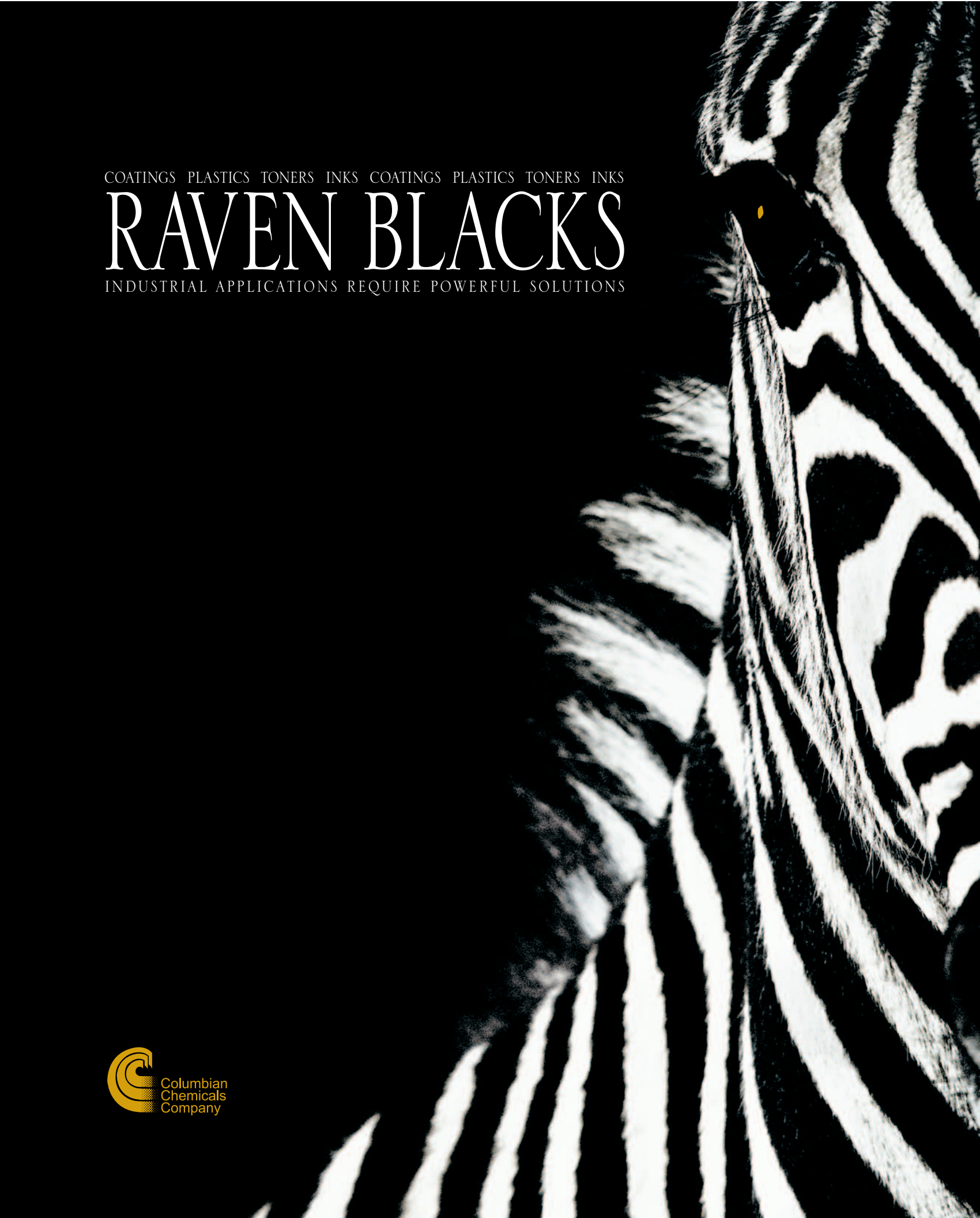
COATINGS PLASTICS TONERS INKS COATINGS PLASTICS TONERS INKS

RAVEN BLACKS

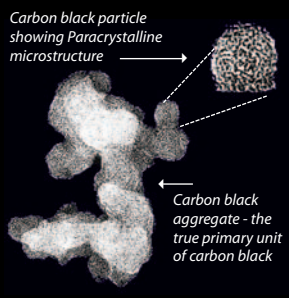
INDUSTRIAL APPLICATIONS REQUIRE POWERFUL SOLUTIONS



Columbian Chemicals Company

A carbon black's application performance is determined by its nature and the level of dispersion achieved. The most important physical and chemical properties include particle size, surface area, porosity, structure, surface chemistry, and physical form. The level of dispersion in any given formulation is strongly influenced by the mixing equipment and procedures used.

PARTICLE SIZE exerts a primary influence on color properties. Finer particle size leads to jetter (darker) color and higher viscosity, but requires increased dispersion energy. Particle size is measured by electron microscopy.



SURFACE AREA is used for quality control purposes and is a function of the carbon black's particle size and porosity. Smaller particle diameter gives rise to higher surface area. High surface area is usually associated with greater blackness and higher viscosity.

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

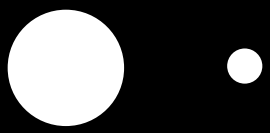
STRUCTURE is a measure of the three-dimensional fusion of carbon black particles to form aggregates. Highly structured carbon blacks provide higher viscosity, greater electrical conductivity and easier dispersion. Measures of aggregate structure may be obtained from shape distributions from EM analysis,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

SURFACE CHEMISTRY of Industrial Carbon Blacks generally refers to the oxygen-containing groups present on a carbon black's surface. Oxidized surfaces improve wettability, rheology and dispersion in selected vehicle 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. A number of Raven® carbon blacks are post-treated to provide enhanced surface functionality.

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, higher bulk densities and improved economics, while powdered carbon blacks offer improved dispersibility.

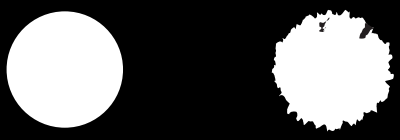
FUNDAMENTAL CARBON BLACK PROPERTIES

Fineness - Particle Size Distribution

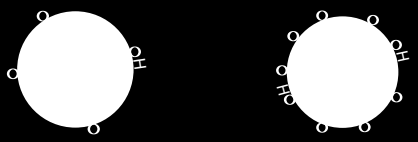


Structure - Aggregate Size/Shape Distribution

Porosity - Pore Size Distribution



Surface Chemistry - Surface Functionality Distribution



Additional Properties

Other Constituents - Sulfur, Ash, Residue, Etc.

INFLUENCE OF CARBON PROPERTIES ON APPLICATIONS PERFORMANCE

Smaller Particle Size (Higher Surface Area)

Increases	Blackness
Increases	Tint
Increases	UV Protection
Increases	Electrical Conductivity
Increases	Vehicle Demand and Viscosity
Reduces	Dispersibility

Higher Structure (Increasing Oil Absorption)

Reduces	Blackness and Tint
Improves	Dispersibility
Increases	Vehicle Demand and Viscosity
Increases	Electrical Conductivity

Higher Porosity (Higher ratio of NSA/STSA)

Increases	Vehicle Demand and Viscosity
Increases	Electrical Conductivity
Enables	Reduced Loadings in Conductive Applications

Higher Surface Functionality (Higher Volatile)

Improves	Vehicle Wetting
Reduces	Viscosity of Liquid Systems
Lowers	Electrical Conductivity

Physical Form - Beads or Powder

FOR CARBON BLACK RECOMMENDATIONS BEST SUITED FOR YOUR APPLICATIONS, CONTACT YOUR COLUMBIAN TECHNICAL REPRESENTATIVE


TONERS


INK


PLASTICS


COATINGS

Industrial Carbon Blacks are used in a wide variety of applications including printing inks, toners, coatings, plastics, paper and building products. The selection of a specific carbon black application depends on the end product requirements as well as processing conditions.

INDUSTRIAL **CARBON BLACK** APPLICATIONS

ULTRA® INDUSTRIAL CARBON BLACKS

Columbian furnace carbon blacks are high performance carbons which are used in demanding applications. Carbon black purity and consistency of performance, always important, are now recognized as being critical to continuing quality improvement. Columbian, committed to improving its quality and meeting the needs of the customers it serves, has developed furnace carbons that are of the highest purity available. These are referred to as Ultra® carbons.

Ultra® carbon blacks benefit various application systems by providing greater uniformity, increased compatibility, improved dispersion, better processing, longer screen life, jetter color development, and reduced scrap. Columbian's Ultra® performance carbons are designed for use in critical quality products with cost effective benefits.

PUREBLACK® Carbons are a new family of carbon blacks offering exceptional chemical purity and performance. They present unique benefits including negligible moisture pickup, low to nil Sulfur, higher electrical and thermal conductivities, increased oxidation resistance and are compliant with FDA regulation 21 CFR 178.3297. PUREBLACK® Carbons are uniquely suited for moisture sensitive systems and high temperature applications. They provide processing advantages such as ease of dispersion and higher masterbatch loading capability compared to other FDA compliant carbon blacks. In conductive applications including high voltage cables and curing bladders, PUREBLACK® Carbons offer significant performance advantages over acetylene black.

COATINGS may be formulated with an extremely wide range of Columbian carbon blacks, ranging from Raven® 410 for low-cost utility finishes to Raven® 5000 Ultra® II & Raven® 5000 Ultra® III for high quality, extremely jet, blue undertone automotive applications. Carbon blacks primarily used for tinting are coarse and have broad particle size distributions. Grades with these properties provide good economics coupled with a desired blue tone and best resistance to flooding and flocculation. For use in machine colorant concentrates, coarse carbon blacks, especially the lampblack replacements are usually specified. Raven® 14, a post-treated lampblack replacement, can provide sufficient mass color, strong tint strength, high loading capability and good dispersibility.

PLASTICS carbon black requirements are also diverse. Carbon black may be incorporated into thermosets or thermoplastics for color, tint or functional reasons. The entire spectrum of carbon blacks is employed in mass color plastic applications and use will depend upon loading, dispersion and cost. Again as in coatings, the coarser carbon blacks are excellent choices in applications where blue tone, tint strength, ease of dispersion and high gloss are preferred. Carbon blacks, marketed under the Conductex® trade name, provide different degrees of electrical conductivity for a wide range of plastics requirements. Conductex® 7055 Ultra offers optimum conductivity with minimal contribution to viscosity in applications such as wire & cable, ESD, as well as conductive coatings. By contrast, oxidized carbon blacks such as Raven® 1255 tend to be less conductive and may be used where controlled electrical insulating properties are required. Fiber applications benefit from the excellent filterability of Raven® 1190 Ultra® and Raven® 1220 Ultra®. For applications requiring very high jetness such as engineering plastics parts, Raven 2000 and Raven® 2500 Ultra® are recommended.

INK grade carbon blacks are generally medium to coarse in particle size and are used for their masstones rather than tint properties. In fluid ink applications such as publication and packaging gravure, Raven® 450 and 460 are widely used because of their rheology, ease of dispersion and blue tone. The standard for news ink applications is Raven® 690 oil beads. High quality paste (oil) inks may be formulated with Raven®760 Ultra®, 860 Ultra®, 1100 Ultra®, 1000, or 1255 depending on specific requirements.

Numerous Columbian carbon blacks have been specially engineered for specific industries. Raven® H2O is a surfactant-treated carbon black which is extremely hydrophilic and is thus useful in the building product industries for applications such as roofing granules and concrete mortar, and in the paper industry where low shear dispersibility is required. Raven® 1190 Ultra® and Raven® 1220 Ultra® have been developed for the fiber industry. Raven® UV Ultra® is an industry standard for ultra violet protection.

Typical Properties of Industrial Carbon Blacks

Test Method (*NA - Not Applicable)	D3849	D2414		D6556		2A-700	NA*	D3265		APPLICATIONS COMMENTS
	Mean Particle Size nm	OAN Oil Absorption cc/100gm Beads	Powder	NSA Surface Area m2/g	STSA Surface Area m2/g	% Volatile	Blackness Index	Tint Strength	Country of Origin	
PERFORMANCE FURNACE CARBON BLACKS										
Raven 7000[1]	11	95	95	575	300	8.5	170	145	USA	High Color Coatings, Plastics, & Toner
Raven 5000 Ultra III[1]	8	95	95	583	350	10.5	190	135	USA	Raven Ultra III provides added benefit of very high purity
Raven 5000 Ultra II[1]	8	95	95	583	350	10.5	190	135	USA	Automotive Topcoat & Engineering Plastics-blackest of blacks
Raven 3600 Ultra	11	-	130	254	187	1.5	168	147	USA	Ink Jet SOHO applications
Raven 3500[1]	13	105	105	375	212	5.0	165	145	USA	Coatings and engineering plastics applications
Raven 2500 Ultra	13	65	67	270	206	1.2	168	147	USA	
Raven 2000	18	65	70	194	168	0.9	166	144	USA	
Raven 1500	17	60	65	180	120	2.7	163	131	USA	
Raven 1255[1]	21	66	66	122	119	2.7	161	135	USA	Premium Offset Inks & Specialty Coatings
Raven 1250	20	55	60	113	102	2.5	165	128	USA	Coatings and plastics
Raven 1220 Ultra	21	77	-	124	112	1.0	132	131	USA	Fiber Applications
Raven 1200	20	55	60	106	104	1.8	164	128	USA	Coatings and plastics
Raven 1190 Ultra	21	57	62	113	100	1.8	162	125	USA	Fiber Applications
Raven 1175	21	55	60	120	116	1.0	163	128	USA	Wide Format Ink Jet applications
Raven 1170	21	55	60	107	101	1.8	162	124	USA	Inks, coatings and plastics applications
Raven 1100 Ultra[1]	32	72	72	101	95	2.4	124	120	USA	High quality sheet fed publication inks applications
Raven 1080 Ultra[1]	28	60	60	79	77	1.6	140	109	USA	High quality heatset inks, sheet fed / offset inks, and coatings applications
Raven 1060 Ultra[1]	30	50	50	66	65	1.6	128	102	USA	
Raven 1040[1]	28	100	100	90	86	2.6	139	115	USA	
Raven 1035[1]	26	65	65	91	91	2.4	155	125	USA	
Raven 1030	24	60	-	95	94	1.5	156	118	USA	Ink, coatings and plastics applications
Raven 1025	24	55	60	96	96	1.0	151	126	USA	Wide Format Ink Jet
Raven 1020	24	58	60	95	90	1.5	151	121	USA	Ink coatings and plastics applications
Raven 1000	24	58	63	92	91	1.9	155	126	USA	
Raven 890	30	-	102	69	68	1.3	130	97	USA	Coatings applications
Raven 880 Ultra	30	102	-	78	76	1.3	128	104	USA	Plastics applications
Raven 860 Ultra	39	48	50	48	48	0.7	112	91	USA	Offset inks - strong blue undertone, high loading, ink concentrates
Raven 850	34	70	75	63	63	1.2	130	101	USA	Coatings, inks, and plastisol applications
Raven 820	32	120	-	73	71	1.7	118	100	USA	Flexographic Ink applications
Raven 790 Ultra	30	-	105	64	64	1.2	135	95	USA	Sealant applications
Raven 785	31	72	-	89	76	0.6	123	105	USA	Toner Applications
Raven 780 Ultra	30	58	60	89	77	0.8	134	109	USA	Electrostatic dry toners
Raven 760 Ultra	30	48	50	64	64	1.4	128	102	USA	High quality heatset inks, sheet fed / offset inks, and coatings applications
Raven 520 / Raven 520 Ultra	58	121	121	40	39	0.9	95	58	USA	Plastic color concentrates for film and injection applications
Raven 510 / Raven 510 Ultra	58	90	-	38	38	0.9	98	57	USA	
Raven 500	53	75	80	44	44	1.2	100	69	USA	Coatings - tint applications
Raven 460	63	61	-	37	37	1.0	97	68	USA	Gravure Inks
Raven 450	65	63	65	35	34	1.0	93	61	USA	Plastic color concentrates for film and injection applications, plastic compounds, carbon paper, and powder coating applications. Blue undertone tints, characteristic of lampblack
Raven 430 Ultra	82	75	78	31	31	1.0	85	58	USA	
Raven 420	86	72	75	28	28	1.0	79	50	USA	
Raven 410 / Raven 410 Ultra	101	65	68	26	26	0.7	65	47	USA	
Raven 22	83	-	113	28	27	0.8	79	44	USA	Blue undertone tints, Carbon Brush applications - lampblack replacement
Raven 16	68	-	105	30	29	0.9	80	46	USA	
Raven 14[1]	55	-	111	44	44	1.7	94	66	USA	Coatings, color concentrates - lampblack replacement
Conductex SC Ultra	20	115	115	205	124	1.5	146	123	USA	Conductive applications
Raven UV Ultra	20	114	-	124	112	1.0	142	118	Canada	UV protection - cable jackets
Raven L Ultra	30	72	78	85	85	1.0	132	110	Canada	Plastics and ink applications
Conductex 7051 Ultra	56	121	-	43	42	1.0	94	55	Canada	Wire & Cable - stripable insulation shield
Conductex 7055 Ultra	42	170	-	55	50	1.0	105	61	Canada	Wire & Cable, ESD, and other Conductive Applications
Raven M	30	-	108	78	76	0.5	128	104	UK	Plastics and ink applications
Raven L	30	72	75	79	79	0.5	132	110	UK	
Raven PFEB	24	98	-	107	91	0.8	143	105	Germany	Plastic pipe and fiber applications
Raven P3	24	115	-	102	97	1.4	137	112	Germany	Fiber and engineering plastics applications
Raven P	22	113	-	155	109	0.9	138	107	Germany	Wire & Cable, ESD and other conductive applications
Statex F-12	32	-	110	72	73	1.7	121	105	Brasil	Wire & cable, PVC color concentrates & compounds, inks and coatings applications
Statex 300	32	-	74	78	80	1.9	125	110	Brasil	Medium Color - engineering plastics, masterbatches, PVC compounds, ink and coatings
Statex 125	22	-	125	110	107	1.0	135	116	Brasil	Engineering plastics, PVC color concentrates & compounds, inks and coatings
Copeblack 890	18	113	-	140	120	1.4	155	122	Brasil	UV protection, plastic color concentrates for film and injection, and letterpress ink applications
Copeblack 690	22	114	-	108	104	0.9	137	115	Brasil	
Copeblack 450	32	72	-	78	80	0.8	125	110	Brasil	Medium color - Applications in Plastics (high Loading), Low rub-off newsink.
Copeblack 49	58	121	-	38	37	0.7	96	57	Brasil	Plastic color concentrates for film and injection application
Copeblack 35	66	90	-	33	32	0.8	90	57	Brasil	Plastic color concentrates for film and injection applications, plastic compounds, carbon paper, and powder coating applications. Blue undertone tints, characteristic of lampblack
Copeblack 25	100	65	-	29	28	0.8	65	55	Brasil	
SPECIALTY ADDITIVE - FURNACE CARBON BLACKS										
Raven 690[3]	33	82	-	54	54	6.5	120	98	UK	Newsink applications
Raven H2O[1,2]	55	-	111	45	45	2.2	90	66	USA	Paper, Building materials, low energy dispersion
HIGH PURITY CARBONS										
PUREBLACK 100 Carbon	80	NA*	-	33	33	0.0	87	58	USA	Compliant with FDA 21CFR 187.3297 for indirect food contact applications. Well suited for high temperature, and moisture sensitive applications
PUREBLACK 115 Carbon	22	NA*	-	97	97	0.0	160	100	USA	
PUREBLACK 205 Carbon	42	NA*	-	50	50	0.0	115	54	USA	High Voltage Power Cable and other Conductive Applications

1 - Surface oxidized, "Treated" grade
treated grades typically range in pH from 3 - 3.5
un-treated grades typically range in pH from 6.5 - 8.0
2 - Specialty treatment for enhanced dispersion and handling properties
3 - Volatile Content includes ~6.5% Beading oil

FAQ's
Furnace carbon blacks have a Nominal specific gravity of 1.80
Furnace carbon black references: Color Index No.77266
Pigment Black 7
CAS No 1333-86-4

Ultra indicates carbon black having high purity with exceptionally low levels of ash and residue.
NA* - Traditional Oil Absorption test methods do not apply to PUREBLACK Carbons, new methods are under development.
Note: All data based on the latest and most reliable test methods available at time of publication

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