

Technical Data Sheet

Product Name: IC3D Standard PLA

Revision Date: 07/24/20



3D Printing Monofilament – General Purpose Grade

Monofilament Applications

IC3D Standard PLA can be converted into 3D printer monofilament. This multipurpose 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.

Processing Information

IC3D Standard PLA biopolymer is available in pellet form. Drying prior to processing is essential. The polymer is stable in the molten state, provided that the extrusion and drying procedures are followed.

Machine Configuration

IC3D Standard PLA biopolymer will process on conventional extruders using general purpose screws with L/D ratios from 24:1 to 30:1 and compression ratio of 2.5:1 to 3:1. Smooth barrels are recommended. Optimization to your specific equipment may require IC3D technical support.

Process Details

Startup and Shutdown is not compatible with a wide variety of resins, and special purging sequences should be followed:

1. Clean extruder and bring temperatures to steady state with low-viscosity, general-purpose polystyrene or high MFR polypropylene.
2. Vacuum out hopper system to avoid contamination.
3. Introduce polymer into the extruder at the operating conditions used in Step 1.

4. Once the biopolymer has purged, reduce barrel temperatures to desired set points.
5. At shutdown, purge machine with high-viscosity polystyrene or polypropylene.

Drying

In-line drying is required. A moisture content of less than 0.025% (250ppm) is recommended to prevent viscosity degradation. Typical drying conditions are 4 hours at 175°F (80°C) or to a dew point of -30°F (-35°C), with an airflow rate greater than 0.5 cfm/lb of resin throughput. The resin should not be exposed to atmospheric conditions after drying. Keep the package sealed until ready to use and promptly reseal any unused material.

Typical Material Properties¹

Physical Properties	Ingeo Resin	ASTM Method
Specific Gravity, g/cc	1.24	D792
MFR, g/10 min ²	6	D1238
Relative Viscosity ³	4	D5225
Clarity	Transparent	-
Peak Melt Temperature, °C	145 - 160	D3418
Glass Transition Temperature, °C	55 - 60	D3418
Mechanical Property		
Tensile Yield Strength, psi (MPa)	8700 (60)	D882
Tensile Strength at Break, psi (MPa)	7700 (53)	D882
Tensile Modulus, psi (MPa)	524,000 (3.6)	D882
Tensile Elongation, %	6	D882
Notched Izod Impact, ft-lb/in (J/m)	0.3 (16)	D256
Flexural Strength, psi (MPa)	12,000 (83)	D790
Flexural Modulus, psi (MPa)	555,000 (3.8)	D790
Heat Distortion Temperature, °C 66 psi (0.45 MPa)	55	E2092

¹ Typical properties for injection molded amorphous bars, not to be construed as specifications

² 210°C / 2.16kg

³ RV measured at 1.0 g / dL in chloroform at 30°C

Processing Temperature Profile⁴

Melt Temp.	410°F	210°C
Feed Throat	113°F	45°C
Feed Temp.	355°F	180°C
Compression Section	375°F	190°C
Metering Section	390°F	200°C
Adapter	390°F	200°C
Die	390°F	200°C
Screw Speed	20 - 100 rpm	
Filament Diameter Inspection (on-line)	Essential for quality monofilament (+/- 3% max deviation)	
3D Printing Temp.	190 - 230°C	
Print Bed Temp.	None needed. (or 50 - 70°C if applicable)	

⁴ Starting points only, and may need to be optimized depending on your system.

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Food Packaging Status

U.S. Status

On January 3, 2002 FCN 000178 submitted by IC3D to FDA became effective. This effective notification is part of list currently maintained on FDA's website at

<http://www.fda.gov/food/ingredientpackaginglabeling/packagingfcs/notifications/default.htm>

This grade of biopolymer may therefore be used in food packaging materials and, as such, is a permitted component of such material pursuant to section 201(s) of the Federal, Drug, and Cosmetic Act, and Parts 182, 184, and 186 of the Food Additive Regulations. All additives and adjuncts contained in the referenced biopolymer formulation meet the applicable sections of the Federal Food, Drug, and Cosmetic Act. The finished polymer is approved for all food types and B-H use conditions. We urge all our customers to clarification, please do not hesitate to contact IC3D.

European Status

This grade of biopolymer complies with Plastics Regulation 10/2011 as amended. No SML's for the above referenced grade exist in Plastics Regulation 10/2011 as amended. This grade of biopolymer is suitable for use for all food types under OM6. IC3D would like to draw your attention to the fact that the EU- Plastics Regulation 10/2011, which applies to all EU-Member States, includes a limit of 10 mg/dm² of the overall migration from finished plastic articles into food. In accordance with Plastics Regulation 10/2011 the migration should be measured on finished articles placed into contact with the foodstuff or appropriate food simulants for a period and at a temperature which are chosen by reference to the contact conditions in actual use, according to the rules laid down in Plastics Regulation 10/2011.

Please note that it is the responsibility of both the manufacturers of finished food contact articles as well as the industrial food packers to make sure that these articles in their actual use is in compliance with the imposed specific and overall migration requirements.

This grade as supplied meets European Parliament and Council Directive 94/62/EC of 20 December 1994 on packaging and packaging waste heavy metal content as described in Article 11. Again, for any application, should you need further clarification, please do not hesitate to contact IC3D.

Bulk Storage Recommendations

The resin silos recommended and used by IC3D are designed to maintain dry air in the silo and to be isolated from the outside air. This design would be in contrast with an open, vented to atmosphere system that we understand to be a typical polystyrene resin silo. Key features that are added to a typical (example: polystyrene) resin silo to achieve this objective include a cyclone and rotary valve loading system and some pressure vessel relief valves. The dry air put to the system is sized to the resin flow rate out of the silo. Not too much dry air would be needed and there may be excess instrument air (-30°F dew point) available in the plant to meet the needs for dry air. Our estimate is 10 scfm for a 20,000 lb/hr rate resin usage. Typically, resin manufacturers specify aluminum or stainless-steel silos for their own use and avoid epoxy-lined steel.

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Safety and Handling Considerations

Safety Data Sheets (SDS) for these biopolymers are available from IC3D. SDS's are provided to help customers satisfy their own handling, safety, and disposal needs, and those that may be required by locally applicable health and safety regulations SDS's are updated regularly; therefore, please request and review the most current SDS's before handling or using any product.

The following comments apply only to these biopolymers; additives and processing aids used in fabrication and other materials used in finishing steps have their own safe-use profile and must be investigated separately.

Hazards and Handling Precautions

These biopolymers have an extremely low degree of toxicity and, under normal conditions of use, should pose no unusual problems from incidental ingestion, or eye and skin contact. However, caution is advised when handling, storing, using, or disposing of these resins, and good housekeeping and controlling of dusts are necessary for safe handling of product. Pellets or beads may present a slipping hazard.

No other precautions other than clean, body-covering clothing should be needed for handling IC3D biopolymers. Use gloves with insulation for thermal protection when exposure to the melt is localized. Workers should be protected from the possibility of contact with molten resin during fabrication.

Handling and fabrication of resins can result in the generation of vapors and dusts that may cause irritation to eyes and the upper respiratory tract. In dusty atmospheres, use an approved dust respirator.

Good general ventilation of the polymer processing area is recommended. At temperatures exceeding the polymer melt temperature (typically 170°C), polymer can release fumes, which may contain fragments of the polymer, creating a potential to irritate eyes and mucous membranes. Good general ventilation should be sufficient for most conditions. Local exhaust ventilation is recommended for melt operations. Use safety glasses to prevent exposure to particles which could cause mechanical injury to the eye. If vapor exposure causes eye discomfort, improve localized fume exhausting methods, or use a full-face respirator.

The primary thermal decomposition product of PLA is acetaldehyde, a material also produced during the thermal degradation of PET. Thermal decomposition products also include carbon monoxide and hexanal, all of which exist as gases at normal room conditions. These species are highly flammable, easily ignited by spark or flame, and can also auto ignite. For polyesters such as PLA, thermal decomposition producing flammable vapors containing acetaldehyde and carbon monoxide can occur in almost any process equipment maintaining PLA at high temperature over longer residence times than typically experienced in extruders, fiber spinning lines, injection molding machines, accumulators, pipe lines and adapters. As a rough guideline based upon some practical experience, significant decomposition of PLA will occur if polymer residues are held at temperatures above the melting point for prolonged periods, e.g., in excess of 24 hours at 175°C, although this will vary significantly with temperature.

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Combustibility

IC3D biopolymers will burn. Clear to white smoke is produced when product burns. Toxic fumes are released under conditions of incomplete combustion. Do not permit dust to accumulate. Dust layers can be ignited by spontaneous combustion or other ignition sources. When suspended in air, dust can pose an explosion hazard. Firefighters should wear positive-pressure, self-contained breathing apparatuses and full protective equipment. Water or water fog is the preferred extinguishing medium. Foam, alcohol-resistant foam, carbon dioxide or dry chemicals may also be used. Soak thoroughly with water to cool and prevent re-ignition.

Disposal

DO NOT DUMP INTO ANY SEWERS, ON THE GROUND, OR INTO ANY BODY OF WATER. For unused or uncontaminated material, the preferred option is to recycle into the process otherwise, send to an incinerator or other thermal destruction device. For used or contaminated material, the disposal options remain the same although additional evaluation is required. Disposal must follow Federal, State/Provincial, and local laws and regulations.

Environmental Concerns

Lost pellets are not a problem in the environment except under unusual circumstances when they enter the water way. They are benign in terms of their physical environmental impact, but if ingested by wildlife, they may mechanically cause adverse effects. Spills should be minimized, and they should be cleaned up when they happen. Plastics should not be discarded into the environment.

Product Stewardship

IC3D has a fundamental duty to all those that use our products, and for the environment in which we live. This duty is the basis for our Product Stewardship philosophy, by which we assess the health and environmental information on our products and their intended use, then take appropriate steps to protect the environment and the health of our employees and the public.

Customer Notice

IC3D encourages its customers and potential users of its products to review their applications from the standpoint of human health and environmental quality. To help ensure our products are not used in ways for which they were not intended or tested, our personnel will assist customers in dealing with ecological and product safety considerations. Your sales representative can arrange the proper contacts. IC3D literature, should be consulted prior to the use of the company's products.

Disclaimer: The technical data contained on this data sheet is furnished without charge or obligation and accepted at the recipient's sole risk. This data should not be used to establish specifications limits or used alone as the basis of design. The data provided is not intended to substitute any testing that may be required to determine fitness for any specific use.