THE ARTHUR G. RUSSELL CO., INC.

# VibroBlock® Systems, Some Basic Concepts And the VBC 2000/2500

**Introduction:**
The following will explain some of the basics of vibration, and more specifically how they relate to VibroBlock® feeders tracks and bins. The importance of tuning and its relationship to the control system will be covered. We will explain these concepts in terms useful to the non-technical person as well as the experienced feeder technician.

**Resonance:**
Virtually everything in our world has resonance. If you strike an object, it will vibrate at some frequency. This frequency is determined by many factors, but we will examine only those relating to the VibroBlock®. If you have ever pushed a child on a swing, you were working with the same sort of resonance that is present in a VibroBlock® system. Because of the length to the chains and the weight of the child, a certain resonant frequency has been created. As long as you push the swing at the proper time, very little energy will be required to keep it moving. If you step closer to the swing you'll be forced to push it before it comes to a complete stop. It will take more energy to keep the swing moving this way. This is an example of trying to move a device at higher than its resonant frequency. If you step a little back from your original position, some of your forward push will be wasted while not in contact with the swing. This is an example of trying to move a device at lower than its resonant frequency. These examples are virtually the same as the concepts used to tune a VibroBlock® system.

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**Tuning:**
Proper tuning is essential to the operation of all VibroBlock® systems. A properly tuned VibroBlock® system will feed efficiently, run cool and use minimal electricity. The above swing example might lead one to believe that exact resonant tuning is the best approach; this is not entirely true however. Experience has shown that tuning a VibroBlock® system approximately 1.5 cycles above line frequency provides the best performance and longest life. When a VibroBlock® system is run at its resonant frequency, it is so efficient that it can become unstable. Tuning slightly above frequency provides the equivalent of a slight friction on the system, which enhances stability. We always tune a VibroBlock® system above frequency rather than below since tuning decays slightly over time. Sometimes there's a temptation to tune at a frequency higher than 1.5 cycles above line frequency. This may be done to increase load current. While this usually isn't harmful it can cause some instability such as pulsations. As a general rule, it is almost always better to tune at 1.5 cycles above line frequency. This should be done at higher than the highest amplitude you ever anticipate to run. This is important since resonant frequency drops as amplitude increases. If you initially tuned at a lower amplitude and increased it later, you could end up too close to line frequency, which would indicate a tuning fault and light the tuning indicator

**Controllers:**
Various methods have been employed over the years in controllers used to drive vibratory equipment. The simplest is the variable transformer and rectifier. This method provides adjustable half wave DC power to the vibrators. Servo feedback cannot be provided with this method to compensate for load in the feeder bowl. By far the most popular is the SCR drive. SCR drives offer many advantages including the ease of incorporating servo control. This type of drive is used in all VibroBlock® controllers. Variable frequency controllers are also available and enable you to run a feeder at its own resonant frequency. While variable frequency can offer some advantages, it does have some drawbacks. The controls are generally much larger and more complex. Also running two vibratory devices on a machine can cause significant vibration problems caused by the differences between the two frequencies. Running feeders and tracks at different frequencies can also cause part transfer problems.

**SCR Drives:**
The SCR is a rectifier; it changes AC current into DC. What makes an SCR unique is its ability to be controlled. By changing the time in the AC cycle that you turn an SCR on, the amount of power going to the vibratory system can be controlled electronically in real-time. VibroBlock controllers typically turn on between 90-180 degrees positive. SCR drives are small simple and able to switch large amounts of current.

**Servo Control:**
The most effective way of maintaining proper vibration over time is servo control. Servo control incorporates some type of sensor that can measure the vibration and report this information back to the controller. The controller can then act on this information and adjust the power output of the controller. Various devices can be used to detect this vibration. Magnetic, proximity, photoelectric and accelerometers have all been used in servo control. The single chip accelerometer, the newest technology is the most accurate and dependable method of measuring vibration. This is the method used in the latest series a VibroBlock® controllers. These are the VBC2000 and VBC2500 series of controllers. The accelerometer assembly is referred to as the transducer.

**Servo Concept:**
The basic servo concept used by VibroBlock® controllers is really quite simple. When the controller is turned on, power output is rapidly increased towards maximum output. As the transducer senses vibration it sends an increasing voltage signal back to the controller. When a user set vibration level is achieved, the transducer causes the controller to hold the power output at that level. The transducer continues monitoring vibration and making small adjustments in power output to keep vibration constant. This is very similar to cruise control in a car.

# VBC 2000/2500

**Transducer Function:**
As the transducer vibrates, it produces a low voltage sine wave signal whose peaks correspond to acceleration and deceleration of the VibroBlock®. The controller stores the peak positive voltage every cycle. The previous stored signal is erased first, so that this new stored signal will have no accumulated error. This stored signal is compared against a reference signal provided by the user, from either the front panel buttons or PLC interface. The phase angle of the transducer signal is compared to the power line and the result is used to indicate proper tuning. Since the tuning indicator light is controlled by phase angle, it is very important that the transducer be installed correctly on the VibroBlock®. An arrow on the transducer indicates the axis of vibration. The arrow points in the direction of the power stroke, which is also pointing at the coil assembly face. Refer to the instruction manual for proper installation of the transducer. Besides mounting the transducer backwards, another common mistake is mounting the transducer on the non-vibrating side of the VibroBlock®. Sometimes this mistake can go unnoticed, since the feeder may appear to run normally. You'll notice however that a very small number of pulses will bring it from 0 to full amplitude. The tuning light is accurate <u>only</u> when vibration is adjusted to operating amplitude.

**Pulse Control:**
VBC2000/2500 controllers offer a unique method of amplitude control. Rather than a potentiometer, amplitude is adjusted by way of push buttons or digital inputs. Repeatedly pressing the left up down arrow button will increase the output power. Doing the same thing while holding down the center button will decrease the output power. When the desired vibration amplitude is reached, pressing the save button will store this setting in non-volatile memory. The functions of the left and center button are also available via optically isolated digital inputs. This allows for remote adjustment from a PLC or other intelligent controller. In this way, analog type adjustment is available without the cost of analog. The save function is not available in this manner and no setting above 0 should ever be saved when using this control method. Sample Allen Bradley PLC code is available in the operators manual. It should be noted that there is a five to seven pulse dead band from 0 until vibration starts. This is provided to guarantee complete shut off under all conditions when using pulse control. The number of pulses required to achieve a particular amplitude will vary with each application. There are three reasons for this: 1. The transducer measures amplitude at the VibroBlock®, so real amplitude measurement on a feeder bowl will depend on the distance from the transducer to the bowl rim. 2. The transducer is an accelerometer and acceleration increases with frequency. The servo concept mentioned earlier means that more pulses of amplitude setting will be required to overcome the larger transducer signal at a higher frequency. 3. Tuning and power to weight ratio also have a small effect on actual amplitude.

Pulsing by the PLC provides a means to soft start/stop the feeder and change the vibration level during operation. This may not be desirable on some devices, such as tracks and bins when instant on/off is desired. Contacts C1 and C2 are available to perform this function.

**Load Current:**
The load current meter can provide useful information. The numbers displayed are actual DC current flowing to the VibroBlock® system. The units are amperes to one decimal point. The meter does not display vibration amplitude and will not always increase, and may even decrease when increasing output power. As vibration increases, the resonant tuning frequency slightly decreases. This makes the vibrator more efficient as was mentioned earlier. This is why current can decrease even while amplitude is increasing. The load current reading can be used to detect overloading the VibroBlock®s by comparing this reading with the sum of the VibroBlock®s nameplate amperage. VibroBlock® systems typically run at 50 to 80 percent of full load current. The load current is a function of the overall power to weight ratio, as well as the tuning of the system. Recording the load current on a new system, and rechecking it periodically can give early warning of potential problems. Such problems could be broken springs, loose or broken screws or weight added or removed from the system.

**Frequency:**
VBC2000 and VBC2500 controls are available for 50 or 60 Hz, 120-volt power sources. Check the nameplate for correct application.