

SPECIALTY CARBON BLACKS FOR PLASTICS



Performance and leadership in black plastics

Cabot Corporation is a global performance materials company and we strive to be our customers' commercial partner of choice. We have been a leading manufacturer of carbon black and other specialty chemicals for more than 135 years, and we have supplied solutions to the plastics industry since its inception. Our global production network and three applications development facilities provide our customers with global service capabilities as well as the latest technical innovations.

Global reach

We support customers around the world in our global production and applications development centers

North America

- ◆ Canada
- ◆ Mexico
- ◆ United States

South America

- ◆ Argentina
- ◆ Brazil
- ◆ Colombia

Europe, Middle East & Africa

- ◆ Belgium
- ◆ Czech Republic
- ◆ France
- ◆ Germany
- ◆ Italy
- ◆ Latvia
- ◆ Norway
- ◆ Switzerland
- ◆ The Netherlands
- ◆ United Arab Emirates
- ◆ United Kingdom

Asia Pacific

- ◆ China
- ◆ India
- ◆ Indonesia
- ◆ Japan
- ◆ Korea
- ◆ Malaysia
- ◆ Singapore



The role of specialty carbon blacks in plastics

Specialty carbon blacks are produced through the partial combustion of hydrocarbons to meet rigorous specifications and deliver important functionality according to end-user performance requirements. There are many types of specialty carbon blacks typically defined by their particle size and structure.

These properties of carbon black enable its unique characteristics that deliver critical value to end-users through a range of functionalities including color, UV protection and conductivity. Selecting the right specialty carbon black requires balancing a range of properties.

Particle size and properties



Larger		Smaller
Lighter	Masstone	Darker
Weaker	Tinting strength	Stronger
Bluer	Tint understone	Browner
Lower	MB viscosity	Higher
Easier	Dispersibility	Harder
Lower	UV protection	Higher

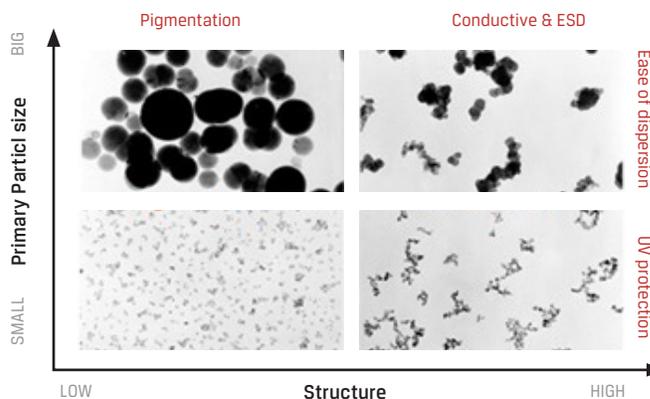
Mechanical performance / dispersion

As shown in the Figure 2, poor dispersion leads to only partial de-agglomeration of particles, causing surface defects. In contrast, excellent dispersion achieves de-agglomeration, minimizes surface defects, delivers strong color performance and minimizes deterioration of mechanical properties.

Physical cleanliness

While dispersion is key to achieving a high level of surface smoothness, physical cleanliness, or elimination of physical contaminants within carbon blacks, is also critical to enabling high levels of surface quality and mechanical properties. The presence of physical contaminants, or ash and grit, can cause degradation of both aesthetic properties and mechanical properties. Our BLACK PEARLS® specialty carbon blacks feature high levels of cleanliness as measured by the 325-mesh delta-P test.

FIGURE 1: Particle size and structure of carbon blacks

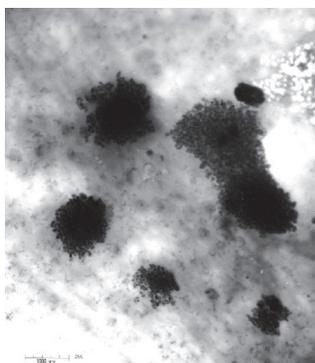


Structure and properties

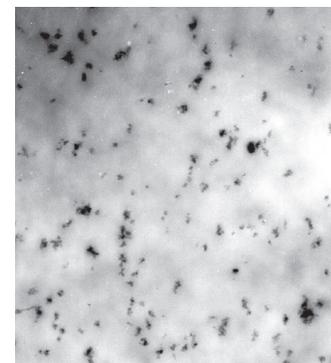


Higher		Lower
Higher	MB viscosity	Lower
Lower	Loadability	Higher
Easier	Dispersibility	Harder
Lower	Gloss	Higher
Higher	Conductivity	Lower
Weaker	Color	Stronger

FIGURE 2: Dispersibility comparison



Poor dispersibility (partial de-agglomeration)



Excellent dispersibility (full de-agglomeration)

FIBER



High jetness specialty carbon blacks for synthetic fiber applications

Delivering exceptional color and cleanliness for fiber and textile applications

For the fiber and textile industries, we offer a portfolio of specialty carbon blacks that deliver exceptional color performance and physical cleanliness enabling processors to maintain consistent, reliable production. Our specialty carbon blacks can help avoid the occurrence of undesirable features caused by dyes in synthetic fiber applications, including inconsistent fiber characteristics, low high color fastness and negative environmental impacts. Our products are suitable for use in a range of polymers, including polyester, nylon and polypropylene.

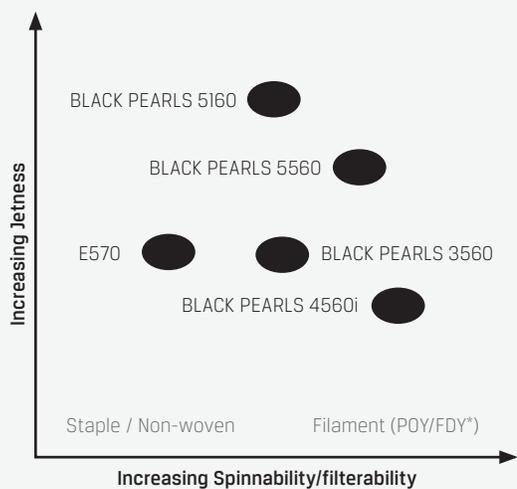
BLACK PEARLS® 5160 specialty carbon black

We are proud to introduce BLACK PEARLS 5160 specialty carbon black, our newest and highest jetness specialty carbon black for synthetic fiber applications that also offers the filterability needed to produce filament fibers.

Our updated portfolio

The new product complements our existing portfolio as shown in Figure 3.

FIGURE 3: Specialty carbon blacks for synthetic fibers



* FDY: Fully Drawn Yarn
POY: Partially Oriented Yarn

CARBON BLACK PRODUCT	DESCRIPTION
BLACK PEARLS 5160	A specialty carbon black for synthetic fiber applications offering Cabot's highest level of jetness without sacrificing filterability (cleanliness) for certain fiber applications
BLACK PEARLS 5560	High jetness specialty carbon black for demanding fiber applications, such as fine denier fiber, providing good blue tone and exceptional cleanliness
BLACK PEARLS 4560i	Specialty carbon black delivering superior cleanliness and processability (higher masterbatch loadings) for demanding fiber applications
BLACK PEARLS 3560	Specialty carbon black that offers a balance of cleanliness and color for standard fibers (e.g. high end carpets, coarse filaments)

MOLDED PARTS

Delivering product performance through superior color

We offer a range of specialty carbon blacks that provide superior color for molded parts (including injection or blow molded parts) used in the consumer, industrial and automotive markets. Our specialty carbon blacks can provide long lasting color or opacity to a wide range of polymers ranging from polyolefins to engineering thermoplastics. In addition, we routinely monitor our specialty carbon blacks for high purity and physical cleanliness to help produce excellent aesthetic quality for your final products.

Product performance

Specialty carbon blacks provide several important functionalities to molded parts including:

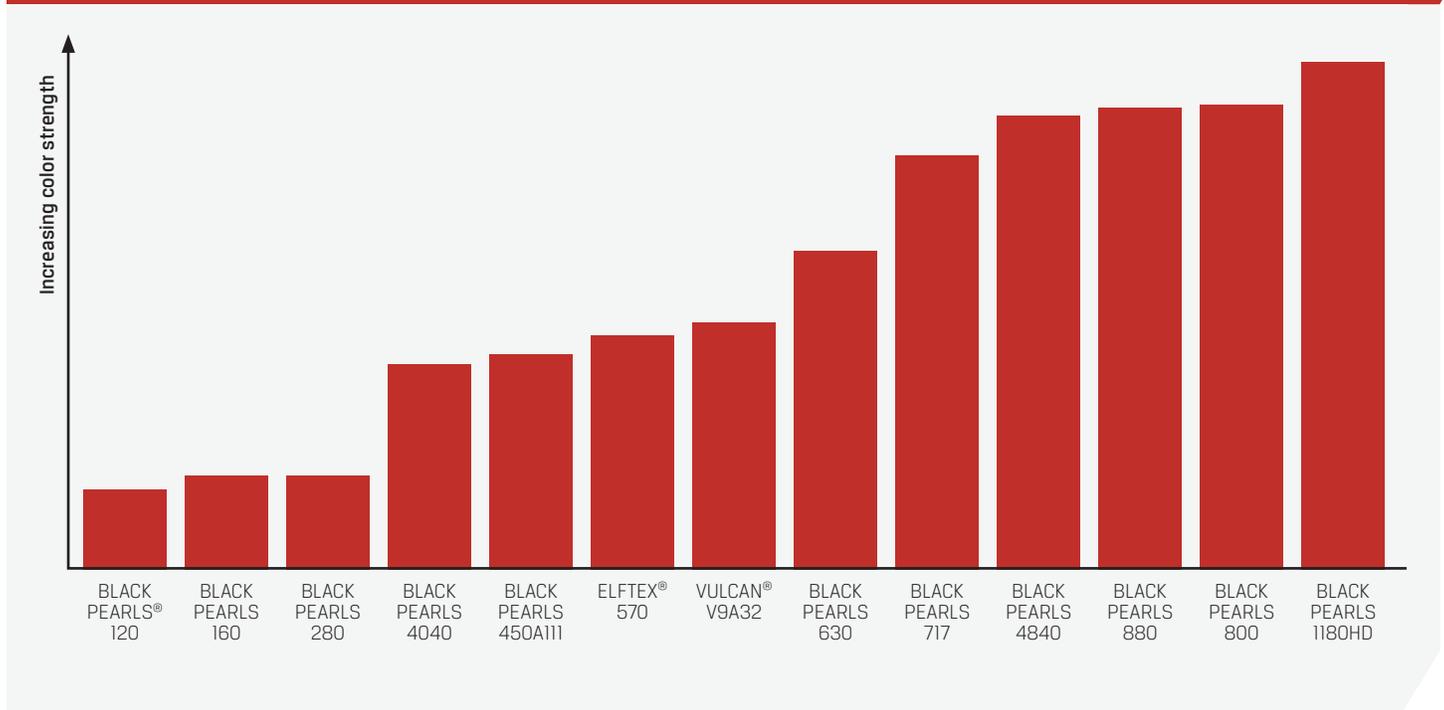
- ◆ Pigmentation to provide deep color
- ◆ Surface smoothness to ensure aesthetic quality
- ◆ Physical cleanliness to maintain mechanical properties of the overall part

We offer products for a variety of systems, including polyolefins and engineering plastics.

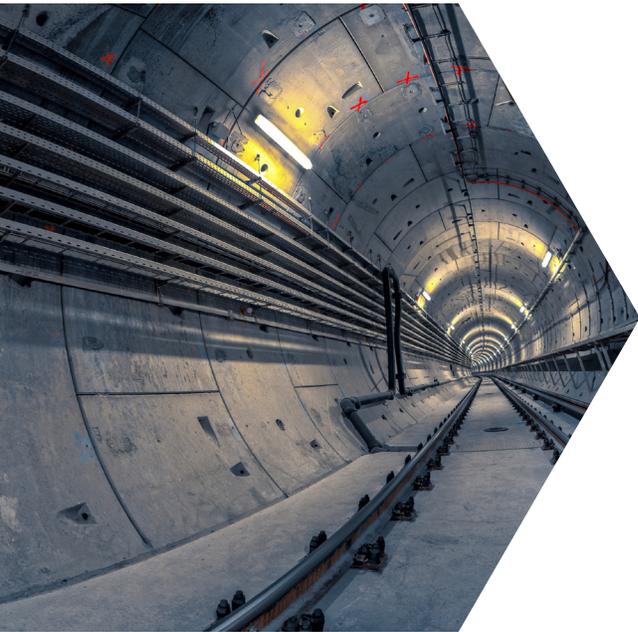
Illustrative color strength performance data for select products is presented in Figure 4 for ABS.



FIGURE 4: Specialty carbon black color strength in ABS



WIRE AND CABLE

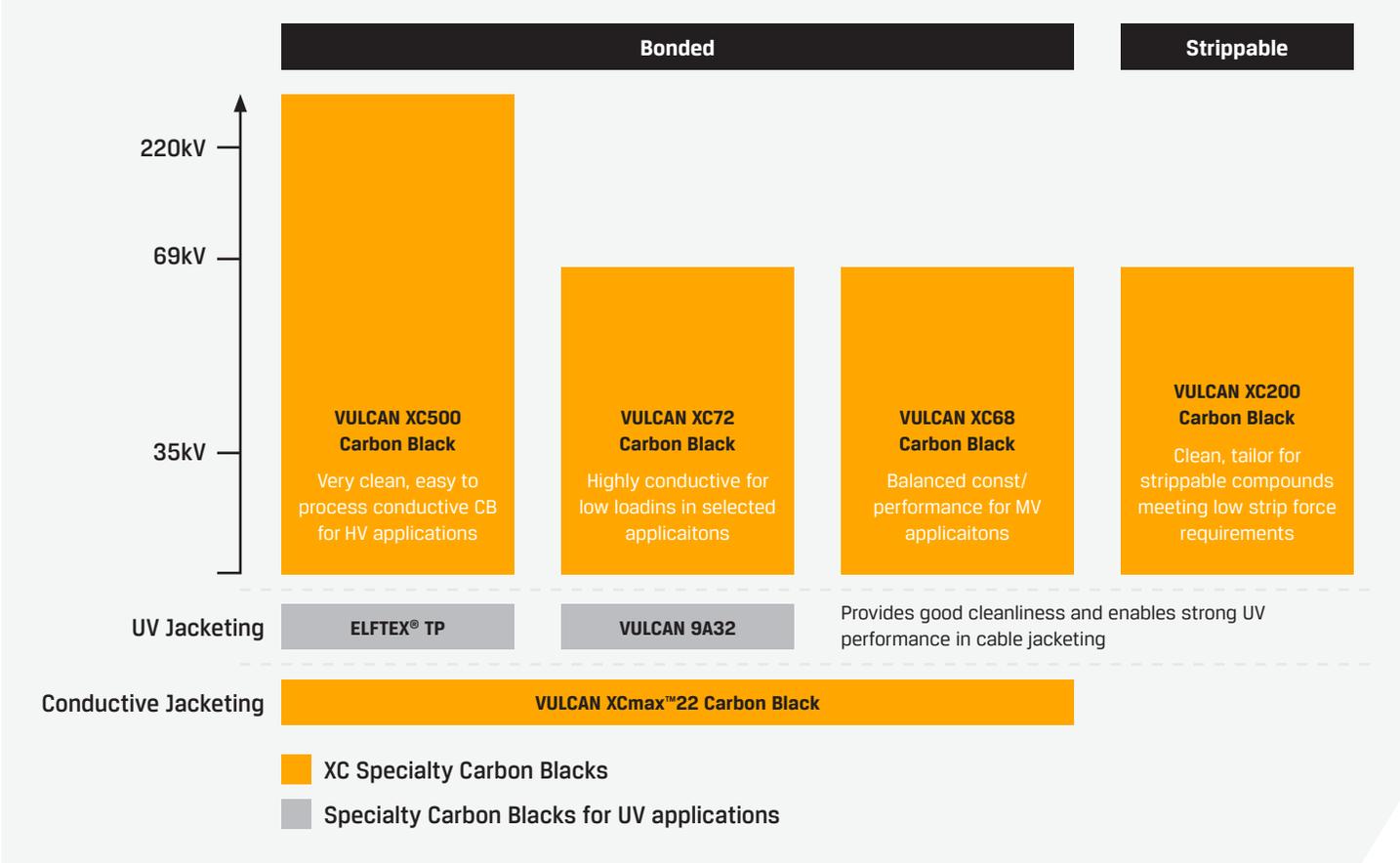


Delivering product performance for long-term reliability

Power cables are one of the most demanding applications for specialty carbon blacks as they provide critical performance in semicon shields. The semicon compound functions as a shield to smooth out sharp edges on the conductor surface and eliminate any electrical field stresses by homogenizing the electrical field around the conductor. Our VULCAN® XC specialty carbon blacks have been specifically designed to provide high performance around conductivity, cleanliness, and consistency to enable long-term performance of electricity cables

Data, telecom and power cable jacketing. Cable jacketing provides power and telecommunication cables with a protective waterproof layer against mechanical shocks, chemicals, oils and weathering exposure. Ultraviolet (UV) protection is critical to ensure the long-life performance of cable jacketing. We offer a full portfolio of specialty carbon blacks that deliver UV protection while offering good processability and end-use performance as well as high levels of cleanliness to ensure good surface smoothness.

FIGURE 5: Our Specialty Carbon Blacks for Wire and Cable Applications



PRESSURE PIPE

Products that enable premium UV protection

For the plastic pressure pipe industry, we are the leader in the development of high purity specialty carbon blacks defined as "p-types" that, when compounded using internationally recognized compounding techniques, can meet ISO and other national standards governing the production and installation of HDPE pressure pipe. Our p-type carbon blacks provide exceptional ultraviolet (UV) weathering and low compound moisture absorption (CMA) with extremely low levels of sulfur, ash and grit ensuring best-in-class performance in regulated pressure pipes.

Product performance

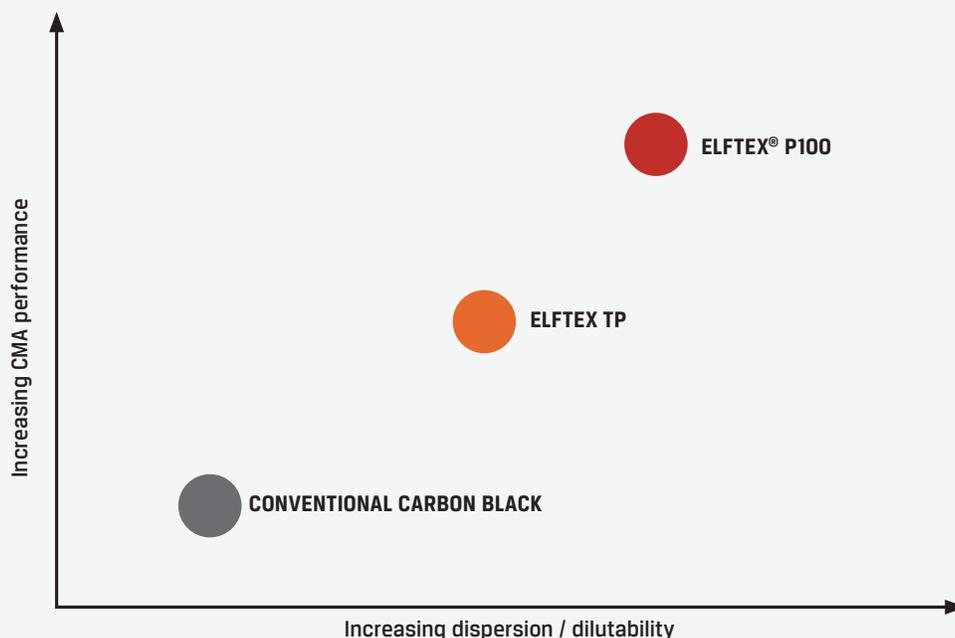
Our ELFTEX® TP and ELFTEX P100 p-type specialty carbon blacks are specifically designed to enable long-term performance in regulated pressure pipes due to the following features:

- ◆ UV protection
- ◆ Dispersibility
- ◆ Physical and chemical cleanliness
- ◆ Low CMA

Figure 6 shows how our featured products for the pressure pipe application compare against conventional carbon black in the areas of compound moisture absorption and dispersion/dilutability.



FIGURE 6: Carbon blacks for pressure pipe



CONDUCTIVE AND ESD

Delivering performance to increase conductivity and protect against electrical damage

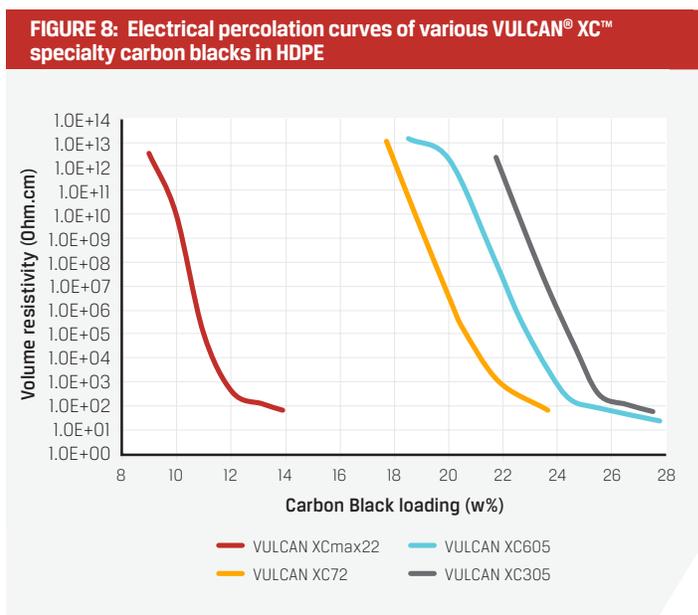
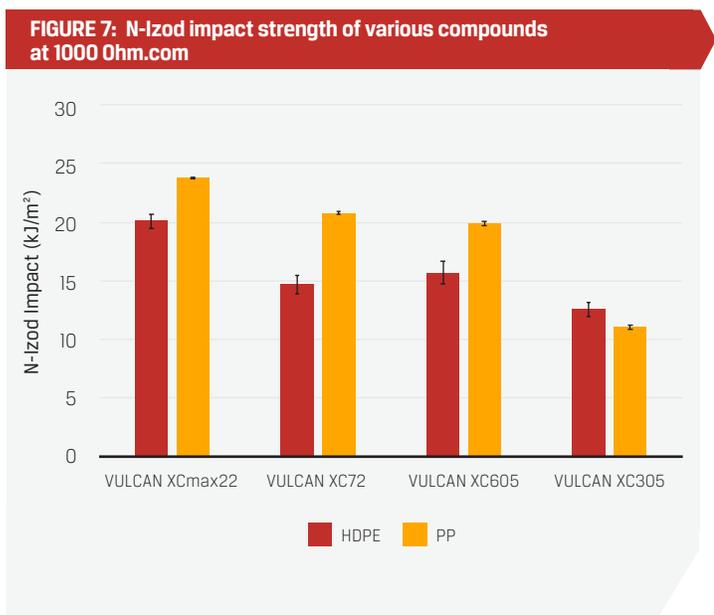
We offer a range of specialty conductive carbon blacks that provide conductive or electrostatic dissipative (ESD) performance in plastics. Conductive plastics are used to protect against premature failure or damage due to electrostatic discharge in a variety of applications such as automotive fuel systems, electronic and electrical packaging and equipment and other plastics applications.

	Application	Benefits
	ESD packaging <ul style="list-style-type: none"> Rigid boxes Thermoformed trays 	<ul style="list-style-type: none"> Prevention of uncontrolled static discharge Secure handling
	Industrial <ul style="list-style-type: none"> Processing & chemical industry Construction & mining industry 	<ul style="list-style-type: none"> Safety Lifetime extension Corrosion resistance Durability
	Transportation <ul style="list-style-type: none"> Fuel systems Motor housing systems 	<ul style="list-style-type: none"> Safe fuel handling Lightweighting Functionalization

All carbon blacks are conductive, however, we have designed a range of conductive specialty carbon blacks to allow our customers to achieve optimal performance for their specific applications considering several key features:

- ◆ **Conductivity:** Ability to conduct electricity; measured by the surface or volume resistivity of a polymer at a given loading
- ◆ **Surface smoothness:** Ability to minimize surface defects and increase aesthetic quality of the final product
- ◆ **Dispersibility:** Ease with which a conductive carbon black can be incorporated into a formulation

The addition of VULCAN®XCmax™22 specialty carbon black to our conductive black portfolio allows customers to select from a wide range of choices to meet their specific requirements. Our VULCAN XC conductive carbon black product line has been synonymous with cleanliness, consistency and conductivity required by highly demanding applications and the VULCAN XCmax family continues the tradition.



FOOD CONTACT PLASTICS

Delivering high purity and superior color performance

Many national and regional laws restrict the additives that can be incorporated into plastic materials and articles intended for food contact. We have designed a range of specialty carbon blacks that meet strict food contact requirements, including those established by the U.S. Food & Drug Administration (FDA) and the European Commission. Customers requiring exceptional color and opacity performance for their food contact applications can turn to us for carbon black products that will help meet performance and regulatory compliance needs.



Products for food contact compliance

We offer a full range of specialty carbon blacks for food contact in various regions. Table 1 describes the key requirements and the available Cabot specialty carbon blacks.

Regulation name	PAH restrictions on the carbon black	Carbon blacks
U.S. FDA (21CFR178.3297) & Cabot FCN 1789	<ul style="list-style-type: none"> ◆ Total PAHs ≤0.5 ppm (22 PAHs are referenced) ◆ Benzo(a)pyrene (BaP) ≤5 ppb ◆ Dosage as necessary 	<ul style="list-style-type: none"> ◆ BLACK PEARLS® 4350 ◆ BLACK PEARLS 4750 ◆ MONARCH® 4750
European Union (Reg. No. 10/2011)	<ul style="list-style-type: none"> ◆ Benzo(a)pyrene ≤ 0.25 mg/kg (250 ppb) ◆ Toluene extract ≤ 0.1% 	<ul style="list-style-type: none"> ◆ BLACK PEARLS 800 ◆ BLACK PEARLS 880 ◆ BLACK PEARLS 4040 ◆ BLACK PEARLS 4350 ◆ BLACK PEARLS 4560i ◆ BLACK PEARLS 4750 ◆ BLACK PEARLS 4840 ◆ ELFTEX® 254* ◆ ELFTEX 570 ◆ ELFTEX P 100 ◆ ELFTEX TP ◆ MONARCH 800 ◆ MONARCH 880 ◆ MONARCH 4750 ◆ VULCAN® 9A32
Mercosur (S. America) (GMC/RES. No 15/10 & GMC/RES No 32/07)	<ul style="list-style-type: none"> ◆ Cyclohexane extinction at 386 nm < 0.02 for 1 cm cell or < 0.1 for 5 cm cell ◆ In the final food contact item, a maximum of 2.5 % carbon black by weight is allowed 	
Switzerland (SR 817.023.21 of 1/5/17)	<p>Additional EU Requirements:</p> <ul style="list-style-type: none"> ◆ Primary particles of 10-300nm, aggregates of 100-1200nm, agglomerates 300nm+ 	
Japan (JHOSPA)	<ul style="list-style-type: none"> ◆ Benzo(a)pyrene (BaP) ≤ 0.25 mg/kg (250 ppb) ◆ Toluene extract ≤ 0.1% 	
China (Standard GB9685-2016)	<ul style="list-style-type: none"> ◆ Toluene extract ≤ 1% ◆ Benzo(a)pyrene ≤ 0.25 mg/kg (250 ppb) ◆ Colorant Purity requirements of China food contact material <p>In the final food contact item, a maximum percentage of carbon black by weight is allowed, depending of the type of polymer:</p> <ul style="list-style-type: none"> ◆ In PMMA, PVC, PVDC, PU, UP, PF, PEI, PPE, PBT, PPS, POM and LCP: maximum 2.5 % ◆ In PE: maximum 3% ◆ In PP, PS, AS, ABS, PA, PET and PC: dosage as necessary 	

* not submitted to JHOSPA

Industry / application	Key performance requirements	Typical polymers	Suggested products
Plastic film & sheet applications			
Packaging and lamination	<ul style="list-style-type: none"> ◆ Color / opacity ◆ Surface smoothness / quality ◆ UV / weatherability ◆ Dispersibility 	PE, Copolymer PE	<ul style="list-style-type: none"> ◆ BLACK PEARLS® 4040, 160, 120 ◆ ELFTEx® 570*
General purpose / utility			
Agricultural film & pipe			
Irrigation pipe & tape	<ul style="list-style-type: none"> ◆ UV / weatherability ◆ Microdispersion ◆ Surface smoothness ◆ Mechanical strength 	PE, Copolymer PE	<ul style="list-style-type: none"> ◆ BLACK PEARLS 4040, 160, 120 ◆ ELFTEx 570 ◆ VULCAN® 9A32
Mulch & silage film	<ul style="list-style-type: none"> ◆ UV / weatherability ◆ Opacity ◆ Mechanical strength 		
Geosynthetics			
Geogrids			
Geotextiles	<ul style="list-style-type: none"> ◆ UV / weatherability ◆ Color / opacity ◆ Dispersibility 	PE, Copolymer PE	<ul style="list-style-type: none"> ◆ ELFTEx TP ◆ BLACK PEARLS 4040, 280
Geomembranes			
Plastic pressure pipe			
Pressure pipe	<ul style="list-style-type: none"> ◆ UV / weatherability ◆ Physical cleanliness (e.g., Ash) ◆ Chemical cleanliness (e.g., sulfur) ◆ Dispersibility 	PE	<ul style="list-style-type: none"> ◆ ELFTEx P100, TP
Plastic Pipe			
Non-regulated & other pipe	<ul style="list-style-type: none"> ◆ UV / weatherability ◆ Color ◆ Dispersibility 	PE, PP, PVC	<ul style="list-style-type: none"> ◆ BLACK PEARLS 4040, 280 ◆ ELFTEx 570
Wire & Cable			
High voltage cable, semiconductive			<ul style="list-style-type: none"> ◆ VULCAN XC500
Medium voltage cable, semiconductive	<ul style="list-style-type: none"> ◆ Conductivity ◆ Surface Smoothness ◆ Physical Cleanliness (e.g., Ash) ◆ Chemical cleanliness (e.g., sulfur) 	EVA, EEA, EBA	<ul style="list-style-type: none"> ◆ VULCAN XC72, XC68, XC200
Conductive jacketing		PE	<ul style="list-style-type: none"> ◆ VULCAN XCmax™
UV jacketing	<ul style="list-style-type: none"> ◆ UV / weatherability ◆ Color ◆ Dispersibility 	PE, PVC	<ul style="list-style-type: none"> ◆ VULCAN 9A32 ◆ ELFTEx TP ◆ ELFTEx 570
Plastic Molded Parts			
Molded parts for consumer products	<ul style="list-style-type: none"> ◆ Color ◆ Surface Smoothness ◆ Dispersibility 	PP, ABS, PC/ ABS Blends, PA, POM	<ul style="list-style-type: none"> ◆ BLACK PEARLS 800, 450A111, 4840 ◆ VULCAN 9A32 ◆ BLACK PEARLS 1180HD*
Molded parts for industrial applications			

*for polar resins

Industry / application	Key performance requirements	Typical polymers	Suggested products
Food contact applications in plastics			
Molded and extruded food contact applications	<ul style="list-style-type: none"> ◆ PAH Levels ◆ Chemical Cleanliness (e.g., Sulfur) ◆ Physical Cleanliness (e.g., Ash) ◆ Color / Opacity 	PE, PP, PET, PS	<ul style="list-style-type: none"> ◆ US FDA: BLACK PEARLS 4350, 4750 ◆ Other Regions: Additional Products
Automotive parts			
Interior	<ul style="list-style-type: none"> ◆ Color ◆ UV / Weatherability ◆ Surface Smoothness / Quality ◆ Mechanical Strength ◆ Dispersibility 	PP, ABS, PC/ABS Blends, PA	<ul style="list-style-type: none"> ◆ BLACK PEARLS 900, 800, 4840, 717 ◆ ELFTX 570 ◆ VULCAN 9A32 ◆ BLACK PEARLS 1180HD*
Exterior			
Under the hood		PA, POM, PP	<ul style="list-style-type: none"> ◆ BLACK PEARLS 1300, 800 ◆ ELFTX 570
Fuel systems (Conductive/ESD)	<ul style="list-style-type: none"> ◆ Conductivity 		<ul style="list-style-type: none"> ◆ VULCAN XCmax, XC72, XC605
Synthetic fiber & textile fabrics			
Apparel	<ul style="list-style-type: none"> ◆ Physical Cleanliness (e.g., Ash) ◆ Color ◆ Dispersibility ◆ Filterability 	PET, PA, PP	<ul style="list-style-type: none"> ◆ BLACK PEARLS 5560, 5160, 4560i, 3560
Home/carpets			<ul style="list-style-type: none"> ◆ BLACK PEARLS 5560, 4560i, 3560 ◆ ELFTX 570
Technical, load-bearing (e.g., nylon)			<ul style="list-style-type: none"> ◆ Color ◆ Surface Smoothness / Quality ◆ Mechanical Strength
Conductive & ESD applications			
Electronic & Electrical <ul style="list-style-type: none"> ◆ IC Carrier Tapes ◆ ESD Films ◆ IC Thermoformed Trays ◆ ESD Corrugated Boards ◆ IC Rigid Trays ◆ ESD Boxes 	<ul style="list-style-type: none"> ◆ Conductivity ◆ Mechanical Strength ◆ Dispersibility ◆ Chemical Cleanliness (e.g., Sulfur) 	PS, PS/PPO Blends, PC LDPE, LLDPE, EVA PS, PS/PPO Blends PP PPO, PES PP, HDPE	<ul style="list-style-type: none"> ◆ VULCAN XCmax, XC72, XC605, XC305
Safety & Other <ul style="list-style-type: none"> ◆ Containers ◆ Fiber/Slit Tape ◆ Conveying ◆ Industrial & Consumer Conductive Moldings 		PP, HDPE PP PE, PP ABS, PP, PS, PA, PE	
Automotive <ul style="list-style-type: none"> ◆ Fuel systems 		PA, POM, PP, PE	

*for polar resins

Additional references

This Global Selection Guide provides high-level information about Cabot's specialty carbon black product offerings. For application-specific products, please refer to respective Cabot literature or contact your Cabot representative.

NORTH AMERICA

Cabot Corporation Business
and Technology Center
157 Concord Road
Billerica, MA 01821-7001
USA
T +1 800 462 2313
F +1 978 670 7035

SOUTH AMERICA

Cabot Brasil Industria
e Comercio Ltda.
Rua do Paraiso 148 - 5 andar
04103-000 São Paulo,
Brazil
T +55 11 2144 6400
F +55 11 3253 0051

EUROPE

SIA Cabot Latvia
74A Gustava Zemgala gatve
Riga LV-1039
Latvia
T +371 6705 0700
F +371 6780 6478

MIDDLE EAST & AFRICA

Cabot Dubai
P.O. Box 17894
Jebel Ali Free Zone
LOB 15, Office 424
Dubai
United Arab Emirates
T +371 6705 0700
F +371 6705 0985

ASIA PACIFIC

Cabot China Ltd.
558 Shuangbai Road
Shanghai 201108
China
T +86 21 5175 8800
F +86 21 6434 5532

JAPAN

Cabot Specialty Chemicals Inc.
Sumitomo Shiba-Daimon Bldg. 3F
2-5-5 Shiba Daimon,
Minato-ku
Tokyo 105-0012
Japan
T +81 3 6820 0255
F +81 3 5425 4500

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