



United States

Consumer Product Safety Commission

Health and Safety Considerations for the Additive Manufacturing/3D-Printing of Consumer Products

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***Disclaimer:** This presentation was prepared by CPSC Staff and may not necessarily reflect the views of the Commission.*

What is the U.S. Consumer Product Safety Commission or CPSC?

Mission: Protecting the public from hazardous consumer products

Vision: A nation free from unreasonable risks of injury and death from consumer products

CPSC is an independent federal regulatory agency formed in 1972 with a mission to protect the public against unreasonable risks of injury or death from consumer products through education, safety standards activities, regulation, and enforcement.



CPSC Overview

Some of the Laws that Give CPSC Authority Over Consumer Products, Imported and Domestic

- Consumer Product Safety Act*
- Federal Hazardous Substances Act*
- Labeling of Hazardous Art Materials Act
- Flammable Fabrics Act
- Poison Prevention Packaging Act
- Virginia Graeme Baker Pool and Spa Safety Act
- Children's Gasoline Burn Prevention Act
- Portable Fuel Container Safety Act
- STURDY Act
- Refrigerator Safety Act
- Drywall Safety Act
- Child Nicotine Poisoning Prevention Act

*Amended by the Consumer Product Safety Improvement Act of 2008



CPSC Overview
**Federal Hazardous
Substances Act
(FHSA)**

- Risk-based—Considers both toxicity and exposure
- Manufacturers must ensure that their products are not hazardous substances or have proper labeling
- If the product is a "hazardous substance," labeling must describe the hazard and list the hazardous ingredient
- Other regulatory options available if labeling does not adequately address the hazards
- Includes acute and chronic effects
- Does not require pre-market approval

CPSC Overview

CPSC Chronic Hazard Guidelines

- 16 CFR § 1500.135
Summary of guidelines for determining chronic toxicity, Federal Register, 1992
- Provides guidance in assessing risks from acute and chronic hazards
 - Carcinogenicity
 - Neurotoxicity
 - Reproductive/developmental toxicity
 - Exposure
 - Bioavailability
- Acceptable daily intake (ADI)
Route-specific exposure limits (Inhalation)
- Risk assessment approaches
Acceptable risk

Art Materials and 3D Printers

- Labeling of Hazardous Art Materials (LHAMA)
 - Possible convergence with 3D printing is fact-specific
- Requires manufacturers to have all products evaluated by a toxicologist to determine any potential harmful health effects
 - Develop a toxicology report
- Products must be evaluated for harm from single exposures as well as from repeated, long-term exposure.
 - State all health risks on the label.
 - List all hazardous ingredients.
 - Provide instructions for safe use, including clean up, storage and disposal
- Testing must conform to ASTM D4236 requirements

Emerging Technologies and Materials

Health Implications

- What is released during 3D printing?
 - VOCs, plasticizers
 - Condensation into micro or nano plastic particles
- Printing may take several hours
 - Minimal to no engineering controls
 - Accumulation in the indoor environment
- Exposures across the lifecycle
 - Durability of 3D printed versus traditionally manufactured products
 - Elevated releases of chemicals and particulates
 - Storage of materials

Emerging Technologies and Materials

Assessment of Emerging or Advanced Materials

- Traditional risk-based approaches
 - Availability of toxicity and lifecycle exposure data
 - Exposure assessment to characterize and quantify releases from products
- Alternative methods for hazard identification and risk assessment
 - Suitable for emerging materials?
 - Can they be used by home manufacturers?
 - Validated?
- Risk Management

Expertise necessary to implement health and safety recommendations?

CPSC Overview

Risk Management Options

- Mandatory labeling
 - Including FHSA labeling as applicable
- Mandatory performance standards
 - Including CPSIA chemical limits as applicable
- Voluntary standards
- Voluntary Recalls
- Enforcement
- Information and education

Voluntary Standards Guidance for Consumers and Small Manufacturers

- Voluntary standards can provide robust methods for health and safety testing
- UL 2904 has revised a test method for emissions from 3D printers
- Developed a guidance document for consumers and small manufacturers
 - Considers safety across the lifecycle from storage to disposal
 - Written for those with limited health and safety expertise

Lifecycle Evaluation of 3D Printers

September 2022



Table 2: 3D Material Samples

Printer	Source Material	Material Type	Number of Variants
Printer A	Filament	PLA	11
		Tough PLA	4
		ABS	10
		PP	1
		Nylon	2
		CPE	9
		TPU95A	4
		PC	3
			Total: 44
Printer B	Filament	PLA	11
		Tough	4
			Total: 15
Printer C	Resin	Standard	4
		Tough/Durable	3
		Flexible/Elastic	2
		Rigid	3
		Specialty	2
			Total: 14
Printer D	Resin	Plant-based	3
		Basic	2
			Total: 5
Printer E	Resin	Standard	10
		Water Washable	2
		ABS-Like	2
			Total: 14

Lifecycle Evaluation of 3D Printers

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Table 3: Elemental content of Brand 3 liquid resins by ICP-OES analysis (mg/Kg)

Element	C1 (R-Grey)	C2 (R-White)	C3 (T-Grey)	C4 (T-Dark Grey)	C5 (F-Clear)	C8 (Sp-Clear)
Arsenic	<i>nd</i>	<i>nd</i>	<i>nd</i>	<i>nd</i>	<i>nd</i>	<i>nd</i>
Cadmium	<i>nd</i>	<i>nd</i>	<i>nd</i>	10.0	<i>nd</i>	159.8
Lead	<i>nd</i>	<i>nd</i>	<i>nd</i>	<i>nd</i>	<i>nd</i>	4.4
Phosphorous*	1146	700.5	332.9	236.4	835.3	1124
Tin	13.0	13.4	19.0	12.3	10.2	5.4
Titanium	87.9	17.1	77.5	46.0	25.2	<i>nd</i>
Zinc	<i>nd</i>	<i>nd</i>	<i>nd</i>	<i>nd</i>	34.1	<i>nd</i>

*above highest calibration point (>750 ppm)

R-Rigid resin, T- Tough resin, F-Flexible resin, Sp-Specialty (Hi-Temp) resin, *nd*-not detected

None contained the following elements: aluminum, antimony, barium, calcium, cobalt, copper, chromium, iron, magnesium, manganese, mercury, molybdenum, nickel, selenium, vanadium

Table 22: Burn Rates for 3D Printed Toys Tested According to 16 CFR 1500.44

ID#	Material Description (Feedstock type/color)	Rattle Burn Rate (inches/second)	Bubble Wand Burn Rate (inches/second)
A1	Filament PLA White	Did Not Ignite	0.03
A2	Filament PLA Pearl White	Did Not Ignite	0.03
A3	Filament PLA Yellow	Did Not Ignite	0.03
A4	Filament PLA Black	Did Not Ignite	0.03

Thank you for your participation

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