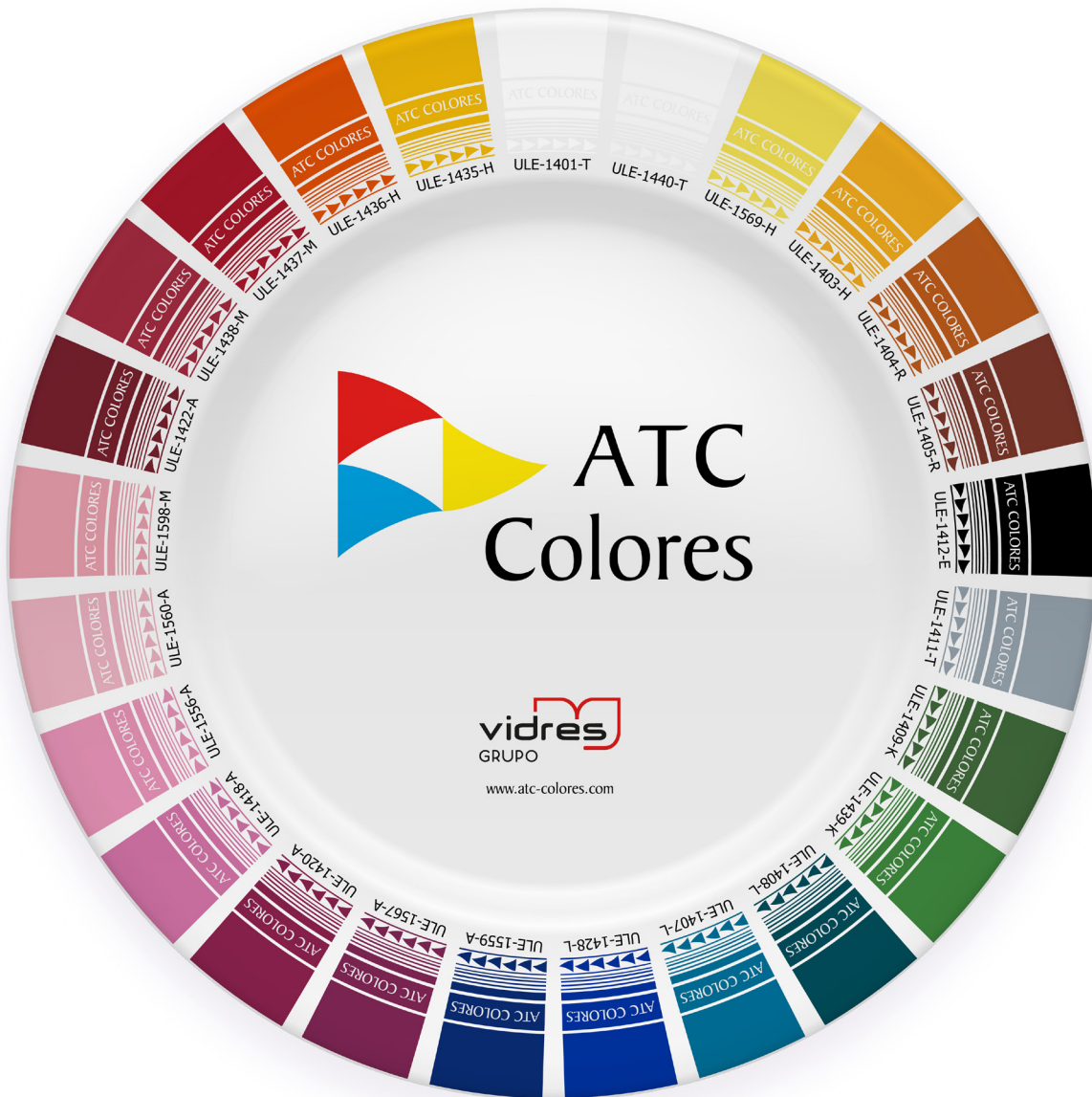


**ULE SERIES - LEAD FREE ONGLAZE ENAMEL COLOURS FOR TABLEWARE, EARTHENWARE, STONEWARE, PORCELAIN, BONE CHINA & TILE**

The Colour Chart shows an approximate impression of the basic colours for a first selection of colours. For exact reproduction of a colour tone it is absolutely necessary to test a sample under original conditions.



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**TECHNICAL DATA SHEET AND USAGE**

The ULE colours are Onglaze colours, lead free for low temperature decoration. They can be used on a variety of substrates and glazes providing a comprehensive range of colours designed for maximum miscibility and optimal metal release.

**MAIN PROPERTIES**

High color intensity

The highest intensity is obtained by printing the colors without flux addition. Gloss and intensity can be fine-tuned by adding a higher or lower amount of fluxes.

Excellent particle size powder distribution

The particle size of the colors will vary depending on the composition, in this series the Typical Diameter particle D50=3-5 microns and D90=15-20 microns with trace residue on a 120 s sieve.

Very good resistance

Mechanical durability is widely resistant showing good resistance in contact with food products, however, it is necessary for users to determine metal release and durability, according to their own production conditions.

Low thermal expansion coefficient

The Coefficient of thermal expansion is  $70-80 \times 10^{-7} \cdot 1/K$  (20 to 400°C) and it is suitable for different surfaces.

**MISCIBILITY AND COMPATIBILITY**

All colours are designed for maximum intermixing. The Main Group & Gold Group can be intermixed together and the use of different Mixing Flux is suitable to create pleasing pastel shades with the exception of Cadmium Group.

For dilution of colours, in order from highest to lowest opacity, we can use the fluxes below:

- ULE-1440-T Mixing White
- ULE-1441-C Hard Mixing Flux
- ULE-1417-C Soft Mixing Flux (Suitable for dilution of colours up to 10-20% maximum)

Cadmium Group are intermixable fully each other and can be mixed with the other colours with limitations up to a maximum of 5% . For dilution of colours we recommend the flux:

- ULE-1427-C Cd. Mixing & Cover Flux (Suitable for overprinting decal schemes to reduce Cadmium metal release and improve mechanical and chemical resistance)

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### APPLICATION

#### DIRECT SCREEN PRINTING AND DECALS

For direct screen printing or decal transfers, 120T - 90T polyester mesh can be used for most colors, 120T can be used to achieve halftone effect, however, we recommend 90T mesh or 230/200/300 GP stainless steel mesh, especially for cadmium-based colors.

The colors require optimal deposition to ensure stability and we recommend customers test them under their specific processing conditions.

On substrates such as hard and soft-paste porcelain, the recommended allowable layer thickness should not exceed 20 to 30 microns to avoid cracking or peeling of enamels and should be observed when applying multiple layers or one thick layer, we recommend asses suitability including re-fired pieces.

ULE colours can be used on low-sol or leaded glazes but this dynamic could increase metal release, so customers need to determine the outcome on their own conditions.

As a guide, recommended mixing ratios and mediums below:

| Reference | Description               | Parts medium per 10 parts of colour | Water Media | Oil-based Media |
|-----------|---------------------------|-------------------------------------|-------------|-----------------|
| L427      | WATER MISCIBLE MEDIUM     | 5                                   | ✓           |                 |
| W172      | WATERBASED PRINT MEDIUM   | 3,5                                 | ✓           |                 |
| M286D     | SEMI-THIXO S/PRINT MEDIUM | 7                                   |             | ✓               |
| M286T     | THIXOTROPIC S/P MEDIUM    | 8                                   |             | ✓               |
| M51D      | SCREEN TRANSFER MEDIUM    | 6                                   |             | ✓               |
| M6        | DIRECT PRINT MEDIUM       | 3,5                                 |             | ✓               |

#### HANDPAINTING-MACHINE BANDING AND LINING & SPRAYING OR AEROGRAPHING

The colors can supplied as dry powder for painting directly onto glazed ware and also in the following mediums:

| Reference | Description                  | Parts medium per 10 parts of colour | Water Media | Oil-based Media |
|-----------|------------------------------|-------------------------------------|-------------|-----------------|
| W108      | WATERBASED HAND PAINT MEDIUM | 5                                   | ✓           |                 |
| M162N     | GELLED BANDING MEDIUM        | 6                                   |             | ✓               |
| M9        | HAND PAINTING MEDIUM         | 5                                   |             | ✓               |

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### FIRING RECOMMENDATIONS

For cycles of 4 hours or more the following temperatures are recommended:

|                      |                   |
|----------------------|-------------------|
| Hard Paste Porcelain | 840 - 880 degrees |
| Soft Paste Porcelain | 840 - 870 degrees |
| Vitreous Tableware   | 840 - 870 degrees |
| Bone China           | 820 - 850 degrees |
| Earthenware/Tiles    | 850 - 900 degrees |

Fast firing and shorter cycles are possible:

860-900 degrees/60-90 min

Firing affect metal release and durability so it is best determined depending on cycle profile.

Be aware that Cadmium Colours ULE-1437-M and ULE-1438-M are more susceptible to higher temperatures.

### ACID AND ALKALI RESISTANCE

The chemical resistance of the fired color layers is influenced by the color deposit, the firing conditions and the glaze. The colors don't show a visible attack with 4%acetic acid solution (22±2°C, 24h) as well as with 5% sodium carbonate solution (60±2°C, 32h).

### METAL RELEASE CHARACTERISTICS

Every effort is made to make these colors technically lead-free, however, lead residues may be analytically detectable due to production processes, but are on the order of less than 0.2% lead and 0.05% cadmium, respectively, under normal application conditions and optimal cooking, that this is well below the limits currently permitted for tableware.

Metal release conditions can be influenced by deposit weight, substrate glaze, firing cycle, etc. and, in general, the higher the cycle temperatures, the better metal release and greater durability will be obtained. Under some conditions, note that the lining of kilns previously used to fire Low-Solubility or Lead products is known to release volatile metals detectable in the test.

The solubility of some particular colors can affect the mechanical strength and metal release in the case of cobalt and cadmium colors, in particular ULE-1428-L, or Cadmium Group Colours.

It is possible to improve mechanical resistance and metal release using Cover Flux ULE-1427-C or by firing and applying in optimal conditions.



























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### REFERENCES

|                       | Colour  | Reference  |                                     | Colour Composition         | Pantone |
|-----------------------|---|------------|-------------------------------------|----------------------------|---------|
| <b>Main Group:</b>    |    | ULE-1401-T | White                               | Ce                         | -       |
|                       |    | ULE-1440-T | Mixing White                        | Ce                         | -       |
|                       |    | ULE-1403-H | Orange                              | Cr-Sb-Ti                   | 130 C   |
|                       |    | ULE-1404-R | Golden Brown                        | Cr-Fe-Zn-Al                | 2429 C  |
|                       |    | ULE-1405-R | Reddish Brown                       | Cr-Fe-Zn                   | 7594 C  |
|                       |    | ULE-1407-L | Cyan                                | Cr-Co-Al-Zn                | 7705 C  |
|                       |    | ULE-1408-L | Greenish Blue                       | Cr-Co-Al                   | 3165 C  |
|                       |    | ULE-1409-K | Chrome Green                        | Cr                         | 7743 C  |
|                       |    | ULE-1411-T | Grey                                | Sn-Sb                      | 7543 C  |
|                       |    | ULE-1412-E | Black                               | Cr-Fe-Co                   | Black C |
|                       |   | ULE-1428-L | Blue                                | Co-Si-Zn                   | 286 C   |
|                       |  | ULE-1569-H | Yellow                              | Cd-S-Zr-Si                 | 106 C   |
|                       |  | ULE-1598-M | Pink                                | Cr-Ca-Sn-Si                | 494 C   |
|                       |   | ULE-1417-C | Soft Flux for Mixing                | -                          | -       |
|                       |   | ULE-1441-C | Hard Mixing Flux                    | -                          | -       |
| <b>Gold Group:</b>    |  | ULE-1418-A | Gold Pink                           | Sn-Al-Ag-Au                | 3582 C  |
|                       |  | ULE-1420-A | Magenta                             | Sn-Al-Ag-Au                | 7435 C  |
|                       |  | ULE-1422-A | Maroon                              | Sn-Al-Ag-Au                | 188 C   |
|                       |  | ULE-1556-A | Light Pink                          | Sn-Al-Ag-Au                | 2044 C  |
|                       |  | ULE-1559-A | Royal Blue                          | Sn-Al-Ag-Au-Co-Si-Zn-Cr-Fe | 288 C   |
|                       |  | ULE-1560-A | Rose Pink                           | Sn-Al-Ag-Au-Cd-S-Se        | 509 C   |
|                       |  | ULE-1567-A | Purple                              | Sn-Al-Ag-Au-Co-Si-Zn       | 683 C   |
|                       |   | ULE-1000-C | Special Cover Flux for Gold Colours | -                          | -       |
| <b>Cadmium Group:</b> |  | ULE-1435-H | Cd. Yellow                          | Cd-S-Zn                    | 7408 C  |
|                       |  | ULE-1436-H | Cd. Orange                          | Cd-S-Se                    | 166 C   |
|                       |  | ULE-1437-M | Cd. Bright Red                      | Cd-S-Se                    | 187 C   |
|                       |  | ULE-1438-M | Cd. Dark Red                        | Cd-S-Se                    | 7427 C  |
|                       |  | ULE-1439-K | Cd. Green                           | Cd-S-Zn-Cr-Co-Al           | 7741 C  |
|                       |  | ULE-1427-C | Cd. Mixing & Cover Flux             | -                          | -       |

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