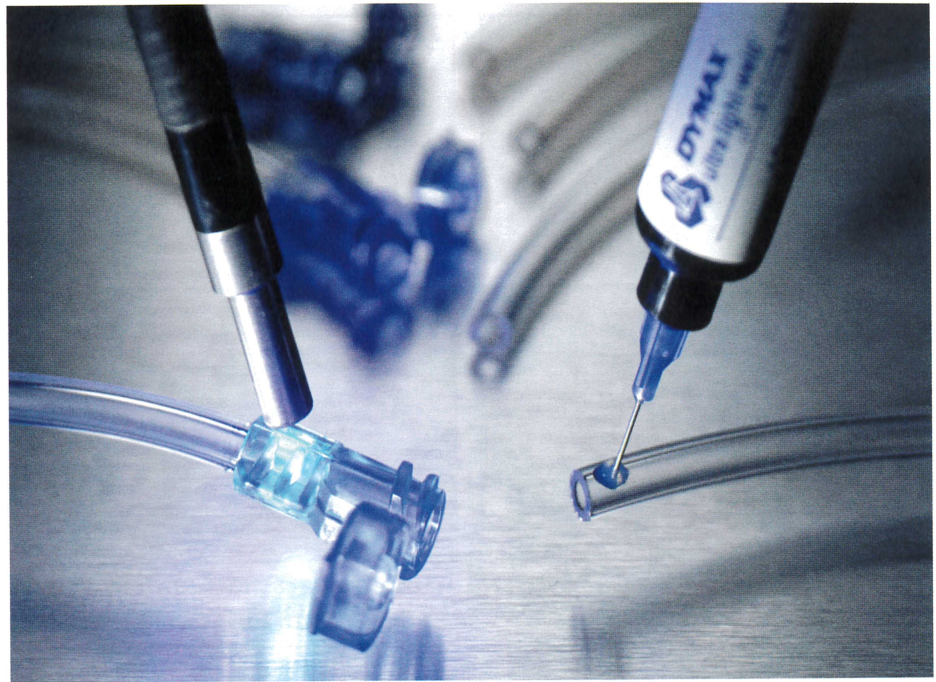


In the tips from Intertronics covered in this feature, the term 'adhesive' also covers coatings, encapsulants, potting compounds, temporary masking materials and form-in-place gaskets, where applicable



# Tipping the balance

**L**et's kickstart proceedings by taking a look at UV curing lamps, which can be based on two types of quite different technology:

■ **Mercury arc lamp** – used successfully for decades and still the predominant lamp type, it produces a broad spectrum of light

■ **LED lamp** – a much newer technology, it produces a narrow spectrum of light. The output from UV curing lamps based on LEDs does not appreciably degrade over time. There are no bulbs to replace in LED lamps, they require no warm up time, they emit cooler light radiation and they are more electrically efficient. They also meet the increasingly stringent regulations regarding the use of mercury. LED UV curing lamps will not work optimally with all UV curing adhesives, many of which are designed to cure with broad spectrum UV light.

## Dosage decisions

By testing, understand the minimum dose needed for your application – how much energy do you need to achieve an optimal cure? Establish a curing process at the minimum dose, plus a recommended 25% safety factor. Make sure the spectral output (UV and/or visible light wavelengths) of your curing lamp is correctly

matched with the material you're curing. Not all materials cure optimally with all lamps, and a mismatch can result in non-optimal or poor bonds. If you're considering taking advantage of the benefits of LED UV curing technology, remember that it is not a simple like-for-like replacement for broad spectrum lamps.

## Variables control

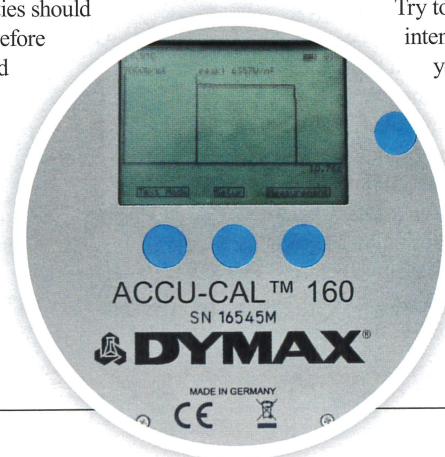
Understand and control the process variables, in order to get repeatability and consistency. Ideally, you would like to fix each process variable i.e. time of exposure, distance, intensity, adhesive quantity and location etc. As a rule of thumb, Intertronics recommends a minimum curing intensity of about 50 mW/cm<sup>2</sup>. Higher intensities should give better cure and therefore better performance – and shorter process time. It is not recommended to use very low power UV lights (or the sun!) for extended times, as this is likely to result in non-optimal or incomplete curing

for most industrial grade products, which may have a minimum activation energy level. Fix the distance between the light source and bondline. This is a critical variable, because the light intensity falls off with the square of the distance – so at twice the distance, you will have only one quarter of the energy. For faster cures, get as close as you can.

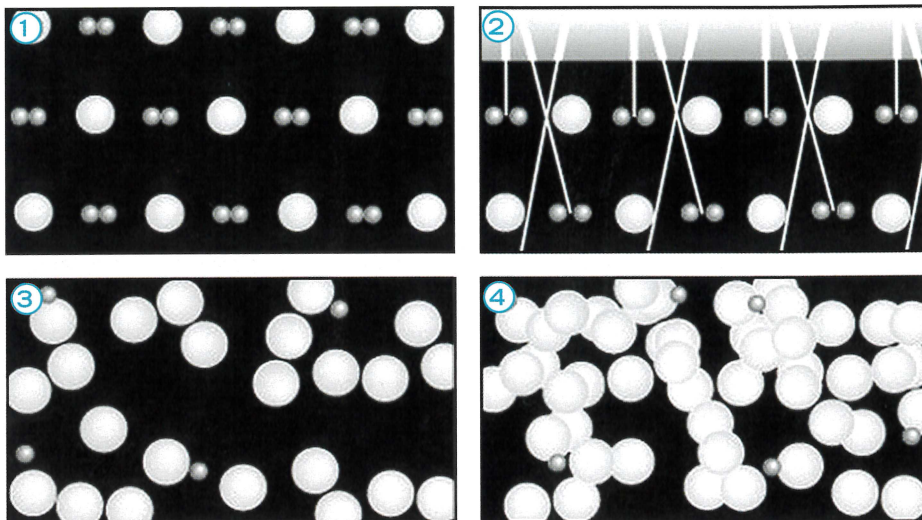
## Radiometers

You can measure the light intensity using a radiometer, which gives an output in mW/cm<sup>2</sup> or W/cm<sup>2</sup>. Radiometers with different spectral sensitivities are recommended for use with the different broad spectrum and LED curing lamps. Some radiometers also measure dose.

Try to understand the curing intensity at the bondline. If you are curing through a substrate, how does this affect the light transmission to the adhesive? Some plastics have UV blocking additives, which can inhibit transmission, and therefore curing. >>



## TECHNOLOGY INSIGHTS



The production process should ensure a full cure during the time of exposure

>> In this case, adhesives with enhanced UV and visible light cure ability can overcome this.

All of the adhesive in the bondline must be exposed to light, in order to cure, so in general at least one substrate must be able to transmit appropriate light; the ability to see through the surface is a good indication. In some cases (eg, conformal coatings), part-shaded areas can be accommodated by using dual-cure materials, such as those that have a secondary cure capability using heat or moisture.

## Full cure

With most UV curing adhesives (ie, those based on free radical polymerisation), curing starts with exposure to light, and stops when the light is removed. So, the production process should ensure a full cure during the time of exposure. If possible, expose all adhesive in one dose of UV light. Multiple exposures are not normally recommended, as they could affect the integrity of the bond.

The output intensity of arc lamp broad spectrum UV light sources degrades over time, so it is recommended that you carry out regular output checks with a radiometer to ensure a minimum dose is achieved. These lamps normally have hour meters, to facilitate the recording of intensity against 'on' time.

With arc lamp broad spectrum UV light sources, bulb life is shortened by frequent turning on and off. It is recommended that the lamp is left on during a normal shift if curing is expected to take place. Allow broad spectrum lamps five minutes to attain full intensity before you use them to cure, and fifteen minutes after turning off to reach room temperature before re-ignition. LED-based curing lamps are instant on/off, requiring no warm-up/warm-down time.

## Light bulb moment

If you use a broad spectrum UV light source, always have a spare bulb readily available to minimise production downtime, should the bulb need replacing due to normal degradation or failure.

Curing performance can be compromised by dirt, dust and process contaminants. If using a spot lamp, regularly check the end of the lightguide for cleanliness. For flood lamps, the reflector and base should both be cleaned as necessary.



Understand the minimum dose needed for your application

## Bright thoughts


Make sure UV/light curable materials are stored in light-proof containers, away from direct sunlight.

UV and light curable materials are available in a range of viscosities, from water-like to paste. If available, choose a viscosity which is optimal for your dispensing and application process, taking into account desired flow and wicking characteristics.

## Full cure

The determination of whether or not a full cure has been accomplished is best achieved by empirical tests. Full cure is the point at which more UV exposure no longer improves cured properties. For an adhesive, pull or lap shear tests against a range of process variables like time or intensity should help determine the optimal cure. Other cured properties like hardness or tackiness can also be indicators. In addition, some materials which indicate an effective cure are available (eg, Dymax See-Cure colour change technology).

If you get a slightly sticky or tacky surface after curing, this could be a result of oxygen inhibition. This is a well understood phenomenon of free radical cure chemistry, where the presence of normal atmospheric oxygen at the surface of the adhesive can inhibit the cure at that surface, resulting in a very thin layer of an adhesive constituent remaining – the bulk of the adhesive is cured. Tackiness can be reduced or prevented by using UV curing lamps with more output in the shorter wavelengths (which means a broad spectrum UV light source) and/or higher intensity.

For more information about any of the tips described above – and further insights – email [info@intertronics.co.uk](mailto:info@intertronics.co.uk) or call the telephone number shown below. 

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Store UV light curable materials in light-proof containers