



# **Raven** and **Conductex** Carbon Blacks for Specialty Applications

# FUNDAMENTAL PROPERTIES OF CARBON BLACK

A carbon black's application performance is determined by its fundamental properties and the level of dispersion achieved. The most important physical and chemical properties include particle size, porosity, structure, and surface chemistry. The level of dispersion in any given matrix is strongly influenced by the mixing equipment, formulation (including dispersant selection), and physical form.

**PARTICLE SIZE** is the primary influence on color properties. Particle size is measured by electron microscopy (EM). Mean particle size is certified via statistical thickness surface area (STSA) correlation according to ASTM D3849-14. Smaller particle diameter gives rise to higher surface area and tinting strength. High surface area is usually associated with greater jetness, higher conductivity, improved weatherability, and higher viscosity, but requires increased dispersion energy.

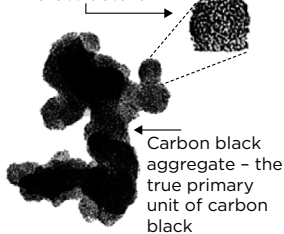
**STRUCTURE** is a measure of the three-dimensional fusion of carbon black particles to form aggregates. Highly structured carbon blacks provide higher viscosity, greater electrical conductivity and easier dispersion. Measures of aggregate structure may be obtained from shape distributions from EM analysis, oil absorption (OAN) or void volume analysis.

**POROSITY** is indicated by comparing a carbon black's external surface area predicted by STSA to the total surface area value obtained with the BET NSA method. Conductive carbon blacks tend to have a high degree of porosity.

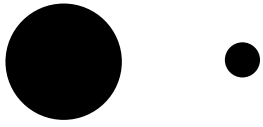


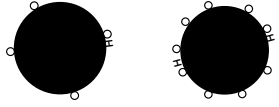
**SURFACE CHEMISTRY** of carbon blacks generally refers to the oxygen-containing groups present on a carbon black's surface. Oxidized surfaces improve pigment wetting, dispersion, rheology, and overall performance in selected systems. In other cases, oxidation increases electrical resistivity and makes carbon blacks more hydrophilic. The extent of surface oxidation is measured by determining the quantity of the "volatile" component on the carbon black. High volatile levels are associated with low pH.

**PHYSICAL FORM** is important in matching a carbon black to the equipment by which it is to be dispersed. Powdered carbon blacks are recommended in low-shear dispersers and on three-roll mills. Beaded carbon blacks are recommended for shot mills, ball mills and other high energy equipment. Beading provides lower dusting, bulk handling capabilities, and higher bulk densities, while powdered carbon blacks offer improved dispersibility.

Carbon black particle showing Paracrystalline microstructure





PROPERTY	INFLUENCE OF PROPERTY ON PERFORMANCE
<b>Particle Size Distribution</b> 	<b>Smaller Particle Size (Higher Surface Area)</b> <ul style="list-style-type: none"> <li>Increases Jetness</li> <li>Increases Tint</li> <li>Increases UV Protection</li> <li>Increases Electrical Conductivity</li> <li>Increases Resin Demand and Viscosity</li> <li>Reduces Dispersibility</li> </ul>
<b>Structure - Aggregate Size/ Shape Distribution</b> 	<b>Higher Structure (Increasing Oil Absorption)</b> <ul style="list-style-type: none"> <li>Reduces Jetness and Tint</li> <li>Improves Dispersibility</li> <li>Increases Resin Demand and Viscosity</li> <li>Increases Electrical Conductivity</li> </ul>
<b>Porosity - Pore Size Distribution</b> 	<b>Higher Porosity (Higher Ratio of NSA/STSA)</b> <ul style="list-style-type: none"> <li>Increases Resin Demand and Viscosity</li> <li>Increases Electrical Conductivity</li> <li>Enables Reduced Loadings in Conductive Applications</li> </ul>
<b>Surface Chemistry - Surface Functionality Distribution</b> 	<b>Higher Surface Functionality (Higher Volatile Content)</b> <ul style="list-style-type: none"> <li>Improves Resin Wetting</li> <li>Reduces Viscosity of Liquid Systems</li> <li>Lowers Electrical Conductivity</li> </ul>

**Additional Properties:** • Other Constituents – Sulfur, Ash, Residue, etc. • Physical Form – Beads or Powder

Specialty blacks are used in a wide variety of applications including coatings, printing inks, plastics, and sealants. The selection of a specific product for an application depends on the end-use requirements as well as processing conditions.

#### ULTRA CARBON BLACKS

Birla Carbon products are high performance pigments targeted for use in demanding applications. Carbon black purity and consistency of performance, always important, are now recognized as being critical to continuing quality improvement. Birla Carbon has developed products that provide the highest level of purity available. These products, referred to as **Ultra** carbon blacks, serve as industry benchmarks in various application segments. **Ultra** products benefit various application systems by providing greater uniformity, increased compatibility, improved dispersion, better processing, longer screen life, enhanced color development, and reduced scrap.

#### COATINGS

Coatings may be formulated with an extremely wide range of products such as **Raven 410** for utility finishes, **Raven 1255** for various medium color industrial coatings, and **Raven 5000 Ultra II** for high quality, extremely jet, blue undertone automotive topcoat applications. Specialty blacks primarily used for tinting have low surface areas and broad particle size distributions. Products with these properties provide good economics coupled with a desired blue tone and best resistance to flooding and flocculation.

**Raven 14 Powder**, an easily dispersed post-treated carbon black, is the industry standard for blue undertone and tinting in paints and coatings.

#### INKS

Specialty blacks for inks are generally medium to coarse in particle size and are used for full color rather than tinting properties. In liquid ink applications such as publication and packaging gravure, the **Raven 400** and **Raven 500** series products are widely used because of their rheology, ease of dispersion, and blue tone. **Raven L Ultra** carbon black is used when the masstone requirements are higher. Depending on specific requirements, high quality inks are formulated with products such as **Raven 760 Ultra**, **Raven 1000**, and **Raven 1035** carbon blacks.

#### PLASTICS

Carbon black may be incorporated into thermosets or thermoplastics for color, tint, or functional reasons. Masstone color plastic applications can employ the entire available range of carbon black particle sizes. Selection will depend upon loading, dispersion, and cost. The coarser products are excellent choices in applications where blue tone, tinting strength, and ease of dispersion are preferred. **Conductex** blacks provide different degrees of electrical conductivity for a wide range of plastics requirements. **Conductex 7055 Ultra** and **Conductex K Ultra** carbon blacks offer optimum conductivity with minimal contribution to viscosity in applications such as wire and cable, ESD, as well as conductive coatings. For applications requiring very high jetness such as engineering plastics, **Raven 2000**, **Raven 2350 Ultra**, and **Raven 2500 Ultra** carbon blacks are recommended. For ultraviolet protection, **Raven UV Ultra** and **Raven PFEB** are industry standard products for jacketing, film, and pipe applications.

# GLOBAL SPECIALTY BLACKS PRODUCT PORTFOLIO

Raven and Conductex Carbon Blacks	D6556		D2414		D3265	2A-700	Typical Applications
	NSA Surface Area m <sup>2</sup> /g	STSA Surface Area m <sup>2</sup> /g	OAN Oil Absorption cm <sup>3</sup> /100g		Tinting Strength	Volatile Content %	
			Beads	Powder			
<b>Raven 5100 Ultra</b>	583	350	75	95	135+ <sup>2</sup>	-	Automotive topcoat, architectural coatings
<b>Raven 5000 Ultra II<sup>1</sup></b>	583	350	95	95	135+ <sup>2</sup>	10.5	
<b>Raven 5000 Ultra 3<sup>1</sup></b>	583	350	95	95	135+ <sup>2</sup>	10.5	
<b>Raven 3500<sup>1</sup></b>	375	212	105	105	135+ <sup>2</sup>	5.0	
<b>Raven 3000 Ultra</b>	260	235	70	73	135+ <sup>2</sup>	-	High jetness plastics; industrial and powder coatings; inkjet ink
<b>Raven 2900 Ultra</b>	254	215	65	67	135+ <sup>2</sup>	-	
<b>Raven 2800 Ultra</b>	257	205	95	100	135+ <sup>2</sup>	-	
<b>Raven 2500 Ultra</b>	270	206	65	67	135+ <sup>2</sup>	-	
<b>Raven 2350 Ultra</b>	195	180	60	62	135+ <sup>2</sup>	-	
<b>Raven 2000</b>	194	168	65	70	135+ <sup>2</sup>	-	
<b>Raven 1255<sup>1</sup></b>	122	119	66	66	135	2.7	Premium offset ink, UV ink and specialty coatings
<b>Raven 1250</b>	113	102	55	60	128	-	Coatings, plastics, inks
<b>Raven 1200</b>	106	104	55	60	128	-	
<b>Raven 1190 Ultra</b>	113	100	57	-	125	-	Inks, coatings, and fiber
<b>Raven 1185 Ultra<sup>1</sup></b>	100	97	-	100	124	2.5	Specialty coatings; high quality inks including offset, packaging, UV, inkjet, toner
<b>Raven 1180<sup>1</sup></b>	110	97	-	60	128	2.7	
<b>Raven 1170</b>	107	101	55	60	124	-	Inks, coatings, and plastics
<b>Raven 1100 Ultra<sup>1</sup></b>	101	95	72	72	120	2.4	High quality inks including heatset, sheetfed, UV, and packaging; coatings
<b>Raven 1080 Ultra<sup>1</sup></b>	79	77	60	60	109	1.6	
<b>Raven 1060 Ultra<sup>1</sup></b>	66	65	50	50	102	1.6	
<b>Raven 1040<sup>1</sup></b>	90	86	100	100	115	2.6	
<b>Raven 1035<sup>1</sup></b>	91	91	65	65	125	2.4	
<b>Raven 1020</b>	95	90	58	60	121	-	Inks, coatings, and plastics
<b>Raven 1010</b>	95	91	-	58	126	-	
<b>Raven 1000</b>	92	91	58	63	126	-	
<b>Raven 900</b>	82	81	-	108	102	-	
<b>Raven 880</b>	78	76	102	-	102	-	Geomembrane, film, and molding
<b>Raven 880 Ultra</b>	78	76	102	-	102	-	
<b>Raven 860 Ultra</b>	48	48	48	50	91	-	High quality inks including heatset, sheetfed, and packaging
<b>Raven 850</b>	63	63	-	75	101	-	Coatings, inks, and plastisol
<b>Raven 820</b>	73	71	120	-	100	-	Flexographic ink
<b>Raven 790 Ultra</b>	64	64	-	105	95	-	Sealants
<b>Raven 780 Ultra</b>	89	77	58	60	109	-	Toner and specialty inks
<b>Raven 760 Ultra</b>	64	64	48	50	102	-	High quality inks including heatset, sheetfed, and packaging; coatings
<b>Raven 675 Ultra</b>	69	68	45	-	97	-	
<b>Raven 525</b>	43	42	121	-	55	-	Plastic color concentrate for film, pipe, and molding
<b>Raven 520</b>	40	39	121	-	58	-	
<b>Raven 520 Ultra</b>	40	39	121	-	58	-	
<b>Raven 510 Ultra</b>	38	38	90	-	57	-	

# GLOBAL SPECIALTY BLACKS PRODUCT PORTFOLIO (CONTINUED)

Raven and Conductex Carbon Blacks	D6556		D2414		D3265	2A-700	Typical Applications
	NSA Surface Area m <sup>2</sup> /g	STSA Surface Area m <sup>2</sup> /g	OAN Oil Absorption cm <sup>3</sup> /100g		Tinting Strength	Volatile Content %	
			Beads	Powder			
<b>Raven 500</b>	44	44	75	80	69	-	Plastic color concentrate for film and molding; blue undertone and tinting in coatings
<b>Raven 450</b>	35	34	63	65	61	-	
<b>Raven 435</b>	35	34	90	-	62	-	
<b>Raven 430 Ultra</b>	31	31	75	78	58	-	
<b>Raven 425</b>	29	29	72	75	54	-	
<b>Raven 420</b>	28	28	72	75	50	-	
<b>Raven 410</b>	26	26	65	68	47	-	
<b>Raven 415</b>	32	32	65	-	61	-	News ink and plastic color concentrate
<b>Raven 415 Ultra</b>	32	32	65	-	61	-	
<b>Raven 22</b>	28	27	-	113	44	-	Blue undertone and tinting in coatings; solid carbon and metallurgical
<b>Raven 16</b>	30	29	-	105	46	-	
<b>Raven 14<sup>1</sup></b>	44	44	-	111	66	1.7	Blue undertone and tinting in coatings
<b>Raven FC1</b>	115	100	100	-	112	-	U.S. FDA 21 CFR 178.3297 indirect food-contact plastics
<b>Raven L</b>	85	85	72	78	110	-	Inks, coatings, and plastics
<b>Raven L Ultra</b>	85	85	72	-	110	-	
<b>Raven M</b>	78	76	102	-	102	-	
<b>Raven P</b>	155	109	113	-	107	-	Conductive and film
<b>Raven P5</b>	109	100	-	117	115	-	Sealant, pipes, film, and fiber
<b>Raven P5 Ultra</b>	109	100	112	117	115	-	
<b>Raven P7 Ultra</b>	90	85	98	-	105	-	Pipe, film, and fiber
<b>Raven P125 Ultra</b>	71	70	100	-	92	-	Pipe, film, and geomembrane
<b>Raven PFEB</b>	107	91	98	-	105	-	Pipe, film, and fiber
<b>Raven SF8 Ultra</b>	125	100	114	-	114	-	Fine denier synthetic fibers
<b>Raven UV Ultra</b>	124	112	114	-	118	-	UV protection, cable jacketing, and fiber
<b>Conductex SC Ultra</b>	205	124	115	115	123	-	Wire and cable, ESD, and other conductive applications
<b>Conductex K Ultra</b>	185	125	141	-	115	-	
<b>Conductex 7097 Ultra</b>	85	82	160	-	97	-	
<b>Conductex 7093</b>	75	73	140	-	98	-	
<b>Conductex 7067 Ultra</b>	63	54	140	-	65	-	
<b>Conductex 7060 Ultra</b>	63	56	156	-	70	-	
<b>Conductex 7055 Ultra</b>	55	50	170	-	61	-	
<b>Conductex 7051 Ultra</b>	43	42	121	-	55	-	Wire and cable insulation shield
<b>Conductex 7054 Ultra</b>	43	42	122	-	60	-	
<b>Conductex 7090</b>	43	42	121	-	55	-	
<b>Conductex 7095 Ultra</b>	39	39	121	-	58	-	

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1 - Surface oxidized, "Treated" product  
 Treated products typically range in pH from 3.0-3.5  
 Non-treated products typically range in pH from 6.5-8.0  
 OAN and tint strength are measured prior to treatment

2 - The ASTM Tinting Strength value for high surface area products plateaus at about 135% ITRB, consequently ASTM Tinting Strength is not indicative of performance for this range of products.

Color Index No. 77266, Pigment Black 7, CAS No. 1333-86-4



## ABOUT BIRLA CARBON

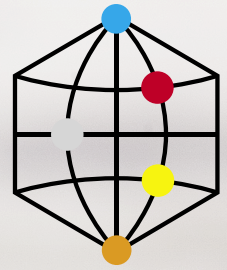
**Birla Carbon** is a leading global supplier of carbon black. As one of the flagship businesses of the leading Indian multinational conglomerate, the **Aditya Birla Group**, Birla Carbon provides innovative sustainable carbon black solutions that enhance the performance of paints and coatings, inks and toners, plastics, adhesives, sealants, textile fibers, mechanical rubber goods, tires, Energy Systems, and Sustainable Carbonaceous Materials.

As an ardent practitioner of sustainable development, Birla Carbon's Sustainable Operational Excellence (SOE) strategy focuses on employee safety, environmental stewardship, efficient use of carbon sources, product circularity and sustainability, and

a key focus on conducting operations in a socially and ethically responsible manner. Birla Carbon has been recognized by EcoVadis since 2016 as an advanced practitioner of sustainability. Our current rating is available on the **Birla Carbon Sustainability webpage**.

Birla Carbon's Purpose, 'Share the Strength', is about balanced and shared leadership, working at the product level to innovate cutting edge solutions through collaboration with its people, customers, and communities and backed by knowledge built over a century.

For more information, visit [birlacarbon.com](http://birlacarbon.com), or follow us @**BirlaCarbon** on **Twitter**, **LinkedIn**, **Facebook**, or **Instagram**.



## SHARE THE STRENGTH

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