HASBRO INC.

CORPORATE QUALITY ASSURANCE
SAFETY AND RELIABILITY SPECIFICATION

SRS - 045
TITLE: PROJECTILES

BY: C. FISCHER APPROVAL:
DATE: JUNE 16, 1999 REVISION: G

1.0. PURPOSE

To establish specifications for the various structural characteristics and kinetic parameters of projectiles used on Hasbro, Inc. products. The intent of these specifications is to minimize any potential for injury (especially eye injury) to children while simultaneously maintaining the traditional play value represented by projectiles at an acceptable, but under reasonably foreseeable conditions of use and abuse, safe level. Conformance to the requirements of this specification will also ensure compliance to global requirements for projectiles.

2.0. SCOPE

This specification applies to both toys A) that are intended to launch projectiles into free flight by means of a discharge mechanism in which the kinetic energy of the projectile is determined by the toy and not by the user and B) certain projectile toys without stored energy. (i.e. arrows and darts intended to be thrown, helicopter rotors, propeller blades, bows and arrows and other items intended to be thrown, but not intended to be caught).

This specification does not apply to discharge mechanisms intended to propel a ground based vehicular toy along a track or other surface, nor when a projectile is inaccessible to a child when it leaves the discharge mechanism (e.g. a pin ball machine).

Projectiles without stored energy are acceptable only for toys with a minimum age grade of 3 years and up.

Projectiles are acceptable only for toys with a minimum age grade of 4 years and up)

Projectile guns and bows and arrows are acceptable only for toys with a minimum age grade of 5 years and up.

Helicopter-type projectiles that are intended for vertical discharges are only acceptable for toys with a minimum age grade of 6 years and up.

3.0 DEFINITIONS

3.1 PROJECTILE WITH STORED ENERGY: an object propelled by means of a discharge mechanism capable of storing and releasing energy under the control of the operator.
3.2 PROJECTILE WITHOUT STORED ENERGY: An object propelled solely by the energy imparted by a child.

3.3 DISCHARGE MECHANISM: an inanimate system for releasing and propelling projectiles.

3.4 PROJECTILE TIP - Any portion of a projectile that can reasonably be expected to contact an impact surface (e.g. an eye) during flight. A tip end or leading edge of a projectile is not the only possible “tip”. On disc or saucer like projectiles, the “edge” of the disc is considered as the tip. On rotor-type projectiles that have a ring around the perimeter, all exposed surfaces of the ring should be considered “tips”.

Note: The requirements of 6.3 apply to all “tips”.

See Figure 2 for a pictorial depiction of the proper radii on a disc-type projectile.

3.5 PROTECTIVE TIP: - a component that is attached to the impacting end of a projectile to minimize injury if it should impact on the body and also to prevent damage to the projectile on striking a target, or prevent damage to inanimate objects.

3.6 RESILIENT TIP: a tip on impact surface of a projectile that has a Shore A durometer not greater than 55 (as measured on the impact surface of the tip).

3.7 RIGID PROJECTILES: projectiles with an impact tip that has a shore A durometer that is greater than 55.

3.8 PROJECTILE GUNS AND BOWS AND ARROWS: are hand-held projectile launchers that are comparable in scale to a real firearm or bow and arrow. For purposes of this specification, small projectile launchers scaled to the size of toy figures (e.g. G.I. Joe) are not “projectile guns”.

4.0. TEST EQUIPMENT

4.1 A radar gun capable of measuring a small projectile (larger than Hasbro small part gage) traveling at a high speed (e.g. 11 miles/hour).

4.2 Hasbro small parts cylinder (per SRS-001, figure 2).

4.3 Laboratory balance with an accuracy of +/- 0.1 gram. (i.e. Sauter K800).

4.4 Aluminum foil complying with the requirements of 5.2.

4.5 A steel ball having a nominal diameter of 15 mm and a mass of 14.00 +/- 0.05 grams.

4.6 Clamps to uniformly clamp the diaphragm in the supporting frame - See Figure 1.
5.0 TEST PROCEDURE

5.1 KINETIC ENERGY DETERMINATION

5.1.1 The kinetic energy (in joules, j) of a projectile shall be determined from the following equation:

\[
\text{kinetic energy} = \frac{1}{2} m v^2
\]

where: 
- \( m \) = mass of projectile (Kg) and,
- \( v \) = velocity of the projectile (meter/sec.)

Conversion factor: Meters/sec = .447142 x miles/hour

5.1.2 The mass of projectile (kg) shall be determined by weighing a sample on a laboratory balance. A sufficient sample size (at least 30) of projectiles shall be weighed to determine the average weight plus 3 standard deviations. This upper limit weight in Kg is used for "m".

5.1.3 The velocity of a projectile (v) shall be determined by firing a sample from the discharge mechanism of the toy projected out in front of the radar gun. Recording m.p.h.). The velocity of the projectile shall be calculated from the expression

\[ v (\text{meters/seconds}) = \text{mph} \times 0.447142 \]

The value of v in the equation is the average of five measurements of a given projectile.

5.2 Test for Penetration of Toy Projectiles with Stored Energy

5.2.1 Foil

From a roll of aluminum foil, cut out twenty samples measuring 105 mm x 105 mm. Ensure that each sample is free from obvious imperfections including creases or wrinkles. Ten samples of aluminum foil are required to verify the quality of the aluminum foil and ten samples are required to test the toy.

5.2.2 Foil Verification.

a) The quality of the foil should be verified as follows:

b) Place one of the samples of foil between the two O-rings of the clamping frame and clamp the foil between the clamps so that the foil diaphragm is evenly tensioned with no creases or wrinkles.

c) Place the clamping frame on a substantially horizontal surface so that the foil diaphragm makes an angle between 15 degrees and 20 degrees relative to the horizontal.
d) Position the steel ball so that when the ball is released, it would fall freely through a vertical distance of 300 mm to strike the central 25 mm diameter area of the foil diaphragm.

e) Examine whether or not the foil diaphragm ruptured, as specified in 5.2.3

f) If the steel ball does not cause the foil diaphragm to rupture, repeat steps b) to d) a further four times, provided that each time the foil diaphragm does not rupture.

g) If all five of the foil diaphragms do not rupture, repeat steps b) to d), but this time, drop the steel ball through a height of 500 mm.

h) If the ball causes the foil diaphragm to rupture, as specified in 5.2.3, repeat steps b) to d) a further four times, provided that each time the foil diaphragm does rupture.

5.2.3 Interpretation

The foil diaphragm shall be considered as not ruptured if the foil shows, without magnification, no split or hole. A mere dent shall not be considered as a rupture.

The foil diaphragm shall be considered as ruptured if the foils shows, without magnification, a split or hole.

The ten remaining foil samples that are to be used to test the toy shall be considered as verified as being of a suitable quality if all five samples that were subjected to the ball drop height of 500 mm did rupture.

5.2.4 Test Specimen

The toy submitted for this test shall be representative of the normal population and shall not have been subjected to any normal use and reasonably foreseeable abuse tests prior to penetration testing the toy.

5.2.5 Procedure

The procedure shall be carried out in a conditional environment as follows:

a) Place one of the verified foil samples between the two O-rings of the clamping frame and clamp the foil using the clamps so that the foil diaphragm is evenly tensioned with no crease or wrinkles.

b) Place the clamping frame such that the foil diaphragm lies in a substantially vertical plane.

c) Load the projectile into the discharge mechanism.
d) Position the toy so that:

1) The end of the toy, that is, the end of the projectile or the end of the discharge mechanism whichever protrudes furthest, is 150 mm from the foil diaphragm; and

2) When the projectile is ejected, the flight path of the projectile would be substantially normal relative to the foil diaphragm and the projectile would strike the foil’s center as possible.

e) Eject the projectile.

f) Observe whether or not the projectile ruptures the foil diaphragm as specified in 5.2.3.

g) Repeat steps a) to f) a further nine times using the other nine verified foil samples.

5.2.6 Report

The report shall state the number of times the projectile ruptured the foil diaphragm when the toy was tested in accordance with 5.2.5.

5.3 Impact Test For Projectiles

Projectiles shall be propelled by their discharge mechanism six times into a concrete block wall (or equivalent surface) located at a distance 1 foot (300 mm) plus the length of the projectile from the front end of the discharge mechanism. The discharge mechanism shall be aimed perpendicular to the wall.

5.4 Use and Abuse Testing

Perform all pertinent use, abuse, life, and environmental testing on the projectile per the appropriate test plan for its parent product.

5.5 Improvised Projectile Test

Determine through experimentation if discharge mechanism is capable of discharging projectiles other than the projectile specifically designed for use with the discharge mechanism. Testing of improvised projectiles shall include, but is not limited to, the following objects:
### A) Correction Pen Cap

1) Pentel Opaquing Fluid Correction Pen  
   Oil-Based Quick Dry  
   18 ml. ZLC1-W  
   Manufacturer: Pentel Co. Ltd.  
   Made in Japan

<table>
<thead>
<tr>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1) total length - 1.10 inches</td>
</tr>
<tr>
<td>maximum diameter - 0.57 inch</td>
</tr>
<tr>
<td>minimum diameter - 0.53 inch</td>
</tr>
</tbody>
</table>

### B) Marker

1) Pentel Marker  
   F50  
   Made in Japan

<table>
<thead>
<tr>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1) total length - 3.3 inches</td>
</tr>
<tr>
<td>diameter - 0.91 inch</td>
</tr>
</tbody>
</table>

| Tip: length - 0.28; width - 0.18 inch |
| Tip Body: length - 0.70 inch |
| max. diameter - 0.65 inch |
| min. diameter - 0.36 inch |

### C) Marker Caps

1) Fluorescent Pen Cap  
   Zebra Pen 2  
   Thin Size Cap

<table>
<thead>
<tr>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1) length - 0.93 inch</td>
</tr>
<tr>
<td>max. diameter - 0.35 inch</td>
</tr>
<tr>
<td>min. diameter - 0.23 inch</td>
</tr>
</tbody>
</table>

2) Fluorescent Pen Cap  
   Zebra Pen 2  
   Thin Size Cap

<table>
<thead>
<tr>
<th>Dimensions</th>
</tr>
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<tbody>
<tr>
<td>C2) length - 1.82 inches</td>
</tr>
<tr>
<td>max. diameter - 0.58 inch</td>
</tr>
<tr>
<td>min. diameter - 0.28 inch</td>
</tr>
</tbody>
</table>

3) Fiber Tip Permanent Marker Cap  
   Artline 70 High Performance  
   Xylene Free EK-70  
   Manufacturer: Shachihata Product  
   Made in Japan

<table>
<thead>
<tr>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>C3) length - 1.71 inches</td>
</tr>
<tr>
<td>max. diameter - 0.66 inch</td>
</tr>
<tr>
<td>min. diameter - 0.51 inch</td>
</tr>
</tbody>
</table>

4) Fiber Tip Permanent Marker Cap  
   Artline 70 High Performance  
   Xylene Free EK-700  
   Manufacturer: Shachihata Product  
   Made in Japan

<table>
<thead>
<tr>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>C4) length - 1.52 inches</td>
</tr>
<tr>
<td>max. diameter - 0.70 inch</td>
</tr>
<tr>
<td>min. diameter - 0.69 inch</td>
</tr>
</tbody>
</table>
D) Paper Clip

1) Trigonal Clip
   # Elephant Trigonal
   Art. No. PM121
   Made in China

   D1) length - 1.19 inches
   max. diameter - 0.37 inch
   min. diameter - 0.15
   diameter of wire - 0.04 inch

E) Pen

1) Ball Pen Body
   Zebra - New Crystal
   N-5000
   Made in Japan

   E1) length - 4.56 inches
   max. diameter - 0.32 inch
   min. diameter - 0.200 inch

2) Ball Pen Body
   Zebra - Hard-Crystal
   N-5100
   Made in Japan

   E2) length - 4.83 inches
   max. diameter - 0.31 inch
   min. diameter - 0.21 inch

3) Ball Pen Body
   Bic #C-B-19

   E3) length - 5.32 inches
   max. diameter - 0.29 inch
   min. diameter - 0.24 inch

4) Ball Pen Cap
   Zebra N-5000
   Made in Japan

   E4) length - 2.32 inches
   max. diameter - 0.47 inch
   min. diameter - 0.25 inch

5) Ball Pen Metal Nozzle
   Zebra - Hard Crystal
   N-5100

   E5) length - 0.46 inch
   max. diameter - 0.22 inch
   min. diameter - 0.13 inch

F) Pen Refill

1) Bic #C-B-19

   F1) length - 5.17 inches
   max. diameter - 0.19 inch
   min. diameter - 0.12 inch

2) Zebra Ballpoint Pen Refill BR-6A-H-BK

   F2) length 5.48 inches
   max. diameter - 0.12 inch
   min. diameter - 0.09 inch
G) **Battery**

<table>
<thead>
<tr>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) “Energizer” AA</td>
</tr>
<tr>
<td>G1) length - 1.74 inches</td>
</tr>
<tr>
<td>diameter - 0.41 inch</td>
</tr>
<tr>
<td>2) “Energizer” AAA</td>
</tr>
<tr>
<td>G2) length - 1.97 length</td>
</tr>
<tr>
<td>diameter - 0.52 inch</td>
</tr>
<tr>
<td>3) “Energizer” C Size</td>
</tr>
<tr>
<td>G3) length - 1.95 inches</td>
</tr>
<tr>
<td>diameter - 0.99 inch</td>
</tr>
</tbody>
</table>

H) **Marble & Pebble**

<table>
<thead>
<tr>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Diameter 1”</td>
</tr>
<tr>
<td>H1) diameter - 1 inch</td>
</tr>
<tr>
<td>2) Diameter 0.635”</td>
</tr>
<tr>
<td>H2) diameter - 0.635 inch</td>
</tr>
<tr>
<td>3) Diameter 0.642”</td>
</tr>
<tr>
<td>H3) diameter - 0.642</td>
</tr>
</tbody>
</table>

Hazard evaluation of launched improvised projectiles shall include (but is not limited to) the following: Tip radii relative to kinetic energy; for rigid projectiles, the kinetic energy; for non-rigid or resilient tipped projectiles; the kinetic energy density.

5.6 **Projectile Configuration Evaluation**

Projectiles must not have projections (i.e. ribs, missiles, fins, etc.) that protrude from the main body of the projectile and have the potential to generate a "fishhook" effect. Generally, projections that extend 3/16” or more from the body of the projectile and subtend an angle of 30-90 degrees from the body and are not "blended" to the body will be considered as having the potential to generate a "fishhook" effect and are not acceptable for use on the Hasbro, Inc., products. However, projectiles of a size and/or shape such that they don’t penetrate to the full depth of the Hasbro Supplemental Test Fixture (see SRS-004, Figure 2) in their normal flight orientation shall be considered acceptable regardless of configuration. The configuration of all projectiles must be approved by Quality Assurance.

5.7 **Unexpected Discharging Of Projectiles**

Determine through experimentation if the discharge mechanism is capable of discharging projectiles in an unforeseeable, unexpected, or inordinately delayed fashion. When the projectile is in its normal launching position only the activating button, lever or switch must be capable of discharging the projectile. The actions and movements of the toy during all of its reasonably foreseeable normal play modes must not activate the discharge mechanism.
Also, reasonably foreseeable and normally expected handling or carrying the toy must not activate the discharge mechanism. In addition, the projectile should discharge within a reasonable time period after activation. (see 6.8)

5.8 Projectile Kinetic Energy Density

The projectile kinetic energy density must be determined on all projectiles with a kinetic energy greater than .08 joule. The Projectile Kinetic Energy Density is the kinetic energy of the projectile divided by its contact area. On non-rigid (i.e. including resilient tipped) projectiles the contact area is measured by applying a suitable staining agent (e.g. Prussian Blue) to the projectile, firing it at a suitable surface 1 foot away and measuring the area of the residual impression. Area is determined by the following:

\[
\text{Radius in meters: } \text{Area} = \pi r^2 \\
\text{Radius in inches: } \text{Area} = .0006452 \pi r^2
\]

The kinetic energy density is expressed as joules/area.

5.9 Arrows, Darts and Other “Thrown” Items and Bows

The kinetic energy of arrows, darts and other projectiles intended to be thrown shall be imparted to the projectile by a adult throwing the projectile with the highest reasonably foreseeable velocity. To determine the highest reasonably foreseeable velocity, child testing with children of the highest age for which the toy is intended may be required.

For bows, use an arrow intended for the bow and stretch the bow string, using a maximum force of 8.0 lbs. (35.6 newton), as far as the arrow allows, but to a 28 inch maximum (71 cm).

6.0 SPECIFICATIONS

6.1 No projectile intended to be fired from the toy shall have sharp edges per SRS-003, sharp points per SRS-002, or parts that fit without compression (i.e. the 1 lb. weight is NOT used) into the Hasbro cylinder per SRS-001. (NOTE: pieces that detach as a result of abuse test and cannot be launched by the discharge mechanism are not projectiles).

6.2 No projectile shall have a configuration that generates a "fishhook" effect. (See 5.6).

6.3 No projectile fired from a toy shall have a tip radius less than 2 mm (.08 in.). The minimum allowable tip radius increases in direct proportion to the kinetic energy of the projectile per the table below:
### Projectile Energy Level

<table>
<thead>
<tr>
<th>Energy Level</th>
<th>Minimum Allowable Tip Radius</th>
</tr>
</thead>
<tbody>
<tr>
<td>up to .025 joule</td>
<td>2 mm</td>
</tr>
<tr>
<td>from .025 to .05 joule</td>
<td>3 mm</td>
</tr>
<tr>
<td>from .05 to .10 joule</td>
<td>4 mm</td>
</tr>
<tr>
<td>from .10 to .15 joule</td>
<td>5 mm</td>
</tr>
<tr>
<td>from .15 to .20 joule</td>
<td>6 mm</td>
</tr>
</tbody>
</table>

NOTE: Any projectile with an energy level of .25 joule or greater must be reviewed and approved by Senior Vice President, Hasbro Quality Assurance.

Projectiles in the form of arrows or darts or other missile-shaped objects that are intended to be thrown by the user must have resilient tips with an impact area of at least $4 \text{ cm}^2$ ($.620 \text{ in}^2$).

Helicopter rotors and single propellers intended to be powered into vertical or nearly vertical flight by a spring mechanism or similar device must have a ring around the perimeter that complies with all the radii requirements of this section.

6.4 Any projectile fired from the toy that has a kinetic energy that exceeds .08 joule (as determined by section 5.1) shall have an impact surface(s) of a resilient material.

NOTE: If the flight characteristics of the projectile are such that it tumbles or turns around in flight when the kinetic energy exceeds .08 joule, then all profile surfaces are to be treated as impact surfaces.

6.5 Discharge mechanisms must be unable to discharge hazardous improvised projectiles.

6.6 All projectiles must withstand the impact test for projectiles (5.3 above) without the generation of a hazardous condition.

6.7 A protective tip shall not be detached from the projectile when subjected to torque/tension test per SRS-006 (i.e. 8 in-lbs torque/20.5 lbs tension) and shall not detach or produce or reveal hazardous points or edges when fired into a solid object according to test procedure described in 5.3 above.

6.8 Projectiles must not be discharged in an unexpected fashion. Projectiles must discharge within 4 seconds after launch activation (unless there is ample warning in the form of lights, sounds, etc.)

6.9 The Kinetic Energy Density of projectiles must not exceed 1600 joules/m. (See section 5.8).

NOTE: Kinetic Energy Density determination is not required for projectiles with an energy level less than .08 joule.
6.10 A toy, when tested in accordance with 5.2, shall not eject a stored energy projectile that results in the rupturing of more than two out of the ten foil diaphragms.

6.11 Any subject toy capable of discharging a projectile with a kinetic energy greater than 0.08 joule must carry a cautionary statement on the toy (see SRS-070 - Section 4.8).

6.12 All projectiles must meet above specifications both before and after all pertinent use, abuse, life and environmental testing per the appropriate test plan.

6.13 Summary of Selected Requirements

<table>
<thead>
<tr>
<th>Projectile Type</th>
<th>Tip Radii (Section 6.3)</th>
<th>Resilient Tip* (6.4)</th>
<th>K.E.D. (6.9)</th>
<th>Foil Test (6.10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rigid</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes**</td>
</tr>
<tr>
<td>Stored energy</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes*</td>
<td>Yes**</td>
</tr>
<tr>
<td>No stored energy</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes*</td>
<td>No</td>
</tr>
</tbody>
</table>

*Applies only if K.E. is > .08 joule

**Does not apply to disc or saucer type projectiles.

7.0 REFERENCES

7.1 F963 (ASTM), sections 4.20 and 8.15

7.2 Product Safety and Liability Reporter, 8/21/81, pp 645-646

7.3 NBS report No. 10-893 "Ocular injury potential of projectile-type toys, 8/1/72

7.4 EN71-1: 1998, Sections 4.17 and 8.25

7.5 "Guidelines for relating children's ages to toy characteristics", CPSC, 10/7/85, Page 181.

7.6 Australian Standard 1647.2-1992, “Children’s Toys (Safety Requirements), Constructional Requirements”, Section 7.15, Appendix K and Appendix DD.
FIGURE 1

FIGURE DD1 PLAN VIEW OF CLAMPING FRAME

NOTES:
1. The dimensions marked * shall be within a tolerance of ±1 mm.
2. The dimensions not marked * shall be within a tolerance of ±0.3 mm.

DIMENSIONS IN MILLIMETRES
Figure 2

Disk Projectiles

2.0mm Min. Full Radius

OR