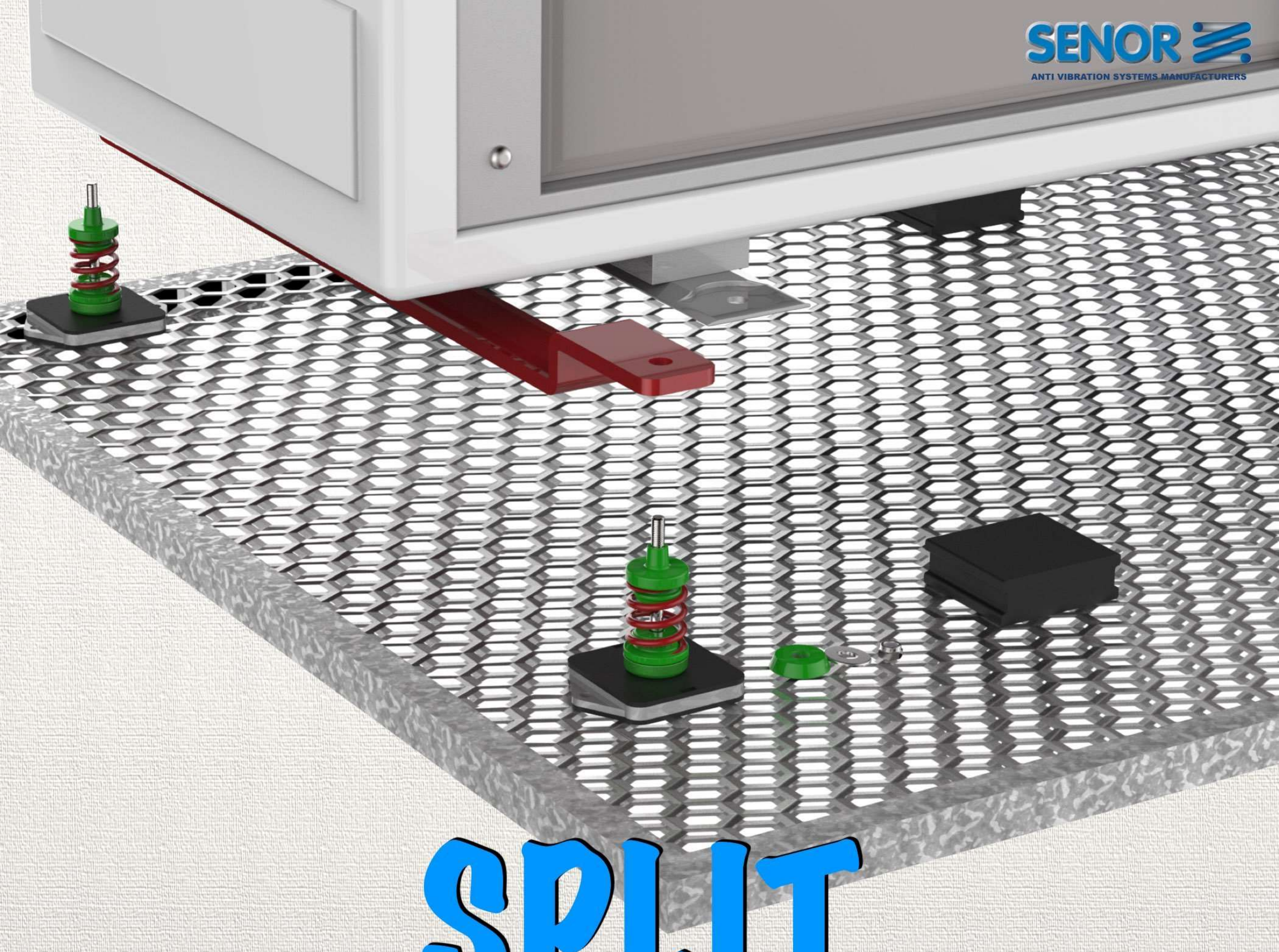


SENOR
ANTI VIBRATION SYSTEMS MANUFACTURERS

SPLIT

Model TBMF-ANTI ROLLOVER

The revolution in the vibratory field has arrived already !

"NOVELTY" *Special AV mount for semi-industrial and domestic machines, of air-conditioning and ventilation sectors.*

To create this new ***TBMF-ANTI ROLLOVER*** *AV mount series, we have gone further than ever, we have improved to the smallest detail, we have taken the new "****TBMF-ANTI ROLLOVER****" products to a new dimension, in its most advanced version.*

The New Range / ***TBMF-ANTI ROLLOVER*** *provides more elegance, performance and safety than* ***TBM-INOX*** *version.*

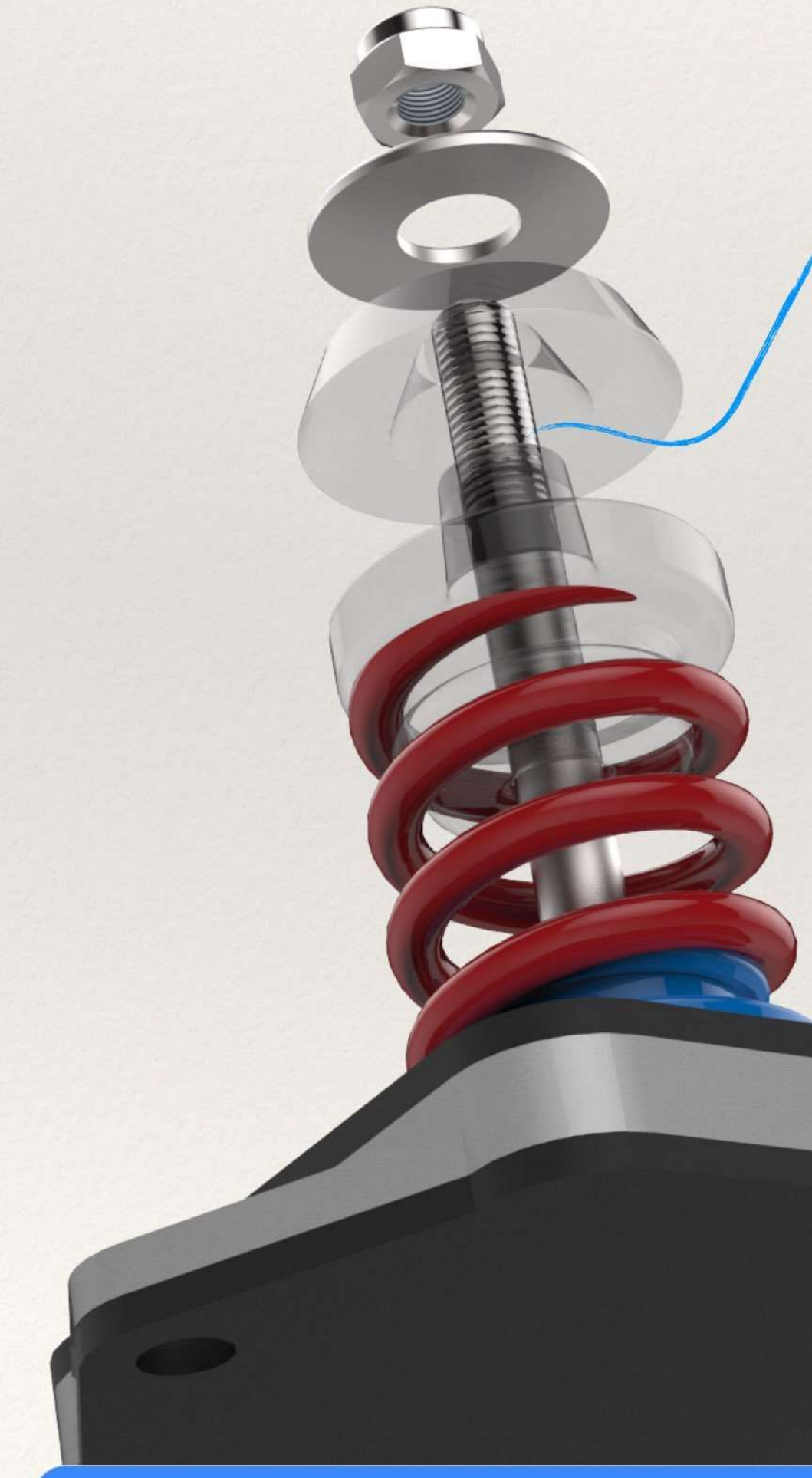
SENOR
ANTI VIBRATION SYSTEMS MANUFACTURERS

2. Model information.

*It is an **Hybrid AV mount** with a anti rollover system incorporated, designed for semi-industrial machines and specially, for the domestic sector. Its hybrid system provides us the best of **"helical steel"** spring properties for a proper performance in eradicating low frequencies Hz while the great quality polymer **"MEGOL"** provides us the damping power, for a proper performance in the low and medium frequencies regime Hz.*

The juxtaposition of these two components makes possible launching an unique AV mount to the market, avoiding the spread of waves across the structure, and reducing vibrations in the whole exciter frequencies range. Ideal for machines working from 350 rpm.

***Application field:** Cooling machines, condensers, ventilators, air processing units, air conditioning units, pumps, etc. Through a bank or directly installed on the system it is intended to isolate.*



3. Anti rollover System.

*"**Steel axis**" Made of high quality stainless steel **304**. Its geometry and design allow to improve the hybrid system performance and, in addition, they avoid the overturn of the unit in case of non-controlled lateral efforts coming from weathering: **Hurricane winds**, **storms** and small **seismic movements**.*

*Due to its low vibration transmissibility, this anti vibration system is the most effective for vibro acoustic isolation in **fan** units, **air conditioners**, **radiators**, **drive pumps**, etc. In addition, it incorporates a movement blocker to avoid the free oscillation of the system, avoiding sudden movements and increasing the spring durability. These springs will be the ideal ones according to its dynamic behavior, depending on the supported load by each of them.*

4. Colors code.

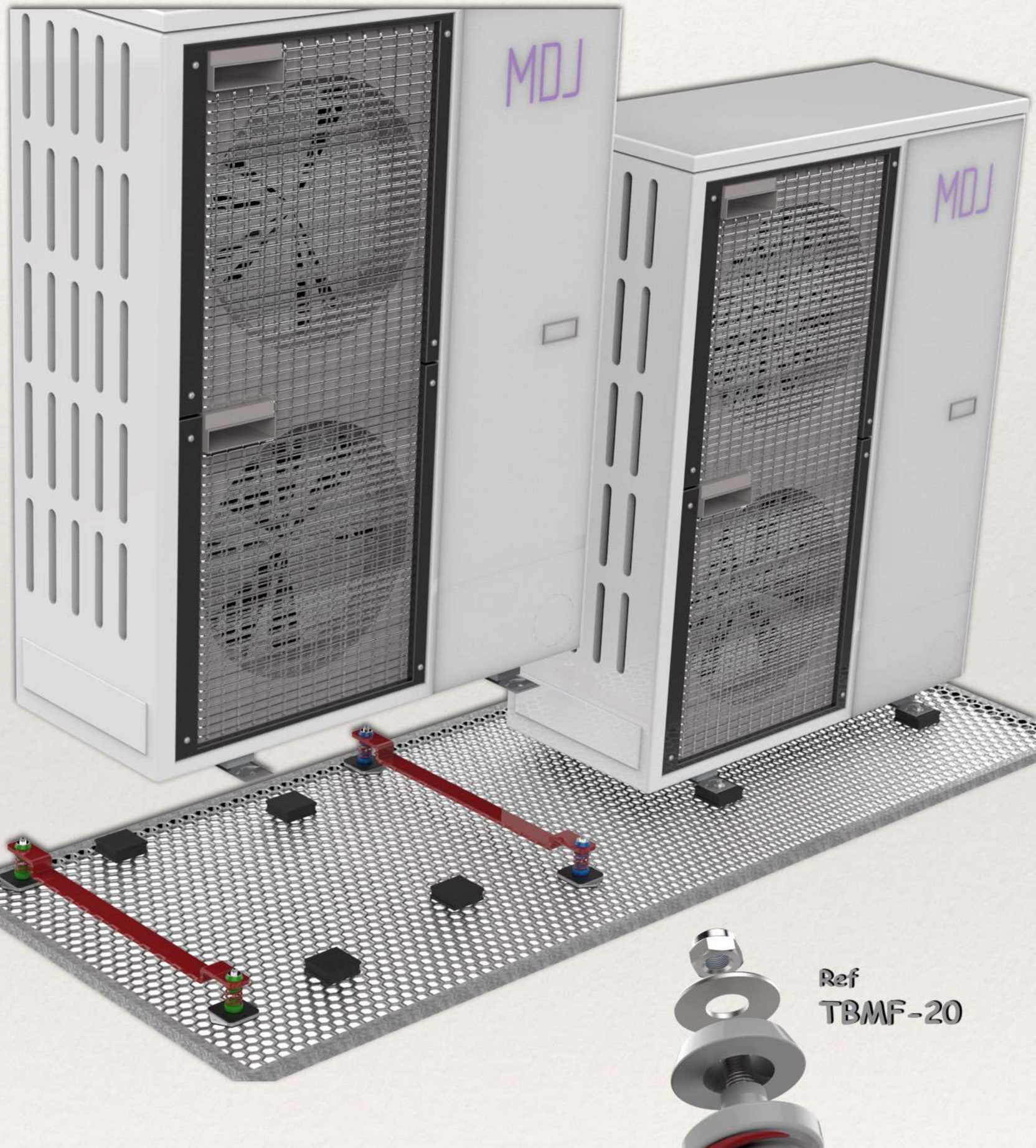
Generally, the gravity center is not coincident with the geometric center.

As we can see in the left picture, the unit is formed by different components: ***Compressor****,* ***condenser****,* ***controls****, etc. These elements are located in one end, and the air extraction in the opposite end. So we can detect that* **70**% *of the load will be located in the* ***compressor*** *area, and* **30**% *remaining will be located in the* ***ventilation*** *area. The* ***TBMF-ANTI ROLLOVER*** *range has the advantage of combining* ***4 colors*** *to differentiate the load quantity per unit (****Kg****).*

Grey*,* ***Green****,* ***Blue*** *and* ***Red.*** *The* ***grey*** *color shows the lowest one, while* ***red*** *color shows the maximum load. In this way, we can treat the unit properly, placing the proper damper according to the load distribution.*

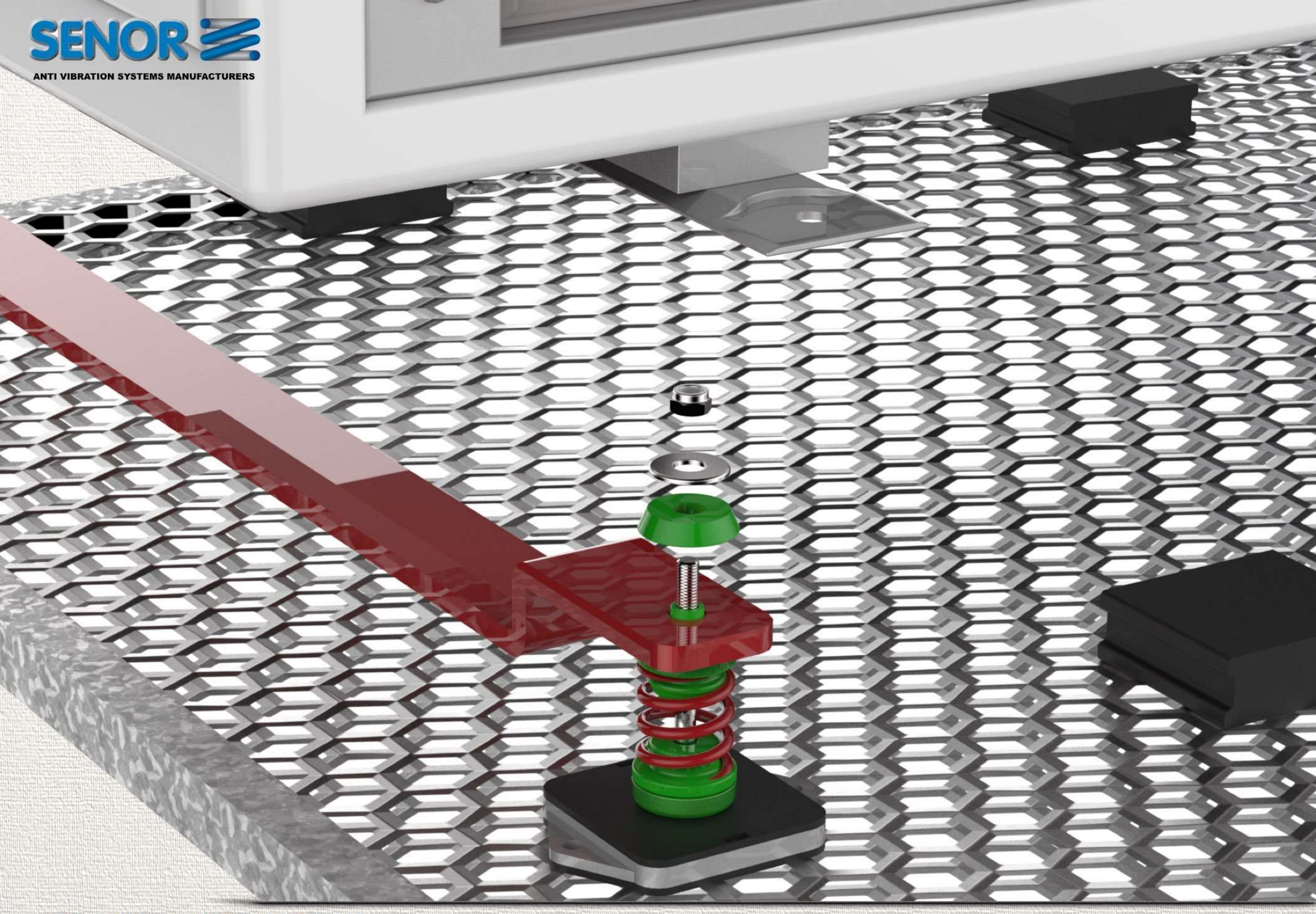

Ref
TBMF-120


Ref
TBMF-75




Ref
TBMF-45


Ref
TBMF-20



5. Calculation Procedure.

It is about determining the static deflection of the steel springs, for different load values.

Using this data, and under the supposition of linear systems, we can determine the elastic constant of springs.

A spring performs a force which is proportional to its deformation:

$$F = k\,\delta$$

Where:

F = *Spring force.*
k = *Rigidity.*
δ = *spring deformation.*

Note: *For systems with linear behavior (**steel spring**), the dynamic rigidity equals the elastic rigidity. However, in case of polymeric viscoelastic materials (Polyurethane, EPDM, Polystyrene, Polyethylene, etc.), they are never coincident, and its dynamic behavior can only be determined through a lab essay.*

*Generally, steel springs have an optimal behavior in a frequency range from **300** and **2500 rpm.***

The resonance frequency of the spring + the machine is given by::

$$w_0 = \sqrt{\frac{K}{m}}$$

Where:

w_0 = *system resonance frequency .* (rad/s)
k = *spring rigidity **(N/m)**.*
m = *system mass **(machine)**.*

If k nor m are not known when calculating the system resonance frequency, it is calculated through its static flexion.

From the spring equation:

$$m\,g = K\,\delta \;\text{®}\; \frac{K}{m} = \frac{g}{\delta}$$

Introducing such result in the expression:

$$w_0^2 = \frac{K}{m} \Rightarrow w_0 = \sqrt{\frac{K}{m}} = \sqrt{\frac{g}{\delta}}$$

$$\left(w_0 = 2\,\pi\; f\right)$$

Because of its negligible damping

(approximation: $\varsigma \;\text{®}\; 0$ *), the transmissibility factor for a spring has the following form:*

$$FT = \frac{F_t}{F_0} = \frac{1}{\left|1-\rho^2\right|}$$

Vibratory isolation degree given in %

$$G = \left(1 - FT\right)100 \quad (\%)$$

The behavior of the spring will depend on how they are placed.

6. Chart of maximum results.

REFERENCIAS / REFERENCES	FUERZA máxima (N)		Flecha (mm)	Rigidez (N/mm)
	Fuerza (N)	Frecuencia Propia (Hz)		
	Force (N)	Natural Frequency (Hz)	Deformation (mm)	Rigidity (mm)
SE-TBMF 20	200	3,78	11,30	17,70
SE-TBMF 45	450	3,95	11,90	37,70
SE-TBMF 75	750	4,00	11,90	62,80
SE-TBMF 120	1200	3,86	11,40	105,70

7. Technical Data Hybrid + Grey MEGOL.

Product: *MEGOL I A 25 C UG/UVI GREY F761 P1250SPE25*
Density *- ASTM D 792 - g/cm3 - 1.15 / 1.19*
Hardness "15sec" *- ASTM D 2240 - Shore A - 20 / 25*
Extreme force *- ASTM D 624 - KN/m - 11 / 19*
Ultimate tensile strength *- ASTM D 638 - MPa - >3.5*
Elongation % break *- ASTM D 638 - % - >800*

A ***Core*** *formed by a steel spring of 3,66 mm thick* ***(Standard DIN 2095-UNI EN 10270)****, with* ***EPOXY*** *treatment* ***Red RAL 330.*** *It provides a high isolation degree from vibrations, in the range of low/medium frequencies Hz.*

Procedure

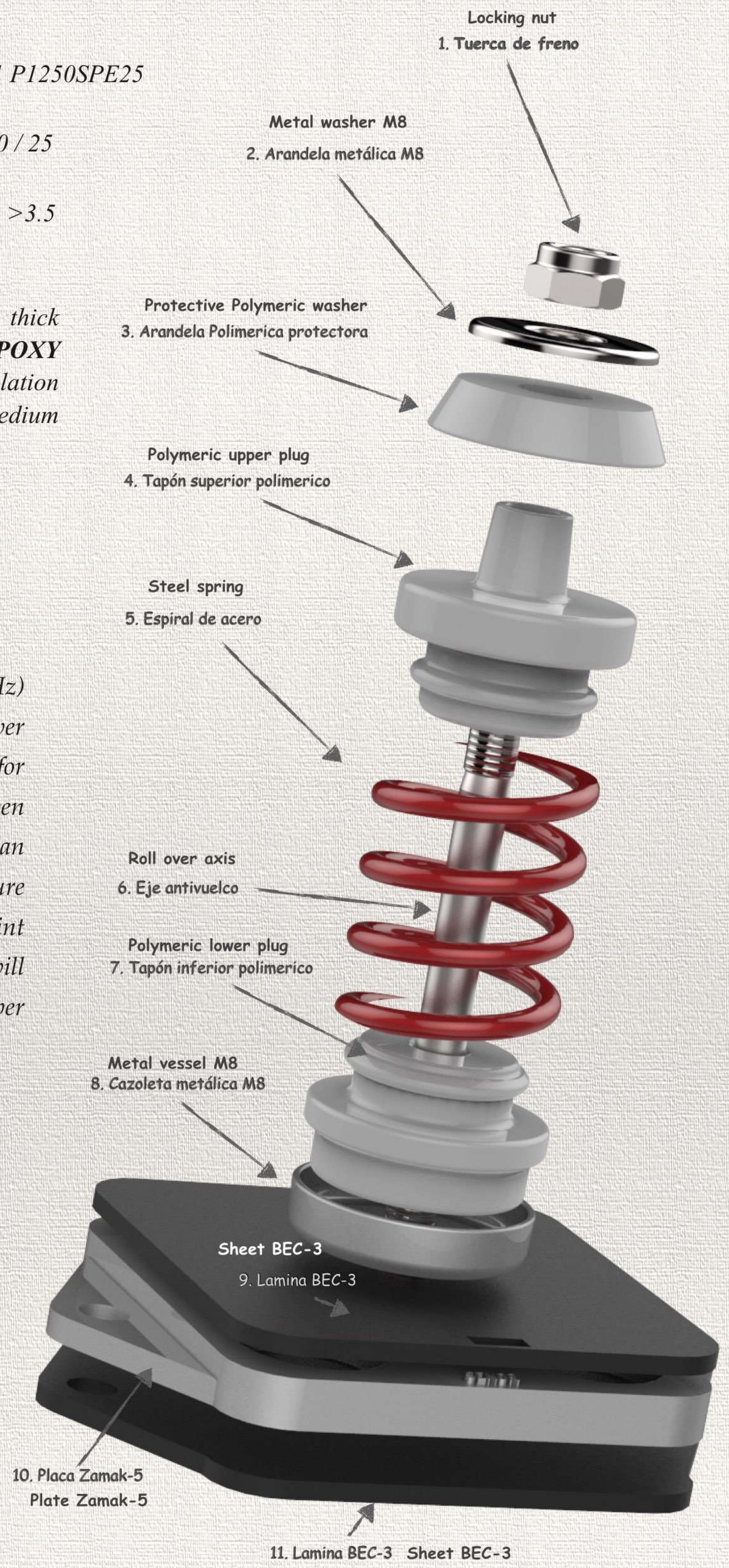
- *Determination of dynamic behavior.*
- *Load Curve and deformation.*

Determination of dynamic behavior.

It is about determining the natural frequency (Hz) and the deformation for different load values, over the shock absorber. A frequency sweep is done for each load state between ***0-100 Hz*** *at a given acceleration level (****0.2 g****). Placing an accelerometer at the rigid part of the structure which serves for control and other on a rear point to the action of the shock absorber, where we will get the results which determine the shock absorber performance.*

Used Equipment:

Accelerometers signal amplifier.
PCB / Code ME 084030
Accelerometer
PCB / Code ME 072021
Essays Machine
NOGREN / Code ME 035002
Vibratory table
LDS / Code ME 075001



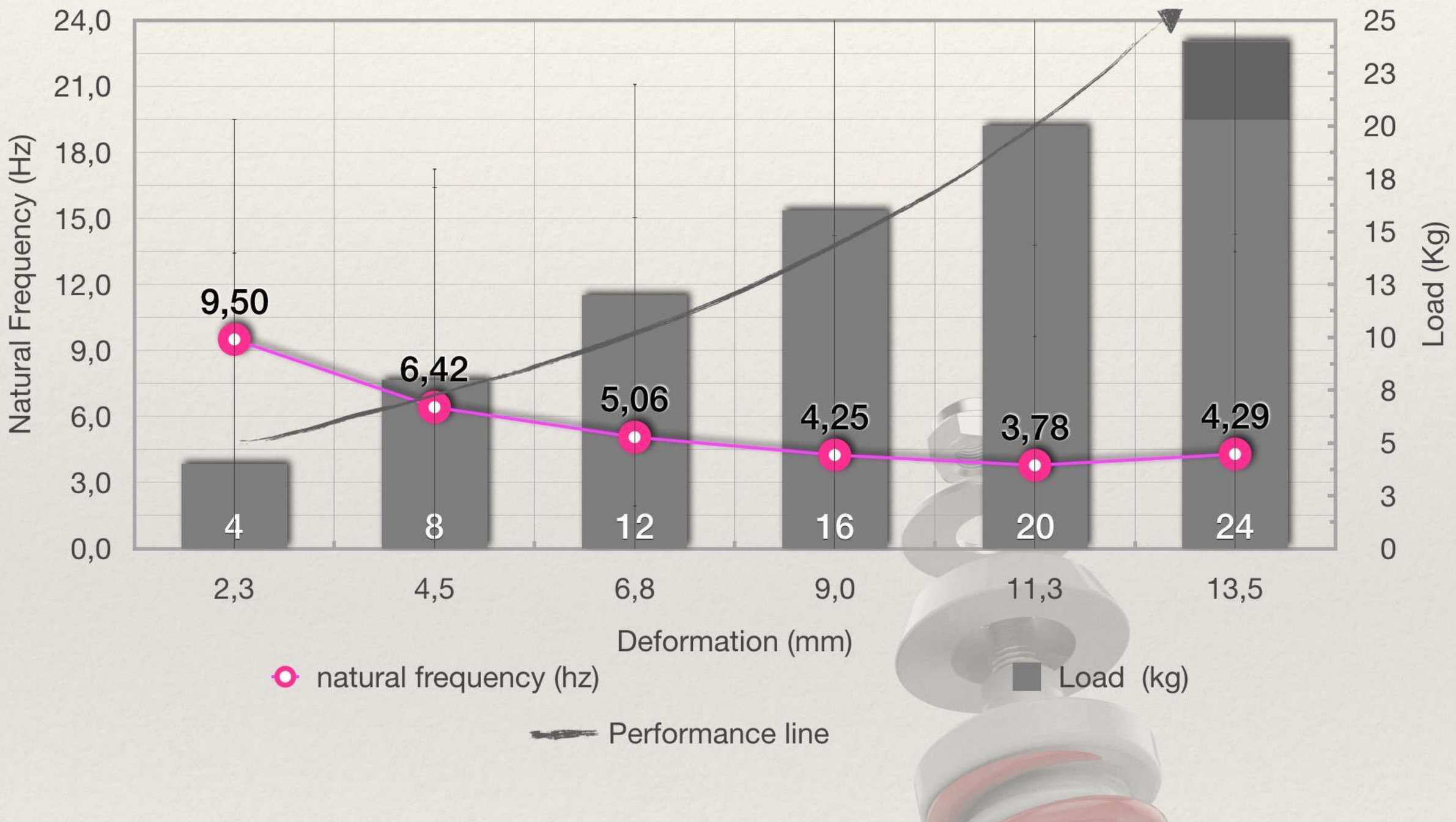
MEGOL I A 25 C UG/UVI GREY F761.
P1250SPE25

Graph Data

DEFORMATION (MM)	NATURAL FREQUENCY(HZ)	LOAD (KG)
2,3	9,50	4
4,5	6,42	8
6,8	5,06	12
9,0	4,25	16
11,3	3,78	20
13,5	4,29	24

*The **performance line** shows the beginning and the end of the work performed by the **HYBRID + GREY MEGOL** system, **6 Kg** and **20 Kg** respectively. Vertical bars in dark **Grey** color provide the following info:*

- ***Deformation in millimeters.***
- ***Load process in each deformed point.***
- ***Optimal degree of elasticity.***



Conclusion: *The shock absorber **TBMF-20** is placed on the hydraulic piston for its compression test, applying the load in a progressive way at a speed of **2 mm/min**, until a maximum of **0,25 kN**. Load and movement data are obtained.*

*When data is transferred to the dynamic graph, it shows that vertical bars which surpass the **performance** line in a higher level are bars **nº 2, 3, 4, and 5**. These bars show us the optimal degree of elasticity. Therefore, the recommended loads to be used.*

8. Technical Data Hybrid + Green MEGOL.

Product: *MEGOL I A 30 C UG/UVI GREEN F084/E P1250SPE25*

Density *- ASTM D 792 - g/cm3 - 1.19*

Hardness "15sec" *- ASTM D 2240 - Shore A - 27 / 35*

Extreme force *- ASTM D 624 - KN/m - 13*

Ultimate tensile strength *- ASTM D 638 - MPa - >5.1*

Elongation % break *- ASTM D 638 - % - >817*

A ***Core*** *formed by a steel spring of 4,20 mm thick* ***(Standard DIN 2095-UNI EN 10270)****, with* ***EPOXY*** *treatment* ***Red RAL 330.*** *It provides a high isolation degree from vibrations, in the range of low/medium frequencies Hz.*

Procedure

- *Determination of the dynamic behavior.*
- *Load curve and deformation.*

Determination of the dynamic behavior.

It is about determining the natural frequency (Hz) and the deformation for different load values, over the shock absorber. A frequency sweep is done for each load state between ***0-100 Hz*** *at a given acceleration level (****0.2 g****). Placing an accelerometer at the rigid part of the structure which serves for control and other on a rear point to the action of the shock absorber, where we will get the results which determine the shock absorber performance.*

Used Equipment:

Accelerometers signal amplifier.

PCB / Code ME 084030

Accelerometer

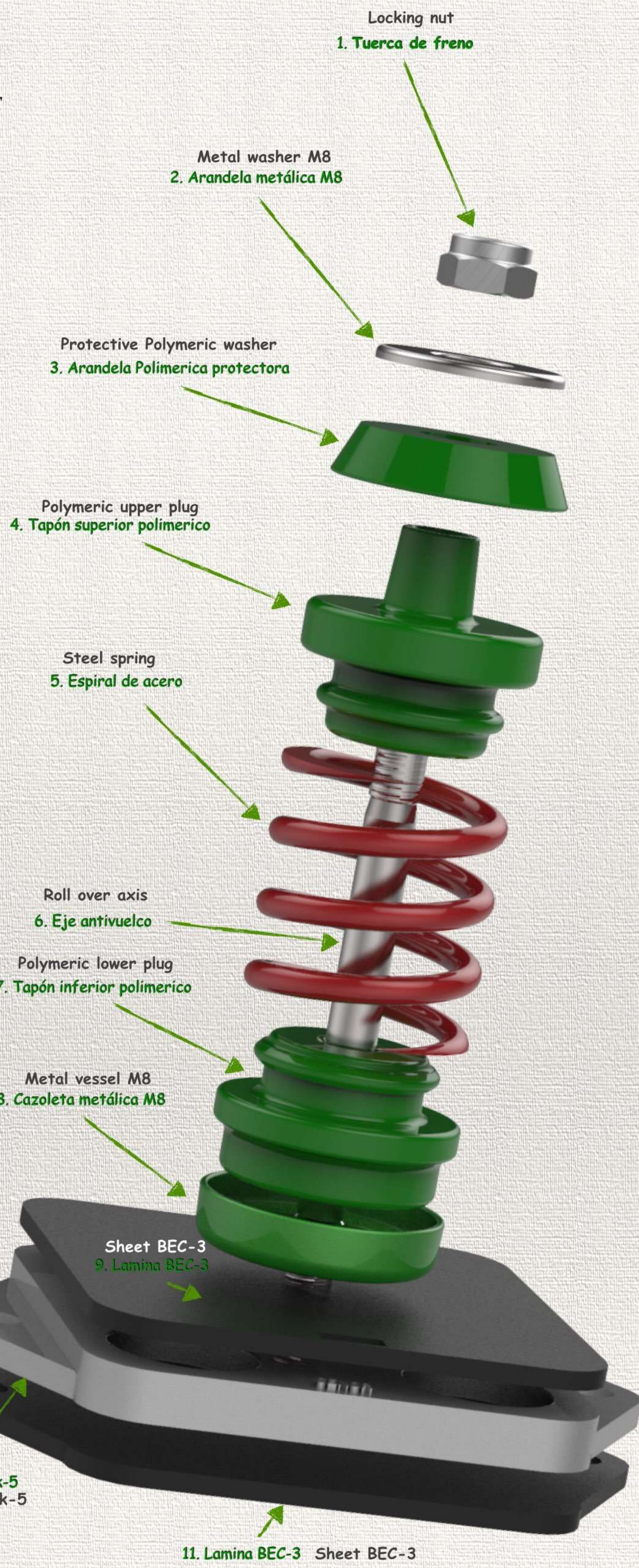
PCB / Code ME 072021

Essays Machine

NOGREN / Code ME 035002

Vibratory table

LDS / Code ME 075001



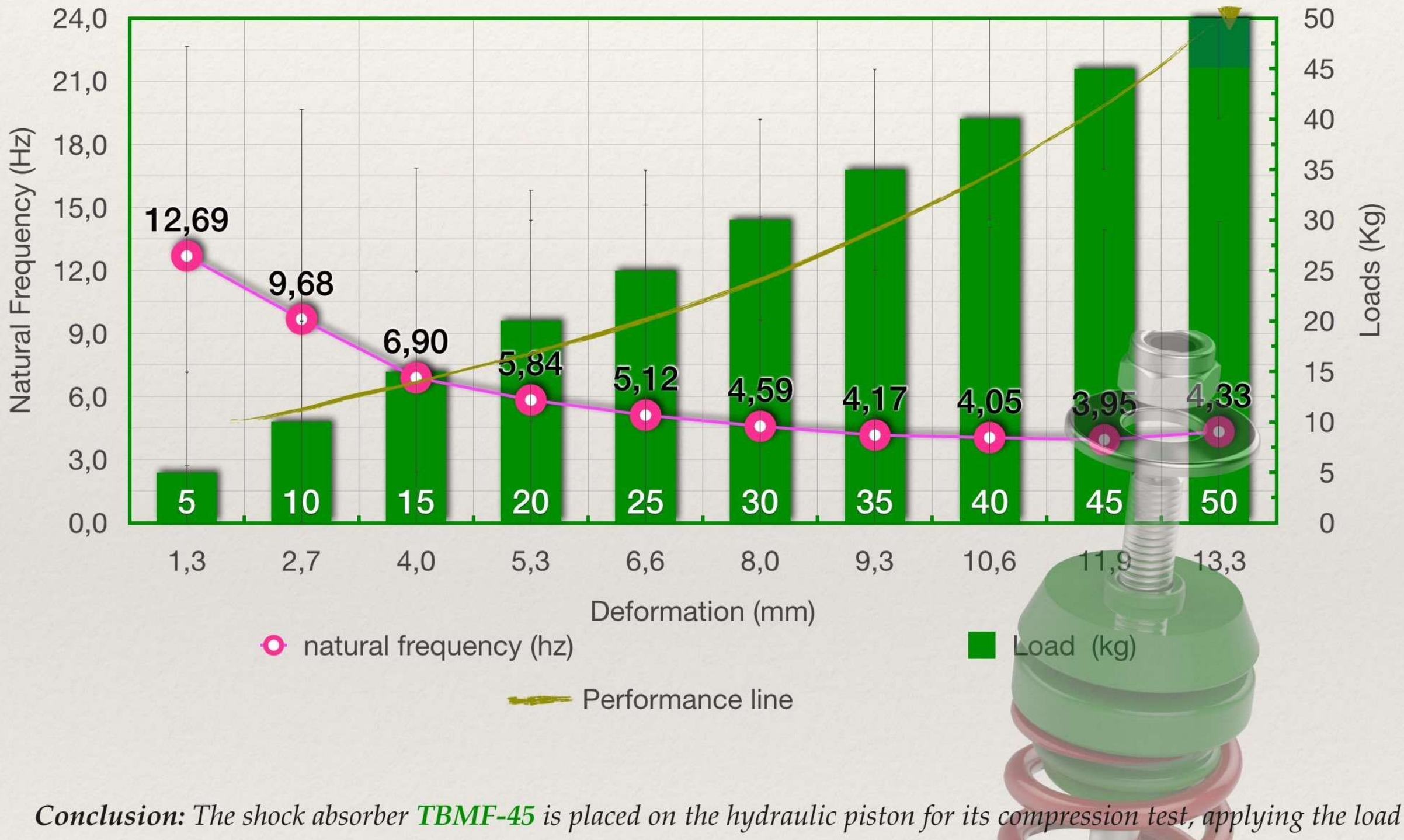
MEGOL I A 30 C UG/UVI GREEN F084/E. P1250SPE25

Graph Data

DEFORMATION (MM)	NATURAL FREQUENCY (HZ)	LOAD (KG)
4,0	6,90	15
5,3	5,84	20
6,6	5,12	25
8,0	4,59	30
9,3	4,17	35
10,6	4,05	40
11,9	3,95	45
13,3	4,33	50

The performance line *shows the beginning and the end of the work performed by the* ***HYBRID + GREEN MEGOL*** *system,* ***15 Kg*** *and* ***45 Kg*** *respectively. Vertical bars in dark* ***Green*** *color provide the following info:*

- ***Deformation in millimeters.***
- ***Load process in each deformed point.***
- ***Optimal degree of elasticity.***



Conclusion: *The shock absorber* ***TBMF-45*** *is placed on the hydraulic piston for its compression test, applying the load in a progressive way at a speed of* ***2 mm/min****, until a maximum of* ***0,50 kN****. Load and movement data are obtained.*

When data is transferred to the dynamic graph, it shows that vertical bars which surpass the ***performance*** *line in a higher level are bars* ***nº 3, 4, 5, 6, 7, 8 and 9****. These bars show us the optimal degree of elasticity. Therefore, the recommended loads to be used.*

9. Technical data Hybrid + Blue MEGOL.

Product: *MEGOL I A 40 C UG/UVI BLUE F085/E P1250SPE25*

Density *- ASTM D 792 - g/cm3 - 1.25*

Hardness "15sec" *- ASTM D 2240 - Shore A - 36 / 42*

Extreme force *- ASTM D 624 - KN/m - 16*

Ultimate tensile strength *- ASTM D 638 - MPa - >5.6*

Elongation % break *- ASTM D 638 - % - >960*

A ***Core*** *formed by a steel spring of 4,20 mm thick* ***(Standard DIN 2095-UNI EN 10270)****, with* ***EPOXY*** *treatment* ***Red RAL 330.*** *It provides a high isolation degree from vibrations, in the range of low/medium frequencies Hz.*

Procedure

- *Determination of the dynamic behavior.*
- *Load curve and deformation.*

Determination of the dynamic behavior.

It is about determining the natural frequency (Hz) and the deformation for different load values, over the shock absorber. A frequency sweep is done for each load state between ***0-100 Hz*** *at a given acceleration level (****0.2 g****). Placing an accelerometer at the rigid part of the structure which serves for control and other on a rear point to the action of the shock absorber, where we will get the results which determine the shock absorber performance.*

Used Equipment:

Accelerometers signal amplifier.

PCB / Code ME 084030

Accelerometer

PCB / Code ME 072021

Essays Machine

NOGREN / Code ME 035002

Vibratory table

LDS / Code ME 075001