Antero 840CN03

FDM Thermoplastic Filament

Electrostatic dissipative PEKK-based thermoplastic.

The information presented are typical values intended for reference and comparison purposes only.
They should not be used for design specifications or quality control purposes.

Overview

Antero™ 840CN03 is a PEKK-based FDM thermoplastic combining the excellent physical and mechanical qualities of PEKK with electrostatic dissipative (ESD) properties. The material is filled 3% by weight with carbon nanotubes.

As a high-performance polymer, Antero 840CN03 exhibits exceptional chemical and wear resistance, ultra-low outgassing properties and consistent ESD performance. ESD values range from 10^4 – 10^9 ohms per square inch. This makes the material particularly suitable for space and industrial applications where these qualities are critical.

Contents:

Ordering Information

3D Printer Compatibility

F900™

T20D tip

T16 tip (support only)

Support Material

SUP8000B™ breakaway support system (BASS)

Build Sheets

High temperature

.02 x 16 x 18.5 in. (0.76 x 406 x 470 mm)

.02 x 26 x 38 in. (0.76 x 660 x 965 mm)

Table 1. Antero 840CN03 Thermoplastic Filament Ordering Information

Part Number	Description
Filament Canisters	
355-02510	Antero 840CN03, 92.3 cu in – Plus
310-21800	SUP8000B, 92.3 cu in – Plus
Printer Consumables	
511-10730-S	T20D tip, 0.010 in. (0.254 mm) layer height
511-10401	T16 tip, 0.010 in. (0.254 mm) layer height
325-00275	High Temperature build sheet, 0.02 x 26 x 38 in (0.76 x 660 x 965 mm)
325-00475	High Temperature build sheet, 0.02 x 16 x 18.5 in (0.76 x 406 x 470 mm)

Physical Properties

Values are measured as printed. XY, XZ, and ZX orientations were tested.

For full details refer to the Stratasys Materials Test Procedure on www.stratasys.com.

DSC and TMA curves can be found in the Appendix.

Table 2. Antero 840CN03 Thermoplastic Filament Physical Properties

Property	Test Method	Typical Values
HDT @ 66 psi	ASTM D648 Method B	150 °C (302 °F)
HDT @ 264 psi	ASTM D648 Method B	153 °C (306 °F)
Tg	ASTM D7426 Inflection Point	158 °C (316 °F)
Mean CTE	ASTM E831 (40 °C to 140 °C)	50 µm/[m·°C] (122 µin/[in·°F])
Volume Resistance(1)	ASTM D257	10^4-10^9 Ω
Specific Gravity	ASTM D792 @ 23 °C	1.27

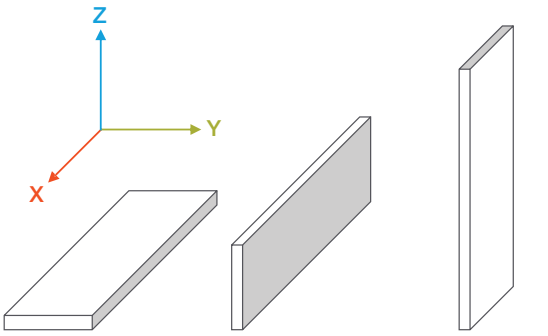
(1) See ESD section

Mechanical Properties

Samples were printed with 0.010 in. (0.254 mm) layer height.
For the full test procedure please see the Stratasys Materials Test Procedure on www.stratasys.com.

Print Orientation

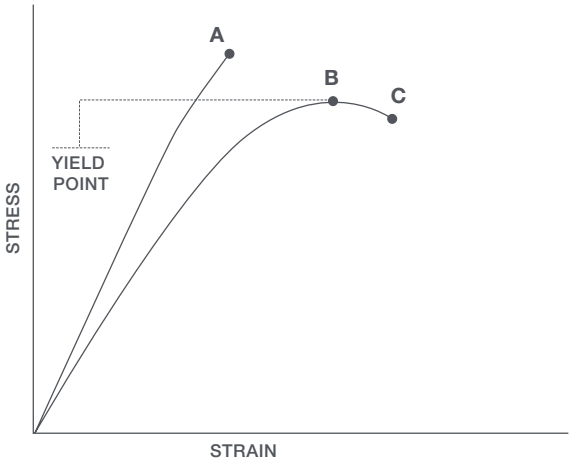
Parts created using FDM are anisotropic as a result of the printing process. Below is a reference of the different orientations used to characterize the material.



Flat (XY) On Edge (XZ) Upright (ZX)

Tensile Curves

Due to the anisotropic nature of FDM, tensile curves look different depending on orientation. Below is a guide of the two types of curves seen when printing tensile samples and what reported values mean.



A = Tensile at break, elongation at break (no yield point)
B = Tensile at yield, elongation at yield
C = Tensile at break, elongation at break

Mechanical Properties

Table 3. Antero 840CN03 Thermoplastic Filament Mechanical Properties

		XZ Orientation[1]	ZX Orientation[1]
Tensile Properties: ASTM D638			
Yield Strength	MPa	95 (5)	No yield
	psi	13,610 (550)	No yield
Elongation @ Yield	%	4.4 (4)	No yield
Strength @ Break	MPa	65 (15)	50 (5)
	psi	9,150 (2330)	7,320 (600)
Elongation @ Break	%	6 (3)	1.8 (0.2)
Modulus (Elastic)	GPa	3.17 (0.04)	3.01 (0.06)
	ksi	460 (7)	435 (10)
Flexural Properties: ASTM D790, Procedure A			
Strength @ Break	MPa	No break	70 (10)
	psi	No break	9,760 (1580)
Strength @ 5% Strain	MPa	135 (3)	-
	psi	19,620 (380)	-
Strain @ Break	%	No break	2.4 (0.6)
Modulus	GPa	3.24 (0.05)	2.7 (0.1)
	ksi	390 (15)	390 (15)
Compression Properties: ASTM D695			
Yield Strength	MPa	100 (2)	105 (3)
	psi	14,920 (290)	15,380 (500)
Modulus	GPa	2.61 (0.04)	2.63 (0.04)
	ksi	380 (6)	380 (6)
Impact Properties: ASTM D256, ASTM D4812			
Izod, Notched	J/m	48 (4)	28 (8)
	ft*lb/in	0.90 (0.07)	0.5 (0.1)
Izod, Unnotched	J/m	1,470 (690)	128 (40)
	ft*lb/in	28 (13)	2.4 (0.8)

(1) Values in parentheses are standard deviations

ESD Properties

Antero 840CN03 was tested per ANSI ESD S20.20, S11.11, STM11.12 to determine the effect that build parameters and part geometries had on ESD properties. Different geometries printed in different orientations all fall into the ESD safe range (10^4 to 10^9 ohms). For full details, see the Antero 840CN03 ESD White Paper.

Figure 1.4 x 4 x 0.1 in plaque resistance in various build orientations.

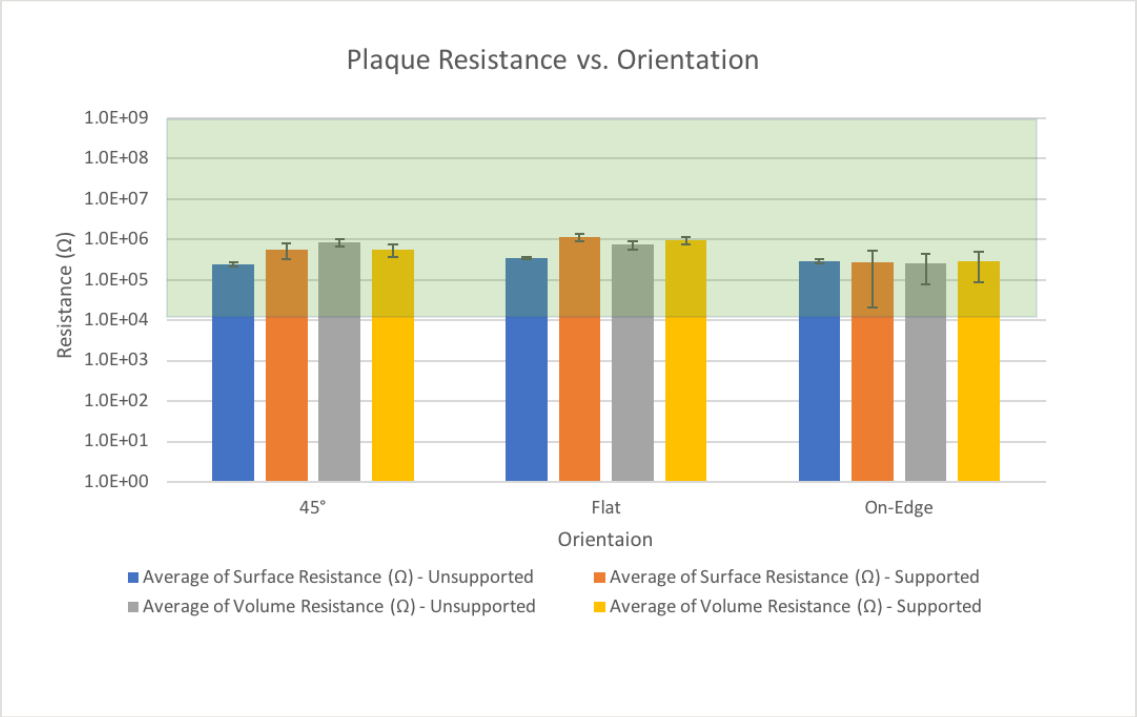
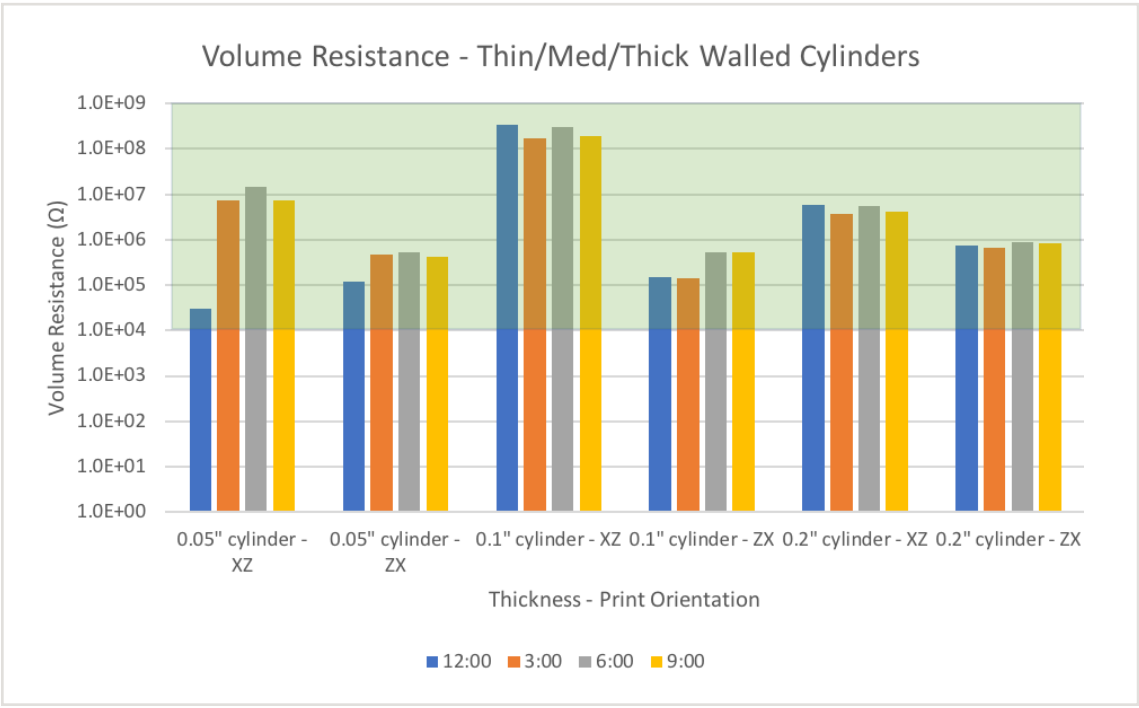


Figure 2. Volume resistance of hollow cylinders with respect to wall thickness, build orientation, and location on the cylinder.



Chemical Resistance

Antero 840CN03 was tested for resistance to chemical exposure per ASTM D543. Chemicals tested and percent change from control is listed below. For further details read the Antero 840CN03 Chemical Resistance White Paper.

Table 4. Antero 840CN03 Thermoplastic Filament Chemical Resistance

Change in Mechanical Properties, Antero 840CN03 - 168 Hour Chemical Exposure (ASTM D543)			
	Reagent	**XZ Orientation[1]**	**ZX Orientation[1]**
Tensile Strength	Dichloromethane	-88%	-74.8%
	Ethyl Acetate	-2.9%	-2.3%
	Jet A	-2.1%	7.3%
	MEK	-0.7%	-2.1%
	Skydrol	-2.1%	6.3%
	Toluene	-5.0%	1.4%
	30% Nitric Acid	-5.7%	5.7%
	30% Sulfuric Acid	-9.3%	-10.1%
	60% Sodium Hydroxide	-1.4%	1.9%
	Concentrated Ammonia	-1.4%	11.0%
% Elongation @ break	Dichloromethane	714.8%	1,598.4%
	Ethyl Acetate	4.2%	16.2%
	Jet A	-0.4%	7.0%
	MEK	-4.4%	11.9%
	Skydrol	32.3%	9.7%
	Toluene	17.2%	32.4%
	30% Nitric Acid	61.4%	52.4%
	30% Sulfuric Acid	47.2%	-5.4%
	60% Sodium Hydroxide	5.2%	-1.6%
	Concentrated Ammonia	11.1%	10.8%
Tensile Modulus	Dichloromethane	-90.7%	-85.3%
	Ethyl Acetate	1.8%	6.4%
	Jet A	1.4%	5.3%
	MEK	3.1%	4.3%
	Skydrol	0.6%	6.7%
	Toluene	-0.4%	6.2%
	30% Nitric Acid	-0.8%	-6.2%
	30% Sulfuric Acid	-7.6%	-5.0%
	60% Sodium Hydroxide	0.2%	3.3%
	Concentrated Ammonia	-0.4%	5.0%

Flame, Smoke, and Toxicity

Antero 840CN03 was printed with a T20D tip on the Stratasys F900 and tested per 14 CFR 25.853, BSS 7238 and 7238, and AITM 2.0007B and 3.0005. The testing done establishes that this material, samples 0.040 inches thick unless otherwise noted, **meets requirements** for:

- 60s and 12s Vertical Burn
- 15s Horizontal Burn
- Toxic Gas Emission
- Smoke Density
- Heat Release Rate of Cabin Materials

Table 5. Antero 840CN03 Flame, Smoke, and Toxicity Test Results

	Avg Time to Extinguish (seconds)	Avg Burned Length (inches)	Drip Time to Extinguish (seconds)
12 Second Vertical Ignition per 14 CFR 25.853(a), Appendix F, Part I, Paragraph (a)(1)(ii)			
Antero 840CN03, Vertical - ZX	3.2	0.3	0 (no drips)
Antero 840CN03, Horizontal - XZ	4.7	0.2	0 (no drips)
60 Second Vertical Ignition per 14 CFR 25.853(a), Appendix F, Part I, Paragraph (a)(1)(i)			
Antero 840CN03, Vertical - ZX	<1	0.5	0 (no drips)
Antero 840CN03, Horizontal - XZ	<1	0.5	0 (no drips)
	Avg Burn Rate (in/min)		
15 Second Horizontal Ignition per 14 CFR 25.853(a), Appendix F, Part I, Paragraph (a)(1)(iv)(v)			
Antero 840CN03, Vertical - ZX	0		
Antero 840CN03, Horizontal - XZ	0		
	Test Mode	**Average D_s (maximum) within 4 minutes, ($^4D_{max}$)**	
Smoke Density per BSS 7238, Rev. C			
Antero 840CN03, Vertical - ZX	Flaming	0	
Antero 840CN03, Horizontal - XZ	Flaming	0	
Smoke Density per AITM 2.0007B, Issue 3			
Antero 840CN03, Vertical - ZX	Flaming	0	
Antero 840CN03, Horizontal - XZ	Flaming	0	
Antero 840CN03, Vertical - ZX	Non-Flaming	0	
Antero 840CN03, Horizontal - XZ	Non-Flaming	0	

Table 5. Antero 840CN03 Flame, Smoke, and Toxicity Test Results

	Test Mode	CO ppm	SO_2 ppm	NO_x ppm	HCN ppm	HCl ppm	HF ppm
Toxic Gas Emission per BSS 7239, Rev. A							
Antero 840CN03, Vertical - ZX	Flaming	5	0 (NI)	0 (NI)	0 (NI)	0 (NI)	0 (NI)
Antero 840CN03, Horizontal - XZ	Flaming	<5	0 (NI)	0 (NI)	0 (NI)	0 (NI)	0 (NI)
Toxic Gas Emission per AITM 3.0005, Issue 2							
Antero 840CN03, Vertical - ZX	Flaming	4	0	0.1	0 (NI)	0 (NI)	0 (NI)
Antero 840CN03, Horizontal - XZ	Flaming	3	0	0.3	0 (NI)	0 (NI)	0 (NI)
Antero 840CN03, Vertical - ZX	Non-Flaming	0	0	0	0 (NI)	0 (NI)	0 (NI)
Antero 840CN03, Horizontal - XZ	Non-Flaming	1	0	0	0 (NI)	0 (NI)	0 (NI)

	Peak HRR (kW/m2)	Time to Peak Heat Release (seconds)	2 Minute Total HRR (kW-min/m2)
Heat Release Rate of Cabin Materials per 14 CFR 25.853(d), Appendix F, Part IV(1)			
Antero 840CN03, Horizontal - XZ	55.9	286.7	0
Antero 840CN03, Vertical - ZX	55.1	293	0.1

(1) Sample thickness: 0.150 in

Outgassing

Table 6. Antero 840CN03 Outgassing Test Results

Sample	TML (%)	CVCM (%)	WVR (%)
Vertical Build - ZX	0.41	<0.01	0.17
Horizontal Build - XZ	0.45	0.01	0.15

Testing Observations(1)			
Visible Condensate	Yes	Opaque	Yes
Percent Covered	10% (ZX), 25% (XZ)	Interference Fringes	No
Thin	Yes	Colored Fringes	No
Heavy	No	Sample Appearance After Test	No change
Transparent	No		

(1) For both orientations

Appendix

Figure 3. 2nd heating scan, DSC, for Antero 840CN03.

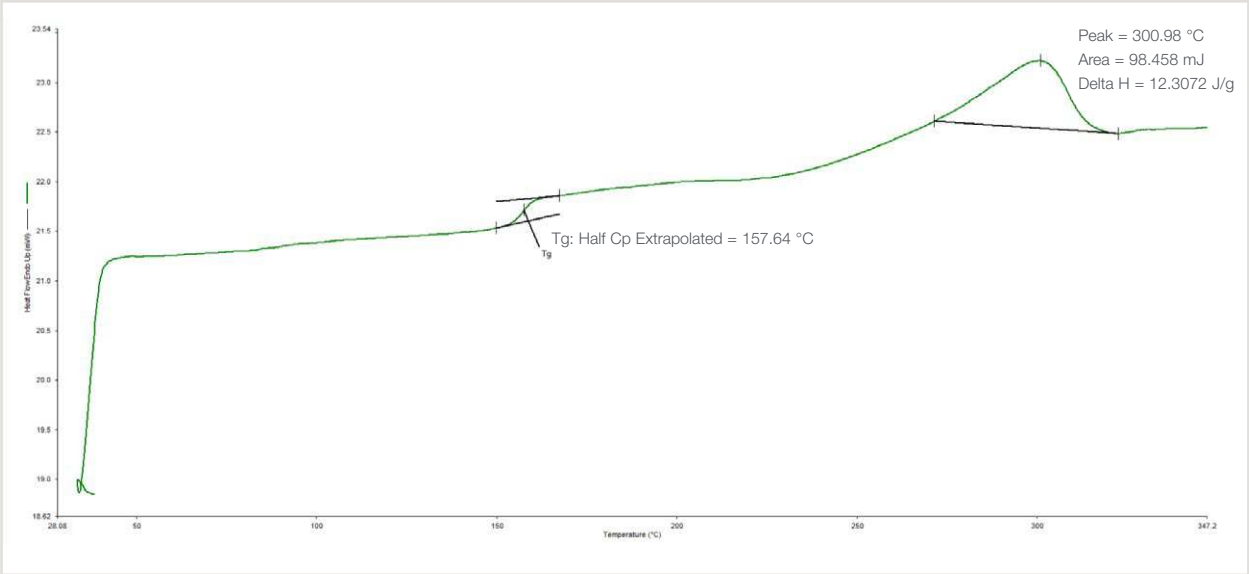


Figure 4. TMA CTE curve normal to the layers.

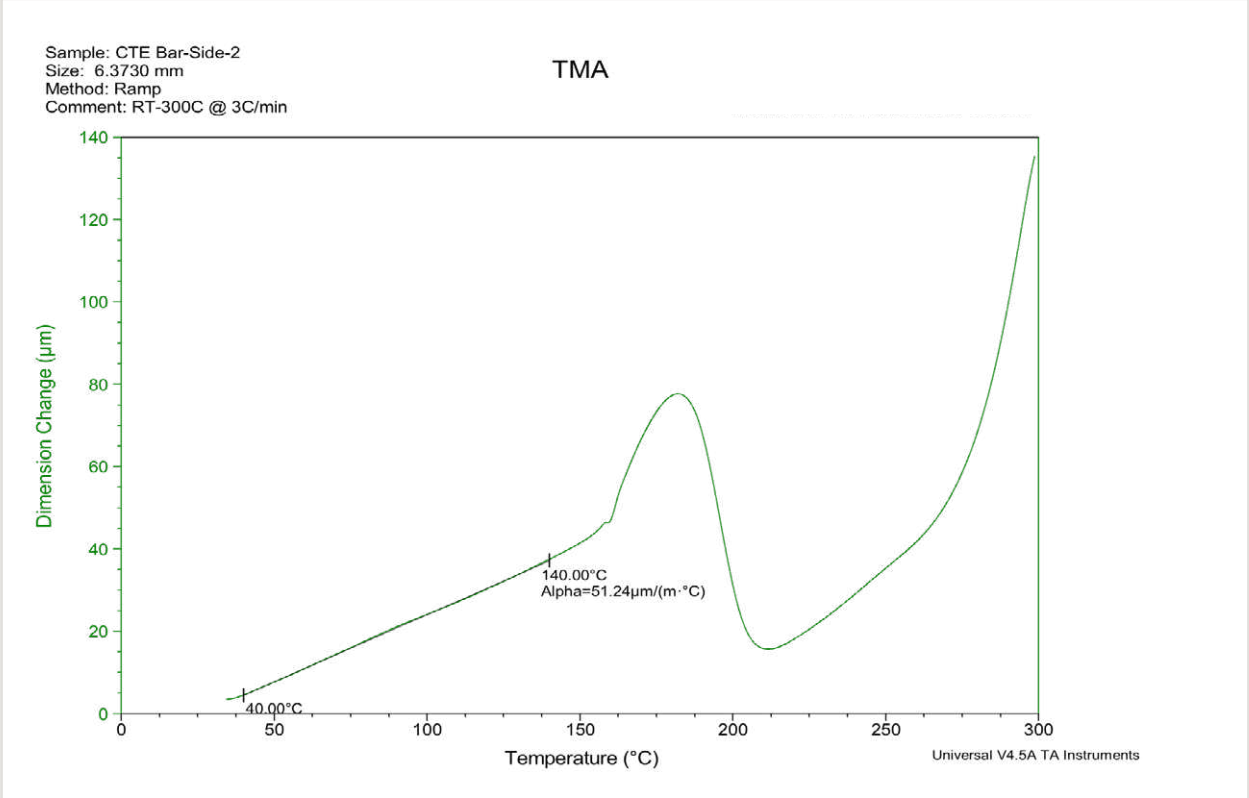
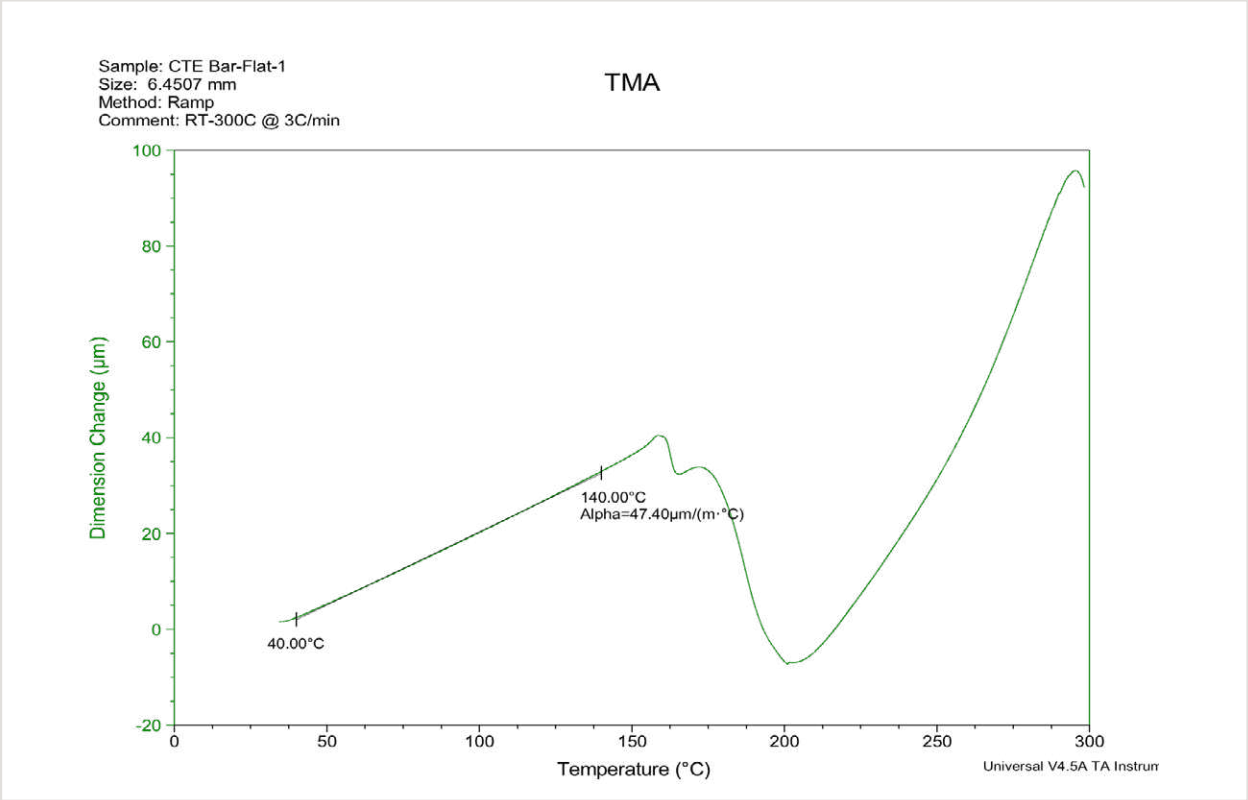


Figure 5. TMA CTE curve inplane with the layers.



Stratasys Headquarters

7665 Commerce Way,
Eden Prairie, MN 55344
+1 800 801 6491 (US Toll Free)
+1 952 937-3000 (Intl)
+1 952 937-0070 (Fax)

1 Holtzman St., Science Park,
PO Box 2496
Rehovot 76124, Israel
+972 74 745 4000
+972 74 745 5000 (Fax)

stratasys.com
ISO 9001:2015 Certified

Antero 840CN03
Material Guide

Antero™ 840CN03 is a high-performance PEKK-based FDM® thermoplastic with strong mechanical properties along with exceptional material properties, such as electro-static dissipation, temperature resistance, chemical resistance, exceptional wear properties, and ultra-low outgassing. This makes it ideal for low-volume, highly-customized production parts and functional prototypes that need to withstand more intemperate conditions. Antero 840CN03's primary advantages over other Stratasys high-performance materials – such as ULTEM™ 9085 resin, ULTEM™ 1010 resin and PPSF – are its ESD, high chemical resistance, and low outgassing properties.

System Overview and Compatibility

Antero 840CN03 is currently available on the Stratasys F900™ with a 0.010 inch (0.254 mm) slice height. It uses SUP8000B™ as a breakaway support system, similar to other Stratasys high-temperature material offerings. This support material is easier to remove than the other break away support systems. Antero 840CN03 requires the hardened head upgrade and utilizes a custom T20D tip for the model material, and the standard T16 tip for the support material. Antero 840CN03 and SUP8000B are available in standard 92.3 cubic inch Fortus Plus™ canisters only and the material will use the existing high-temperature material build sheets.

Position Paper

stratasys

Part Design

Designing parts for Antero 840CN03 follows much of the same process for designing other FDM parts and design for additive manufacturing guidelines (DFAM) should be followed (e.g., utilizing self-supporting angles where possible, observing minimum wall thicknesses, allowing proper clearance for assemblies, etc.). A general list of DFAM guidelines can be found in the FDM Design Guidelines document.

For Antero 840CN03 and other high-performance FDM materials, the breakaway support system is used to support the model material in areas of overhang to prevent sagging. Although Antero 840CN03 support is one of the easiest supports to be removed by hand, the designer should take this into account while designing the part. Self-supporting angles (angles greater than 45 degrees from the build platen) should be used whenever possible to reduce the need for support material. Areas that require support must be accessible for removal.

In order to design for ESD properties see the Antero ESD white paper.

Part Processing

This material is available in Insight™ and the Advanced FDM feature of GrabCAD Print™ software.

Support removal is the main consideration that should be taken into account during part processing. In areas where support cannot be eliminated by part design, the part must be oriented so the support is accessible for removal. Perforation layers can be added to the support structure to aid in removal of large areas of support.

Default processing parameters should be used unless the user is sufficiently advanced in Insight or GrabCAD Print and has determined that the changed values produce better results for a specific geometry.

Part Packing

Multiple Antero 840CN03 parts can be packed together in the same build. This often reduces build time (due to elimination of tip swaps between model and support for each part) and should be used to increase system utilization when operators are not present. For example, add another part to the pack so the build will finish in the morning rather than at night, or pack multiple parts together for a longer build over the weekend.

For higher quality seams and a reduced potential for purge material in the part, a sacrificial tower should be included in the pack, up to the full height of the parts. Refer to the ***Options > Sacrificial tower*** menu in Control Center™ software.

System Preparation

The system should be set up using the tips, build sheets, and hardened head mentioned in the system overview section of this document. A tip calibration must be performed when switching from a different material to Antero 840CN03, when replacing the tip at the end of its recommended life, or anytime the model or support tips are removed from the head. If the system was running lower temperature materials, be sure to vacuum out any scrap pieces or material in the purge tower to prevent the lower temperature material from melting or burning.

The tip life of the T20D Antero 840CN03 tip is four canisters of material. The user will receive a warning after three canisters of material and will be prevented from starting another build after four canisters of material without first changing the tip. It should be noted that many short toolpaths are harder on the tip than longer toolpaths. If building parts with many short toolpaths, it is recommended to change the tip when the tip warning is displayed (after three canisters of material) to prevent a potential decrease in print quality.

Support Removal

Parts are easily removed from the build sheet by first removing the build sheet from the machine and flexing the sheet. Once parts are removed from the build sheet, support material can be removed by breaking it off by hand using a chisel, scraper, pliers, or various other tools and picks.

SUP8000B is moisture sensitive and if the support is embedded in the model or is difficult to remove, the material is most likely wet. If it is left idle in the machine for more than 48 hours (even if the machine is printing model and not support material), especially in a humid climate or time of year, the canister should be unloaded and exposed filament discarded prior to reloading into the machine. This will help to prevent support oozing into the model material during printing.

Post-Processing

Antero 800NA can be sanded, painted, media blasted, bonded, machined, drilled, receive inserts and more, similarly to other FDM thermoplastics.

Stratasys Headquarters

7665 Commerce Way,
Eden Prairie, MN 55344
+1 952 937-3000 (Intl)
+1 952 937-0070 (Fax)

stratasys.com
ISO 9001:2015 Certified

1 Holtzman St., Science Park,
PO Box 2496
Rehovot 76124, Israel
+972 74 745 4000
+972 74 745 5000 (Fax)