INTERNATIONAL STANDARD

ISO 8124-1

Third edition
2012-10-01

AMENDMENT 1
2014-07-01

Safety of toys —

Part 1: Safety aspects related to mechanical and physical properties

AMENDMENT 1: Projectiles, rotors and propellers

Sécurité des jouets —

Partie 1: Aspects de sécurité relatifs aux propriétés mécaniques et physiques

AMENDEMENT 1: Projectiles, rotors et propulseurs

Reference number
ISO 8124-1:2012/Amd.1:2014(E)

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Published in Switzerland

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The committee responsible for this document is ISO/TC 181, *Safety of toys*.

Safety of toys —

Part 1:
Safety aspects related to mechanical and physical properties

AMENDMENT 1: Projectiles, rotors and propellers

Page 9, Clause 3

Amend the existing definitions with the following:

3 Terms and definitions

3.47
projectile
object without capacity for self-propulsion, intended to be launched into free flight

Note 1 to entry: The definition does not include self-propelled flying toys such as remote control helicopters and wind-up airplanes unless the capacity for self-propulsion is from self-contained compressed gas and/or liquid (e.g. rockets).

3.48
projectile toy with stored energy
toy with a projectile launched by means of a discharge mechanism capable of storing energy independent of the user and incorporating a release mechanism

Note 1 to entry: Release mechanisms should operate following at least one single discrete activation by the user.

Note 2 to entry: Toy rockets and similar toys propelled by a chemical reaction or compressed gasses (e.g. air) where the energy can be stored independent of the user are considered as projectile toys with stored energy. For example, in a rocket propelled by a mixture of vinegar and baking soda, the user initiates the reaction by mixing the two substances but no longer has control of the actual launching. The rocket will launch when the pressure build up overcomes the force that holds the rocket onto the launch platform.

3.49
projectile toy without stored energy
toy with a projectile propelled by energy imparted by the user or by means of a discharge mechanism incapable of storing energy independent of the user

Page 12, Clause 3

Add the following new definitions:

3.71
free flight
unconstrained travel through the air

Note 1 to entry: to entry:This includes projectiles that are ultimately restrained by means of a non-rigid tether (e.g. a pop-gun).

3.72
arrow
projectile in the form of a shaft with a length of 150 mm or more, intended to be discharged from a bow held by the user

3.73
discharge mechanism
a component of the toy, separate from the projectile, which releases or propels the projectile into free flight

3.74
dart
a projectile in the form of a shaft less than 150 mm in length that is intended to be thrown or blown

3.75
leading edge
an area of the projectile (e.g. tips, edges or protrusions) which would be expected to make contact with the eyeball in the event of launching towards the eye

Note 1 to entry: This includes all areas on projectiles that travel in unpredictable orientations (e.g. tumbling) that could reasonably be expected to strike the eyeball.

Page 29, Subclause 4.18

Replace the existing Subclause 4.18 with the following:

4.18 Projectile toys

See E.32.

4.18.1 General

a) The requirements of 4.18.2 a), b), c), 4.18.3 b) to e) and 4.18.5 do not apply to projectiles that have a maximum range of 300 mm or less when measured in accordance with 5.35 (determination of projectile range).

b) The requirements of 4.18.3 a) do not apply to projectile toys for children 3 years and above with a range of 100 mm or less when measured in accordance with 5.35 (determination of projectile range).

c) The requirements of 4.18.2, 4.18.3, 4.18.4 do not apply to

- components that function as projectiles which are permanently enclosed within a toy unless they are liberated when the outer container is tested according to 5.24 (reasonably foreseeable abuse tests);
- ground based toys propelled along a track or launched onto another surface;

NOTE These are not considered to be projectile toys even if they include an element of motion in free flight, for example leaps between tracks or surfaces.

- rotors and propellers.

4.18.2 Projectiles

Projectile toys shall conform to the following requirements.

a) Tips or leading edges on rigid projectiles shall not protrude beyond the depth of the gauge shown in Figure X(5) when tested according to 5.36 (tip assessment of rigid projectiles).

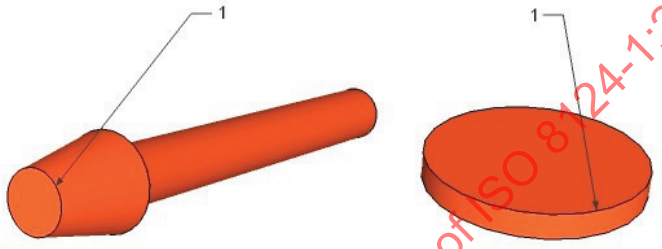
b) The leading edges of a projectile, as well as any corners that are adjacent to the leading edge(s) shall be smooth and free of points, burrs, flash or similar projections.

c) For rigid projectiles discharged by projectile toys with stored energy, the corners of the projectile that are adjacent to the leading edge(s) shall have rounded edges. For purposes of this requirement a radius of 0.25 mm shall be considered sufficient. This requirement does not apply to projectiles made from paper or paperboard.

NOTE 1 There may be multiple leading edges that require evaluation, especially in situations where the projectile may travel in irregular or unpredictable orientations (e.g. tumbling).

NOTE 2 To determine if a leading edge and/or adjacent corner can strike the eye, the spherical shape of the eyeball should be considered, as well as the size and shape of the projectile relative to the eye, the regularity or predictability of the flight path, and any other relevant factors.

See Figure X(1) for examples of corners adjacent to leading edges.



Key

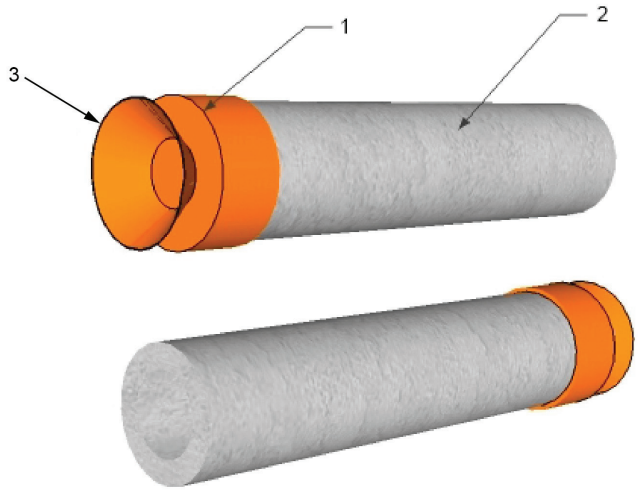
1 corners adjacent to leading edges

Figure X — (1) — Examples of corners adjacent to leading edges on missile and disc-type projectiles

d) Projectiles with a suction cup as a contact surface shall have a length of 57 mm or more when measured according to 5.37 (length of suction cup projectiles) before and after testing according to 5.24.5 (torque test) and 5.24.6.5 (tension test for a projectile with a suction cup) unless:

— the suction cup does not pass entirely through template C when tested according to 5.4 (small balls test), or

— the suction cup is on a foam shaft projectile (see Figure X(2) where the suction cup diameter measured in the relaxed state, is less than or equal to the diameter of the foam shaft.



Key

1 plastic collar

2 foam

3 suction cup

Figure X — (2) — Foam projectile with suction diameter less than or equal to the diameter of foam shaft

NOTE The requirement of 4.18.2 d) applies to both suction cups that have been separately affixed to the shaft and to those that are integral with the shaft (i.e. one-piece mouldings).

e) Suction cups on projectiles with a suction cup as a contact surface shall not detach when tested according to 5.24 (reasonably foreseeable abuse tests) unless:

— the detached suction cup does not pass entirely through template C when tested according to 5.4 (small balls test), and the exposed shaft end complies with 4.8 projections, or

— the suction cup is on a foam projectile where the suction cup diameter, when measured in the relaxed state, is less than or equal to the diameter of the foam shaft, see Figure X(2).

NOTE The requirement of 4.18.2 e) applies to both suction cups that have been separately affixed to the shaft and to those that are integral with the shaft (i.e. one-piece mouldings).

4.18.3 Projectile toys with stored energy

Projectile toys with stored energy shall conform to the following requirements:

a) Projectiles shall not, whatever their orientation, fit entirely into the small parts cylinder when tested in accordance with 5.2 (small parts test).

NOTE This requirement applies to projectile toys intended for children 3 years and above.

This requirement does not apply to:

— small parts that are released after testing in accordance with 5.24 (reasonably foreseeable abuse testing) and 5.15.2 (wall impact test for projectiles) that cannot be launched or are unable to travel a distance greater than 100 mm when measured in accordance with 5.35 (determination of projectile range);

— small parts of foam that are released from projectiles whose shafts are completely made of foam following testing in accordance with 5.24 (reasonably foreseeable abuse testing) and 5.15.2 (wall impact test for projectiles).

b) Projectiles with a kinetic energy greater than 0,08 J when tested according to 5.15.1 (kinetic energy of projectiles) shall:

— have a contact surface(s) made of a resilient material, and

— be accompanied by a warning about aiming at the eyes or face (see B.2.15 a) for guidance). This requirement only applies to projectiles that might reasonably be able to be aimed at the face (see E.32.);

— have a kinetic energy per unit area not greater than 2 500 J/m^2 when tested according to 5.15.1.3.2 (determination of kinetic energy per area of contact).

c) Where a protective cap, cover or tip is used it shall either:

— not become detached from the projectile when tested in accordance with 5.24.5 (torque test) and 5.24.6.4 (tension test for protective components), or

— if the protective cap, cover or tip becomes detached and if any resulting component can still be discharged from the discharge mechanism, the toy shall continue to comply with the requirements of 4.18.3.

c) When tested in accordance with 5.15.2 (wall impact test for projectiles), projectiles shall not produce a hazardous sharp edge or a hazardous sharp point and shall continue to meet the requirements of 4.18.3.

d) The discharge mechanism shall be designed so that it is unable to launch the improvised projectiles, specified in Figure AA and Table AA, in a manner determined to be hazardous.

NOTE 1 The discharge mechanism shall be assessed in the form in which it is supplied in the toy, i.e. there shall be no user modifications.

NOTE 2 Improvised projectiles that are discharged 300 mm or less are not considered to be hazardous [see 4.18.1 a)]

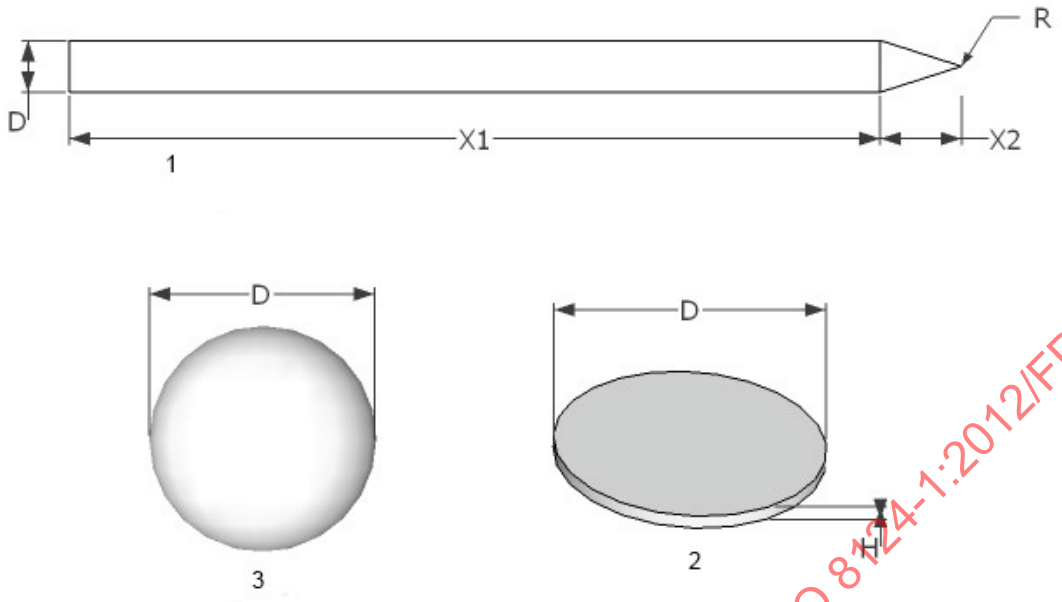
When evaluating the ability of a discharge mechanism to launch improvised projectiles in a hazardous manner, consideration should be given to the following factors:

— the repeatability and ease of loading and then launching the improvised projectile;

— the orientation of the discharge mechanism;

— distance travelled by the improvised projectile;

— other factors considered to be relevant.



Key

1 cylindrical shaft
2 disc
3 sphere

Figure — AA — Improvised projectiles

Table — AA — Dimensions of improvised projectiles shown in Figure AA

Dimensions in millimetres

Designation	Name	Material	D	X1	X2	R[a]	H
Shafts							
A	Pencil	Hardwood	7	155	15	0,5	
B	Long nail / pen refill	Aluminium	3	100	5	0,1	
Z	Pen refill	Aluminium	3	50	5	0,1	
C	Short nail / toothpick	Aluminium	1,5	50	2,3	0,05	
D	Toothpick	Aluminium	1,5	25	2,3	0,05	
Spheres							
E	Steel ball	Steel	8				
F	Small marble	Glass	16				
G	Large marble	Glass	25				
Discs							
H	Small coin	Steel	15				1,5
I	Medium coin	Steel	20				2
J	Medium/large coin	Steel	25				3
K	Large coin	Steel	30				3

[a] Radius on shaft tips are non-critical dimensions.

4.18.4 Projectile toys without stored energy

Projectile toys without stored energy that might reasonably be able to be launched at the face, should be accompanied by instructions for use, which draw attention to the hazards of aiming at eyes or face [see B.2.15 b)]. This requirement does not apply to projectile toys intended to be thrown towards people, e.g. flying discs, balls and similar objects.

4.18.4.1 Mouth actuated projectile toys

Mouth actuated projectile toys shall comply with the requirements of 4.25 (mouth-actuated toys).

4.18.4.2 Projectiles in the form of a dart

Projectiles in the form of a dart shall conform to the following requirements:

a) When measured in accordance with 5.15.1.3.2 a) to f) (contact surface area), the contact area of the dart shall be at least 3 cm^2.

b) The dart shall either be:

- provided with a protective cap, cover or tip that is integral with the front end of the shaft, or
- have a blunted front end to which a protective cap, cover or tip is attached, or
- be made of a resilient material, unless it is reliant on magnetic forces.

c) After testing in accordance with 5.24.5 (torque test) and 5.24.6.4 (tension test for protective components) projectiles in the form of a dart with a protective cap, cover or tip shall conform with at least one of the following requirements:

- the protective cap, cover or tip shall not become detached from the projectile, or
- if the protective cap cover or tip becomes detached from the projectile, the projectile shall not be capable of being launched by the discharge mechanism, or

— if the projectile is made of a resilient material, it shall continue to have a contact area of at least 3 cm^2 when measured in accordance with 5.15.1.3.2 a) to f) (contact surface area).

4.18.4.3 Arrows (e.g. bow and arrow set)

Projectiles in the form of an arrow shall have a maximum kinetic energy per unit area of contact not greater than 2500 J/m^2 when determined in accordance with 5.15.1.3.2 (determination of kinetic energy per area of contact).

After testing in accordance with 5.15.2 (wall impact test for projectiles), the projectiles in the form of an arrow shall not produce a hazardous sharp edge or hazardous sharp point and shall continue to meet the requirements of 4.18.4

Projectiles in the form of an arrow shall also:

a) be provided with a protective cap, cover or tip that is integral with the front end of the shaft, or

b) have a blunted front end to which a protective cap, cover or tip is attached, or

c) be made of a resilient material, unless it is reliant on magnetic forces.

After testing in accordance with 5.24.5 (torque test) and 5.24.6.4 (tension test for protective components) projectiles in the form of an arrow with a protective cap, cover or tip shall conform to at least one of the following requirements:

— the protective cap, cover or tip shall not become detached from the projectile, or

— if the protective cap cover or tip becomes detached from the projectile, the projectile shall not be capable of being launched by the discharge mechanism, or

— if the projectile is made of a resilient material, it shall continue to have a maximum kinetic energy per unit area of contact not greater than 2500 J/m^2 when determined in accordance with 5.15.1.3.2 (determination of kinetic energy per area of contact).

4.18.5 Rotors and propellers

These requirements do not apply to propellers that normally rotate in the vertical plane, e.g. a propeller on an aeroplane or remote controlled flying toy.

Rotors and propellers powered by electrical, spring or inertial energy and that take off into free flight shall be designed to minimize the potential of rotating blades to cause injury. For example, this may be accomplished by one or more of the following:

a) the design of the rotor or propeller shall prevent access to the blade ends during operation;

b) the blade ends shall be “clutched” or loosely attached to the rotor so that the ends are not directly powered by the rotor drive;

c) rotors or propellers shall be designed so that the leading edges are protected with a resilient material

Examples of designs that achieve these conditions are given in E.32 Figure X(10).

Page 49, Subclause 5.15

Replace the existing subclause 5.15 with the following:

5.15 Kinetic energy and wall impact test

5.15.1 Kinetic energy of projectiles

5.15.1.1 Principle

Calculate the kinetic energy of the projectile, used under normal conditions, from the maximum of five velocity readings. If more than one type of projectile is supplied with the toy, the kinetic energy of each type of projectile shall be calculated.

5.15.1.2 Apparatus

5.15.1.2.1 Means 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 kinetic energy

Determine the maximum kinetic energy E_k, of the projectile in free flight using Formula 1:

Formula 1

$$E_k = mv^2/2$$

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 5.15.1.3.1.1

E_k is the maximum kinetic energy, in joules.

5.15.1.3.1.1 Determination of velocity

Measure the velocity of the projectile using Formula 2:

Formula 2

$$v = d/t$$

where

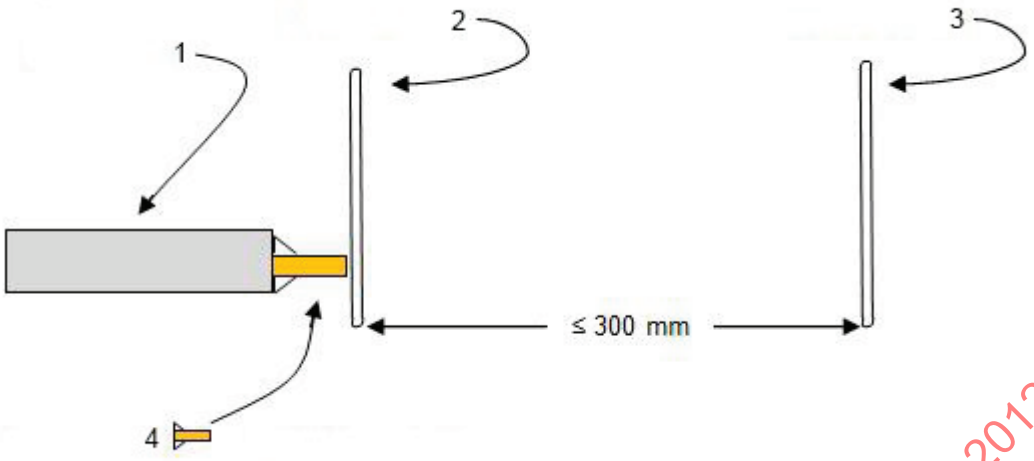
d is the distance in metres;

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 X(7).

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.



Key

1 discharge mechanism
2 first screen
3 second screen
4 projectile at the point of horizontal *free flight*

Figure X — (3) — 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 5.15.1.3.1 above.

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 per area of contact

Determine the maximum kinetic energy per area of contact, $E_{k,\ area}$, using Formula 3:

Formula 3

$$E_{k,\ area} = mv^2/2A$$

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 5.15.1.3.1.1

A is the contact area of the projectile, in square metres;

$E_{k,\ area}$ 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 the block so that it will not move when impacted or,

b) Hold the sheet flat against the block and place a sheet of clean white paper between the block and a sheet of carbon paper (carbon side facing the white paper). Hold the sheets flat against the block.

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 mm ± 5) mm from the block.

   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) Propel 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.

   NOTE When calculating the contact area, exclude any areas of white areas 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 (see Annex E.32)

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

Position the toy such that the projectile will launch in a direction perpendicular to a vertically orientated concrete block or similar 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 surface of the impact surface.

For a bow and arrow, set 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.

Propel projectile into the contact surface.

NOTE Use a new projectile for the test of Clause 5.15.2 when possible.

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

Page 54, Subclause 5.24

Add a new subclause 5.24.6.5 to subclause 5.24:

5.24.6.5 Tension test for a projectile with a suction cup

For projectiles with a suction cup as a contact surface, attach a clamp on the shaft such that the edge of the clamp is at a point 57 ($^{+1}_{0}$) mm from the contact surface of the projectile. Determine this distance in accordance with the procedure contained in 5.37 (length of suction cup projectiles). If, due to the length of the projectile, it is not possible to achieve 57 mm between the clamp and the contact surface of the projectile, place the clamp such that its distance from the contact surface of the projectile is maximized. Place a second clamp around the suction cup such that it is held securely against a flat surface as shown in Figure X(3).

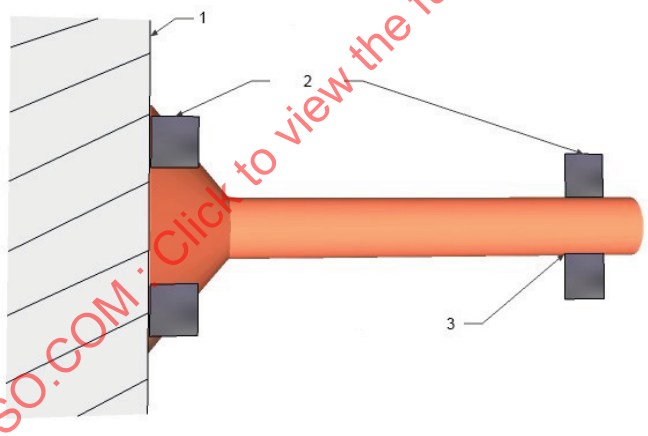
If clamping causes any damage to the projectile, it is allowable to use alternative methods to secure the projectile.

NOTE If glue is used to fasten the suction cup to a flat surface, care must then be taken that the solvents in the glue do not influence the material properties of the suction cup or its fastening to the shaft.

Subject the projectile to a longitudinal force of (70 ± 2) N evenly over a 5 s period and maintain for 10 s.

If the suction cup has detached determine whether the suction cup passes through template C in 5.4 (small balls test).

If the shaft has broken, determine whether or not the remaining portion of the shaft and suction cup has a total length of 57 mm or more.



Key

1 flat surface
2 clamps
3 57 mm from tip

Figure X — (4) — Example of attachment of clamps when testing suction cups on projectiles

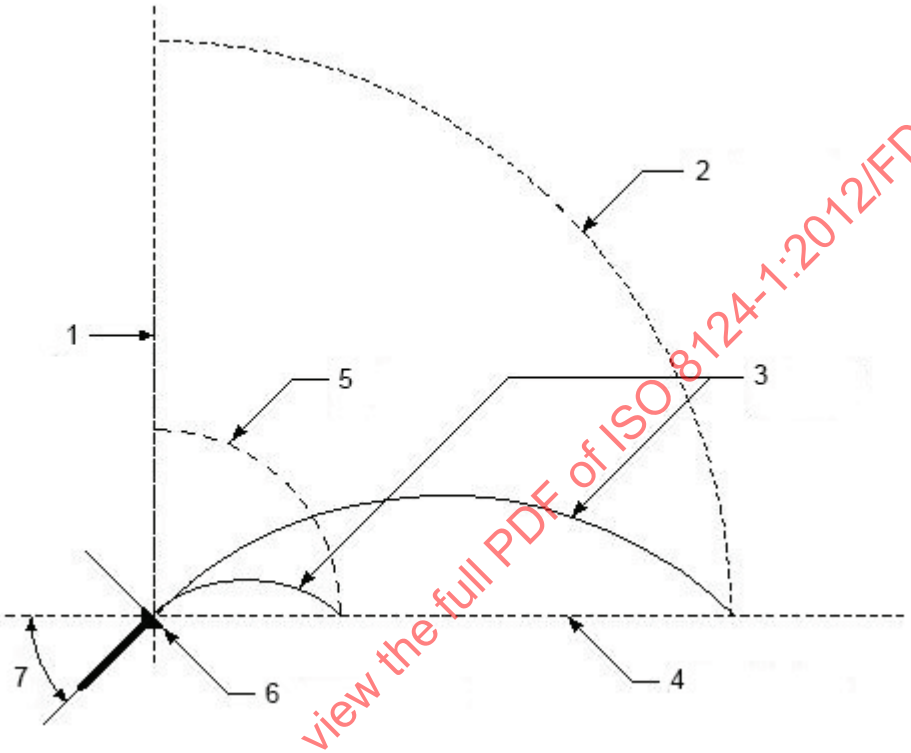
Page 72, after Subclause 5.34

Add a new subclause 5.35 as follows:

5.35 Determination of projectile range

Discharge the projectile in any normally foreseeable manner using a discharge angle that will maximize the distance travelled (typically this is 45°). At the point of discharge, the projectile shall be disengaged from the discharge mechanism and in free flight. Determine the maximum distance the projectile travels from the point of discharge while in the air. See Figure X(4).

NOTE A projectile intended to be discharged vertically would also be launched at lower angles if this is possible.



Key

1 vertical plane
2 distance 300 mm
3 trajectory examples
4 horizontal plane
5 distance 100 mm
6 point of discharge
7 angle of discharge

Figure X — (5) — Determination of projectile range

Page 72, *after Subclause 5.34 and the new Subclause 5.35*

Add a new subclause 5.36 as follows:

5.36 Tip assessment of rigid projectiles

Apply the gauge shown in Figure X(5), to any leading edge using minimal force and in any case not greater than the force due to the mass of the projectile. Visually determine whether the tip or leading edge protrudes beyond the depth of the gauge.

All dimensions in millimetres

Tolerance of measurements $^{+0}_{-1}$ mm

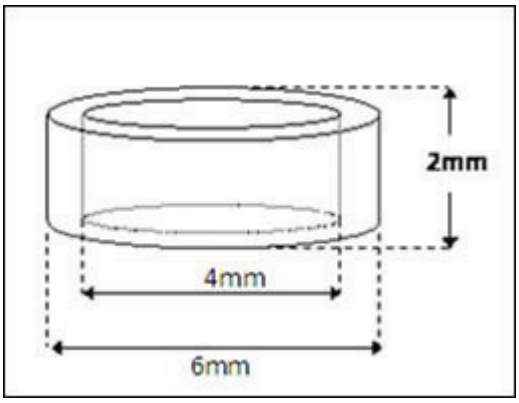


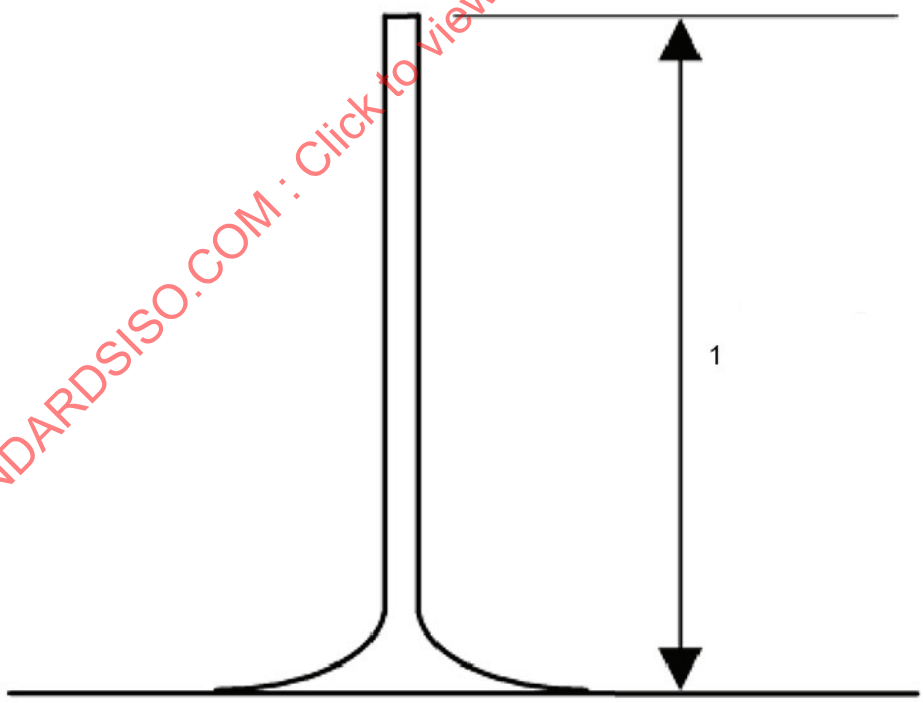
Figure X — (6) — Cylindrical gauge for measurement of projectile tips

Page 72, *after Subclause 5.34 and the new Subclause 5.36*

Add a new suclause 5.37 as follows:

5.37 Length of suction cup projectiles

Rest the suction cup on a flat horizontal surface such that its shaft is substantially vertical without it being subjected to any force other than that produced by its own mass. If the projectile falls over without support, support the projectile with just a sufficient horizontal force during the measurement. Measure the length of the projectile as shown in Figure X(6).



Key

1 length of projectile

Figure X — (7) — Measurement of length of projectiles with suction cup

Page 79, B.2.15

Replace the existing Subclause B.2.15 with the following:

B.2.15 Projectile toys

See 4.18.3 b) and 4.18.4.

a) Projectile toys with stored energy with projectiles with a kinetic energy greater than 0,08 J when tested according to 5.15.1, should be accompanied by a warning, which may appear in the instructions for use, concerning aiming at the eyes or face, such as

"Warning. Do not aim at eyes or face."

NOTE This requirement for a warning does not apply to projectile toys that are not reasonably able to be aimed at the eyes or face of the user or third party

b) Projectile toys with projectiles without stored energy that might reasonably be able to be launched at the face should be accompanied by instructions for use which draw attention to the hazards of aiming at eyes or face.

Page 91, E.32

Replace the existing Subclause E.32 with the following:

E.32 Projectile toys

See 4.18.

These requirements relate to certain, but not all, potentially unexpected hazards that might be caused by projectile firing toys and by the firing of improvised projectiles from such toys. Toys that are designed to fly (e.g. wind-up elastic band powered aeroplanes and remote controlled helicopters) do not present the same degree of hazard and are not within the scope of the projectile requirements.

Certain well-recognized hazards that are inherent in toy versions of traditional weapons such as slingshots, catapults and boomerangs are not covered by these requirements.

In general, projectiles having a range of less than 300 mm are not considered to possess sufficient energy to pose a risk of injury and are therefore exempt from the majority of requirements apart from those relating to small parts. A more conservative approach was taken in the case of projectiles that are small parts because these have featured in injury data from around the world. One of the injury mechanisms for small part projectiles involves accidentally launching the projectile into the mouth/airways. This injury mechanism does not exist for projectiles that can only launch a very short distance and so an exemption is included for projectiles that have a maximum range not greater than 100 mm. These projectiles would most commonly be seen on play sets where an initial action triggers the release of projectile(s) (e.g. boulders, car parts, etc.) that travel relatively minor distances. Play sets such as these have been sold for many years without history of injury. Other types of toys that launch a projectile only very small distances are considered to present an equivalent risk of airway obstruction to other types of small parts and so are addressed by the applicable non-projectile requirements of this standard.

Projectiles with suction cups as a contact surface have been involved in fatal accidents which are unrelated to the distance the projectile can be launched. Therefore it is important that the suction cups are either large or firmly attached and that the length of these projectiles is sufficient to hinder swallowing and to aid removal if a suction cup projectile does block the airway. The requirement for a length of 57 mm or more applies also after testing to 5.24 (reasonably foreseeable abuse tests) meaning that, if the shaft breaks during testing, the part to which the suction cup is attached must still be at least 57 mm long. However the requirements in 4.18.2 d) do not apply to suction cups on projectiles with foam shafts where the diameter of the suction cup is less than or equal to the diameter of the foam shaft. This