

# Ingeo™ 4043D

## NatureWorks® LLC - Polylactic Acid

Tuesday, March 10, 2020

### General Information

#### Product Description

##### Film Characteristics/ Applications

- Ingeo 4043D - a product from NatureWorks LLC - can be converted into a biaxially oriented film with use temperatures up to 265°F (130°C). This film has excellent optics, good machinability and excellent twist and deadfold. These properties make 4043D film an ideal candidate for candy twist wrap and other packaging applications. Additional properties include advantageous barrier to flavor and grease and superior oil resistance.

##### Monofilament Applications

- Ingeo 4043D can be converted into 3D printer monofilament. This multi-purpose extrusion grade results in 3D printing monofilament with excellent printability characteristics such as precise detail, good adhesion to build plates (no heating needed), less warping or curling, and low odor (no strong, greasy, or oily smell while printing). These properties make this grade well-suited for 3D printing using many different types of printers and for a broad range of printing applications.

#### General

Material Status	• Commercial: Active		
Availability	• Africa & Middle East • Asia Pacific	• Europe • Latin America	• North America
Features	• Compostable • Crystalline • Excellent Printability • Food Contact Acceptable	• Good Adhesion • Grease Resistant • Low Odor • Low Warpage	• Oil Resistant • Renewable Resource Content
Uses	• Bi-axially Oriented Film • Film	• Food Packaging • Packaging	
Agency Ratings	• EU 10/2011	• FDA Food Contact, Unspecified Rating	
Appearance	• Clear/Transparent		
Forms	• Filament	• Pellets	
Processing Method	• 3D Printing, Fused Filament Fabrication (FFF)	• Filament Extrusion	• Film Extrusion

### ASTM & ISO Properties<sup>1</sup>

Physical	Nominal Value	Unit	Test Method
Density	1.24	g/cm <sup>3</sup>	ASTM D1505
Melt Mass-Flow Rate (MFR) (210°C/2.16 kg)	6.0	g/10 min	ASTM D1238
Mechanical	Nominal Value	Unit	Test Method
Tensile Modulus	3600	MPa	ASTM D638
Tensile Strength (Yield)	60.0	MPa	ASTM D638
Tensile Strength (Break)	53.0	MPa	ASTM D638
Tensile Elongation (Break)	6.0	%	ASTM D638
Flexural Modulus	3800	MPa	ASTM D790
Flexural Strength	83.0	MPa	ASTM D790
Films	Nominal Value	Unit	Test Method
Film Thickness - Tested	25	µm	
Elastic Modulus - MD (25 µm)	3310	MPa	ASTM D882
Elastic Modulus - TD (25 µm)	3860	MPa	ASTM D882
Tensile Strength - MD (Yield, 25 µm)	110	MPa	ASTM D882
Tensile Strength - TD (Yield, 25 µm)	145	MPa	ASTM D882
Tensile Elongation - MD (Break, 25 µm)	160	%	ASTM D882
Tensile Elongation - TD (Break, 25 µm)	100	%	ASTM D882
Elmendorf Tear Strength - MD (25 µm)	15	g	ASTM D1922

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<b>Films</b>	<b>Nominal Value</b>	<b>Unit</b>	<b>Test Method</b>
Elmendorf Tear Strength - TD (25 µm)	13	g	ASTM D1922
Oxygen Permeability (25 µm)	17	cm <sup>3</sup> ·mm/m <sup>2</sup> /atm/24 hr	ASTM D1434
Carbon Dioxide Permeability (25.4 µm)	72	cm <sup>3</sup> ·mm/m <sup>2</sup> /atm/24 hr	ASTM D1434
Spencer Impact (25.4 µm)	2.50	J	
Water Vapor Permeability	380	g-mil/m <sup>2</sup> /24 hr	ASTM F1249
<b>Impact</b>	<b>Nominal Value</b>	<b>Unit</b>	<b>Test Method</b>
Notched Izod Impact	16	J/m	ASTM D256
<b>Thermal</b>	<b>Nominal Value</b>	<b>Unit</b>	<b>Test Method</b>
Deflection Temperature Under Load 0.45 MPa, Unannealed	55.0	°C	ASTM E2092
Glass Transition Temperature	55.0 to 60.0	°C	ASTM D3418
Peak Melting Temperature	145 to 160	°C	ASTM D3418
<b>Optical</b>	<b>Nominal Value</b>	<b>Unit</b>	<b>Test Method</b>
Gloss (20°)	90		ASTM D1003
Haze (25.4 µm)	2.10	%	ASTM D1003

### Processing Information

<b>Extrusion</b>	<b>Nominal Value</b>	<b>Unit</b>
Drying Temperature	79	°C
Drying Time	4.0	hr
Suggested Max Moisture	0.025	%
Hopper Temperature	45	°C
Cylinder Zone 1 Temp.	179	°C
Cylinder Zone 2 Temp.	191	°C
Cylinder Zone 3 Temp.	199	°C
Adapter Temperature	199	°C
Melt Temperature	202 to 218	°C
Die Temperature	199	°C

#### Extrusion Notes

Screw Speed: 20 to 100 rpm  
 MD Draw Temperature: 140 to 160°F  
 TD Draw Temperature: 160 to 175°F

#### Notes

<sup>1</sup> Typical properties: these are not to be construed as specifications.