Foundation Isolation Solutions for Buildings, Equipment & Machines

FABREEKA®
VIBRATION & SHOCK CONTROL

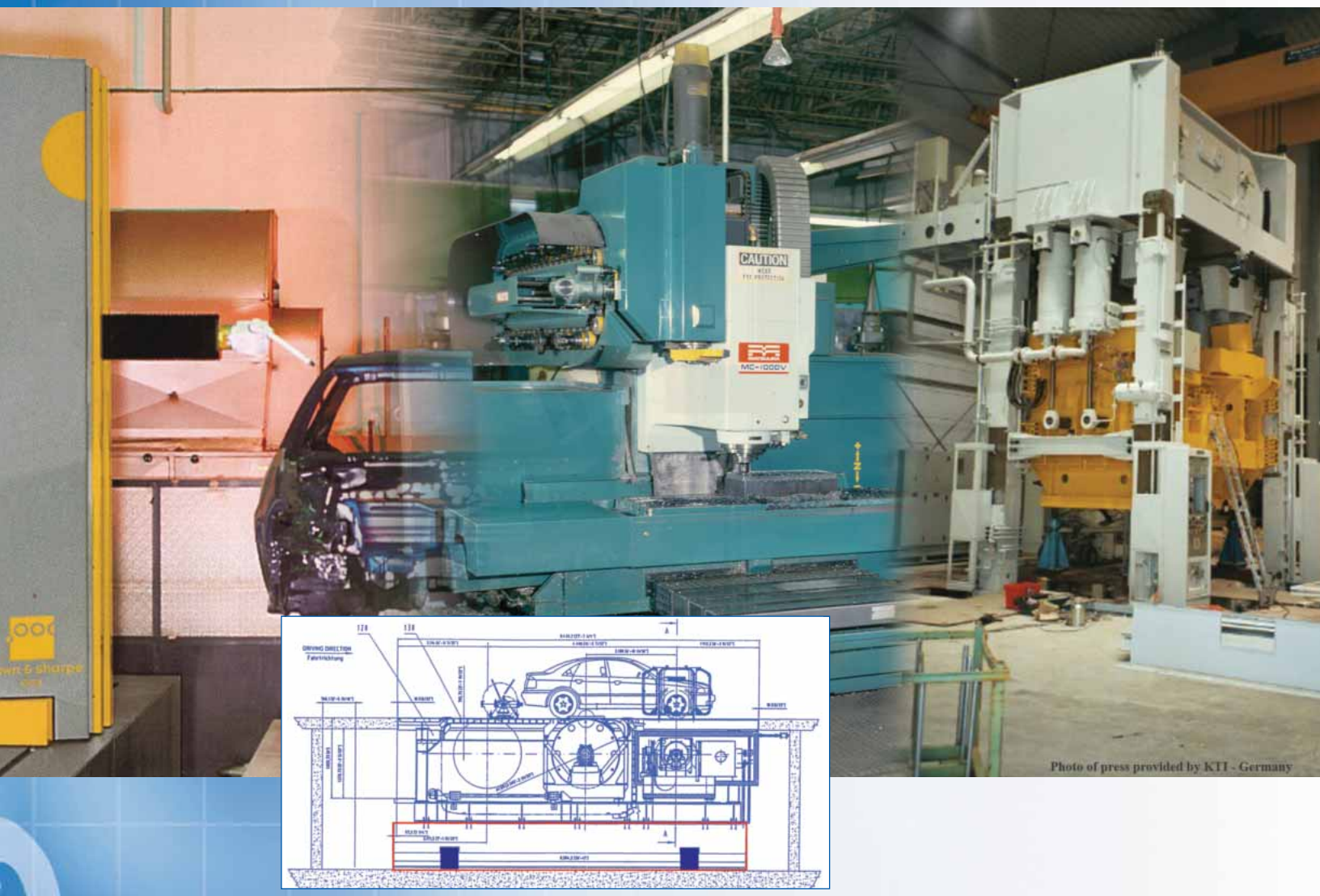

Photo of press provided by KTI - Germany

Foundation Isolation Products and Services for Buildings, Equipment & Machines

The purpose of isolation is to control unwanted vibration so that its adverse effects are kept within the scope of work (SOW) acceptable limits. When is a foundation (inertia block, reaction mass) required? In certain applications, it is not desirable or feasible to mount a machine directly on vibration isolators. An integral part of many machine tool and equipment installations is a properly designed and isolated foundation.

In this brochure, you will find Fabreeka's solutions for foundation isolation. Please refer also to our brochure "FAB 3000-050 Theory" for an in depth discussion on the theory of isolating foundations from vibration.

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3 **FAB-EPM HP®**
FAB-EPM HP isolation materials provide low frequency isolation, ease of installation and design flexibility to meet a wide range of applications under equipment and machinery, as well as isolating a building or structure from its surroundings.

16 **FABSORB®**
Fabsorb® isolation material is an economical approach to foundation isolation where high frequency vibration control is required.

20 **Pneumatic and Air Bag Isolators**
Pneumatic isolators provide exceptional low frequency and shock isolation for sensitive machines and equipment. Air bag isolators allow for large displacements (stroke) where solutions require the same.

22 **Vibration Measurement & Analysis**
Fabreeka provides Vibration Measurement & Analysis services prior to and after installation to determine and/or verify the resultant amplitude and frequency of vibration at your facility.

23 **Design Services**
Our engineering team can provide dynamic, structural and finite element (FE) analysis as part of the total isolation solution.

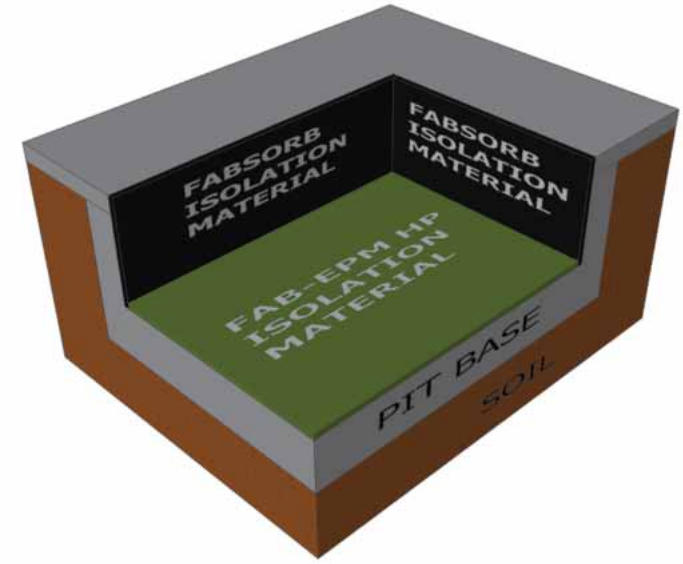
FAB-EPM HP® Isolation Material

FAB-EPM HP® vibration isolation material is a mixed cell polyurethane foam specifically designed to provide low frequency vibration isolation for building and machine foundation isolation and light rail applications.

FAB-EPM HP is a high performance material manufactured in different densities, which allows for optimal isolation performance. The damping rate of the different material types varies, and natural frequency can be as low as 6 Hz. Additionally, with increased thickness, the natural frequency is reduced, which also improves isolation. FAB-EPM HP is impervious to most chemicals, alkaline solutions and oil.

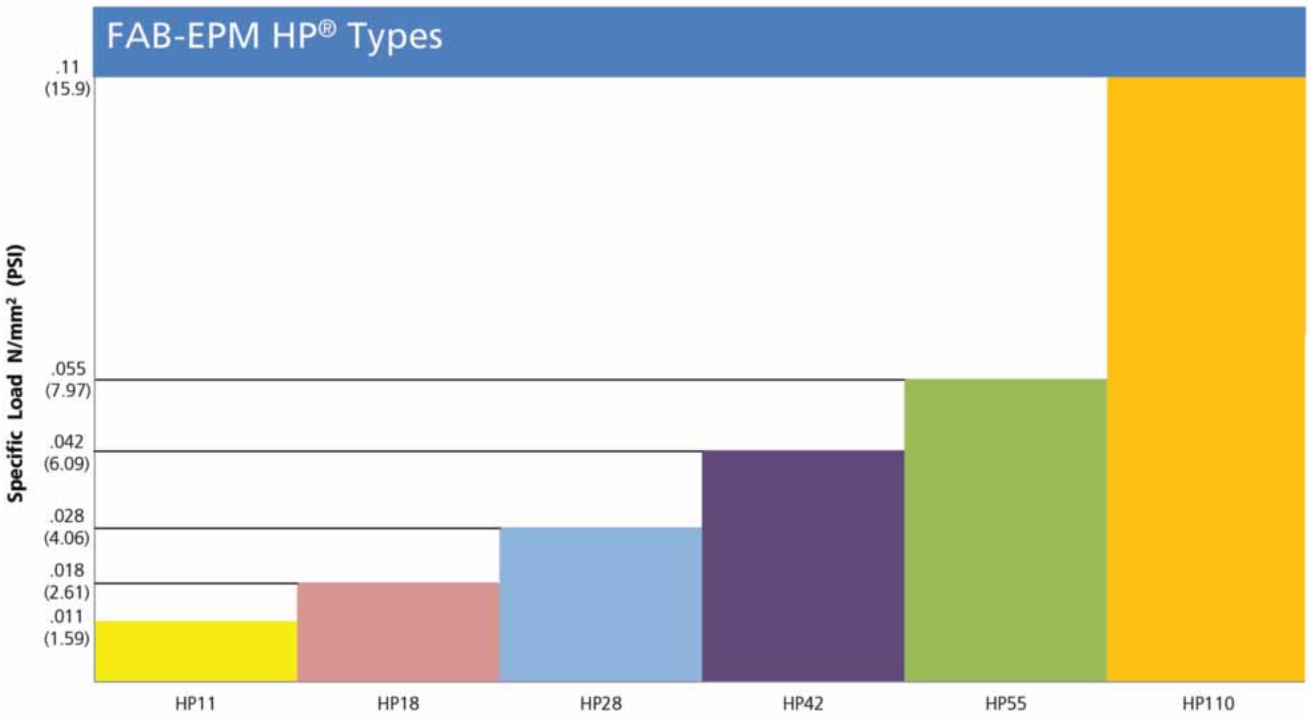
FAB-EPM HP material can be supplied and used in full sheet form, strips or even blocks. However, when used in full sheet form, the material becomes the base formwork for the concrete foundation. This advantage creates a simple, less labor-intensive construction method, which reduces the overall project cost.

As with all non-linear, elastomeric isolators, FAB-EPM HP material reacts stiffer under dynamic loads than under static loads. The degree of stiffness depends on the material type and the load applied.



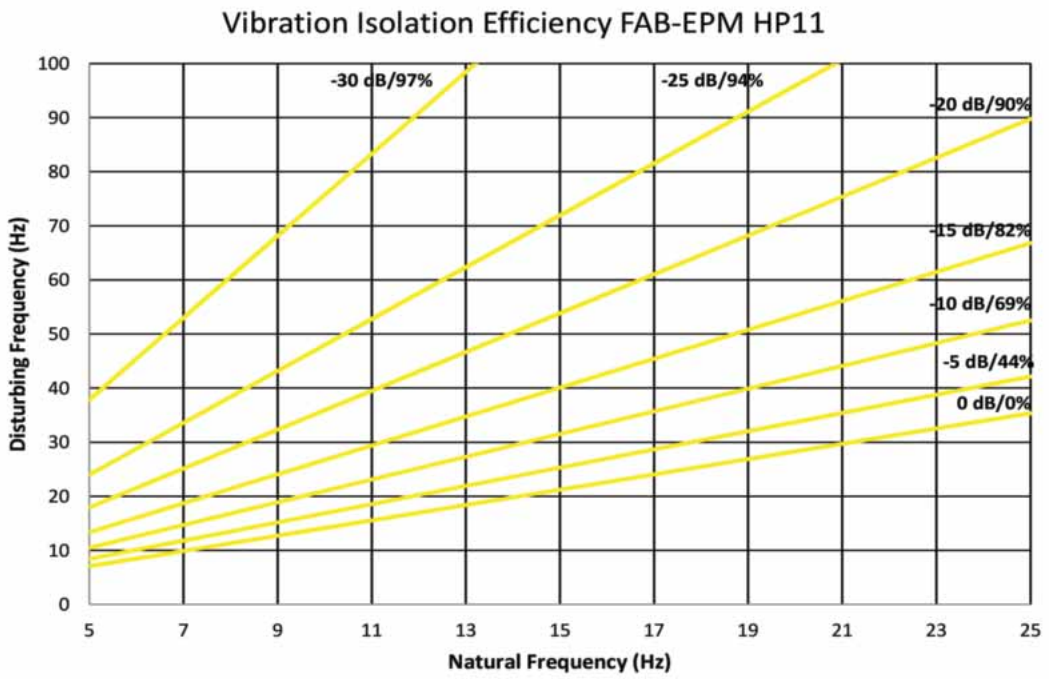
Additional small dynamic loads can be applied beyond the maximum static load for each type of material.

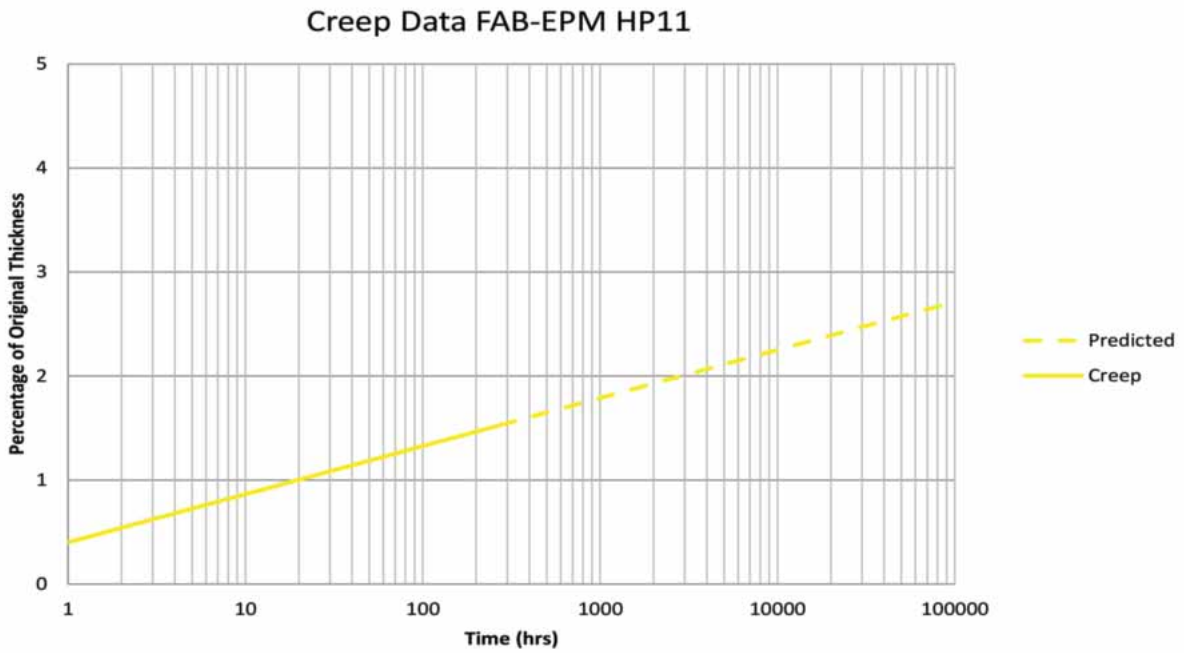
Permanent static loads cause a certain amount of creep (additional deflection over time) in all elastomeric materials. The long term creep of FAB-EPM HP material is very low when used in the static load range.

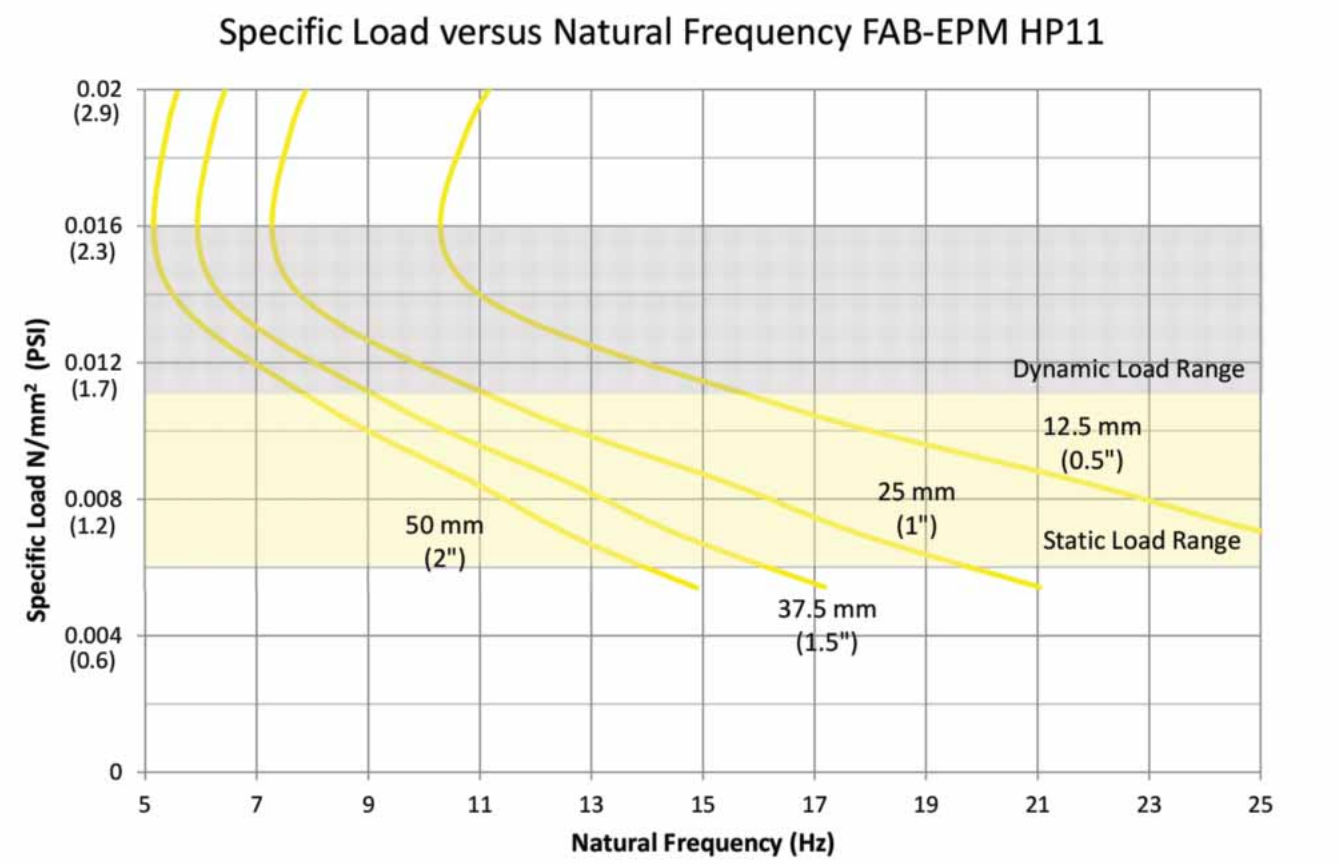


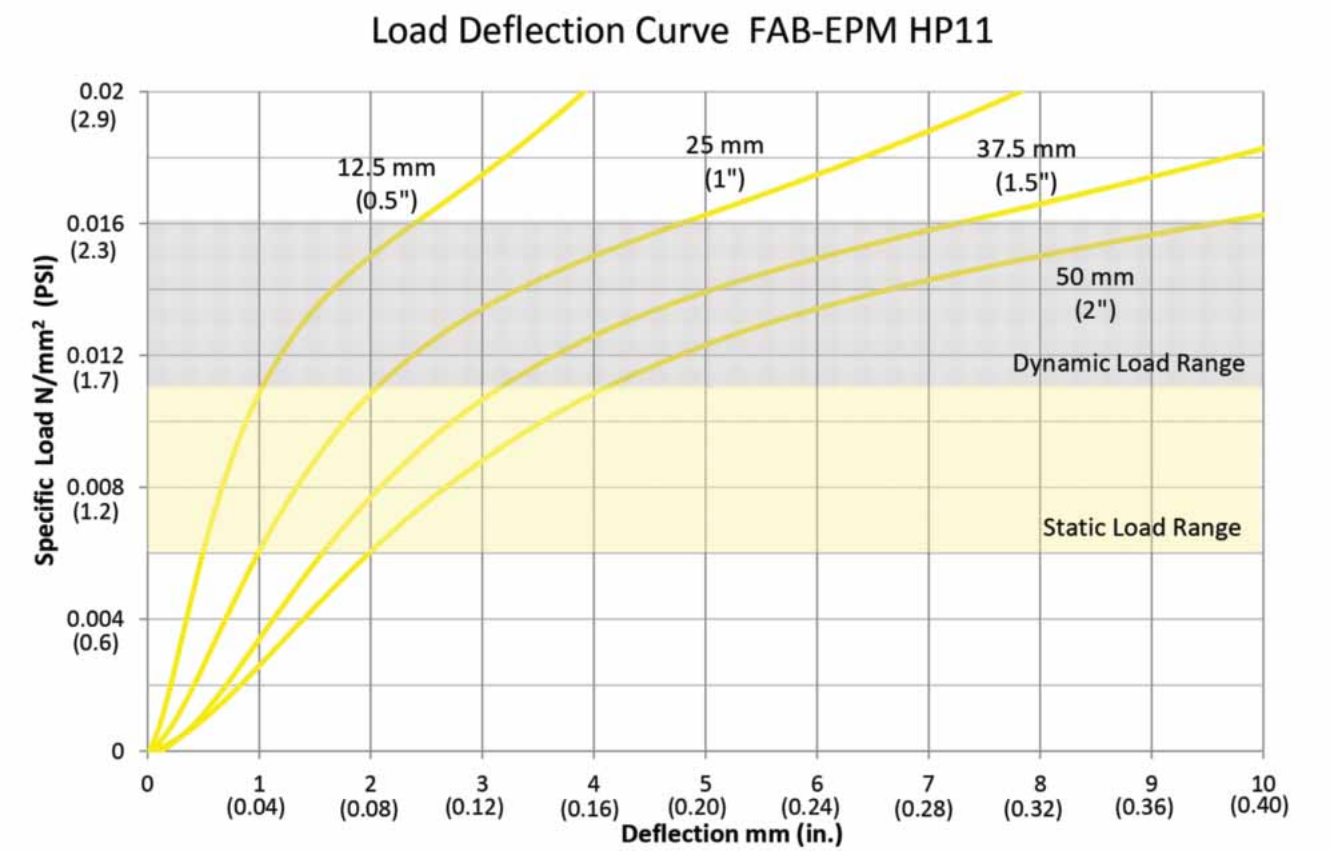
FAB-EPM® HP11 Material Specification

Color:	Yellow
Standard Sizes:	1.5 m x 5.0 m (5' x 16.5')
Thickness:	12.5 mm (1/2"), 25 mm (1")
Optimal Static Load Range: [Approx. 7%]	up to 0.011 N/mm^2 (1.59 psi)
Additional Dynamic Load Range: [Approx. 25%]	up to 0.016 N/mm^2 (2.32 psi)
Mechanical Loss Factor:	0.18
Rebound Resilience:	35%



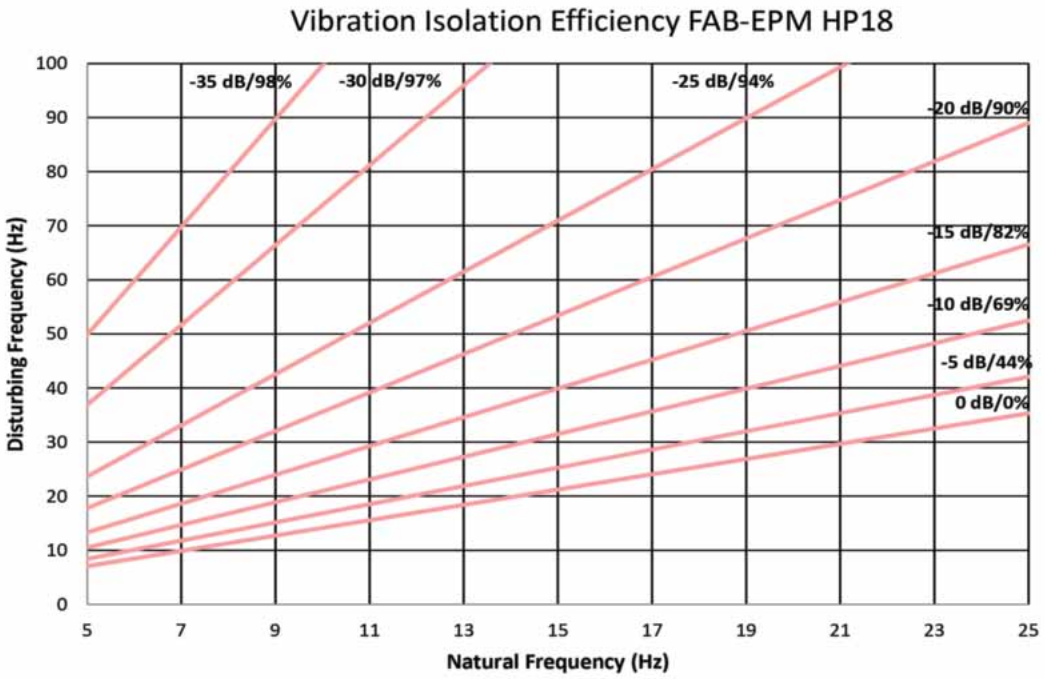


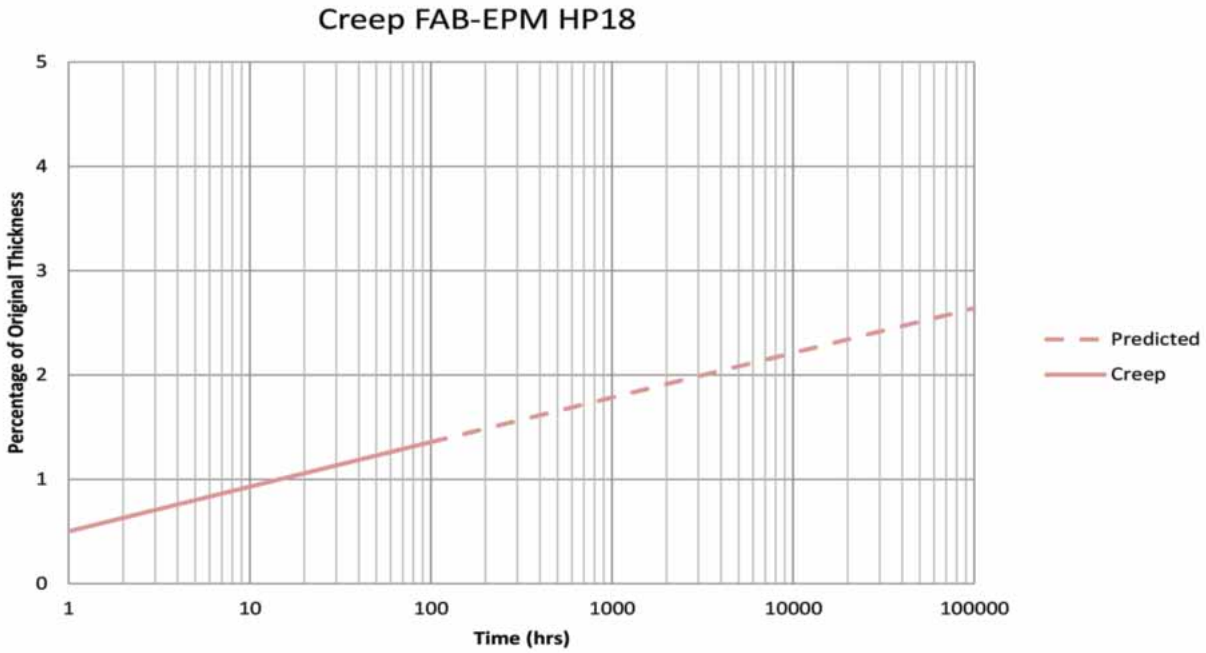

Specific Load versus Natural Frequency FAB-EPM HP11
Specific Load N/mm² (PSI)
0.02 (2.9)
0.016 (2.3)
0.012 (1.7)
0.008 (1.2)
0.004 (0.6)
0
5
7
9
11
13
15
17
19
21
23
25
Natural Frequency (Hz)
Dynamic Load Range
Static Load Range
12.5 mm (0.5")
25 mm (1")
37.5 mm (1.5")
50 mm (2")


Load Deflection Curve FAB-EPM HP11
Specific Load N/mm² (PSI)
0.02 (2.9)
0.016 (2.3)
0.012 (1.7)
0.008 (1.2)
0.004 (0.6)
0
0
1 (0.04)
2 (0.08)
3 (0.12)
4 (0.16)
5 (0.20)
6 (0.24)
7 (0.28)
8 (0.32)
9 (0.36)
10 (0.40)
Deflection mm (in.)
12.5 mm (0.5")
25 mm (1")
37.5 mm (1.5")
50 mm (2")
Dynamic Load Range
Static Load Range

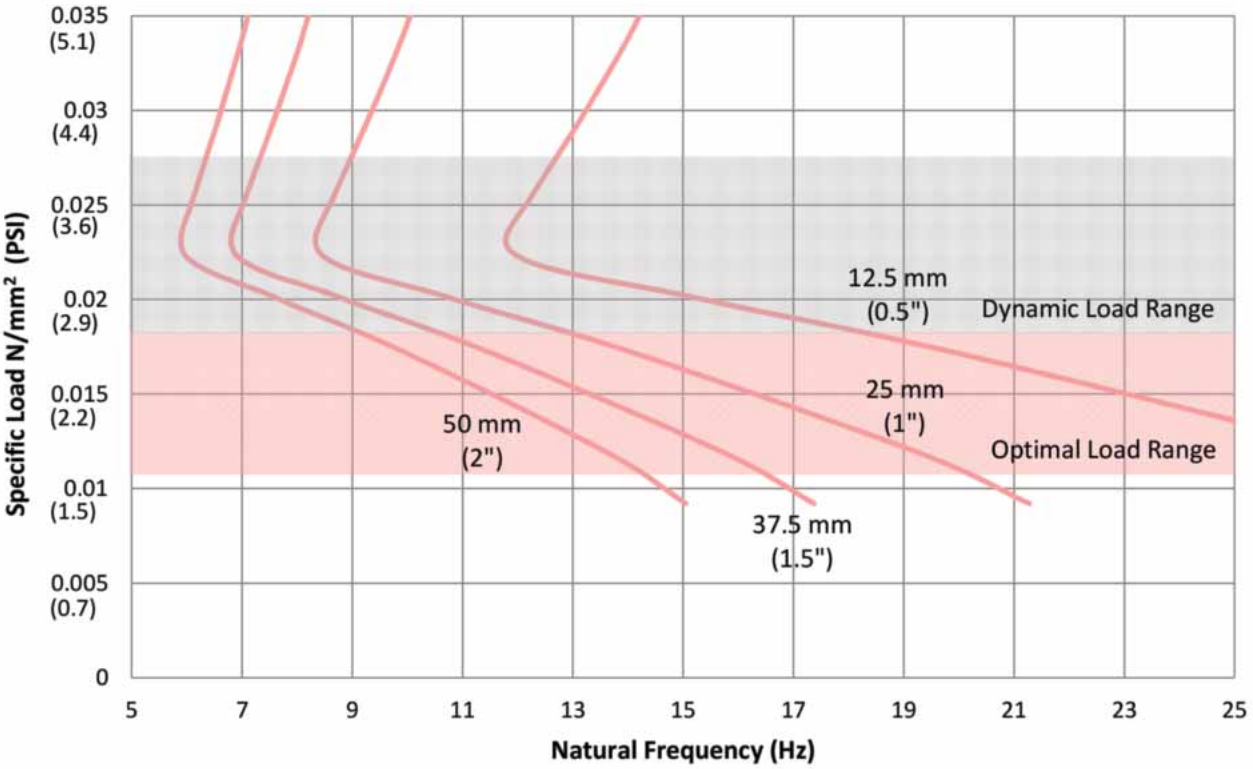
FAB-EPM® HP18 Material Specification

Color:	Pink
Standard Sizes:	1.5 m x 5.0 m (5' x 16.5')
Thickness:	12.5 mm (1/2"), 25 mm (1")
Optimal Static Load Range: [Approx. 7%]	up to 0.018 N/mm^2 (2.61 psi)
Additional Dynamic Load Range: [Approx. 25%]	up to 0.028 N/mm^2 (4.06 psi)
Mechanical Loss Factor:	0.17
Rebound Resilience:	35%

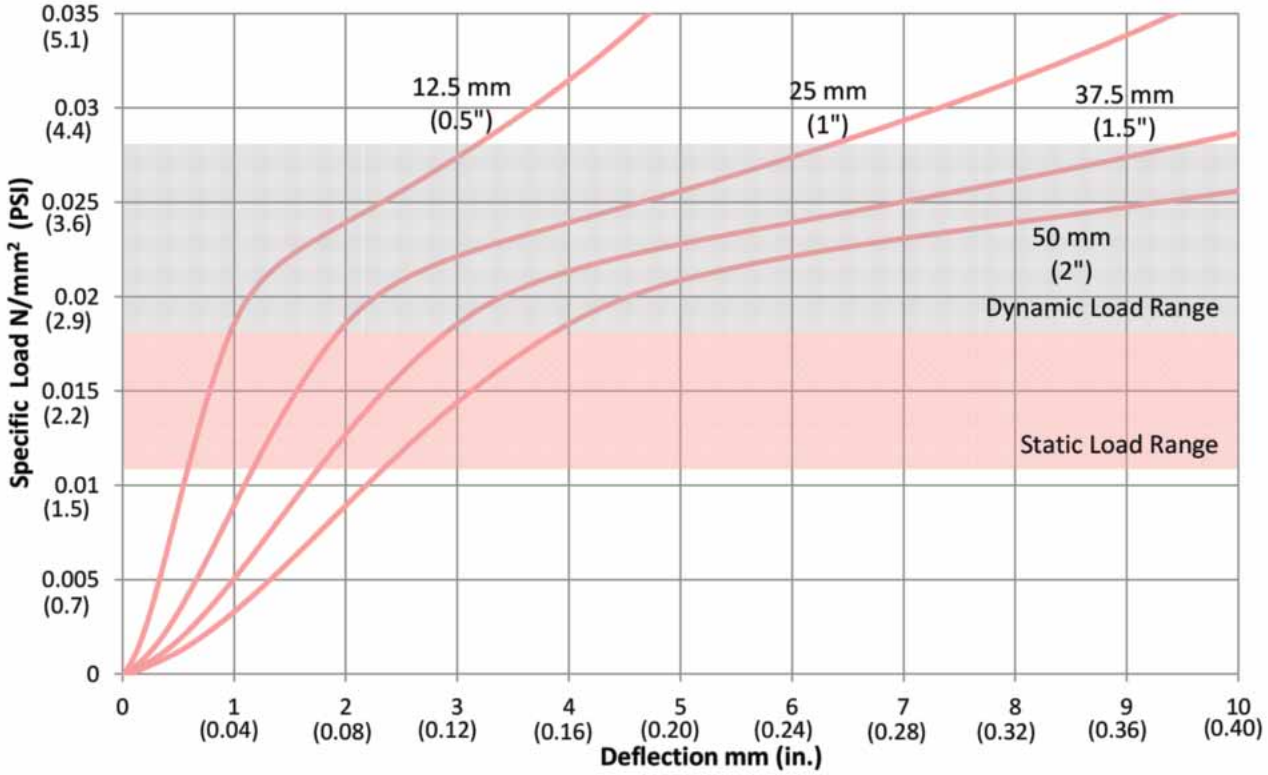




Specific Load versus Natural Frequency FAB-EPM HP18

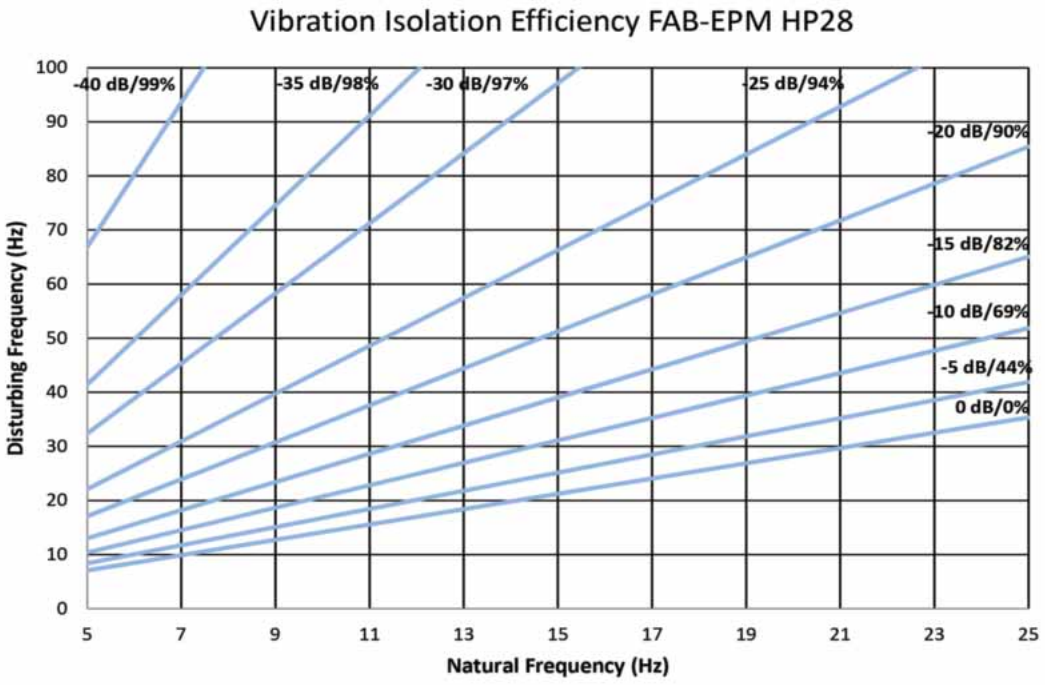


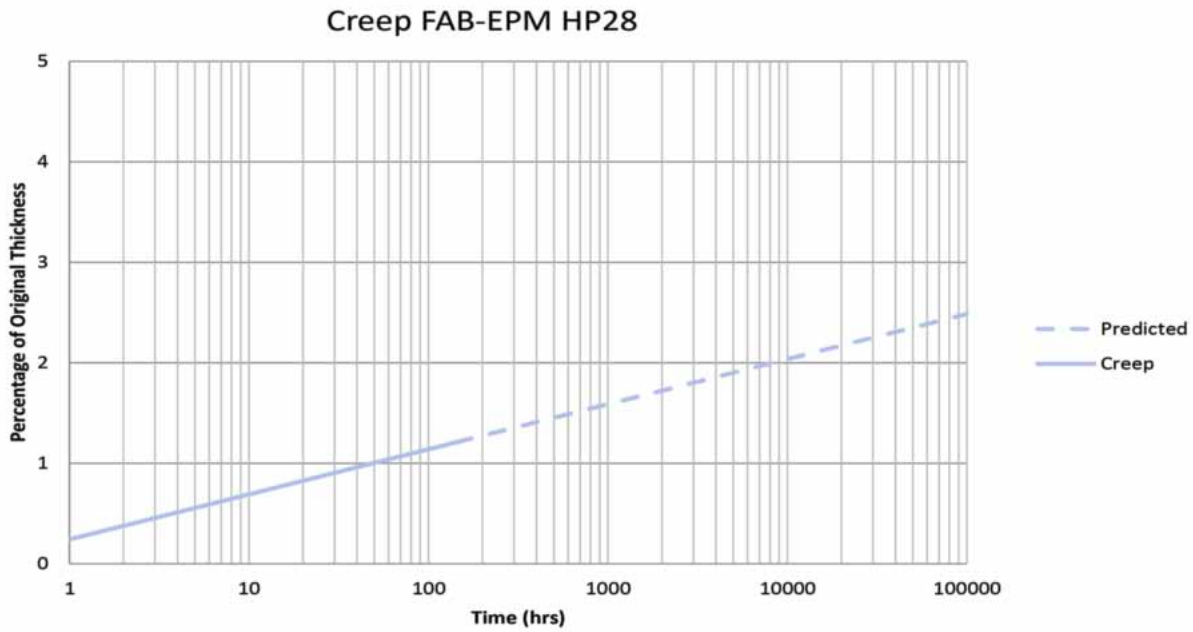
Load Deflection Curve FAB-EPM HP18

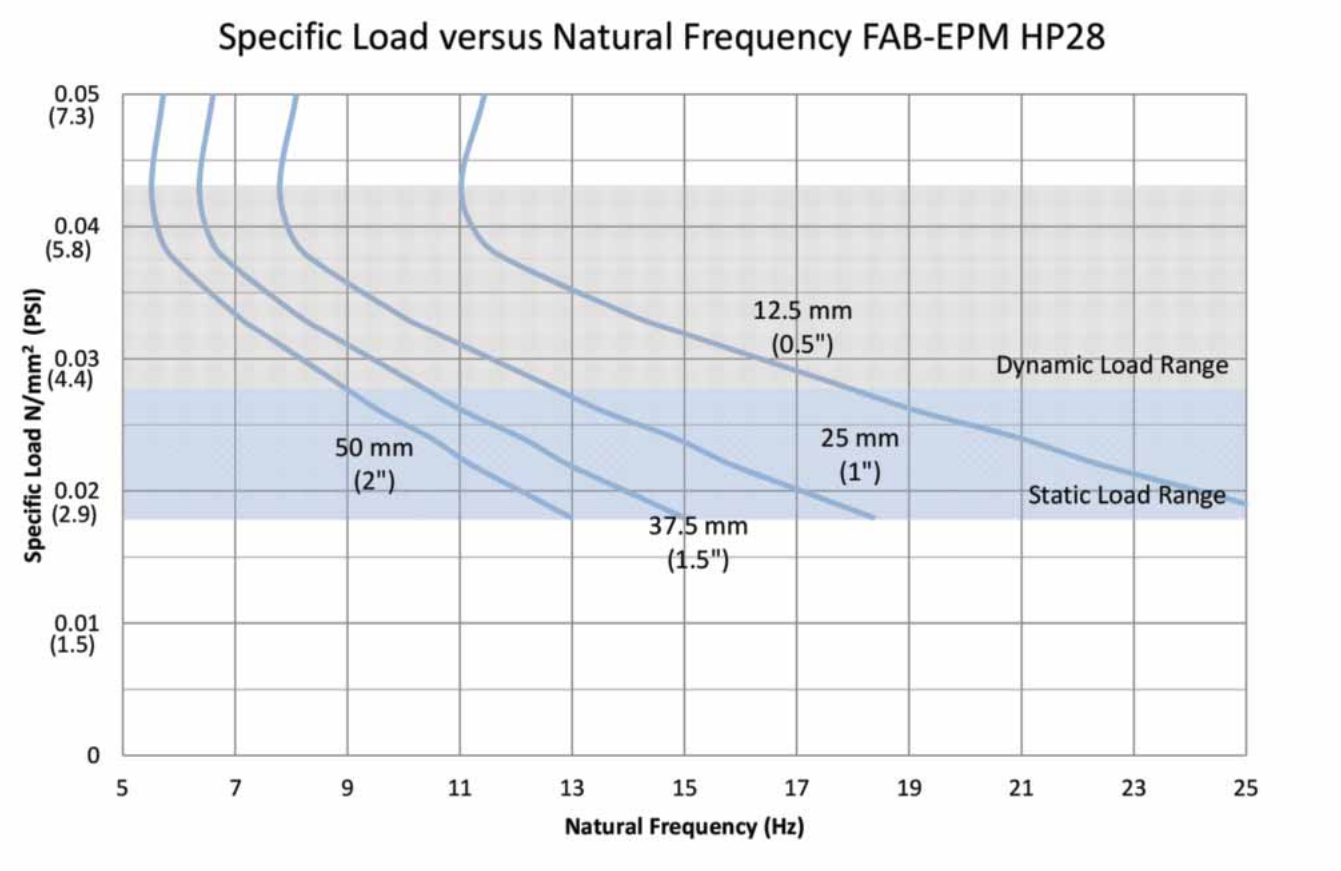


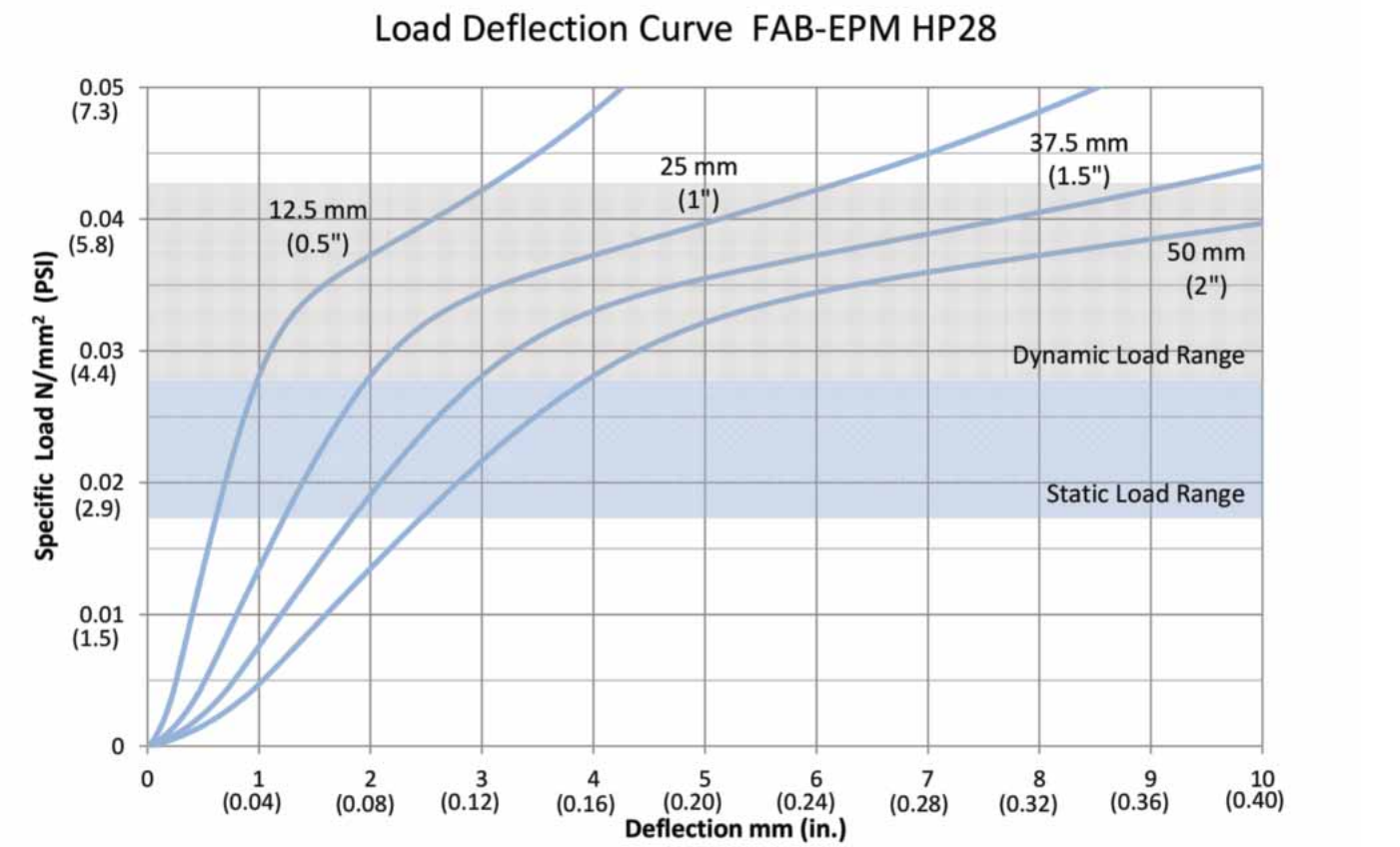
FAB-EPM® HP28 Material Specification

Color:	Blue
Standard Sizes:	1.5 m x 5.0 m (5' x 16.5')
Thickness:	12.5 mm (1/2"), 25 mm (1")
Optimal Static Load Range: [Approx. 7%]	up to 0.028 N/mm^2 (4.06 psi)
Additional Dynamic Load Range: [Approx. 25%]	up to 0.042 N/mm^2 (6.09 psi)
Mechanical Loss Factor:	0.11
Rebound Resilience:	48%



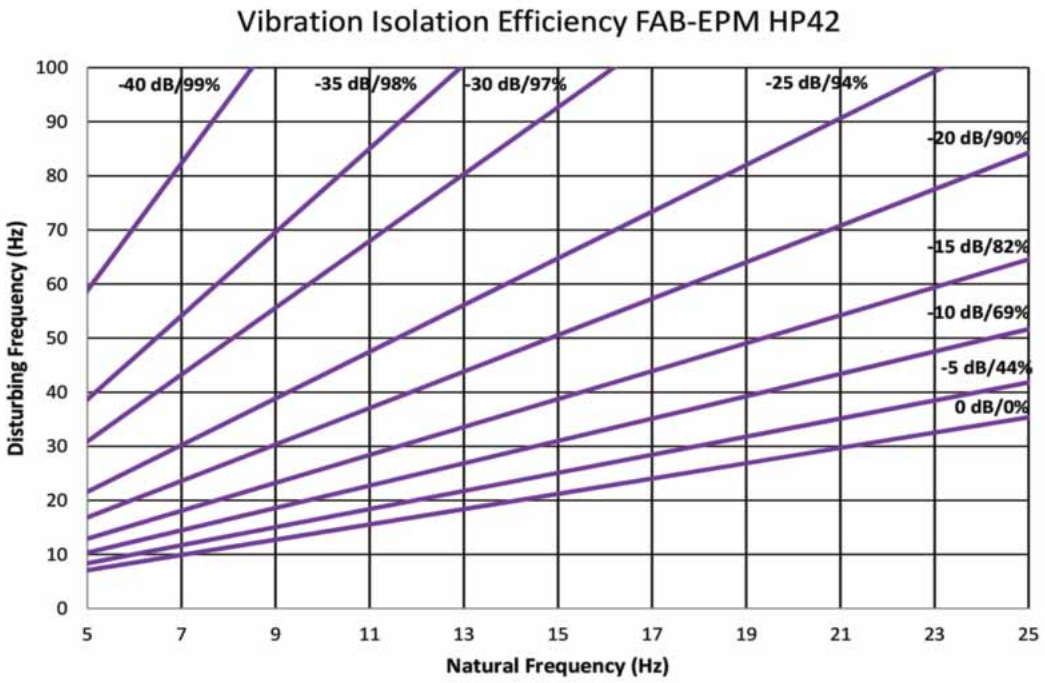


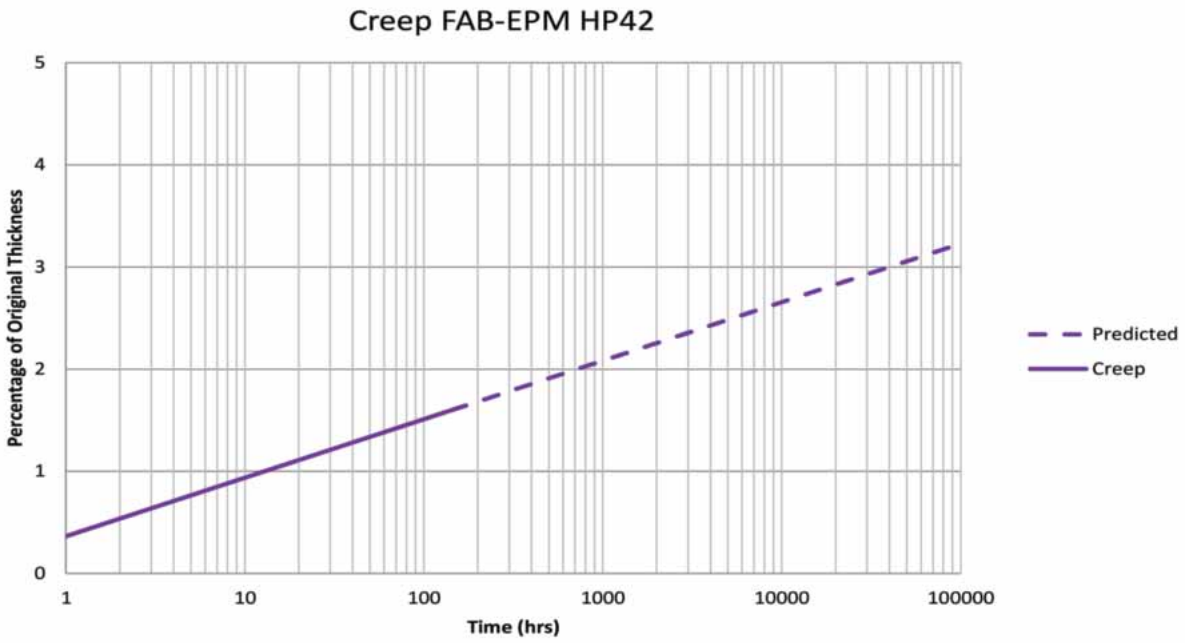

Specific Load versus Natural Frequency FAB-EPM HP28
Specific Load N/mm² (PSI)
0.05 (7.3)
0.04 (5.8)
0.03 (4.4)
0.02 (2.9)
0.01 (1.5)
0
5
7
9
11
13
15
17
19
21
23
25
Natural Frequency (Hz)
12.5 mm (0.5")
25 mm (1")
37.5 mm (1.5")
50 mm (2")
Dynamic Load Range
Static Load Range

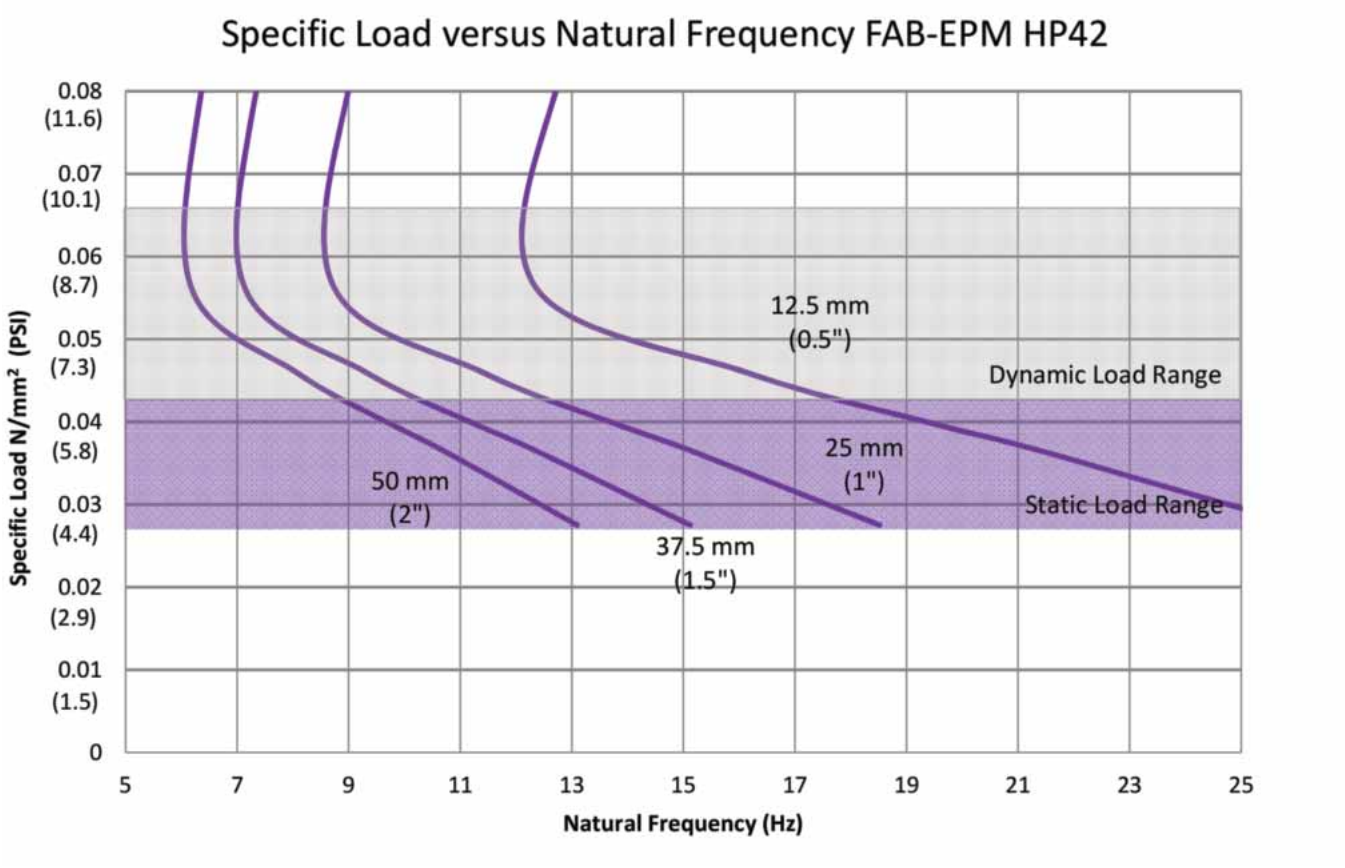

Load Deflection Curve FAB-EPM HP28
Specific Load N/mm² (PSI)
0.05 (7.3)
0.04 (5.8)
0.03 (4.4)
0.02 (2.9)
0.01 (1.5)
0
0
1 (0.04)
2 (0.08)
3 (0.12)
4 (0.16)
5 (0.20)
6 (0.24)
7 (0.28)
8 (0.32)
9 (0.36)
10 (0.40)
Deflection mm (in.)
12.5 mm (0.5")
25 mm (1")
37.5 mm (1.5")
50 mm (2")
Dynamic Load Range
Static Load Range

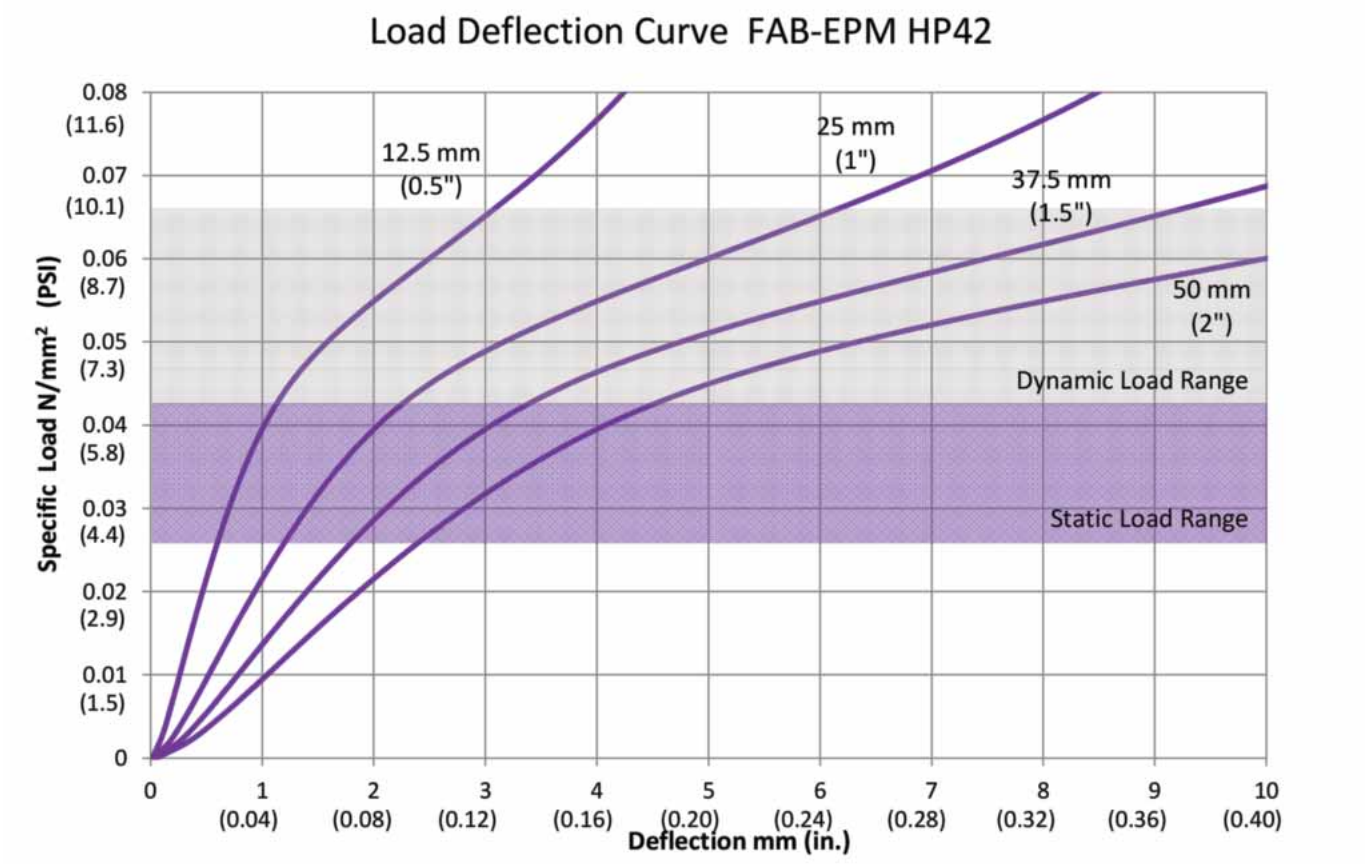
FAB-EPM® HP42 Material Specification

Color:	Purple
Standard Sizes:	1.5 m x 5.0 m (5' x 16.5')
Thickness:	12.5 mm (1/2"), 25 mm (1")
Optimal Static Load Range: [Approx. 7%]	up to 0.042 N/mm^2 (6.09 psi)
Additional Dynamic Load Range: [Approx. 25%]	up to 0.065 N/mm^2 (9.42 psi)
Mechanical Loss Factor:	0.08
Rebound Resilience:	51%



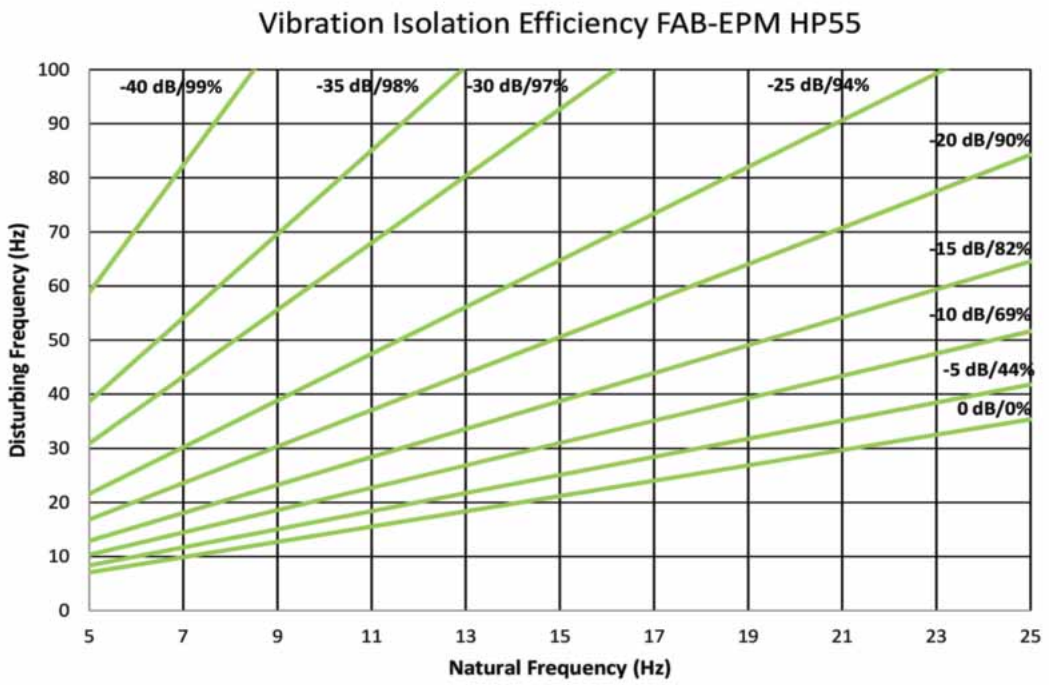


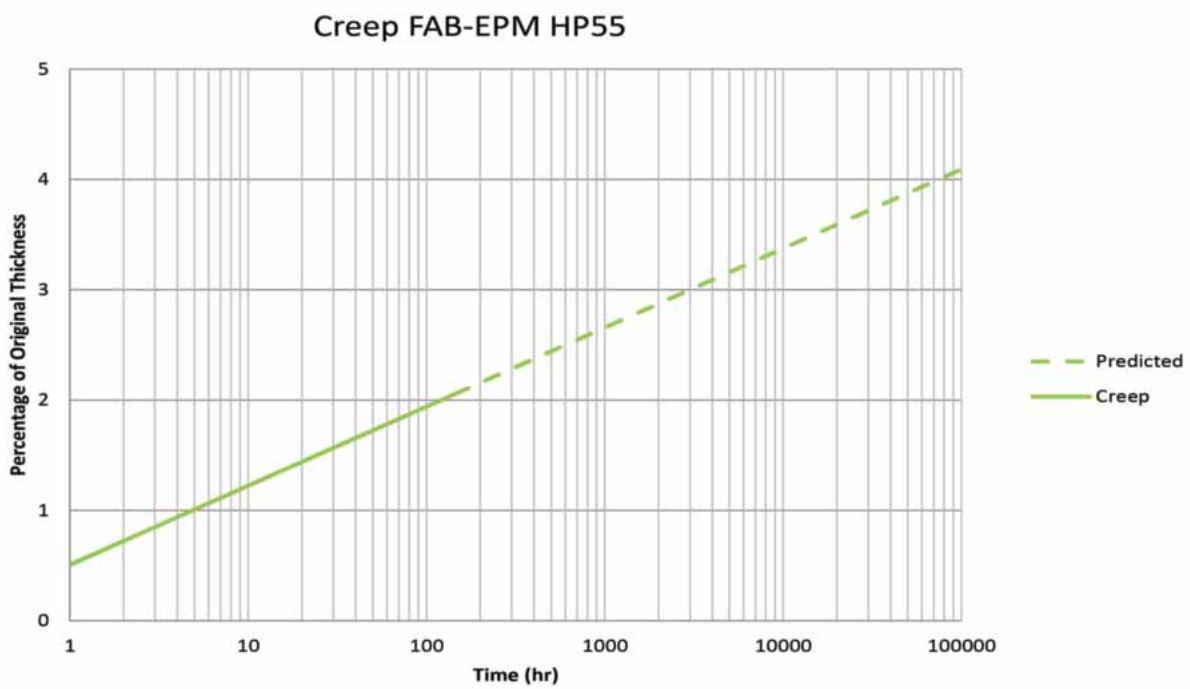

Specific Load versus Natural Frequency FAB-EPM HP42
Specific Load N/mm² (PSI)
0.08 (11.6)
0.07 (10.1)
0.06 (8.7)
0.05 (7.3)
0.04 (5.8)
0.03 (4.4)
0.02 (2.9)
0.01 (1.5)
0
5
7
9
11
13
15
17
19
21
23
25
Natural Frequency (Hz)
12.5 mm (0.5")
25 mm (1")
37.5 mm (1.5")
50 mm (2")
Dynamic Load Range
Static Load Range

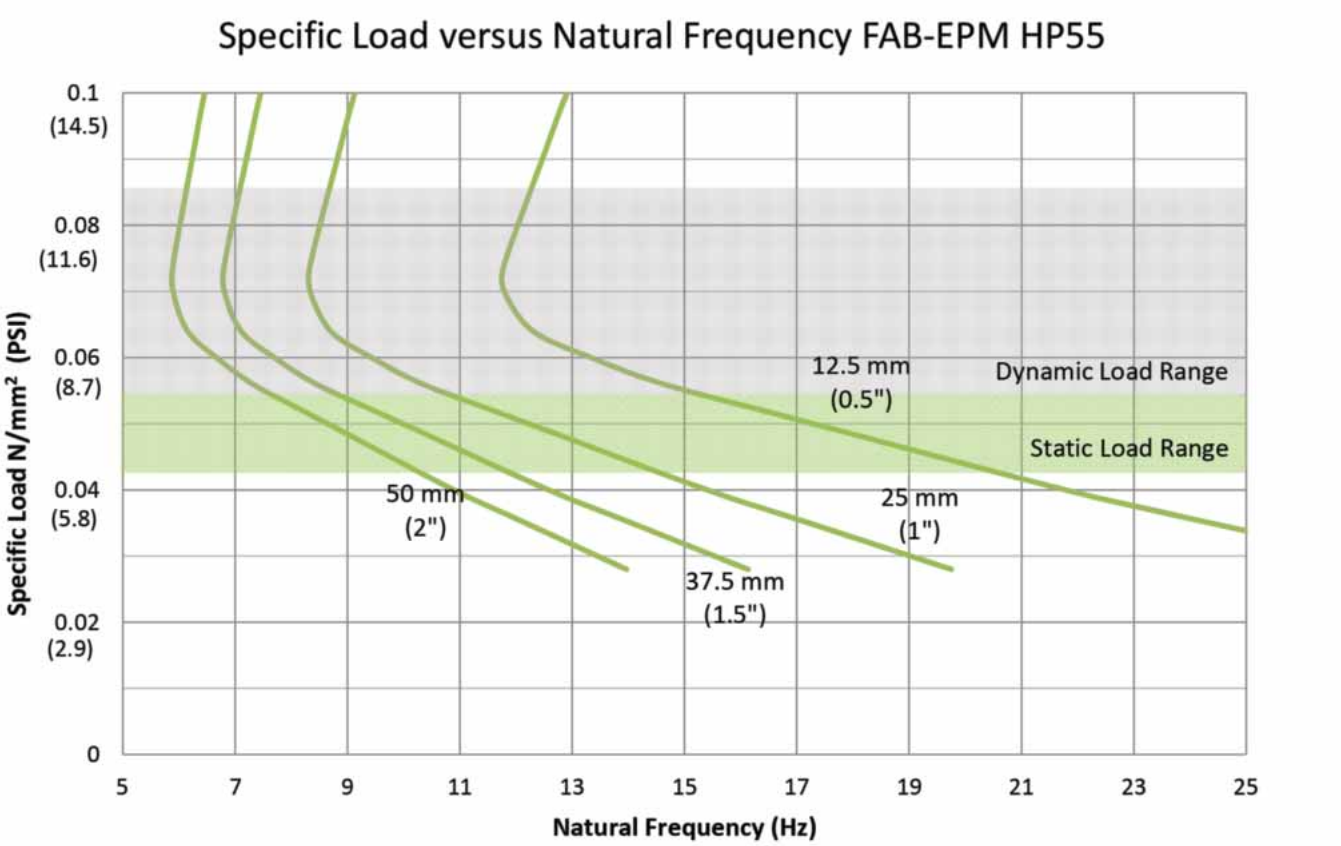

Load Deflection Curve FAB-EPM HP42
Specific Load N/mm² (PSI)
0.08 (11.6)
0.07 (10.1)
0.06 (8.7)
0.05 (7.3)
0.04 (5.8)
0.03 (4.4)
0.02 (2.9)
0.01 (1.5)
0
0
1 (0.04)
2 (0.08)
3 (0.12)
4 (0.16)
5 (0.20)
6 (0.24)
7 (0.28)
8 (0.32)
9 (0.36)
10 (0.40)
Deflection mm (in.)
12.5 mm (0.5")
25 mm (1")
37.5 mm (1.5")
50 mm (2")
Dynamic Load Range
Static Load Range

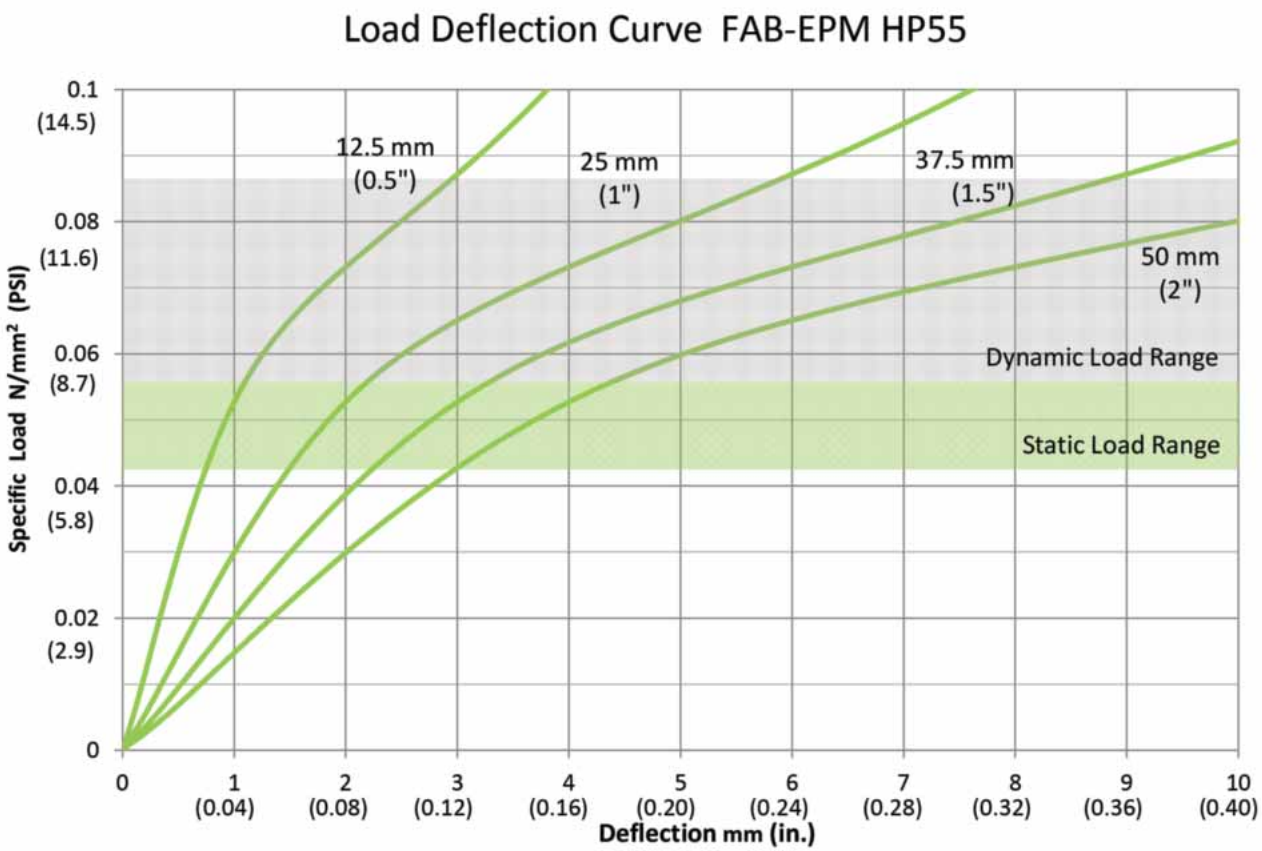
FAB-EPM® HP55 Material Specification

Color:	Green
Standard Sizes:	1.5 m x 5.0 m (5' x 16.5')
Thickness:	12.5 mm (1/2"), 25 mm (1")
Optimal Static Load Range: [Approx. 7%]	up to 0.055 N/mm^2 (7.97 psi)
Additional Dynamic Load Range: [Approx. 25%]	up to 0.085 N/mm^2 (12.32 psi)
Mechanical Loss Factor:	0.08
Rebound Resilience:	52%



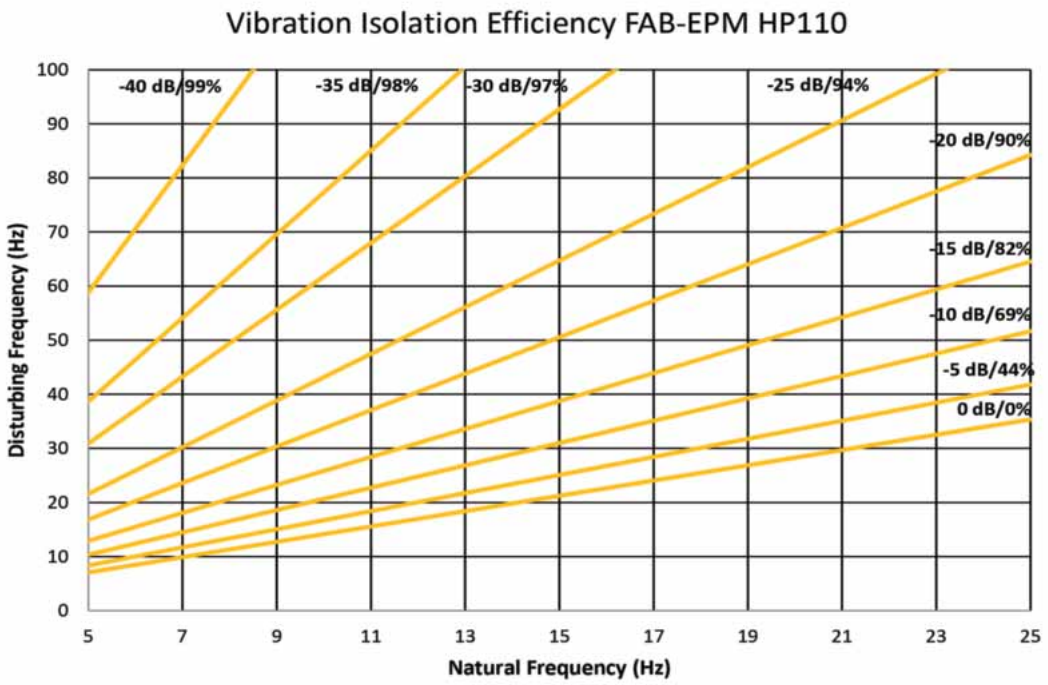


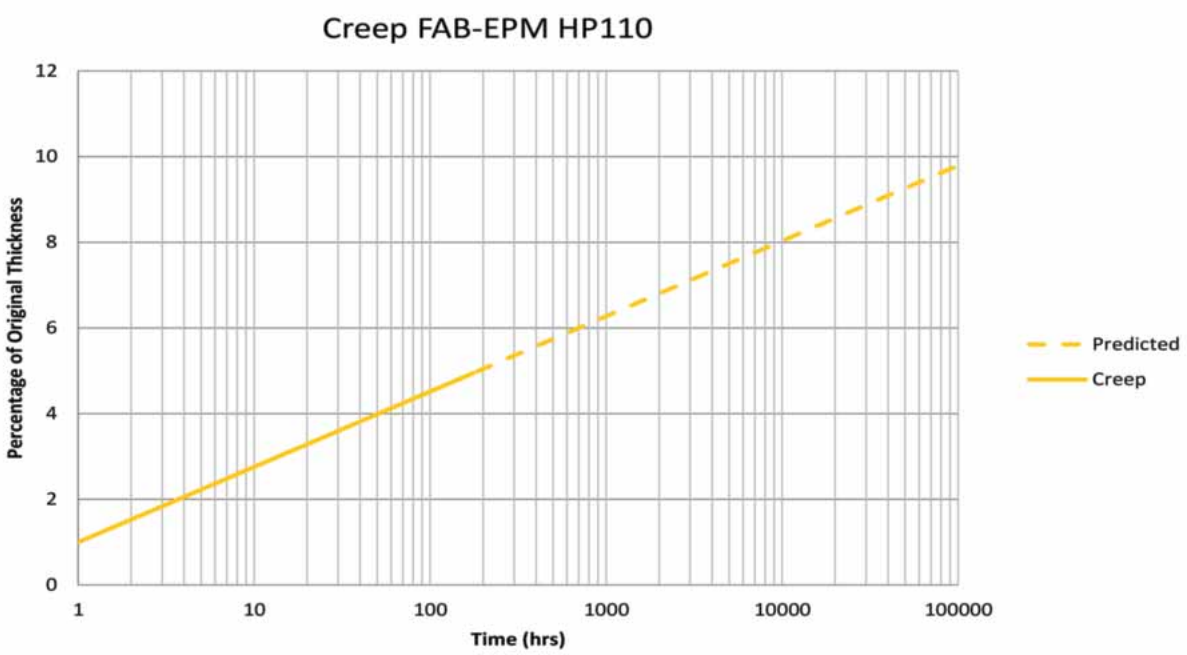

Specific Load versus Natural Frequency FAB-EPM HP55
Specific Load N/mm² (PSI)
0.1 (14.5)
0.08 (11.6)
0.06 (8.7)
0.04 (5.8)
0.02 (2.9)
0
5
7
9
11
13
15
17
19
21
23
25
Natural Frequency (Hz)
12.5 mm (0.5")
25 mm (1")
37.5 mm (1.5")
50 mm (2")
Dynamic Load Range
Static Load Range

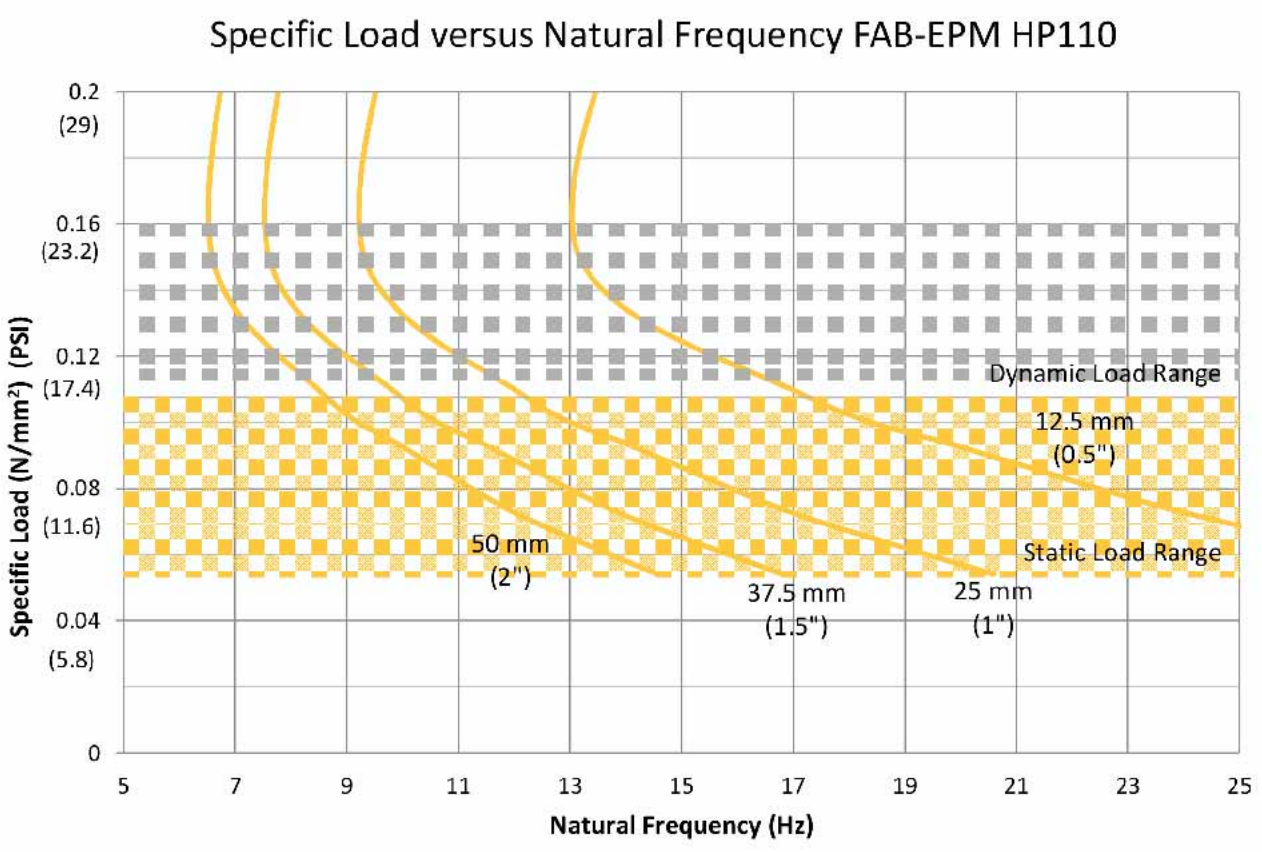

Load Deflection Curve FAB-EPM HP55
Specific Load N/mm² (PSI)
0.1 (14.5)
0.08 (11.6)
0.06 (8.7)
0.04 (5.8)
0.02 (2.9)
0
0
1 (0.04)
2 (0.08)
3 (0.12)
4 (0.16)
5 (0.20)
6 (0.24)
7 (0.28)
8 (0.32)
9 (0.36)
10 (0.40)
Deflection mm (in.)
12.5 mm (0.5")
25 mm (1")
37.5 mm (1.5")
50 mm (2")
Dynamic Load Range
Static Load Range

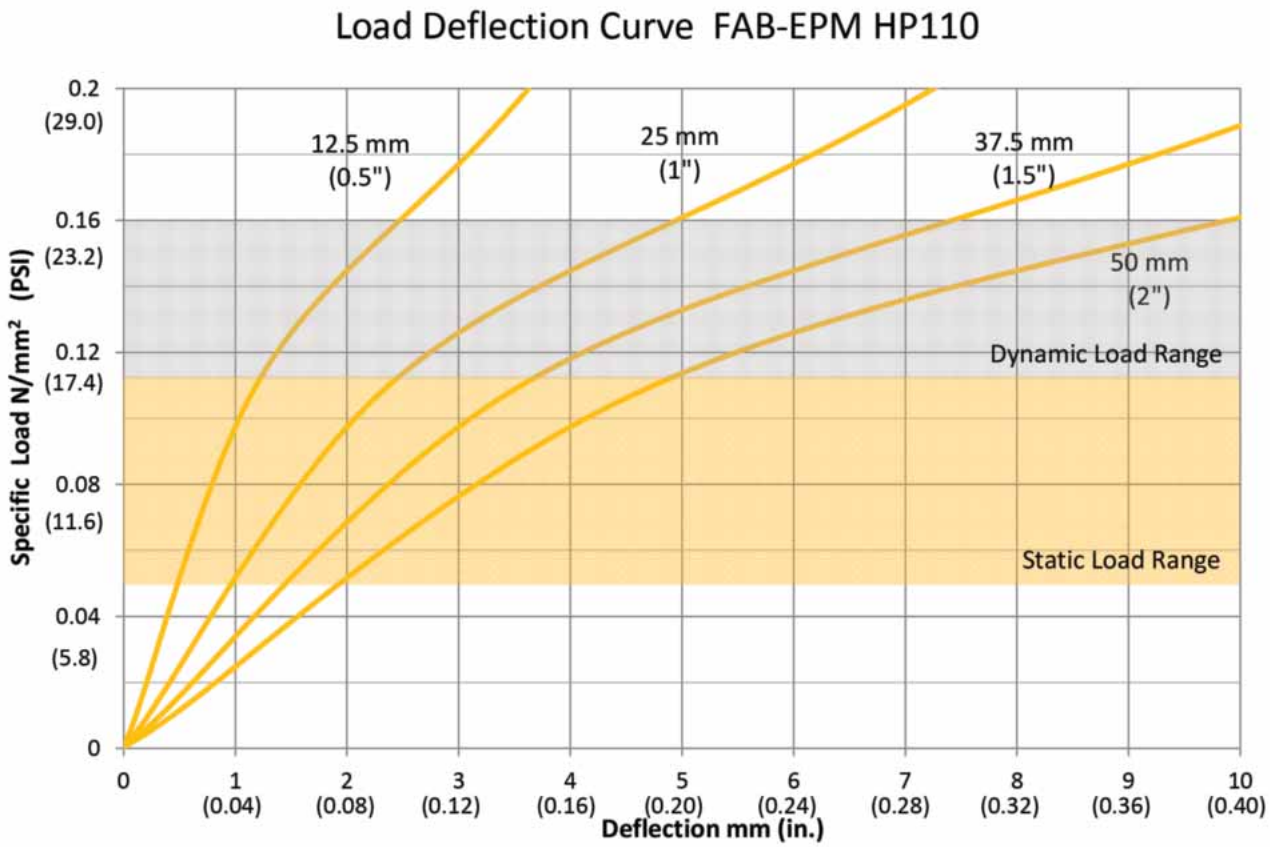
FAB-EPM® HP110 Material Specification

Color:	Orange
Standard Sizes:	1.5 m x 5.0 m (5' x 16.5')
Thickness:	12.5 mm (1/2"), 25 mm (1")
Optimal Static Load Range: [Approx. 7%]	up to 0.11 N/mm^2 (15.9 psi)
Additional Dynamic Load Range: [Approx. 25%]	up to 0.16 N/mm^2 (23.2 psi)
Mechanical Loss Factor:	0.08
Rebound Resilience:	50%






Specific Load versus Natural Frequency FAB-EPM HP110
Specific Load (N/mm²) (PSI)
0.2
(29)
0.16
(23.2)
0.12
(17.4)
0.08
(11.6)
0.04
(5.8)
0
5
7
9
11
13
15
17
19
21
23
25
Natural Frequency (Hz)
Dynamic Load Range
12.5 mm
(0.5")
Static Load Range
50 mm
(2")
37.5 mm
(1.5")
25 mm
(1")


Load Deflection Curve FAB-EPM HP110
Specific Load N/mm² (PSI)
0.2
(29.0)
0.16
(23.2)
0.12
(17.4)
0.08
(11.6)
0.04
(5.8)
0
0
1
(0.04)
2
(0.08)
3
(0.12)
4
(0.16)
5
(0.20)
6
(0.24)
7
(0.28)
8
(0.32)
9
(0.36)
10
(0.40)
Deflection mm (in.)
12.5 mm
(0.5")
25 mm
(1")
37.5 mm
(1.5")
50 mm
(2")
Dynamic Load Range
Static Load Range

FABSORB® Foundation Isolation

Fabsorb® vibration isolation material is an economical approach to foundation isolation where moderate vibration control is required.

Fabsorb material absorbs machine-induced energy, limits the transmission of higher frequency disturbances and provides isolation from ambient and induced shock and vibration, which otherwise would affect the accuracy of the machine being installed.

Fabsorb material is specifically designed for vibration isolation applications of support foundations for machine tools, shock testing equipment, grinders and similar equipment.

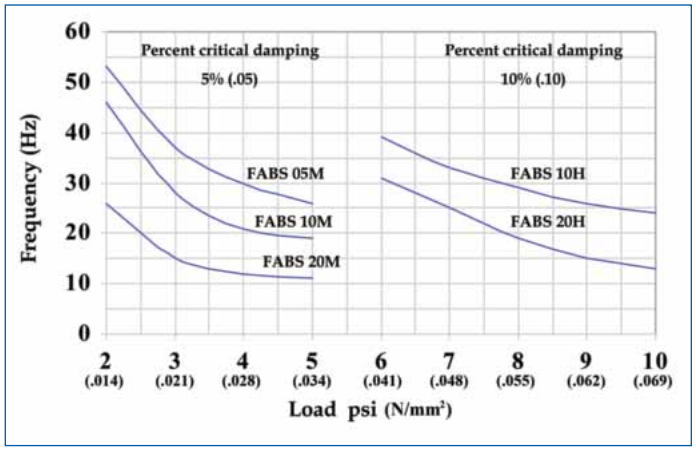
The natural frequency of Fabsorb is dependent on load and type of material, and ranges from 12 Hz to 50 Hz.

Material Specification

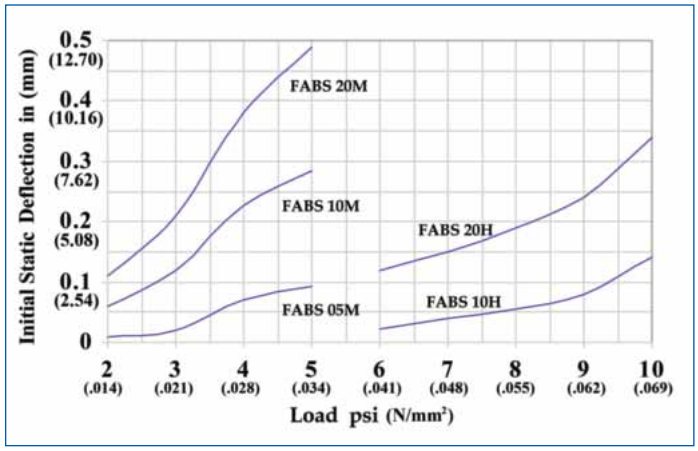
Unlike other isolation materials, Fabsorb is not subject to deterioration through water absorption and wicking, which causes felt-like material to stiffen over time, losing its original isolation characteristics. By comparison, the stiffness of Fabsorb and, therefore, its natural frequency and isolation characteristics, are constant over time, resulting in reliable performance and durability. Fabsorb is a medium-density, closed-cell foam material, manufactured using a patented compound. It is designed specifically to perform as a vibration isolation and shock absorbing material. It is impervious to most chemicals and performs consistently over a wide range of temperatures and time.

Fabsorb vibration isolation material is manufactured in the following standard sheet sizes for base and sidewall isolation.

Type	Sheet Size
FABS 05M	48" x 108" x 1/2" thick
FABS 10M	48" x 108" x 1" thick
FABS 20M	48" x 108" x 2" thick
FABS 10H	24" x 108" x 1" thick
FABS 20H	24" x 108" x 2" thick



Dynamic Natural Frequency



Load Deflection

Fabsorb® Compressive Creep Characteristics

Maximum Percent[1] of Original Thickness

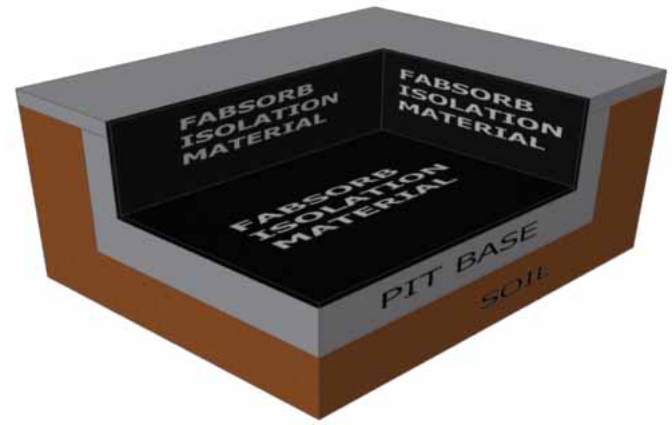
Load (psi)	Type M	
	10M	*20M*
2	4%	2%
3	40%	6%
4	40%	40%
5	40%	40%
	Type H	
	10H	*20H*
6	5%	1%
7	30%	20%
8	30%	30%
9	40%	30%
10	50%	30%

[1]Creep results at maximum stress after 700 hours under static load. Creep is in addition to initial static deflection.

For ease of installation, Fabsorb is manufactured in sheets (4' x 9' and 2' x 9').

Installation

The construction of the foundation and the installation of the isolation material generally are performed using either of two methods.



Method 1
Installation site is excavated to specified depth and grade. Pit is formed and poured. Fabsorb base and sidewall panels are installed in pit. Foundation is poured.

Method 2
Installation site is excavated to specified depth and grade. Fabsorb base panels are installed on grade, and foundation is formed and poured. Forms then are removed and Fabsorb sidewall panels are placed along foundation sides. Soil is backfilled up to isolated foundation. Floor slab is poured on grade.

Installation Procedure (Method 1)

Following the layout drawings provided by Fabreeka®, install the Fabsorb® panels on the sidewalls of the pit. Sidewall panels should rest on pit floor.

Sidewall panels can be secured to the pit walls by construction adhesive or by 3" duct tape (lower right). Additionally, all vertical seams also should be taped to prevent concrete from creeping into any gaps.

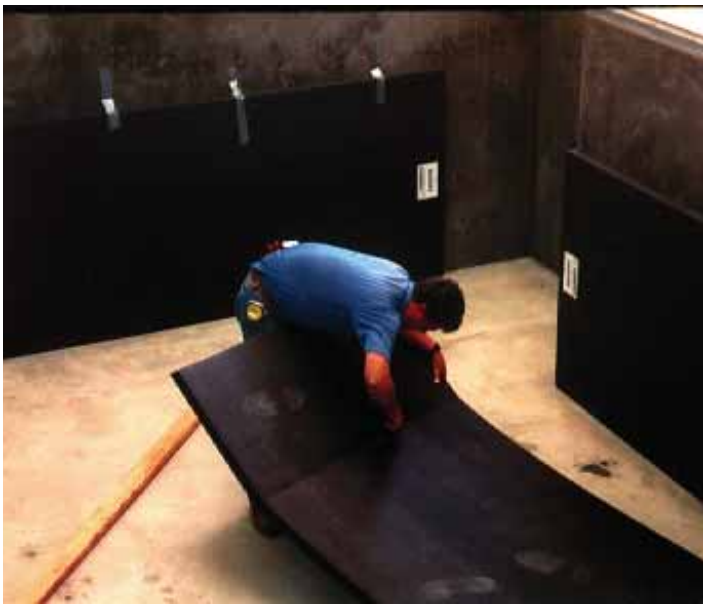
Install Fabsorb base isolation panels. Base panels should not contact pit sidewalls - only sidewall isolation panels. Tape all seams.

Lay polyethylene sheeting over Fabsorb material on base and sidewalls. Tape all seams to prevent concrete seepage into the material.

Place reinforcement rod per structural design drawings using shim material to keep rod elevated and to prevent puncturing or tearing the sheeting and material.

Pour concrete, and trim polyethylene sheeting at floor level after fully cured.

A proven mastic sealer, Sika joint sealant or equivalent, should be used to seal the isolation material at grade between the floor and the foundation at the exposed edge.



Fabsorb can be supplied cut to size, marked and furnished with detailed layout drawings for installation by contractors. Supplied in standard sheet sizes, it can be easily cut with a utility knife when the foundation dimensions vary.

Installation Procedure (Method 2)

Following the layout drawings provided by Fabreeka, install the Fabsorb panels on grade. Allowable soil loading should be verified by soils survey / report. All seams should be taped using 3" wide duct tape.

Lay polyethylene sheeting over Fabsorb base material, and construct forming for foundation around base isolation panels.

Place reinforcement rod per structural design drawings using shim material to keep rod elevated and to prevent puncturing or tearing the sheeting and material.

Pour concrete for foundation and allow for proper cure time. Remove forming and secure Fabsorb sidewall isolation panels to sides of foundation using construction adhesive or duct tape.

Backfill soil against sidewall isolation panels.

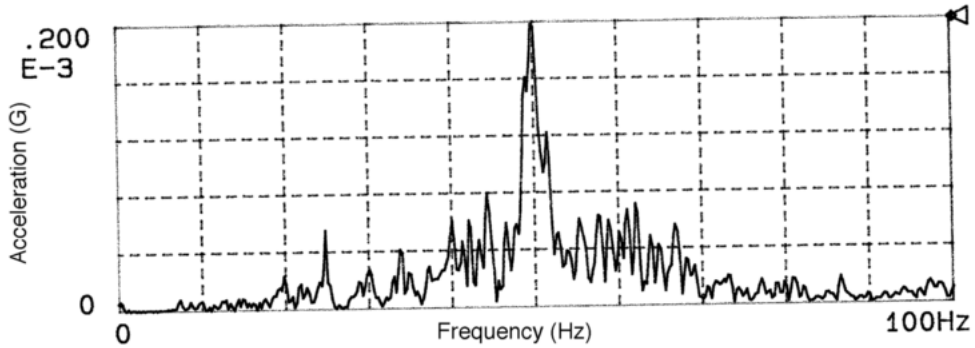
Pour floor slab on grade.

A proven mastic sealer, Sika joint sealant or equivalent, should be used to seal the isolation material at grade between the floor and the foundation at the exposed edge.

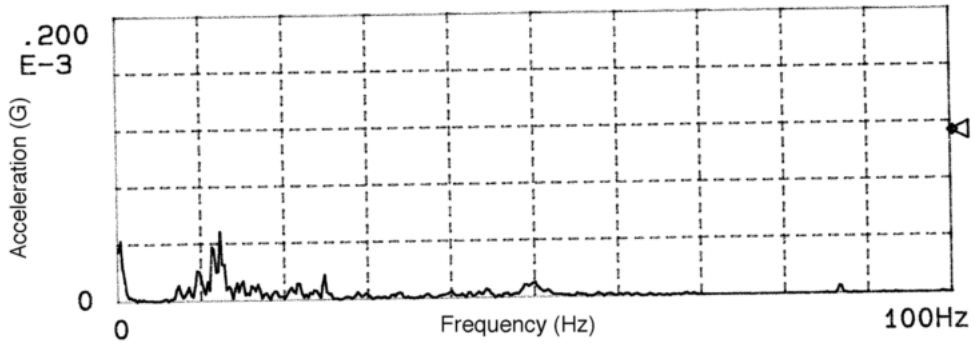
Fabsorb® Test Data

Following are the results from two case studies with and without Fabsorb isolation material in use.

Case 1

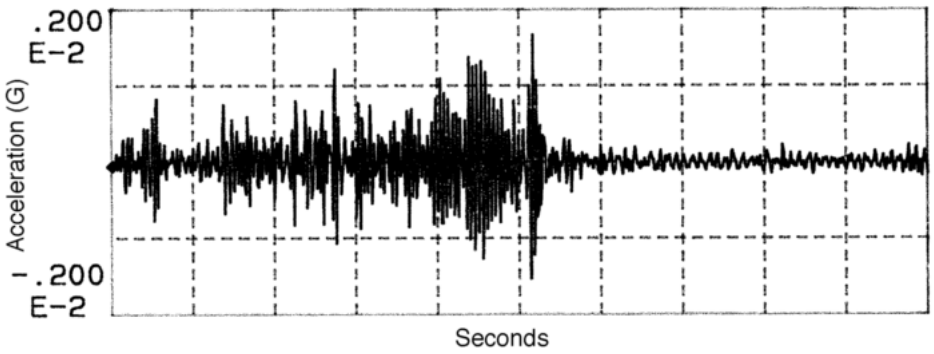


Random vibration input on shop floor.

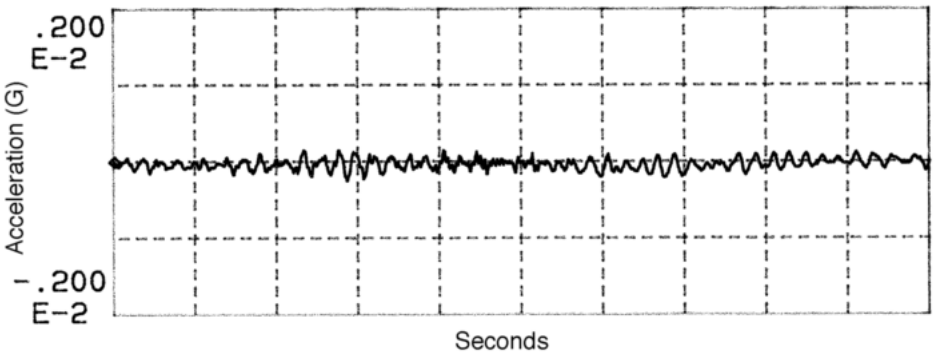


Isolated response on foundation isolated with FABS 20M type material under 5 psi load.

Case 2



Transient input from shear machine on shop floor.



Isolated response on foundation isolated with FABS 20M type material under 5 psi load.

Pneumatic Isolators

Precision-Aire™ Leveling isolators provide superior low frequency isolation for metrology instruments, electron microscopes, MRI, coordinate measuring machines and precision manufacturing equipment.

Fabreeka® PAL pneumatic and air bag isolators can be designed to have natural frequencies as low as 0.5 Hz vertically and 0.4 Hz horizontally, while the standard line of isolators have natural frequencies of 1.5 Hz and 5.0 Hz. The natural frequency and isolation efficiency of these isolators remain constant throughout their load range.

Fabreeka designs and manufactures large capacity pneumatic and air bag isolators, which support loads from 13,000 lbs (5,800 kg) to 120,000 lbs (54,000 kg) each for foundation isolation applications requiring low frequency vibration isolation. Air bag isolators provide a larger dynamic stroke than our standard PAL isolators and are used in applications where a low natural frequency (0.5 - 1.5 Hz) and large displacements must co-exist.

PAL isolation systems react quickly to position changes of support load and center of gravity shifts by automatically compensating and releveling. Settling time is minimal with optimum damping and correct valve gain.

For large machine tools and CMM's using automatic part handling systems where parts can weigh several tons, loading and unloading can generate vertical motion on the isolators. To avoid this problem, Fabreeka can vary the internal pressure of the isolators to lower the support foundation onto hard stops.

Air bag isolators provide a low natural frequency and large dynamic stroke where dynamic deflection is acceptable.

Pneumatic isolators are installed after the foundation has cured and the machine/equipment has been installed and anchored properly. The isolators are positioned under the foundation at predetermined support points and then activated to float or lift the foundation and machine off the pit floor.

Pneumatic isolators with lifting capacities of up to 120,000 lbs each are used to provide low frequency isolation for large concrete reaction masses (foundations). The isolators shown above are 72" (1,830 mm) in height and have vertical and horizontal natural frequencies of 0.7 and 0.5 Hz respectively.

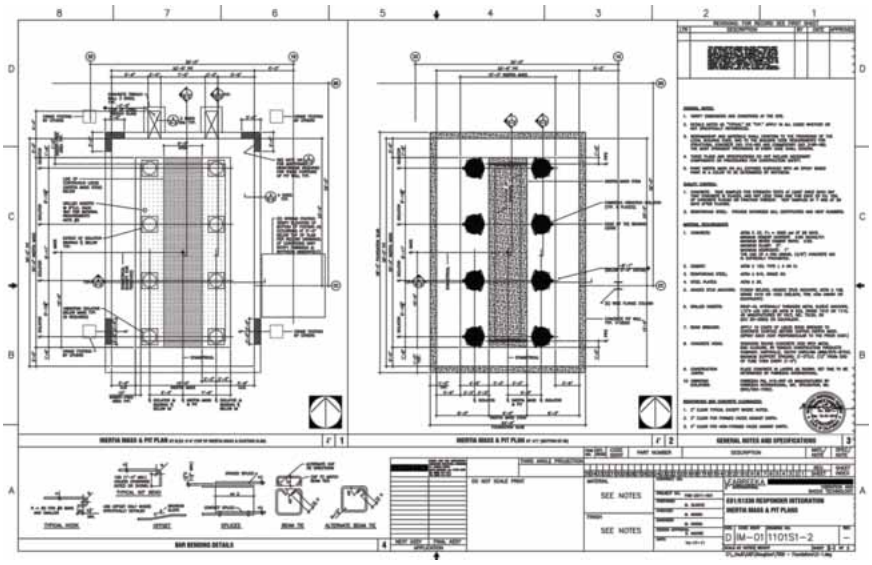
Fabreeka PAL type low frequency, pneumatic isolators support and isolate a foundation having moderate displacement.

Fabreeka RLA type pneumatic isolators provide low frequency isolation for test rigs, large reaction masses and applications where low profile, large dynamic displacement and lift height are required.

Consultation & Project Management

Fabreeka® provides complete, detailed design drawings and specifications for your construction or fabrication.

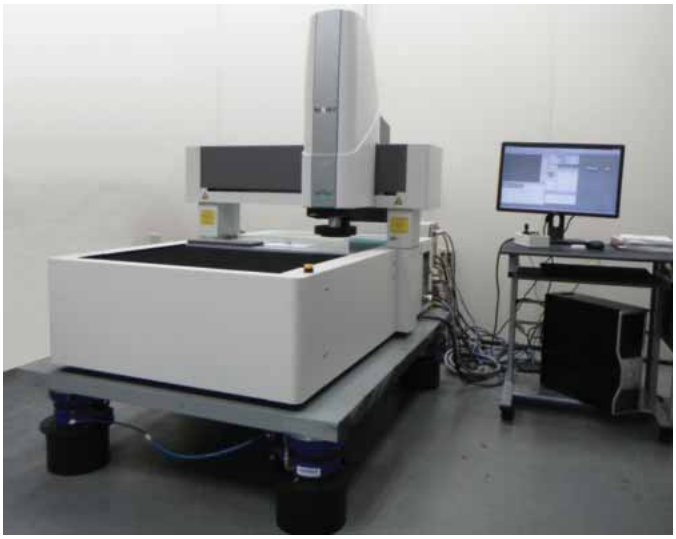
Our engineers can supervise critical phases of construction and provide oversight for the design, installation and testing of installed isolation systems. Design review meetings are held with customers as part of overall project management.



Vibration Measurement & Analysis Services

Low frequency vibrations and large shock inputs can affect the accuracy, repeatability and throughput of precision machines and equipment. Most precision machine tool and measuring machine manufacturers have established allowable vibration specifications for their machines. Fabreeka® utilizes highly accurate instrumentation to quantify the amplitude and frequency of vibration to make proper vibration control recommendations.

Measurements with unique data analysis requirements are performed regularly by our Engineering staff for vibration isolation projects worldwide.



Vision system with Fabreeka vibration isolation system installed.

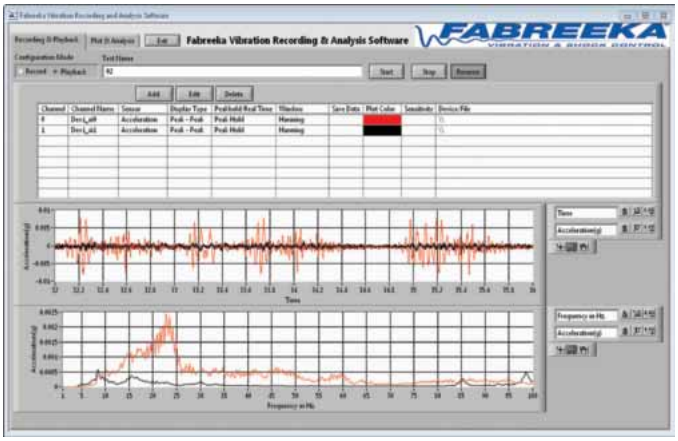
Project Summary

Above right, a Nikon VMR 6555/Z120X/LU Vision System is installed in an environment where stamping presses are operating on the manufacturing floor. The Nikon Vision System could not be calibrated within the designated limits.

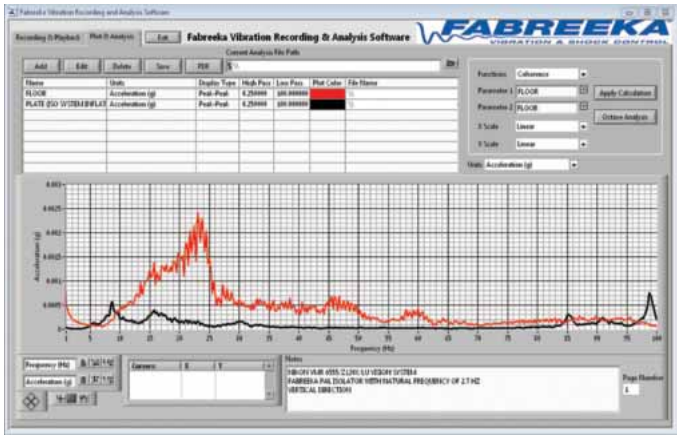
Middle right, measurements were recorded to analyze the floor inputs and determine the correct isolation solution.

Lower right, Fabreeka Engineers also conduct acceptance test measurements after isolation system installation. Acceptance test measurements provide the resultant vibration amplitudes after isolation is installed.

For this project, a Fabreeka PAL 21 isolation system with a vertical natural frequency of 2.7 Hz was installed underneath the machine and floated. The floor inputs from the stamping presses were reduced by approximately 90%.



Vibration measurement software



Acceptance Test Measurements

Dynamic and Finite Element Analysis

The dynamic response of a support structure is part of the total system vibration solution.

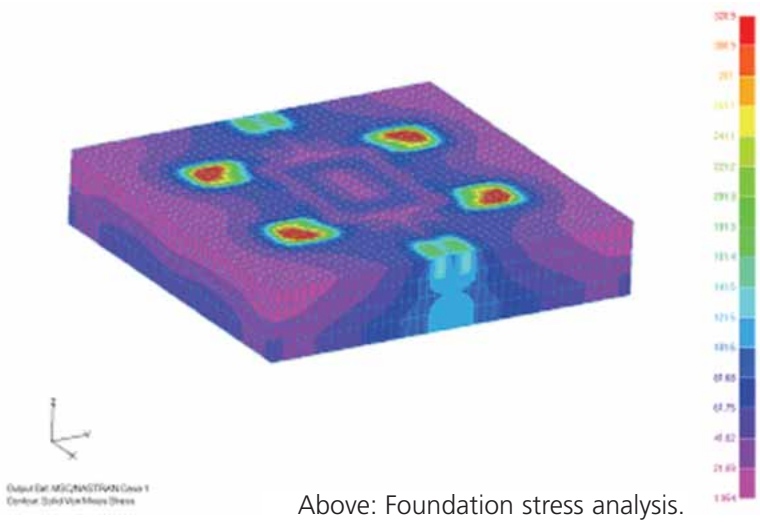
Examining mode shapes in a vibrating structure is a valuable step in adjusting vibration amplitudes at critical points by varying the stiffness, mass and damping.

A finite element analysis will define and model the mode shapes and response frequencies of a structure, as well as the response of the isolation system to machine-induced inputs and/or environmental inputs.

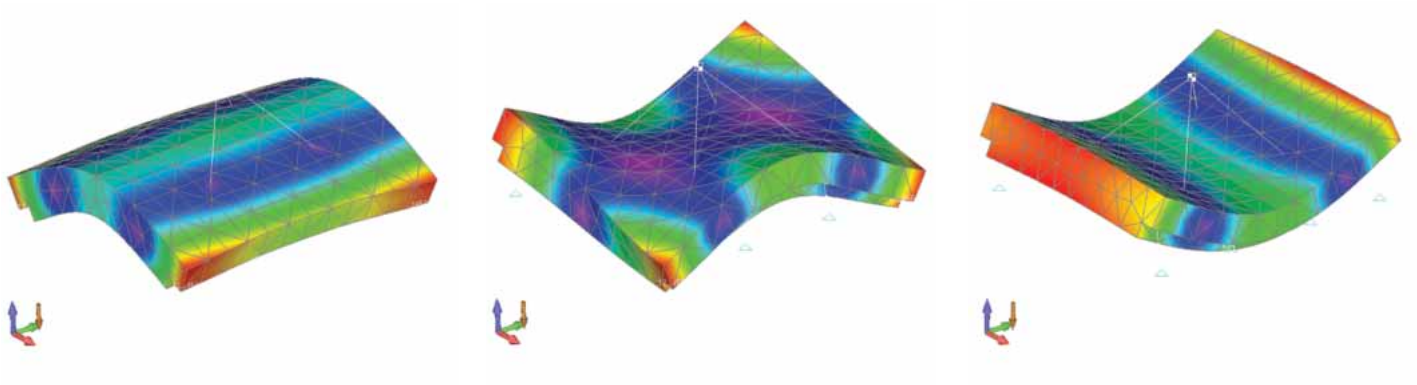
Mode shapes (stiffness in each axis) identify the physical direction of each frequency mode and any deformations, such as bending or twisting. In general, a structure's modes indicate the relative degree of structural stiffness among various points on that structure.

To be acceptable, the proposed design of a foundation or any support structure must provide a reliable structural configuration that also meets the static and dynamic criteria for the structure. Deflections caused by static loads or by dynamic forces/inputs should be within acceptable limits. This design approach requires modeling so that the real structure behavior is predetermined and errors are minimized.

The calculations for the stiffness of a support structure yield the static and dynamic behavior and stress concentration points that occur. Stresses are related to the geometry of the structure and the distribution of loads and forces acting upon it. A stress analysis will indicate the magnitude of stress imposed by static and dynamic loading.



Above: Foundation stress analysis.



Structural modes of a concrete support foundation.

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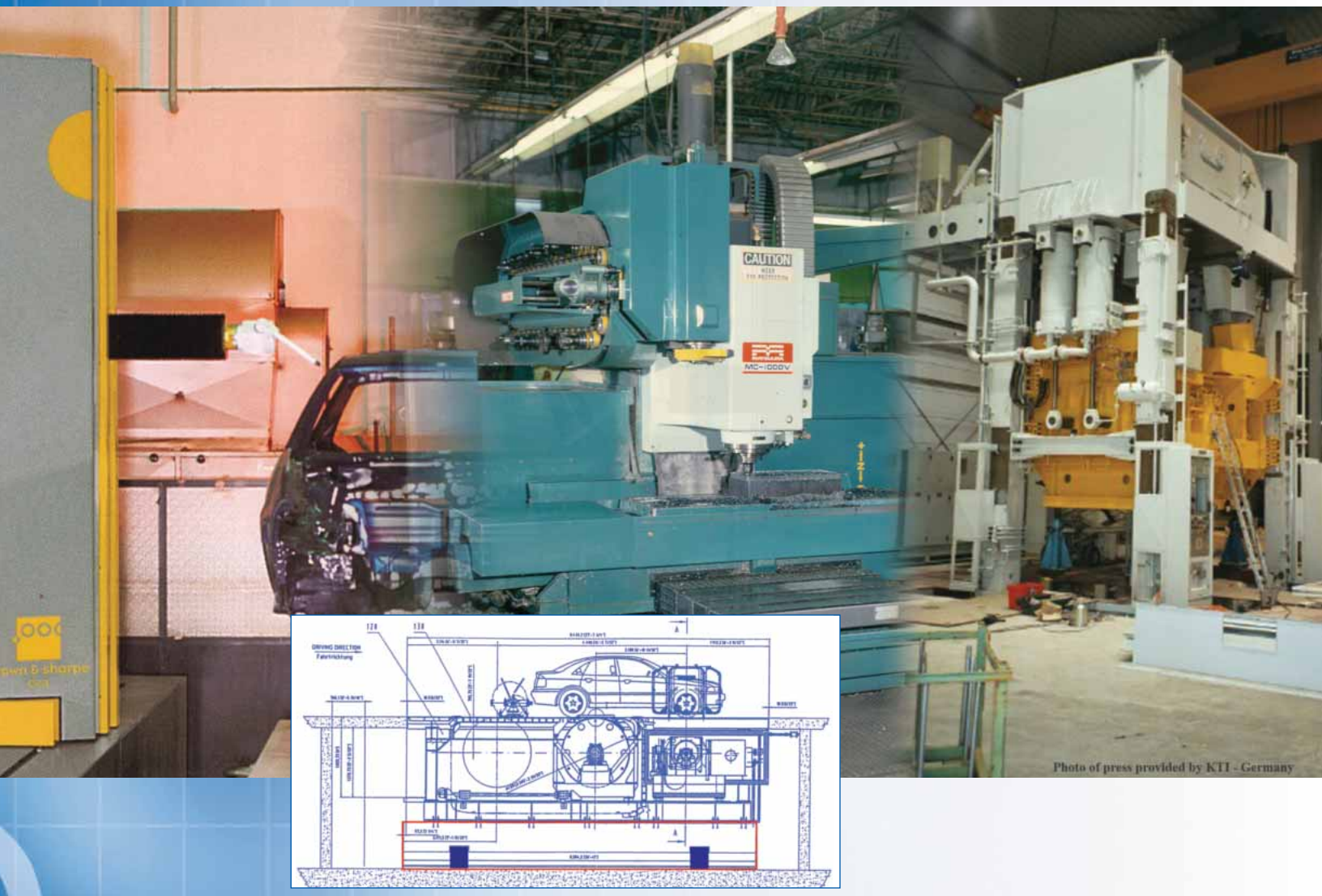
VIBRATION & SHOCK CONTROL



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