



Power Plate®

Basic Fitness Academy Training

# Bio-Mechanics

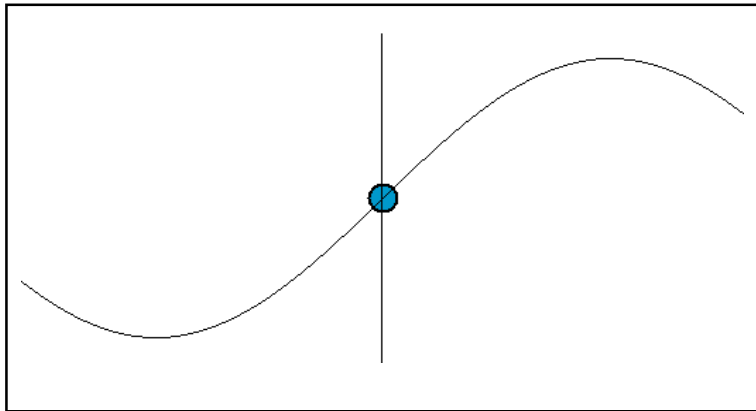


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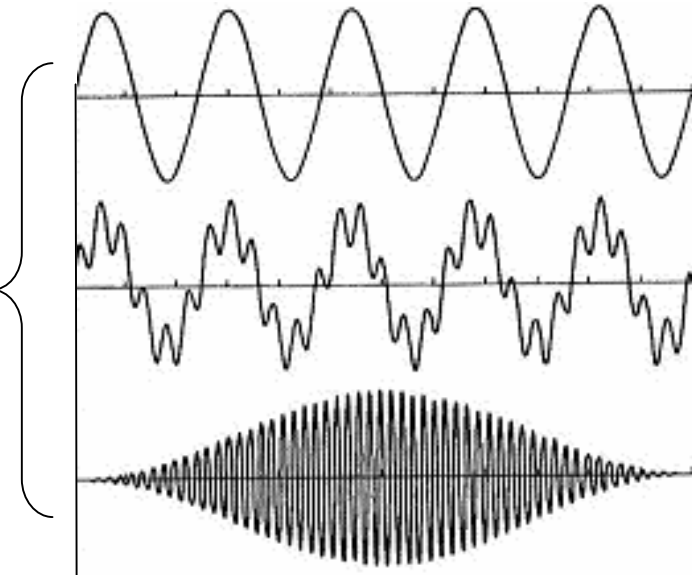
## Vibrations in general



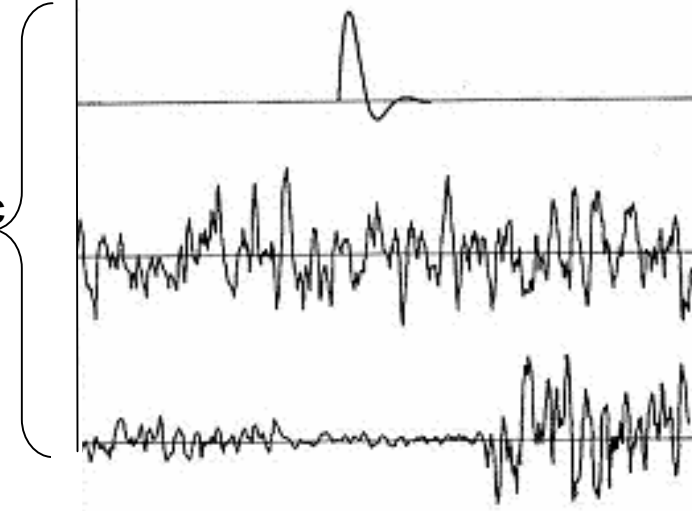
### Definition of Vibration:

A mechanical vibration (also called oscillation) is a periodically repeated inversion of the movement direction.

harmonic vibrations



Non-harmonic vibrations





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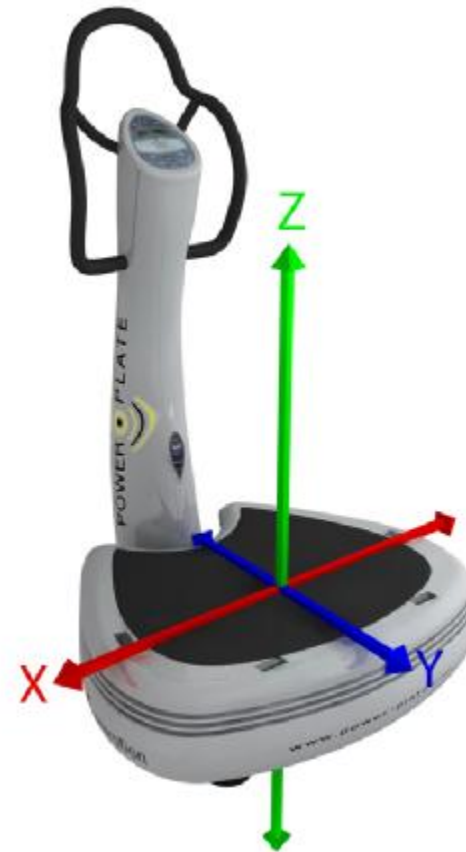
## Characteristics of Power-Plate vibrations I

### Direction of the vibration:

Movement up and down, forward and backward displacement, sideward displacement

“multi-dimensional”

Z = up and down  
X = left and right  
Y = forwards and backwards





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## Characteristics of Power-Plate vibrations II

### Frequency of the vibration:

The number of times per second that the Power-Plate moves up and down.  
Frequency is expressed in Hz (30 Hz, 35 Hz, 40 Hz or 50 Hz)

### Length of the movement:

The distance which the surface of Power-Plate rises per cycle.  
Amplitude expressed in low and high





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## Resonance

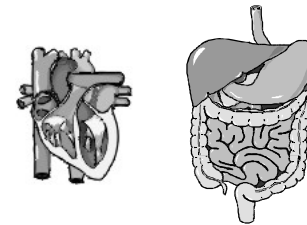
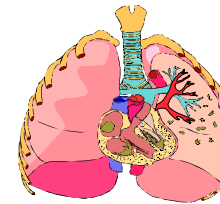
Be careful not to stimulate organs in the range of their own frequencies in order to avoid an **uncontrollable increase of intensity!**



Entire body:  
» **5-15 Hz**



Spine/muscles:  
» **8 Hz**



Inner organs:  
» **8 Hz**



Head/eyes:  
» **18-20 Hz**

### Important!

The Power-Plate generates vibrations in a range between 30 and 50 Hz, clearly out of range of resonance in the human body!



## Classification of acceleration forces (g-forces)

**1 g = 9,81 m/s<sup>2</sup> (normal earth gravity)**

Values greater than 1 means that one becomes heavier (i.e. Roller coaster driving → max. 6 g!)

Values smaller than 1 means that one becomes lighter (i.e. 0 g in space)

### Allowed g-forces in the person without causing damages:

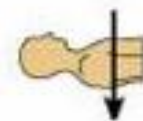
In the direction of the spine:

- longer repeatedly up to fourfold earth acceleration (4 g)
- for a short time (pushes) up to 18-fold earth acceleration (18 g)



Vertically to the backbone (i.e. start of rocket):

- longer repeatedly up to 16-fold earth acceleration (16 g)





## Force output in strengthening

Formula van Force

$$F_{(g/vertical)} = M \times A \text{ (m/s}^2\text{)}$$

**Conventional resistance training:**

$$F_{(g/vertical)} = [70 \text{ kg} + 70 \text{ kg extra weight}] \times 9.81 \text{ m/s}^2 \text{ (1 g)}$$

$$= 1373.4 \text{ Newton}$$

**Power-Plate training:**

40 Hz and high amplitude → peak acceleration 50.0 m/s<sup>2</sup>

$$F_{(g/vertical)} = 70 \text{ kg (bodyweight)} \times 50.0 \text{ m/s}^2$$

$$= 3500 \text{ Newton}$$



$$F = \uparrow M \times A \downarrow$$

$$F = M \times A \uparrow$$

$$F = \uparrow M \times A \uparrow$$



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## Acceleration measured by the University of Leuven

<u>Amplitude</u>	<u>Frequency (Hz)</u>	<u>Gravity Force (g)</u>	<u>Acceleration (m/s<sup>2</sup>)</u>
Low	30	1.83	18.00 m/s <sup>2</sup>
	35	2.32	22.80 m/s <sup>2</sup>
	40	2.76	27.10 m/s <sup>2</sup>
	50	3.48	34.10 m/s <sup>2</sup>
High	30	3.17	31.10 m/s <sup>2</sup>
	35	3.99	39.10 m/s <sup>2</sup>
	40	5.11	50.09 m/s <sup>2</sup>
	50	6.36	62.40 m/s <sup>2</sup>