

Proposed Ethical Product Standards

The quality and suitability standards for ethical filament are based on the following five umbrella standards, most of which have sub standards:

- 1) **Dimensional uniformity,**
- 2) **Printability,**
- 3) **Mechanical testing of printed components,**
- 4) **Color-fastness,**
- 5) **Degree of contamination.**

We welcome any comments, feedback or suggestions you might have on these standards and you can get in touch with us by the comments section of the Ethical Filament Foundation website – www.ethicalfilament.org or by email – katherine.hughes@techfortrade.org

1.) Dimensional uniformity

- **Diameter Uniformity** – 1.75mm (1.6 mm-1.85mm), 3.00mm (2.75mm-3.25mm)
- **Cross sectional Uniformity (determine roundness)** - 1.75mm (1.6 mm-1.85mm), 3.00mm (2.75mm-3.25mm)

2.) Printability

- **Bed Adhesion** – No peeling during printed object testing, peeling can be prevented with raft or brim, object can finish printing with raft or brim (with minor deformations), object cannot finish, or only with major deformations.
- **Interlayer Adhesion** – No delamination during printed object testing, delamination can be prevented with extra support, object can finish printing with only minor delamination on exterior surfaces, clear delamination throughout print.
- **Shrinkage** - +/- 1%
- **Bridging** – Successfully bridge a span of 25mm with less than 2mm of sag.
- **Dimensionality (advanced)** – Within 1% of STL.
- **Transition temperatures** – To be developed from <http://www.astm.org/Standards/D3418.htm>, Standard Test Method for Transition Temperatures and Enthalpies of Fusion and Crystallization of Polymers by Differential Scanning Calorimetry.
- **Glass transition temperature** – To be developed from <http://www.astm.org/Standards/E1356.htm>, Standard Test Method for Assignment of the Glass Transition Temperatures by Differential Scanning Calorimetry.

3.) Mechanical testing of printed components

- **Tensile Testing** – Print 10 tensile test specimens quasi-conforming to the ASTM D638 and following guidelines of Tymrak et al. 2014. Print: 0.2mm layer height, 100% infill, +45°/-45° orientations ABS: at least 27MPa, PLA: at least 48MPa.
- **Compressive properties** – To be developed from <http://www.astm.org/Standards/D695.htm> - Standard Test Method for Compressive Properties of Rigid Plastics.
- **Shear Strength** – To be developed from <http://www.astm.org/Standards/D732.htm> - Standard Test Method for Shear Strength of Plastics by Punch Tool Temperatures by Differential Scanning Calorimetry.

4.) Colour fastness

- **Water soak test** - Test water after x period of time. The ASTM standard has been withdrawn <http://www.astm.org/DATABASE.CART/WITHDRAWN/D620.htm> Other materials may also be useful depending on the application including: bases acids, oil, soap, alcohol.

5.) Degree of contamination

- **Inclusions** - No inclusions with greater than $\frac{1}{2}$ the diameter of the nozzle.
- **Density** – To be developed from <http://www.astm.org/Standards/D792.htm> Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
- **Void density** - <http://www.astm.org/Standards/D2734.htm> Standard Test Methods for Void Content of Reinforced Plastics.
- **Chemical Composition/ chemical contaminates** – Chemical analysis by PPM.