Light Curing
Benefits, Adhesives and Curing Lamps
Light curing – the fast way to a perfect bond

Short cycle times, smoothly running processes and reliable products are essential criteria in industrial serial manufacturing. DELO’s light-curing adhesives ideally exceed these expectations. The products are characterized by reliable function and fast curing in seconds. The bonding process is easy to integrate into production processes.

Bonding has successfully established itself as an outstanding and material-friendly joining method in a wide variety of industries. Without DELO’s light-curing adhesives, it would not be possible to produce mobile phones, smart cards, CCM cameras or modern shower enclosures as efficiently and effectively as we know them today.
Clear advantages of DELO’s light curing adhesives:

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<td>Fast curing in seconds</td>
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<td>Adhesive cures after irradiation with the required wavelength and thus enables precise positioning and fixing of the components to be bonded</td>
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<td>Outstanding optical properties</td>
<td>Adhesive features optical functions, e.g., thanks to the matched index of refraction</td>
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<td>New construction and design possibilities, e.g., thanks to the high transparency</td>
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<td>High reliability</td>
<td>Reliable function over the entire lifetime of the component</td>
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<td>Simple processing</td>
<td>One-component, no mixing systems required</td>
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<td>Excellent adhesion</td>
<td>Outstanding strength over the entire lifetime of the component</td>
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<td>Low temperature stress</td>
<td>Joining of temperature-sensitive components, increased flexibility in the selection of component materials</td>
<td>5, 8</td>
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<td>Product types with secondary curing mechanism available</td>
<td>Curing of adhesive in shadowed areas, for example by heat, humidity or anaerobic curing</td>
<td>5, 6, 11</td>
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</table>
DELO’s adhesive can be found in three out of four smart cards. The revolving, high-viscous dam material encloses the low-viscous fill material. (Adhesive colored magenta in the figure)

**Light curing =**
**Fast curing in seconds**

**Dam & Fill chip encapsulation**

In the production of chip modules for smart cards, the contacted chip is first encircled by a high-viscous adhesive (dam), that is subsequently filled with a low-viscous chip encapsulant (fill). The adhesive can be applied with systems provided by Mühlbauer or Ruhlamat.

Both DELO KATIOBOND Dam & Fill adhesives are then cured in one go with the DELOLUX 820/365 curing lamp.

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<tr>
<td>High production capacity</td>
<td>Encapsulation of up to 40,000 modules/h</td>
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<tr>
<td>Quality</td>
<td>Steady dispensing results even when using showerhead dispensers</td>
</tr>
<tr>
<td>Optimized production flow</td>
<td>In-line process from the blank tape to the finished module</td>
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<tr>
<td>Operational reliability</td>
<td>Requirements of the ISO specification are exceeded</td>
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**Technical properties of DELO KATIOBOND Dam & Fill**
- High ion purity
- Dam & Fill encapsulants can be processed wet in wet, that means that the dam does not have to be cured first
- Dam & Fill adhesives form a chemically homogeneous unit
- Tension-equalizing or hard products for various requirement profiles
- Also suitable for glob top

**Advantages of light curing**
- High production capacity
- Quality
- Optimized production flow
- Operational reliability

**Fast curing in seconds – further examples:**
- Bonding of mini loudspeakers
- Bonding of compact camera modules
- Bonding of lenses into LED packages

We have been collaborating with DELO for more than 20 years. We use DELO KATIOBOND Dam & Fill adhesives to produce our smart card modules as they cure fast in seconds and enable short cycle times. The innovative and reliable products help us achieve our goals as technology and quality leader.

*Peter Stampka, Director Marketing, ChipCard & Security, Infineon Technologies AG*
Active alignment process of camera modules: dispensing – alignment – light fixing – heat curing (Adhesive colored magenta in the figure)

Light curing = Curing on demand

Bonding of compact camera modules

Optical components, such as lenses and image sensors, are precisely aligned using DELO DUALBOND. The adhesive remains liquid during alignment. As soon as the component has reached the position for optimal image quality, the adhesive is quickly fixed within seconds by exposure to light using DELOLUX LED curing lamps specifically adapted to this process. Subsequent final curing by heat proceeds at just +80 °C.

Technical properties of DELO DUALBOND
- Fast fixation by UV light in less than 1 second
- Curing at low temperatures: Final curing possible at +80 °C
- Excellent adhesion to plastics, such as PBT, FR4, etc.
- Low outgassing, low shrinkage
- Good temperature stability
- Good resistance to climatic changes, humidity and in salt spray test
- Halogen-free according to IEC 61249-2-21

Advantages of light curing  Your benefit

Increased production capacity  Reliable fixing in less than 1 s (depending on component) enables short cycle times

Optimized process flow  Curing at low temperatures (at only +80°C) makes possible the bonding of temperature-sensitive components

Process reliability  Unchanging, low shrinkage leads to high yield

High efficiency  Low energy consumption

Compact camera module for smartphones

Thanks to DELO DUALBOND, it is now also possible to bond temperature-sensitive components and cure shadowed areas in a fast and highly reliable process. These adhesives are perfectly suited for the active alignment process by providing fast light curing with secondary temperature curing at only +80°C. We often recommend that customers use DELO DUALBOND adhesives because we know, they work without fail!

Andre By, Chief Technology Officer, Automation Engineering Incorporated
Light curing = Outstanding optical properties

Bonding of displays and touch panels

Light-curing adhesives are more than just a joining element. When bonding touch panel displays for smartphones, tablet PCs and industrial displays, the adhesive also features optical functions: It fills the air gap between touch panel and display. The adhesive’s adapted index of refraction prevents undesirable reflections and allows readability even under direct sunlight.

Technical properties of DELO PHOTOBOND and DELO DUALBOND display adhesives
- High transparency
- Tension-equalizing
- Secondary curing mechanism (humidity) for shadowed areas, for example under black print on the display glass
- Fast, reliable and durable connection of various materials

Advantages of light curing

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<thead>
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<tr>
<td>Functionality</td>
<td>Improved optical properties of the displays</td>
</tr>
<tr>
<td>Short innovation cycles</td>
<td>Faster development of new products and designs compared to tapes</td>
</tr>
<tr>
<td>Quality</td>
<td>Increased ruggedness, impact and vibration resistance of touch panel and display, no contamination in the air gap</td>
</tr>
<tr>
<td>Prolonged lifetime</td>
<td>Improved shock and vibration behavior</td>
</tr>
</tbody>
</table>

Outstanding optical properties – further examples:
- Protection of glass covers of industrial displays against extreme stress
- Bonding of lenses into LED packages
- Glass bonding: shower enclosures, glass jewelry, flacons

"LCD with protective glass cover:
On the right side, reflections are visible due to the air gap between LCD and glass cover. On the left side, the gap is filled with DELO’s index-matched adhesive.

Radtech Europe Innovation Award 2011 for the development of light-curing, transparent adhesives for display bonding.
RadTech Europe Association, October 2011"
The world market leader Duscholux, Switzerland, uses DELO’s light-curing adhesives to bond its shower enclosures.

We decided to use bonding technology as joining methods in order to provide our customer with modern appearance and innovative design with user-friendly cleaning properties. The invisible and yellowing-resistant DELO PHOTOBOND adhesives are ideal for this application.

Guido Riegger, Development Manager, Duscholux AG

Light curing = Innovation

Bonding of door hinges for glass shower enclosures

DELO PHOTOBOND is used in mixed glass bondings for shower enclosures, as an example, to join door hinges made of stainless steel to glass panels. The adhesive is cured with DELOLUX LED area modules. Intensity and irradiation time can be controlled. The irradiation time can precisely be set by simply switching the lamp on and off. As a result, the LED does not age or consume current during the non-irradiation phase.

Technical properties of DELO PHOTOBOND
- Reliable adhesion to glass, stainless steel, and anodized aluminum
- Invisible, yellowing-resistant and light-fast
- Humidity-resistant
- Equalization of thermal tensions between glass and metal, impact-resistant

Advantages of light curing | Your benefit
---|---
New design possibilities | Esthetical and easy-to-clean designs
Cost-efficient production | Omission of boreholes and screws
Quality | Positively tested acc. to DIN EN 14428 with more than 250,000 opening/closing cycles

Innovation – further examples:
- Bonding of organic solar cells
- Encapsulation of OLED displays
- Bonding of connection elements / ONSERT®
Eight individual components are bonded to assemble miniloudspeakers for mobile phones, dictating machines, etc. Light-curing adhesives are used for most of them.

Light curing = Miniaturization

Bonding of miniloudspeakers for mobile phones

Today’s mobile phones include two to three high-performance miniloudspeakers. The individual components, such as membranes, coils, or covers, are bonded with DELO PHOTOBOND adhesives which are cured with specifically adapted high-power DELOLUX LED lamps.

Technical properties of DELO PHOTOBOND
- Fast curing in less than 1 second
- Good adhesion to various materials, such as metal and plastic
- Very good temperature and humidity resistance
- High flexibility and impact resistance
- Light curing: No thermal stressing of the sensitive membranes

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<tr>
<td>More flexible production</td>
<td>Easy adaptation of the bonding process over many product generations</td>
</tr>
<tr>
<td>Quality</td>
<td>Loudspeakers bonded with DELO PHOTOBOND are characterized by superior acoustic quality over their entire lifetime</td>
</tr>
<tr>
<td>Increased production capacity</td>
<td>Short cycle times allow production of up to 6,000 loudspeakers per hour on one system</td>
</tr>
<tr>
<td>Production reliability</td>
<td>In-process check of the exact adhesive application thanks to the fluorescence of the adhesive</td>
</tr>
<tr>
<td>Optimized process flow</td>
<td>Loudspeakers can be fully tested directly after adhesive curing, buffer stock not necessary therefore</td>
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</table>

Comparison of an outdated loudspeaker with today’s models: The performance density of modern miniloudspeakers clearly increased while the size was reduced © Knowles Electronics Austria GmbH

We are the market and innovation leader in mobile phone loudspeakers and have successfully been collaborating with DELO for more than 20 years. Here, world market leader meets world market leader! We can rely on DELO when we develop new products. They always supply us with innovative adhesives that fulfill our individual needs for mobile acoustic products.

Wolfgang Suete, Process Engineer, Knowles Electronics Austria GmbH

Miniaturization – further examples:
- Smart label applications
- Bonding of compact camera modules
Light curing = High reliability

Casting of automotive microswitches

When bonding electronic automotive components such as microswitches, relays or sensors, special adhesives are in demand: they must seal the components against temperatures, pressure, humidity or aggressive media. Open contact areas at the housing must be reliably covered to protect the entire component from corrosion.

Technical properties of DELO KATIOBOND
- Excellent adhesion to plastic, metal, and glass
- High flexibility even at low temperatures
- Very good flow and wetting behavior
- Resistant to chemicals, humidity, temperatures, and shocks
- High corrosion resistance

Advantages of light curing | Your benefit
---|---
Quality | Reliable function of safety-relevant components even after years of use
Process reliability | Fast curing allows functional tests directly in the system
Increased efficiency | Technically and economically ideal solution compared to two-component or heat-curing adhesives

Behr-Hella Thermocontrol produces operator and control devices for automotive air conditioning systems. They use light-curing adhesives to cast electrical pins.

Important requirements on the adhesive include that the component is reliably sealed against contaminations and humidity. DELO KATIOBOND is ideal for this purpose.

Heinz Sträter, Production Engineer, Behr-Hella Thermocontrol GmbH

High reliability – further examples:
- Smart card encapsulation
- Bonding and sealing of mobile phone displays
Bonding of connection elements

In the aircraft and automotive industries more and more carbon-fiber-reinforced plastics (CFRP) are used. Boreholes are omitted to prevent damage to the material when attaching connection and fixing elements. Instead, clips or thread inserts covered in transparent plastic are bonded to the CFRP.

The ONSERT® method jointly developed by DELO and BÖLLHOFF (supplier of mechanical connection elements, such as rivets and screws) has many advantages over other joining methods.

Technical properties of DELO PHOTOBOND

- Excellent adhesion to many plastics, metals, and glass
- Tension-equalizing
- High long-term and media resistance

Advantages of light curing

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<tr>
<td>Decrease in production costs</td>
<td>Easier handling compared to two-component or heat-curing adhesives</td>
</tr>
<tr>
<td>Increased production capacity</td>
<td>Fast curing in seconds for short cycle times</td>
</tr>
<tr>
<td>Production reliability</td>
<td>A high degree of automation is possible</td>
</tr>
<tr>
<td>Continuously high level of the product properties</td>
<td>Unlike rivets, bonding does not weaken or damage the component structures</td>
</tr>
<tr>
<td>New design possibilities</td>
<td>In contrast to welded elements, bonded fixing elements can flexibly be attached and are not apparent on the visible side</td>
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</table>

Simple processing – further examples:

- Bonding of faceplates of household appliances (ovens, dishwashers, washing machines)
- Bonding of stop rails and door hinges of shower enclosures – instead of boreholes
- Bonding of automotive cameras

The ONSERT® joining method is an excellent combination of innovative bonding technology and connection elements. Short cycle times, a simple process with a high degree of automation and adhesive curing in just seconds enable simple and reliable handling. This is a fantastic creation of DELO and BÖLLHOFF.

Michael Stumpf, Product Manager, Böllhoff Verbindungstechnik GmbH
Bonding of electric motors

Electric motors are getting more and more compact and efficient. The degree of efficiency of small motors is continuously increasing. DELO-ML DB adhesives connect the individual components in seconds, save weight, equalize tensions and, unlike anaerobic-curing competitive products, provide high strength even at high torque.

Technical properties of DELO-ML DB
- Dual-curing: Curing by light and under exclusion of oxygen (anaerobic)
- Very good chemical resistance to media in the engine compartment including oil, gasoline, and Diesel
- Normal temperature range of use up to +180 °C
- Tension-equalizing
- Very high impact resistance
- Excellent adhesion to smooth metal surfaces

Advantages of light curing

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<tr>
<td>Increased operational reliability and longer lifetime</td>
<td>Metals with dissimilar coefficients of expansion and even larger magnets are bonded with high strength</td>
</tr>
<tr>
<td>Optimized production flow</td>
<td>Preliminary light fixation enables immediate firmness to touch and saves mechanical component fixtures</td>
</tr>
<tr>
<td>Increased efficiency</td>
<td>Anaerobic adhesive curing in shadowed areas reduces energy costs and saves expensive process steps</td>
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</table>

We bond with the dual-curing DELO-ML DB as it provides clearly better strength in torque tests than the previously used adhesive.

Daniel Rauer, Project Team Leader, Industrial Drive Development, ebm-papst GmbH & Co. KG

In addition, it is not necessary to mechanically fix the components during anaerobic curing thanks to the preliminary light fixation.
## DELO’s light-curing adhesives

<table>
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<tr>
<th>Curing</th>
<th>DELO PHOTOBOND acrylates</th>
<th>DELO KATIOBOND epoxy resins</th>
<th>DELO DUALBOND acrylates / epoxy resins</th>
<th>DELO-ML DB methacrylates DB = DUALBOND</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light-curing</td>
<td>Light-curing, partly light-activated</td>
<td>Dual-curing: Light-curing and heat- or humidity-curing depending on the product</td>
<td>Anaerobic-curing, with additional light curing</td>
<td></td>
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</table>

| Wavelength range for curing | 320 – 450 nm depending on the type | 320 – 550 nm depending on the type | 320 – 550 nm depending on the type | 320 – 450 nm depending on the type |

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<tr>
<th>Application areas</th>
<th>Automotive</th>
<th>Mobile phones</th>
<th>Displays</th>
<th>Glass</th>
<th>Optoelectronics</th>
<th>Smart labels</th>
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| Special features * | Extremely fast curing | High equalization of tensions | High impact resistance | High optical clearness and UV resistance | Universally good adhesion | High thermal and chemical resistance | Low outgassing | Optically clear and yellowing-resistant even at elevated temperatures | High ion purity | Low corrosion potential | High water barrier effect | Secondary curing mechanism for reliable curing in shadowed areas | Otherwise like the corresponding basic product group | Anaerobic- and light-curing, one-component adhesives | Excellent adhesion to metal | Good adhesion even to certain plastics | Tension-equalizing and impact-resistant |
|-------------------|------------------------|-------------------------------|------------------------|------------------------|-------------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|--------------------------|-------------------------------|-----------------------------|-----------------------------|-----------------------------|
| High thermal and chemical resistance | • High thermal and chemical resistance | • Low outgassing | • Optically clear and yellowing-resistant even at elevated temperatures | • High ion purity | • Low corrosion potential | • High water barrier effect | • Secondary curing mechanism for reliable curing in shadowed areas | • Otherwise like the corresponding basic product group | • Anaerobic- and light-curing, one-component adhesives | • Excellent adhesion to metal | • Good adhesion even to certain plastics | • Tension-equalizing and impact-resistant |

| Curing in shadowed areas | – | ✓ light-activated product types | ✓ by heat or humidity depending on the product | ✓ by anaerobic curing |

* The strong points show in which areas the product groups are particularly efficient. Depending on the product, these strong points may differ.
In order to better utilize the advantages of light curing in production, including miniaturization, maximum reliability and extremely fast processes, DELO has developed complementary dispensing technology, such as the DELO-DOT PN3 jet valve and DELO FLEXCAP.

DELO-DOT PN3 microdispensing valve – Precise, compact and light-weight

The pneumatic DELO-DOT PN3 microdispensing valve is precise, fast and compact. It has an operating frequency of up to 330 Hz (drops per second). This unique system is made to be robust due to its modular design. This design allows the dispensing valve to be easily disassembled into its single parts. The fluid system is strictly separated from the actuator. This avoids time-consuming cleaning, and the valve can be put into operation again quickly. The actuator has an extremely long lifetime of more than 1 billion cycles.

DELO FLEXCAP cartridge system with integrated fill level sensor in the pressure tank

A flexible, hermetically tight foil replaces the conventional cartridge piston. As a result, adhesives can be stored, transported and dispensed without bubbles. The cartridge system which is free of trapped air enables the highest dispensing reliability, precision and maximum emptying. DELO FLEXCAP is available in 10 ml and 30 ml container. The fill level sensor of the pressure tank for DELO FLEXCAP provides benefits for fully automated production. Integrated sensors transmit a signal that indicates when the cartridge is nearly empty and again when it is completely empty. As a result, the user can prepare a new cartridge in time to minimize downtime.

Advantages at a glance:
- Process reliability thanks to bubble-free dispensing
- Reproducible processes with a high yield rate
- Easy to integrate into every production system
- Cost savings through reduced waste, minimized downtime, and maximum emptying of the cartridges
- The air-tight cartridge enables easy and cost-efficient transport

All DELO products are developed and produced in Germany, ensuring the highest quality of design and manufacture.
# Curing in seconds with DELOLUX

<table>
<thead>
<tr>
<th>Description</th>
<th>High-intensity spot light source</th>
<th>High-intensity area lamp for smaller bonding areas</th>
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</thead>
</table>
| **Dimensions of lamp head** | x1: 12 mm dia. × 71 mm  
   x4: 15 mm dia. × 76 mm | 365 nm: 27 mm dia. × 84 mm  
   400 nm: 27 mm dia. × 92 mm  
   460 nm: 20 mm dia. × 85 mm |
| **Light exit area** | x1: 8.6 mm dia.*  
   x4: 11.5 mm dia.* | 365 nm: 23.0 mm dia.  
   400 nm: 23.0 mm dia.  
   460 nm: 16.9 mm dia. |
| **Wavelength / typical intensity** | 365 nm x1: up to 12,000 mW/cm²  
   365 nm x4: up to 2,500 mW/cm²  
   400 nm x1: up to 12,000 mW/cm²  
   400 nm x4: up to 2,500 mW/cm² | 365 nm: up to 1,500 mW/cm²  
   400 nm: up to 6,000 mW/cm²  
   460 nm: up to 3,000 mW/cm² |
| **Cooling mechanism** | Passively cooled Powerguide, heat sink in lamp head | Closed and monitored Coldguide™ liquid cooling system |
| **Control** | DELO-UNIPRO, DELO-UNIPRO Light or external PLC | DELO-UNIPRO, DELO-UNIPRO Light or external PLC |
| **Application examples** | Bonding of compact camera modules:  
   ▪ Several LED heads are spread over the component circumference and enable flexible irradiation of several bonding areas  
   ▪ Any installation position of the LED heads thanks to flexible, robust conduit | Bonding of miniloudspeakers for mobile phones:  
   ▪ The light exit area is ideal for the size of the miniloudspeaker components  
   ▪ High intensity  
   ▪ Short switching cycles are possible with the LED lamp |

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## Properties

- Emission spectra optimized for adhesives
- Evenly distributed intensity
- Monitoring of the LED temperature and function
- Regular intensity measurement at the component with DELOLUXcontrol

## Your benefits

- Reliable adhesive curing, high process reliability
- Low operating costs
- Fast curing in seconds, short cycle times
- Easy integration into systems

### DELOLUX 20, 202

**Area lamp for even irradiation**

- **DELOLUX 20:** 112 mm × 112 mm × 185 mm
- **DELOLUX 202:** 209 mm × 59 mm × 218 mm

- **DELOLUX 20:** 101 mm × 101 mm
- **DELOLUX 202:** 198 mm × 48 mm

- **365 nm:** 300 mW/cm²
- **460 nm:** 400 mW/cm²

- Active air cooling

- **DELO-UNIPRO, DELO-UNIPRO Light or external PLC**

- Bonding of touch panel displays:
  - Arraying the lamp heads creates the optimal light exit areas for the specific display size
  - Fast light curing within seconds, handling of the display can continue immediately

### DELOLUX 20, 202

**High-intensity area lamp for even irradiation**

- **DELOLUX 20:** 112 mm × 112 mm × 121 mm
- **DELOLUX 202:** 209 mm × 67 mm × 121 mm

- **DELOLUX 20:** 100 mm × 100 mm
- **DELOLUX 202:** 202 mm × 49 mm

- **400 nm (A1):** 1,000 mW/cm²
- **400 nm (A2):** 2,000 mW/cm²

- Active air cooling

- **DELOLUX pilot and optional downstream PLC**

- Casting of microswitches:
  - High intensity
  - Fast curing within seconds “on demand”, handling can continue immediately after irradiation

### DELOLUX 820

**Area lamp for even irradiation**

- x4: 848 mm × 82.8 mm × 179 mm
- x6: 1,267 mm × 82.8 mm × 179 mm

- x4: 830 mm × 30 mm
- x6: 1,250 mm × 30 mm

- **365 nm:** 300 mW/cm²

- Liquid cooling with external cooling unit

- **DELO-UNIPRO, DELO-UNIPRO Light or external PLC**

- Encapsulation of chip modules for smart cards:
  - The light exit area enables the linear irradiation of smart card modules in reel-to-reel processes
  - Evenly distributed intensity, the cold LED light source and defined heat influence by heating bars from below enable absolutely constant adhesive curing
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