OmniCure®

UV Curing • In Control

# Applications on fiber optic and electrical cables using UV-curable inks and UV-LED curing systems

## The Challenge

Fiber optic cables are essential components of modern telecommunications infrastructure. These cables consist of multiple fiber optic cores, fiber optic bundles, bundling material, rip cord and even electrical conductors. Advances in bundling technology allow for over 3400 individual optical fibers to be combined into a single fiber optic cable that carries an enormous amount of information over long distance. However, these cables must be clearly and durably marked, without causing damage or stress to the bundle.

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## The Solution

UV-curable inks present an alternative approach for marking fiber optic cables. With this technology, ink is jetted onto the cable assembly using an appropriately sized and compatible inkjet engine, then it is cured with intense UV light. To enhance ink adherence to the jacket material, corona or plasma treatment is applied to the cable jacket immediately upstream of the inkjet head. Also, when using UV-curable inks, there are lower concentrations of solvents and no need to discard ribbon backing material as with indent or hot press printing.

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## The Benefit

This technology is safe, easily implemented, does not introduce stress into the cables and results in extremely durable and legible markings.

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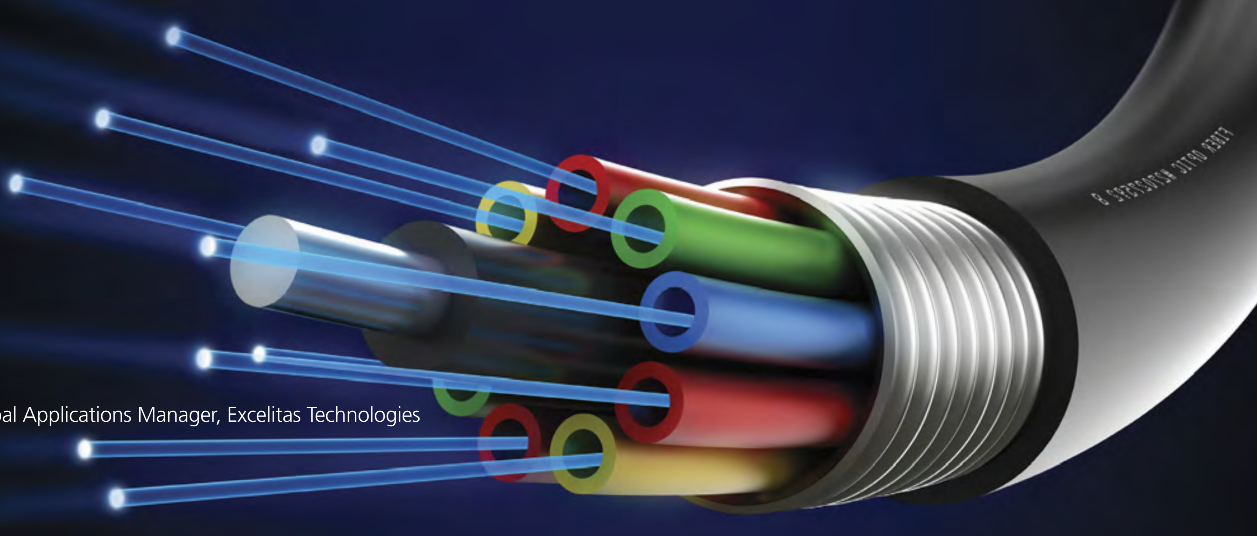

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# Introduction

## Inkjet Printing & Marking Technology

The application presented in this article describes a process for inkjet printing and marking technology for fiber optic and electrical cables using UV-curable inks and UV LED curing systems. This technology is safe, easily implemented, does not introduce stress into the cables and results in extremely durable and legible markings.

Fiber optic cables must comply with a wide range of regulatory standards including standards for marking the cable jacket. Cable jackets are typically made of medium-density polyethylene and high-density polyethylene as well as polyurethane (PU) and polyamide (PA), all of which present challenges for ink adherence. The marked text on each cable must be legible and it must endure harsh physical and chemical environments. Since cable installation often involves dragging the cable through miles of conduit, exposing the cable to abrasive gravel and concrete environments, processes for cable marking must face particularly demanding requirements, and be durable to the wear and tear.

Traditional marking or printing technologies for fiber optic and electrical cables include emboss printing, indent printing, hot foil printing, hot stamp printing and sinter printing. Some of these technologies introduce unwanted stress into the fiber optic cables, while others are not entirely compatible or, in the case of indent printing, can introduce safety concerns in the workplace.


Many UV-curing systems have used high-intensity lamps as a UV source. But lamp-based systems have a number of disadvantages including high power consumption, high cost of operation and maintenance and the need for ventilation to remove ozone from the work area. These lamps also generate and deliver heat to the curing site, which can cause product shrinkage and deformation.

The disadvantages of lamp-based systems are mitigated by using UV LED-based curing systems. UV LED systems have a longer service life and reduced operational cost, and they are more energy efficient. They also generate relatively little heat compared to lamp-based systems. The UV LEDs can also be engineered to operate in tight spectral bands at for example, 385 nm, 395 nm and 405 nm, that work with many UV curable inks already on the market as well as new inks that are optimized for UV LED curing.

As a demonstration of UV LED curing, an OmniCure® AC9300P-395 UV curing system was used in the marking process of fiber optic cables. This system, which is placed immediately following the inkjet head, delivered a high dose (up to 14 W/cm$^2$) of UV light at 395 nm for rapid curing of UV-curable inks. Many such inks already on the market are compatible with this LED system, and new inks from suppliers such as GEM Gravure are specifically designed to work with UV LED curing units. In this particular application, GEM Gravure's WTG 3360 ink was used. There are similar inks available from this manufacturer as well as from others.

In this application, cable diameters ranged from 3 mm to greater than 100 mm. The printed text size was typically 3 to 5 mm in height, while the cable assembly vibration in X-Y directions results in a spatial text height of 10 to 15 mm. The large 25 mm wide optical emitting window of the OmniCure AC9300P-395 allowed the system to compensate for cable vibration. The ideal working distance for the AC9300P-395 was determined to be 15 mm between its emitting face and the cable.

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An additional challenge arose from the occasional build-up of jacket material in the extruder. This buildup of jacket material caused knots to become attached to the jacket and increased the cable diameter tenfold. These knots had the potential to damage elements of the printing equipment including the corona generator, the inkjet and the AC9300P-395 curing system. As a result, tools to monitor the cable diameter were designed and implemented to automatically increase the working distance between the printing equipment and the cable.

Using the OmniCure AC9300P-395 LED head, print speeds of 200 mpm (depending on cable thickness) were achieved at an intensity setting of 70% to 80%. This is more than twice the print speed of many similar printing applications.

The durability of the printed information is a concern for this application. Therefore, print durability was subjected to a number of tests that met or exceeded industry standards. After curing with the OmniCure AC9300P-395 LED head, the cured print was tested by applying MEK (methyl ethyl ketone) with a cloth with average abrasiveness. The ink was swiped (rubbed) at least 25 times. Additional testing was accomplished by pulling a weighted (1 kg) dense water-saturated sponge back and forth across the cured ink for 1000 swipes. In these tests, any significant reduction in ink thickness or legibility is deemed a failure.

All testing with the OmniCure AC9300P-395 head resulted in excellent durability. No failures or significant ink reduction were observed, even after curing at speeds of up to 200 mpm. The advantages of using the OmniCure AC9300P-395 System are as follows:

- Enhanced speeds for printing and marking applications with UV-curable inks.
- Reduction of workplace injuries due to removal of the unsafe indent wheel in indent printing process.
- Reduced operational costs and resource consumption.
- Improved customer satisfaction through enhanced marking durability.

Our technical staff  has decades of expertise in solving application problems. Every incoming inquiry is assigned to an experienced technical representative who will work with you throughout the design, prototyping and manufacturing processes. We take pride in the support we provide to building long-term relationships.

## Learn more about OmniCure

For additional details, please visit www.excelitas.com or contact us at omnicure@excelitas.com today.

## Company Profile:

Excelitas Technologies® Corp. is a leading industrial technology manufacturer focused on delivering innovative, market-driven photonic solutions to meet the illumination, optical, optronic, sensing, detection and imaging needs of our OEM and end-user customers. Serving a vast array of applications across biomedical, scientific, semiconductor, industrial manufacturing, safety, security, consumer products, defense and aerospace sectors, Excelitas stands committed to enabling our customers' success in their many various end-markets. Our team consists of more than 7,500 professionals working across North America, Europe and Asia, to serve customers worldwide.

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