Antero 840CN03

FDM Thermoplastic Filament

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.

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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:

Overview 2
Ordering Information 3
Physical Properties 4
Mechanical Properties 5
ESD Properties 8
Chemical Resistance 10
Flame, Smoke, and Toxicity 11
Outgassing 14
Appendix 15

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Ordering Information

Table 1. Printer and Support Material Compatibility

Printer	Model Tip (Slice)	Support Material	Support Tip
Fortus 450mc™	T20F (10 slice)	SUP8000B™ (breakaway)	T16
F900™	T20D (10 slice)	SUP8000B (breakaway)	T16

Build Sheets

High temperature

.02 x 16 x 18.5 in. (0.51 x 406 x 470 mm)

.02 x 26 x 38 in. (0.51 x 660 x 965)

Table 2. Antero 840CN03 Ordering Information

Part Number	Description
Filament Canisters	
355-02510	Antero 840CN03, 92.3 cu in. – Plus
355-03260	SUP8000B, 92.3 cu in. – Plus
Printer Consumables	
511-10730-S	T20D tip
511-10740-S	T20F tip
511-10401	T16 tip
325-00275-S	High Temperature build sheet, 0.02x26x38 in. (0.51x660x965 mm)
325-00475-S	High Temperature build sheet, 0.02x26x38 in. (0.51x660x965 mm)

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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 3. Antero 840CN03 Physical Properties

Property	Test Method	F900	Fortus 450mc
HDT @ 66 psi	ASTM D648 Method B		149.5 C (301.1 F)
HDT @ 264 psi	ASTM D648 Method B	150.8 C (303.4 F)	147.1 C (296.8 F)
Tg	ASTM D7426 Inflection Point	157.1 C (314.8 F)	154.9 C (310.8 F)
Melt Point	ASTM D7426 Peak Heat	300.3 C (572.5 F)	301.4 C (574.5 F)
Mean CTE	ASTM E831 (40 °C to 140 °C)	51.34 µm/[m*°C] (28.47 µm/[m*°F])	53.59 µm/[m*°C] (29.77 µm/[m*°F])
Volume Resistivity	ASTM D257	10^4-10^9 Ω*cm (1)	10^4-10^9 Ω*cm (1)
Specific Gravity	ASTM D257 @23 °C	1.27	1.27

(1) See ESD section.

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Mechanical Properties

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

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

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Mechanical Properties

Table 4. Antero 840CN03 Mechanical Properties - Fortus 450mc w/T20F tip

		XZ Orientation[1]	ZX Orientation[1]
Tensile Properties: ASTM D638			
Yield Strength	MPa	93.2 (4.1)	No break
	psi	13500 (600)	No break
Elongation @ Yield	%	4.5 (0.57)	No break
Strength @ Break	MPa	56.5 (29)	57.9 (3.5)
	psi	8190 (4300)	8400 (510)
Elongation @ Break	%	12 (7.8)	2.0 (0.17)
Modulus (Elastic)	GPa	2.97 (0.051)	2.94 (0.039)
	ksi	431 (7)	426 (5.6)
Flexural Properties: ASTM D790, Procedure A			
Strength @ Break	MPa	No break	87.3 (13)
	psi	No break	12700 (1800)
Strength @ 5% Strain	Mpa	139 (4.1)	-
	psi	20100 (590)	-
Strain @ Break	%	No break	3.16 (0.57)
Modulus	GPa	3.36 (0.057)	2.88 (0.11)
	ksi	487 (8.3)	418 (164)
Compression Properties: ASTM D695			
Yield Strength	MPa	105 (1.7)	107 (2.0)
	psi	15200 (250)	15600 (290)
Modulus	GPa	2.53 (0.077)	2.45 (0.026)
	ksi	366 (11)	355 (3.8)
Impact Properties: ASTM D256, ASTM D4812			
Notched	J/m	34.8 (4.6)	29.3 (6.1)
	ft*lb/in.	0.653 (0.086)	0.548 (0.11)
Unnotched	J/m	2670 (1300)	133 (31)
	ft*lb/in.	50.0 (23)	2.49 (0.59)

[1] Values in parentheses are standard deviations.

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Mechanical Properties

Table 5. Antero 840CN03 Mechanical Properties - F900 w/T20D tip

		XZ Orientation[1]	ZX Orientation[1]
Tensile Properties: ASTM D638			
Yield Strength	MPa	93.9 (3.8)	No yield
	psi	13600 (550)	No yield
Elongation @ Yield	%	4.4 (0.41)	No yield
Strength @ Break	MPa	63.1 (16)	50.5 (4.1)
	psi	9150 (2300)	7320 (600)
Elongation @ Break	%	6.5 (3.3)	1.8 (0.21)
Modulus (Elastic)	GPa	3.17 (0.045)	3.01 (0.061)
	ksi	460 (6.5)	437 (8.8)
Flexural Properties: ASTM D790, Procedure A			
Strength @ Break	MPa	No break	67.3 (11)
	psi	No break	9760 (1600)
Strength @ 5% Strain	MPa	135 (2.6)	-
	psi	19600 (380)	-
Strain @ Break	%	No break	2.38 (0.64)
Modulus	GPa	3.24 (0.046)	2.69 (0.11)
	ksi	470 (6.6)	390 (16)
Compression Properties: ASTM D695			
Yield Strength	MPa	103 (2.0)	106 (3.4)
	psi	14900 (290)	15400 (500)
Modulus	GPa	2.61 (0.047)	2.623 (0.041)
	ksi	378 (6.8)	381 (5.9)
Impact Properties: ASTM D256, ASTM D4812			
Notched	J/m	48.3 (3.9)	27.7 (7.7)
	ft*lb/in.	0.904 (0.073)	0.518 (0.14)
Unnotched	J/m	1470 (690)	128 (42)
	ft*lb/in.	27.6 (13)	2.39 (0.8)

[1] Values in parentheses are standard deviations.

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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 1a. 4 x 4 x 0.1 in plaque resistance on the Fortus 450mc in various build orientations.

Fortus 450mc

Figure 1b. 4 x 4 x 0.1 in plaque resistance on the F900 in various build orientations.

F900

Figure 2a. Volume resistance of hollow cylinders with respect to wall thickness, build orientation, and location on the cylinder on the Fortus 450mc.

Fortus 450mc

Figure 2b. Volume resistance of hollow cylinders with respect to wall thickness, build orientation, and location on the cylinder on the F900.

F900

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 6. Antero 840CN03 Thermoplastic Filament Chemical Resistance Results

Change in Mechanical Properties, Antero 840CN03 - 168 Hour Chemical Exposure (ASTM D543)			
	Reagent	**XZ Orientation[1]**	**ZX Orientation[1]**
Tensile Strength	Dichloromethane	-87.6%	-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%

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Flame, Smoke, and Toxicity (Fortus 450mc)

Antero840CN03 was printed with a T20F tip on the Stratasys Fortus 450mc 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 7. Antero 840CN03 Flame, Smoke and Toxicity Test Results (Fortus 450mc)

	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)			
Antero840CN03, Vertical - ZX	2.9	0.2	0 (No drips)
Antero840CN03, Horizontal - XY	6.7	0.2	0 (No drips)
60 Second Vertical Ignition per 14 CFR 25.853(a), Appendix F, Part I, Paragraph (a)(1)(ii)			
Antero840CN03, Vertical - ZX	<1	0.4	0 (No drips)
Antero840CN03, Horizontal - XY	<1	0.5	0 (No drips)
	Avg Burn Rate (in/min)		
15 Second Vertical Ignition per 14 CFR 25.853(a), Appendix F, Part I, Paragraph (a)(1)(ii)			
Antero840CN03, Vertical - ZX		0	
Antero840CN03, Horizontal - XY		0	
	Test Mode	**Average D_s (maximum) within 4 minutes, ($^4D_{max}$)**	
Smoke Density per BSS 7238, Rev C			
Antero840CN03, Vertical - ZX	Flaming	0	
Antero840CN03, Horizontal - XY	Flaming	0	
Smoke Density per AITM 2.0007B, Issue 3			
Antero840CN03, Vertical - ZX	Flaming	0	
Antero840CN03, Horizontal - XY	Flaming	0	
Antero840CN03, Vertical - ZX	Non-Flaming	0	
Antero840CN03, Horizontal - XY	Non-Flaming	0	

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Table 7. Antero 840CN03 Flame, Smoke and Toxicity Test Results (Fortus 450mc)

	Test Mode	CO ppm	SO_2 ppm	NO_x ppm	HCN ppm	HCl ppm	HF ppm
Toxic Gas Emission per BSS 7239, Rev. A							
Antero840CN03, Vertical - ZX	Flaming	5	0 (NI)	0 (NI)	0 (NI)	0 (NI)	0 (NI)
Antero840CN03, Horizontal - XY	Flaming	<5	0 (NI)	0 (NI)	0 (NI)	0 (NI)	0 (NI)
Toxic Gas Emisison per AITM 3.0005, Issue 2							
Antero840CN03, Vertical - ZX	Flaming	5	0	0.1	0 (NI)	0 (NI)	0 (NI)
Antero840CN03, Horizontal - XY	Flaming	3	0	0.3	0 (NI)	0 (NI)	0 (NI)
Antero840CN03, Vertical - ZX	Non-Flaming	1	0	0	0 (NI)	0 (NI)	0 (NI)
Antero840CN03, Horizontal - XY	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]			
Antero840CN03, Vertical - ZX	57.7	300	0
Antero840CN03, Horizontal - XY	59.9	269	0.1

(1) Sample thickness: 0.150 in

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Flame, Smoke, and Toxicity (F900)

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 8. Antero 840CN03 Flame, Smoke, and Toxicity Test Results (F900)

	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

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Table 8. Antero 840CN03 Flame, Smoke, and Toxicity Test Results (F900)

	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	0	0	0	0
Antero 840CN03, Horizontal - XZ	Flaming	<5	0	0	0	0	0
Toxic Gas Emission per AITM 3.0005, Issue 2							
Antero 840CN03, Vertical - ZX	Flaming	4	0	0.1	0	0	0
Antero 840CN03, Horizontal - XZ	Flaming	3	0	0.3	0	0	0
Antero 840CN03, Vertical - ZX	Non-Flaming	0	0	0	0	0	0
Antero 840CN03, Horizontal - XZ	Non-Flaming	1	0	0	0	0	0

	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 9. 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

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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.

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