

# MELART-II Full-Color Graphic Painting Finish

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**Key Words:** computer graphics, painting, full color, ink-jet printer

## ABSTRACT

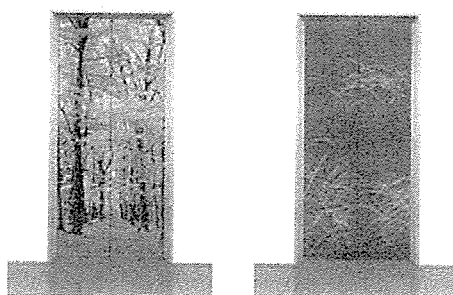
The MELART-II is a type of painting method whose technology was originally developed by Mitsubishi Electric Corporation. The technology comes with three unique features --- photo-realistic presentation, higher light resistance, and flexibility in the materials that ranges from organic to inorganic. This paper introduces these technology features in details.

## 1. INTRODUCTION

Various technologies have been used in order to decorate elevators. For instance, different types of materials, chemical treatment and coloration are used depending on the types of desired finish and appearance.

In 1995, we developed a painting technology where "sublimation dye" was used to create unique and superior finish. We further developed this technology, and in 1999, we have completed the development, of MELART-II, the enhanced version of MELART. With this version, patterns are designed by computer graphics, therefore our customers can have any patterns they would like to have --- for example, their company logos, personal photos, and even paintings --- just about anything they like to adorn with their elevators. With higher resolution of 720dpi, inks of up to six different colors can be used, and with the final painting utilizing clear urethane, MELART-II provides even more vivid images of higher quality.

In this paper, we introduce the newly developed painting method named "MELART-II", in which the latest painting technologies are applied.



*Figure 1. The appearance of MELART-II*

**2. FEATURES**

**2.1. Product outline**

The features of MELART-II technology is shown below,

- (1) Presentation of fine details and the extremely smooth color gradations.
- (2) There is little waste in the production process, and it is gentle painting technology to the environment.
- (3) Capable of production for various patterns in small quantities.
- (4) It is the general-purpose technology that can be applied for not only the door of the elevator but also the high-class surface painting of the electric product, the machine product, and the decorations.
- (5) An art piece of the modern era accomplished by the most advanced high technology and the superior craftsmanship at Mitsubishi Electric corp.

**2.2. Comparison with the existing technology**

The table that compared MELART-II with the existent technology is shown about the specification and the product character in the following Table1 and 2.

*Table 1. Specifications*

	Others	MELART-II
Printer	Electro static plotter	On-demand piezo inkjet printer
Ink	Sublimation dye	Pigment
	4 colors	6 colors
Paint	Urethane	Urethane
Resolution	212micro meter	60micro meter or less
Image process time	70~90minutes	10minutes or less
Area processed (mm)	630×2450	1000×2450

**2.2.1. Specification comparison.**

The points that MELART-II proceeds through are three points of the next.

Firstly, an image dot diameter was made small. Secondly, It is that a light primary color was added to the ink primary color. And thirdly, it is that ink was changed from the sublimation dye to the pigment.

It comments on the dot diameter that is the first point. Much shows a minimum position control limit in the resolution being used with the performance expression of the general printer, and a dot diameter isn't indicated. The size of the image dot diameter was defined with MELART-II with the proper size in sight. Therefore, it is smooth in the looks, and there is no sense of incongruity in the expression with MELART-II. Even if it is compared with the printing, MELART-II is beautiful without dirty spots.

Next, it comments on the ink primary color that is the second point. Generally, an ink primary color is four of yellow, red, blue and black. A color is expressed by using these. When the brightness of the ink is high, for example it doesn't feel a sense of incongruity like yellow

for the existence of the dot. But, when ink brightness is low, for example the existence of the point feels a sense of incongruity such as red, blue. Therefore, as for cyan and magenta, the light primary color that the level of the brightness was adjusted to was added. Therefore, it is smooth in the looks, and there is no sense of incongruity in the expression with MELART-II.

Next, it comments on the pigment ink that is the third point. Former MELART used a sublimation dye for the ink. The same technology as this is being used widely at present. But, a sublimation dye has a double fault. Dyes own formation is unstable. Then, an image is unstable by the sublimation process. As for the sublimation dye, color-fadeout happens due to the time progress or the irradiation of the light. A dot diameter spreads out again due to the sublimation, and difficult to make it proper size in sight. And, the condition of the sublimation changes by the error of the slight applicable thing. It is difficult to express a proper color in sight uniformly. MELART-II uses pigment ink. Special coating is being used. A dot diameter doesn't spread out, and condition never changes by the applicable thing. It made it possible that a proper color in sight was expressed uniformly.

### 2.2.2. Product characteristic comparison.

The environment load of the existent technology is expensive, and there is much industry waste especially in it. It paid attention to this point from the development moment, and MELART-II could recycle most of the waste.

The product cost of this existent technology is high in proportion to the amount of discharge of the industry waste, too.

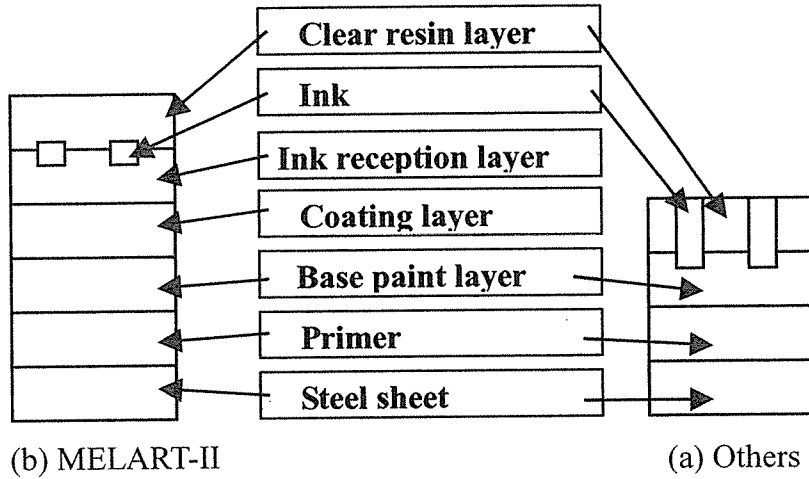
The image expression that is equal to the photograph is difficult with the existent technology. A dot is rough, and there is a hindrance in the expression with the technology such as former MELART that a sublimation dye was used for. Then, it is unstable and inferior to the reliability.

*Table 2. Products effect*

	Conventional		MELART-II
	Silk-screen-printing	Dye-sublimation	
Product waste	Film, screen, solvent, developer waste	Solvent, developer waste	Almost everything are recyclable
Cost	2.5	1.5	1
Light resistance	Usually	Inferior	Excellent
Figure expression	Excellent	Inferior	Excellent
Image expression	Usually	Usually	Excellent
Color unevenness	Excellent	Inferior	Excellent

**2.2.3. Manufacturing process.**

A manufacture process is explained with comparing the MELART-II and others.

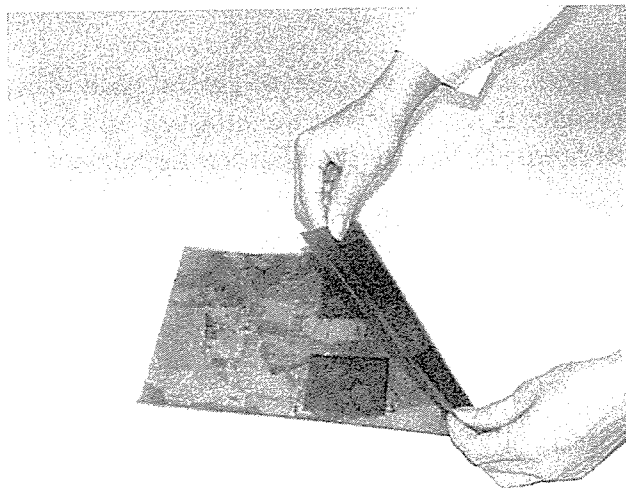


*Figure 2. Construction (sectional)*

Figure.2 show MELART-II and others in section. As for the example of figure.2, base is a steel sheet painting.

Primer is applied to the steel sheet first in the same way as the general painting, and the color that becomes a base color is painted.

Next, thermal hardening makes it wear the thing that recorded a pattern in pattern paper (It is the formation which MELART-II which contains ink, Ink reception layer and Coating layer. show figure 3), and sticks.



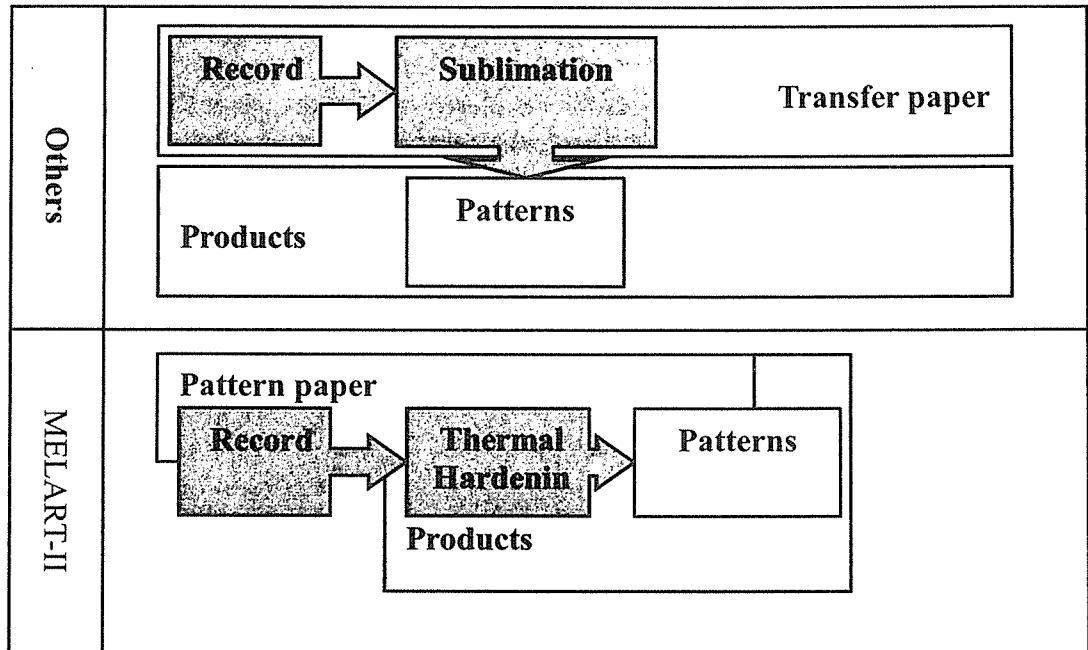
*Figure 3. Pattern paper (recorded)*

Clear resin layer is set up on that.

Others set up Clear resin layer first. It sticks (transfer paper which recorded a pattern with the sublimation dye on that). It is heated after that, and made to sublimate.

Silkscreen printing sets up Clear resin layer after a pattern is formed in the same way as MELART-II in the printing in the base color above.

Table 3. Manufacturing process



Next, it is explained from the product and the relations of the pattern.

In case of others, a pattern is recorded on the unrelated transfer paper with the product. When sublimation is completed, transfer paper is scrapped.

When it sublimates, a pattern and colors are moved between the different materials as shown in table3. Therefore, image precision deteriorates in the sublimation process. A processing process contains most of the strong points of the product and a fault from the first.

In case of MELART-II, A pattern and colors are never moved with MELART-II between the materials, because pattern paper is included into the product, and it composes a part. Image precision doesn't deteriorate in the Thermal hardening process.

**2.2.3.1. Detail of Thermal hardening process**

A jig is contained, and the process of Thermal hardening is explained.

It is put in the material made the target on the jig which has vacuum pressure due at the mechanism (Figure 4-1), a cushion, the seat for shutting up, the order of the frame for shutting up. (Figure 4-2)

A clamp is given to secure shutting up. (Figure 4-3, and sectional Figure 4-4)

The condition that makes it drives vacuum pressure due at the mechanism. (Figure 4-5)

It is heated to the fixed condition, and Thermal hardening becomes completion with maintaining this condition.

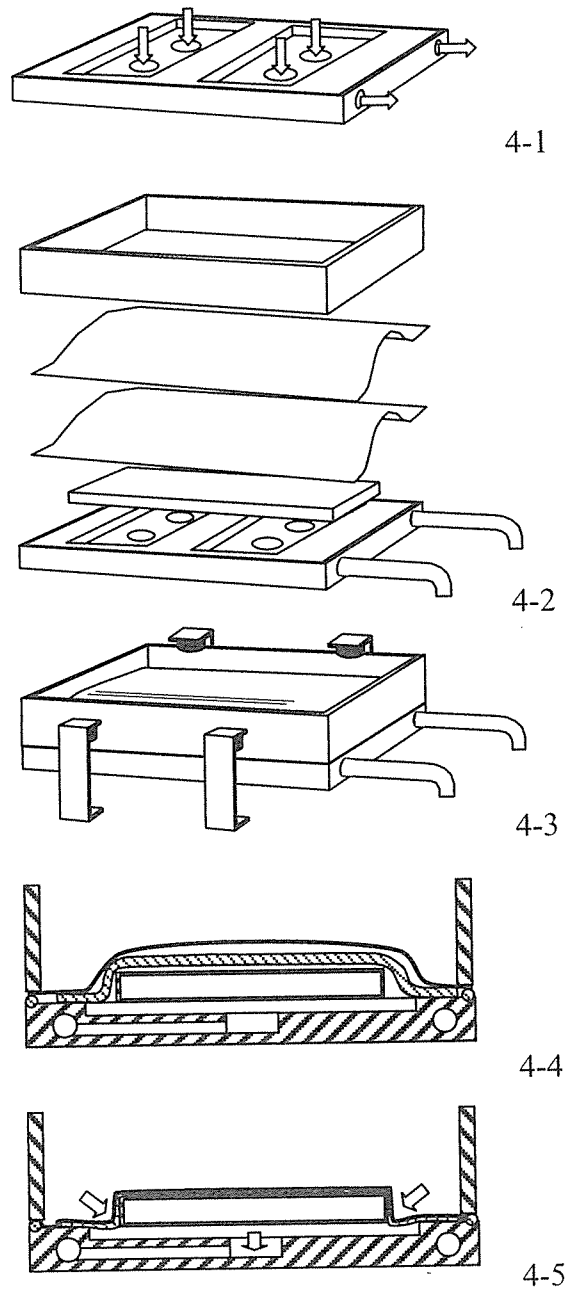


Figure 4. Thermal hardening process.

### 2.3. Improved light resistance technology

The process in which ink fades under light depends not only on the chemical composition of the ink but also on the external conditions such as the color states of the ink, the characteristics of the base material, heat, and light, and also is determined by the internal conditions such as the chemical compounds coexisting in the material.

A drop to light resistance is mainly caused by the oxidation reaction. This is because the auto-oxidation occurs due to the radical chain reaction related to the oxygen, which brings the ink into discoloration.

This kind of color fade-out mechanism and methods to suppress it is shown in table 4.

*Table 4. Color fade-out mechanism and inhibiting method*

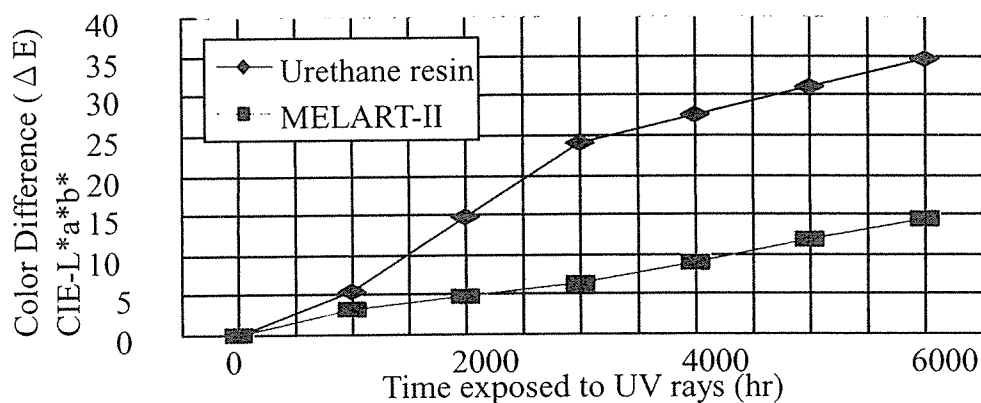
Color fade-out mechanism		Inhibiting method
	<p>Oxidation color fade-out due to auto-oxidation</p> <p>Alkyl radicals      Peroxin radicals</p>	<p>UV ray absorbent solution</p> <p>Light stabilizer</p> <p>Anti-oxidation solution</p>
	<p>Oxidation color fade-out due to single oxygen</p> <p>Single oxygen</p>	<p>Single oxygen quencher</p>

Based on these color fade-out mechanisms we evaluated the use of sublimation dyes and pigments to act as color fade-out inhibitors.

A urethane base resin had good ink stability. Color fade-out inhibitors were added to this resin to obtain getting light resistance.

The results are shown figure 5.

The method that gets this light resistance is effective in which of the pigment and the sublimation dye as well.



3. *Figure 5. Difference between MELART-II and others concerning color fade-out*

Figure 5 is comparison with the urethane paints being used for the car exterior. This graph shows the ultraviolet rays irradiation time when it was evaluated with the Sunshine weather mater, and the difference in color. This graph shows that light resistance of MELART-II is superior to the urethane paints. An open-air exposure examination is being enforced, too, and it shows the about same result.

#### 2.4. Pattern paper

MELART-II is characteristic of Pattern paper that showed it with Figure3.

Ink reception layer is transparent. Therefore, if coating layer is made transparent, it becomes Pattern paper of the transparency. Therefore, it becomes Pattern paper of the transparency if coating layer is made transparent. The appearance of the material can be shown through the pattern recorded in Pattern paper. It can get an effect like stained glass when for example glass is used for the material. When for example stainless steel is used for the material, stainless steel luster and surface finishing such as etching can be seen through the pattern, and it becomes the strange appearance that is not here by this. Therefore, if coating layer is made white un-transparency, it becomes white Pattern paper, and only the pattern recorded as Pattern paper which material was covered with can be shown.

Surface hardness is the same as the usual urethane coating with MELART-II. The surface of MELART-II becomes the surface of the mat if it can get luster and frosting medicine is added if it is ground in the same way as the coating.

MELART-II became general-purpose technology by developing pattern paper. Base material can be used from the organic material to the inorganic material.

MELART-II became capable of production for various patterns in small quantities.

### 3. CONCLUSION

In this paper, the outline of newly developed painting method MELART-II has been introduced.

In the future, we will hope to keep improving technology about the appearance of the elevator. Furthermore, we are aiming at developing technology about the appearance.



## REFERENCES

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## BIOGRAPHY

Yasuyuki Suzuki has joined Mitsubishi Electric Corp. in 1984. Then he has served Inazawa works and engaged in the industrial design of the elevator and it's the development of the research of the computer graphics and the application to the elevator.

Akinobu Mori has joined Mitsubishi Electric Corp. in 1986. Then he has served at Material research laboratory and Inazawa works in 1993. He has been chiefly engaged in the development of fiber reinforcement plastics and elevator appearance component.