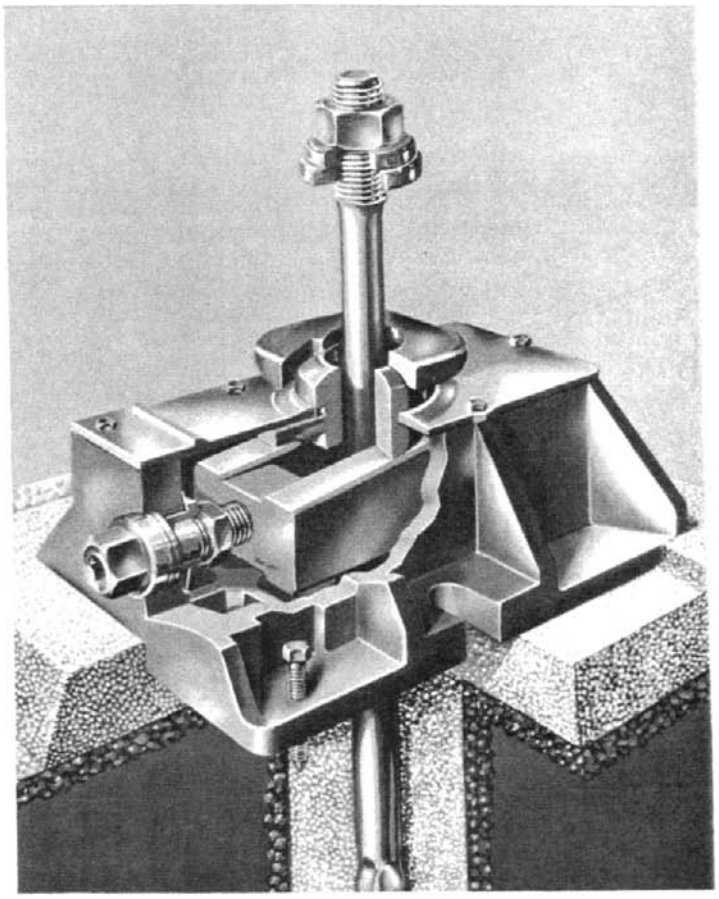
VIBRATION DAMPENING CONSIDERATIONS



CHOOSE THE FULL SERVICE COMPANY

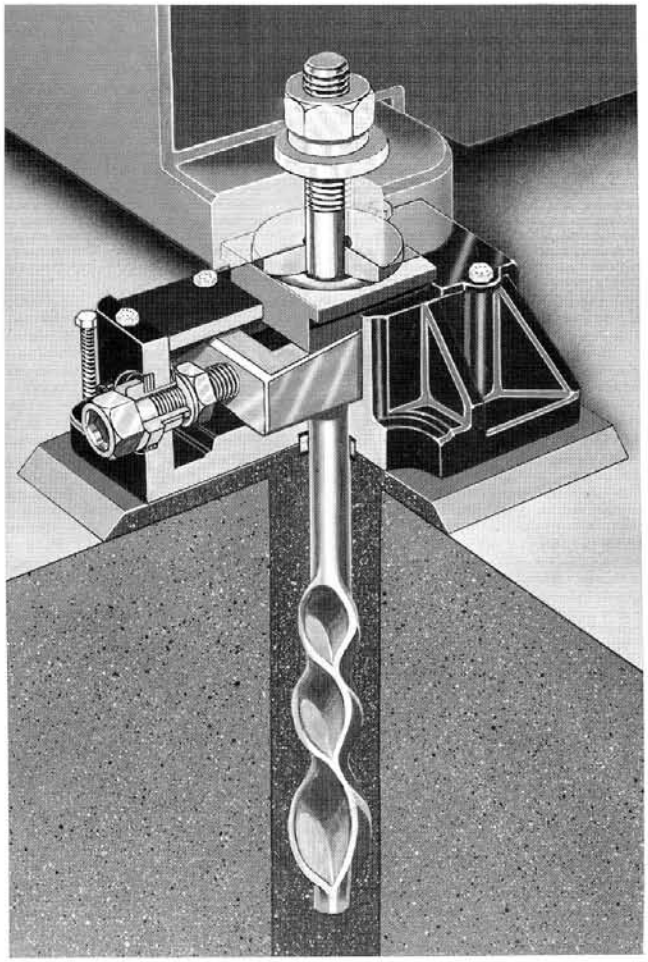
ACORN offers complete technical service for any mount selection or application and will visit your plant to recommend a solution to your vibration damping and mount problems.

SECTION I

VIBRATION DAMPENING CONSIDERATIONS

WHY VIBRATION DAMPING MATERIAL

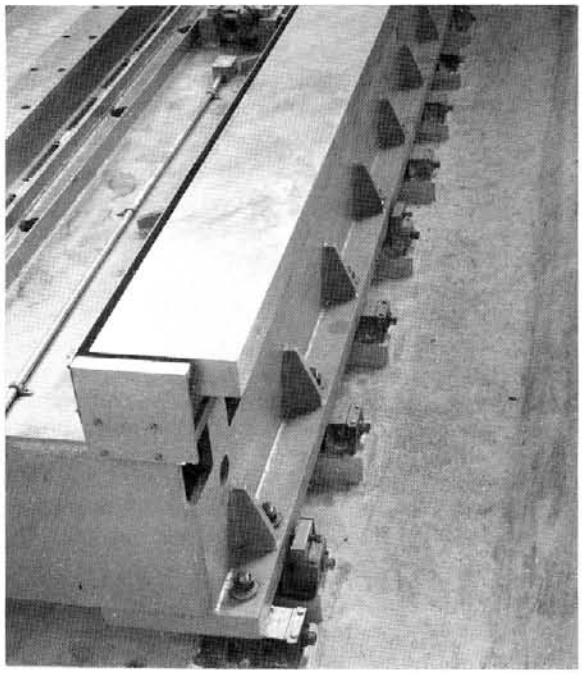
FIXATORS ALLOW RE-ALIGNMENT UNDER LOAD WITHOUT LOOSENING ANCHOR BOLTS



FIXATORS® SAVE MONEY BY:

- Allowing faster completion of new installations.
- Decreasing frequency of, and shorten time required for future re-alignments.
- Maintaining machine accuracy for longer time periods.
- Decreasing required maintenance.
- Ensuring maximum machine productivity.

Installation of a large grinder with a 50′ bed length and a total weight in excess of 100,000 pounds was completed and aligned in 2½ hours using the FIXATOR® ANCHORING/ALIGNMENT SYSTEM. The machine was supported at 35 mounting points. Installation was made using Model KIII FIXATORS®, Option WES Anchor Bolts, Option P Spherical Washer Sets and UNISORB® V-1 GROUT. Installation was prepared in the usual manner with the FIXATORS® prehung from the machine base and grouted into holes provided in the foundation. The installation went as planned and required only 2½ hours to make final adjustments. Using a conventional installation and alignment method on a previous installation had taken the company four days to complete.



2-1/2 HOURS REQUIRED TO MAKE FINAL ADJUSTMENTS W/ FIXATORS
VS
4 DAYS BY CONVENTIONAL INSTALLATION AND ALIGNMENT METHOD

WHY VIBRATION DAMPING MATERIAL

1. - TO REDUCE INSTALLATION AND MAINTENANCE COSTS

SIMPLE , EASY AND RAPID MOUNTING OF MOST FREE STANDING INSTALLATIONS OF MACHINES.

LITTLE LOSS OF PRODUCTION WHEN RELOCATING EQUIPMENT.

SUBSTANTIAL COST SAVINGS IN EXTENDING EQUIPMENT LIFE , WITH LESS MAINTENANCE AND REDUCED DOWN TIME , AT THE SAME TIME IMPROVING THE QUALITY OF THE WORK-PIECE.

2. - TO PROTECT BUILDINGS AND MACHINERY

PREVENTS DAMAGE TO FLOOR OR CEILING SUPPORTS

NO DESTRUCTIVE EFFECTS DUE TO MECHANICAL VIBRATIONS.

LESS WEAR ON MACHINERY PARTS AND TOOLS BECAUSE OF REDUCED ACTIVE AND PASSIVE DISTURBING FREQUENCIES.

3. - TO IMPROVE THE QUALITY OF THE WORKPIECE

REDUCES BOTH THE ACTIVE AND PASSIVE EFFECTS OF MECHANICAL VIBRATIONS RESULTS IN IMPROVED SURFACE FINISHES.

VIBRATION DAMPING MATERIAL REDUCES THE DISTURBING FREQUENCIES OF MACHINES AND THUS THE CAUSE OF SWAYING.

4. - TO REDUCE NOISE AND STRUCTURE BORN VIBRATIONS

THE AUDIBLE RANGE OF HEARING OF THE HUMAN EAR IS 16HZ TO 20 HZ . THE RADIATION OF NOISE AND STRUCTURE BORN VIBRATIONS OF NEARLY ALL MACHINES INSTALLATIONS IS IN THIS RANGE AND IS HIGHLY DISTURBING AND ANNOYING TO PERSONNEL

VIBRATION DAMPING MATERIAL ISOLATES THESE CONDUCTED VIBRATIONS AND SEPARATES THE DISTURBING FREQUENCIES FROM THE RESONANCE OF THE CONCRETE AND STEEL STRUCTURAL NOISE AND STRUCTURAL-CONDUCTED VIBRATIONS.

THEORY OF VIBRATION DAMPING

BRIEF THEORY OF VIBRATION DAMPING

As a general rule, the degree of vibration damping for any equipment, machine or system is a function of the characteristics of the damping pads, the loading on them and the frequency of the disturbing vibrations.

The DAMPING PAD OR ISOLATOR must have some resilience in order to isolate vibration.

For low disturbing frequencies more resilience is required,while for high disturbing frequencies,the resilience can be limited. For heavy machines, limited resilience is most often required to provide proper stability.

In order to select the right mounting material for any system , several factors have to be taken into consideration:

1. The **NATURAL FREQUENCY** of the mass, machine or system to be isolated.

2. The **FORCING FREQUENCIES** causing disturbance to the system or machine to be isolated.

3. The **FREQUENCY RATIO** which is a ratio of the **Forcing Frequency** divided by the **Natural Frequency**.

4. The degree of vibration isolation which is expressed as **TRANSMISSIBILTY.**

Whenever a mass or weight is mounted on pads and is subjected to an external force , which is suddenly removed , it will oscillate freely up and down on its mounting a definite number of times per second until it dies out.The rate of this free oscillation is measured in cycles per second and is called **NATURAL FREQUENCY.**

The NATURAL FREQUENCY for any identical weight on the same mounting will always be the same. A greater weight on the same mounting would give a lower natural frequency and a lesser weight, a higher natural frequency.

The NATURAL FREQUENCY can also be altered by changing the stiffness of the mounting. A more resilient mounting would give a lower natural frequency and a less resilient mounting a higher natural frequency.

Now , if a machine is mounted on these same pads, it too, would have a definite **natural frequency and** can produce disturbing vibrations of its own while in operation.These disturbing vibrations are caused by either unbalanced moving parts in the machine or by an unbalanced condition arising while the machine performs its work . These disturbing vibrations have frequencies of their own which depend on the operating speed of the machine as well as other factors. and are called - **FORCING FREQUENCIES.**

The **MAJOR FORCING FREQUENCY,** which is the disturbance needed to be isolated is sometimes the operating speed of the heaviest parts of machine. However,higher secondary frequencies, determined through instrumentation , very often create more disturbance than those created by operating speed and must also be satisfactorily isolated.

The ratio of the FORCING FREQUENCY to the NATURAL FREQUENCY is expressed as the FREQUENCY RATIO. It is this ratio that determines the effectiveness of the vibration DAMPING MOUNTING.

The degree of vibration isolation is expressed by the term - TRANSMISSIBILITY. It is defined as the ratio of vibration amplitude transmitted to the foundation beneath the machine to the amplitude of the machine vibration.

If no isolation material is used (i.e. the machine is mounted rigidly on its foundation) the **transmissibility would equal unity**. This means the amplitude of the vibration transmitted to the foundation would be the same as that of the machine vibration.

To obtain theoretically perfect isolation TRANSMISSIBILITY would have to equal zero.

Referring to figure1,the **TRANSMISSIBILITY** for a isolator having no damping (Dotted Line Curve) is plotted against **FREQUENCY RATIO** .

For theoretically perfect isolation (in the case of no damping) would occur when the ratio of forcing frequency to natural frequency was infinitely high. A frequency ratio of unity means the forcing frequency equals the natural frequency. This is the condition of RESONANCE.

It is evident from figure 1

RESONANCE PRODUCES AGGRAVATED VIBRATORY CONDITIONS WHERE THE TRANSMITTED AMPLITUDE IS MANY TIMES GREATER THAN THAT WHICH WOULD BE TRANSMITTED WERE NO MOUNTINGS USED AT ALL.

THEORY OF VIBRATION DAMPING

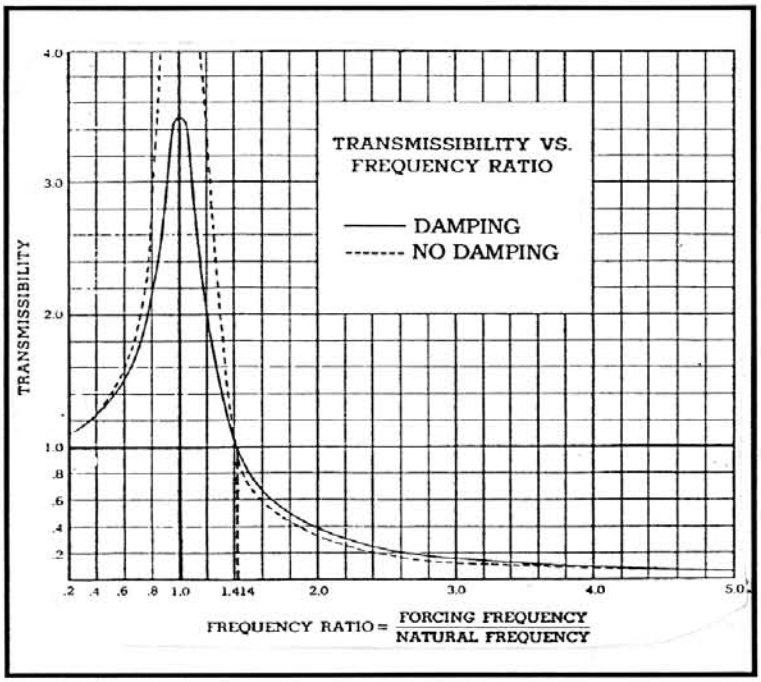


FIGURE 1

Again referring to the dotted transmissibilty curve in figure 1,it can be noted that when the forcing frequency is less than the natural frequency (i.e. when the frequency ratio is less than unity), the amplitude transmitted to the machine's foundation is greater than the amount than would have been generated were the machine mounted rigidly on its foundation.

Further it can be noted from fig. 1 that there will be no more reduction in transmissibilty , until a frequency ratio of 1.414 is reached. **The more the frequency ratio exceeds the value 1.414, the greater the reduction in transmitted amplitude.**

If a certain forcing frequency is to be isolated, the natural frequency of the machine on its mounting should be made low enough to give the desired degree of isolation.

However,it is not always possible to lower the natural frequency sufficiently without creating a mounting so soft and unstable as to be impractical. Compromise mountings / mounting systems are used where stabilty is a major factor.

Thus far, DAMPING WITH **VIBRATION ISOLATION** MATERIAL has not been discussed.

DAMPING is a force the resists motion and causes free oscillation to die out. This resistance or hysteresis dissipates energy in the form of heat.

When a free oscillation exists on an **DAMPING** pad, a large percentage of the vibratory energy is dissipated during each vibration cycle,with the result that the oscillation is quickly damped out.

Tests have been conducted to determine how fast the amplitude of a free oscillation on various type **ISOLATION** materials damp out.

These tests consist of mounting a heavy mass on the **ISOLATION** PADS and subjecting this mass to a large external compressive force. This gives a deflection in the DAMPING material greater than the static deflection produced by the weight of the mass only. **Upon release of this external force a recording of AMPLITUDE VERSUS TIME is made to determine the free motion of the mass.**

Figure 2 shows a typical damping curve for - ISOLATION DAMPING material.

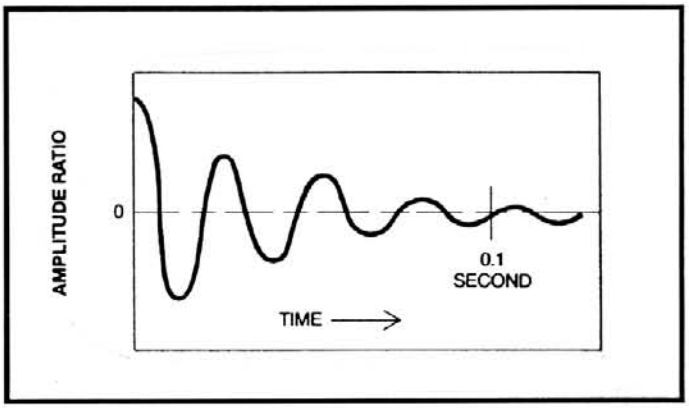


FIGURE 2

The ratio of the maximum amplitude of two successive cycles in a free oscillation is commonly used to indicate the degree of damping in a mount.

A high ratio is desirable. Particularly in the case of forging hammers where it is important that this motion be stopped before the next blow is struck.

The time necessary to stop an oscillation on ACORN selected type DAMPING PADS has been laboratory recorded and is utilized in the selection of any particular pad for the required installation requirements.

The tested damping effect of the DAMPING PADS has been proven to be equal or better than all commercially available damping pads much better than rubber or springs.

THEORY OF VIBRATION DAMPING

The **DOTTED** transmissibility curve in fig 1 applies to a mounting having no damping,while the **SOLID LINE** curve represents a **VIBRATION ISOLATION PAD MOUNTING.**

It is noted that above a frequency ratio of 1.414 the dotted line shows a slightly less transmissibility than **VIBRATION DAMPING PADS**, but for values less than 1.414 , **DAMPING PADS** show lower transmissibility.

This is important , for

WHEN USING VIBRATION DAMPING PADS A SLIGHT AMOUNT OF EFFICIENCY IS SACRIFICED OVER PART OF THE FREQUENCY RANGE IN ORDER TO OBTAIN A MUCH BETTER CONDITION AT RESONANCE.

An example of this importance can be illustrated by a machine mounted on **DAMPING PADS** designed to isolate the major disturbing frequency.
(which is assumed to be the operating speed of the machine)
When the machine is started up ,it will gradually gain speed until the operating speed is attained. At some time during this start -up , the speed of the machine will be such that its frequency will be equal to the natural frequency of the mounting producing a resonance condition.

If no mounting pad is used or if used with a pad having limited damping ,then the transmissibilty at this resonant speed would be high, with the great possiblility of damage due to the excessive movement of the machine on its mounting.

However , with the proper **VIBRATION DAMPING MATERIAL** , the transmissibility is limited when passing through resonance because of the correct damping characteristics.

NATURAL FREQUENCY DATA HAS BEEN RECORDED ON ALL MOUNTS AND ARE IMPORTANT IN SELECTING OF THE PROPER TYPE PAD FOR ANY APPLICATION.

All mention of loading above refers only to static loading that develops due to the total weight of the machine, which includes any of the parts it may carry. Nuts on Bolt-Thru or hold-down bolts should only be tightened enough to give proper stability and avoid loose bolts. Excessive tightening will reduce mounting efficiency by raising the natural frequency,which. REDUCES the FREQUENCY RATIO .

ISOLATION OF MACHINES FROM OUTSIDE DISTURBANCES.

Very often it is impractical to isolate a machine disturbance at its source.Therefore if a machine is affected by this outside disturbance, a proper vibration damping mount can be selected for this machine. The same vibration theory, as previously described , applies whether the disturbance emanates from the machine or some outside source.

The natural frequency of the mounting should be made lower than the disturbing frequency to produce a frequency ratio sufficient to give the desired reduction in transmissibility.

In practical applications,there is usually more than one forcing frequency involved in each case.

An example would be a single phase motor,which has two disturbing frequencies,one at the operating speed of the motor, the other at twice the current frequency. In this case , the latter current frequency is often more disturbing than the vibration caused by the operating speed (which is usually of a very low amplitude)

Practical experience has shown that the VIBRATION pad materials are very satisfactory from an over-all standpoint .

This because the more damaging frequencies are isolated without producing resonant conditions with the lower frequencies.

In few cases,we find ,through experience ,a different pad is needed. This is the exception rather than the rule.

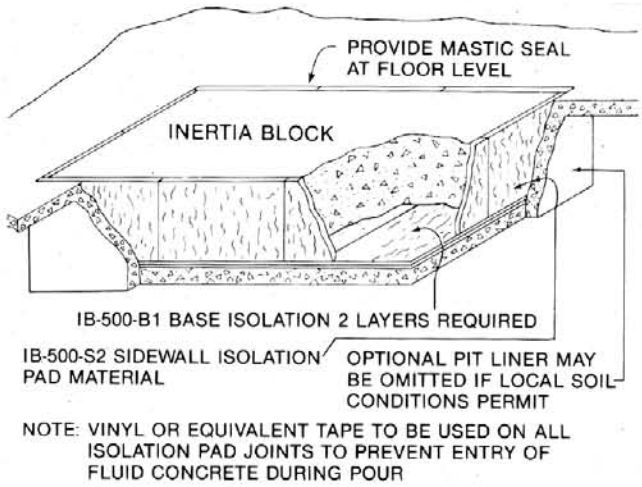
VIBRATION DAMPING mountings have proven to be extremely successful in isolating outside disturbances affecting precision machinery, such as precision grinders. Whenever possible, a disturbance that affects nearby precision machinery should be isolated at its source and conditions may also warrant added isolation on the machines being affected.

SATISFACTORY ISOLATION OR DAMPING OFTEN REQUIRES A COMPROMISE BETWEEN THEORETICAL PRINCIPLES AND PRACTICAL APPLICATION EXPERIENCE.

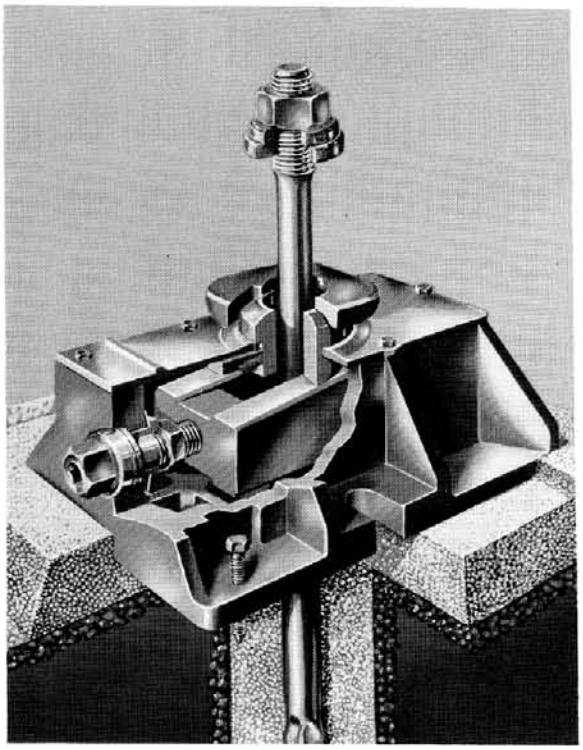
THEORY OF VIBRATION DAMPING

ISOLATION FOR LOW FREQUENCY VIBRATION DAMPING

IF THE MAJOR DISTURBING VIBRATION IS LOW FREQUENCY,IT IS FOUND THAT A HEAVY CONCRETE INERTIA BLOCK IS NECESSARY , BENEATH THE MACHINE , TO ADD TO THE TOTAL MASS TO BE ISOLATED. WE PROVIDE COMPLETE ENGINEERING SERVICE FOR A TURN KEY INERTIA BLOCK SYSTEM.



END: Basic theory of Vibration Damping



FIXATOR® ANCHORING/ALIGNMENT SYSTEMS permit fast installations and allow easy re-alignment when necessary. Alignment adjustments are made after FIXATOR® anchor nuts are tight. The only adjusting tool required is a small hand wrench.

CHOOSE THE FULL SERVICE COMPANY

ACORN offers complete technical service for any mount selection or application and will visit your plant to recommend a solution to your vibration damping and mount problems.

Over 25 years technical experience WITH VIBRATION DAMPING MOUNTS enables us to solve any vibration problem.

REGARDLESS OF THE MACHINE , ACORN CAN PROVIDE THE BEST MOUNTING SYSTEMS , PADS AND PRODUCTS TO DO YOUR JOB.

PLEASE CALL OR FAX - TOLL FREE.

CONSIDERATIONS FOR PROPER MACHINE INSTALLATION

1 . DETERMINE IF THE MACHINE REQUIRES ANCHORING

Before designing a foundation for a particular machine tool , the following questions should be answered.

a. Does the machine require support from its foundation to maintain alignments between machine elements ?

b. Will shock / vibration isolation be required to assure the desired levels of finish quality and accuracy ?

An excellent example of a machine that requires a large amount of support to operate properly , is the horizontal boring mill illustrated below in figure 1.

In this application the only connection between the machine column and the work table (or the spindle and workpiece) is the floor or foundation.

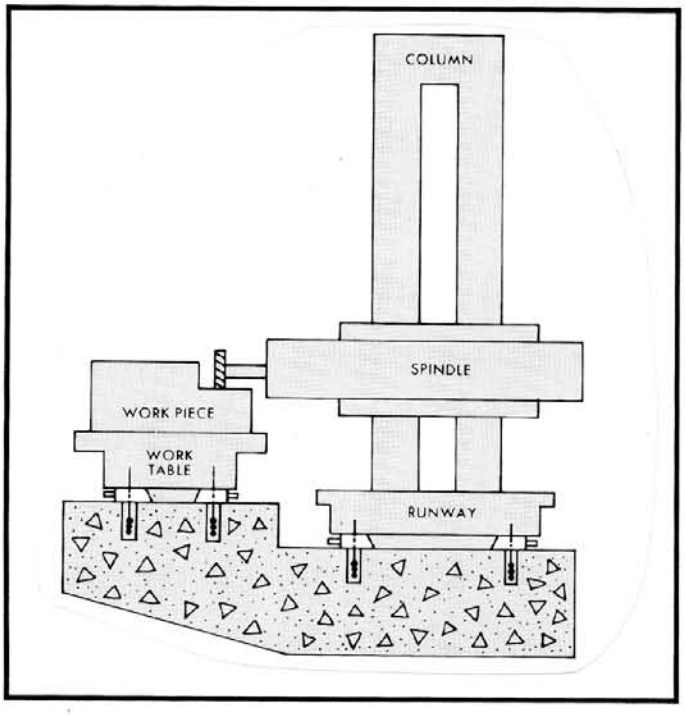


Figure 1

In designing the foundation for an alignment-critical machine , three factors are important.

1. FOUNDATION THICKNESS.

The stiffness of a foundation varies with the cube of its thickness.The stiffer the required support , the more concrete required.

2. ONE FOUNDATION BLOCK

All machine elements should be mounted on the same foundation block.

3. LOCAL SOIL CONDITIONS

Local soil conditions must be taken into account to assure that the foundation will be stable on the soil on which it is placed.

2. USE CORRECT FOUNDATION REINFORCING DESIGNS AND ADEQUATE METHODS OF ANCHORING FOR THE EQUIPMENT BEING INSTALLED.

In order for the foundation to become an integral part of the machine tool structure , a connection of adequate rigidity must be provided.

Also , in many types of machinery , a means of adjusting the relationship of the machine base to the foundation is necessary.

SEVERAL APPROACHES MAY BE FOLLOWED

1. ANCHOR BOLTS AND SHIMS.

This selection is generally inadequate where alignment requirements are at all critical.

2. LEVELING SCREWS

This method provides for faster adjustment than shimming , but there is a tendency for the machines to " creep " under load.Usually adjustments are difficult and time consuming.

CONSIDERATIONS FOR PROPER MACHINE INSTALLATION

3. ANCHOR BOLTS AND GROUT

These provide a strong , continuous rigid support between the machine and the foundation.

Grouting is used to assure that the voids between the machine base and the foundation surface are completely filled and also to spread concentrated loads over a larger area.

4. LEVELING MOUNTS

These provide a more rigid support than the leveling screw.

The most elementary of the wedges is the two piece **UNISORB LEV-L-LINE** for general purpose installations.

The new LK FIXATORS provide greater mechanical advantage and permit more precise leveling . The **LK FIXATOR with spherical washer** is an excellent leveler and allows leveling under load..

Also the **UNISORB FIXATOR ANCHORING / ALIGNMENT SYSTEM** is the right choice **when critical alignment and leveling is required under load** .

3. ISOLATE SUPPORT CRITICAL MACHINES

Carefully evaluate the environment into which a machine is being placed.

For support critical machines (and for non-support critical machines when high amplitude and low frequency vibrations are involved) an inertia block foundation is the best solution.

The concrete foundation is then isolated from the rest of the environment.

To limit the transmission of shock / vibration from the environment to the machine or in the case of a source machine , from the machine to the environment either **ISOLATION PADS** or **NOVIBRA** are used.

The **ISOLATION PAD** approach can be carried out using only normal construction practices and much less is involved than the **AIR SPRING METHOD**.

In the majority of applications , the low natural frequency of DAMPING PADS permits isolation efficiency of 90% and better.

3. ISOLATE NON- SUPPORT CRITICAL MACHINES

Be sure the machine which is not support critical is properly mounted.

If the machine is not support critical , it is still best to provide a mounting device to comply with OSHA requirements , permit the machine to be leveled easily , prevent " walking " and also isolate it from shock and vibration.

Most machines can use ANY OF THE FOLLOWING:

- **LEVEL - RITE MOUNTS**
- **PRESSMOUNTS**
- **PROPER TYPE ISOLATION PADS**

See the general application section for a standard mount to be used on various type machines. If it is not here - CALL US TOLL FREE and we can give you the right recommendation immediately.

CONCLUSION

The correct installation is second in importance to the proper selection of the machine tool itself in guaranteeing optimum performance and proper return on capital investment.

However , when it is realized that correctly installing a machine often costs less that 1% of the total value of the machine ,it is in the best interest of your company to spend the time and money to insure the proper installation. CALL TOLL FREE.

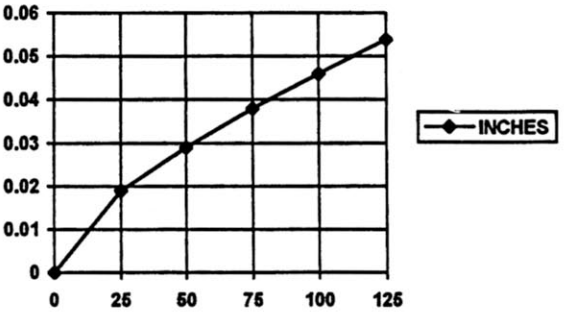
VIBRATION DAMPING TECHNICAL INFORMATION

NEOPRENE PAD

The smooth edge design of the low cost oil-resistant Unisorb Neoprene Pad prevents oil, grease and dirt from accumulating beneath the load bearing surface of the pad.

Neoprene Pad characteristics include:

- Pad size is 18" x 18" x 5/16" thick.
- Square pattern on one side.
- Stiffness is 60 DURO.
- Maximum recommended load to 125 PSI. Please refer to the chart below for load/deflection curve.



LOAD (PSI)/DEFLECTION (INCHES) CURVE

NEOSORB AASHTO GRADE 50, 60, 70 DUROMETER

THICKNESS
1/8"
1/4"
3/8"
1/2"
3/4"
1"

NOTE: Holes/Slots or other special fabrications may raise cost.

VIBRATION DAMPING TECHNICAL INFORMATION

TECHNICAL SPECIFICATION

Unisorb Type E

Red-Line Pad

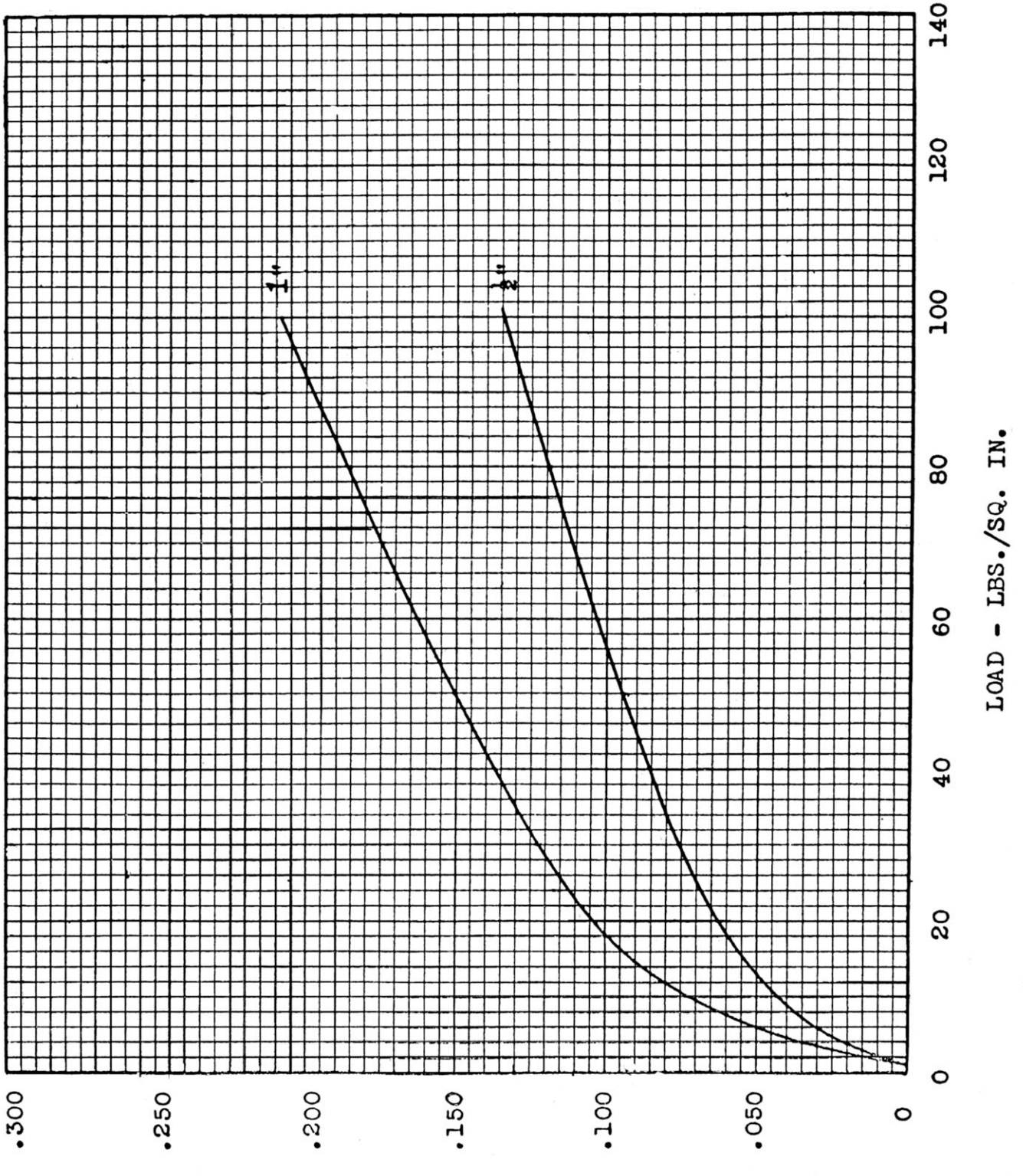
DESCRIPTION:	Felted wool pad with trademarked red layer through center. Designed to be used from 50-100 psi as a vibration pad. The pad is unaffected by exposure to common oils, water and other industrial liquids.
THICKNESS:	1/2" and 1"
COMPOSITION:	Natural Wool Fibers, 90% min. content
DENSITY:	1.2 lbs. per sq. ft. (1/2" thickness)
OPTIONAL HIGH FRICTION COATING:	Specified by "EB" adds a coating offering over 0.90 coefficient of friction. Designed to keep equipment from walking.

VIBRATION DAMPING TECHNICAL INFORMATION

Boston Research Division

United States Testing Company, Inc. Case No. 2536

Figure 2. Load-Deflection Curves for Unisorb E



VIBRATION DAMPING TECHNICAL INFORMATION

Unisorb Type F

Red-Line Pad

DESCRIPTION:	Felted inorganic pad with trademarked red layer through center. Designed to be used from 50-250 psi as a vibration pad. The pad is unaffected by exposure to common oils, water and other industrial liquids.
THICKNESS:	1/2" and 1"
COMPOSITION:	Blend of multiple diameter and length 100% inorganic fibers. No biodegradable components are used and environmentally safe.
DENSITY:	1.1 lbs. per sq. ft. (1/2" thickness)
TENSILE STRENGTH:	1000 psi
OPTIONAL HIGH FRICTION COATING:	Specified by "FB" adds a coating offering over 0.90 coefficient of friction. Designed to keep equipment from walking.

Unisorb Type S

Red-Line Pad

DESCRIPTION:	Felted inorganic pad with trademarked red line through center. Designed to be used to 100 psi as a vibration pad. The pad is unaffected by exposure to common oils, water and other industrial liquids.
THICKNESS:	1/2" and 1"
COMPOSITION:	Blend of multiple diameter and length 100% inorganic fibers. Non-biodegradable components are environmentally safe.
DENSITY:	0.8 lbs. per sq. ft. (1/2" thickness)
OPTIONAL HIGH FRICTION COATING:	Specified by "SB" adds a coating offering over 0.90 coefficient of friction. Designed to keep equipment from walking.

VIBRATION DAMPING TECHNICAL INFORMATION

TECHNICAL SPECIFICATION

Unisorb Type H

Red-Line Pad

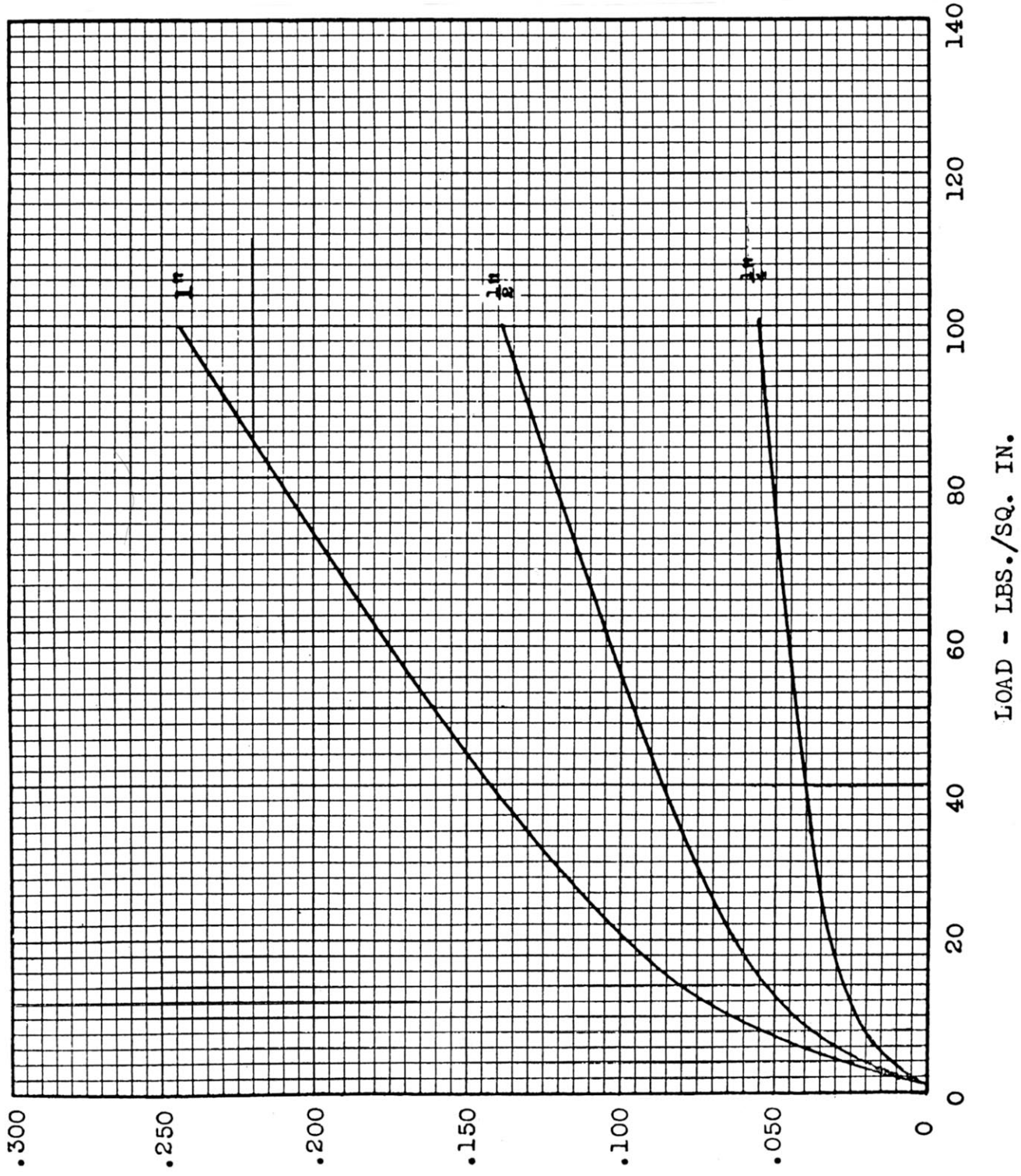
DESCRIPTION:	Felted wool pad with trademarked red layer through center. Designed to be used from 0-50 psi as a vibration pad.
THICKNESS:	1/4" and 1/2"
COMPOSITION:	Natural wool fibers, 90% min. content
DENSITY:	0.95 lbs. per sq. ft. (1/2" thickness)
TENSILE STRENGTH:	400 psi
SPLIT RESISTANCE:	22 lbs. per 2" wide maximum
OPTIONAL HIGH FRICTION COATING:	Specified by "HB" adds a coating offering over 0.90 coefficient of friction. Designed to keep equipment from walking.

VIBRATION DAMPING TECHNICAL INFORMATION

Boston Research Division

United States Testing Company, Inc. Case No. 2536

Figure 1. Load-Deflection Curves for Unisorb H



VIBRATION DAMPING TECHNICAL INFORMATION

TECHNICAL SPECIFICATION

Unisorb Type D

Red-Line Pad

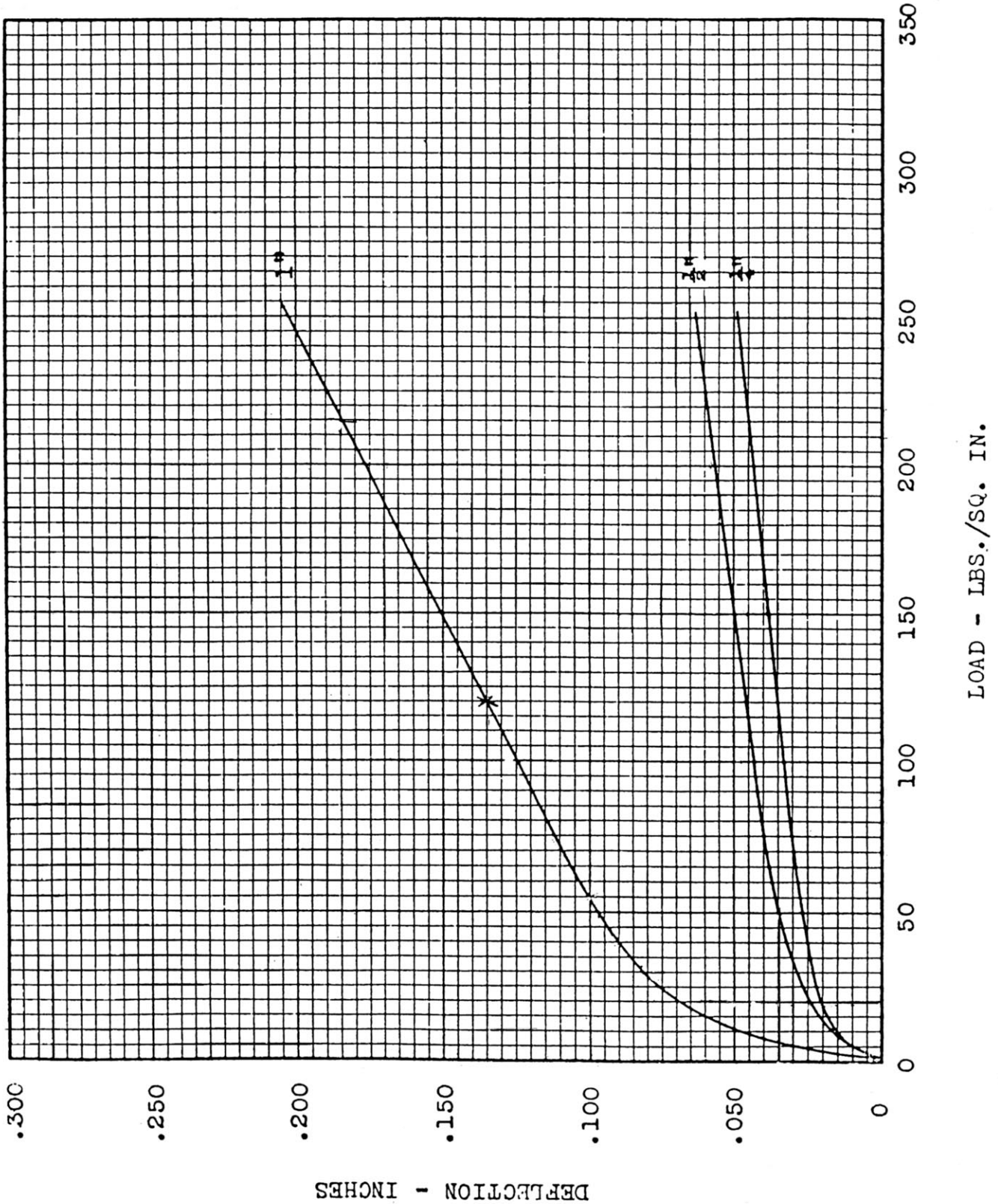
DESCRIPTION:	Felted wool pad with trademarked red layer through center. Designed to be used from 100-250 psi as a vibration pad. The pad is unaffected by exposure to common oils, water and other industrial liquids.
THICKNESS:	1/2" and 1"
COMPOSITION:	Natural wool fibers, 90% min. content
DENSITY:	1.5 lbs. per sq. ft. (1/2" thickness)
TENSILE STRENGTH:	1200 psi
OPTIONAL HIGH FRICTION COATING:	Specified by "DB" adds a coating offering over 0.90 coefficient of friction. Designed to keep equipment from walking.

VIBRATION DAMPING TECHNICAL INFORMATION

Boston Research Division

United States Testing Company, Inc. Case No. 2526

Figure 4. Load-Deflection Curve for Unisorb D

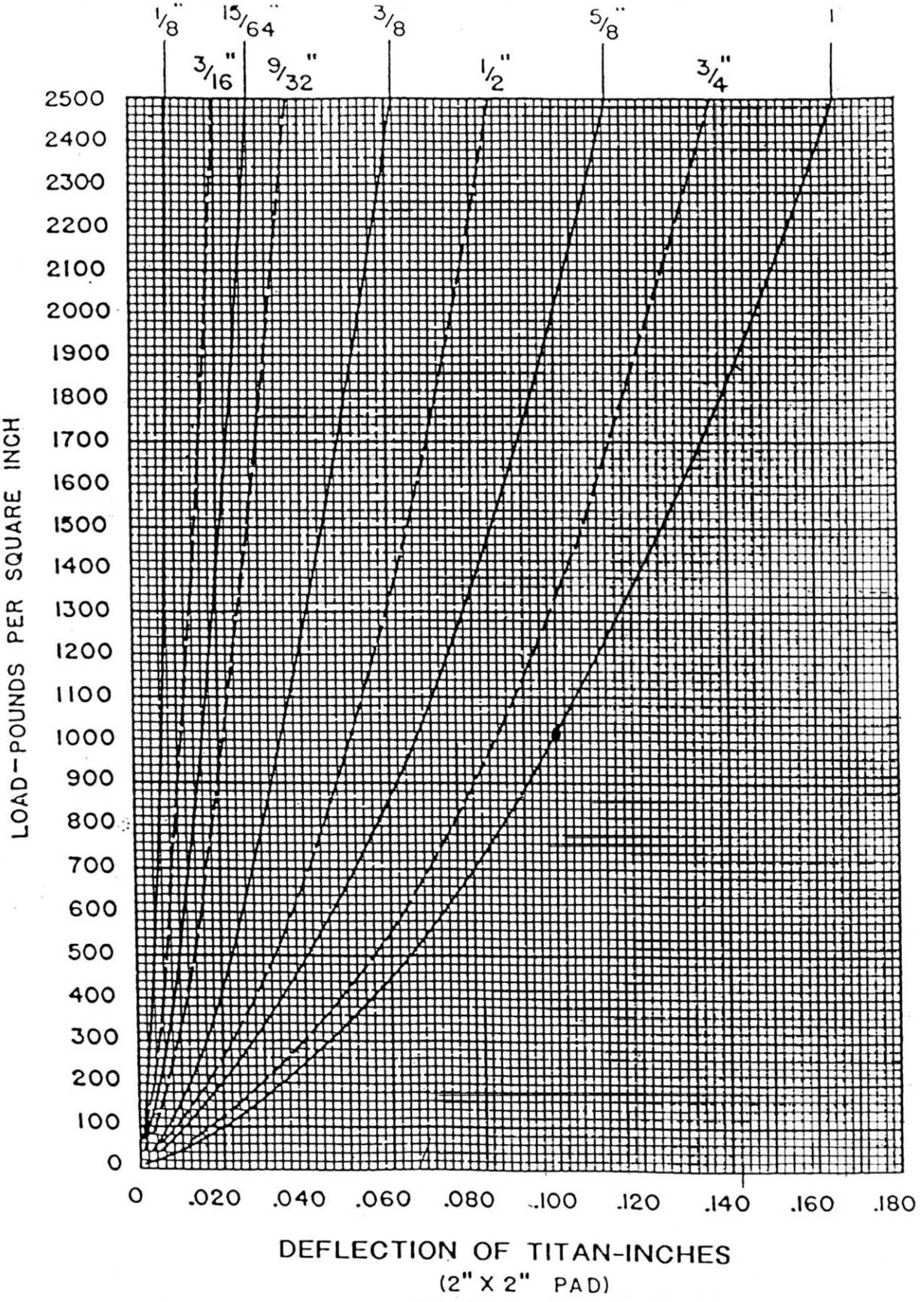


UNISORB TITAN PADS

TABLE II. Load deflection.

Load lb/in^2	Deflections of laminated material											
	14/64 - 16/64 inch thick		17/64 - 19/64 inch thick		21/64 - 23/64 inch thick		15/32 - 17/32 inch thick		19/32 - 21/32 inch thick		61/64 - 67/64 inch thick	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
	inch	inch	inch	inch	inch	inch	inch	inch	inch	inch	inch	inch
52	0.001	0.005	0.002	0.005	0.002	0.007	0.003	0.009	0.004	0.011	0.006	0.019
100	.002	.007	.003	.009	.004	.011	.005	.014	.007	.017	.010	.028
200	.003	.011	.006	.013	.007	.016	.009	.021	.013	.027	.018	.043
300	.005	.014	.008	.017	.010	.020	.013	.027	.018	.034	.025	.054
400	.006	.016	.010	.020	.012	.024	.016	.033	.022	.040	.031	.064
500	.008	.018	.012	.023	.014	.027	.019	.038	.026	.046	.037	.073
600	.009	.020	.013	.025	.016	.030	.022	.042	.029	.052	.043	.081
700	.010	.022	.015	.027	.018	.033	.025	.047	.033	.056	.049	.090
800	.012	.024	.017	.029	.019	.035	.028	.051	.036	.062	.055	.098
900	.013	.025	.018	.031	.021	.038	.031	.055	.040	.066	.060	.105
1,000	.014	.027	.020	.033	.023	.040	.034	.058	.043	.070	.065	.111
1,200	.017	.030	.023	.037	.026	.044	.040	.065	.049	.078	.075	.124
1,400	.019	.033	.025	.040	.029	.048	.045	.072	.055	.086	.085	.136
1,600	.021	.035	.028	.043	.032	.052	.050	.078	.061	.093	.094	.147
1,800	.024	.038	.031	.046	.035	.055	.055	.084	.067	.100	.103	.157
2,000	.026	.040	.033	.049	.038	.058	.060	.090	.072	.107	.112	.168

VIBRATION DAMPING TECHNICAL INFORMATION



SIZES AND PRODUCT CODES

RED- LINE ANCHOR PADS - WOOL FELT

3'x5' SHEET	PRODUCT CODE
H-1/4	400010
HB-1/4	400110
H-1/2	400040
HB-1/2	400140
E-1/2	402040
EB-1/2	402140
E-1	402060
EB-1	402160
D-1/2	403040
DB1/2	403140
D-1	403060
DB-1	403363

RED- LINE ANCHOR PADS - NON WOOL FELT

3'X6' SHEET	PRODUCT CODE
S-1/2	406020
SB-1/2	406021
S-1	406030
SB-1	406031
F-1/2	406060
FB-1/2	406061
F-1	406070
FB-1	406071

SIZES AND PRODUCT CODES

NEOPRENE PAD (60 DUROMETER)

18" X 18"	PRODUCT CODE
NEOPRENE PAD	500200

TITAN SHOCK PADS

THICKNESS	PRODUCT CODE
1/8"	434421
15/16"	434451
11/32"	432171
1/2"	434401
5/8"	434481
3/4"	434491
1"	434321

VIBRATION ISOLATION ANCHORING PADS

VIBRATION DAMPENING QUALITIES OF ENGINEERED FELT

For thousands of years, man has used felted fiber to absorb shock and vibration. Even with advances in technology in polymer and elastomer chemistry, no other substance to this day equals felt in its ability to isolate against transmitted shock and vibration. UNISORB® RED-LINE™ PADS are also highly resistant or impervious to most industrial chemicals, oils and moisture. Life expectancy, in most cases, will exceed that of the machinery with which they are installed.

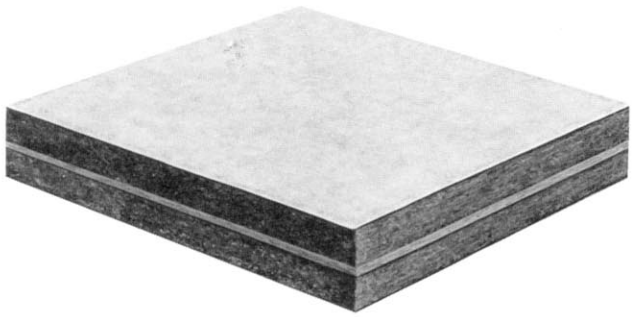
UNISORB® MOUNTS AND PADS SATISFY OSHA REQUIREMENTS

UNISORB leveling mounts, pads and anchor bolts satisfy OSHA requirements for machinery installation. Proper use of these products will:

- Improve the efficiency of production equipment.
- Provide safer, more desirable environment for workers.
- Reduce down time and extend the operating life of your machinery.
- Prevent floor damage.

Harmful effects of vibration and noise may cause serious impairment to the efficiency of your workers and the overall effectiveness of your production machinery.

RED-LINE™ ANCHOR PADS



BONDED PAD ILLUSTRATED

Reduced vibration contributes to more efficient operation and longer life of costly machinery. UNISORB's job-engineered RED-LINE™ ANCHOR PADS substantially reduce vibration transmission and keep light and medium-duty machines from "creeping" or "walking" without the use of anchor bolts and will materially reduce transmitted noise. Installations are fast, easy and inexpensive.

HOW TO SPECIFY UNISORB® ISOLATING & ANCHORING PADS

UNISORB® RED-LINE™ ANCHOR PADS Type H, HB, E, EB, D and DB have long been the standard for achieving superior results in the toughest shock/vibration applications. These pads are 100% wool fiber and are suitable for normal industrial environments being unaffected by exposure to oils, cutting fluids and coolants.

UNISORB® RED-LINE™ and RED-LINE™ ANCHOR PADS Type S, SB, F and FB are manufactured from 100% man-made fibers offering excellent performance at a lower cost. Types S, SB, F and FB pads are recommended for use in wet or "exposed to weather" applications or where strong concentrations of acids or bases will be encountered.

Both families of pad materials may be expected to outlive the machinery on which they are installed.

Use this formula to determine the proper pad materials from the chart below:

$$\frac{\text{Weight (pounds per foot)}}{\text{Foot length (inches) X Width (inches)}} = \text{Pounds per square inch}$$

PAD TYPE SELECTION

Load Range (in PSI)	0-50	50-100	100-250	Over 250
Extra Light	Neoprene H-¼, S-½	Neoprene E-½, S-½	D-½, F-½	Titan-½
Normal	H-½, S-½	E-½, F-½	D-½, F-½	Titan-½
Walking Normal	HB-½, SB-½	EB-½, FB-½	DB-½, FB-½	Titan-½
Normal Heavy Impact	E-1, S-1	E-1, F-1	D-1, F-1	Titan-1
Walking Heavy Impact	EB-1, SB-1	EB-1, FB-1	DB-1, FB-1	Titan-1
Severe Horizontal	S-½, H-½ + Adhesive	F-½, E-½ + Adhesive	F-½, D-½ + Adhesive	Titan-½ + Adhesive

RED-LINE™ ANCHOR PADS TYPE HB, EB, DB, SB & FB

The nylon-bonded surface of RED-LINE™ ANCHOR PADS provides a high coefficient of friction to effectively prevent machinery from "creeping" and "walking". These pads are not affected by most oils and solutions found in manufacturing plants. Available in standard sheets

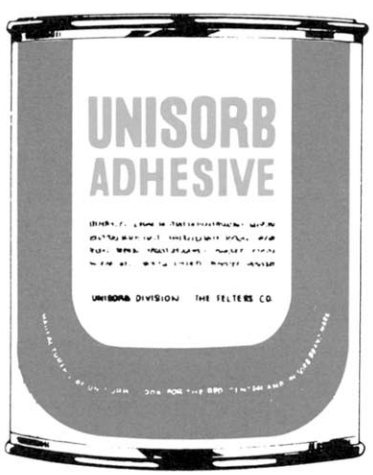
WOOL FELT SHEETS - (HB, EB, DB) STD SIZE 3' X 5'
NON- WOOL FELT SHEETS - (SB, FB) STD SIZE 3' X 6'
ALL AVAILABLE IN " CUT-TO SIZE " PIECES

RED-LINE™ PADS TYPE H, E, D, S & F

Available in a variety of densities and thicknesses to fit machine load requirements, RED-LINE™ PADS provide effective, low cost vibration control for machinery. Used with UNISORB® ADHESIVE, RED-LINE™ PADS effectively anchor "hard-to-hold" machinery in place without lagging or bolting. Available in standard sheets

WOOL FELT SHEETS - (H , E , D) STD SIZE 3' X 5'
NON - WOOL FELT SHEETS - (S , F) STD SIZE 3' X 6'
ALL AVAILABLE IN " CUT-TO SIZE " PIECES

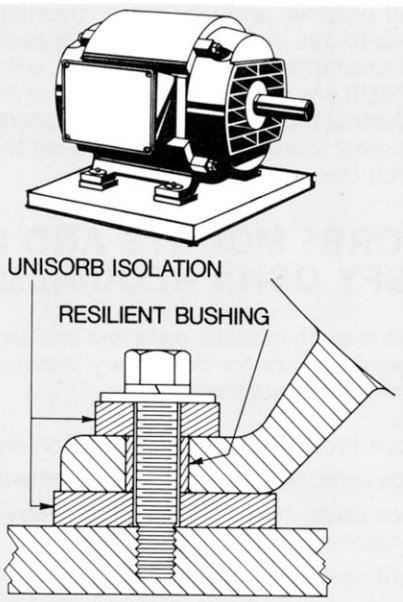
UNISORB® ADHESIVE 90 PSI HOLDING POWER



For permanent bonding of RED-LINE™ PADS, UNISORB® ADHESIVE creates a permanent bond to steel, iron, concrete, wood and other floor materials when properly applied. Available in gallon or quart containers. One gallon covers approximately 2,000 square inches of pad on both sides. Will achieve a full cure in as little as four hours. UNISORB® ADHESIVE is freeze/thaw stable and develops sufficient initial tack to permit its use in holding foundation isolation materials in place on vertical foundation surfaces during construction.

PRODUCT APPLICATIONS

BOLT-THROUGH ISOLATION



This basic approach has been applied satisfactorily to equipment from ¼ horsepower electric motors to 2,000 ton capacity stamping presses. The machine foot is completely isolated from contact with either the mounting structure or anchor bolt by isolation material. Neoprene tubing (of the appropriate size) is used for the resilient bushing around the anchor bolt.

RED-LINE PADS

UNISORB was contacted by a company planning to relocate 41 assorted cold headers, bolt makers and nut forming machines from one plant to another. We recommended the use of Type D½ RED-LINE™ PADS and UNISORB® ADHESIVE for proper machine installation but our proposal was initially rejected by the customer as being too expensive. They selected a competitive non-felt material which was lower in cost.

Almost as soon as the machines were installed and operating the company began to experience failure in the installations. A significant number of machines had "walked" off their pads, and in some cases, were stopped only by the walls of the factory.

We were again contacted and our recommendation was to reinstall at least some of the machines on RED-LINE™ PADS. Once our installation was completed and the results observed the company requested that all of the pads in the plant be replaced. Our approach to the correct application of pads is now the approved standard method with the company.

UNISORB ADHESIVE APPLICATION DATA

UNISORB ADHESIVE

DESCRIPTION: A water based, high strength adhesive for anchoring Unisorb Red-Line vibration isolation pads to wood, concrete, steel, aluminum, stone and other surfaces in the installation of industrial machinery and application of foundation isolation materials. Available in quart and gallon containers, a gallon covers approximately 2000 sq. in. of pad on both sides.

Application Instructions

When applying Unisorb Red-Line pads to equipment bases and the floor, it is necessary that the bonding area be completely clean. Apply Unisorb adhesive evenly with a spatula to both sides of the pad, about 1/32" thick. Unisorb Adhesive will achieve full bond in 4-12 hours depending on temperature, humidity and the surface area involved. Equipment may be operated after a full cure is achieved. One gallon of Unisorb Adhesive will cover both sides of a standard 3' x 5' sheet.

Unisorb Adhesive is ideal for bonding inertia block isolation pads to concrete foundations. Apply by using a notched trowel or caulk gun. The adhesive will bond in 30 secs. to 12 mins. depending on temperature, humidity and surface conditions. Unisorb Adhesive may be applied at the rate of 60-75 sq. ft. per gallon.

After use cover the can tightly to prevent evaporation. Prior to cure Unisorb Adhesive can be cleaned up with soap and water. To remove Unisorb Adhesive after cure, soak approximately 30 minutes with Trichlorethylene or MEK.

Physical Properties

Base	Synthetic Elastomer
Carrier	Water
Color	Black
Solids Content	69%
Flash Point	None (COC)
Consistency	Buttery Mastic

Storage and Handling

Store above 40°F, optimum storage between 60°F and 80°F. If stored at lower temperatures, allow material to warm to room temperature before using. Unisorb Adhesive is freeze/thaw stable for a few cycles at 0°F.

Avoid eye contact. Immediately flush with plenty of water for 15 minutes and seek medical attention.

SHIPPING CLASSIFICATION: Adhesive Cements, NOI

D.O.T. HAZARD CLASSIFICATION: None

CHEMICAL RESISTANCE OF RED LINE PADS - TYPE S & F

CHEMICAL RESISTANCE OF UNISORB RED-LINE PADS
TYPE S AND F

CHEMICAL	RATING
Water	E
Detergent/Water	E
Acetone	G
Methyl Ethyl Ketone	N/R
Methyl Alcohol	E
10% Sulfuric Acid	F
10% Sodium Hydroxide	F
5% Hydrochloric Acid	N/R
6% Ammonium Hydroxide	F
Gasoline	G
Trichlorethylene	E
Glycerin	E
Mineral Oil	E
Motor Oil	E
Lubricating Oil	E
Hydraulic Oil	E

E = Excellent, OK for immersion or repeated exposure.
G = Good, OK for occasional exposure.
F = Fair, OK for infrequent exposure.
N/R = Not Recommended

Please contact ACORN for chemical resistance for chemicals not listed. Because each application varies by the exact combination of chemicals exposure and temperature , we recommend product performance be verified by a test prior to the installation.

APPLICATION GUIDELINES - COLD HEADERS

APPLICATION GUIDELINES FOR THE INSTALLATION OF
NATIONAL COLD HEADING AND BOLT MAKING EQUIPMENT
PADS AND ADHESIVE METHOD

The following guidelines have been developed over the past several years and reflect knowledge gained through hundreds of successful applications involving National Cold Headers and Bolt Makers. Adherence to the guidelines presented herein will insure cost-effective and long-life installations.

PAD MATERIAL RECOMMENDATIONS:

In all cases, it is recommended that UNISORB Red-Line Type D½" Pad Material be employed. In this application, the Red-Line Type D½" Pad Material should be loaded to between 40 and 60 psi (static).

ADHESIVE:

In all applications, standard UNISORB Adhesive is recommended.

DESIGN CONSIDERATIONS:

These applications are well-served by installing one pad under each corner of the machine. The size of the pads must be adjusted so that the psi loadings of the individual pads are equal. On the later type machines, which typically employ a flat base plate, this is simply done by varying the pad dimensions. On the earlier and smaller machines, which typically have four individual support feet, it is usually necessary to use an additional steel plate, bolted securely to the machine foot. A single, large plate encompassing all four mounting points is usually used for this service. If desired, however, individual plates may be fabricated for each machine support point which corresponds with the calculated pad area. It is recommended that plate thicknesses of 1" for machines up to 50,000 lbs. be employed with 1½" plates used on larger units.

Experience has shown that weight distribution between the four mounting areas is relatively representative of the entire line. Figure 1 presents the approximate weight distribution to be used in calculating pad areas.

As previously stated, it is necessary to insure that the isolation pads are sized so that the psi loadings seen by each are very nearly equal. Knowing the weight distribution and the static weight of a given machine, it is possible to calculate simply the required area of pad material for each corner. Figure 2 presents a sample calculation for 5/16 bolt maker. Calculations for other units should follow this example.

For machines with static weights in excess of 70,000 lbs , it is recommended that ACORN be contacted for a review of the application.

INSTALLATION PROCEDURE - COLD HEADERS

INSTALLATION PROCEDURE:

The basic procedure to be followed consists of preparing the floor area where the machine is going to be installed, locating the proper UNISORB Pads, applying the UNISORB Adhesive to the upper and lower surfaces of the pads, and lowering the machine into position. It is important that the concrete floor in the area where the pads are to be applied is in good condition and free from grease, oils or other contaminants. Trichlorethylene or mineral spirits are excellent solvents for use in preparing existing concrete floors. It is recommended that once the machine has been placed, a minimum curing time of 48 hours be observed prior to operating the unit.

NATIONAL HEADER INSTALLATION GUIDELINES

Figure 1 Typical Weight Distribution

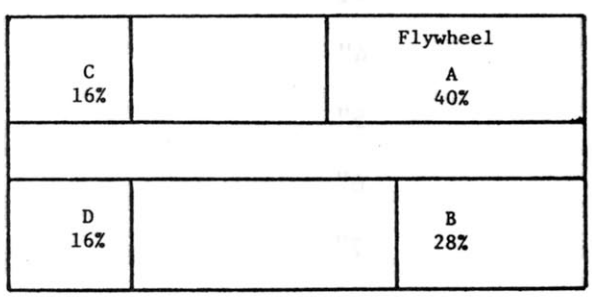


Figure 2 Sample Pad Calculation (National 5/16 Bolt Maker)

Machine Weight: 16,300 lbs.

(1) Load at A 16,800 x 40% = 6,720#

Load at B 16,800 x 28% = 4,704#

Load at C & D 16,800 x 16% = 2,688#

Desired Pad Loading: 50 psi (D⅓)

(2) Area of Pad Required at A 6,720# ÷ 50 = 134.4 sq. in.*

Area of Pad Required at B 4,704# ÷ 50 = 94.1 sq. in.

Area of Pad Required at B & C 2,688# ÷ 50 = 53.8 sq. in.

(3) At A Use 7" x 20" Pad**

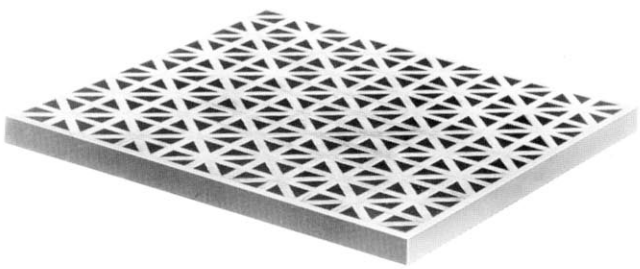
At B Use 7" x 14" Pad

At C & D Use 7" x 8" Pad

* 80 sq. in. minimum allowable under flywheel

** Flywheel overall length should be 3 times it width minimum.

NEOPRENE PADS FOR MACHINES WITH FLOOR LOADING 5 TO 100 PSI



The smooth edge design of the low cost oil-resistant UNISORB® NEOPRENE PAD prevents oil, grease, and dirt from accumulating beneath the load-bearing surface of the pad. Available in 24″ x 24″ x 5/16″.

Applications involved include:

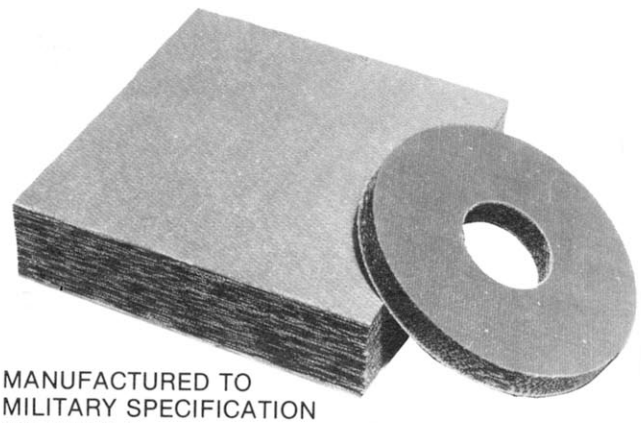
Heat Pumps
Roof-Top Air-Conditioners (gas/electric type and evaporative type)
Exhaust Fans
Furnace Bases
Refrigeration Equipment

In general the Unisorb isolation pads are employed to prevent the transmission of undesired sound and vibration to building structures.

For these applications it is important to note the following advantages of the Formula I Neoprene pad:

The material is easily cut to size with scissors.
The cross-patch pattern on the pad itself effectively pre-measures (by square inches) the pad.
The loading of 5 - 50 PSI is adequate for all applications.
The standard 2' x 2' sheet is conveniently handled and easily stored.
No need to duplicate inventory with additional sizes and types as Formula I does all.
Unisorb Neoprenes are resistant to oil, grease, acid, etc.
Once in place, the pad is self-sealing regardless of how it is cut or shaped.
The 5/16" thickness does not add substantially to the height of the installed unit.

TITAN™ SHOCK PADS FOR EXTREME LOADINGS AND HEAVIEST IMPACTS



MANUFACTURED TO
MILITARY SPECIFICATION
MIL-C-882 D

TYPICAL APPLICATIONS

- Ball mills
- Compressors
- Forging hammers
- Heavy presses
- Impact generating machine shop equipment
- Presses
- Pumps
- Structural bearings
- Central air conditioning
- Foundry equipment (jolters, shakeouts, etc.)
- Generators
- Hydraulic hammers
- Motors
- Printing presses
- Refrigeration equipment
- Textile machinery

Impact shock and vibration can do costly damage to machines, mounting devices and floors and noise may reduce efficiency of operating personnel. TITAN™ SHOCK PADS offer an easy economical way to solve these problems.

Made of a tough textile base laminated with a specially formulated oil-resistant neoprene compound, these multi-ply pads provide protection and vibration isolation needed for machines and equipment, ranging in size from presses to forging hammers. TITAN™ SHOCK PADS protect floors and machine mountings against damaging impact shock while absorbing vibration and dampening structure-borne noise.

TITAN SHOCK PAD SPECIFICATIONS

CONSTRUCTION —	Laminated plies of oil-resistant neoprene-frictioned fabric. All plies laid straight with a continuous ply of frictioned duck on each cover side. 64 plies of frictioned duck per one-inch thickness.
MAXIMUM SIZE —	Mill run sheet sizes 1/8″ through 3/8″ thick: 48″ wide. 1/2″ thick and over: 48″ x 14 1/2′
THICKNESS TOLERANCE —	± 5%
TENSILE STRENGTH —	4,000 psi, minimum
HEAT RESISTANCE —	No visible change after 72 hours at 160° F
COMPRESSION STRENGTH—	Up to 18,000 psi perpendicular to the plane of laminations
DENSITY —	0.0487 lbs. per cubic inch
DUROMETER —	Shore A 90 ±5

TYPICAL DEFLECTION

Load in Lbs. per Sq. In.	14 Ply 15/64″ Thick	21 Ply 11/32″ Thick	31 Ply 1/2″ Thick	39 Ply 5/8″ Thick	48 Ply 3/4″ Thick	64 Ply 1″ Thick
50	.003″	.005″	.006″	.008″	.010″	.012″
100	.005	.007	.010	.013	.015	.021
200	.008	.012	.017	.021	.025	.034
500	.014	.021	.031	.038	.046	.061
1,000	.022	.032	.047	.058	.070	.093
2,000	.033	.048	.070	.088	.105	.140

Thicknesses other than standard are available.

TITAN PAD GENERAL INFORMATION

TITAN PAD - GENERAL INFORMATION

Unisorb Titan Pad material is composed of multiple layers of finely woven cotton polyester duck impregnated and bound with a high quality neoprene compound with the appropriate treatment for the prevention of mold and mildew. The physical properties of the Titan pad are unusually well suited to applications where high impact shocks and large amplitude vibrations are encountered. The Titan pad will withstand compressive loads of 10,000 psi minimum before permanent deformation occurs making it highly suitable for applications where high impact and shock loads are associated with exceptionally heavy machine loads.

The Titan pad exhibits minimal changes in characteristics through extremely long periods of continuous hard service, and features excellent resistance to oils and other normal industrial contaminants. It may be applied in both indoor and outdoor applications.

Titan Pad Application Under Heavy Presses

As a press blow is struck, the entire press frame including its foundation is set into motion. This motion is essentially a free oscillation. As the press frame undergoes forced excursions from the "at rest" position, extremely high loads can be induced into internal press frame components and in the foundation area providing bearing support. The Titan pad sharply reduces the maximum forces generated through energy absorption and due to a high coefficient of damping (approximately 22% of critical), quickly dampens out this free oscillation limiting the total number of shock pulses transmitted throughout the press frame and into the surrounding area. This action also ensures that the press frame and foundation will be completely at rest before the next blow is struck. The use of Titan pads in mounting heavy presses will effectively:

1. Reduce the magnitude and number of high amplitude shock waves to which the press frame and foundation structure are exposed.

2. Provide protection for the concrete foundation against mechanical wear and damage caused by excessively high shock transmission.

3. Reduce transmission of secondary high frequency vibrations into the press frame proper and the surrounding foundation and building structure.

4. Limit interference of heavy press shocks with other nearby operations and minimize the likelihood of disturbances in adjoining property.

5. Greatly reduce the incidence of anchor bolts loosening or failing during normal operation.

TITAN PAD GENERAL INFORMATION

Noise Control With Titan Pads

The high frequency secondary vibrations mentioned above when transmitted into floor and surrounding building structures can create objectionable noise adding to the already severe problem of airborne noise transmission directly from the press frame and dies proper. Much of this noise coming from secondary radiators can be eliminated through the use of Titan pad.

Design Considerations For the Application of Titan Pad Materials

For use under heavy machinery the 1" thickness of Titan pad is generally recommended. This selection will insure that a maximum amount of inputted energy will be absorbed by the pad material proper. It is further recommended that a design compressive load of 1500# psi maximum be used to ensure maximum pad life. It is also recommended that when anchor bolts are being employed, a washer of the Titan pad material be placed underneath the anchor nut to provide isolation for the upper side of the press foot from the anchor bolt. This will eliminate the possibility of telegraphing shock and vibration to the foundation through the anchor bolt.

Installation of Titan Pads

Titan pads are normally supplied cut to customer specifications complete with holes for anchor bolts ready for placement on the bearing surface of the foundation before the press is moved into position. The foundation surface should be clean and free from grease and foreign material. If, as in the case of certain types of machinery, no bolts are being employed, it is recommended that the Titan pad be cemented in place with Unisorb Adhesive. This will insure that the machine being mounted does not "walk" away from it location.

PLEASE CONTACT US TOLL FREE FOR SPECIFIC APPLICATIONS OR ADDITIONAL INFORMATION ON TITAN PADS.