrosives have to be moved through.
- Adjust air pressure regulator to increase vibrator's speed
- Check that the air supply is connected to the inlet port and not to the exhaust port (arrow marks)
- Check that the flexible tube is not bent.
- Check to make sure that the inner span of the air pressure supply pipe (Paragraph 2.4. and 6.1.2.) is wide enough and not too long. Also check the inner span of the valves used.
- Check that there are not too many air consumers being operated at the same time with one air line. The consumers should be selectively controlled.

Existing Installations

- Remove silencer or exhaust hose. If the vibrator operates properly without them, then the silencer or exhaust hose is probably clogged with dirt. Wash out with petroleum (kerosene) or replace.
- Check the air line filter for accumulation of dirt. Air supply pipe irons may get rusty and these particles may clog the filter.
- Check the air supply for leaks. Make sure that the compressor is working continuously. Check to see if the flexible tube is bent.
- Eventually the lubrication oil will gum up. Add a few drops of petroleum (kerosene) into the air inlet port

to clean.
- Check vibrator for accumulation of dirt and clean with petroleum (kerosene).

7.2.4. Excessive noise during operation

High acoustic frequency:

- The vibrator is probably running too quickly or mounted too rigidly. Reduce the air pressure and adjust the vibrator to its optimal working frequency.
- The ball of ball vibrators may be worn out and cause an increase in frequency and a decrease in vibrating force.

Crackling sound

- Verify that the vibrator mounting screws are securely fixed
- If the bin or hopper is empty, cut down air supply.
- In turbine vibrators, ball bearings may be damaged

7.3. Repair

All FINDEVA vibrators except the K-series can be easily dismanteld, maintained and repaired if necessary.

The following tools are necessary :

- Pin Wrench Pin 4, 5, 6, 7 or 8 mm (refer to list figure 7.1.)
- Vise with aluminum jaws
- Hammer
- For T-Turbines: Allen key (2.5 mm : T-50/-65 ; 3 mm : T-80/-100)

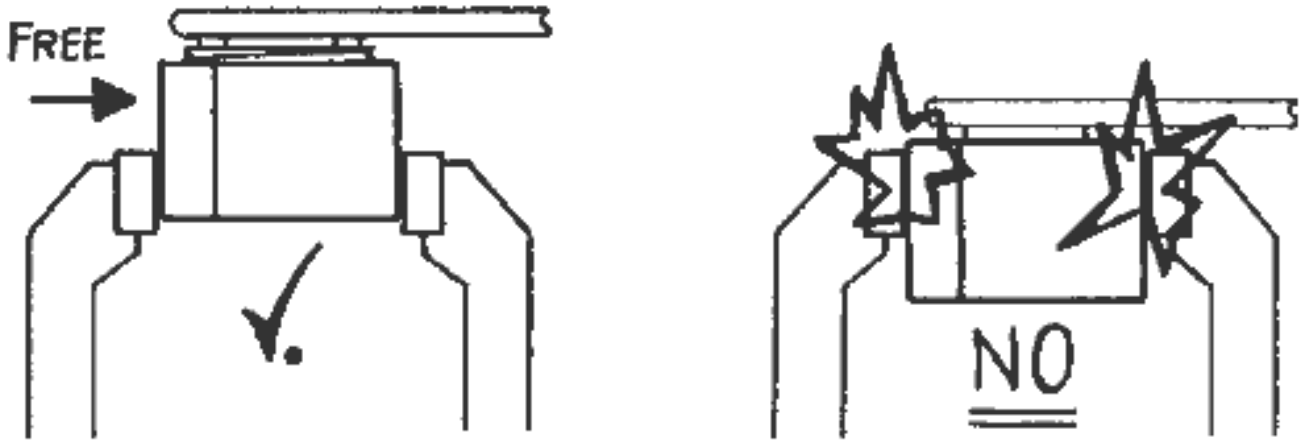
Wrench Pin diameter in mm	Models / Types			
	R	DAR	GT	FP
4	50	2	8/10	12/18
5	65	3	13/16	---
6	80	4	20/25	25/35
7	100	5	30/36	---

8	120	6/7	40/48	---
Turbine Vibrators : Pin dia. = 7 mm				

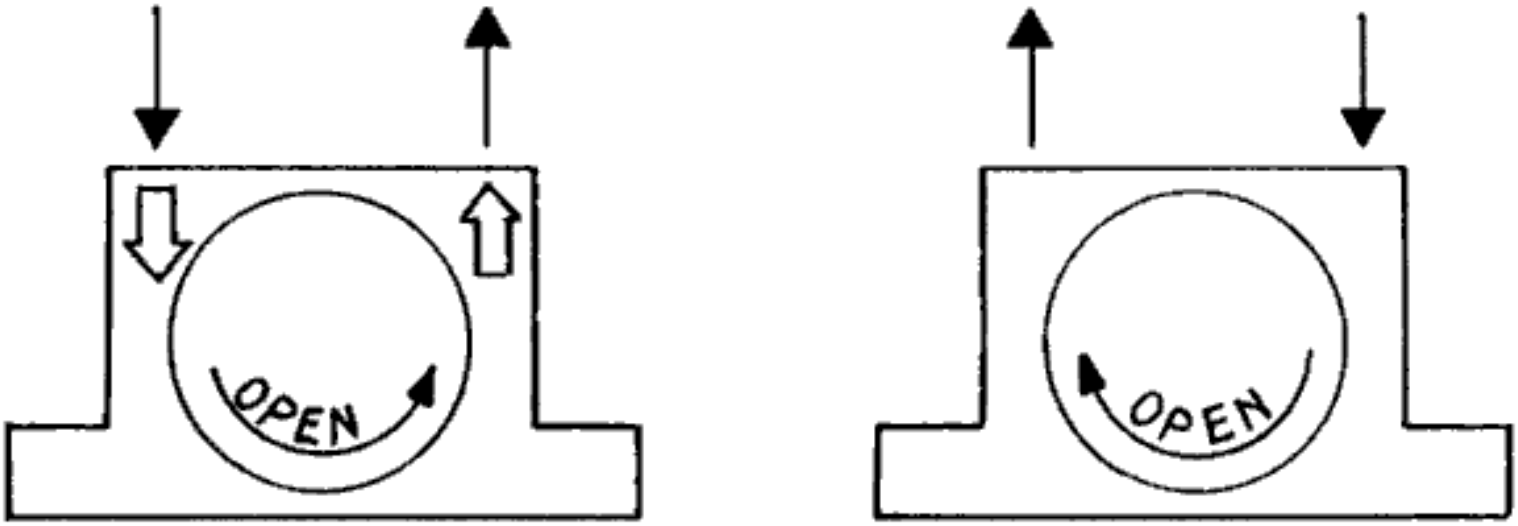
Fig. 7.1. : Pin wrench diameter cross reference

Place the vibrator as shown in figure 7.2. in the vise. Make sure that the part with the end cap to be loosened is not be pressed by the vise. Open the end cap in the same direction the rotor, ball or roller moves (figure 7.3.). Piston Vibrator end caps or sockets should be opened counter clockwise.

NOTE: If both end caps or the end cap and socket of a piston vibrator are to be opened, first loosen both sides before opening. This prevents the housing from breaking.



Do not press the end cap



Turning direction to open the end cap

NOTE: When changing parts, use only original parts. Other parts may not be of the same quality and may lead to malfunction.

7.3.1 Ball vibrators K-series

Ball vibrators should not be repaired since only the end caps and the ball can be replaced. If the ball is worn out, the races will be also, but the races can not be changed.

It is still possible to gain a few hundred hours of operation with a new ball.

The only way to open the end cap is to destroy it by drilling a hole into it. Check the races for cracks before closing again. A new end cap can be pressed in by hand.

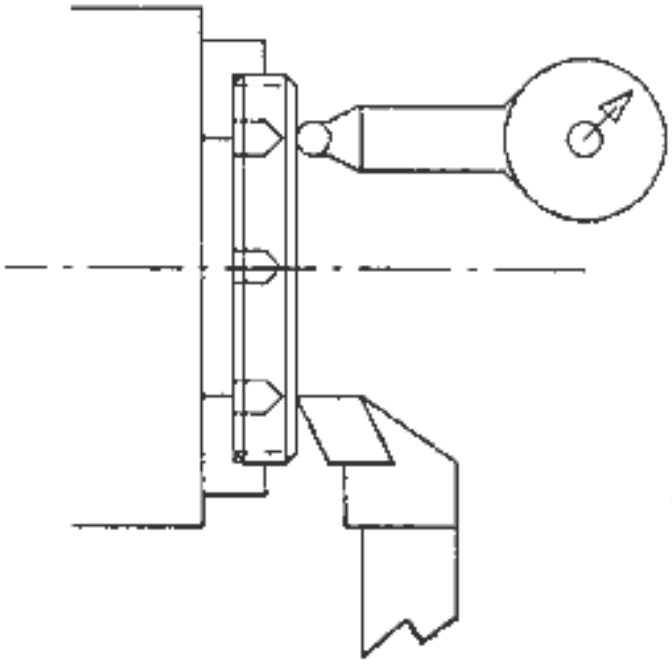
7.3.2. Roller vibrator R-series

When opening the vibrator check both of the black end caps for grooves due to abrasion of the roller. If grooves are visible it is an indication to use more lubrication and that the end caps should be changed. Please note that the end caps have right- and left-hand thread, and are sold in matched pairs only.

Also, check the roller race for rust, cracks, etc. Rust or other dirt particles may cause the roller to jump, causing the race to be worn out quickly.

It is possible to run the vibrator without the silencer plates on the end caps but the noise level will be greatly increased, and the silencer plates protect the vibrator from dirt entering through the exhaust holes.

7.3.3. Roller vibrator DAR-series



Overturn of the end plate

Like the R-series, the brass end caps may be worn out due to lack of lubrication or dirt contamination. If so place the end plate in a lathe as shown above. Check that the surface of the endplate is running true using D.T.I., and overturn the plate until it is even again.

This should be done before the groove is more than 30 µm (0.03 mm).

The total thickness of the endplate should not be less than shown below.

DAR-type DAR	-2	-3	-4	-5	-6	-7
Minimum thickness in mm	7	8	9	10	11	11

Minimum thickness of the brass end plate

Also, check the roller race for rust, cracks, etc. Rust or other dirt particles may cause the roller to jump, causing the race to be worn out quickly.

7.3.4. Turbine vibrator T-series

NOTE: Before opening the threaded end cap, make sure the Allen Key Screw on top of the housing is loosend to avoid destroying the thread.

The Allen key screw is a 2.5 mm (T-50 and T-65) or 3 mm type (T-80 and T-100).Open the threaded end cap counterclockwise. The other end cap is the same used with ball vibrator K-series and should not be moved away under normal circumstances.

The rotor and the ball bearings on its axles can be taken out of the housing. The ball bearings can be removed from the rotor's axles using a ball bearing extractor.

When reassembling the vibrator, the direction of the rotor blades is important, but the rotor cannot be mounted the wrong way because one end of the rotor axle contains a hole that fits into the fixed end cap.

When using a new threaded end cap make sure that the end cap is tightend before screwing in the Allen key screw. Now use a 4.2 mm drill (T-50 and T-65) or a 5.0 mm drill for T-80 and T-100 to spot-drill the end cap's thread through the allen screw hole, so that the headless Allen screw is securely blocking the end cap. Then, tighten the Allen key screw securely and place the sticker on the side of the end cap.

If new ball bearings are in use please note that the vibrator will need a few minutes to work up to its nominal frequency as the grease used in manufacturing is displaced.

When putting the vibrator back into operation, check the lubricator to make sure that it is operating properly and that the reservoir is filled.

7.3.5. Turbine vibrator GT-series

Under normal circumstances, the GT-Vibrator can only be openend on one side. The rotor and the ball bearings

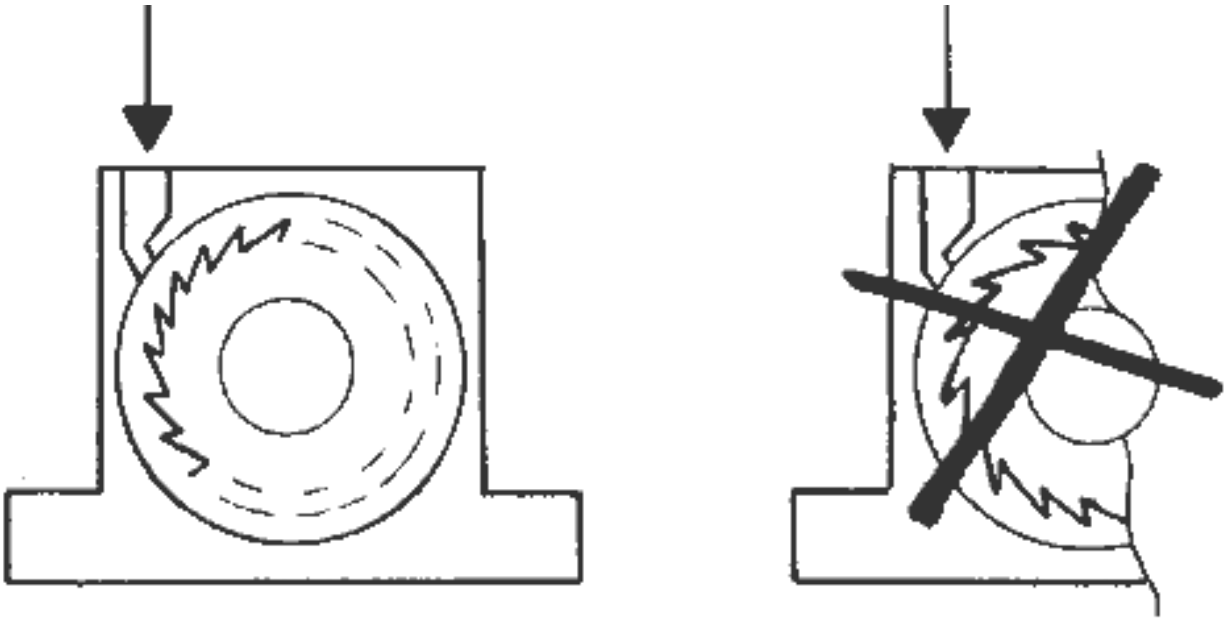
can be taken out, and the ball bearings can be removed from the axles very easily.

Please note that the ball bearings are not standard, since they must be shielded and they contain only one tenth of the standard amount of grease. This is sufficient to guarantee optimal greasing, while a standard amount of grease slows the frequency down considerably.

As a temporary solution to keep the production machines running, a pair of standard ball bearings may be used, but they must not be used longer than a few days while waiting for new original spare bearings to arrive.

NOTE: We do not recommend the use of other than the original spare ball bearings and will not take any responsibility for any damage resulting from the use of standard ball bearings.

When reassembling the vibrator, make sure that the rotor is mounted correctly. As shown in Fig. 7.6. the pockets of the rotor must be mounted so that the air pressure may fill them. Otherwise the rotor will turn, but with only about 50% of frequency and vibrating force.



Correct mounting of the rotor

Under normal circumstnces a GT-vibrator will last longer than any other type of vibrator because changing the ball bearings makes the vibrator as good as a brand new one.

7.3.6 Piston vibrator FP-series

We recommend opening the socket end (the end with the metric mounting thread and the smaller diameter).

Check the spring for correct length and the piston for abrasion tolerance according to figure 7.7.

FP-Type	Nominal Diameter / Abrasion Tolerance	Spring Length Tolerance

FP-12-S FP-12-M FP-12-L	11.985 mm / -20 µm	L=13 mm +/- 3 mm L=17 mm +/- 3 mm L=20 mm +/- 3 mm
FP-18-S FP-18-M FP-18-L	17.985 mm / -15 µm	L=19 mm +/- 3 mm L=22 mm +/- 3 mm L=25 mm +/- 3 mm
FP-25-S FP-25-M FP-25-L	24.985 mm / -10 µm	L=26 mm +/- 3 mm L=32 mm +/- 3 mm L=42 mm +/- 3 mm
FP-35-S FP-35-M FP-35-L	34.985 mm / -5 µm	L=30 mm +/- 3 mm L=34 mm +/- 3 mm L=38 mm +/- 3 mm

Fig. 7.7. : Piston abrasion tolerance and spring length tolerance

The vibrator will work if it is out of tolerance, but the leakage area between piston and boring increases with the square of the diameter. The higher the leakage the less vibrating power the vibrator is able to generate. This is especially important with both the larger models FP-25 and FP-35 because of their already large diameter. Hence, we strongly recommend lubricating the piston vibrator to avoid abrasion as much as possible.

When reassembling the vibrator, it is important to place the spring as shown in figure 7.8., with the smaller end of the spring against the piston, otherwise the spring will block and damage the vibrator.

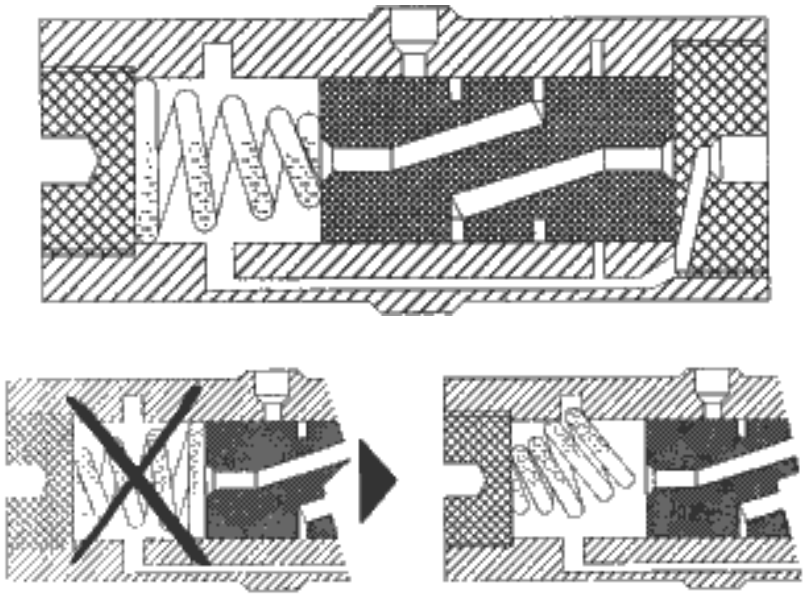


Fig. 7.8 - Correct / Incorrect installation of the spring

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Spare Parts

8. Spare parts list

8.1. Ball Vibrator K-series

Type	Plastic-Cap	Steel Ball	Silencer
K-8	91008.10	91008.20	44026.00
K-10	91008.10	91010.20	44026.00
K-13	91013.10	91013.20	44026.00
K-16	91013.10	91016.20	44026.00
K-20	91020.10	91020.20	44026.00
K-25	91020.10	91025.20	44026.00
K-30	91030.10	91030.20	44027.00
K-36	91030.10	91036.20	44027.00

8.2. Roller Vibrators R-series

Type	Threaded Cap Right	Threaded Cap Left	Roller	Screw Plug
R-50	93050.11	93050.12	93050.20	93050.30
R-65	93065.11	93065.12	93065.20	93065.30
R-80	93080.11	93080.12	93080.20	93065.30
R-100	93100.11	93100.12	93100.20	93100.30
R-120	93120.11	93120.12	93120.20	93100.30
R-80-S	96080.10	96080.10	96080.20	93065.30

8.3 Roller Vibrators DAR-series

Type	Threaded Cap Right	Threaded Cap Left	Roller
DAR-2	97002.11	97002.12	97002.20
DAR-3	97003.11	97003.12	97003.20

DAR-4	97004.11	97004.12	97004.20
DAR-5	97005.11	97005.12	97005.20
DAR-6	97006.11	97006.12	97006.20
DAR-7	97006.11	97006.12	97007.20
Silencers :	DAR-2 Sintered Type 1/8" DAR-3 to 4 Sintered Type 1/4" DAR-5 to 7 Sintered Type 3/8"		39371.00 39372.00 39373.00

8.4. Turbine Vibrators GT-series

Type	Threaded Cap Right	Threaded Cap Left	Ball Bearing	Rotor
GT-4	98004.31	98004.32	98004.10	98004.20
GT-6	98004.31	98004.32	98004.10	98006.20
GT-8	98008.31	98008.32	98008.10	98008.20
GT-10	98008.31	98008.32	98008.10	98010.20
GT-10-S	98008.31	98008.32	98008.10	98010.21
GT-13	98013.31	98013.32	98013.10	98013.20
GT-16	98013.31	98013.32	98013.10	98016.20
GT-16-S	98013.31	98013.32	98013.10	98016.21
GT-20	98020.31	98020.32	98020.10	98020.20
GT-25	98020.31	98020.32	98020.10	98025.20
GT-25-S	98020.31	98020.32	98020.10	98025.21
GT-30	98030.31	98030.32	98030.10	98030.20
GT-36	98030.31	98030.32	98030.10	98036.20
GT-36-S	98030.31	98030.32	98030.10	98036.21
GT-40	98040.31	98040.32	98040.10	98040.20
GT-48	98040.31	98040.32	98040.10	98048.20
GT-48-S	98040.31	98040.32	98040.10	98048.21
Silencers :	GT-4 to GT-10-S GT-13 to GT-25-S GT-30 to GT-48-S	Filter Type 1/8" Filter Type 1/4" Filter Type 3/8"	44025.00 44026.00 44027.00	

8.5. Turbine Vibrator T-series

Type	Threaded Cap Plastic	End Cap Plastic	Ball Bearing	Rotor

T-50-LP	98050.30	91008.10	98050.10	98050.40
T-50-HP	98050.30	91008.10	98050.10	98050.50
T-65-LP	98065.30	91013.10	98065.10	98065.40
T-65-HP	98065.30	91013.10	98065.10	98065.50
T-80-LP	98080.30	91020.10	98080.10	98080.40
T-80-HP	98080.30	91020.10	98080.10	98080.50
T-100-HP	98100.30	91030.10	98100.10	98100.50
Silencers :	T-50 and T-65 series T-80 and T-100 series	Filter Type Filter Type	44046.00 44027.00	

8.6. Piston Vibrator FP-series

Type	Piston	Spring	Socket	End Cap
FP-12-S	99012.10	99012.20	99012.30	99012.40
FP-12-M	99012.11	99012.21	99012.30	99012.40
FP-12-L	99012.12	99012.22	99012.30	99012.40
FP-18-S	99018.10	99018.20	99018.30	99018.40
FP-18-M	99018.11	99018.21	99018.30	99018.40
FP-18-L	99018.12	99018.22	99018.30	99018.40
FP-25-S	99025.10	99025.20	99025.30	99025.40
FP-25-M	99025.11	99025.21	99025.30	99025.40
FP-25-L	99025.12	99025.22	99025.30	99025.40
FP-35-S	99035.10	99035.20	99035.30	99035.40
FP-35-M	99035.11	99035.21	99035.30	99035.40
FP-35-L	99035.12	99035.22	99035.30	99035.40
Silencers :	FP-12 and FP-18 series FP-25 and FP-35 series		Filter Type Free Flow	44025.00 44029.00

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ON-LINE MANUAL
Technical Data

9. Technical data

CAUTION: In the following tables all data regarding frequencies and force have been obtained when the vibrator was mounted on a heavy laboratory test block.

In normal operation the frequency MUST NEVER reach the values given in the data tables. The normal operating frequency will reach about 60%. The practical frequency values MUST NOT exceed 75% of the given values. The values given are for comparison only since all manufacturers use data obtained on heavy lab test block or calculated without testing.

NOTE: If turbine vibrators (T- or GT-series) run too fast, ball bearings will crack or wear out very quickly!

EXAMPLE: GT-25 :

Frequency according table 9.5:
12,000 r.p.m. up to 17,000 r.p.m. (2 to 6 bar)

Practical maximum frequency on the object (60% of above):
7,200 r.p.m. up to 10,200 r.p.m. (2 to 6 bar)

9. 1. Working Moments of FINDEVA Vibrators

For some applications or comparisons it may useful to know the calculated working moments of the vibrator because the vibrating force can be calculated by multiplying by the speed of the vibration. Still, disturbances such as stiffness of the mounting, influences of the body mass and amplitude interference with external oscillations or frequencies may affect the force value and must be taken into consideration.

9.2. Ball Vibrator K-Series

Click here for dimensions and performance specifications

Noise Level Range 75 to 95 dBA

9.3. Roller Vibrator R-Series

Click here for dimensions and performance specifications

Noise Level Range 75 to 100 dBA

9.4. Roller Vibrator DAR-Series

Click here for dimensions and performance specifications

Noise Level Range 75 to 100 dBA

9.5. Turbine Vibrator T-Series

Click here for dimensions and performance specifications

Noise Level Range 65 to 80 dBA

9.6. Turbine Vibrator GT-Series and GT-S-Series

Click here for dimensions and performance specifications

Noise Level Range 60 to 75 dBA

9.7. Piston Vibrator FP-Series

Click here for dimensions and performance specifications

Noise Level Range 55 to 80 dBA .

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ON-LINE MANUAL
Definitions

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10. Definitions and terms

Acceleration
The rate of change of velocity with time (Dv/Dt) usually along a specific axis, expressed in "g".

Amplitude
The magnitude of variation from a base value (normally zero). It is used for displacement, velocity or acceleration. Excursion is double the Amplitude (Peak to peak). The value is useful in the balancing procedure to reduce the vibration forces generated by rotation by adjusting a mass in the rotating element.

Critical Frequency
The particular resonant ferquency at which a damage (or degrading in performance) to the installation occurs.

Cycle
The complete sequence of instantaneous values of a periodic event that occur during one period.

Damping
The dissipation of vibratory energy with motion or time. Critical damping is the value of damping that provides most rapid response to a step function without overshot.

Forced Vibration
The vibration motion of a system is said to be forced if it is caused by some mechanical excitation.

Free Vibration
Occurs without forcing, as after a string is plucked.

Frequency
The reciprocal value of the period. The bestknown unit is Hertz (Hz), which represents cycles per second. When referreing to vibrators, cycles per minute or revolutions per minute (r.p.m.) are common.

Impact
Impact is a single collision between masses at least one of which is in motion.

Impulse
The intergral force within a time window.

Intensity
The severity of a vibration or shock. Similar to amplitude but without specific connotation.

Isolation
Isolation is the reduction in severity of motion, usually attained by proper use of resilient support.

Jerk
Refers to the ratio of change of acceleration with time (Da/Dt).

Natural Frequency
The frequency of free vibration of a system.

Oscillation
The variation with time of a quantity, such as force, pressure, displacement or velocity. Usually some regularity such as sinusoidal or complex vinration is implied.

Peak
The extreme value of a varying quantity measured from the base or mean value.

Period
The period of a periodic vibration is the smallest interval of time in which the vibration repeats itself.

Response
The vibration motion, force or energy of a mechanical system that results from some mechanical input to that system.

Resonance
In a true Single-Degree-of-Freedom system resonance exists when any change of excitation frequency causes a decrease in its response. Therefore, resonance represents the maximum response of the sprung mass, if frequency is varied while input force is kept constant.

Transient Vibration
The temporarily sustained vibration of a mechanical system.

Vibrometer
A device to measure the frequency of a vibrating machine. Usually an extendable spring that can be adjusted to come in resonance at defined lengths.

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