



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

This standard is issued under the fixed designation F3188; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

## 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 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

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

<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.

Current edition approved Dec. 1, 2021. Published December 2021. Originally approved in 2016. Last previous edition approved in 2016 as F3188 – 16. DOI: 10.1520/F3188-16R21.

<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.

<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

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.

## 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.

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.

<sup>5</sup> ACS Reagent Chemicals, Specifications and Procedures for Reagents and Standard-Grade Reference Materials, American Chemical Society, Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see *Analar 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.



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 =  $90 - (90 \times 0.30) = 90 - 27 = 63$  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

*ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.*

*This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.*

*This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org). Permission rights to photocopy the standard may also be secured from the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923, Tel: (978) 646-2600; <http://www.copyright.com/>*