



# Standard Specification for Extractable Hazardous Metals in Synthetic Turf Infill Materials<sup>1</sup>

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## 1. Scope

1.1 This specification relates to the amount of certain metals that have the potential to be extracted from synthetic turf infill materials if ingested. The time, temperature, and pH of the extraction fluid approximate the conditions the infill material would experience in the stomach during the digestive process. The levels of extractable metals are compared to maximum levels allowed in children's toys.

1.2 This specification applies to all materials (man-made or natural) that are intended for use as infill materials for synthetic turf sports surfaces.

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

2.1 *ASTM Standards:*<sup>2</sup>

D1193 Specification for Reagent Water

F963 Consumer Safety Specification for Toy Safety

F2075 Specification for Engineered Wood Fiber for Use as a Playground Safety Surface Under and Around Playground Equipment

F3012 Specification for Loose-Fill Rubber for Use as a Playground Safety Surface under and around Playground Equipment

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee F08 on Sports Equipment, Playing Surfaces, and Facilities and is the direct responsibility of Subcommittee F08.65 on Artificial Turf Surfaces and Systems.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

2.2 *European Standard:*<sup>3</sup>

EN 71-3:2013 Safety of toys – Part 3: Migration of certain elements

2.3 *U.S. EPA Standards and Methods:*<sup>4</sup>

EPA Method 6010B Inductively Coupled Plasma-Atomic Emission Spectrometry; SW 846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods

EPA Method 7470A Mercury in Liquid Waste (Manual Cold-Vapor Technique); SW 846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods

## 3. Terminology

3.1 *Definitions:*

3.1.1 *hazardous metal, n*—metal that could have the potential to cause harm to humans.

3.1.2 *infill material, n*—any material added to a synthetic turf fabric to provide shock attenuation, ballast, or other functions as part of the synthetic turf system.

## 4. Performance Requirements

4.1 *Hazardous Metal Content*—When the infill sample is analyzed using the procedure described in 10.4 (including the correction for statistical errors as described in 10.6) the maximum content of hazardous metals shall not exceed the level shown in Table 1.

## TEST METHODS

## 5. Summary of Test Method

5.1 The synthetic turf infill soluble hazardous metal content is determined using a procedure contained in Consumer Safety Specification F963. This procedure simulates the situation in which synthetic turf infill material remains in contact with stomach acid for a period of time after swallowing. The resultant solution is analyzed for mercury content using EPA Method 7470A and for the other hazardous metals using EPA Method 6010B.

<sup>3</sup> Available from European Committee for Standardization (CEN), Avenue Marnix 17, B-1000, Brussels, Belgium, <http://www.cen.eu>.

<sup>4</sup> Available from United States Environmental Protection Agency (EPA), William Jefferson Clinton Bldg., 1200 Pennsylvania Ave., NW, Washington, DC 20460, <http://www.epa.gov>.

**TABLE 1 Maximum Soluble Migrated Element in ppm (mg/kg)**

NOTE 1—Information in this table taken from Consumer Safety Specification **F963**.

Element	Antimony	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium
	Sb	As	Ba	Cd	Cr	Pb	Hg	Se
	60	25	1000	75	60	90	60	500

**TABLE 2 Analytical Corrections**

Element	Sb	As	Ba	Cd	Cr	Pb	Hg	Se
Analytical correction, %	60	60	30	30	30	30	50	60

## 6. Sampling

6.1 The laboratory sample of infill material is a representative sample of at least 100 g collected from a synthetic turf field or from a super sack or infill container.

## 7. Significance and Use

7.1 This test method is based on subsection 8.3 of Consumer Safety Specification **F963**, which specifies a test procedure to determine the amount of hazardous metals that have the potential to be present in toys and handled or ingested by children. Since it is possible for users of synthetic turf playing surfaces to handle or ingest particles of synthetic turf infill materials, it is necessary to determine the level of hazardous metals in the synthetic turf infill materials. The limits of hazardous metals used in this specification are based on those specified in Consumer Safety Specification **F963**, adjusted for statistical error correction factor as described in Consumer Safety Specification **F963**.

## 8. Apparatus

8.1 *pH Meter*, accurate to 0.2 pH units.

8.2 *Membrane Filter*, having a pore size of 0.45  $\mu\text{m}$ .

8.3 *Centrifuge*, capable of achieving  $5000 \pm 500$  rpm.

8.4 A means to constantly agitate the mixture at a temperature of  $37 \pm 2^\circ\text{C}$ .

8.5 *Container*, of gross volume between 1.6 and 5.0 times that of the volume of the hydrochloric acid extractant (see **10.2**).

## 9. Reagents

9.1 *Purity of Reagents*—Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society where such specifications are available.<sup>5</sup> Other grades are permitted, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening of the accuracy of the determination.

<sup>5</sup> *Reagent Chemicals, American Chemical Society Specifications*, American Chemical Society, Washington, DC. For Suggestions on the testing of reagents not listed by the American Chemical Society, see *Annual Standards for Laboratory Chemicals*, BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopeia and National Formulary*, U.S. Pharmacopeial Convention, Inc. (USPC), Rockville, MD.

9.2 *Hydrochloric Acid Solution*, 0.08 mol/L.

9.3 *Hydrochloric Acid Solution*, 2.0 mol/L.

9.4 *Purity of Water*—Unless otherwise indicated, reference to water shall be understood to mean reagent water as defined by Type 3 of Specification **D1193**.

## 10. Procedure

10.1 From the laboratory sample (**6.1**) of infill material, select a test portion of at least 100 mg

10.2 Mix the test portion with 50 times its mass of an aqueous solution of 0.08-mol/L hydrochloric acid at  $37 \pm 2^\circ\text{C}$ . Shake for 1 min.

10.3 Measure the pH of the mixture. If the pH is greater than 1.5, add drop-wise while shaking an aqueous solution of 2 mol/L (7.3 %) hydrochloric acid until the pH is between 1.0 and 1.5. Protect the mixture from light. Continuously shake the mixture for 1 h and allow to stand for 1 h at a temperature of  $37 \pm 2^\circ\text{C}$ .

NOTE 1—It has been shown that the extraction of soluble cadmium can increase two to five times when extraction is conducted in the light rather than in the dark.

10.4 Without delay, separate the solids from the mixture by filtering through a membrane filter with a pore size of 0.45  $\mu\text{m}$ . If necessary, centrifuge at  $5000 \pm 500$  rpm for no longer than 10 min. Analyze the solution using EPA Methods 7470A and 6010B to determine the present of the elements listed in **Table 1**.

10.5 If it is not possible to analyze the sample within one working day, stabilize by the addition of hydrochloric acid (HCl) so that the solution is approximately 1 mol/L of HCl; then proceed with EPA Methods 7470A and 6010B.

10.6 The analytical results as determined in **10.4** and **10.5** shall be adjusted by subtracting the analytical correction factor in **Table 2** as shown in examples in **10.7**. This is necessary to make statistical correction for interlaboratory error.

10.7 *Example of Calculations Using Table 2:*

10.7.1 *Example 1*—The analytical result for lead is 120 mg/L; the correction factor from **Table 2** is 30 % (0.30). Adjusted analytical results =  $120 - (120 \times 0.30) = 120 - 36 = 84$  mg/L. The result does not exceed the value for lead in **Table 1** and is therefore acceptable.

10.7.2 *Example 2*—The analytical result for chromium is 90 mg/L; the correction factor from **Table 2** is 30 % (0.30).

Adjusted analytical result =  $90 - (90 \times 0.30) = 90 - 0.27 = 63$  mg/L. The result exceeds the allowed value for chromium in **Table 1** and therefore is not acceptable.

10.8 *Report*—Report the analytical result for the elements listed in **Table 1**, adjusted for statistical correction following the procedure discussed in **10.6**.

## 11. Keywords

11.1 hazardous metal; synthetic turf; synthetic turf infill

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