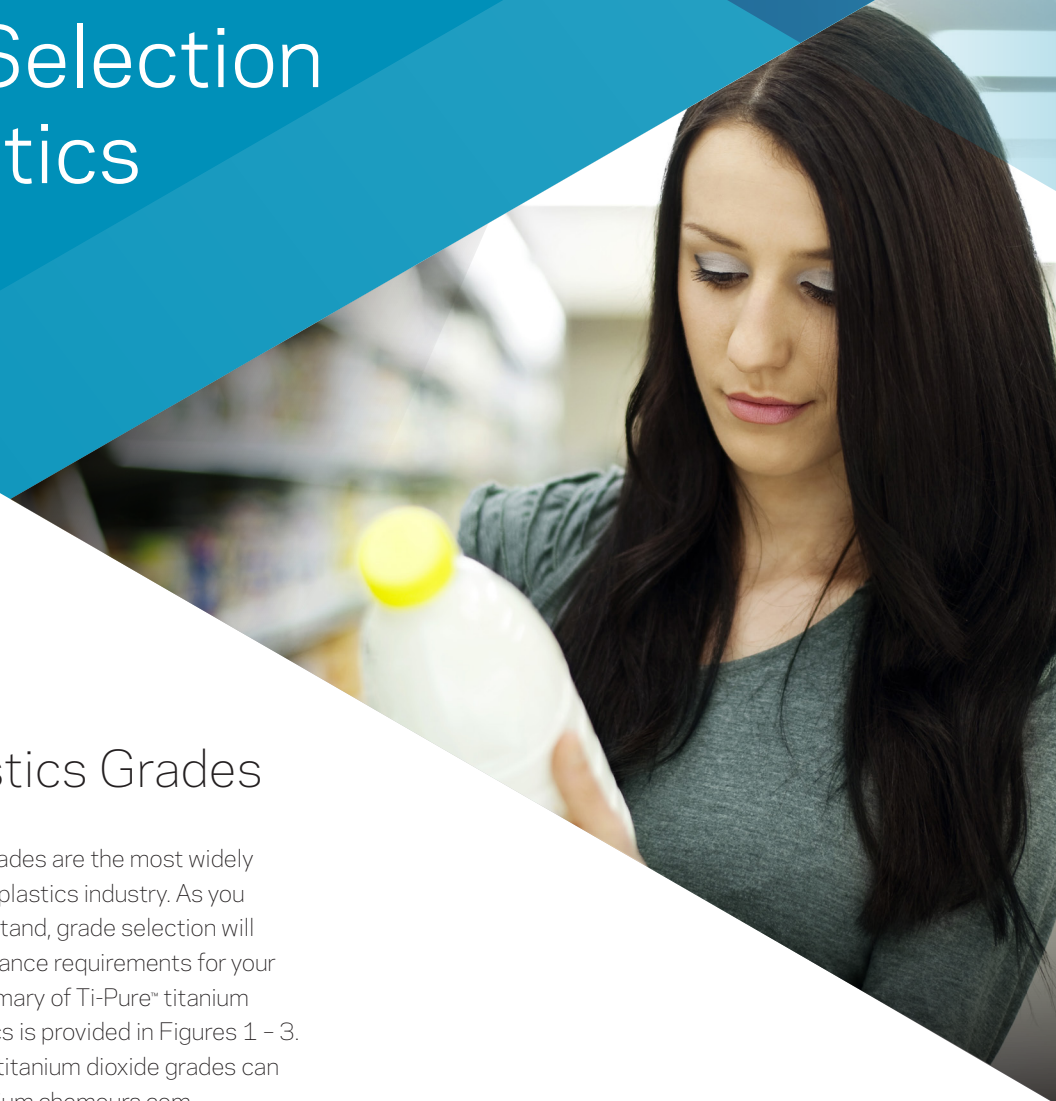




# Ti-Pure™

Titanium Dioxide

## Grade Selection for Plastics



### Ti-Pure™ Plastics Grades

Ti-Pure™ titanium dioxide grades are the most widely used rutile pigments in the plastics industry. As you read further, you will understand, grade selection will depend on desired performance requirements for your specific application. A summary of Ti-Pure™ titanium dioxide properties in plastics is provided in Figures 1 – 3. Information about Ti-Pure™ titanium dioxide grades can also be obtained from [titanium.chemours.com](http://titanium.chemours.com)

## Ti-Pure™ Plastics Grade Overview

**Ti-Pure™ R-101:** A high strength and brightness grade that exhibits excellent dispersibility and high temperature lacing resistance, imparting excellent opacity. This grade can be used in polyolefin applications including photographic paper applications, as well as PVC and PU color pastes.

**Ti-Pure™ R-103:** A very blue undertone, high brightness pigment exhibiting high tinting strength and superior yellowing resistance. This product can be used in rubber and leather applications.

**Ti-Pure™ R-104:** A high strength, blue undertone, high brightness pigment exhibiting excellent dispersion in a variety of thermoplastic resins. This grade is well suited to highly loaded masterbatch applications having least effect on melt rheology. Ti-Pure™ R-104 also has excellent lacing resistance in high temperature flexible PO thin film applications.

**Ti-Pure™ R-105:** Specially designed for outdoor applications, combining neutral undertone with moderate opacity

strength for easy color formulation work. Ti-Pure™ R-105 is highly recommended for use in polyethylene/polypropylene exterior applications, exterior non-chalking PVC and lead-stabilized PVC systems.

**Ti-Pure™ R-350:** A high strength, blue undertone pigment with superior dispersion and excellent processibility in a variety of thermoplastic polymers, with minimal reactivity with additives in polyolefin applications. It offers excellent thermostability and superior mechanical properties in high-end applications such as ABS systems.

**Ti-Pure™ R-960:** A low tint strength pigment combined with exceptional durability makes this TiO<sub>2</sub> well suited for dark-colored exterior applications.

### How to Select a Suitable Ti-Pure™ Titanium Dioxide Grade

Selecting a suitable titanium dioxide grade for an application will depend on resin type and processing conditions, as well as finished product performance requirements. This section describes the performance of Ti-Pure™ titanium

dioxide grades in major resin systems and identifies properties important to that application.

### Polyolefins

With few exceptions, most polyolefin applications involve preparing a TiO<sub>2</sub> concentrate by batch or continuous compounding before reducing the concentrate into the finished product. In this regard, ease of dispersion, resistance to yellowing, and optical properties are important performance properties. For thin-film and extrusion-coating applications, dispersion performance and resistance to lacing and discoloration at elevated processing temperatures are of major concern.

Ti-Pure™ R-350 provides superior performance in polyolefins. It has high opacity strength, very blue undertone, exceptional processing and dispersion in highly loaded concentrates. Its unique surface treatment provides additive discoloration resistance and moderate durability while also being highly resistant to lacing.

**Figure 1.**

Plastics Grades TiO<sub>2</sub> Physical Properties

Property	Grade					
	R-101	R-103	R-104	R-105	R-350	R-960
TiO <sub>2</sub> , wt%, min.	97	96	97	92	95	89
Alumina, wt%, max.	1.7	3.2	1.7	3.3	1.7	4.0
Silica, wt%, max.	N/A	N/A	N/A	3.5	3.0	6.5
Organic Treatment	hydrophilic	hydrophilic	hydrophobic	hydrophobic	hydrophobic	N/A
Color CIE L*, min.	97.9	97.8	97.5	98.5	98.5	98.5
Specific Gravity	4.2	4.1	4.2	4.0	4.1	3.9
Median Particle Size, µm	0.29	0.22	0.22	0.31	0.22	0.35
Vinyl Tint Strength	110	110	113	104	110	90
Vinyl Undertone	0.005	0.035	0.030	-0.010	0.030	-0.030
pH	8.5	6.5	N/A	N/A	N/A	7.4
Resistance, min.	2.0	4.0	N/A	N/A	N/A	4.0

**Notes:** Unless noted, values are typical. Resistance is reported as the minimum value in k ohm-cm. Test methods used to determine the values reported are available from your TiO<sub>2</sub> sales or technical service representative.

**Figure 2.**

Application Guide for Plastic End-Uses

Finished Product	Grade					
	R-101	R-103	R-104	R-105*	R-350	R-960*
Polyethylene/Polypropylene						
Injection Molding	●	●	●		◆	
Blow Molding	●	●	●		◆	
Blown Film	●	●	●		◆	
Extruded Sheet	●	●	●		◆	
High-Temperature Cast Film or Extrusion Coating	◆		◆		◆	
Exterior, Durable*				◆		●
Liquid Colorants		◆				
PVC						
Interior, Rigid	●	●	●			
Exterior, Chalking	●	●	●			
Exterior, Nonchalking				◆		◆
Flexible, Durable*	●	◆		◆		
Plastisol		●		●		●
Lead-Stabilized Systems		●		◆		●
Pipe**	●	●				
ABS	●	●	●	●	◆	●
Polystyrene	●	◆	◆		●	●
Polycarbonate	●	●	◆	●		
Polyamide	●	◆	●	●		●
Polyester		●	◆	●		
Thermoset (PES)	●	●	●			●

◆ Preferred grade for application

● Grade fully usable for application

\*Grades R-105 and R-960 are maximum durability grades and recommended for all applications that require extended outdoor service life.

\*\*Grades R101, R103, R105, R902+, R706 and R900, are listed with the NSF International for plastic pipe use.

Ti-Pure® R-101 exhibits outstanding dispersibility and is highly resistant to lacing. These properties make R-101 an ideal choice for high temperature extrusion-coating applications.

Ti-Pure® R-103 provides high tinting strength with a very blue undertone. It has excellent dispersibility and discoloration resistance in polyolefin applications. R-103, however, is not as resistant to lacing as R-101, R-104 or

R-350. When using liquid color to color polyolefins, R-103 is the best choice.

Ti-Pure® R-104 provides the high tinting strength and very blue undertone desired in many applications. Its organic treatment provides optimum processing and rheology for producing very highly loaded concentrates. R-104, like R-101 and R-350, is highly resistant to lacing.

Ti-Pure® R-105 and R-960 are preferred in systems where maximum

weatherability is required. R-105 has improved dispersion and processing versus R-960 when used in polyolefin concentrates.

## Polyvinyl Chloride (PVC)

### Plasticized Polyvinyl Chloride

Ti-Pure® R-103 provides the optimal performance in flexible PVC and PVC plastisols. The blue tint and high strength of R-103 provides excellent optimal performance. The alumina surface treatment of R-103 provides good dispersion and good shelf stability in plastisols.

### Rigid Polyvinyl Chloride

Selecting the optimal grade of Ti-Pure® titanium dioxide for rigid vinyl applications depends on the intended use of the product and the type of heat stabilizers used in the PVC compound to protect the resin.

Ti-Pure® R-101 and R-103 grades can be used in white profiles intended for exterior applications such as building siding and window profiles, where controlled chalking is desired, primarily in tin stabilized systems. These grades encompass the full optical range of blueness available for these products. R-103 is the recommended grade due to its bluer tint versus R-101.

Ti-Pure® R-105 is the recommended grade for high gloss exterior white products using all types of heat stabilizers. The dense silica surface treatment of R-105 minimizes chalking, providing excellent gloss retention. R-105 has strong opacity strength and very good bulk flow.

Ti-Pure® R-960 is the recommended grade for exterior tinted products such as building siding, regardless of the heat stabilizer system used. As with Ti-Pure® R-105, its dense silica surface treatment minimizes chalking, which is perceived as color fade in tint products. The lower opacity strength of Ti-Pure™

R-960 versus R-105 gives significant savings in color toner cost for PVC exterior products where high  $\text{TiO}_2$  loadings are needed for UV protection.

Some organic lead stabilized compounds pigmented with untreated  $\text{TiO}_2$  grades may experience lead graying on outdoor exposure. For compounds containing such stabilizers, Ti-Pure™ R-103, R-105, R-350, or R-960 are recommended. While R-103 and R-350 will not catalyze lead graying, they will surface chalk at a greater rate than R-105.

For PVC pipe and general-purpose applications,  $\text{TiO}_2$  grade selection is based largely on optical performance. Ti-Pure™ R-103, with its high tinting strength and very blue undertone, is the recommended grade. Ti-Pure™ R-101, R-103 and R-104 are approved by NSF for plastic pipe applications.

### ABS and ABS Blend Polymers

Among  $\text{TiO}_2$  pigment's key performance attributes, optical properties, thermal and UV stability, and mechanical property retention are considered to

be most critical. Higher tinting strength and bluish-white undertone color help to produce brighter and whiter appearance and can also positively impact the mechanical properties. Because higher tinting strength  $\text{TiO}_2$  can be used at lower loadings, the mechanical property degradation of the polymer is minimized and the  $\text{TiO}_2$  pigment economy is improved, resulting in raw material cost savings.

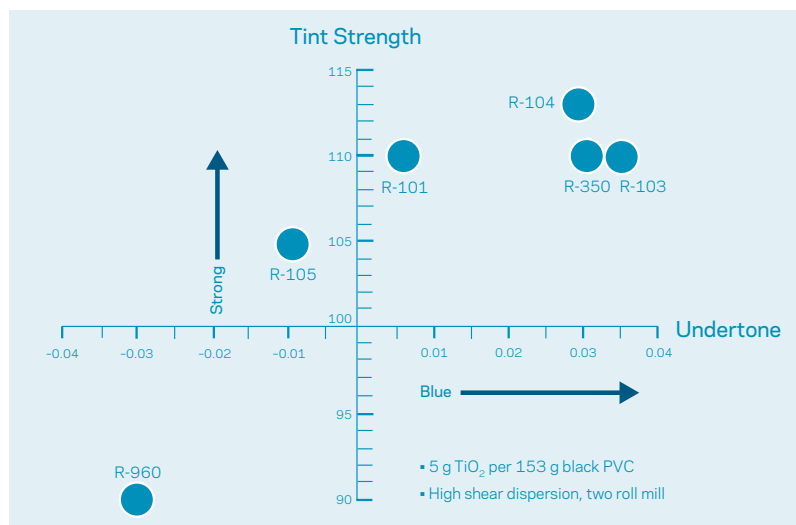
Ti-Pure™ R-350 is designed to provide optimum bright blue optics, thermal and UV stability, and impact strength retention which ABS and ABS blend polymers value most. Ti-Pure™ R-105 and R-960 have been valued for the applications requiring maximum thermal stability during polymer melt processing and long-term weather resistance during use.

### Other Engineering and Performance Polymers

Thermal stability, melt-rheology stability, chemical reactivity, and polymer mechanical property influence of a  $\text{TiO}_2$  pigment are the most crucial attributes of a  $\text{TiO}_2$  pigment for these very high processing and end use temperature polymers. For PC blended with ABS (or with other suitable polymers) Ti-Pure™ R-103 is preferred. When durability is required Ti-Pure™ R-105 is suggested. Polyamide product selection depends on the desired end use color, compound formula, processing methods and equipment. For these applications Ti-Pure™ R-103, R-104 or R-105 can be considered. Please consult your local Ti-Pure™ sales representative for additional application information.

**Figure 3.**

Optical properties of Ti-Pure™ titanium dioxide shows the relationship between tint strength and undertone for a number of grades Ti-Pure™ titanium dioxide.



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