

HOW TO LEVEL A PRESS USING A PRECISION MACHINISTS LEVEL



A Technical Bulletin by
VIBRO/DYNAMICS LLC

HOW TO LEVEL A PRESS USING A PRECISION MACHINISTS LEVEL

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HOW TO LEVEL A PRESS USING A PRECISION MACHINISTS LEVEL

The purpose of this bulletin is to provide a better understanding of the importance of properly installing and leveling a press, and to provide instructions and helpful hints on how to properly use a machinists level to ensure the best results. In order for a press to perform to its maximum design capabilities, and to extend the life of the press and tooling, the press must be installed and mounted in a way that accomplishes all four conditions:

1. The press bed surface must be level or in one plane if bed is sloped.
2. The press structure and components must be in precise alignment and parallelism.
3. The press must have a support condition that equals its weight distribution.
4. Vibration must be effectively controlled without compromising conditions 1, 2, or 3.

If any of the four conditions above are not met, then the maximum potential of the press will not be realized. All four conditions can be easily accomplished with Vibro/Dynamics' Anti-Vibration Isolators.

This technical bulletin will cover the first three conditions listed above, namely leveling, alignment, and fine-tuning the support condition of the press.

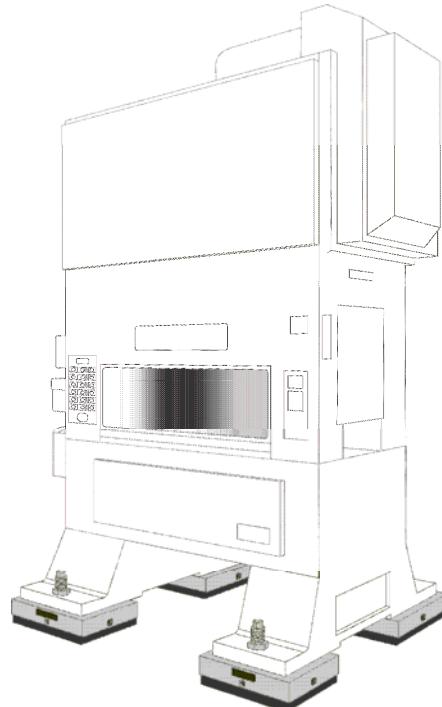
IMPORTANCE OF LEVELING AND FINE-TUNING

It is common knowledge that presses perform better when they are precisely leveled and aligned. This is easily accomplished using Vibro/Dynamics' Isolators with integral leveling adjustment screws.

Two things occur when the isolator's precision adjustment screws are turned:

1. You raise or lower the isolator to precisely level and align the press bed.
2. You increase or decrease the amount of load supported by the isolator to fine-tune the support condition of the press.

Press beds are very rigid, but they will twist. Steel and iron will stretch, bend, and twist when load is applied. When a press is initially set down, the floor doesn't support all four feet properly because the floor surface is not a precise surface and not in one level, flat plane. This causes the press bed to be out-of-level and to twist slightly. Even a slight twist can cause excessive wear and tear on the press and on the dies.

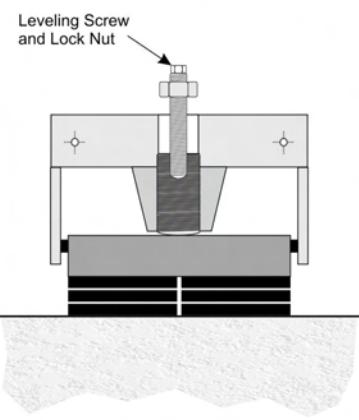


The best way to remove twist from a press bed is to adjust the precision leveling adjustment screws in the Vibro/Dynamics' Isolators until the press bed is level and in one plane over its entire surface. Using isolators, this is a very fast, easy, and accurate process.

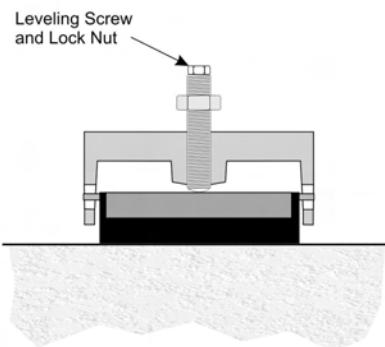
Press builders design and machine the press bed to very tight tolerances to assure a nearly perfect bed surface. Many begin construction of the press by setting-up the bed in their plant, using press isolators or some other device to make sure the bed surface is level and in one plane. Virtually every other part of the press will be assembled parallel or perpendicular to the bed. This proper alignment and parallelism can be duplicated only if the press bed is installed at the user's plant using a method that returns it to a precisely level, untwisted, and properly fine-tuned support condition.

EXAMPLES OF PRECISION LEVELING ISOLATORS

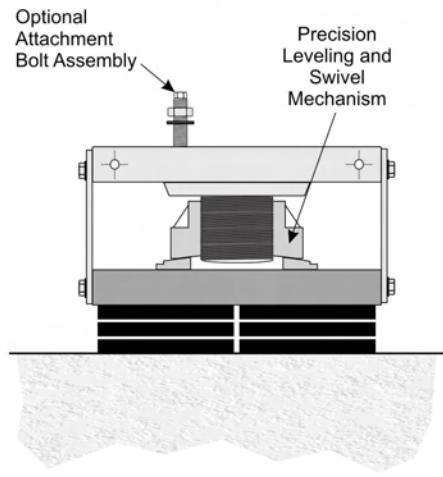
Vertical Leveling Screw Type for Large Presses



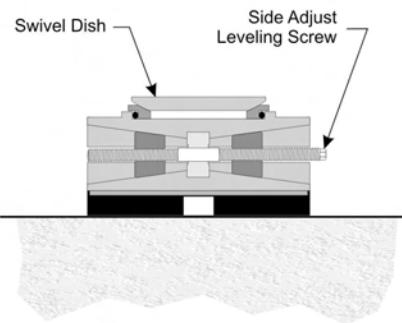
Vertical Leveling Screw Type for Small to Medium Size Presses



All Internal Vertical Leveling Type



4-Piece Wedge Type



Features and Benefits

- ◆ Integrated precision leveling
- ◆ Precisely adjustable
- ◆ Swiveling capability
- ◆ No grout, shims or anchors
- ◆ Effective control of vibration and shock

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HOW TO USE THE MACHINISTS LEVEL

A precision machinists level is a very precise instrument. It is designed to detect very small deviations in the level of a surface (inclination), and more importantly, to indicate when that surface is level. When properly used, it will indicate when a press bed is level and flat (untwisted) to tenths of thousandths of an inch. This is extremely important, because the dies, bearings, gibbs, and other components of the press are designed and built to these close tolerances.

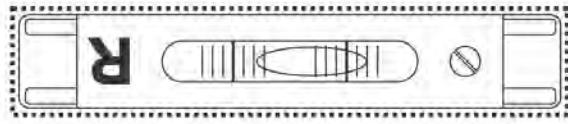
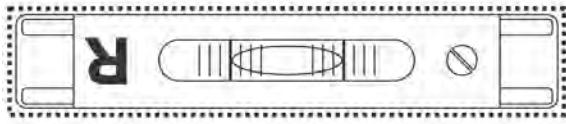
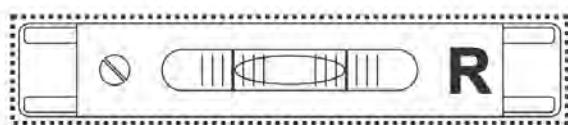
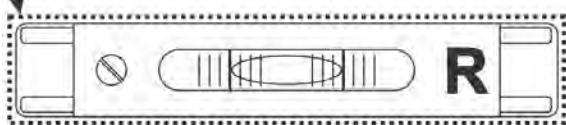
The machinists level must be used correctly, or the readings may be misleading. It must always be stored, handled, and used carefully. It must also always be kept in precise calibration. If it is not calibrated properly, it may indicate that the press bed is level, flat, and untwisted, when it really is out of level, not flat, and twisted.

LEVEL CALIBRATION

To calibrate your level, see the instructions supplied with the level, or use the following procedure:

1. Clean the bottom surface of the level. It must be clean, dry, and free of nicks and scratches.
2. Place the machinists' level on a clean flat surface.
3. Outline the level with a felt-tip pen. See figure below.
4. Record the bubble reading.
5. Turn the level 180° and carefully place within the outline marking.
6. Record the bubble reading.
7. If both readings are the same, the level is in calibration.
8. If the readings are different, the level must be calibrated. See the Level's Owner's Manual for instructions.

Outlined Area



Level is Calibrated

Level is NOT Calibrated

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LEVEL PREPARATION

Mark the letter "R" on the top of one end of the machinist's level as per Figure 1. Every time you place the level on the press bed, the end marked "R" must be either toward the **Rear** of the press or to the **Right** end of the press. See Figure 2.

When reading the level, look at both ends of the bubble because the bubble size can change:

1. When it is cold, the bubble gets bigger
2. When it is warm, the bubble gets smaller

The liquid expands as the temperature goes up, leaving less room for air in the bubble. If someone breathes on the bubble or covers it with their hand when moving the level, the bubble size can change. Other things that can affect the bubble size are drafts and temperature changes caused by heating/air conditioning units, doors opening and closing, nearby high intensity lighting, and so forth.

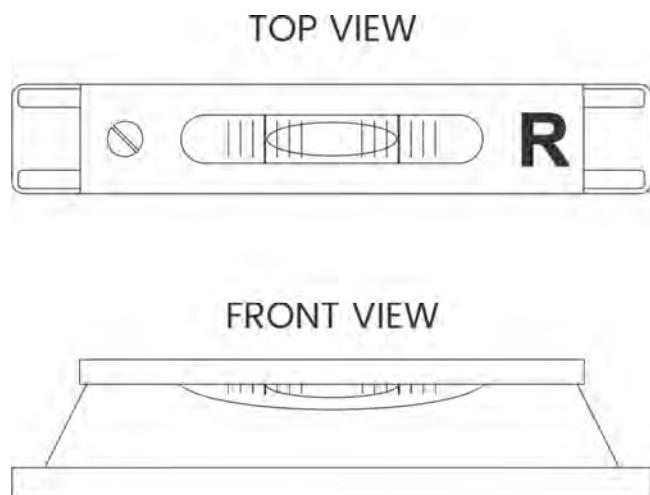


Figure 1

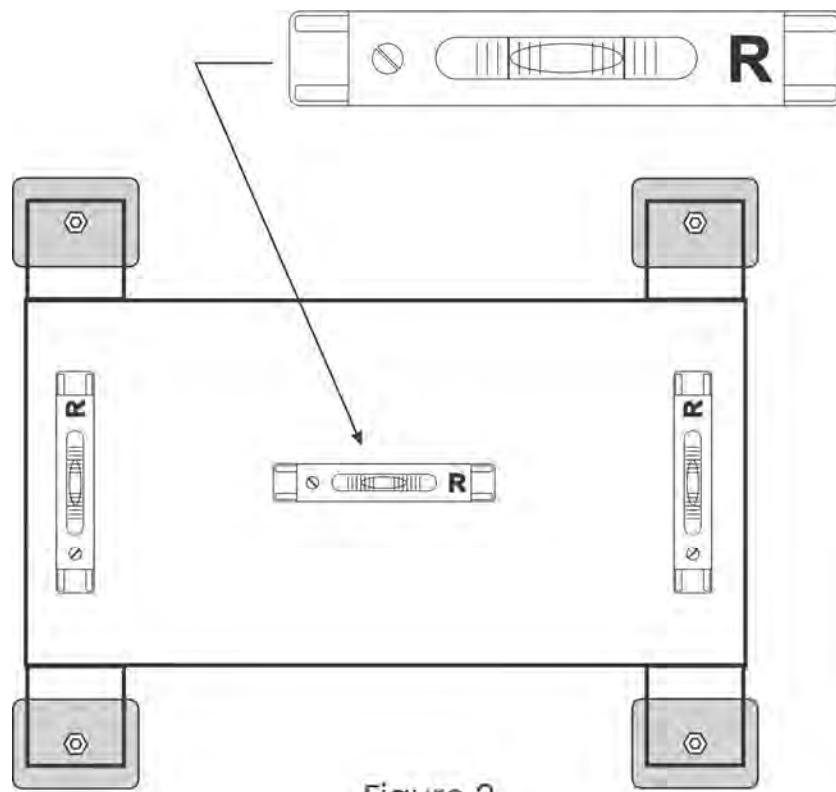


Figure 2

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A typical machinist's level reads in units of .0005 inch per 12 inches, although some use different units. When reading a typical machinists level, if the bubble is one division to the right, then the measured surface has an upward slope to the right of .0005 inch for each 12 inches of distance along that surface. For example, referring to Figure 3, if the press bed is 72 inches wide, and the bubble is one division to the right, then the level is indicating that the right side of the press bed is 0.003" higher than the left side. $(1 \text{ bubble} \times 0.0005" \text{ in./ft.}) \times (72/12 \text{ ft.}) = 0.003"$

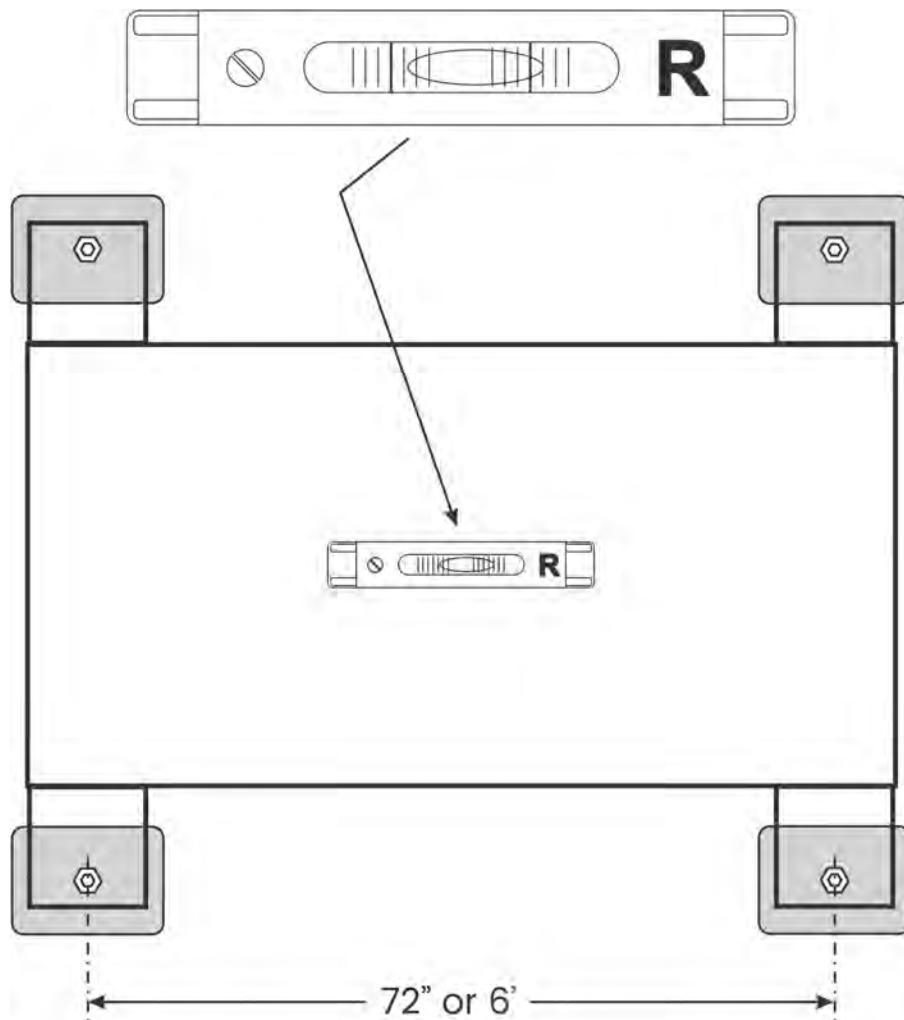


Figure 3

PRESS BED PREPARATION

USE CAUTION! – ALWAYS FOLLOW REQUIRED SAFETY PROCEDURES WHEN WORKING ON THE PRESS. FOLLOW ALL LOCKOUT AND TAG-OUT PROCEDURES, BE SURE THE FLYWHEEL HAS STOPPED TURNING, AND THAT SAFETY BLOCKS ARE IN PLACE BEFORE EXTENDING ANY PART OF YOUR BODY INTO THE DIE AREA!

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After calibrating the machinists' level, prepare the surface of the press bed or bolster plate to ensure accurate readings. Make sure that each spot on the bolster plate where the level is placed is clean, dry, and perfectly flat with no scratches, dents, or bumps. Wherever there is a scratch, there is a ridge sticking up next to it. If there is a drilled hole, the metal around the hole is raised. If you place the level on these ridges or high spots, the level will give false readings.

If you can't find a good spot to place the level, the bolster plate should be ground flat and parallel. If there are just a few scratches or small dents, you can usually correct it by stoning the area with a fine-grained stone. Don't use a file or coarse stone; you may remove too much metal. All you want to do is remove the raised metal around the scratches and dents. Remember, you are measuring this surface to tens of a thousandths of an inch or better. The level should be positioned so that it is parallel to the front and rear edges for left-to-right readings, and parallel to the left and right edges for front-to-rear readings, as in Figure 4.

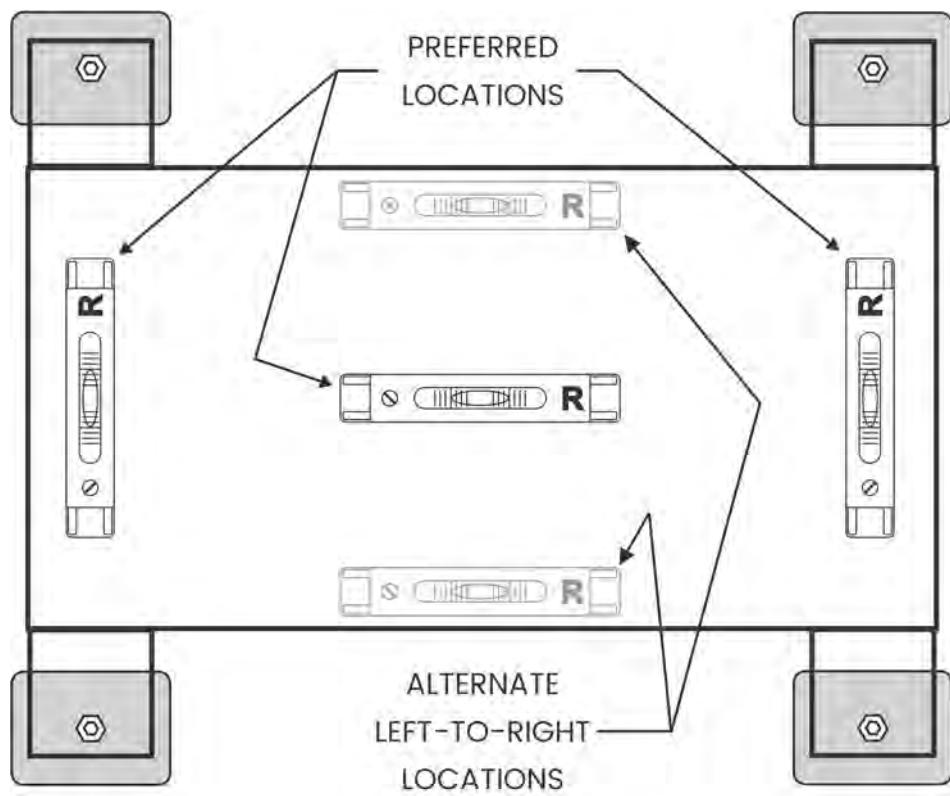


Figure 4

When you have the level in the desired leveling location, mark the outline of the level on the bolster plate with a felt tip pen. This allows you to return the level to exactly the same location. When you return the level to a leveling location, make sure that it's within the marked outline and not sitting on any ink. When you relocate the level, make sure that the bottom surface of the level is clean by carefully wiping the level with a clean, dry cloth.

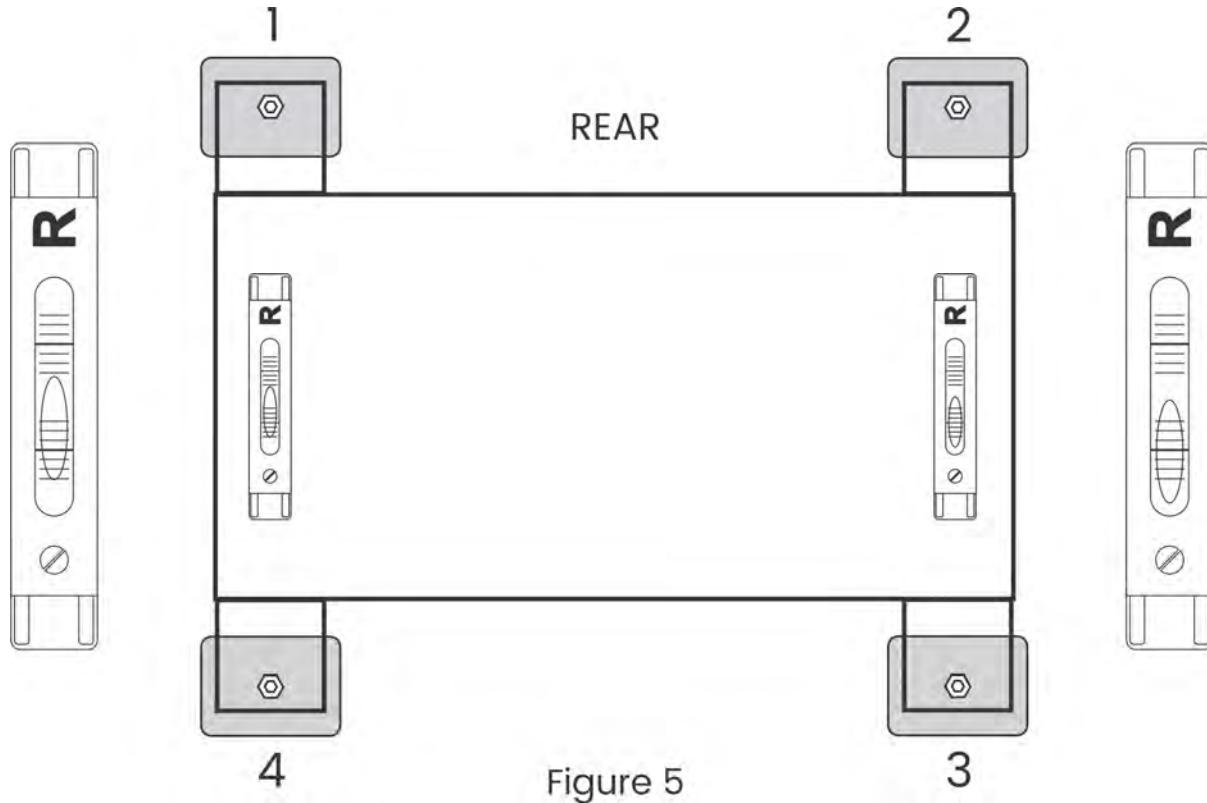
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HOW TO LEVEL THE PRESS BED

USE CAUTION! – ALWAYS FOLLOW REQUIRED SAFETY PROCEDURES WHEN WORKING ON THE PRESS. FOLLOW ALL LOCKOUT AND TAG-OUT PROCEDURES, BE SURE THE FLYWHEEL HAS STOPPED TURNING, AND THAT SAFETY BLOCKS ARE IN PLACE BEFORE EXTENDING ANY PART OF YOUR BODY INTO THE DIE AREA!

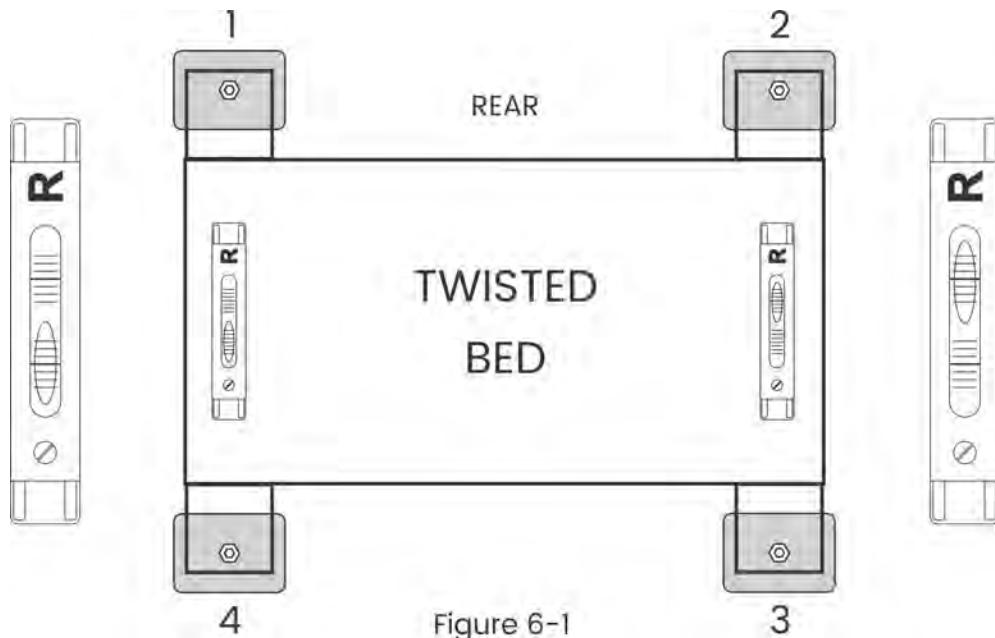
Leveling in the Front-to-Rear Direction

1. Using a precision machinists level, check the level of the machine in the front-to-rear direction; making sure that the “R” is to the **Rear** of the press.
2. If your level condition is as shown in Figure 5, the rear of the press is low. Raise feet 1 & 2, alternately and in small increments, until the press is level at both level locations.
3. If the front of the press is low, raise feet 3 & 4, alternately and in small increments, until the press is level at both level locations.

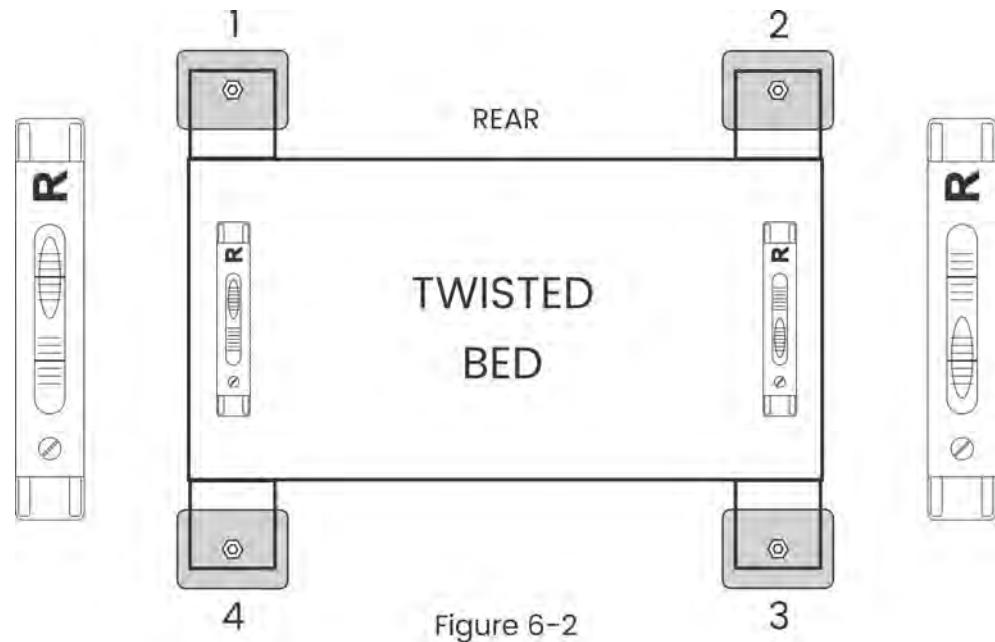


If your level condition is as shown in Figure 6-1, the press is twisted. Raise feet 1 and 3, alternately and in small increments, until press is level in both locations.

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4. If your level condition is as shown in Figure 6-2, the press is twisted in the other direction. Raise feet 2 and 4, alternately and in small increments, until press is level in both locations.

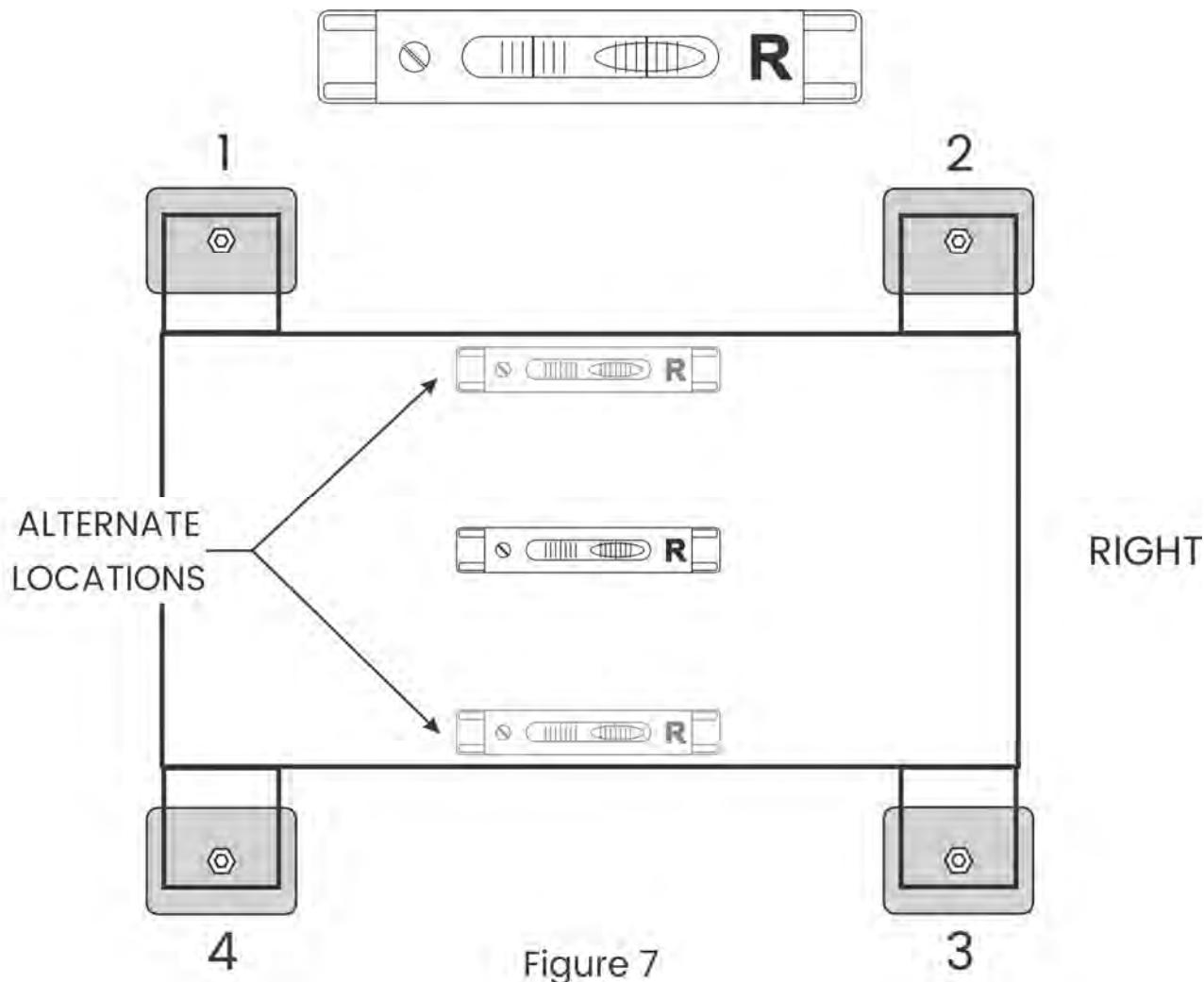


CAUTION: Any twist in the press structure will result in increased wear and tear on the press and its tooling. Every effort should be made to remove all twist!

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Leveling in the Left-to-Right Direction

5. Using a machinists' level, check the level of the machine in the Left-to-Right direction, making sure that the "R" is to the Right side of the press.
6. If your level condition is as shown in Figure 7, the left side of the press is low. Raise feet 1 & 4, alternately and in small increments, until the press is level at both level locations.
7. If the right side of the press is low (bubbles reversed), raise feet 2 & 3, alternately and in small increments, until the press is level at both level locations.
8. Repeat Steps 1 through 8 until the press is level at all of the level locations shown in Figure 4.



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FINE-TUNING™ THE SUPPORT CONDITION

The third condition required for optimal press performance and long life is to properly support the press so that its support condition mirrors the weight distribution.

Fine-Tuning is not usually required if the press was carefully leveled and aligned. However, if the press bed is very rigid, it can maintain apparent level even when supported mainly by three isolators. The leveling screw of an isolator not carrying proper support will turn easily. If this condition is found, then fine-tuning is required.

In some cases, lack of proper support by an isolator may not become apparent until the machine starts running and excessive press motion results. The excessive motion is caused by the press rocking on a high diagonal pair of isolators, similar to a table with one short leg. Fine-Tuning can help correct this situation.

Fine-Tuning is a process of making fine adjustments to a machine's support condition without affecting the machine's level condition. This is possible because as the isolator's leveling screw is turned, that isolator supports additional weight. The additional weight deflects (compresses) the isolator's resilient member, offsetting the added height due to the turning of the leveling screw. This results in very precise adjustments.

The goal is to achieve a support condition where the percentage of press weight supported by each isolator matches the press weight distribution. Equal adjustments to each isolator on the diagonal pair will also maintain the machine's level condition.

The benefits of Fine-Tuning are increased press and tooling life; less downtime; higher quality, repeatable parts; greater productivity; less stamping force required to make a part; reduced press motion; and a longer lasting, trouble-free installation.

It may be possible to use a Manual Fine-Tuning Process on lighter, high-speed presses using the energy generated by the press (press rocking) to make adjustments. Also, inspecting how much an isolator's resilient member bulges can also serve as a guide as to how much load an isolator is carrying compared to the others. *Remember:* Depending on where the machine's center-of-gravity is located, all isolators may not support an equal amount of load, so the resilient members will not bulge the same amount! Let logic be your guide.

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For comparison purposes, it should be noted that hard-mounted presses typically have support conditions where 90% of the press weight is on one diagonal and 10% on the other. Often, one of the press feet does not support any weight at all!

Pad material and competitive isolation mounts are not much better, since they are often too small to handle the heavy loads and severe impact over long periods of time and tend to pack down, causing improper support.

Improper support causes the press to twist during operation, causing excessive press and tooling wear and increased machine motion.

MANUAL FINE-TUNING

Only one man should perform the following steps. Make sure that none of the leveling screws is rubbing against the inside surface of the mounting hole. This *will* affect the Fine-Tuning Process.

1. Loosen the Lock Nuts if tight.
2. Run the press at full speed and observe the amount of vertical motion at each support point.
3. Using a short-handled wrench, apply torque to the leveling screw of the isolator that appears to be moving the most.
4. If the leveling screw turns easily, it should be noted and returned to its original position. The leveling screw turns easily because the isolator is not carrying enough support and is unloading as the press rocks from corner to corner. The screw will turn in a step-like sequence with the rocking of the press.
5. If the screw turns hard, it should be noted how difficult it was to turn and left at its original position.
6. Continue the process until all isolators have been checked, results recorded, and a complete picture of the press' fine-tune support condition is developed.
7. Check your findings with the estimated weight distribution of the press and make a determination on which isolator needs adjustment, if any.
8. If adjustment is determined to be necessary, continue with the following steps. If not, tighten the Lock Nuts and end the process.
9. Return to the isolator whose screw turned the easiest and make a *small* adjustment while observing the effect of the adjustment on the press motion.
10. If press motion is reduced, record the amount that the leveling screw was turned and proceed to Step 12.
11. If press motion was unaffected, return the leveling screw to its original position and check the isolator that had the next greatest amount of motion. Repeat Step 10 until all isolators have been checked and then proceed to Step 12.

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12. Recheck the press' level.
13. If press level is not level, turn the diagonal isolator of the one that was adjusted, an equal amount or return all isolators to their original level positions.
14. Recheck the press' level.
15. If press is level and motion reduced to a satisfactory amount, proceed to Step 16. If not, continue making fine adjustments to the diagonal pair of isolators until press is level and motion is reduced as much as possible. Proceed to Step 16.
16. End Process.

Properly functioning isolators *will* allow some motion. This is normal! The motion is due to the press shock energy being isolated.

If you were unable to reduce press motion to a satisfactory amount, there may be other causes. Excessive motion may result from an inadequate foundation or floor; poor soil conditions; overloading of the press; extremely off-centered tooling; or isolators that are too soft to handle the unbalanced forces generated by the press. Contact Vibro/Dynamics for assistance.

FINAL CHECKOUT

Check all leveling locations (Figure 8) to see if the press remained level and free of twist after the initial leveling and fine-tuning procedures.

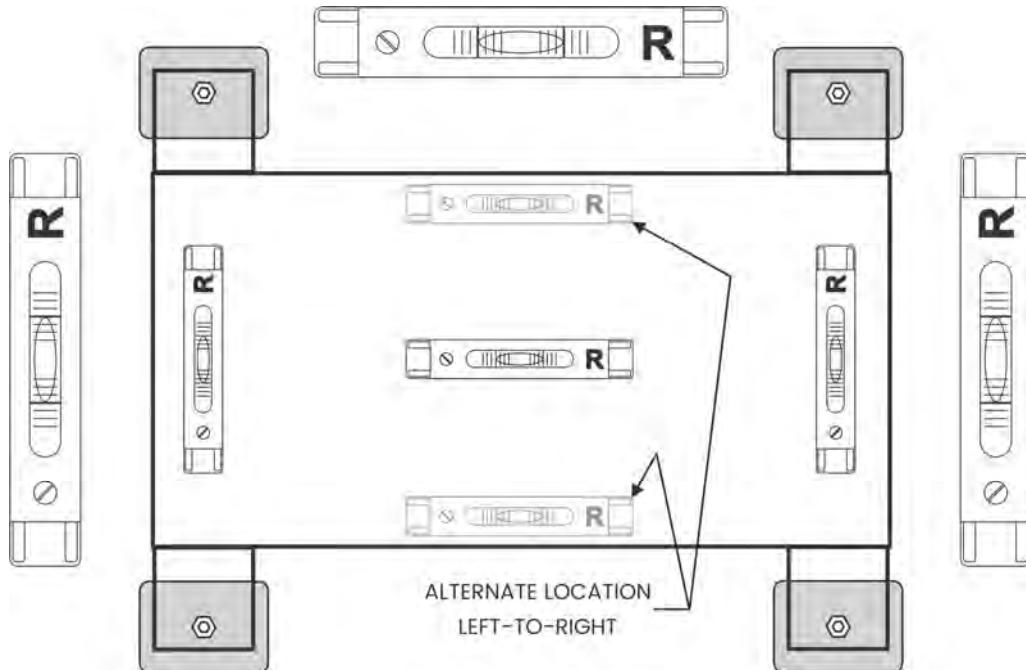


Figure 8

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To check for a twist, take two level readings in the left-to-right direction, one along the front edge of the press bed and the second along the rear edge.

By comparing these two readings as you did the front-to-rear readings in steps 1 and 2 in the "How to Level the Press Bed" section, you can determine whether a twist is indicated.

Several things may cause the apparent twist. If it is a new press, with the surface of the bed/bolster in perfect condition, then the surface may not have been machined perfectly flat in a stress free state. A bed surface that was not machined flat is very difficult, if not impossible, to make perfectly flat by adjusting the support under the press feet. The bolster and/or bed surfaces may have to be re-machined to make them flat and parallel.

Before going to the expense of re-machining the bed/bolster, you should check two things:

- Is the amount of twist great enough to cause problems of excessive wear on the press and the tooling, and
- Is the apparent twist really due to machining imperfections, or is it due to inaccurate level readings?

The ten most common causes of inaccurate level readings are:

1. Level not calibrated properly,
2. Level not read properly,
3. Level turned 180° when moved from one reading location to the next,
4. Level not placed in same position for each reading,
5. Level knocked out of calibration during readings,
6. Level placed near left end when taking front reading, and near right end when taking rear reading (instead of being centered left-to-right),
7. Bed surface not prepared properly so it still had scratches, bumps, etc.,
8. Bed surface or bottom surface of level not kept clean while taking readings,
9. Material accidentally left between top of bed and bottom of bolster, causing the bolster to be warped, and
10. Bolster not bolted down tightly or uniformly.

HOW OFTEN TO RE-LEVEL?

Every excellent press maintenance program stresses the importance of leveling and fine-tuning the support of a press at the time it's first installed. It is equally important to keep it that way.

The floor/foundation supporting a press will usually shift and settle under the weight of the press and the tremendous impact forces and vibration caused by the stamping operation. Settling can occur throughout the life of an installation, but usually the greatest amount of settling occurs during the first few months. Settling occurs no matter what method is used to install a press. When using isolators, settling generally occurs more slowly and to a much lesser extent.

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Whatever method has been used to install and level the press, Vibro/Dynamics recommends checking the level after the first 200 hours of operation, depending on the severity of the operation (*heavy blanking presses should be checked sooner than light forming operations*) If no settling has occurred and the press is still level, a second check should be done after another 400 hours If the press remains level, a third check should be done after 800 hours, and once a year thereafter.

If settling is observed at any check, than the press should be brought to correct elevation and level and the frequency of checks should be increased. If the floor/foundation continues to change and settle continuously, you may want to contact a foundation design and soil characteristic engineer for recommendations.

In most cases, settling is not a major factor and becomes negligible within a year. However, annual level checks should continue. During the time that settling occurs, you may have to level the press several times. If the press is installed on Vibro/Dynamics Isolators, the leveling process is very fast, easy, and precise. You loosen the locknut on the isolator, adjust the isolator leveling screw to quickly level the press bed, and tighten the locknuts. It usually takes in-house maintenance personnel only a few minutes to do, and production can start again immediately.

In cases where isolators are *not* used, the settling can be expected to occur more rapidly and to a greater extent, requiring frequent re-leveling. Without the isolators, leveling will be much more costly, difficult and time consuming. If grout and shims were originally used, the press may have to be raised so the existing grout can be jackhammered out, forms fabricated and positioned, new grout poured and left to set, and new shims sized and placed. The press must then be lifted and lowered as each shim is tried and the level checked. The entire process can take days, may require outside riggers and contractors, and delay production until the process is completed.

In some cases, layers of pad material are used in addition to the grout and shims in an attempt to reduce some vibration transmission. Most pad material on the market exhibits significant creep such that the material packs down over time causing loss of isolation effectiveness and also change to the machine level and elevation. To maintain the isolation performance, the pad material may need to be replaced once the vibration levels become intolerable. As a result, the elevation and level of the press may change even if the foundation does not settle, requiring that the leveling process be repeated. As the pad material absorb fluids and compresses, it become less effective at reducing vibration transmission, which in turn accelerates foundation settling, and the deterioration of the grout, floor, and the pad material itself.

Vibro/Dynamics Isolators have elastomeric cushions that are specially compounded to be highly resistant to lubricants, coolants and other fluids commonly found in a stamping environment. They are selected and specified by Vibro/Dynamics' Application Engineers to assure low working stresses and very long effective life. As a result, Vibro/Dynamics' Isolators maintain dimensional stability and keep presses level and properly supported for a very long time.

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In addition to the weight and operation of a press causing settling of a floor/foundation, other events and factors may also cause changes that affect the level and Fine-Tune support of the press bed. In some plants, machines are frequently relocated and should be leveled each time. The weight of the press added to a floor may cause the floor to sink and affect the slope of the floor under adjacent machines, and their level condition.

If a floor is cut, the strength of the floor is affected and its elevation may change. Cutting the floor and digging a new foundation almost always causes settling in adjacent foundations and floor sections.

Changes in operation such as going from drawing to blanking, increasing press speed, heavier die sets, heavier tonnage jobs being performed, and so forth, can all cause additional settling and require leveling of the press.

HINTS TO MAKE THE JOB EASY

- When you turn the leveling screws, use either an open-ended or box wrench. They are better than an adjustable wrench. Never use a pipe wrench.
- If you can't turn the leveling screw fairly easily, use a hydraulic jack to lift the press foot. Raise the press foot only high enough to make it possible to turn the leveling screw easily. Never put a pipe extension on the wrench handle to increase torque. It's dangerous; and you might break the wrench, damage the leveling screw, or jam it in the isolator's housing.
- If it's hard to turn the leveling screw with a wrench, another possible cause may be the leveling screw rubbing against the inside of the mounting hole in the press foot. Check to see that there is clearance between the leveling screw and the mounting hole.
- Another possible cause may be that a chip, debris, or grit has gotten into the isolator threads. To prevent this, clean the press foot and mounting hole thoroughly before putting the isolator under the press foot. Don't rub the threads of the leveling screw against any surface and check to see that the threads are not nicked. If the screw threads are damaged or dirty, the leveling screw may jam in the housing if forced.
- Record and store all your level readings.
- When tightening the isolator's locknuts, use a separate wrench to keep the leveling screw from turning.

Following these few, simple precautions will make your job much easier and help to assure a successful, trouble-free and long-lasting installation. Detailed installation instructions are supplied with each set of isolators and also sent in advance of the isolator shipment. Instructions can also be acquired on the Vibro/Dynamics' website www.vibrodynamics.com/instruct/levinstr.htm. For further information, please contact Vibro/Dynamics LLC.

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