VIBRO DYNAMICS
a Socitec company

TECHNICAL BULLETIN M/L- 697

Vibration and Shock Isolation Systems for Forging Machinery

Introduction

The installation of forging presses, hammers and screw presses has evolved over the past several decades from installations that used massive foundations and anchors, employing large oak timbers for isolation, to the highly engineered steel coil spring and elastomer isolation systems more commonly used today.

Today's elastomer isolator technology spans from very simple layered systems to sophisticated resilient units that offer better damping and isolation. Coil spring isolators are also widely used today. Because they are very soft, they offer the highest degree of vibration and shock isolation, but machine motion has to be controlled using damping systems and sometimes other adaptations like structural steel outriggers, steel plates, or concrete inertia blocks.

Foundations

A good installation always starts with a properly designed foundation. The foundation must be designed large enough to handle all the static and dynamics loads produced by the machine. Examples of the types of forces the foundation will experience are:

- Static weight – any weight that will be supported by the foundation (i.e. machine, tooling, die holder, feeds, conveyors, etc.)
- Inertia Force – generated by an unbalanced, moving mass (i.e. slide, hammer, connections, drive screw, etc.)
- Impact Force – generated by a sudden release of energy and/or application of force.
- Twisting or Torsional Forces caused by improper support and/or machine action.
- Vibration and Shock as a result of the above.

Soil conditions must be taken into account. The forces exerted on the foundation and the bearing capacity of the soil are key factors in determining the foundation size and design. Poorly designed foundations may transmit more vibration and shock, settle unevenly, or sink.

Good planning and communication is critical between the foundation designers, the isolation system provider, and the customer for a successful foundation design and machine installation.

Benefits of Isolation Systems

The most obvious benefit is the shock and vibration isolation. Not only does this greatly improve the working environment for personnel, but also helps avoid potential neighbor problems.

Isolating forging machines also helps protect nearby precision machinery and equipment (i.e., coordinate measuring machines, grinders, heat-treating furnaces, etc.) from incoming vibration and shock. Sensitive equipment may have to be installed on vibration isolators also, depending on the isolation system used to isolate the forging machine.

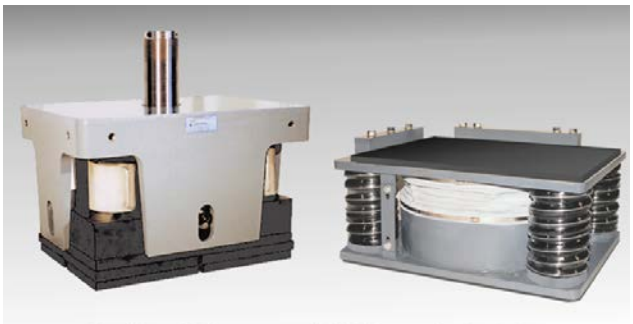
Case studies have shown the installation of machinery on vibration isolators also reduces structural-borne noise levels, further improving the working environment.

Less obvious benefits include reduced wear and tear on the machine and its components; less machine downtime; faster, easier installations; and less costly and more stable foundations.

Types of Isolation Systems

Isolation systems for the Forging Industry typically use either a resilient material (synthetic elastomer) or steel coil springs as isolation material. Elastomer type isolation is available in simple sheet form or custom-engineered isolation elements that offer precision leveling and hydraulic *level-assist* capabilities. Steel coil spring isolators are available with either frictional (*material*) or viscous fluid type damping systems.

Elastomer and steel coil spring type isolators are the two most common types used today. Each type has



Micro/Level® Elastomer and FSV Viscous Spring Isolators

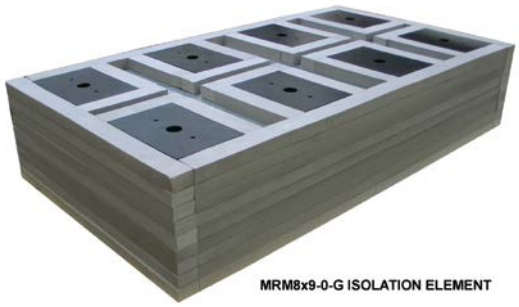
different features and advantages.

2443 Braga Drive ● Broadview, Illinois 60155-3941 USA ● 708-345-2050 ● Toll Free 1-800-842-7668 ● Fax: 708-345-2225
www.vibrodynamics.com ● vibro@vibrodynamics.com

Layered Elastomeric Systems

This type of system uses alternating layers of elastomeric material and steel sheet for isolation. The more layers-the softer the system. This type of system is used mostly for hammer installations.

There are two basic types: a simple alternating layers approach and a layered elastomer assembly design, like Vibro/Dynamics MRM Isolation Elements. Although similar, the MRM Isolation Element design offers easier installation and isolation performance advantages over the simple layering approach.



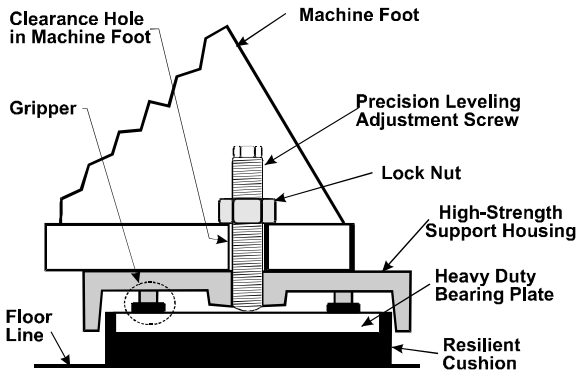
MRM8x9-0-G ISOLATION ELEMENT

The advantage of this type of system is the relatively low cost. However, this cost savings is offset by the cost of the larger foundation, which would be required to handle the higher amount of force being transmitted to the soil.

Typical isolation performance is in 20 to 60 percent range for hammer installations, depending on the system selected.

Elastomeric Isolators

Isolators or machinery mounts are used to install a wide variety of industrial machinery, including forging presses. They offer excellent vibration isolation and press stability and are usually installed directly to the press foot without any modifications. They offer advantages over Layered Elastomeric Systems in leveling and ease of installation.



CUTAWAY VIEW OF A MICRO/LEVEL ISOLATOR

Precision leveling and alignment is critical for forging press applications. Isolators have an integral leveling feature that makes leveling and alignment faster and easier than other methods.

Elastomeric Isolators also have a swiveling feature that keeps the machine foot properly supported and the isolator's elastomer evenly loaded when the bottom of the machine foot is not parallel with the supporting surface. This distributes load to the foundation and foot evenly. Static plus dynamic stresses are usually less than 700 psi (4.8 MPa).

Typical isolation performance for press applications is 50 – 95% versus anchoring to concrete.

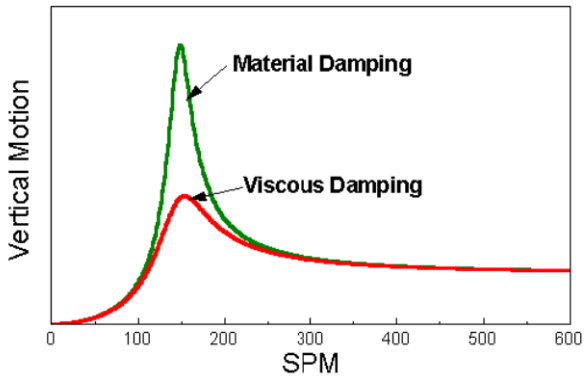
Steel Coil Spring Isolators

Spring isolators have been used to install hammers and forging presses. They offer excellent shock and vibration isolation due to their low stiffness and dynamic natural frequency (~4-7 Hz). Isolation performance is around the 80 percent range for hammers and up to 98% for presses.

Spring isolators will have either viscous or frictional damping systems to provide a fast decay of motion between press cycles or hammer blows. Viscous damping systems are more effective than frictional systems and have a longer life since there is no physical wear between components. Because viscous dampers are almost purely velocity dependent, and frictional dampers provide steady resistance, the viscous damper transmits less force to the foundation.

Forging presses generate high rocking forces and

Relative Motion Comparison Between Material and Viscous Damping



spring isolators are soft. To minimize rocking motion, outrigger beams are used to increase the base size of the press.

2443 Braga Drive ● Broadview, Illinois 60155-3941 USA ● 708-345-2050 ● Toll Free 1-800-842-7668 ● Fax: 708-345-2225
www.vibrodynamics.com ● vibro@vibrodynamics.com

Die Forgers and Drop Hammers

In the past, hammers were installed on large oak timbers. This approach was somewhat effective, but it offered little shock isolation. Today, Die Forgers and Hammers are typically installed on layered elastomer isolation systems or viscous spring isolators.

Layered Elastomer Systems

Users of these systems like the limited machine motion, but the trade-off is vibration and shock isolation. As stated earlier, layered elastomer systems provide about 20-60 percent vibration and shock isolation for hammer installations. This is due to the dynamic natural frequency range of these isolation systems (~10-20 Hz) being closer to the impulse frequency (25-50 Hz) of the shock generated by the hammer.

The cost is relatively low for the materials, but since this type of system transfers more force, the foundation has to be larger accordingly.

Viscous Spring Isolators

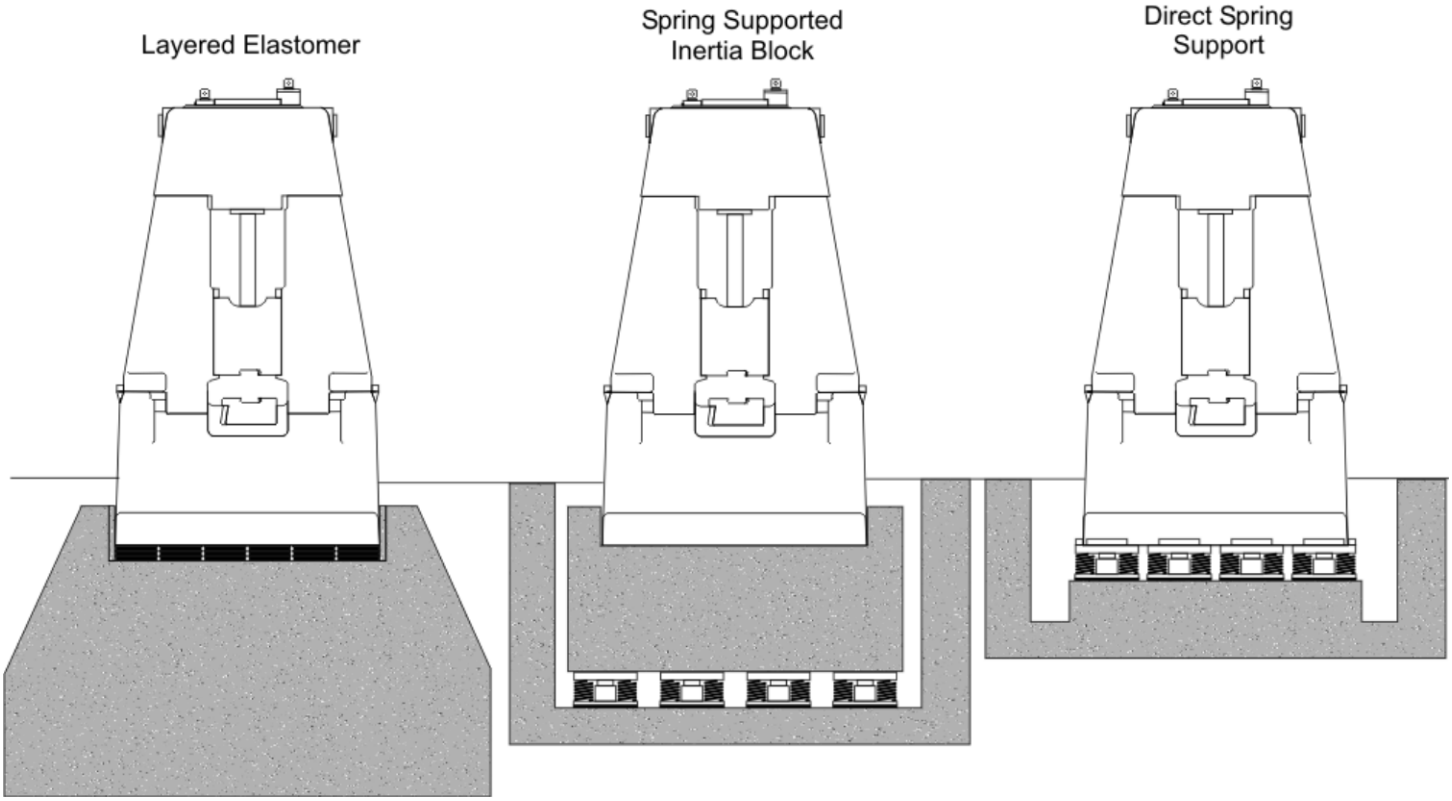
Spring isolators offer the greatest degree of vibration and shock isolation because they are relatively soft when compared to elastomeric isolation systems. The natural frequency of these isolators (4-7 Hz) is much lower than the impulse frequency of the hammer, thereby providing greater isolation.

Because spring isolators are soft, machine motion occurs in response to every blow. It is important that the motion decays between blows.

Viscous damping is very effective at reducing motion, but sometimes mass must be added in the form of a concrete inertia block or a steel plate to limit machine motion. If the hammer's anvil is too light or too small in area to fit the required amount of isolators, then a spring supported inertia block will be required.

For most modern hammers, added mass is not necessary and the hammer can be mounted directly on viscous spring isolators as shown below.

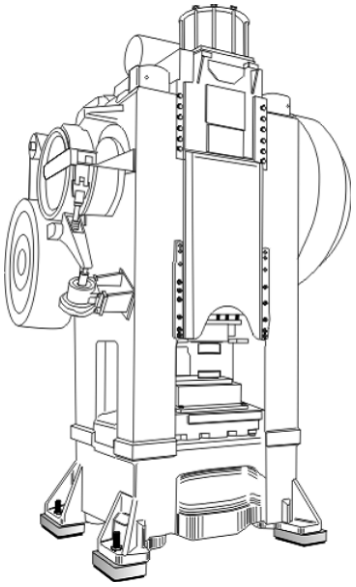
Isolated Foundation Types for Forging Hammers



2443 Braga Drive ● Broadview, Illinois 60155-3941 USA ● 708-345-2050 ● Toll Free 1-800-842-7668 ● Fax: 708-345-2225
www.vibrodynamics.com ● vibro@vibrodynamics.com

Forging Presses

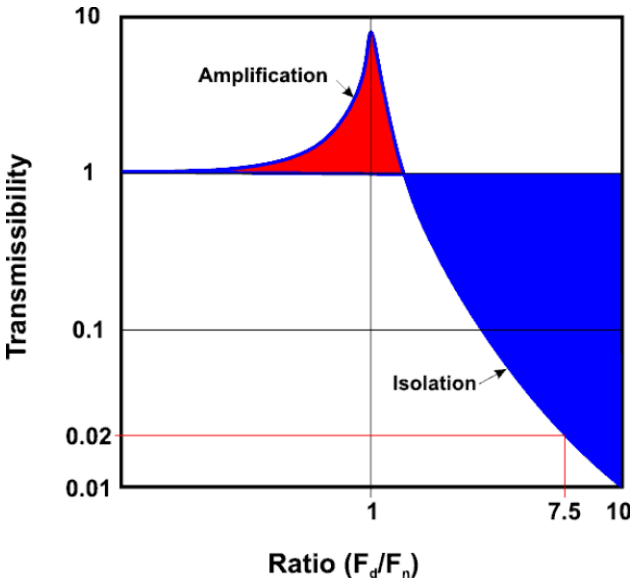
Forging presses are usually installed using elastomeric isolators or viscous spring isolators.



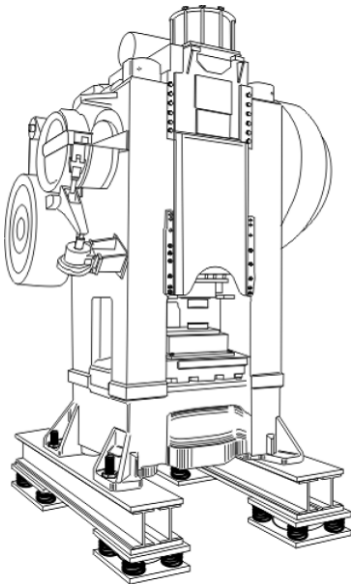
Elastomeric isolators like Vibro/Dynamics® Micro/Level® Isolators, are low-cost and offer easier, faster installations; precision leveling and alignment; and very good vibration and shock isolation. Adaptors, such as outriggers, are seldom required.

Micro/Level isolators are very effective in isolating the impact force that occurs between the press and the foundation due to the stretching and contraction of the press tie rods. These forces occur predominately in the 90-120 Hz range. Since these isolators typically have natural frequencies in the 12-20 Hz range, a high level of isolation is possible.

For example, if the disrupting frequency (F_d) of a forging press is 90 Hz and the isolator's natural frequency (F_n) is 12 Hz, the resulting ratio is 7.5. Transmitted vibration is 0.02 (2%) or 98% vibration isolation. (See below chart).



Viscous damped spring isolators, like Vibro/Dynamics FSV Hy/Damp™ Spring Isolators, can also be used to install forging presses. However, forging presses generate substantial rocking forces due to the design of the drive system. Direct mounting of the press on spring isolators is not recommended due to the resulting excessive motion.

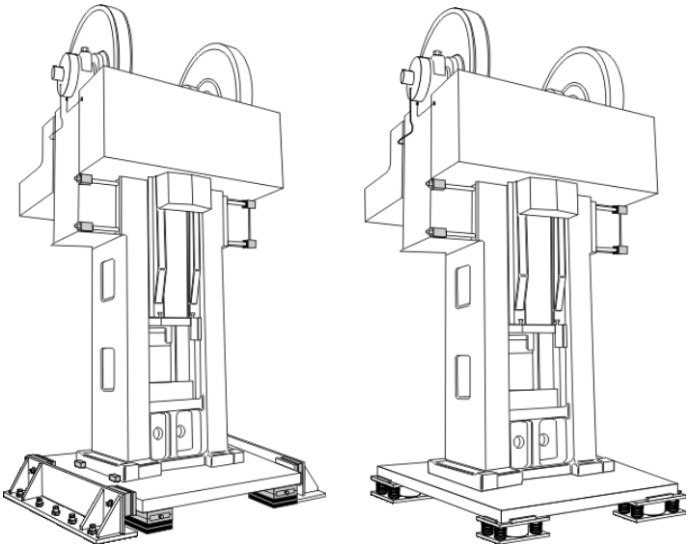


Motion can be reduced using a steel plate or outrigger beams that increase the "wheelbase" of the machine. This substantially reduces motion. (See sketch).

Screw Presses

Screw presses have similar characteristics to both hammers and forging presses. The drive mechanism is a large screw driven by a horizontal flywheel. This action generates rotational as well as vertical forces.

In order to control the rotational force, and to limit motion, these presses are usually installed on large steel plates that spread out the isolators to stabilize the press and to gain a mechanical advantage over the rotational forces. Buttress isolators in the elastomeric system and viscous dampers in the spring system keep the press motion under control and prevent it from walking.



2443 Braga Drive ● Broadview, Illinois 60155-3941 USA ● 708-345-2050 ● Toll Free 1-800-842-7668 ● Fax: 708-345-2225
www.vibrodynamics.com ● vibro@vibrodynamics.com

The impact duration of a screw press is somewhere between a forging press and a hammer. Both elastomer and spring isolators offer good vibration and shock isolation solutions.

The elastomer system offers easier leveling and alignment, but the spring system provides a little better isolation. Both systems offer vast improvements over anchoring a press to a foundation.

Summary

Due to the high impact nature of forging operations, vibration and shock isolation is essential for a good working environment and relations with the neighbors. Documentation has shown that isolation systems increase the life of machine and tooling, decrease downtime, and speed the installations of these machines. There are many types of systems to choose from and each has its advantages, so make sure that you choose a supplier that can offer more than one solution. It's in your best interest!

ML-697 20170605 hr

2443 Braga Drive ● Broadview, Illinois 60155-3941 USA ● 708-345-2050 ● Toll Free 1-800-842-7668 ● Fax: 708-345-2225
www.vibrodynamics.com ● vibro@vibrodynamics.com