FERRO PIGMENTS FOR COATINGS
Ferro Corporation (NYSE: FOE) is a leading global supplier of technology-based performance materials, including glass-based coatings, pigments and colors, and polishing materials. Ferro products are sold into the building and construction, automotive, appliances, electronics, household furnishings, and industrial products markets. The Company is headquartered in Mayfield Heights, Ohio, USA.

Our Values and behaviors:

- **CUSTOMER FOCUS**
  Our customers are why we exist. We build relationships with internal and external customers that are built on trust, a desire to understand their needs and challenges, and a genuine interest in making them more successful.

- **ACCOUNTABILITY FOR PERFORMANCE**
  As individuals and teams, we work to achieve the highest performance standards. We prioritize safety and environmental stewardship; providing high-value solutions for our customers; and creating value for Ferro’s shareholders.

- **INNOVATIVE THINKING**
  We encourage our associates to seek out new ideas for technologies and business processes, and to always look for ways to improve and to better serve our customers.

- **TEAMWORK AND COLLABORATION**
  We are committed to a work environment that promotes trust, mutual respect, teamwork and collaboration, and that focuses on consistently delivering value to our customers and shareholders.
### INORGANICS

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Color</th>
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</thead>
<tbody>
<tr>
<td>PB28</td>
<td>Cobalt Aluminate Blue Spinel</td>
<td>BLUE</td>
</tr>
<tr>
<td>PB29</td>
<td>Ultramarine Blue</td>
<td>BLUE</td>
</tr>
<tr>
<td>PB36</td>
<td>Cobalt Chromite Blue-Green Spinel</td>
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<tr>
<td>PV15</td>
<td>Ultramarine Violet</td>
<td>VIOLET</td>
</tr>
<tr>
<td>PV62</td>
<td>Strontium Phosphate Violet</td>
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<tr>
<td>PG17</td>
<td>Chrome Oxide Green</td>
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<td>PG26</td>
<td>Cobalt Chromite Green Spinel</td>
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<tr>
<td>PG50</td>
<td>Cobalt Titanate Green Spinel</td>
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<tr>
<td>PY34</td>
<td>Chrome Yellow</td>
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</tr>
<tr>
<td>PY42</td>
<td>Iron Oxide Yellow-Opaque</td>
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</tr>
<tr>
<td>PY42</td>
<td>Iron Oxide Yellow-Transparent</td>
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<tr>
<td>PY53</td>
<td>Nickel Antimony Titanium Yellow Rutile</td>
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</tr>
<tr>
<td>PY184</td>
<td>Bismuth Vanadate</td>
<td>YELLOW</td>
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<td>PBBr24</td>
<td>Chrome Antimony Titanium Buff Rutile</td>
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<td>PY119</td>
<td>Zinc Ferrite Brown Spinel</td>
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<td>PY164</td>
<td>Manganese Antimony Titanium Buff Rutile</td>
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<tr>
<td>PO85</td>
<td>Bismuth Oxysulphide</td>
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</tr>
<tr>
<td>PR101</td>
<td>Iron Oxide Red-Opaque</td>
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<tr>
<td>PR101</td>
<td>Iron Oxide Red-Transparent</td>
<td>RED</td>
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<td>PR104</td>
<td>Molybdate Orange</td>
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<td>PBk11</td>
<td>Black Iron Oxide</td>
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<td>PBk26</td>
<td>Manganese Ferrite Black Spinel</td>
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<td>PBk28</td>
<td>Copper Chromite Black Spinel</td>
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<td>PBk33</td>
<td>Iron Manganese Black Oxide</td>
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<td>PBBr29</td>
<td>Chrome Iron Brown Hematite</td>
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<tr>
<td>PG17</td>
<td>Chromium Green-Black Hematite</td>
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### FUNCTIONAL PIGMENTS

**COOL PIGMENTS**

**CORROSION INHIBITORS**

### ORGANICS

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<thead>
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<th>Code</th>
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<td>PV19</td>
<td>Quinacridone Violet</td>
<td>VIOLET</td>
</tr>
<tr>
<td>PV23</td>
<td>Dioxazin Violet</td>
<td>VIOLET</td>
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<tr>
<td>PG7</td>
<td>Phthalocyanine Green</td>
<td>GREEN</td>
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<tr>
<td>PY3</td>
<td>Monoazo Yellow</td>
<td>YELLOW</td>
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<tr>
<td>PY65</td>
<td>Monoazo Yellow</td>
<td>YELLOW</td>
</tr>
<tr>
<td>PY74</td>
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<td>PY83</td>
<td>Diarylide Yellow</td>
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<td>PY110</td>
<td>Isoindolinone Yellow</td>
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<td>PY138</td>
<td>Quinophthalone Yellow</td>
<td>YELLOW</td>
</tr>
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<td>PY139</td>
<td>Isoindoline Yellow</td>
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<td>PY151</td>
<td>Benzoimidazolone Yellow</td>
<td>YELLOW</td>
</tr>
<tr>
<td>PY154</td>
<td>Benzoimidazolone Yellow</td>
<td>YELLOW</td>
</tr>
<tr>
<td>PY170</td>
<td>Diarylide Yellow</td>
<td>YELLOW</td>
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<td>PY194</td>
<td>Benzoimidazolone Yellow</td>
<td>YELLOW</td>
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<td>PO34</td>
<td>Disazopyrazolone Orange</td>
<td>ORANGE</td>
</tr>
<tr>
<td>PO36</td>
<td>Benzimidazolone Orange</td>
<td>ORANGE</td>
</tr>
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<td>PR3</td>
<td>Beta-Naphthol Orange</td>
<td>RED</td>
</tr>
<tr>
<td>PR48:4</td>
<td>Bona Lake Red</td>
<td>RED</td>
</tr>
<tr>
<td>PR122</td>
<td>Quinacridone Red</td>
<td>RED</td>
</tr>
<tr>
<td>PR170</td>
<td>Naphthol AS Red</td>
<td>RED</td>
</tr>
<tr>
<td>PR177</td>
<td>Anthraquinone Red</td>
<td>RED</td>
</tr>
</tbody>
</table>

### ECO-LYSOPAC

**APPLICATION GUIDE**
PB15:X  PHTHALOCYANINE BLUE

MAIN CHARACTERISTICS

- Pigment Blue-crystal 15:X (C.I. 74160)
- Good overall fastness properties
- High tinting strength
- Wide range of coating applications

Heat fastness  >225°C*, 30 min
Light fastness  Excellent (8 on the blue wool scale)
Weather fastness  Excellent (5 on the grey scale)
Acid fastness  Excellent
Alkali fastness  Excellent
Solvent fastness  Excellent

RECOMMENDED PRODUCTS

Phthalocyanine Blue 1511C
Reddish blue α-crystal modification (PB15:1)

Phthalocyanine Blue 1531C
Greenish blue β-crystal modification (PB15:3)

Phthalocyanine Blue 1541C
Greenish blue β-crystal modification (PB15:4)

* Paint
PB28 COBALT ALUMINATE BLUE SPINEL

MAIN CHARACTERISTICS

- CoAl₂O₄
- Pigment Blue 28 (C.I. 77346)
- Spinel structure
- Reddish blue shade
- Ease of dispersion
- UV transparent, opaque to visible light, with moderate NIR reflectance ("cool" pigment)

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat fastness</td>
<td>&gt;500°C*, 5 min</td>
</tr>
<tr>
<td>Light fastness</td>
<td>Excellent (8 on blue wool scale)</td>
</tr>
<tr>
<td>Weather fastness</td>
<td>Excellent (5 on grey scale)</td>
</tr>
<tr>
<td>Acid fastness</td>
<td>Excellent</td>
</tr>
<tr>
<td>Alkali fastness</td>
<td>Excellent</td>
</tr>
<tr>
<td>Cement compatibility</td>
<td>Excellent</td>
</tr>
<tr>
<td>Solvent fastness</td>
<td>Excellent</td>
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</table>

RECOMMENDED PRODUCTS

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>22-5091</td>
<td>Standard grade</td>
</tr>
<tr>
<td>10336</td>
<td>High tinting strength, reddish shade</td>
</tr>
<tr>
<td>10446</td>
<td>High tinting strength, reddish shade</td>
</tr>
<tr>
<td>22-5500</td>
<td>Turquoise Blue</td>
</tr>
<tr>
<td>22-5600</td>
<td>Turquoise Blue, high tinting strength</td>
</tr>
<tr>
<td>22-5700</td>
<td>Turquoise Blue, greenish shade</td>
</tr>
<tr>
<td>22-5475</td>
<td>Modified cobalt blue with most reddish shade in the range</td>
</tr>
</tbody>
</table>
**PB29 ULTRAMARINE BLUE**

**MAIN CHARACTERISTICS**

- Sodium Aluminum Sulfosilicate $Na_{8-x}[(Al,Si)_{12}]O_{24}(S_x)_{2}$
- Pigment Blue 29 (C.I. 77007)
- Unique reddish blue shade
- Excellent ability to make whites “whiter”, greys bluer and blacks “jetter/deeper”
- Ease of dispersion

Semitransparent to visible light, transparent to NIR (“cool pigment”, but its cool performance will be highly dependent on substrate and formulation)

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
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<tbody>
<tr>
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<td>350°C, 5 min</td>
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<tr>
<td>Light fastness</td>
<td>Excellent (8 on blue wool scale)</td>
</tr>
<tr>
<td>Weather fastness</td>
<td>Excellent (4-5 on grey scale)</td>
</tr>
<tr>
<td>Acid fastness</td>
<td>Low, except acid resistant series</td>
</tr>
<tr>
<td>Alkali fastness</td>
<td>Excellent</td>
</tr>
<tr>
<td>Cement compatibility</td>
<td>Low, except Nubicem Series</td>
</tr>
<tr>
<td>Solvent fastness</td>
<td>Excellent</td>
</tr>
</tbody>
</table>
RECOMMENDED PRODUCTS

Nubicoat SERIES
Ultramarine Blues specifically designed and quality controlled for coatings
Nubicoat HWR (High Weather Resistance)
New generation, encapsulated Ultramarine Blue to enhance acid and weather fastness, suitable for indoor and outdoor applications
Nubicoat HTS (High Tinting Strength) and Nubicoat HRD (Highly Reddish)
For indoor and outdoor applications (the latter, only with highly cross-linked resins and/or highly stabilized-to-UV systems and/or high resistance to industrial/acid environment systems)

Nubicem SERIES
Ultramarine Blues specifically designed to be compatible with cementitious formulations, highly alkaline coatings, paints over highly alkaline substrates and lime paints; quality control in cement
Nubicem B-101
Cement compatible Ultramarine Blue, for indoor and outdoor applications (the latter, only when the contact with water or high humidity is not severe i.e. in dry areas or when the formulation is highly hydrophobic)
Nubicem B-201
Cement compatible Ultramarine Blue modified with Cobalt Blue, for the most demanding applications
PB36 COBALT CHROMITE BLUE-GREEN SPINEL

MAIN CHARACTERISTICS

- Co(Al,Cr)₂O₄
- Pigment Blue 36 (C.I. 77343)
- Spinel structure
- Greenish blue shade
- Ease of dispersion
- UV transparent, opaque to visible light, with moderate NIR reflectance (*"cool" pigment)

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
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<tbody>
<tr>
<td>Heat fastness</td>
<td>&gt;500°C*, 5 min</td>
</tr>
<tr>
<td>Light fastness</td>
<td>Excellent (8 on blue wool scale)</td>
</tr>
<tr>
<td>Weather fastness</td>
<td>Excellent (5 on grey scale)</td>
</tr>
<tr>
<td>Acid fastness</td>
<td>Excellent</td>
</tr>
<tr>
<td>Alkali fastness</td>
<td>Excellent</td>
</tr>
<tr>
<td>Cement compatibility</td>
<td>Excellent</td>
</tr>
<tr>
<td>Solvent fastness</td>
<td>Excellent</td>
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RECOMMENDED PRODUCTS

<table>
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<tr>
<th>Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>22-5070</td>
<td>Standard grade</td>
</tr>
<tr>
<td>22-5096</td>
<td>High tinting strength</td>
</tr>
<tr>
<td>22-5096B</td>
<td>The highest tinting strength</td>
</tr>
<tr>
<td>22-4400</td>
<td>Turquoise Blue, greenish shade</td>
</tr>
</tbody>
</table>

* Paint
PV15  ULTRAMARINE VIOLET

MAIN CHARACTERISTICS

- Sodium Aluminum Sulfosilicate $\text{Na}_{8-4}[(\text{Al},\text{Si})_{12}]\text{O}_{44}(\text{S})_{8-4}\text{H}_{2}$
- Pigment Violet 15 (C.I. 77007)
- Unique violet shades
- Excellent ability to make whites “whiter”
- Ease of dispersion
- Semitransparent to visible light, transparent to NIR (“cool” pigment”, but its cool performance will be highly dependent on substrate and formulation)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
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<tbody>
<tr>
<td>Heat fastness</td>
<td>300°C*, 5 min</td>
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<tr>
<td>Light fastness</td>
<td>Excellent (8 on blue wool scale)</td>
</tr>
<tr>
<td>Weather fastness</td>
<td>Excellent (4-5 on grey scale)</td>
</tr>
<tr>
<td>Acid fastness</td>
<td>Low</td>
</tr>
<tr>
<td>Alkali fastness</td>
<td>High</td>
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<tr>
<td>Cement compatibility</td>
<td>Low</td>
</tr>
<tr>
<td>Solvent fastness</td>
<td>Excellent</td>
</tr>
</tbody>
</table>

RECOMMENDED PRODUCTS

Nubix SERIES
The high dispersibility, narrow colorimetric tolerances, low free Sulfur content
Ultramarine Violets

- Nubix V-5  Bluish shade
- Nubix V-9  High tinting strength, unique blue shade
- Nubix V-40 High tinting strength, unique reddish shade
- Nubix V-60  Reddish/pink shade

* Paint
MAIN CHARACTERISTICS

- Pigment Violet 19 (C.I. 73900)
- Clean reddish Violet shade (β-modification)
- High tinting strength
- Good transparency
- Useable as shading component in both solid and metallic shades

Heat fastness 200°C*, 30 min
Light fastness Good (7-8 on blue wool scale)
Weather fastness Good (4 on grey scale)
Acid fastness Excellent
Alkali fastness Excellent
Solvent fastness Good

RECOMMENDED PRODUCTS

Lysopac Red Violet 1940C
Standard grade
**PV23**  
**DIOXAZINE VIOLET**

**MAIN CHARACTERISTICS**

- Pigment Violet 23 (C.I. 51319)
- Bluish Violet shade
- Very high tinting strength
- Much used as shading component

<table>
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<th>Characteristic</th>
<th>Value</th>
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<tbody>
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<td>Heat fastness</td>
<td>180°C*, 30 min</td>
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<td>Excellent (8 on blue wool scale)</td>
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<tr>
<td>Weather fastness</td>
<td>Excellent (5 on grey scale)</td>
</tr>
<tr>
<td>Acid fastness</td>
<td>Excellent</td>
</tr>
<tr>
<td>Alkali fastness</td>
<td>Excellent</td>
</tr>
<tr>
<td>Solvent fastness</td>
<td>Good</td>
</tr>
</tbody>
</table>

**RECOMMENDED PRODUCTS**

- Lysopac Violet 2341C  
  More reddish grade
- Lysopac Violet 2342C  
  More bluish grade

* Paint
PV62 • STRONTIUM PHOSPHATE VIOLET

MAIN CHARACTERISTICS

- Strontium Phosphate Violet Sr₅(PO₄)₂Cu₂O₃
- Apatite structure
- Unique violet shade
- Suitable for replacing PV23
- Excellent ability to make whites “whiter”
- Ease of dispersion
- Semitransparent to visible light, NIR absorbent

RECOMMENDED PRODUCTS

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
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<tbody>
<tr>
<td>Heat fastness</td>
<td>&gt;500°C, 5 min</td>
</tr>
<tr>
<td>Light fastness</td>
<td>Excellent (8 on blue wool scale)</td>
</tr>
<tr>
<td>Weather fastness</td>
<td>Excellent (5 on grey scale)</td>
</tr>
<tr>
<td>Acid fastness</td>
<td>High</td>
</tr>
<tr>
<td>Alkali fastness</td>
<td>High</td>
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<tr>
<td>Cement compatibility</td>
<td>High</td>
</tr>
<tr>
<td>Solvent fastness</td>
<td>Excellent</td>
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</table>

28-5333 Standard grade

* Paint
PG7  
**PHTHALOCYANINE GREEN**

### MAIN CHARACTERISTICS

- Pigment Green 7 (C.I. 74260)
- Good overall fastness properties
- High tinting strength
- Wide range of coatings applications

### RECOMMENDED PRODUCTS

**Phthalo cyanine Green 0762C**  
Bluish green standard grade

<table>
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<th>Value</th>
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<td>Heat fastness</td>
<td>250°C*, 30 min</td>
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<td>Light fastness</td>
<td>Excellent (8 on a blue wool scale)</td>
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<tr>
<td>Weather fastness</td>
<td>Excellent (5 on grey scale)</td>
</tr>
<tr>
<td>Acid fastness</td>
<td>Excellent</td>
</tr>
<tr>
<td>Alkali fastness</td>
<td>Excellent</td>
</tr>
<tr>
<td>Solvent fastness</td>
<td>Excellent</td>
</tr>
</tbody>
</table>

* Paint
**GREEN / inorganic pigments**

**PG17 CHROME OXIDE GREEN**

**MAIN CHARACTERISTICS**

- \( \text{Cr}_2\text{O}_3 \)
- Pigment Green 17 (C.I. 77288)
- Prismatic/Rhombohedral structure
- Olive green shade
- Ease of dispersion
- Opaque to visible light, with high NIR reflectance ("cool" pigment)

**Heat fastness**  800°C*, 5 min
**Light fastness**  Excellent (8 on blue wool scale)
**Weather fastness**  Excellent (5 on grey scale)
**Acid fastness**  Excellent
**Alkali fastness**  Excellent
**Cement compatibility**  Excellent
**Solvent fastness**  Excellent

**RECOMMENDED PRODUCTS**

**SMM SERIES**
- The micronized Chrome Oxide Greens
  - SMM-4  Bluish shade
  - SMM-6  Yellowish shade
  - SMM-7  Yellowish shade

**Nubicrom SERIES**
- The highly micronized/high dispersibility Chrome Oxide Greens
  - Nubicrom 02  Yellowish shade

* Paint
PG26  COBALT CHROMITE GREEN SPINEL

MAIN CHARACTERISTICS

- CoCr₂O₄
- Pigment Green 26 (C.I. 77344)
- Spinel structure
- Dark bluish green shade
- Ease of dispersion
- Opaque to visible light, with moderate NIR reflectance ("cool" pigment)

RECOMMENDED PRODUCTS

<table>
<thead>
<tr>
<th>Property</th>
<th>Grade</th>
</tr>
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<tbody>
<tr>
<td>Light fastness</td>
<td>Excellent (8 on blue wool scale)</td>
</tr>
<tr>
<td>Weather fastness</td>
<td>Excellent (5 on grey scale)</td>
</tr>
<tr>
<td>Acid fastness</td>
<td>Excellent</td>
</tr>
<tr>
<td>Alkali fastness</td>
<td>Excellent</td>
</tr>
<tr>
<td>Cement compatibility</td>
<td>Excellent</td>
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<tr>
<td>Solvent fastness</td>
<td>Excellent</td>
</tr>
<tr>
<td>Heat fastness</td>
<td>&gt;500°, 5 min</td>
</tr>
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</table>

21-4700  Standard grade

* Paint
PG50 COBALT TITANATE GREEN SPINEL

MAIN CHARACTERISTICS

- \( \text{Co}_2\text{TiO}_4 \)
- Pigment Green 50 (C.I. 77377)
- Spinel structure
- Bright green shade
- Ease of dispersion
- Opaque to visible light, with moderate NIR reflectance ("cool" pigment")
- Ni free products available

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat fastness</td>
<td>&gt;500°C*, 5 min</td>
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<tr>
<td>Light fastness</td>
<td>Excellent (8 on blue wool scale)</td>
</tr>
<tr>
<td>Weather fastness</td>
<td>Excellent (5 on grey scale)</td>
</tr>
<tr>
<td>Acid fastness</td>
<td>Excellent</td>
</tr>
<tr>
<td>Alkali fastness</td>
<td>Excellent</td>
</tr>
<tr>
<td>Cement compatibility</td>
<td>Excellent</td>
</tr>
<tr>
<td>Solvent fastness</td>
<td>Excellent</td>
</tr>
</tbody>
</table>

* Paint

RECOMMENDED PRODUCTS

- **21-4045** Standard grade
- **21-4030** High tinting strength, bluish shade
- **21-5801** Ni free (CMR classification free), bluish shade
- **21-5901** Ni free (CMR classification free), yellowish shade
- **21-4345** Ni free (CMR classification free), color like 21-4045
## MAIN CHARACTERISTICS

- Pigment Yellow 3 (C.I. 11710)
- Clean greenish yellow
- Semi-transparent version
- Coloristic suitable to replace greenish Chrome Yellow grades
- Less stable to strong organic solvents

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
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<tbody>
<tr>
<td>Heat fastness</td>
<td>140°C*, 30 min</td>
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<tr>
<td>Light fastness</td>
<td>Good (6-7 on blue wool scale)</td>
</tr>
<tr>
<td>Weather fastness</td>
<td>Good (4 on grey scale)</td>
</tr>
<tr>
<td>Acid fastness</td>
<td>Good</td>
</tr>
<tr>
<td>Alkali fastness</td>
<td>Excellent</td>
</tr>
<tr>
<td>Solvent fastness</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

* Paint

## RECOMMENDED PRODUCTS

- Acetanil Yellow 10 GH 0314C
  - Standard grade
PY34 • CHROME YELLOW

MAIN CHARACTERISTICS

- PbCrO$_4$·PbSO$_4$
- Pigment Yellow 34 (C.I. 77603)
- Monoclinic to Rhombic structure, depending on shade
- Bright yellow shade (middle, lemon and primrose)
- Ease of dispersion
- Opaque to visible light

CONVENTIONAL (L/D) SERIES

<table>
<thead>
<tr>
<th>Property</th>
<th>Middle/Lemon</th>
<th>Lemon</th>
<th>Primrose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat fastness</td>
<td>180°C*, 5 min</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light fastness</td>
<td>Middle/Lemon = Fair</td>
<td>Lemon = Medium</td>
<td>Primrose = Low</td>
</tr>
<tr>
<td>Weather fastness</td>
<td>Middle/Lemon = Medium</td>
<td>Lemon = Medium</td>
<td>Primrose = Low</td>
</tr>
<tr>
<td>Acid fastness</td>
<td>Fair</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alkali fastness</td>
<td>Low</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cement compatibility</td>
<td>Incompatible</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solvent fastness</td>
<td>Excellent</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

RECOMMENDED PRODUCTS

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AD-74</td>
<td>Conventional middle yellow</td>
</tr>
<tr>
<td>AD-81</td>
<td>Conventional lemon yellow</td>
</tr>
<tr>
<td>AL-90</td>
<td>Conventional primrose yellow</td>
</tr>
<tr>
<td>AR-73</td>
<td>Resistant middle yellow</td>
</tr>
<tr>
<td>ARS-82</td>
<td>Resistant lemon yellow</td>
</tr>
</tbody>
</table>

N.B. Ferro has not requested the REACH authorization for the use of Chrome Yellows in the European Union.

RESISTANT (R/S) SERIES

<table>
<thead>
<tr>
<th>Property</th>
<th>Middle/Lemon</th>
<th>Lemon</th>
<th>Primrose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat fastness</td>
<td>220-260°C, 5 min</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light fastness</td>
<td>Middle/Lemon = High</td>
<td>Lemon = High</td>
<td>Primrose = Fair</td>
</tr>
<tr>
<td>Weather fastness</td>
<td>Middle/Lemon = High</td>
<td>Lemon = High</td>
<td>Primrose = Fair</td>
</tr>
<tr>
<td>Acid fastness</td>
<td>High</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alkali fastness</td>
<td>Low</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cement compatibility</td>
<td>Incompatible</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solvent fastness</td>
<td>Excellent</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Nubiterm K SERIES

<table>
<thead>
<tr>
<th>Property</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat fastness</td>
<td>300°C*, 5 min</td>
</tr>
<tr>
<td>Light fastness</td>
<td>High</td>
</tr>
<tr>
<td>Weather fastness</td>
<td>High</td>
</tr>
<tr>
<td>Acid fastness</td>
<td>High</td>
</tr>
<tr>
<td>Alkali fastness</td>
<td>Low</td>
</tr>
<tr>
<td>Cement compatibility</td>
<td>Incompatible</td>
</tr>
<tr>
<td>Solvent fastness</td>
<td>Excellent</td>
</tr>
</tbody>
</table>

* Paint
**PY42 • IRON OXIDE YELLOW-OPAQUE**

**MAIN CHARACTERISTICS**

- FeOOH
- Pigment Yellow 42 (C.I. 77492)
- Goethite structure
- Dull, buff shade
- Ease of dispersion
- Opaque to visible light, with low NIR reflectance
- Possible replacement of Chrome Yellows in combination with Organics
- Good coloristics to combine with Organics and Inorganics to reach specific colors at very competitive cost e.g. natural greens, bright reds, chocolate browns, light beiges

**RECOMMENDED PRODUCTS**

<table>
<thead>
<tr>
<th>Heat fastness</th>
<th>160ºC, 5 min except Nubifer Y-7050 (260ºC, 5 min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light fastness</td>
<td>Excellent (8 on blue wool scale)</td>
</tr>
<tr>
<td>Weather fastness</td>
<td>Excellent (5 on grey scale)</td>
</tr>
<tr>
<td>Acid fastness</td>
<td>Excellent</td>
</tr>
<tr>
<td>Alkali fastness</td>
<td>Excellent</td>
</tr>
<tr>
<td>Cement compatibility</td>
<td>Excellent</td>
</tr>
<tr>
<td>Solvent fastness</td>
<td>Excellent</td>
</tr>
</tbody>
</table>

**Nubifer Y-5000 SERIES**

- The micronized/high dispersibility/narrow colorimetric tolerances Yellow Iron Oxides
  - Nubifer Y-5010: Light shade
  - Nubifer Y-5020: Reddish shade
  - Nubifer Y-5028LV: Reddish shade, enhanced rheological performance

**Nubifer Y-7000 SERIES**

- The micronized, high heat fastness Yellow Iron Oxides
  - Nubifer Y-7050: Encapsulated grade for high temperature curing coatings (heat fastness = 260ºC, 5 min)
PY42  IRON OXIDE YELLOW-TRANSPARENT

MAIN CHARACTERISTICS

- FeOOH
- Pigment Yellow 42 (C.I. 77492)
- Highly transparent
- Clean shade
- Absorb strongly UV-Light providing a natural and continuous UV protection
- Suitable to produce effect shades

Heat fastness  160°C*, 30 min
Light fastness  Excellent (8 on blue wool scale)
Weather fastness  Excellent (5 on grey scale)
Acid fastness  Excellent
Alkali fastness  Excellent
Solvent fastness  Excellent

RECOMMENDED PRODUCTS

Cappoxyt Yellow 4212X
Standard grade

Cappoxyt Yellow 4214X
Grade also suitable for OEM applications

* Paint
PY53 • NICKEL ANTIMONY TITANIUM YELLOW RUTILE

MAIN CHARACTERISTICS

- \((\text{Ti}, \text{Ni}, \text{Sb})\) \(\text{O}_2\)
- Pigment Yellow 53 (C.I. 77788)
- Rutile structure
- Light yellow shade
- Ease of dispersion
- Opaque to visible light, with high NIR reflectance ("cool" pigment)
- Possible replacement of Chrome Yellows in combination with Organics
- Cement compatibility: excellent

<table>
<thead>
<tr>
<th>Property</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Heat fastness</strong></td>
<td>500°C, 5 min</td>
</tr>
<tr>
<td><strong>Light fastness</strong></td>
<td>Excellent (8 on blue wool scale)</td>
</tr>
<tr>
<td><strong>Weather fastness</strong></td>
<td>Excellent (5 on grey scale)</td>
</tr>
<tr>
<td><strong>Acid fastness</strong></td>
<td>Excellent</td>
</tr>
<tr>
<td><strong>Alkali fastness</strong></td>
<td>Excellent</td>
</tr>
<tr>
<td><strong>Cement compatibility</strong></td>
<td>Excellent</td>
</tr>
<tr>
<td><strong>Solvent fastness</strong></td>
<td>Excellent</td>
</tr>
</tbody>
</table>

* Paint

RECOMMENDED PRODUCTS

10401 Standard grade
PY65 MONOAZO YELLOW

MAIN CHARACTERISTICS

- Pigment Yellow 65 (C.I. 11740)
- Reddish Yellow shade
- Semi-transparent version
- Coloristic suitable to replace reddish Chrome Yellow grades
- Less stable to strong organic solvents

Heat fastness 140°C*, 30 min
Light fastness Good (7 on blue wool scale)
Weather fastness Good (4 on grey scale)
Acid fastness Excellent
Alkali fastness Excellent
Solvent fastness Moderate

RECOMMENDED PRODUCTS

Acetanil Yellow R 6514C
Standard grade

* Paint
PY74 • MONOAZO YELLOW

MAIN CHARACTERISTICS

- Pigment Yellow 74 (C.I. 11741)
- Greenish to medium Yellow shade
- Good hiding power
- Coloristic suitable to replace medium Chrome Yellow grades
- Favorable pigment rheology to improve the pigment loading
- Less stable to strong organic solvents

Heat fastness: 140°C*, 30 min
Light fastness: Good (7 on blue wool scale)
Weather fastness: Good (4 on grey scale)
Acid fastness: Good
Alkali fastness: Good
Solvent fastness: Moderate

RECOMMENDED PRODUCTS

Acetanil Yellow 2GO 7415C
Standard grade
Acetanil Yellow 2GO 9116C
More economical grade
Acetanil Yellow 7416C
Grade with improved solvent resistance
PY83

DIARYLIDE YELLOW

MAIN CHARACTERISTICS

- Pigment Yellow 83 (C.I. 21108)
- Reddish Yellow shade
- Good tinting strength
- Both transparent and opaque grades available

Heat fastness: 200°C*, 30 min
Light fastness: Good (7-8 on blue wool scale)
Weather fastness: Good (3-4 on grey scale)
Acid fastness: Excellent
Alkali fastness: Excellent
Solvent fastness: Excellent

RECOMMENDED PRODUCTS

Diacetanil Yellow 3RH 8315C
Standard transparent grade
Lysopac Yellow 8312S
Cleaner and greener opaque grade

Lysopac Yellow 8313S
Standard opaque grade

* Paint
PY110 ISOINDOLINONE YELLOW

MAIN CHARACTERISTICS

- Pigment Yellow 110 (C.I. 56280)
- Very reddish yellow
- The transparency is an asset in metallic finishes
- Overall good fastness properties

Heat fastness: 220°C*, 30 min
Light fastness: Good (7-8 on blue wool scale)
Weather fastness: Good (4-5 on grey scale)
Acid fastness: Excellent
Alkali fastness: Excellent
Solvent fastness: Excellent

* Paint

RECOMMENDED PRODUCTS

Lysopac Yellow 1010C
Standard grade
PY138  QUINOPHTHALONE YELLOW

MAIN CHARACTERISTICS

- Pigment Yellow 138 (C.I. 56300)
- Greenish yellow shade
- Good hiding power
- Overall good fastness properties

Heat fastness  220°C*, 30 min
Light fastness  Good (7-8 on blue wool scale)
Weather fastness  Good (4-5 on grey scale)
Acid fastness  Excellent
Alkali fastness  Excellent
Solvent fastness  Good

* Paint

RECOMMENDED PRODUCTS

Lysopac Yellow 3810C
Standard grade
PY139 • ISOINDOLINE YELLOW

MAIN CHARACTERISTICS

- Pigment Yellow 139 (C.I. 56298)
- Reddish Yellow
- Good opacity
- Behaves poorly in contact with alkaline substrate

Heat fastness: 220°C*, 30 min
Light fastness: Good (7-8 on blue wool scale)
Weather fastness: Good (4-5 on grey scale)
Acid fastness: Excellent
Alkali fastness: Excellent
Solvent fastness: Excellent

RECOMMENDED PRODUCTS

Lysopac Yellow 3912C
Standard grade
PY151  BENZIMIDAZOLONE YELLOW

MAIN CHARACTERISTICS

- Pigment Yellow 151 (C.I. 13980)
- Clean greenish Yellow
- Good opacity
- Good rheological behavior
- Coloristic suitable to replace greenish Chrome Yellow grades
- Limited alkali resistance

RECOMMENDED PRODUCTS

<table>
<thead>
<tr>
<th>Heat fastness</th>
<th>200°C*, 30 min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light fastness</td>
<td>Good (7-8 on blue wool scale)</td>
</tr>
<tr>
<td>Weather fastness</td>
<td>Good (4-5 on grey scale)</td>
</tr>
<tr>
<td>Acid fastness</td>
<td>Excellent</td>
</tr>
<tr>
<td>Alkali fastness</td>
<td>Moderate</td>
</tr>
<tr>
<td>Solvent fastness</td>
<td>Good</td>
</tr>
</tbody>
</table>

* Paint
**PY154** • BENZIMIDAZOLONE YELLOW

### MAIN CHARACTERISTICS

- Pigment Yellow 154 (C.I. 11781)
- Greenish to medium Yellow
- Good rheological behavior
- One of the most weather fast organic yellows
- Coloristic suitable to replace medium Chrome Yellow grades

### RECOMMENDED PRODUCTS

<table>
<thead>
<tr>
<th>Product</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lysopac Yellow 5410C</td>
<td>Standard grade</td>
</tr>
<tr>
<td>Lysopac Yellow 5410P</td>
<td>Improved dispersibility</td>
</tr>
<tr>
<td>Lysopac Yellow 5412C</td>
<td>Improved behavior in water based applications</td>
</tr>
</tbody>
</table>

- Heat fastness: 160°C*, 30 min
- Light fastness: Excellent (8 on blue wool scale)
- Weather fastness: Excellent (5 on grey scale)
- Acid fastness: Excellent
- Alkali fastness: Excellent
- Solvent fastness: Good

* Paint
PY170 • DIARYLIDE YELLOW

MAIN CHARACTERISTICS

- Pigment Yellow 170 (C.I. 21104)
- Very reddish Yellow offering high gloss
- Unique shade developed by Ferro
- Good dispersibility
- Good hiding power

Heat fastness: 200°C*, 30 min
Light fastness: Good (6-7 on blue wool scale)
Weather fastness: Good (3-4 on grey scale)
Acid fastness: Excellent
Alkali fastness: Excellent
Solvent fastness: Good

RECOMMENDED PRODUCTS

Lysopac Yellow 7010C
Standard grade

Lysopac Yellow 7011C
Grade suitable for universal tinting systems
**PY184 • BISMUTH VANADATE**

**MAIN CHARACTERISTICS**

- BiVO₄
- Pigment Yellow 184 (C.I. 771740)
- Bright, primrose yellow shade
- Ease of dispersion
- Opaque to visible light, with high NIR reflectance ("cool" pigment)
- Possible replacement of Chrome Yellows in combination with Organics

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat fastness</td>
<td>200°C*, 30 min</td>
</tr>
<tr>
<td>Light fastness</td>
<td>Excellent (8 on blue wool scale)</td>
</tr>
<tr>
<td>Weather fastness</td>
<td>Excellent (5 on grey scale)</td>
</tr>
<tr>
<td>Acid fastness</td>
<td>Excellent</td>
</tr>
<tr>
<td>Alkali fastness</td>
<td>Excellent</td>
</tr>
<tr>
<td>Cement compatibility</td>
<td>Low</td>
</tr>
<tr>
<td>Solvent fastness</td>
<td>Excellent</td>
</tr>
</tbody>
</table>

* Paint

**RECOMMENDED PRODUCTS**

- **Lysopac Yellow 6601B** Standard grade
- **Lysopac Yellow 6602B** Standard grade (Replacement of Nubivan Y-901)
- **Lysopac Yellow 6607B** Newest generation of BiVa with superior color strength
- **Lysopac Yellow 6608B** Most economical grade
- **Lysopac Yellow 6611B** Most greenish version in alkyd melamine systems
- **Lysopac Yellow 6615B** Most reddish version
- **Lysopac Yellow 6616B** Standard grade
- **Lysopac Yellow 6618B** Grade with improved heat resistance for use in powder coatings
- **Lysopac Yellow 6716B** Very reddish and unique shade
PY194  •  BENZIMIDAZOLONE YELLOW

MAIN CHARACTERISTICS

- Pigment Yellow 194 (C.I. 11785)
- Greenish to medium Yellow shade
- Very high tinting strength
- Very good opacity

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat fastness</td>
<td>200°C*, 30 min</td>
</tr>
<tr>
<td>Light fastness</td>
<td>Good (7-8 on blue wool scale)</td>
</tr>
<tr>
<td>Weather fastness</td>
<td>Good (4 on grey scale)</td>
</tr>
<tr>
<td>Acid fastness</td>
<td>Excellent</td>
</tr>
<tr>
<td>Alkali fastness</td>
<td>Excellent</td>
</tr>
<tr>
<td>Solvent fastness</td>
<td>Good</td>
</tr>
</tbody>
</table>

RECOMMENDED PRODUCTS

Lysopac Yellow 9410C
Standard grade

* Paint
BUFF / inorganic pigments

PBr24  CHROME ANTIMONY TITANIUM BUFF RUTILE

MAIN CHARACTERISTICS

- (Ti, Cr, Sb) O₂
- Pigment Brown 24 (C.I. 77310)
- Rutile structure
- Clean, buff shade
- Ease of dispersion
- Opaque to visible light, with high NIR reflectance ("cool" pigment)
- Possible replacement of Chrome Yellows in combination

RECOMMENDED PRODUCTS

<table>
<thead>
<tr>
<th>Heat fastness</th>
<th>&gt;500°C, 5 min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light fastness</td>
<td>Excellent (8 on blue wool scale)</td>
</tr>
<tr>
<td>Weather fastness</td>
<td>Excellent (5 on grey scale)</td>
</tr>
<tr>
<td>Acid fastness</td>
<td>Excellent</td>
</tr>
<tr>
<td>Alkali fastness</td>
<td>Excellent</td>
</tr>
<tr>
<td>Cement compatibility</td>
<td>Excellent</td>
</tr>
<tr>
<td>Solvent fastness</td>
<td>Excellent</td>
</tr>
</tbody>
</table>

10406H  Standard grade, yellowish shade
10408H  Standard grade, reddish shade

23-6019  Yellowish shade
23-6070  Yellowish shade
23-6075  Reddish shade
**PY119 • ZINC FERRITE BROWN SPINEL**

**MAIN CHARACTERISTICS**

- ZnFe₂O₄
- Pigment Yellow 119 (C.I. 77496)
- Spinel structure
- Reddish buff shade
- Ease of dispersion
- Opaque to visible light, with moderate NIR reflectance ("cool" pigment)
- Possible replacement of Chrome Yellows in combination with Organics
- Good coloristics to combine with Organics and Inorganics to reach specific colors at very competitive cost e.g. natural greens, bright reds, chocolate browns, light beiges

**Heat fastness**
- Nubifer Y-805K (300°C, 5 min)
- Nubifer Y-905K (260°C, 5 min)

**Light fastness**
- Excellent (8 on blue wool scale)

**Weather fastness**
- Excellent (5 on grey scale)

**Acid fastness**
- Excellent

**Alkali fastness**
- Excellent

**Cement compatibility**
- Excellent

**Solvent fastness**
- Excellent

**RECOMMENDED PRODUCTS**

- **Nubifer Y-805K**
  - Very high heat fastness
  - (300°C, 5 min), dark, reddish shade

- **Nubifer Y-905K**
  - High heat fastness
  - (260°C, 5 min), light, yellowish shade
BUFF / inorganic pigments

PY164  MANGANESE ANTIMONY TITANIUM BUFF RUTILE

MAIN CHARACTERISTICS

- \((\text{Ti}, \text{Mn}, \text{Sb}) \text{O}_2\)
- Pigment Yellow 164 (C.I. 77899)
- Dark brown shade
- Ease of dispersion
- Opaque to visible light, with high NIR reflectance (“cool” pigment)

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat fastness</td>
<td>200°C, 30 min</td>
</tr>
<tr>
<td>Light fastness</td>
<td>Excellent (8 on blue wool scale)</td>
</tr>
<tr>
<td>Weather fastness</td>
<td>Excellent (5 on grey scale)</td>
</tr>
<tr>
<td>Acid fastness</td>
<td>Excellent</td>
</tr>
<tr>
<td>Alkali fastness</td>
<td>Excellent</td>
</tr>
<tr>
<td>Cement compatibility</td>
<td>Excellent</td>
</tr>
<tr>
<td>Solvent fastness</td>
<td>Excellent</td>
</tr>
</tbody>
</table>

RECOMMENDED PRODUCTS

- 10550  Standard grade
**PO34**

**DISAZOPYRAZOLONE ORANGE**

**MAIN CHARACTERISTICS**

- Pigment Orange 34 (C.I. 21115)
- Bluish orange clean shade
- Good opacity
- Coloristic suitable to replace red lead molybdates

**Heat fastness**: 200°C*, 30 min

**Light fastness**: Good in full shade only
- (6-7 on blue wool scale)

**Weather fastness**: Good in full shade only
- (3-4 on grey scale)

**Acid fastness**: Excellent

**Alkali fastness**: Excellent

**Solvent fastness**: Good

**RECOMMENDED PRODUCTS**

- **Lysopac Orange 3420C**
  - Standard grade
- **Lysopac Orange 3421C**
  - A more bluish grade

* Paint
***MAIN CHARACTERISTICS***

- Pigment Orange 36 (C.I. 11780)
- Reddish somewhat dull orange
- Good rheological behavior
- Good opacity
- Coloristic suitable to replace red lead molybdates

---

**RECOMMENDED PRODUCTS**

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat fastness</td>
<td>160°C*, 30 min</td>
</tr>
<tr>
<td>Light fastness</td>
<td>Good (7-8 on blue wool scale)</td>
</tr>
<tr>
<td>Weather fastness</td>
<td>Good (4-5 on grey scale)</td>
</tr>
<tr>
<td>Acid fastness</td>
<td>Excellent</td>
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<tr>
<td>Alkali fastness</td>
<td>Excellent</td>
</tr>
<tr>
<td>Solvent fastness</td>
<td>Good</td>
</tr>
</tbody>
</table>

* Paint

Lysopac Orange 3620C  
Standard grade

Lysopac Orange 3621C  
A slightly more bluish grade
MAIN CHARACTERISTICS

- BiOX
- Pigment Orange 85
- Bright Yellowish Orange with high chroma
- Ease of dispersion
- Exceptional coloristic property allows to produce clean yellow, orange and red shades in combination with appropriate organic pigments

RECOMMENDED PRODUCTS

Heat fastness 200°C*, 30 min
Light fastness Good (7-8 on blue wool scale)
Weather fastness Good (4-5 on grey scale)
Acid fastness Moderate
Alkali fastness Good
Solvent fastness Excelent

Lysopac Orange 6820B
Standard grade for coatings

Lysopac Orange 6821B
Coated version with improved chemical resistance
PR3  BETA-NAPHTHOL RED

MAIN CHARACTERISTICS

- Pigment Red 3 (C.I. 12120)
- Yellowish to Bluish red shade
- Yellowish version has more gloss and higher tinting strength
- Good light and weather fastness in full shade only

<table>
<thead>
<tr>
<th>Property</th>
<th>Test Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat fastness</td>
<td>180°C*, 30 min</td>
</tr>
<tr>
<td>Light fastness</td>
<td>Good in full shade only</td>
</tr>
<tr>
<td></td>
<td>(7-8 on blue wool scale)</td>
</tr>
<tr>
<td>Weather fastness</td>
<td>Good in full shade only</td>
</tr>
<tr>
<td></td>
<td>(4-5 on grey scale)</td>
</tr>
<tr>
<td>Acid fastness</td>
<td>Good</td>
</tr>
<tr>
<td>Alkali fastness</td>
<td>Good</td>
</tr>
<tr>
<td>Solvent fastness</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

* Paint

RECOMMENDED PRODUCTS

- Toluidine Red RN 0333C
  - Yellowish grade

- Toluidine Red RB 0336C
  - Bluish grade
PR48:4 BONA LAKE RED

MAIN CHARACTERISTICS

- Pigment Red 48:4 (C.I. 15865:4)
- Yellowish to bluish (maroon) red shade
- The more bluish the shade, the more transparent
- Can be combined with molybdate oranges to get solid red shades

Heat fastness 150°C*, 30 min
Light fastness Good (6-7 on blue wool scale)
Weather fastness Good in full shade only (4 on grey scale)
Acid fastness Moderate
Alkali fastness Moderate
Solvent fastness Moderate

RECOMMENDED PRODUCTS

Bonithol Red M 4844C
Yellowish grade
Bonithol Red 4845C
More bluish grade

Bonithol Red BM 4846C
Most bluish grade

* Paint
**PR101**  IRON OXIDE RED-OPAQUE

### MAIN CHARACTERISTICS

- **Fe₂O₃**
- Pigment Red 101 (C.I. 77491)
- Hematite structure
- Dull red shade
- Ease of dispersion
- Opaque to visible light, with moderate NIR reflectance

### Heat fastness

800°C, 5 min

### Light fastness

Excellent (8 on blue wool scale)

### Weather fastness

Excellent (5 on grey scale)

### Acid fastness

Excellent

### Alkali fastness

Excellent

### Cement compatibility

Excellent

### Solvent fastness

Excellent

### RECOMMENDED PRODUCTS

**Nubifer R-5500 SERIES**

The micronized/high dispersibility/narrow colorimetric tolerances Red Iron Oxides

- **Nubifer R-5501**  The most yellowish/lightest shade  
- **Nubifer R-5510**  Yellowish shade  
- **Nubifer R-5520**  Yellowish-medium shade  
- **Nubifer R-5530**  Yellowish-medium shade  
- **Nubifer R-5540**  Bluish-medium shade  
- **Nubifer R-5560**  Bluish-medium shade  
- **Nubifer R-5580**  The most bluish/darkest shade
PR101  IRON OXIDE RED-TRANSPARENT

**MAIN CHARACTERISTICS**

- Fe₂O₃
- Pigment Red 101 (C.I. 77491)
- Highly transparent
- Clean shade
- Absorb strongly UV-Light providing a natural and continuous UV protection
- Suitable to produce effect shades

**Heat fastness**  >300°C*, 30 min
**Light fastness**  Excellent (8 on blue wool scale)
**Weather fastness**  Excellent (5 on grey scale)
**Acid fastness**  Excellent
**Alkali fastness**  Excellent
**Solvent fastness**  Excellent

**RECOMMENDED PRODUCTS**

- **Cappoxyt Red 4435B**
  - Standard grade
- **Cappoxyt Red 4437B**
  - Higher transparency
- **Cappoxyt Red 4438B**
  - Bluer shade and higher tinting strength
PR104  MOLYBDATE ORANGE

MAIN CHARACTERISTICS

- PbCrO₄·PbSO₄·PbMoO₄
- Pigment Red 104 (C.I. 77605)
- Tetragonal structure
- Bright red shade (orange, scarlet and red)
- Ease of dispersion
- Opaque to visible light

CONVENTIONAL (L) SERIES

- Heat fastness: 180°C-200°C, 5 min
- Light fastness: Fair
- Weather fastness: Fair
- Acid fastness: Fair
- Alkali fastness: Low
- Cement compatibility: Incompatible
- Solvent fastness: Excellent

RESISTANT (R/S) SERIES

- Heat fastness: 240°C-260°C, 5 min
- Light fastness: High
- Weather fastness: High
- Acid fastness: High
- Alkali fastness: Low
- Cement compatibility: Incompatible
- Solvent fastness: Excellent

NUBITERM (K) SERIES

- Heat fastness: 300°C, 5 min
- Light fastness: High
- Weather fastness: High
- Acid fastness: High
- Alkali fastness: Low
- Cement compatibility: Incompatible
- Solvent fastness: Excellent

RECOMMENDED PRODUCTS

- NRC-36  Resistant, scarlet shade
- NRC-38  Resistant, orange shade

N.B. Ferro has not requested the REACH authorization for the use of Molybdate Oranges in the European Union.
**PR122 QUINACRIDONE RED**

**MAIN CHARACTERISTICS**
- Pigment Red 122 (C.I. 73915)
- Very clean bluish red referred to as pink or magenta
- High tinting strength
- Good transparency
- Useable as shading component in both solid and metallic shades

**RECOMMENDED PRODUCTS**

<table>
<thead>
<tr>
<th>Property</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat fastness</td>
<td>200°C*, 30 min</td>
</tr>
<tr>
<td>Light fastness</td>
<td>Good (7-8 on blue wool scale)</td>
</tr>
<tr>
<td>Weather fastness</td>
<td>Good (4-5 on grey scale)</td>
</tr>
<tr>
<td>Acid fastness</td>
<td>Excellent</td>
</tr>
<tr>
<td>Alkali fastness</td>
<td>Excellent</td>
</tr>
<tr>
<td>Solvent fastness</td>
<td>Good</td>
</tr>
</tbody>
</table>

* Paint

Lysopac Red 2230C
- Standard grade

Lysopac Red 2231C
- More bluish grade
PR170  NAPHTHOL AS RED

MAIN CHARACTERISTICS

- Pigment Red 170 (C.I. 12475)
- Medium Red shade
- Semi-transparent to opaque
- Opaque grades are more Yellowish
- Opaque grades have better overall performance

Heat fastness 160°C*, 30 min
Light fastness Good in full shade only (6-7 on blue wool scale)
Weather fastness Good in full shade only (3-4 on grey scale)
Acid fastness Excellent
Alkali fastness Excellent
Solvent fastness Good

RECOMMENDED PRODUCTS

Lysopac Red 7030C
Standard opaque grade
Lysopac Red 7031C
More bluish opaque grade

Naphthol Red B 7032C
Standard semi-transparent grade
Naphthol Red 7034C
More yellowish semi-transparent grade

* Paint
PR177  ANTHRAQUINONE RED

MAIN CHARACTERISTICS

- Pigment Red 177 (C.I. 65300)
- Yellowish red shade
- Highly transparent
- Useable as shading component in both solid and metallic shades
- Good overall fastness properties

Heat fastness  220°C*, 30 min
Light fastness  Excellent (8 on blue wool scale)
Weather fastness  Excellent (5 on grey scale)
Acid fastness  Excellent
Alkali fastness  Excellent
Solvent fastness  Excellent

RECOMMENDED PRODUCTS

Lysopac Red 7731C
Standard grade

* Paint
PBk11  IRON OXIDE BLACK

MAIN CHARACTERISTICS

- Fe3O4
- Pigment Black 11 (C.I. 77499)
- Magnetite structure
- Bluish black shade
- Ease of dispersion
- Opaque to visible light, NIR absorbent

Heat fastness  180°C*, 5 min
Light fastness  Excellent (8 on blue wool scale)
Weather fastness  Excellent (5 on grey scale)
Acid fastness  Excellent
Alkali fastness  Excellent
Cement compatibility  Excellent
Solvent fastness  Excellent

RECOMMENDED PRODUCTS

Nubifer NB-5970
Micronized, high tinting strength, very bluish shade

* Paint
PBk26  MANGANESE FERRITE BLACK SPINEL

MAIN CHARACTERISTICS

- MnFe₂O₄
- Pigment Black 26 (C.I. 77494)
- Spinel structure
- Very bluish/deep shade, the strongest black CICP
- Ease of dispersion
- Opaque to visible light, UV/NIR absorbent
- The black CICP with the highest heat fastness, very suitable for high temperature resistant coatings

Heat fastness     >500°C*, 5 min
Light fastness    Excellent (8 on blue wool scale)
Weather fastness  Excellent (5 on grey scale)
Acid fastness     Excellent
Alkali fastness   Excellent
Cement compatibility Excellent
Solvent fastness  Excellent

* Paint

RECOMMENDED PRODUCTS

24-3060  High tinting strength, very bluish shade
PBk28 COPPER CHROMITE BLACK SPINEL

MAIN CHARACTERISTICS

- CuCr₂O₄
- Pigment Black 28 (C.I. 77428)
- Spinel Structure
- Bluish, deep shade
- Opaque to visible light, NIR absorbent

RECOMMENDED PRODUCTS

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat fastness</td>
<td>&gt;500°C, 5 min</td>
</tr>
<tr>
<td>Light fastness</td>
<td>Excellent (8 on blue wool scale)</td>
</tr>
<tr>
<td>Weather fastness</td>
<td>Excellent (5 on grey scale)</td>
</tr>
<tr>
<td>Acid fastness</td>
<td>Excellent</td>
</tr>
<tr>
<td>Alkali fastness</td>
<td>Excellent</td>
</tr>
<tr>
<td>Cement compatibility</td>
<td>Excellent</td>
</tr>
<tr>
<td>Solvent fastness</td>
<td>Excellent</td>
</tr>
</tbody>
</table>

* Paint

24-3095 Standard grade
**PBk33**

**MANGANESE FERRITE BLACK OXIDE**

**MAIN CHARACTERISTICS**

- $\text{MnFe}_2\text{O}_4$
- Pigment Black 33 (C.I. 77537)
- Hematite structure
- Brownish to bluish black shade
- Ease of dispersion
- Opaque to visible light, with moderate NIR reflectance ("cool" pigment)
- Used when neither Carbon Black nor Black Iron Oxide can be used for technical reasons

**Heat fastness**

- $>500^\circ\text{C}^*$, 5 min

**Light fastness**

- Excellent (8 on blue wool scale)

**Weather fastness**

- Excellent (5 on grey scale)

**Acid fastness**

- Excellent

**Alkali fastness**

- Excellent

**Cement compatibility**

- Excellent

**Solvent fastness**

- Excellent

**Heat fastness**

- $>500^\circ\text{C}^*$, 5 min

**RECOMMENDED PRODUCTS**

- **24-3303**  Reddish shade
- **Nubifer NB-803K**  Bluish shade

*$^*$ Paint
PBr29  CHROME IRON BROWN HEMATITE

MAIN CHARACTERISTICS

- \((\text{Cr,Fe})_2\text{O}_3\)
- Pigment Brown 29 (C.I. 77500)
- Hematite structure
- Brownish to bluish black shade
- Ease of dispersion
- Opaque to visible light, with high NIR reflectance ("cool" pigment)

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat fastness</td>
<td>&gt;500°C, 5 min</td>
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</tr>
<tr>
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<tr>
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<td>Alkali fastness</td>
<td>Excellent</td>
</tr>
<tr>
<td>Cement compatibility</td>
<td>Excellent</td>
</tr>
<tr>
<td>Solvent fastness</td>
<td>Excellent</td>
</tr>
</tbody>
</table>

RECOMMENDED PRODUCTS

- 10466  Reddish shade
- V-785   The most bluish shade
- V-10121 Dark brown

* Paint
PG17  CHROMIUM GREEN-BLACK HEMATITE

MAIN CHARACTERISTICS

- $\text{Cr}_2\text{O}_3$
- Pigment Green 17 (C.I. 77288)
- Hematite structure
- Brownish to bluish black shade
- Ease of dispersion
- Opaque to visible light, with high NIR reflectance ("cool" pigment)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat fastness</td>
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<tr>
<td>Cement compatibility</td>
<td>Excellent</td>
</tr>
<tr>
<td>Solvent fastness</td>
<td>Excellent</td>
</tr>
</tbody>
</table>

RECOMMENDED PRODUCTS

- **V-774**  High tinting strength, bluish shade
- **V-775**  The most bluish shade

* Paint
ECO-LYSOPAC

MAIN CHARACTERISTICS

There have always been customized shades, but nowadays they are becoming more and more important for many different reasons, such as lead chrome replacement, matching RAL shades, brand owners and customers asking for specific shades.

Hybrid pigments are the most suitable solution to respond to these kinds of demands, thanks to the possibility of having a single product color solution for a given application.

Ferro has a very broad pigment offering and has built up a lot of knowledge in color matching and shade development. Therefore, Ferro is well placed to guide its customers to the right color solution for any of their applications (from decorative to the most demanding industrial coatings).

A number of standardized hybrid pigments are already available and new developments are always on the way based on new market demands.

MAIN APPLICATIONS AND BENEFITS

- **APPLICATIONS**
  A broad range of applications is reachable depending on the targeted market. The right hybrid pigment can be produced to meet customers’ expectations on shade and quality specifications for a given application while keeping the most economical solution in view.

- **BENEFITS**
  - One per single product color solution
  - Applications based color solutions
  - Sustainable solutions for lead chrome replacement
  - Saving lab time on color matching

MAIN PRODUCTS

<table>
<thead>
<tr>
<th>6623B</th>
<th>9913C</th>
<th>9917C</th>
<th>9934C</th>
</tr>
</thead>
<tbody>
<tr>
<td>6624B</td>
<td>9914C</td>
<td>9923C</td>
<td>9937C</td>
</tr>
<tr>
<td>6625B</td>
<td>9915C</td>
<td>9924C</td>
<td></td>
</tr>
<tr>
<td>6626B</td>
<td>9916C</td>
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<td>9932C</td>
</tr>
</tbody>
</table>
COOL PIGMENTS / functional pigments

MAIN CHARACTERISTICS

It is well known that under the sun, dark surfaces become hot and white surfaces remain cooler. When comparing a white coating containing TiO₂ (Near Infrared-NIR-reflecting pigment) with a black coating containing Carbon Black (Near Infrared-NIR-absorbent pigment) the surface temperature difference can reach more than 30°C on a hot, sunny day.

This common effect is not only related to color but also to NIR absorption of the pigments used in a particular application. By using the appropriate pigments, even dark surfaces can stay cool under the sun.

This type of pigments, also referred to as Cool Pigments, do not absorb the NIR portion of wavelengths coming from sunlight. There are 2 types of Cool Pigments: NIR reflecting pigments and NIR transparent pigments. The fnal behavior of the latter will be fnfluated by the entire system; therefore, when using NIR transparent pigments it is recommended to apply the coating over a NIR relecting substrate or use such pigments in combination with NIR reecting pigments in the coatings formula.

Ferro Pigments has a full range of Cool Pigments and many years of experience developing projects in this fleld, so we are the ideal partner to support you in your cool projects.

MAIN APPLICATIONS AND BENEFITS

APPLICATIONS
- Coil Coatings for roofs
- Exterior paints for roofs and façades
- Roof shingles
- Sport fields
- Automotive coatings

BENEFITS
- Reduced air conditioning and energy consumption
- Increased building comfort
- Increased service life of the roof, EIFS (External Insulation Finishing System)

MAIN PRODUCTS

Ferro offers a full range of Cool Pigments in the whole color spectra.
COOL PIGMENTS

FERRO COOL PIGMENTS COLOR SPACE

COOL PIGMENTS (High NIR Reflectance)

- PY53  Nickel Antimony Titanium Yellow Rutile
- PB24  Chrome Antimony Titanium Buff Rutile
- PY184 Bismuth Vanadate
- PG17  Chromium Green-Black Hematite
- PG17  Chrome Oxide Green
- PB29  Chrome Iron Brown Hematite
- PY164 Manganese Antimony Titanium Buff Rutile

COOL PIGMENTS (Moderate NIR Reflectance or NIR transparency)

- PBk12  Iron Titanium Brown Spinel
- PB28  Cobalt Aluminate Blue Spinel
- PB36  Cobalt Chromite Blue-Green Spinel
- PBk33  Manganese Ferrite Black Oxide
- PG26  Cobalt Chromite Green Spinel
- PG50  Cobalt Titanate Green Spinel
- PR101  Iron Oxide Red
- PY119  Zinc Ferrite Brown Spinel
- PB29  Ultramarine Blue
- PV15  Ultramarine Violet
CORROSION INHIBITORS

ANTICORROSIVE PIGMENTS
ZINC-BASED ANTICORROSIVE PIGMENTS

NUBIROX ANTICORROSIVE PIGMENTS

- High performance anticorrosive pigments for long term corrosion protection
- Suitable for solvent and water based protective coatings

Zinc Phosphate (\(\text{Zn}_3(\text{PO}_4)_2 \cdot 2\text{H}_2\text{O}\))

NUBIROX N2
- Standard Zinc Phosphate

NUBIROX SP
- Special particle Zinc Phosphate
  - Nubirox Technology
  - Special particle Zinc Phosphate with higher specific surface area than standard Zinc Phosphate
  - Efficiency at low concentration
ANTICORROSIVE PIGMENTS
ZINC-BASED ANTICORROSIVE PIGMENTS

Nubirox 100 series & Nubirox 200 series
Modified Zinc Phosphates of enhanced performance
due to specific combinations of active compounds

Nubirox 102
Organophilized Zinc Phosphate and Zinc Molybdate
• Direct replacement of Zinc Phosphate with improved activity
• Suitable for high film thickness & medium-gloss DTM coatings

Nubirox 106
Organophilized Zinc Phosphate and Zinc Molybdate
• High anticorrosive activity at low concentrations
• Excellent performance in many water/solvent based systems and
thin film application

Nubirox 213
Iron Phosphate and Zinc Phosphate
• Anticorrosive activity at low concentrations
• Specially suitable for alkyd and epoxy primers
CORROSION INHIBITORS

ANTICORROSIVE PIGMENTS
NON ZINC-BASED ANTICORROSIVE PIGMENTS

NUBIROX ANTI CORROSION PIGMENTS

High performance anticorrosive pigments for long term corrosion protection

Suitable for solvent and water based protective coatings

NUBIROX 300 series

Alternative to Zinc-based pigments with excellent performance in many applications, and suitability in systems where Zinc-based anticorrosive pigments are reactive

NUBIROX 301
Calcium Strontium Phosphosilicate

• Protection of different metal substrates, specially galvanized
• Good performance in etch/wash primers and DTM coatings

NUBIROX 302
Organophilized Calcium Strontium Phosphosilicate

• Wider compatibility and enhanced performance
• Suitable for glossy DTM coatings thanks to low impact on gloss
# CORROSION INHIBITORS

## ANTICORROSIVE PIGMENTS

### NUBIROX

<table>
<thead>
<tr>
<th>ANTI-CORROSION APPLICATIONS MAP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

- Highly recommended 🟢🟦
- Recommended 🟢
- Limited suitability 🟢
- Not recommended ✗
CORROSION INHIBITORS

ANTICORROSIVE PIGMENTS
CHROMATE BASED PIGMENTS

Z-952
Zinc Chromate
Yellow anticorrosive pigment used in solvent based paint systems (alkyds, epoxy-polyamides...)

T-902
Zinc Tetraoxochromate
Yellow anticorrosive pigment commonly used in Wash and Shop Primers

FLASH RUST INHIBITORS

Liquid inhibitors to prevent flash rust and in-can rust in water based paint systems without detracting from the long-term performance properties

NUBIROX FR-11
Nitrite based liquid Flash Rust Inhibitor
- Effective at low loading

N.B. For classification and safety please refer to SDS
N.B. Ferro has not requested the REACH authorization for the use of Zinc Chromates and Zinc Tetraoxochromates in the European Union.
<table>
<thead>
<tr>
<th>APPLICATIONS GUIDE</th>
</tr>
</thead>
</table>

## BLUE PIGMENTS

<table>
<thead>
<tr>
<th>Liquid decorative / architectural coatings</th>
<th>Liquid industrial coatings</th>
<th>High temperature curing coatings</th>
<th>Automotive</th>
<th>High temperature resistant coatings</th>
<th>Cool coatings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PB28</strong> Cobalt Aluminate Blue Spinel</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td><strong>PB36</strong> Cobalt Chromite Blue-Green Spinel</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td><strong>PB29</strong> Ultramarine Blue Nubicoat series</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td><strong>PB29</strong> Nubicoem series</td>
<td>***</td>
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<td>***</td>
<td>***</td>
</tr>
</tbody>
</table>

## VIOLET PIGMENTS

<table>
<thead>
<tr>
<th>Liquid decorative / architectural coatings</th>
<th>Liquid industrial coatings</th>
<th>High temperature curing coatings</th>
<th>Automotive</th>
<th>High temperature resistant coatings</th>
<th>Cool coatings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PV15</strong> Ultramarine Violet</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td><strong>PV62</strong> Strontium Phosphate Violet</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td><strong>PV19</strong> Quinacridone Violet</td>
<td>***</td>
<td>***</td>
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<tr>
<td><strong>PV23</strong> Dioxazin Violet</td>
<td>***</td>
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</table>

## GREEN PIGMENTS

<table>
<thead>
<tr>
<th>Liquid decorative / architectural coatings</th>
<th>Liquid industrial coatings</th>
<th>High temperature curing coatings</th>
<th>Automotive</th>
<th>High temperature resistant coatings</th>
<th>Cool coatings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PG50</strong> Cobalt Titanate Green Spinel</td>
<td>***</td>
<td>***</td>
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<tr>
<td><strong>PG50</strong> Cobalt Titanate Green Spinel Ni-free</td>
<td>***</td>
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<td>***</td>
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<tr>
<td><strong>PG17</strong> Chrome Oxide Green</td>
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<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td><strong>PG26</strong> Cobalt Chromite Green Spinel</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td><strong>PG7</strong> Phthalocyanine Green</td>
<td>***</td>
<td>***</td>
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</tr>
</tbody>
</table>

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* Highly recommended  
* Recommended  
* Limited suitability  
* Not recommended  
(*) Being NIR transparent, cool performance is highly dependent on substrate and formulation
### YELLOW PIGMENTS

<table>
<thead>
<tr>
<th>Pigment Code</th>
<th>Pigment Name</th>
<th>Liquid decorative / architectural coatings</th>
<th>Liquid industrial coatings</th>
<th>High temperature curing coatings</th>
<th>Automotive</th>
<th>High temperature resistant coatings</th>
<th>Cool coatings</th>
</tr>
</thead>
<tbody>
<tr>
<td>PY53</td>
<td>Nickel Antimony Titanium Yellow Rutile</td>
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<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>PY184</td>
<td>Bismuth Vanadate</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>x</td>
<td>x</td>
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<tr>
<td>PY34</td>
<td>Chrome Yellow</td>
<td>Conventional (L/D) series</td>
<td>*</td>
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<td>x</td>
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<tr>
<td></td>
<td></td>
<td>Resistant (R/S) series</td>
<td>*</td>
<td>***</td>
<td>*</td>
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<td>Nubiterm K series</td>
<td>*</td>
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- **Highly recommended**: 3 stars
- **Recommended**: 2 stars
- **Limited suitability**: 1 star
- **Not recommended**: 0 stars

(*) Being NIR transparent, cool performance is highly dependent on substrate and formulation.
# APPLICATIONS GUIDE

## BUFF PIGMENTS

<table>
<thead>
<tr>
<th>Liquid decorative / architectural coatings</th>
<th>Liquid industrial coatings</th>
<th>High temperature curing coatings</th>
<th>Automotive</th>
<th>High temperature resistant coatings</th>
<th>Cool coatings</th>
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<td>Powder</td>
<td>Coil</td>
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## ORANGE PIGMENTS

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<th>High temperature curing coatings</th>
<th>Automotive</th>
<th>High temperature resistant coatings</th>
<th>Cool coatings</th>
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<td>PO85 Bismuth Oxyhalide</td>
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</tbody>
</table>

* Highly recommended  ** Recommended  * Limited suitability  x Not recommended  (*) Being NIR transparent, cool performance is highly dependent on substrate and formulation
## RED PIGMENTS

| Red Iron Oxide | Opaque Series | *** | *** | *** | *** | *** |  |
| Red Iron Oxide | Transparent Series | *** | *** | *** | *** | *** |  |
| Molybdate Orange | Conventional (L) series | * | *** | ** | ** | * | x | x |
| Molybdate Orange | Resistant (R/S) series | * | *** | ** | ** | * | x | x |
| Nubiterm K series | * | *** | ** | ** | * | x | x |
| Beta-Naphthol Red | *** | * | x | x | x | x |  |
| Bona Lake Red | *** | ** | x | x | x | x |  |
| Quinacridone Red | *** | *** | *** | *** | *** | * | x | x |
| Napthol AS Red | *** | *** | ** | x | * | x | x | x |
| Anthraquinone Red | *** | *** | *** | *** | * | x | x | x |

### BLACK PIGMENTS

| Copper Chromite Black Spinel | *** | *** | *** | *** | ** | x |  |
| Chromium Green-Black Hematite | *** | *** | *** | *** | *** | *** |  |
| Chrome Iron Brown Hematite | *** | *** | *** | *** | *** | *** |  |
| Manganese Ferrite Black Spinel | *** | *** | *** | *** | *** | x |  |
| Iron Manganese Black Oxide | *** | *** | *** | *** | *** | ** |  |
| Black Iron Oxide | *** | *** | *** | *** | * | x | x |  |

### Notes:
- Highly recommended: ***
- Recommended: **
- Limited suitability: *
- Not recommended: x

(*) Being NIR transparent, cool performance is highly dependent on substrate and formulation.