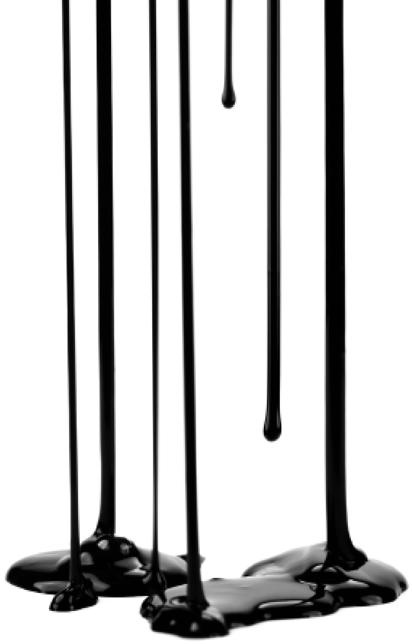
COLOUR BLACK FW 310 CARBON BLACK WITH DEEPEST BLACKNESS FOR WATER-BORNE AND SOLVENT-BORNE COATINGS

Technical Information 1485

1 INTRODUCTION



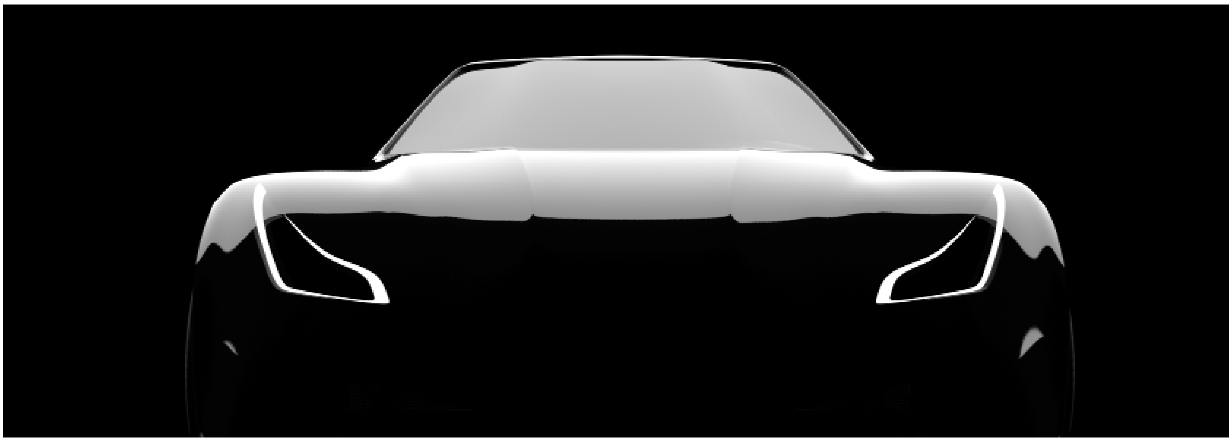
Deep, deeper, deepest blackness is the desire especially in the automotive world. To differentiate from other cars, end users and coatings manufacturers strive to achieve the ultimate black coatings for their cars. Although automotive is the main driver, further coatings segments like 3C coatings and high class industrial applications are also very interested in carbon blacks that can achieve ultra-high jetness. Following this demand, Orion has put huge efforts in innovation work, and thus presents our currently best in class high blackness carbon black: COLOUR BLACK FW 310.

COLOUR BLACK FW 310 extends our portfolio of specialty carbon blacks at the upper level and underlines our commitment to deliver to our customer best in class products. Orion has been offering over many years specialty carbon blacks in powder and for beaded forms that are manufactured by the Degussa gas black and the furnace black process to produce high quality high color carbon blacks for the coatings industry. Orion is the sole manufacturer of high color gas blacks and high color furnace blacks, both untreated and after-treated. This offers the unique opportunity to select the right pigment for any application based on different chemical behavior.

2 HOW TO ACHIEVE A SPECIALTY CARBON BLACK SUITABLE FOR ULTRA-HIGH JETNESS?

Mixtures of fine and coarse carbon blacks typically give low jetness performance. Same is true for carbon blacks with a broad particle size distribution or with a narrow particle size distribution in combination with a long tail of some coarser particles. The experienced technicians in our innovation department met the challenge, working with our unique pilot reactor on bringing the aggregate size and the primary particle size to a nearly mono-modal curve.

Furnace blacks with very fine particle size are typically suit-able for water-borne systems. Our target was to have a pigment based on a furnace black that is suitable for both solvent- and water-borne systems. To reach this target we took the furnace base black and gave it a special after-treatment. This after-treatment enhances the amount of oxygen containing groups (e.g. carboxylic groups) and thus gives the surface more polarity. So the pigment suits finally to both solvent- and water-borne systems. This enables customers to purchase one single grade that can be used in both applications. Complexity can be reduced, and, even more important, the same product can be used e.g. in automotive OEM and automotive refinish products, where different solvents are used.



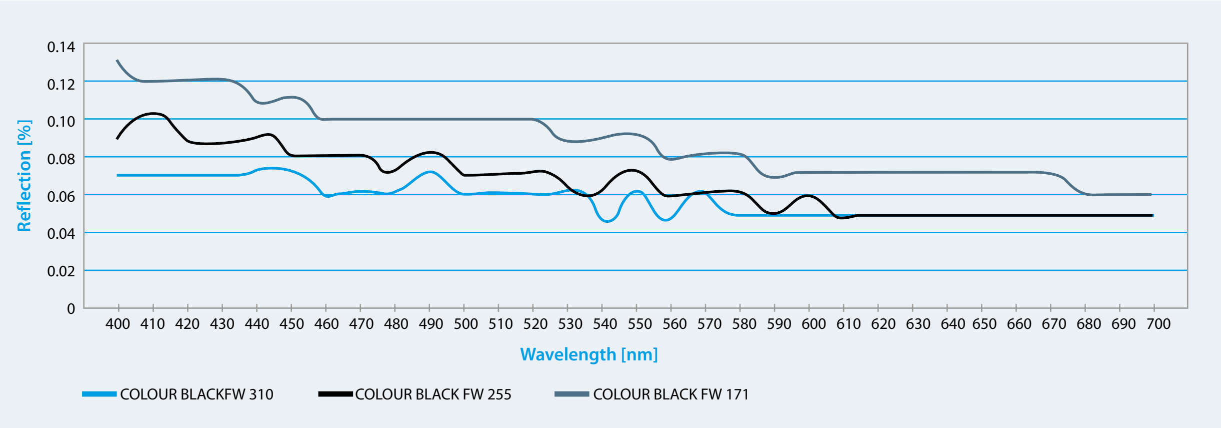
3 OUTSTANDING COLORISTIC PERFORMANCE

The first desire of coatings customers looking at a pigment like COLOUR BLACK FW 310 is the coloristic performance. In this high jetness area L*a*b* values are typically not giving good differentiation of different pigments. According to our experience, jetness M_Y and undertone dM are much better to describe deep black coatings. Details, how to measure these values, are given in literature [1] and [2].

In figure 1 you see the reflection curves of different high jetness carbon blacks in comparison. The reflectance of light is very low for all high jetness carbon blacks. Following consequently to optimize COLOUR BLACK FW 310, we have been able to significantly reduce the reflectance for a coating based on our new pigment COLOUR BLACK FW 310.

Figure 1

Comparison of reflectance of high jet carbon blacks in water-borne coating system, measured with Pausch Q35 spectrometer



3.1. COLOUR BLACK FW 310 in a water-borne mass tone application

The specialty carbon blacks were dispersed as follows:
In order to improve the dispersion of the specialty carbon black powders and stabilize the water-borne mill bases, 70% of active wetting agent related to the specialty carbon black powders was used. A suitable additive for this purpose is TEGO® Dispers 760W (Evonik Resource Efficiency GmbH, 35% active). After the initial wetting out of the pigment using a lab dissolver (Pendraulik LR34, 5 minutes at a peripheral speed of 10 m/s) milling was done using standard laboratory shaker (Skandex-Disperser DAS 200 or BA S-20), steel beads (3 mm) and a dispersing time of one hour. The viscosities of the mill bases were water like. Fineness of grind was below 5 µm. The concentration of the specialty carbon blacks in the binder-free millbases was 13%. More detailed recommendations regarding dispersion parameters and selecting the right dispersion equipment and milling beads can be found in literature [3].

Final coatings with a carbon black concentration of 1.5% (typical for automotive) were prepared using a coating system based on a commercially available 35 % PU dispersion (Alberdingk® U9800, Alberdingk & Boley GmbH).

Table 1

Guide line formulation used to prepare the mill base for the coatings given in figure 2

Deionizised water	60.5 g
TEGO Dispers® 760W	26 g
TEGO Foamex® 830	0.4 g
DMEA	0.1 g
Specialty carbon black	13 g
Total	**100 g**

Table 2

Let down formulation used to prepare the coatings given in figure 2

Alberdingk® U9800	75.8 g
Butylglykole	13.0 g
Deionizised water	10.0 g
BYK®-015	0.6 g
Tego® Wet 280	0.4 g
DMEA	0.2 g
Total	**100 g**

The coatings were applied on glass plates (200 µm wet film thickness), flash-off for 15 minutes and force dried at 60°C for 15 minutes.

Figure 2

Comparison of jetness M_Y and undertone dM of COLOUR BLACK FW 310 against COLOUR BLACK FW 255, COLOUR BLACK FW 200 & COLOUR BLACK FW 171 in a water-borne one component Polyurethane system.

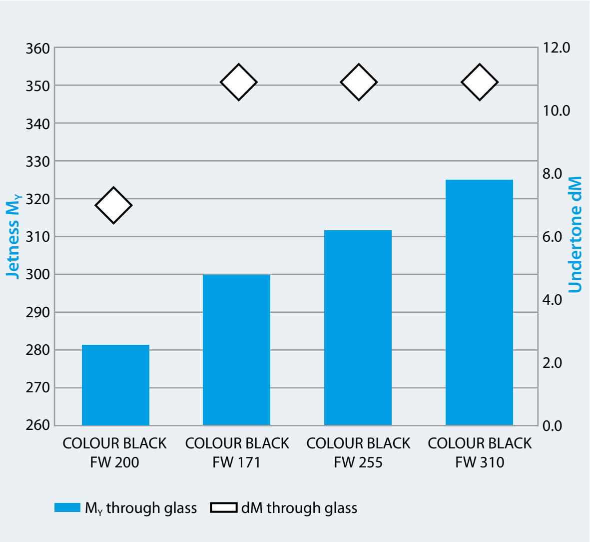


Figure 2 shows that in the tested water-borne coating system, COLOUR BLACK FW 310 achieves more than ten point higher jetness compared to the former best in class pigment COLOUR BLACK FW 255. The undertone is with more than ten as well on a very high level providing bluish undertone to the high jetness black coating.

As it is well known that the performance of high surface area carbon black depends strongly on the whole formulation and especially on the additive in use, we tested three different additives from different additive suppliers. The selection of the additives is not intended to be exhaustive, but rather indicative, as the selection of a dispersant is highly depending on the coating system and the specialty carbon black. 100% SOP has been used and the mill base concentration of carbon black has been 15%. Let down was done in the same manner as described on page 3. The final carbon black concentration in the coating was 1.5%.

Figure 3

Influence of additives on the performance of COLOUR BLACK FW 310 in a water-borne one component Polyurethane system.

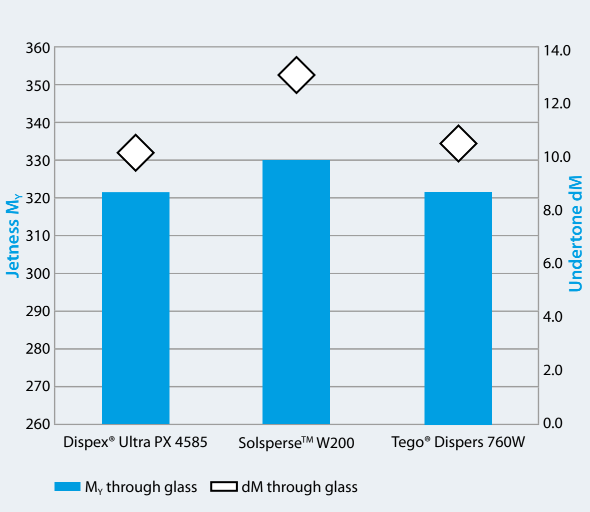


Figure 3 shows that the additives can give up to 10 point deviation in jetness and up to three points deviation in undertone. Looking at the whole color perception, this can result in close to a 15 point difference, which is clearly visible under bright light as well by the untrained human eye. Thus we recommend to every customer to look at the whole coating system including, additive, additive concentration, pH value, mill base viscosity, grinding time and energy to select the right conditions to get the utmost out of the high performance pigment. An analog to describe this is that if you want to drive a racing car, you need besides the car itself a great team, good tires, good gasoline, etc. to win the championship.

3.2. COLOUR BLACK FW 310 in a solvent-borne mass tone application

The colorimetric properties of COLOUR BLACK FW 310 were tested at a total specialty carbon black concentration of 2.2% in a solvent-borne 2K PU coating system, based on an acrylic binder. In a first step, the pigment was wetted with binder and solvent by using a lab dissolver (Pendraulik LR34, 5 minutes at a peripheral speed of 10 m/s), followed by the milling step with a standard laboratory shaker (Skandex-Disperser DAS 200 or BA S-20), steal beads (2 mm), and a dispersing time of one hour. The concentrated paste was let down with acrylic binder, solvent, and isocyanate as cross-linker. The formulation used, is given in table 3 and 4.

Table 3

Guide line formulation used to prepare the mill base for the coatings given in figure 4

DEGALAN® VP 4157 L	68.7 g
Butyl Acetate	23.0 g
Specialty carbon black	8.3 g
Total	**100 g**

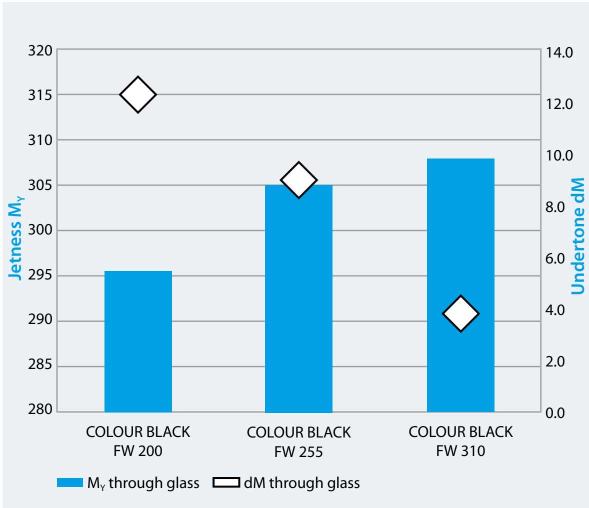
Table 4

Let down formulation used to prepare the coatings given in figure 4

Mill base	26.5 g
DEGALAN® VP 4157 L	47.5 g
DESMODUR® N75 MX 75%	6.0 g
2K-Diluent	20.0 g
Total	**100 g**

Figure 4

Comparison of jetness M_Y and undertone dM of COLOUR BLACK FW 310 against COLOUR BLACK FW 255 and COLOUR BLACK FW 200 in a solvent-borne two component Polyurethane system.



As demonstrated for water-borne coatings, as well in solvent-borne coatings the selection of the right additive and the right additive amount, is crucial. This is shown in figure 5. Deviations of more than 20 points of jetness can be found. Of course the findings will be completely different when using a different binder system. This is only to demonstrate that the formulation needs to be optimized with all ingredients.

For those trials an adjusted mill-base formulation was used based on Laropal® A81, with ~100% dispersant sop. The formulation is given in table 5. Let down was done as described in table 4.

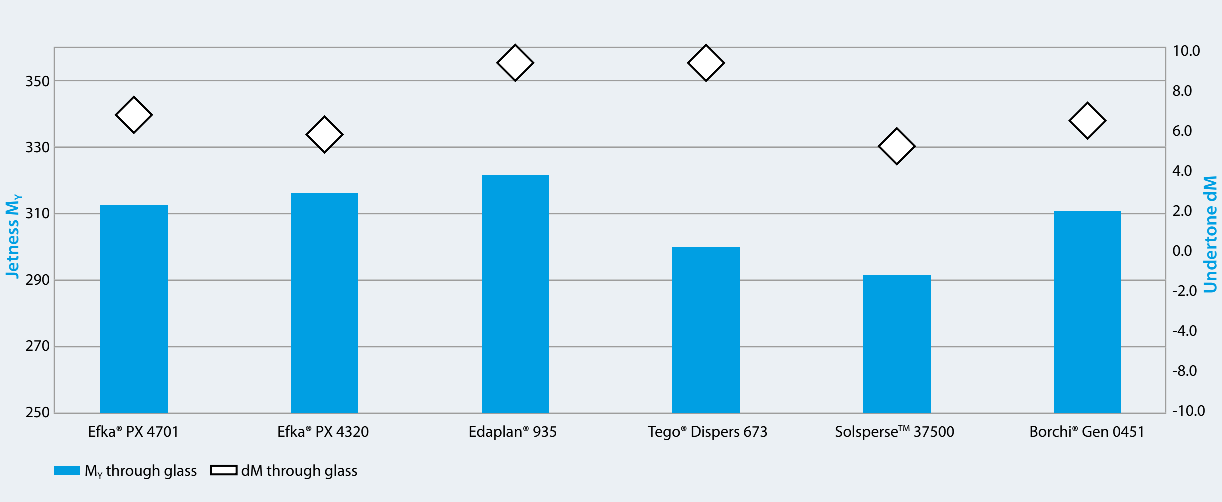
Table 5

Formulation used for the additive trials in a solvent-borne system

Laropal A81 (65 % in Butylacetate)	36.9 g
Dispersant (100 %)	10.5 g
Specialty carbon black	10.0 g
Butylacetate	42.6 g
Total	**100 g**

Figure 5

Influence of additives on the performance of COLOUR BLACK FW 310 in a solvent-borne two component Polyurethane system using millbases based on Laropal® A81



3.3. COLOUR BLACK FW 310 in a water-borne metallic application

Besides mass tone coatings, designers strive as well to get extraordinary good results for metallic coatings. Here often the carbon black used in combination with e.g. aluminum flakes plays a crucial role to achieve certain effects. Therefore we tested the new COLOUR BLACK FW 310 in comparison to COLOUR BLACK FW 171 and COLOUR BLACK FW 255 in such a formulation.

Metallic reductions were done using water-borne carbon black pastes (formulation as given as in table 1) in combination with commercially available aluminum pigment paste. The ratio of carbon black to aluminum pigment and also the resulting pigment mass concentration in the dried film are given in table 6.

Table 6

Guide line formulation used to prepare the coatings given in figures 6 - 8

Aluminum pigment ALP 20447*	72.7 %
Specialty carbon bBlack	27.3 %
PMC in dry film	41.7 %

Figure 6

Comparison of ΔL* depending on observation angle for metallic coatings prepared with COLOUR BLACK FW 310 (rReference) against COLOUR BLACK FW 255 and COLOUR BLACK FW 171

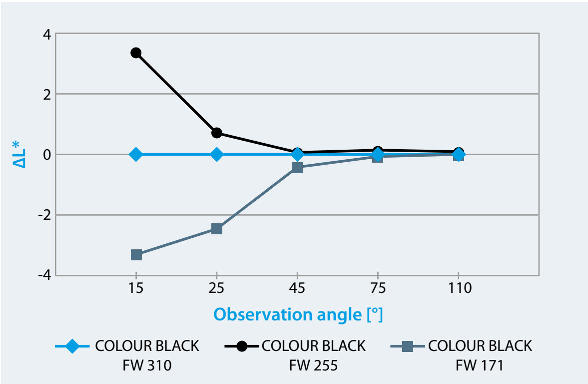


Figure 7

Comparison of Δa* depending on observation angle for metallic coatings prepared with COLOUR BLACK FW 310 (reference) against COLOUR BLACK FW 255 and COLOUR BLACK FW 171

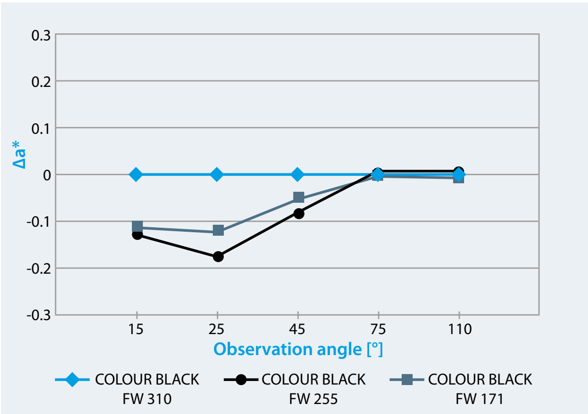
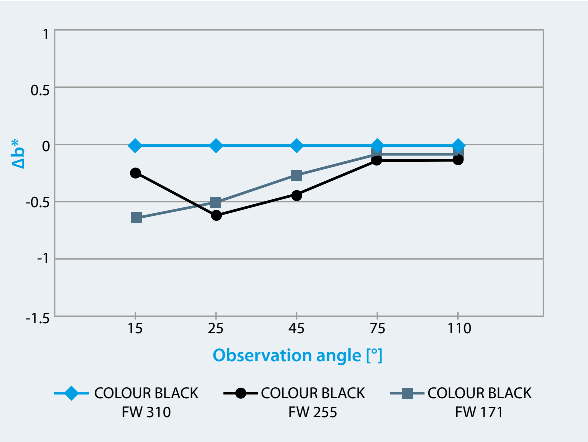


Figure 8

Comparison of Δb* depending on observation angle for metallic coatings prepared with COLOUR BLACK FW 310 (Reference) against COLOUR BLACK FW 255 and COLOUR BLACK FW 171



All trials with the metallic formulation were done using the same amount of specialty carbon black.

The color strength of COLOUR BLACK FW 171 is higher compared to both COLOUR BLACK FW 255 and COLOUR BLACK FW 310. In the 15° observation angle COLOUR BLACK FW 171 is darker, more bluish, and more greenish in comparison to COLOUR BLACK FW 310.

In the 15° observation angle COLOUR BLACK FW 255 is lighter, more bluish and more greenish in comparison to COLOUR BLACK FW 310. It appears more metallic like and the flop is stronger compared to both other tested pigments.

COLOUR BLACK FW 310 appears more golden in all observation angles. The flop is not that strong / more neutral compared to both other pigments.

Of course this is only an indication for this specific metallic system in use. But it clearly demonstrates that depended on the desires of a designer, variable effects can be achieved by selecting between the different high jetness carbon blacks. COLOUR BLACK FW 310 enlarges thus the color space for metallic coatings.

4 SUMMARY

With our goal to provide customers with technical solutions meeting their requirements, we have developed COLOUR BLACK FW 310. This carbon black is intended to give highest jetness values in combination with blue undertone for both solvent- and water-borne coating systems. To achieve this, the selection of the right additive depending on the coatings system is mandatory. Customers following the recommendations given in this technical information and using COLOUR BLACK FW 310 can meet the requests of car manufacturers to have ultra-high jetness cars with deep blue undertone and as well find new options for metallic coatings.

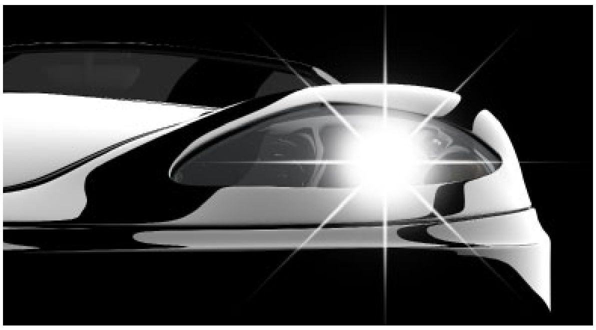
5 LITERATURE

[1] Lippok-Lohmer, Farbe und Lack 92 (11), 1024 (1986)

[2] Coloristic properties of specialty carbon blacks in full tone and tinting applications for coatings - Technical Information 1464, Orion Engineered Carbons GmbH (2015)

[3] Short cispersion guideline for specialty carbon blacks in coatings - Technical Information 1375, Orion Engineered Carbons GmbH (2017)

[4] Specialty carbon blacks in modern coating systems – Industry Information 0402, Orion Engineered Carbons GmbH (2017)



THE AMERICAS

Orion Engineered Carbons LLC
1700 City Plaza Drive, Suite 300
Spring, TX 77389
USA
Phone +1 832 445 3300

AMERICAS@orioncarbons.com

EUROPE/ MIDDLE EAST/ AFRICA

Orion Engineered Carbons GmbH
Frankfurter Straße 60 - 68
65760 Eschborn
Germany
Phone +49 6196 771 929 100

EMEA@orioncarbons.com

ASIA PACIFIC

Orion Engineered Carbons (China) Investment Co., Ltd.
Room 2301, 2302, 2307, BM InterContinental Business Center
100 Yutong Road, Jing'an District, Shanghai 20007
P. R. China
Phone +86 21 6107 0966

APAC@orioncarbons.com

INCORPORATED IN LUXEMBURG

Orion S.A., 6, Route de Trèves, 2633 Senningerberg, Luxembourg, Phone +352 270 48 06 0

Delivering sustainable solutions

www.orionsa.com

OEC-TI 1485-11/2024