

Technical Information

DF43



15 Series – Resistant, Opaque Glass Colors

In this Technical Information Ferro presents the **15 Series**. This series comprises 28 lead containing glass colors for the decoration of drinking glasses by indirect printing. Due to the lead release, the lip rim of drinking glasses should stay undecorated. Sometimes colors of the 15 Series are used for decorating earthenware if a lower firing temperature is preferred.

The colors are delivered in powder form.

The most significant properties of the 15 Series colors are their opacity and resistance. In addition to this, they also show high brilliance and a pretty gloss.

The available colors are listed in table 1 and fig. 1.

Application

The colors of the **15 Series** have excellent processing properties in all conventional decorating methods like screen printing (direct and indirect), spraying, pad printing and brush application. For cleaning of equipment and screens, we recommend cleaning oil 80 452.

Screen Printing (direct and indirect)

We recommend polyester screens with 68 - 90 threads/cm (175 - 230 mesh/inch) or stainless steel screens VA with 220 – 300 mesh/inch.

For further enhancement of opacity and color intensity, a white underlayer may be printed first. For this purpose 19 15007 is perfectly suited.

Spraying

Color suspensions for spraying application can be produced with oil-based media as well as with water-soluble media.

Media

For all standard methods, Ferro offers suitable media and covercoats. Further detailed technical information can be found in our **CerDePrint Media Guide**.

Storage

The colors should be stored in a dry place. Opened containers should be closed carefully. To ensure that the colors have not absorbed any humidity, we recommend drying the color powder at approx. 130 °C prior to mixing.

According to our experience, pastes can be stored up to 6 months in originally sealed containers. We recommend using pasted colors as soon as possible. If the paste is too thick, the viscosity has to be adjusted by addition of a medium.

Miscibility and Compatibility

All colors of the 15 Series are intermixable. However, not all mixture results can be foreseen in advance. Tests have shown that for example a mixture between blue and red does not result in a clear violet, but in a dim color shade.

Firing Conditions

The firing temperature range is between 580 and 630 °C. Soak times of 10 to 15 minutes at 580 °C are sufficient for the formation of a smooth surface. If a shorter peak time is required, a higher firing temperature is necessary.

The optimum firing result depends on the firing temperature, on the total firing time, the soak time and not least on the properties of the glaze. To achieve an optimized firing result, we therefore recommend the user to check under his own individual conditions.

All colors of the 15 Series contain lithium oxide. A decreased internal pressure resistance of the containers due to the diffusion of lithium during the firing process can not be excluded. Before applying the colors, the user has to check according to DIN 52 320 „Innendruckversuch für Hohlglasbehältnisse, insbesondere Behälterglas“ if the containers are suitable to be filled with beverage containing carbon dioxide.

Expansion Coefficient

The expansion coefficient of the colors lies between 88 and 92 x 10⁻⁷/K.

Acid and Alkali Resistance

The alkali and acid resistance of fired color layers is influenced by the thickness of the layer, the firing conditions. In lab tests and under industrial conditions, the colors of the **15 Series** show a good resistance to acids and alkalis (test with 4% acetic acid, 22 °C, 5 h, as well as with 0.5 % Calgonite solution, 77 °C, 16 h), exception: Royal Blue 12 15115).

Heavy Metal Release and Heavy Metal Content

The colors of the **15 Series** contain lead, some of them also contain cadmium.

The release of heavy metals is primarily influenced by the glaze composition, the firing conditions (firing cycle and kiln atmosphere), and the color deposit. It is therefore necessary that the end user tests the heavy metal release according to the relevant standard procedures for all products manufactured under his technical production conditions.

Our safety data sheets, which are available for every product, provide you with useful advice for working with our products.

Fig. 1: Color Samples of the 15 Series

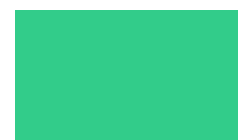
11 15143 Aqua



11 15417 Teal



11 15436 Moss Green



11 15446 Green



11 15449 Dark Green



12 15110 Sky Blue



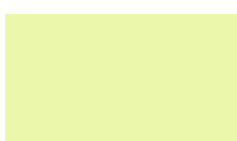
12 15112 Light Blue



12 15114 Blue



12 15115 Royal Blue



13 15330 Creme



13 15332 Yellow



13 15335 Sun Yellow



13 15503 Salmon



13 15535 Orange



13 15575 Tangerine



14 15886 Black



15 15884 Grey



16 15226 Red Brown



16 15228 Dark Brown



16 15234 Ochre



17 15072 Rose



17 15773 Cherry



17 15777 Red

**77 1499 Purple**

12 15104 Cyan



13 15304 Yellow



14 15804 Black



17 15704 Red

While every attempt has been made to reproduce colors exactly, the samples printed here may differ slightly from the finished ceramic products.

Table 1: The 15 Series colors

Product No.	Color Shade	Pantone® Code ¹
11 15143 ²	Aqua	319 c
11 15417 ²	Teal	322 c
11 15436 ²	Moss Green	377 c
11 15446 ²	Green	339 c
11 15449 ²	Dark Green	349 c
12 15110 ²	Sky Blue	299 c
12 15112 ²	Light Blue	284 c
12 15114 ²	Blue	285 c
12 15115 ²	Royal Blue	2728 c
13 15330 ²	Creme	393 c
13 15332 ²	Yellow	120 c
13 15335 ²	Sun Yellow	116 c
13 15503 ²	Salmon	1565 c
13 15535 ²	Orange	1585 c
13 15575 ²	Tangerine	172 c
14 15886 ²	Black	Process Black c
15 15884 ²	Grey	429 c
16 15226 ²	Red Brown	1685 c
16 15228 ²	Dark Brown	175 c
16 15234 ²	Ochre	143 c
17 15072 ²	Rose	169 c
17 15773 ²	Cherry	485 c
17 15777 ²	Red	1797 c
77 1499 ²	Purple	689 c
19 15007 ²	Opaque White	
10 15000 ²	Flux	
Process Colors:		
12 15104 ²	Cyan	285 c
13 15304 ²	Yellow	116 c
14 15804 ²	Black	Process Black c
17 15704 ²	Red	1797 c

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¹ The above mentioned **Pantone®** code is only a guideline for the color shade.

² GHS symbol 07, 08, 09, H phrases 302, 332, 360Df, 373, 410

Table 2: Mixing recommendations

Pantone No.	Color Shade	Parts in %	Color	Parts in %	Color	Parts in %	Color	Remarks
110 C	Ochre Yellow	70	13 15335	30	16 15234			77-48 Polyester
116	Ochre Yellow	70	13 15335	30	16 15234			230 VA Steel
120 C	Light Ochre	25	13 15332	25	16 15234	50	19 15007	77-48 Polyester
121 C	Yellow	15	13 15332	15	16 15234	70	19 15007	230 VA Steel
1215 C	Beige Yellow	80	19 15007	20	16 15234			230 VA Steel
122 C	Light Ochre	70	13 15332	30	16 15234			230 VA Steel
122 C	Light Ochre	25	13 15332	25	16 15234	50	19 15007	230 VA Steel
1225 C	Beige Yellow	50	16 15234	50	13 15330			230 VA Steel
123 C	Ochre	50	13 15332	50	16 15234			230 VA Steel
124 C	Ochre	30	13 15332	70	16 15234			230 VA Steel
124 C	Ochre	50	13 15335	50	16 15234			230 VA Steel
130 C	Ochre	30	13 15335	70	16 15234			230 VA Steel
131 C	Ochre	30	16 15226	70	13 15335			230 VA Steel
134 C	Beige Yellow	70	19 15007	30	16 15234			77-48 Polyester
135 C	Beige Yellow	50	19 15007	50	16 15234			77-48 Polyester
139 C	Ochre	30	16 15226	70	13 15335			77-48 Polyester
1395 C	Beige Brown	30	16 15228	70	16 15234			230 VA Steel
145 C	Beige	30	16 15226	70	16 15234			230 VA Steel
146 C	Yellow Brown	70	16 15226	30	11 15449			77-48 Polyester
1505 C	Orange	50	13 15335	50	13 15535			77-48 Polyester
151C	Orange	70	13 15335	30	13 15535			77-48 Polyester
153 C	Beige	30	16 15226	70	16 15234			77-48 Polyester
1535 C	Light Brown	50	16 15226	50	16 15234			77-48 Polyester
154 C	Beige Brown	50	16 15226	50	13 15335			77-48 Polyester
1545 C	Brown	70	16 15228	30	16 15234			77-48 Polyester
1555 C	Rose Salmon	70	19 15007	30	13 15503			230 VA Steel
1555 C	Rose Salmon	50	19 15007	50	13 15503			77-48 Polyester
1555 C	Light Salmon	30	13 15503	70	19 15007			230 VA Steel
1555 C	Light Salmon	50	13 15503	50	19 15007			77-48 Polyester
1565 C	Rose Salmon	55	13 15503	45	19 15007			230 VA Steel
1605 C	Red Brown	70	16 15226	30	16 15234			230 VA Steel
161 C	Brown	50	16 15228	50	16 15234			77-48 Polyester
162 C	Rose Salmon	70	19 15007	30	13 15503			77-48 Polyester
162 C	Rose Salmon	92	19 15007	8	16 15226			230 VA Steel
162 C	Light Salmon	10	16 15226	90	19 15007			230 VA Steel
167 C	Orange Red	70	16 15234	30	17 15777			230 VA Steel
168 C	Dark Brown	85	16 15226	15	14 15886			230 VA Steel
1685 C	Red Brown	70	16 15226	30	16 15234			77-48 Polyester
169 C	Rose	50	19 15007	50	17 15072			230 VA Steel
174 C	Rose Brown	70	16 15226	30	19 15007			77-48 Polyester
176 C	Rose	50	17 15072	50	19 15007			77-48 Polyester
179 C	Red	50	19 15007	50	17 15773			230 VA Steel
1795 C	Red	30	19 15007	70	17 15773			230 VA Steel
1795 C~	Red	10	13 15335	90	17 15777			77-48 Polyester
1797 C	Red	50	17 15072	50	17 15777			230 VA Steel
180 C	Salmon Red	30	16 15234	70	17 15777			230 VA Steel
180 C	Salmon Red	70	19 15007	30	17 15777			230 VA Steel
1805 C	Intensive Red	10	13 15335	90	17 15777			230 VA Steel
1805 C	Intensive Red	50	19 15007	50	17 15777			230 VA Steel
1807 C	Red	50	17 15072	50	17 15777			230 VA Steel
1807 C	Red	15	13 15535	85	17 15777			230 VA Steel
181 C	Dark Red	50	16 15226	50	17 15777			230 VA Steel
1815 C	Dark Red	30	16 15226	70	17 15777			230 VA Steel

Pantone No.	Color Shade	Parts in %	Color	Parts in %	Color	Parts in %	Color	Remarks
1815 C	Wine Red	50	12 15115	50	17 15777			230 VA Steel
1817 C	Wine Red	50	12 15114	50	17 15777			230 VA Steel
188 C	Dark Red	30	12 15114	70	17 15777			230 VA Steel
195 C	Wine Red	50	12 15115	50	17 15777			77-48 Polyester
200 C	Red	30	19 15007	70	17 15777			230 VA Steel
201 C	Dark Red	30	12 15115	70	17 15777			77-48 Polyester
202 C	Dark Red	30	12 15115	70	17 15777			230 VA Steel
285 C	Blue	80	12 15115	20	11 15417			77-48 Polyester
2915 C	Blue	90	12 15112	10	11 15417			77-48 Polyester
2925 C	Blue	70	12 15112	30	11 15417			77-48 Polyester
2935 C	Blue	90	12 15114	10	11 15417			230 VA Steel
294 C	Blue	80	12 15115	20	11 15417			230 VA Steel
2945 C	Blue	70	12 15114	30	11 15417			230 VA Steel
2985 C	Light Blue	50	12 15114	50	11 15143			77-48 Polyester
299 C	Light Blue	70	12 15114	30	11 15143			77-48 Polyester
299 C	Light Blue	60	12 15115	40	11 15417			77-48 Polyester
2995 C	Light Blue	50	12 15114	50	11 15143			230 VA Steel
3005 C	Blue	80	12 15114	20	11 15417			230 VA Steel
301 C	Blue	60	12 15115	40	11 15417			230 VA Steel
3015 C	Blue	70	12 15114	30	11 15417			230 VA Steel
302 C	Dark Blue	60	12 15115	30	11 15417	10	14 15886	230 VA Steel
3025 C	Turquoise Blue	50	12 15115	50	11 15417			230 VA Steel
3035 C	Turquoise Blue	50	12 15114	40	11 15417	10	14 15886	230 VA Steel
308 C	Blue	70	12 15114	20	11 15417	10	14 15886	270 VA Steel
3105 C	Light Turquoise	30	11 15417	70	19 15007			77-48 Polyester
3115 C	Light Turquoise	30	11 15417	70	19 15007			230 VA Steel
314 C~	Turquoise Blue	40	12 15114	60	11 15417			77-48 Polyester
315 C	Turquoise Blue	40	12 15114	60	11 15417			230 VA Steel
3165 C	Bluish Green	90	11 15417	10	14 15886			230 VA Steel
318 C	Light Turquoise	50	12 15110	50	13 15330			77-48 Polyester
319 C	Light Turquoise	50	12 15110	50	13 15330			230 VA Steel
320 C	Turquoise	60	11 15417	40	19 15007			77-48 Polyester
321 C	Bluish Green	95	11 15417	5	14 15886			77-48 Polyester
321 C~	Turquoise	50	11 15143	50	11 15417			230 VA Steel
322 C	Bluish Green	90	11 15417	10	14 15886			77-48 Polyester
323 C	Bluish Green	95	11 15417	5	14 15886			230 VA Steel
3285 C	Turquoise Green	70	11 15417	30	11 15449			77-48 Polyester
3289 C	Dark Green	50	11 15417	50	11 15449			77-48 Polyester
3308 C	Dark Green	90	11 15449	10	14 15886			230 VA Steel
332 C	Turquoise Green	30	12 15110	70	13 15330			77-48 Polyester
336 C	Turquoise Green	70	11 15417	30	11 15449			230 VA Steel
337 C	Turquoise Green	30	11 15446	70	19 15007			77-48 Polyester
337 C	Turquoise Green	30	12 15110	70	13 15330			230 VA Steel
338 C	Turquoise Green	60	11 15446	40	19 15007			77-48 Polyester
338 C	Turquoise Green	30	11 15446	70	19 15007			230 VA Steel
339 C	Turquoise Green	60	11 15446	40	19 15007			230 VA Steel
342 C	Dark Green	95	11 15449	5	14 15886			77-48 Polyester
370 C	Green	30	13 15335	70	11 15446			230 VA Steel
371 C	Green	40	13 15335	50	11 15417	10	16 15228	230 VA Steel
377 C	Green	30	13 15335	70	11 15446			77-48 Polyester
378 C	Green	40	13 15335	50	11 15449	10	14 15886	230 VA Steel
378 C	Moss Green	95	11 15436	5	14 15886			230 VA Steel
378 C	Green	40	13 15335	50	11 15449	10	16 15228	230 VA Steel
383 C	Light Green	50	13 15335	50	11 15436			77-48 Polyester

Pantone No.	Color Shade	Parts in %	Color	Parts in %	Color	Parts in %	Color	Remarks
384 C	Green	30	12 15114	70	13 15335			77-48 Polyester
385 C	Moss Green	50	12 15115	50	13 15335			77-48 Polyester
385 C	Dark Green	40	13 15335	40	11 15417	20	16 15228	77-48 Polyester
391 C	Light Green	30	12 15110	70	13 15335			230 VA Steel
391 C	Light Green	30	12 15115	70	13 15335			77-48 Polyester
392 C~	Olive Green	40	13 15335	40	11 15449	10	16 15228	77-48 Polyester
398 C	Light Green	70	13 15335	30	11 15436			77-48 Polyester
408 C	Brown Grey	10	16 15226	90	15 15884			230 VA Steel
419 C	Brown Grey	10	16 15228	90	15 15884			230 VA Steel
428 C	Light Grey	40	15 15884	60	19 15007			77-48 Polyester
429 C	Light Grey	60	15 15884	40	19 15007			77-48 Polyester
430 C	Grey	10	11 15143	90	15 15884			77-48 Polyester
437 C~	Gray Rose	10	17 15777	90	15 15884			230 VA Steel
444 C	Grey	95	15 15884	5	14 15886			270VA Steel
445 C	Grey	70	19 15007	30	14 15886			230 VA Steel
445+446 C	Grey	60	19 15007	40	14 15886			230 VA Steel
446 C	Dark Grey	50	19 15007	50	14 15886			230 VA Steel
4495 C	Light Khaki	80	13 15335	20	15 15884			230 VA Steel
4505 C	Light Khaki	80	13 15335	20	15 15884			77-48 Polyester
4645 C	Rose Brown	20	13 15535	80	15 15884			77-48 Polyester
4665 C	Skin Colored	90	19 15007	10	16 15228			77-48 Polyester
4665 C	Skin Colored	10	16 15228	90	19 15007			77-48 Polyester
4705 C	Rose Brown	50	16 15228	50	13 15330			77-48 Polyester
4705 C	Light Brown	60	19 15007	40	16 15228			77-48 Polyester
4715 C	Rose Brown	30	16 15228	70	13 15330			77-48 Polyester
4715 C	Skin Dark	80	19 15007	20	16 15228			77-48 Polyester
483 C	Red Brown	95	16 15226	5	14 15886			230 VA Steel
484 C	Dark Red	50	16 15226	50	17 15777			77-48 Polyester
484 C	Dark Red	30	16 15226	70	17 15777			77-48 Polyester
485 C	Orange Red	50	16 15234	50	17 15777			77-48 Polyester
486 C	Rose Beige	80	19 15007	20	16 15226			77-48 Polyester
487 C	Rose Beige	90	19 15007	10	16 15226			77-48 Polyester
490 C	Red Brown	50	12 15115	50	16 15226			77-48 Polyester
492 C	Dark Red	20	16 15226	80	17 15777			230 VA Steel
5115 C~	Dark Violet	70	12 15115	30	17 15777			230 VA Steel
5185 C~	Dark Violet	70	12 15114	30	17 15777			230 VA Steel
5415 C~	Bluish Grey	20	12 15115	80	15 15884			77-48 Polyester
5425 C	Bluish Grey	30	12 15110	70	15 15884			230 VA Steel
5425+5435 C	Grey	10	12 15114	90	15 15884			77-48 Polyester
5435 C	Bluish Grey	30	12 15110	70	15 15884			77-48 Polyester
5483 C	Green Grey	20	11 15417	80	15 15884			77-48 Polyester
5487 C	Green Grey	70	12 15115	30	16 15234			77-48 Polyester
5487+5497 C	Green Grey	10	11 15449	90	15 15884			77-48 Polyester
5497 C	Turquoise Grey	30	12 15115	70	13 15330			230 VA Steel
5503 C~	Grey	10	12 15110	90	15 15884			77-48 Polyester
5503+5507 C	Green Grey	30	11 15143	70	15 15884			77-48 Polyester
5507 C	Turquoise Grey	30	12 15115	70	13 15330			77-48 Polyester
5773 C	Grey Green	10	11 15436	90	15 15884			77-48 Polyester
620 C	Dark Khaki	30	12 15115	70	16 15234			320 VA Steel
625 C	Water Green	90	11 15446	10	14 15886			77-48 Polyester
625 C	Water Green	20	11 15449	80	15 15884			77-48 Polyester
695 C~	Rose	25	17 15777	75	15 15884			77-48 Polyester
696 C~	Rose	25	17 15777	75	15 15884			230 VA Steel
705 C	Rose	70	19 15007	30	17 15072			77-48 Polyester
7454 C	Greyish Blue	30	12 15114	70	15 15884			77-48 Polyester

Pantone No.	Color Shade	Parts in %	Color	Parts in %	Color	Parts in %	Color	Remarks
7483 C	Dark Green	30	16 15234	70	11 15449			230 VA Steel
7491 C	Green	70	12 15110	30	13 15335			77-48 Polyester
7495 C	Green	70	13 15335	30	11 15449			77-48 Polyester
7495 C	Green	50	12 15110	50	13 15335			230 VA Steel
7496 C	Green	50	12 15114	50	13 15335			77-48 Polyester
7496 C	Green	40	13 15335	40	11 15449	20	14 15886	77-48 Polyester
7498 C	Green	40	13 15335	50	11 15417	10	14 15886	230 VA Steel
7503 C	Light Khaki	10	13 15335	90	15 15884			77-48 Polyester
7503 C~	Dark Khaki	30	12 15115	70	16 15234			77-48 Polyester
7504 C	Grey Beige	10	13 15535	90	15 15884			77-48 Polyester
7517 C	Light Brown	30	16 15226	70	16 15234			77-48 Polyester
7522 C	Light Rose	30	16 15226	70	13 15330			77-48 Polyester
7524 C	Rose	50	16 15226	50	13 15330			77-48 Polyester
7524 C	Rose Brown	60	19 15007	40	16 15226			77-48 Polyester
7543 C	Grey	10	12 15115	90	15 15884			77-48 Polyester
7544 C	Grey	10	12 15115	90	15 15884			230 VA Steel
Black 4C	Brown Black	70	16 15228	30	11 15449			77-48 Polyester
Black 5C	Black Brown	50	12 15115	50	16 15228			77-48 Polyester
C.Gray 9C	Grey	90	15 15884	10	14 15886			77-48 Polyester
C.Gray 9C	Grey	80	19 15007	20	14 15886			77-48 Polyester
Cool Gray 7C	Grey	90	19 15007	10	14 15886			77-48 Polyester
Cool Gray10C	Grey	85	15 15884	15	14 15886			230 VA Steel
Cool Gray11C	Grey	80	15 15884	20	14 15886			230 VA Steel
Warm Red	Red	92	13 15575	8	17 15777			230 VA Steel
WarmGr. 6C	Brown Grey	10	16 15226	90	15 15884			77-48 Polyester
WarmGr. 7C	Brown Grey	10	16 15228	90	15 15884			77-48 Polyester

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* The above mentioned Pantone® code is only a guideline for the color shade.

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