5.15.1 Kinetic energy of projectiles

5.15.1.1 Principle

The kinetic energy of the projectile, when used under normal conditions, is calculated from the maximum of 5 velocity determinations. If more than one type of projectile is supplied with the toy, the kinetic energy of each type of projectile is calculated.

5.15.1.2 Apparatus

Timing device for determining the velocity, to give a calculated kinetic energy to an accuracy of 0,005 J.

5.15.1.3 Procedure

5.15.1.3.1 Determination of velocity

Determine the velocity of the projectile using Formula 1:

$$v = d/t \tag{1}$$

where

d is the distance in metres;

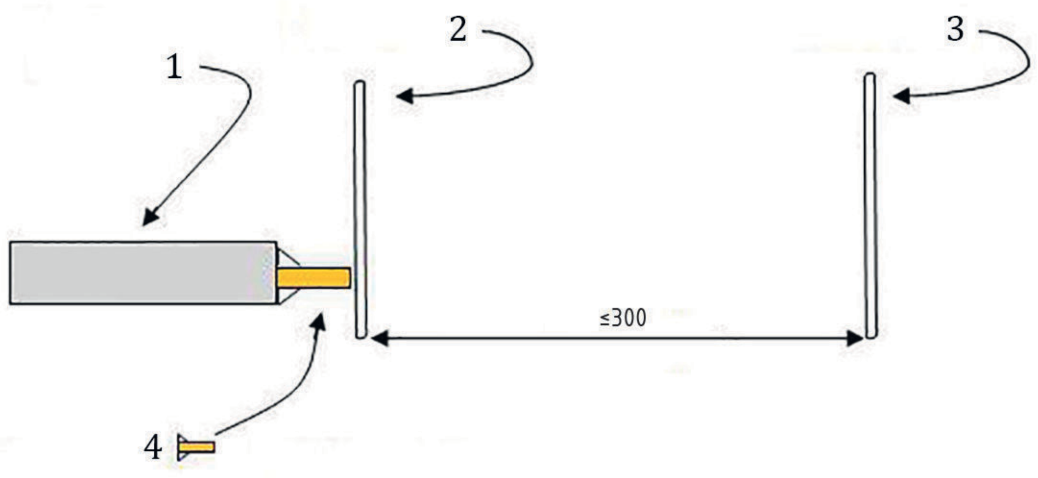
t is the time in seconds.

Position the discharge mechanism so that the projectile is launched in its intended manner, e.g. vertically for a rocket, through a suitable timing device (e.g. a chronoscope or ballistic screen). Measure the time (t) over a distance (d) of not more than 300 mm, measured from the contact surface of the projectile as soon as it has entered free flight. See Figure 38.

The measurement distance (d) must be reduced if necessary to ensure that the entire measurement is done with the projectile in free flight.

NOTE The natural deceleration of the projectile once it has left the discharge mechanism may cause different results to be obtained depending on the measurement distance.

Dimensions in millimetres



Key

1 discharge mechanism

2 first screen

3 second screen

4 projectile at the point of horizontal *free flight*

Figure 38 — Example of determination of velocity using ballistic screens

Discharge the projectile through the timing device 5 times and use the minimum time for the calculation of the velocity. If more than one type of projectile is supplied with the toy, repeat this process and use the projectile with the greatest velocity for the calculation of kinetic energy in 5.15.1.3.2 (determination of kinetic energy) below.

For bows, use an arrow intended for the bow, and stretch the bowstring until the first of one of the following occurs, before firing the arrow:

a) a 150 N pull force is reached, or

b) the arrow cannot be pulled back further due to its length, or

c) a 70 cm pull back distance has been reached.

5.15.1.3.2 Determination of kinetic energy

Determine the maximum kinetic energy E_k, of the projectile in free flight using Formula (2):

$$E_k = mv^2/2 \qquad (2)$$

where

m is the mass of the projectile, in kilograms;

v is the maximum velocity of the projectile, in metres per second measured according to 5.15.1.3.1 (determination of velocity);

E_k is the maximum kinetic energy, in joules.

5.15.1.3.3 Determination of kinetic energy per area of contact

Determine the maximum kinetic energy per area of contact, E_k, *area*, using Formula (3):

$$E_{k,\text{ area}} = mv^2/(2A) \tag{3}$$

where

- m is the mass of the projectile, in kilograms;
- v is the maximum velocity of the projectile, in metres per second measured according to 5.15.1.3.1 (determination of velocity);
- A is the contact area of the projectile, in square metres;
- E_k is the maximum kinetic energy per area of contact, in J/m^2.

For the measurement of contact area of a resilient-tipped projectile, one acceptable method is to apply a suitable staining or inking agent (e.g. Prussian blue) to the projectile, firing it at a suitable perpendicular hard flat surface from a distance of (300 ± 5) mm, and measuring the area of residual impression. An alternative method suitable for some projectiles is the use of an impressionable contact surface (e.g. covered with a carbon paper system) rather than inking the projectile. Determine the contact area as follows:

a) Apply a suitable staining or inking agent to the contact surface of the projectile. Place a sheet of clean white paper on a hard flat surface. Support this surface so that it will not move when impacted or,

b) Place a sheet of carbon paper against a sheet of white paper and hold these sheets against a hard flat surface so that the projectile impact image will be transferred from the carbon paper onto the white paper.

c) Load the projectile to be tested into the discharge mechanism. Orientate the loaded discharge mechanism perpendicular to the hard flat surface, with the contact surface of the projectile from a distance of (300 ± 5) mm from the hard flat surface.

   If the discharge mechanism has more than one speed setting, set to the maximum speed.

   For bows use an arrow intended for the bow and stretch the bowstring until the first of one of the following occurs:

   1) a 150 N pull force is reached, or

   2) the arrow cannot be pulled back further due to its length, or

   3) a 70 cm pull back distance has been reached.

d) Discharge the projectile onto the paper.

e) Measure the image area on the white paper. The contact area is the average of a minimum of 10 measurements. When calculating the contact area, exclude any areas of white, i.e. areas without ink transfer.

f) Calculate the maximum kinetic energy per area of contact in J/m^2

5.15.2 Wall impact test for projectiles

If the discharge mechanism has multiple speed settings, set it to discharge at maximum speed.

Position the toy such that the projectile will discharge in a direction perpendicular to a vertically orientated concrete block or similar hard flat impact surface. The distance between the leading edge of the projectile and the impact surface shall be such that the projectile enters free flight (disengaged from the discharge mechanism) as it strikes the impact surface.

For bows use an arrow intended for the bow and stretch the bowstring until the first of one of the following occurs:

a) a 150 N pull force is reached, or

b) the arrow cannot be pulled back further due to its length, or

c) a 70 cm pull back distance has been reached.

Discharge the projectile onto the impact surface.

NOTE If possible, use a projectile that has not been previously subjected to any test.

Carry out the test three times. Examine the projectile for any hazardous sharp edge, or hazardous sharp point.

5.16 Free-wheeling facility and brake performance test

5.16.1 Determination of free-wheeling facility

See 4.21 (braking) and 4.22.3 (braking requirements).

To determine free-wheeling facility, load the toy as in 5.12.2 (stability test, feet available for stabilization) with the appropriate mass as given in Table 3 and place it on a horizontal plane.

Pull the toy at a constant speed of (2 ± 0,2) m/s on a surface covered with aluminium oxide paper P60 and determine the maximum pull force, *F*.

The toy is not free-wheeling if [using Formula (4) or Formula (5)]:

$$F_1 \geq (m + 25) \times 1{,}7 \qquad (4)$$

or

$$F_2 \geq (m + 50) \times 1{,}7 \qquad (5)$$

where

F_1 is the maximum pull force, in newtons, for a toy intended for children under 36 months;

F_2 is the maximum pull force, in newtons, for a toy intended for children 36 months and over;

m is the mass of the toy, in kilograms.

NOTE If a toy accelerates down a slope of 10° when loaded with a mass of 50 kg, it can be expected to be free-wheeling.

5.16.2 Brake performance for mechanically or electrically powered ride-on toys other than toy bicycles

See 4.21 (braking).

Load the toy as in 5.12.2 (sideways stability test, feet available for stabilization) with the appropriate mass as given in Table 3 and place it on a plane inclined at $\left(10^{+0,5}_{\ 0}\right)^{\circ}$ covered with a surface of aluminium oxide paper P60, with its longitudinal axis parallel to the incline.

Apply a force of (50 ± 2) N in the direction in which the brake handle is normally operated.

If the brake is operated by a handle similar to that of a bicycle, apply a force of (30 ± 2) N at right angles to the axis of the handle, at the middle of the handle.

If the brake is operated by a pedal, apply a force of (50 ± 2) N to the pedal in the operating direction producing the effect of the brake.

If the vehicle has several brakes, test each brake separately.

Determine whether the toy moves more than 5 cm upon application of the braking force.

5.16.3 Brake performance for toy bicycles

See 4.22.3 (braking requirements).

Load the toy bicycle with a mass of (50 ± 0,5) kg, whose centre of gravity is 150 mm above the surface on which a child sits. Place the toy bicycle on a plane inclined at $\left(10^{+0,5}_{\ 0}\right)^{\circ}$ with its longitudinal axis parallel to the incline.

If the brake is operated by a handle similar to that of a bicycle, apply a force of (30 ± 2) N at right angles to the axis of the handle, at the middle of the handle.

If the brake is operated by a pedal, apply a force of (50 ± 2) N in the operating direction producing the effect of the brake.

Determine whether the toy moves more than 5 cm upon application of the braking force.

5.17 Determination of speed of electrically driven ride-on toys

See 4.23 (speed limitation of electrically driven ride-on toys).

Load the toy in its normal sitting or standing position with a mass of (25 ± 0,2) kg.

Operate the toy on a horizontal surface and determine whether the maximum velocity exceeds 8 km/h.

5.18 Determination of temperature increases

See 4.24 (toys containing a heat source).

In an ambient draft-free atmosphere with a temperature of (21 ± 5) °C, operate the toy according to the instructions for use at the maximum input until equilibrium temperature is reached.

Measure the temperature of the accessible parts and calculate the temperature increases.

Observe whether the toy ignites.

5.19 Leakage of liquid-filled toys

See 4.25 (liquid-filled toys).

Condition the liquid-filled toy at a temperature of (37 ± 1) °C for a minimum of 4 h.

Within 30 s of removing the toy from conditioning, apply a force of $\left(5^{+0,5}_{\ 0}\right)$N to the external surface of the toy through a steel needle with a diameter of (1 ± 0,1) mm and with a tip radius of (0,5 ± 0,05) mm.

Apply the force gradually within a period of 5 s. Maintain the force for 5 s.

After completion, determine leakage by applying cobalt chloride paper over the area where the force was applied while elsewhere compressing with a force of $\left(5^{+0,5}_{\ 0}\right)$N using suitable means other than a needle.

Repeat the test after conditioning the toy at a temperature of (5 ± 1) °C for a minimum of 4 h.

After completion, examine the toy for leakage of the contents.

If liquid other than water is used, confirm leakage using another suitable method.

Cobalt chloride paper should not be used for the 5 °C test as condensation may give false results.

5.20 Durability of mouth-actuated toys

See 4.26 (mouth-actuated toys).

Connect a piston pump capable of discharging and receiving more than 300 cm^3 of air in less than 3 s to the mouthpiece of the mouth-actuated toy. Arrange a relief valve so that the pump will not generate a positive or negative pressure of more than 13,8 kPa. Subject the toy to 10 alternating blowing and sucking cycles, each within 5 s and of at least (295 ± 10) cm^3 of air including the volume which may be discharged through the relief valve. If the air outlet is accessible, ensure that the above is also applied to the outlet.

Determine whether any released component fits entirely in the cylinder when tested in accordance with 5.2 (small parts test).

5.21 Expanding materials

See 4.3.2 (expanding materials).

Condition the toy or component at (21 ± 5) °C and at a relative humidity of 40 % to 65 % for at least 7 h before the test. Measure the maximum dimensions *x*, *y*, and *z* of the toy or any component of the toy using callipers.

Submerge the toy or component completely in a container of demineralized water at (20 ± 5) °C for (24 ± 0,5) h. Ensure that sufficient water is used so that the toy or component still remains under water at the end of the test.

Remove the item using a pair of tongs. If the item cannot be removed because of insufficient mechanical strength, it is considered to comply with the requirement of 4.3.2.

Allow water adhering to the toy or component to drain for 1 min and re-measure the item.

After re-measuring, place the item in the demineralized water again and repeat the above procedure twice, such that the item has been measured after 24 h, 48 h and 72 h of submersion.

Calculate the expansion in the *x*, *y* and *z* dimensions as a percentage of the original dimension.

Determine whether the item complies with the requirements of 4.3.2.

5.22 Folding or sliding mechanisms

5.22.1 Loads

Load the toy with a mass of (50 ± 0,5) kg.

For toys intended for children under 36 months, load the toy with a mass of (25 ± 0,2) kg.

5.22.2 Toy pushchairs and perambulators

See 4.12.1 (toys pushchairs, perambulators and similar toys).

Precondition the toy by erecting and folding it 10 times.

a) For toy pushchairs and perambulators covered by 4.12.1 a), carry out the following.

   Erect the toy on a horizontal surface with the locking devices engaged and load the toy with the appropriate mass specified in 5.22.1 (loads), ensuring that the load is borne by the frame. Where necessary, use a suitable support to ensure that the seat material is not damaged. Apply the load to the frame in the least favourable position with respect to the folding parts. Apply the load evenly over 5 s and maintain for 5 min.

   Determine whether it is possible to partially erect the toy without engaging one of the locking devices. If so, also carry out the above loading in the partially erect position.

   If the seat of the body is detachable from the chassis, this test shall also be carried out on the chassis only, using suitable support for the test mass.

   Determine whether the toy collapses and whether the locking devices are still operable and engaged.

b) For toy pushchairs and perambulators covered by 4.12.1 b), carry out the following.

   Erect the toy on a horizontal surface with the locking devices engaged and load the toy with the appropriate mass specified in 5.22.1 ensuring that the load is borne by the frame. Where necessary, use a suitable support to ensure that the seat material is not damaged. Apply the load to the frame in the most onerous position with respect to the folding parts. Apply the load evenly over 5 s and maintain for 5 min.

   Determine whether it is possible to partially erect the toy without engaging the locking devices. If so, also carry out the above loading in the partially erect position.

   Determine whether the toy collapses and whether the locking devices or safety stop are still operable and engaged.

5.22.3 Other toys with folding mechanisms

See 4.12.2 (other toys with folding mechanisms).

a) Erect the toy. Lift the toy and observe whether the locking device disengages when the toy is tilted in any (30 ± 1)° angle from the horizontal.

b) Erect the toy and position it on a surface inclined $\left(10\ {}^{+0,5}_{\ \ 0}\right)^\circ$ in the most onerous position with respect to the folding parts. Engage any locking device. Load the toy for 5 min with the appropriate mass specified in 5.22.1 (loads). Apply the load wherever it is possible for a child to sit and in the least favourable position with respect to the folding parts. Ensure that the load is borne by the frame. Where necessary, use a suitable support to ensure that the seat material is not damaged.

Determine whether the toy collapses or the locking device disengages.

5.23 Washable toys

See 4.1 (normal use).

Determine the mass of each washable toy prior to the beginning of the test.

Subject the toy to six washing-machine and tumble-dryer cycles, unless a different method is specified by the toy manufacturer by means of a permanent label.

Any commercially available washer, dryer or laundry detergent intended for use in the home may be used for this test. Consideration should be given to the specific types of washing machines (top- or front-loading) used in the country in which the toy is meant to be sold.

Wash the toys plus a dummy load of clothes sufficient to bring the total dry mass to a minimum 1,8 kg in an automatic washing machine, using the "warm" water setting and approximately 12 min wash cycle at the "normal" setting.

Dry the toys and dummy load in accordance with the manufacturer's instructions.

NOTE For equivalent settings on other types of machines, "warm" is approximately 40 °C and a "normal" load is for an average size load according to the machine being used.

The toy shall be deemed to be dry when the final mass does not exceed the original dry mass by more than 10 %.

Determine whether the toy still conforms to the relevant requirements of Clause 4 (requirements).

5.24 Reasonably foreseeable abuse tests

See 4.2 (reasonably foreseeable abuse).

5.24.1 General

The tests in 5.24 are meant to simulate situations in which possible damage can occur to a toy as a result of reasonably foreseeable abuse.

Unless otherwise stated, these tests are only applicable for toys intended for children under 96 months.

After undergoing each of the appropriate tests, the toy shall still continue to conform to the relevant requirements of Clause 4 (requirements).

NOTE The tests specified in 4.31.2 (all other toys with magnets and magnetic components) are carried out in the order specified in 4.31.2 on a toy, or part of a toy, that has not been previously tested according to this subclause (5.24, reasonably foreseeable abuse tests).

5.24.2 Drop test

Except for toys covered in 5.24.3 (tip-over test for large and bulky toys), toys falling below the mass limits indicated in Table 5 shall be dropped onto a specified impact surface. The number of times the toy shall be dropped and the height from which it is dropped shall also be determined from Table 5. The toy shall be dropped in random orientation.

The impact surface shall consist of vinyl composition tile of approximately 3 mm nominal thickness laid over concrete of at least 64 mm thickness. The tile shall have a hardness of (80 ± 10) Shore A and the impact surface shall be at least 0,3 m^2.

For battery-operated toys, the recommended batteries shall be in place during the drop test. If no specific type of battery is recommended, the heaviest battery which is generally available shall be used.

Table 5 — Drop test

Age group	Mass criterion kg	Number of drops	Drop height cm
Under 18 months	< 1,4	10	138 ± 5
18 months and over but under 96 months	< 4,5	4	93 ± 5

After each drop, the toy shall be allowed to come to rest and shall be examined and evaluated before continuing.

Determine whether the toy continues to conform to the relevant requirements of Clause 4 (requirements).

5.24.3 Tip-over test for large and bulky toys

See E.3

Large and bulky toys shall not be tested according to 5.24.2 (drop test), but in accordance with the following procedure:

Place the toy on a horizontal surface, as prescribed in 5.24.2. Attempt to tip it over by pushing it slowly past its centre of balance three times, one of which shall be in its most onerous position. Gradually apply a force, which is not to exceed 120 N, in a horizontal direction and 1 500 mm above the horizontal surface or at the top edge of the toy for toys less than 1 500 mm in height. A non-resilient step with a height of (25 ± 2) mm shall be positioned such that it prevents sliding or rolling of the toy during the test.

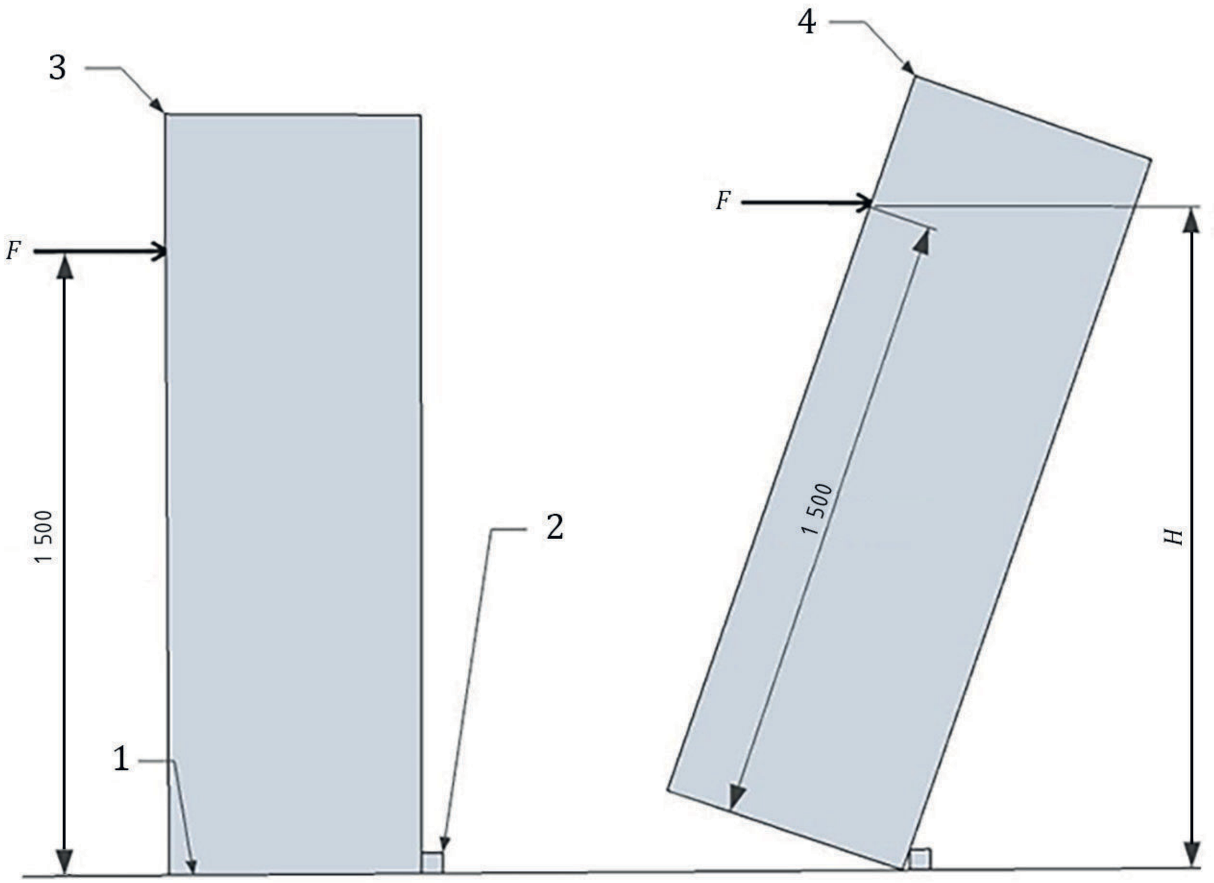
The original point of application relative to the toy shall be maintained, and the force shall remain horizontal, throughout the test. The vertical position of the point of application relative to the horizontal surface is permitted to increase during the test.

If a force greater than 120 N is required to bring the toy beyond its centre of balance, or if the vertical position of the point of application, relative to the horizontal surface, exceeds 1 800 mm, the tip-over test shall be stopped. The test shall also be stopped if the toy slides or rolls over the non-resilient step without tipping over (see Figure 39).

After each tip-over, the toy shall be allowed to come to rest and shall be examined and evaluated before continuing to determine whether the toy continues to conform to the relevant requirements of Clause 4 (requirements).

Toys supplied with anchors and intended to be permanently fixed (e.g. in concrete) when in use, according to the manufacturer's instructions, shall not be subjected to the tip-over test.

Dimensions in millimetres



Key

1 test surface

2 25 mm step

3 toy at rest

4 toy during tipping

F force direction and application point

H height not to exceed 1 800 mm

Figure 39 — Tip-over test for large and bulky toys

5.24.4 Dynamic strength test for wheeled ride-on toys other than toy scooters

Load the toy for 5 min in the most onerous position with the appropriate mass in accordance with Table 3 on its standing or sitting surface.

Secure the load to the toy in a position corresponding to the normal use of the toy.

Drive the toy three times at a speed of (2 ± 0,2) m/s into a non-resilient step with a height of 50 mm.

If the toy is intended to bear the mass of more than one child at a time, test each sitting or standing area simultaneously.

Determine whether the toy continues to conform to the relevant requirements of Clause 4 (requirements).