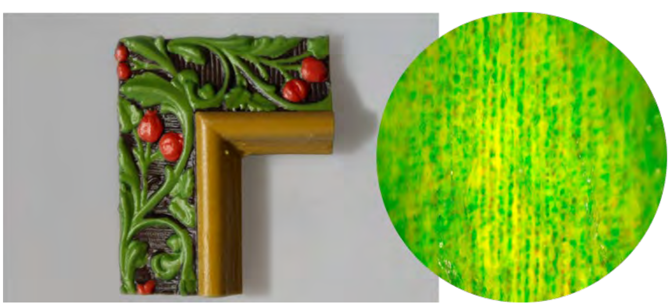
A Guide to: The IPI 3D Print Research and Education Collection

Material Extrusion

Powder Bed Fusion

Material Jetting



Introduction

This 3D Print Collection was created by the Image Permanence Institute (IPI) at Rochester Institute of Technology (RIT) as part of an Institute of Museum and Library Services (IMLS) grant-funded research project completed 2021-2025 and titled *Foundational Research to Inform Preservation Guidelines for the Creation, Collection, and Consumption of 3D Printed Objects in Museums* (MG-249368-OMS-21).

This collection contains 3D printed samples created using a variety of different materials and printing technologies and is intended as a material reference to inform preservation practices and as a study collection for research and education. Many of these samples are composed of common 3D printed plastic materials found in museums, as identified in a field-wide survey conducted as part of this project (see report at: https://www.rit.edu/ipi/3d-printed-materials), while others represent less common materials, such as metal or ceramic, and are provided as additional examples of materials that can be 3D printed.

The digital files used to print this collection were created by Xinxin Li during her tenure as a graduate student in RIT’s Industrial Design MFA program. The process of creating these files is outlined in the next section of this guide to provide insight into the skillsets required and time intensive aspect of 3D scanning and digital design. The files themselves are made available by request and can be used to print additional samples for the collection, if so desired. Except where otherwise indicated, these files are licensed under CC-BY-NC.

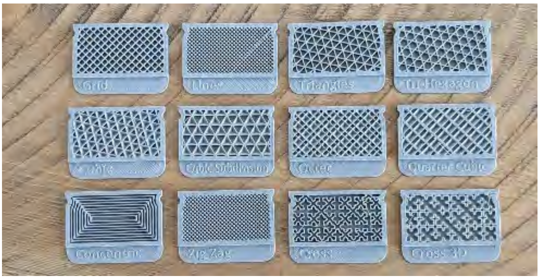
The box housing the collection contains two layers of cavity storage spaces, identified as the 1) top and 2) bottom layers:

TOP LAYER: The top layer contains a material sample set that represents 18 different technology/material combinations. The materials encompass five different 3D print process categories, including material extrusion (MEX), vat photopolymerization (VPP), powder bed fusion (PBF), binder jetting (BJT), and material jetting (MJT). Samples were printed at a variety of locations including at IPI, in makerspaces and 3D printing labs at RIT, and using a third-party 3D printing vendor, Shapeways (https://www.shapeways.com/). Each sample features an ASTM naming convention printed on the top side of the sample that includes abbreviations for the 3D print process category, print technology, and material used to create the sample. Manufacturing information provided for each sample includes the type of printing process, make and model of equipment (where available), material used, settings used (where available), and troubleshooting. The total estimated cost of each sample is also provided for comparison.

BOTTOM LAYER: The bottom layer contains 8 samples. Five samples were created using 3D scans generated by the IPI project team from the corner of a picture frame (see Frame Corners section of this guide). These were printed using MEX, VPP, PBF, BJT, and MJT to demonstrate differences between printing processes. Two additional samples are examples of linked "chainmail", and demonstrate the types of intricate, continuous and interlocking designs that can be 3D printed without support. The final sample is a cube of 3D printed porcelain. 3D printing is often associated with plastic materials, and this sample demonstrates that other classes of materials can also be printed. Each of these samples is intended for educational use, including 3D print process and/or material identification. The information provided for each sample includes type of printing process and the estimated cost of creating each sample.

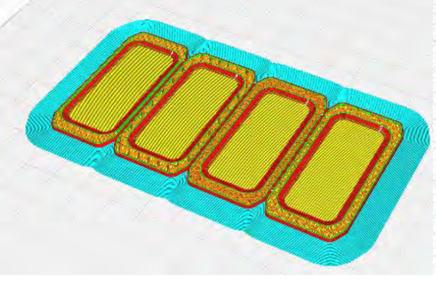
3D Material Samples

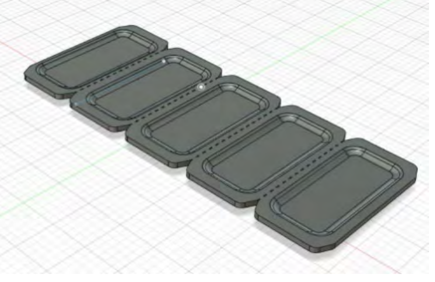
The 18 material samples on the top layer were iteratively designed to consist of two sections. The first section consists of a larger-sized, smooth surface designed to highlight surface features and color, which also incorporates an integrated label designating the 3D print process category, the specific technology, and the material (CAT-TECH/MAT). The second section extends beyond this smooth surface to four ‘fins’ that are designed to be detached for material analysis or testing. These ‘fins’ can be broken off or cut off in all samples except for the metal prints.



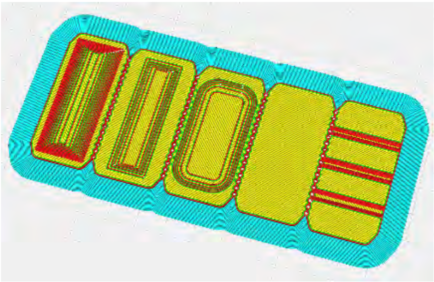
The initial idea for these samples stemmed from sample sets designed to demonstrate different types of infill on FDM printed objects, similar to those from https://www.printables.com/model/234745-cura-infill-sample-swatches (pictured above).

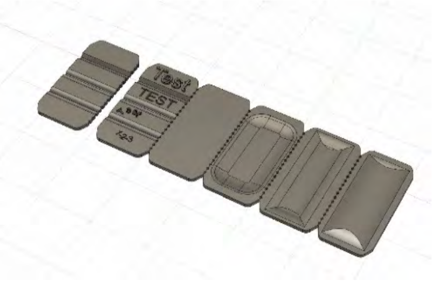
The first design iteration included larger sections that were perforated to enable easy detachment.



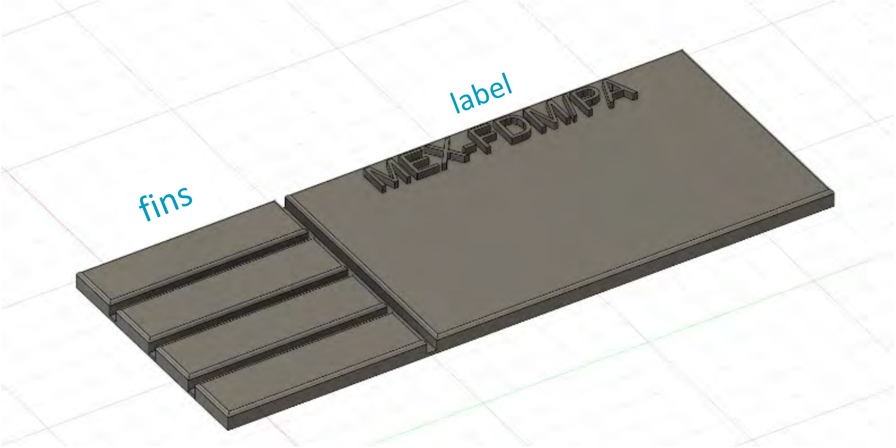


The second design iteration modified the larger sections to demonstrate different printing features, while smaller test ‘fins’ were included for material testing and designed to detach.





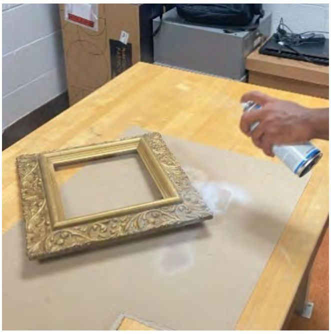
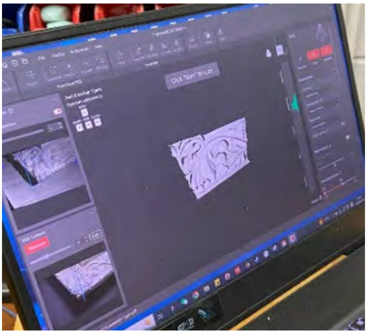
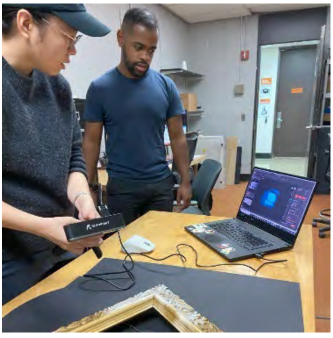
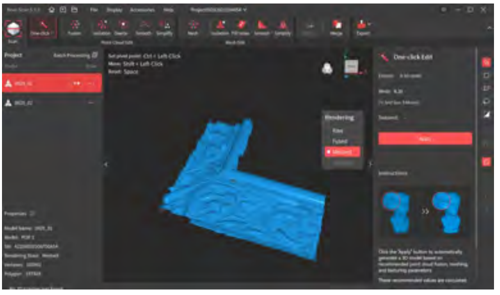
The final design (pictured below) maintained these detachable ‘fins’, but the larger section was simplified and included a label printed onto the sample surface.



The final measurements of this design are L x W x H 91.5 mm x 36.5 mm x 2.5 mm. With additional text, the total height is 3.5 mm. The gap between the ‘fins’ is 1.5 mm, and the gap height is 0.5 mm. The overall height and the gap height were modified as needed during printing for specific technology types.

Frame Corners

The frame corner samples originated from a 3D scan of a privately-owned gilded picture frame (above), scanned using a Revopoint Pop 2 3D scanner with Revo Scan 5.3.0 software. The frame itself had a reflective gold surface, so a matte spray called AESUB vanishing scanning spray was used to aid in scanning. The spray is intended to sublimate within hours following application, theoretically leaving no residue behind. However, a residue was left on the gilded surface that was subsequently removed using DI water.

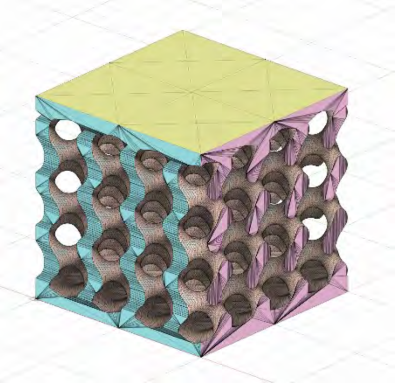





After scanning the frame, RevoScan5 software was used to edit the mesh files and simplify the data for printing. This involved reducing the file size (Max. 50 MB) in order to output the file into a 3D printable format (i.e. .ply/.obj/.stl/.step). The initial scan was discontinuous, capturing only the top surfaces and leaving holes where data was missing. For those areas that were not captured during the scanning process, Rhino software was used to patch using the pitch tool to fix these areas, as well as to add the bottom surfaces, ensuring the model was complete and without holes (i.e. watertight) and suitable for 3D printing. Any extraneous data points that were accidentally scanned were also manually removed. Finally, Autodesk Netfabb software was used to prepare, optimize, and simulate the 3D prints, making final edits and adding color to the model.

The actual color of the frame was not captured during the scanning process due to the high gloss surface of the frame and the need to apply a scanning spray. In order to demonstrate full color printing technologies, colors were simulated/added digitally. The final color choices were Red- R207-G33-B15, Green- R56-G96-B3, Gold- R144-G112-B15, and Black- R28-G28-B28.

Lattice Cubes

The lattice cubes were created in AutoDesk Fusion360 software using the volumetric lattice function, and were intended to be symmetrical. The final print delaminated from the print bed at the final few layers, and due to time constraints, was unable to be reprinted. The final sample in the collection was sanded on one side to remove the partial end cap.



List of Software Used:

Scanning

- RevoScan5 (3D scanning tool): https://www.revopoint3d.com/pages/revoscan5

3D Modeling and Rendering

- Autodesk Netfabb (free for educational use): https://www.autodesk.com/education/edu-software/overview
- Autodesk Fusion 360 (free for educational use): https://www.autodesk.com/education/edu-software/overview
- Rhino (free 90-day trial): https://www.rhino3d.com/
- Solidworks: https://www.solidworks.com/
- Blender (free download): https://www.blender.org/download/

3D Slicing Software

- Ultimaker Cura (free download): https://ultimaker.com/software/ultimaker-cura/
- Bambu Studio (free download): https://bambulab.com/en-us/download
- Formlabs PreForm (free download): https://formlabs.com/software/
- Tethon Tethonware (comes with purchase of printer): https://tethon3d.com/

Printing the Research and Education Collection: Lessons Learned

To create this collection, samples were 3D printed at IPI, with makerspaces on RIT's campus, and also with a third-party 3D printing company. In each case, IPI researchers had differing levels of control and transparency during the process.

Comparison of Sample Control when Printing Locally, in Collaborative Spaces, or with Vendors

Printing locally at IPI allowed greater control over material specifications and supplies, in addition to greater flexibility and experimentation. A range of different design files and print settings could be trialed. There was also no additional cost outside of the purchase of spools of material. Printing was naturally more iterative, and the 3D sample designs were finalized through a process of adjusting file characteristics and printer settings. It is worth noting, the iterative process did generate more waste and plastic consumption.

Working with **RIT makerspaces** provided access to high-end equipment, such as the Bambu Lab X1 Carbon printer and the Mosaic Array. While there was less direct control over printing in this case, working in person with the maker spaces still enabled transparency and some amount of iteration during the printing process, although it was slightly more expensive than printing directly at IPI.

Working with a **third-party 3D printing company** was the most expensive option, and also provided the least amount of control. However, it did provide access to printing processes such as PBF, BJT, and MJT, which utilize expensive equipment. When submitting a file for printing, the user was asked to specify the material and the process, along with any specific post-processing requirements (in most cases, for the collection, no post-processing was used). The third-party website provided technical data sheets about the materials available, including the manufacturer, but in many cases the specific make and manufacturer of the printer was not provided. Without an individual point of contact, documenting this information is not always possible.

The high costs of printing with a third-party company necessitated a single round of tests to ensure that each 3D process category requiring offsite printing was compatible with the specific digital design file. Feedback was provided by the vendor via email on whether the digital file met the minimum design requirements for each printer and material (e.g. minimum thickness, length, and width, etc.). When the vendor was not confident the sample design would print as submitted, this was communicated alongside the option to “print it anyway.” This option was selected for one design following a previously successful test.

As outlined above, the third-party 3D printing company used for creating some of the samples in the research and education collection was Shapeways. Shapeways is one of the larger 3D printing companies providing prints on demand. There are many smaller, regional companies offering printing services, often known as printing bureaus. The smaller printing bureaus can provide more control or knowledge transfer during the design and/or printing process. It is also worth noting that not all 3D printing services are the same. For example, companies like Shapeways may have printers on-site and engineers that print the parts in situ, while other companies such as Xometry offer similar services, but contract out the printing to other companies.

Printer Variations: A Note on FDM Printers Used for this Project

FDM prints were made with four different types of printers, all of which vary in overall cost. On the low end, IPI printed with a consumer-use desktop FDM printer (Fokoos brand, purchase price $160). This exact printer is no longer produced, but it is similar to other well-known desktop printers like the Ender 3 by Creality. Using RIT campus makerspaces, IPI also accessed a Bambu Lab X1 Carbon 3D Printer (purchase price $1,500), Ultimaker S5 printer (purchase price $7,000), and a Mosaic Array (purchase price $60,000). In reality, most FDM materials can be printed on a standard desktop 3D printer, and the difference between these printers comes down to printing speed and material options. The Fokoos desktop printer was the slowest, printing a single sample in 1.5-5 hours depending on the material and speed, and could only allow for one material at a time. The Ultimaker S5 printer has a slightly faster speed and is dual nozzle, meaning it can print with two materials at the same time. The Bambu Lab X1 Carbon printer has a higher throughput, printing six samples in about 1.5 hours, depending on the material. It can also accommodate up to sixteen different materials. Finally, the Mosaic Array is designed for automated high throughput FDM printing, can accommodate up to 32 different materials, and has four individual printing bays.

Overall cost of materials used to 3D print each collection (excluding time, equipment, etc.), were as follows:

Top Layer: $341.93
Bottom Layer: $345.91
Total: $687.84

Sample Descriptions

Top Layer

1. *MEX-FDM/PLA*
   Printed at RIT Makerspace
   Date Printed: Jan 2024
   Printer Make and Model: Ultimaker S5 Printer
   Material: Matterhackers Build Series PLA in white (unknown purchase date)
   Settings: 30% infill, nozzle temperature 190-200°C, bed temperature 60°C, fan speed 100%
   Cost: A 1kg spool of PLA cost $21. Excluding the cost of the printer, the material cost of the sample was $0.79.
   Sample Mass: 8.3g

2. *MEX-FDM/PETG*
   Printed at RIT's AMPrint Center, a research center dedicated to additive manufacturing
   Date Printed: Dec 2023
   Printer Make and Model: Bambu Lab X1 Carbon 3D Printer
   Material: Matterhackers Pro Series PETG in white (purchased Nov 2023)
   Settings: 30% infill, nozzle temperature 230-237°C, bed temperature 73-79°C, fan speed 50-70%
   Cost: A 1kg spool of PETG cost $57. Excluding the cost of the printer, the material cost of the sample was $0.57.
   Sample Mass: 6.6g

3. *MEX-FDM/TPU*
   Printed at IPI
   Date Printed: Dec 2023
   Printer Make and Model: Fokoos FDM desktop printer
   Material: Matterhackers Pro Series TPU in white (purchased Nov 2023)
   Settings: 30% infill, nozzle temperature 215-220°C, bed temperature 60°C, fan speed 100%, printing speed reduced to 25-50%.
   Cost: A 1lb spool of TPU cost $50. Excluding the cost of the printer, the material cost of the sample was $1.00.
   Sample Mass: 5.6g

   Notes: TPU is a flexible material and is stringy when hot. Slowing print time achieved higher quality samples. Test prints were produced using the Ultimaker S5 printer and the Fokoos desktop printer. In this particular case, the less expensive Fokoos printer produced a higher quality print.

4. *MEX-FDM/PA*
   Printed at IPI
   Date Printed: Apr 2024
   Printer Make and Model: Fokoos FDM desktop printer
   Material: Matterhackers Pro Series Nylon in white (purchased Feb 2024)
   Settings: 35% infill, nozzle temperature 250°C, bed temperature 60-63°C, fan speed 50%, printing speed reduced to 60-80%. Used blue tape on the print bed to improve adhesion.
   Cost: A 0.75kg spool of Nylon cost $62. Excluding the cost of the printer, the material cost of the sample was $0.75.
   Sample Mass: 5.2g

   Notes: Nylon is a hygroscopic material, and must be sufficiently dry before attempting to print. Successful prints were achieved by increasing the part infill, reducing the layer height of the print, and slowing down the print speed.

5. *MEX-FDM/ABS*
   Printed at RIT Makerspace
   Date Printed: Aug 2024
   Printer Make and Model: Mosaic Array
   Material: Matterhackers Pro Series ABS in white (purchased Nov 2023)
   Settings: 30% infill
   Cost: A 1kg spool of ABS cost $52. Excluding the cost of the printer, the material cost of the sample was $0.42.
   Sample Mass: 6.7g

   Notes: Printing ABS requires special considerations, because the material off-gasses styrene when heated, which is a health and safety concern. The print bed should be enclosed and the printer placed in a well-ventilated location.

6. *MEX-FDM/CF-PLA*
   Printed at IPI
   Date Printed: Dec 2023
   Printer Make and Model: Fokoos FDM desktop printer
   Material: Protopasta carbon fiber (CF) reinforced PLA (purchased Nov 2023)
   Settings: 30% infill, nozzle temperature 195-200°C, bed temperature 60°C, fan speed 60-80%.
   Cost: A 0.5kg spool of CF reinforced PLA cost $30. Excluding the cost of the printer, the material cost of the sample was $0.75.
   Sample Mass: 7.1g

   Notes: The CF reinforced PLA is very brittle and is difficult to print. Heating the filament reduces brittleness as it is fed through the printer, however this necessitates close proximity between the drive feeding the filament and the heated print nozzle. In some printers (i.e. Bambu Lab X1 Carbon), the distance between these components is too great, causing the filament to break.

7. *VPP-SLA/Rigid10K*
   Printed at RIT Makerspace
   Date Printed: Feb 2024
   Printer Make and Model: Formlabs Form 3
   Material: Formlabs Rigid10K, a glass reinforced resin with ceramic-like properties and feel (purchased Jan 2024)
   Settings: Standard Formlabs guidelines (https://support.formlabs.com/s/article/Using-Rigid-10k-Resin?language=en_US)
   Cost: 1L of Rigid10K cost $299. We also purchased a separate resin tray for the printer, which cost $149. Excluding the cost of the printer, the material cost of the sample is estimated at $5.60.
   Sample Mass: 18.7g

   Notes: During printing, the sample displayed warping. Although the glass reinforcement provided strength and rigidity, the thickness to width ratio meant that the sample remained brittle. Therefore, the digital file was modified to increase the overall thickness from 2.5mm to 3mm (4mm with label), and the thin connecters between the “fins” increased from 0.5mm to 0.7mm.

8. *VPP-SLA/Resin White*
   Printed at RIT Makerspace
   Date Printed: Jan 2024
   Printer Make and Model: Formlabs Form 3
   Material: Formlabs Resin in white (unknown purchase date)
   Settings: Standard Formlabs guidelines (https://formlabs.com/store/materials/white-resin/)
   Cost: $1.65 per sample
   Sample Mass: 9.1g

9. *VPP-SLA/Resin Grey*
   Printed at RIT Makerspace
   Date Printed: Feb 2024
   Printer Make and Model: Formlabs Form 3
   Material: Formlabs Resin in grey (unknown purchase date)
   Settings: Standard Formlabs guidelines (https://formlabs.com/store/materials/grey-resin/)
   Cost: $1.63 per sample
   Sample Mass: 9.1g

   Notes: The thickness to width ratio meant that the sample displayed warping and curvature when printed in this material. Sample support structures were trialed, but greater success was achieved when printing directly onto the printer bed without a support.

10. PBF-SLS/PA12

Printed using Shapeways

Date Printed: Dec 2023

Printer Make and Model: EOS, model of SLS machine unavailable.

Material: PA 2200 from EOS, a powder form on the basis of PA12. Printed in white with a natural finish.

Cost: $9.35 per sample

Sample Mass: 8.2g

11. PBF-SLS/TPU

Printed using Shapeways
Date Printed: Dec 2023
Printer Make and Model: EOS, model of SLS machine unavailable.
Material: EOS TPU 1301, a TPU powder. Printed in white with a natural finish.
Cost: $20.74 per sample
Sample Mass: 7.6g

Notes: The thickness of the gap height was increased from 0.5 mm to 1.0 mm on recommendation from the 3D printing company.

12. PBF-MJF/PA12

Printed using Shapeways

Date Printed: Dec 2023

Printer Make and Model: HP, model of MJF machine unavailable.

Material: HP 3D High Reusability PA12. Printed in grey with a natural finish.

Cost: $10.06 per sample

Sample Mass: 7.6g

13. PBF-MJF/GF PA12

Printed using Shapeways
Date Printed: Dec 2023
Printer Make and Model: HP, model of MJF machine unavailable.
Material: HP 3D High Reusability PA12 Glass Beads. Printed in grey with a natural finish.
Cost: $11.66 per sample
Sample Mass: 10.3g

Notes: The thickness of the gap height was increased from 0.5 mm to 0.75 mm on recommendation from the 3D printing company.

14. PBF-MJF/PP

Printed using Shapeways

Date Printed: Dec 2023

Printer Make and Model: HP, model of MJF machine unavailable.

Material: HP 3D High Reusability PP. Printed in grey with a natural finish.

Cost: $12.22 per sample

Sample Mass: 6.9g

15. *PBF-SLM/AlSi10Mg*
    Printed using Shapeways
    Date Printed: Dec 2023
    Printer Make and Model: Make and model of SLM machine unavailable.
    Material: Renishaw AlSi10Mg-0403 powder, printed with natural finish.
    Cost: $115.57 per sample
    Sample Mass: 20.5g

    Notes: The thickness of the gap height was increased from 0.5 mm to 0.8 mm on recommendation from the 3D printing company.

16. BJT/Steel 420+Bronze

Printed using Shapeways

Date Printed: Dec 2023

Printer Make and Model: ExOne binder jetting technology, model of machine unavailable.

Material: ExOne 420 stainless steel infiltrated with bronze (steel alloy 420, bronze 90% Cu/10% Sn), printed in bronze matte finish.

Cost: $70.80 per sample

Sample Mass: 60g

Notes: The final samples were received with fingerprints originating from handling at the 3D printing company.

17. MJT/Visijet

Printed using Shapeways

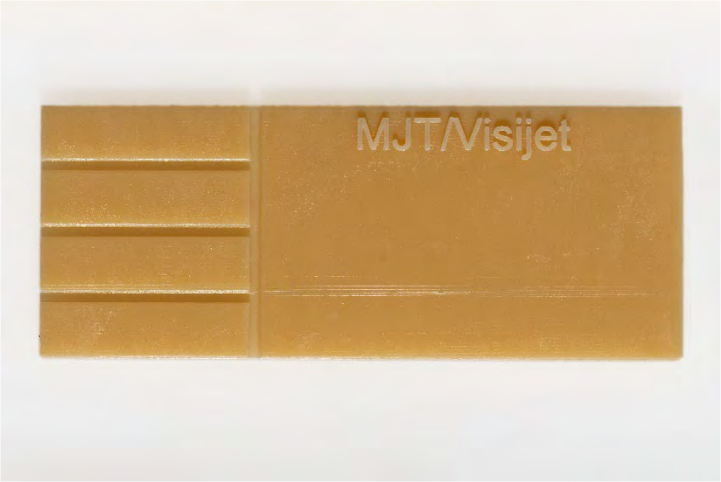
Date Printed: Dec 2023

Printer Make and Model: 3D Systems Projet MJP 2500 Series

Material: 3D Systems Visijet M2R-TN material

Cost: $16.26 per sample

Sample Mass: 9.4g



18. BJT/Steel 17-4PH

Printed using Shapeways

Date Printed: Dec 2023

Printer Make and Model: Desktop Metal Shop System

Material: Desktop Metal 17-4PH Stainless Steel. Media blasted after sintering.

Cost: $62.11 per sample

Sample Mass: 61g

Notes: The thickness of the connector was increased from 0.5 mm to 1.0 mm on recommendation from the 3D printing company.

Bottom Layer

Frame Corners

1. Material Extrusion Frame Corner
   Printed at RIT Makerspace
   Date Printed: Jan 2024
   Printer Make and Model: Ultimaker S5 Printer
   Material: Matterhackers Build Series PLA in white
   Cost: $2.41 per sample
   Sample Mass: 27g

2. Vat Photopolymerization Frame Corner
   Printed at RIT Makerspace
   Date Printed: Jan 2024
   Printer Make and Model: Formlabs Form 3
   Material: Formlabs Resin in white
   Cost: $11.09 per sample
   Sample Mass: 62g

3. Powder Bed Fusion Frame Corner
   Printed using Shapeways
   Date Printed: Dec 2023
   Printer Make and Model: EOS, model of SLS machine unavailable.
   Material: PA 2200 from EOS, a powder form on the basis of PA12. Printed in white with a “natural finish” (e.g. no post-processing).
   Cost: $41.83 per sample
   Sample Mass: 52g

4. Binder Jetting Frame Corner
   Printed using Shapeways
   Date Printed: Dec 2023
   Printer Make and Model: 3D Systems Projet CJP x60 printer
   Material: Visijet PXL with ColorBond (sandstone material)
   Cost: $68.22 per sample
   Sample Mass: 80g

5. Material Jetting Frame Corner
   Printed using Shapeways
   Date Printed: Dec 2023
   Printer Make and Model: Mimaki, unknown model of material jetting system
   Material: Proprietary resin with standard finish
   Cost: $207.83 per sample
   Sample Mass: 62g

Lattice Cube

Vat Photopolymerization/Digital Light Processing
Printed at RIT's AMPrint Center, a research center dedicated to additive manufacturing.
Date Printed: Feb 2024
Printer Make and Model: Tethon Bison 1000
Material: Bison Porcelite
Cost: Bison Porcelite costs $395 per liter. Other necessary consumables cost $295. Use of the printer, curing box, and furnace were free through the AMPrint Center. Material cost per sample was estimated to be ~$5.
Sample Mass: 9.8g

Notes: The lattice cubes were printed, cured, and fired using Tethon's recommended parameters. The printing process from start to finish was heavily time intensive. The 3D printing took 15 hours, followed by a 7-hour cure and a 25-hour sintering cycle. The process required numerous iterations to test designs and complete a successful print. From start to finish, this process took a total of four months to complete.

The first test samples discolored to bone white following sintering when compared to the final prints. Tethon customer service was not able to explain these differences. The samples included in the collection have a gray tone. Additionally, the tops of the cubes were designed to have a flat surface (see sample design in Lattice Cubes section), however, this feature caused the prints to delaminate from the printer bed. Due to time constraints, instead of reprinting, the partially printed surface was post-processed by sanding to create a smoother surface. In the final sample, printing lines and some delamination of individual layers can be seen, which occurred during the final sintering step.

Materials for Chainmail

Two types of ‘chainmail’ are included as examples of the types of samples that can be 3D printed without support. The file for this sample was downloaded from Ultimaker’s Thingiverse and licensed under CC BY-SA: https://www.thingiverse.com/thing:3096598.

1. MEX-FDM/PLA+
   Printed at IPI
   Date Printed: Feb 2024
   Printer Make and Model: Fokoos FDM desktop printer
   Material: Fokoos PLA+ in white
   Cost: A 1kg spool of PLA cost $21. Excluding the cost of the printer, the material cost of the sample was $0.17.
   Sample Mass: 5.8g

2. PBF-SLS/PA12
   Printed using Shapeways
   Date Printed: Feb 2024
   Printer Make and Model: EOS, model of SLS machine unavailable.
   Material: PA 2200 from EOS, a powder form on the basis of PA12. Printed in white with a “natural finish” (i.e. no post-processing).
   Cost: $9.36 per sample
   Sample Mass: 5.3g

Acknowledgements

Thank you to the Institute of Museum and Library Services for funding this project through IMLS Grant Award Number MG-249368-OMS-21.

IPI would like to thank the individuals and departments on RIT's campus that graciously lent their time, facilities, and instruments to help build this collection: Dr. Denis Cormier and Kambar Mangibayev at the AMPrint Center, Michael Buffalin at the SHED Makerspace, and Tiree Walker at the CAD FabLab, the latter of whom also assisted with 3D scanning the picture frame. We would also like to thank Elizabeth Lamark for her photography of each of the collection samples and Jacek Olender for taking the microscopy images used on the front cover. Thank you also to Lauren M. Parish for her feedback on the collection samples as they were being designed.

This document was prepared by IPI staff members. The following individuals made important contributions to the research collection and this guide:

- Meredith Sharps Noyes, Research Scientist (conceptualization, printing, writing, and editing)
- Xinxin Li, RIT Industrial Design MFA (conceptualization, 3D design, scanning, and printing)
- Jennifer Jae Gutierrez, Executive Director (conceptualization, editing, visualization)
- Emma J. Richardson, Director of Research (conceptualization, editing)

Image Permanence Institute
Rochester Institute of Technology
70 Lomb Memorial Drive
Rochester, NY 14623-5604
(585) 475-5199
ipiwww@rit.edu