

ANNEX 2

Task 2 - Trampoline Classification

1. Introduction

By definition a trampoline is “a tough canvas sheet suspended by springs or elasticated cords from a frame, used by acrobats, gymnasts, etc” (Collin Dictionary¹) or “a piece of sports equipment that you jump up and down on, consisting of a piece of strong material joined by springs to a frame” (Cambridge Dictionary²).

The trampoline evolved with an increasing number of variations but the modern original one is an invention by George Nissen and Larry Griswald who produced the first viable prototype in 1934 and named and patented it as a Tumbling device in 1945 (Kindy, 2020).

At the beginning, the trampoline was a training device to aid in the training of other sports (diving, gymnastics, freestyle skiing), also pilots and later astronauts³. Only later it became used for fun and finally became a recognized sporting activity when the Federation Internationale de Trampoline was formed in 1964.

The norms relating to trampolines in different uses have different classifications (CEN- EN71-14; CEN- EN1176-4.2.16; CEN- EN 13219), which makes it difficult to compare them, and impairs the decision to include a trampoline in any one of them.

Our aim in this work was to start by finding the main characteristics that can identify a trampoline and its potential, and then propose a classification of most of the commercialized trampolines.

2. Methodology

This classification arises through the triangulation of data collected in the bibliography, in the standards and through expert’s opinions.

¹ <https://www.collinsdictionary.com/dictionary/english/trampoline>

² <https://dictionary.cambridge.org/pt/dicionario/ingles/trampoline>

³ <https://www.olympic.org/trampoline-equipment-and-history>

We made a table with all types of trampolines identified in the standards (CEN- EN71-14; CEN- EN1176-4.2.16; CEN- EN 13219). Then added the types or models found in FIG apparatus norms, the catalogues of brands recognized by FIG, consulted some catalogues with domestic trampolines, and finally included the opinion of the experts, according with information in the European Gymnastics directives for equipment.

3. Results

Regarding the shape, we can consider four types of trampolines: round, rectangular or square, oval and other shapes.

Considering the Nissen trampoline as the reference (it has legs and a certain distance from the bed to the ground) and having as starting point the classification of the domestic trampolines (CEN- EN71-14) we have trampolines and buried trampolines, raised and at ground level.

For size, we consider the measurements of the competition trampolines and the CEN-EN71-14 standard as a reference. Due to the performance differences associated with the size of the frame and the number of springs associated with it, we find four size categories: mini ($\leq 1500\text{mm}$), small ($\leq 2500\text{mm}$), medium ($\leq 3700\text{mm}$) and large.

The round trampolines include several mini models, normally used in fitness sessions but that can easily be used at home.

Rectangular or square trampolines include regular trampolines (used in training or at school), tracks (longer and for horizontal displacement) and competition (approved FIG or EG⁴).

The tracks are used in training to link technical elements/stunts, to be performed on the floor (artistic gymnastics and acrobatic gymnastics) or in tumbling, but it is not approved by FIG as they are not used in competition. If not included in any of the analysed standards, we are presented with a legal vacuum with possible problems for the safety of users.

The competition trampolines have specific characteristics. In addition to the size it is necessary to consider the slope of the structure and respective bed. We have mini trampolines (mini size as the name implies) square or close with a slope, because they have one leg higher than the other. The double mini trampoline is medium in size and has a slope at the entrance and then a flat area. These have an entrance with a running approach and then an exit with a landing on the

⁴ FIG – Fédération Internationale de Gymnastique and EG – European Gymnastics

mat. The trampoline is large, and like the others it has a web-type bed, which decreases the effect of air resistance and increases the rebound.

In the others category we have included other types of shapes like hexagonal, octagonal, 60° and 90° trampolines (angle between the two sides of the frame) most used as playground trampolines.

Some mini or small trampolines have legs with a single support in the structure (4 to 10 pieces), and in the other models the legs are double, because they have two supports in the structure and are connected in the bottom part that is on the ground (2 to 21).

The bed could be suspended by springs or elasticated cords from the frame, but the majority of trampolines have springs. The springs are different in size and number. The larger the size, or the number of springs, the greater the rebound. The competition trampoline (FIG approved) has the largest springs (256 to 258mm, depending on the brand), but there is a large regular trampoline with 140 springs although they are slightly smaller (250mm) which is considered domestic, and has a capacity of identical rebound, reduced only by the characteristics of the bed.

Most trampolines have synthetic fabric beds with considerable air resistance. There are plastic or rubber beds, both for outdoor use, suitable for the playground due to their greater resistance to vandalism and wear. Competition trampolines have web-like beds, with thinner strips, which greatly reduces air resistance and increases the rebound capacity.

The extra parts to consider are the handles, used in the mini models, the enclosures with greater height for the larger models and the connection to the pit.

The enclosures height is related with trampoline size and there are enclosures with 2200 mm height for large trampolines.

The thickness of the padding system is important for safety when the falls happen over the structure. The greater the rebound capacity, the greater the thickness should be. In competition trampolines the thickness varies between 32mm and 100mm.

Regarding maximum allowed weight, we found less than 25kg in a model that should be considered a toy, and others between 50 to 100kg, which can be justified by the quality of the material (bed) and frame (without load capacity). This is an important point to consider in the safety of users.

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Table 1.
Types and characteristics of trampolines

Shape	Design	Size	frame length	frame width	frame height	N Legs	springs size	springs number	bed	extra parts	Padding Thickness	Padding Width	max user weight	
Round	a) buried trampolines (BT)													
	raised buried trampoline	Small	2000mm		200mm/550mm	na	135mm	36	PVC-coated synthetics	enclosure 1500mm	20mm	380mm	50kg	
		Medium	2700-3300		200mm/750mm	na	135-190	48-72	PVC-coated synthetics	enclosure 1800mm	20mm	380mm	70-100	
		Large	3800-4300		200mm/750mm	na	190	80-96	PVC-coated synthetics	enclosure 1800mm	20mm	380mm	110-120	
	ground-levelled trampoline	Mini	1250-1500		400mm	na			plastic lamellas threaded on steel cables					
		Small	1600-2250		400mm	na			plastic lamellas threaded on steel cables					
		Medium	3300mm		1000mm	na	190	72	PVC-coated synthetics		30 mm	370mm	100-110	
		Large	3800-4300		1000mm	na			PVC-coated synthetics					
	b) trampolines	Mini	560-1270		225	4-8pcs	Elastic		PVC-coated synthetics	handrail or enclosure (min1,5m)				<= 25 kg
			812-1371		225-275	5-8pcs	80-86	26-44	PVC-coated synthetics					50-100kg
		Small	1524		275	10pcs	80-86	48	PVC-coated synthetics	enclosure (min 1,5m)				50kg
			1800-2438		450-600	3 Double	135-175	36-48	PVC-coated synthetics		30 mm	290mm		50kg
		Medium	2700-3660		760-864mm	3-4 Double	135-216	48-72		enclosure (min 1,8m)	30 mm	350mm		70-100kg
		Large	3800-4876		900-965	4-5 Double	190-216mm	80-128		enclosure (min 2,2m)	30 mm	370mm		110-unlimited
Rectangle/square	a) buried trampolines (BT)													
	raised buried trampoline	Medium	2800-3300	1900-2200	600-750	na			webbing bed 6-loop steel wire reinforcement					
	ground-levelled trampoline	Mini	1250-1500	1250-1500	400-730	na	145mm	36	PVC-coated fabric	or wire reinforced belt				
		Small	1750-2500	1750-2500	400-730	na	145mm	56	plastic lamellas threaded on steel cables	or PVC coated fabric				
		Medium	3000mm	1500-2000	400-1000	na	235mm	62	plastic lamellas threaded on steel cables	or PVC coated fabric				
		Large	4100-5240	2500-3110	950-1150	na	235mm	100-118	woven polypropylene					
	ground levelled tracks	open ended	5200mm	3050mm	1150mm	na	258	98	6mm x 6mm web bed	connection with a foam pit	32mm			
		Large	4000-10000	1560mm	710mm	na								
	b) trampolines													
	Training	Mini	1120mm	1120mm	356 – 425 mm	2 Double	185	28	13x13mm or 6x6mm web bed	4 rubber cable/ Double perlon				
		Medium	3320-3650	2230-2540	900-910	2-4 double	221-235mm	74-80	PVC-coated synthetics		32mm			
		Large	4400-5200	2520-3050	1000-1350	2-4 double	212-250	100-140	PVC-coated synthetics/13mm woven web	bungee cord woven/enclosure (min 2,2m)	35 mm	400mm		
		Tracks	4000-20000	2000mm	700-720mm	5-21 double	185	128-640	PVC-coated synthetics		32mm			
	competition	MT std oend	1200mm	1200mm	355-375mm	2 Double	185	32			32mm			
	MT std	1250mm	1250mm	357 – 425 mm	2 Double	185	32	13x13mm or 6x6mm web bed						
	Team gym	1240-1300	1240-1250	237-285 mm	2 Double	185	36-40	6mm x 6mm web bed						
	DMT	3500mm	1900mm	700mm	3 double	235-229	102			32mm				
	TR	5200mm	3050mm	1150mm	2 Double	258-256	110-126	6mm x 6mm web bed		32-100mm				
Oval	a) buried trampolines (BT)													
	raised buried trampoline	Medium	3500mm	2500mm	270/800mm	na		80	PVC-coated synthetics	enclosure 1,8m	30 mm	390mm	110 Kg	
		Large	4700-5200	3100-3450	270/800mm	na		112-144	PVC-coated synthetics	enclosure 1,8m	30 mm	390mm	120 Kg	
	ground-levelled trampoline													
b) trampolines														
Regular	Medium	3500mm	2500mm	950mm			80	PVC-coated synthetics	enclosure 1,8m	30 mm	390mm	110 Kg		
	Large	4700-5200	3100-3450	950mm			112-144	PVC-coated synthetics	enclosure 1,8m	30 mm	390mm	120 Kg		
Others	a) buried trampolines (BT)													
	raised buried trampoline													
	ground-levelled trampoline													
	Hexa	Small	1700mm	1470mm		na			plastic lamellas threaded on steel cables					
	60°	Small	1600mm	1550mm		na			plastic lamellas threaded on steel cables					
	90°	Small	1850mm	1850mm		na			plastic lamellas threaded on steel cables					
	b) trampolines													
	Hexa	Mini	1100-1219		250mm	6	85mm	36	PVC-coated synthetics	rubber cable				
		Small	2400mm											
	Octagonal	Medium	3400mm	900mm			230mm	88	PVC-coated synthetics					
	Large	4000-4600	900mm			230mm	120	PVC-coated synthetics						

4. Conclusions

There are some models of trampolines that are not covered by the standards (CEN- EN71-14; CEN- EN1176-4.2.16; CEN- EN 13219).

As main characteristics to consider in safety, we have: size, length and number of springs. These, together with the type of bed (complete fabric or web) determine the rebound capacity.

The height of the structure only exists to provide space for the bed and springs (suspension system) to stretch and not touch the floor. So, if we want to limit the height of the jump, it is necessary to reduce the size of the springs, the strength of the springs, the elasticity and the bed air resistance.

All trampolines on this list can be purchased for domestic use, but not all are covered by the respective standard.

Enclosures height should be higher for medium and large trampolines and it's already possible to find 2200m high enclosures.

Padding system should have more than 30 mm to be an absorb-shock system and there are already some brands with frame pads between 35 mm to 100 mm.

The model found with a maximum capacity of 25kg is the only one to be considered as a toy because all the others have sufficient rebound capacity for users to perform somersaults.

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