New Advances in Dose Controlled 3D UV Curing

By Douglas DeLong

DDU ENTERPRISES, INC.

DOCTORUV.COM™

RADTECH 2012 UV&EB

The 3D UV Curing Processes has always had challenges in getting good UV uniformity and UV power measurement in the past years.

DOCTORUV.COM™

RADTECH 2012 UV&EB

Lamp placement and position set up was a difficult task.

We had to try many hit and miss trial lamp positions until we found a setup that worked well.

DOCTORUV.COM™

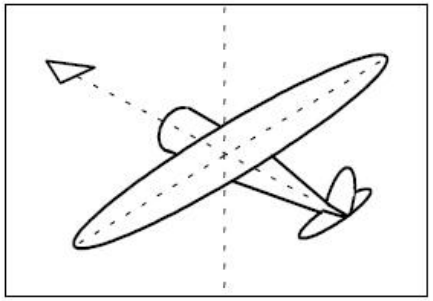
RADTECH 2012 UV&EB

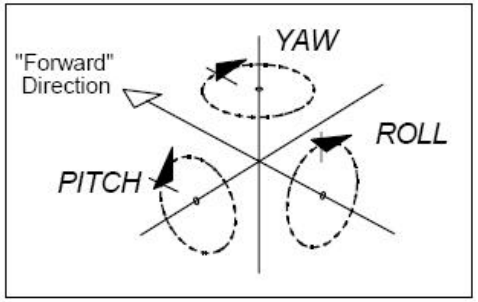
In the Rad Tech Report in 2002 a language was introduced for 3D lamp position location angles in an article by Dick Stowe of Fusion UV

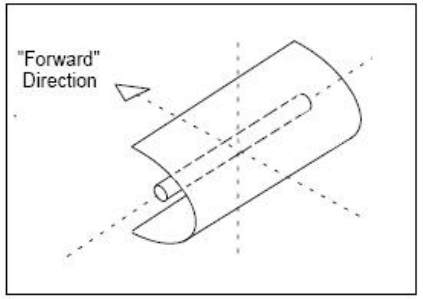
Attitude

Think airplane. We begin with ***pitch, yaw,*** and ***roll***. For the pilot of an airplane, ***pitch*** is the angle relative to a plane, for example, the horizon – nose up, nose down or level. ***Yaw*** is turning right or left. ***Roll*** is raising one wing and lowering the other. These three axes will completely describe the *attitude* of the aircraft.

Think of the axis of the UV bulb aligned with the wingspan of the aircraft, and you get the picture.



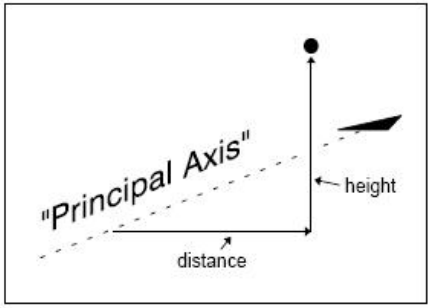


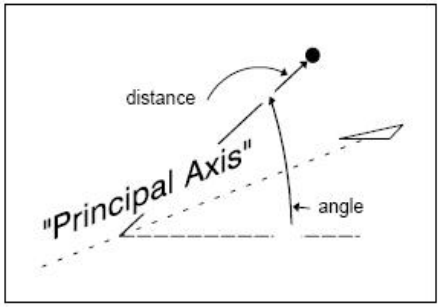


Position

This is a little trickier, because there are several ways to locate a point in space. First, the *principle axis* is along the direction of travel of the production line. The principal axis can be located anywhere parallel to the travel. The centerline of the conveyor and the floor, for example, are convenient reference points for locating the principal axis.

Imagine a horizontal plane through this principal axis. This is like the horizon. A point can be located by its height (altitude) from the plane and its horizontal distance from the centerline (these are its Cartesian coordinates). Another way to locate the point is to use its angle of elevation from the "horizon" plane and the distance to the principal axis. Pick one of these ways and stick with it.





PITCH, YAW, ROLL, HORIZONTAL PLANE, CARTISIAN COORDINATES

DOCTORUV.COM™

RADTECH 2012 UV&EB

PITCH, YAW, ROLL, HORIZONTAL PLANE, CARTISIAN COORDINATES

These words were used to describe the 3D lamp location placement because there was no easy way to describe it.

PITCH, YAW, ROLL, HORIZONTAL PLANE, CARTISIAN COORDINATES

These words were used to describe the 3D lamp location placement because there was no easy way to describe it.

At times it seems to be a black art. Once you had a working 3D UV set up and had to change to a different shaped 3D substrate you could have a different lamp location set up again for best results.

PITCH, YAW, ROLL, HORIZONTAL PLANE, CARTISIAN COORDINATES

These words were used to describe the 3D lamp location placement because there was no easy way to describe it.

At times it seems to be a black art. Once you had a working 3D UV set up and had to change to a different shaped 3D substrate you could have a different lamp location set up again for best results.

The easy answer was to add more UV lamps to fill in the under UV exposed areas.

PITCH, YAW, ROLL, HORIZONTAL PLANE, CARTISIAN COORDINATES

These words were used to describe the 3D lamp location placement because there was no easy way to describe it.

At times it seems to be a black art. Once you had a working 3D UV set up and had to change to a different shaped 3D substrate you could have a different lamp location set up again for best results.

The easy answer was to add more UV lamps to fill in the under UV exposed areas.

This added new lamp costs, more energy use, extra spare parts, added cooling etc.

Multiple Lamps that are located in multiple positions makes accurate UV measurement a difficult and time consuming task

DOCTORUV.COM™

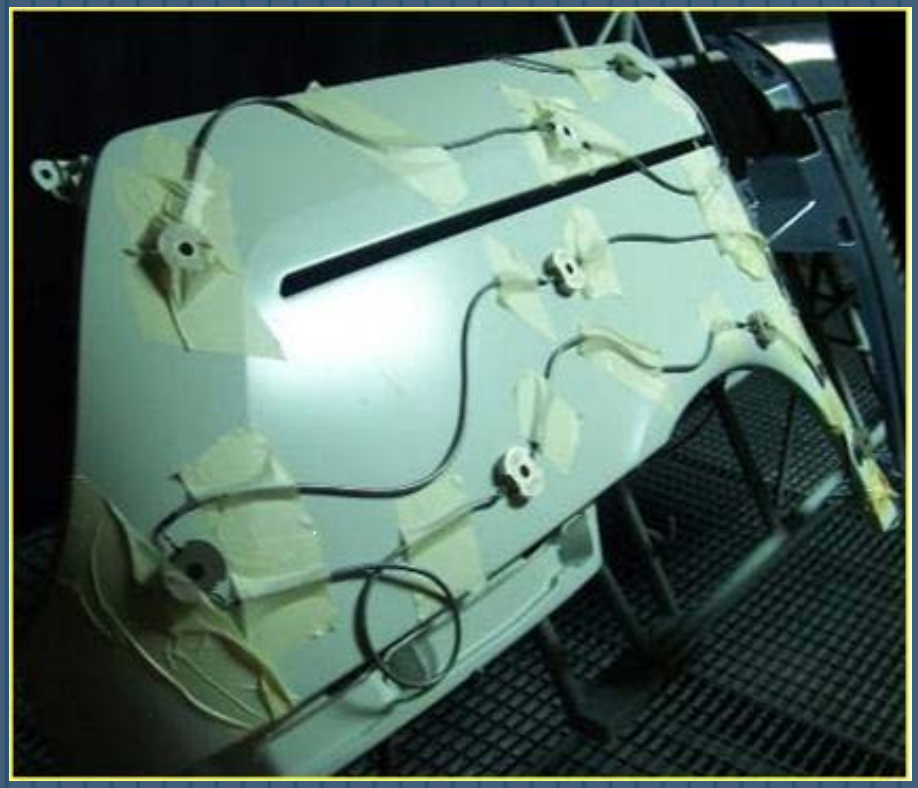
RADTECH 2012 UV&EB

To measure all lamp positions takes multiple passes with one radiometer

DOCTORUV.COM™

RADTECH UV&EB 2012

Or One Pass with multiple radiometers



DOCTORUV.COM™

RADTECH 2012 UV&EB

Multiple radiometer passes take too much time and in many cases the 3D UV operators cut corners when they validate the UV measurements

DOCTORUV.COM™

RADTECH UV&EB 2012

Poor UV validation measurements can result in:

DOCTORUV.COM™

RADTECH 2012 UV&EB

Poor UV validation measurements can result in:

- ✓Excess scrap / Rework

DOCTORUV.COM™

RADTECH UV&EB 2012

Poor UV validation measurements can result in:

- ✓Excess scrap / Rework
- ✓Recalled or Returned Products

DOCTORUV.COM™

RADTECH UV&EB 2012

Poor UV validation measurements can result in:

- ✓Excess scrap / Rework
- ✓Recalled or Returned Products
- ✓Unhappy Customers

DOCTORUV.COM™

RADTECH UV&EB 2012

Now there is a way for 3D UV Curing to have NIST Traceable validated dose control featuring:

DOCTORUV.COM™

RADTECH 2012 UV&EB

Now there is a way for 3D UV Curing to have NIST Traceable validated dose control featuring:

✓UV light with +/- 5% uniformity

DOCTORUV.COM™

RADTECH UV&EB 2012

Now there is a way for 3D UV Curing to have NIST Traceable validated dose control featuring:

- ✓UV light with +/- 5% uniformity
- ✓Low IR heat

DOCTORUV.COM™

RADTECH UV&EB 2012

Now there is a way for 3D UV Curing to have NIST Traceable validated dose control featuring:

- ✓UV light with +/- 5% uniformity
- ✓Low IR heat
- ✓Less UV lights possibly needed

DOCTORUV.COM™

RADTECH UV&EB 2012

Complex 3D parts make it difficult to establish the true dose on a multiple UV lamp 3D curing line

- Complex shapes of 3D parts won't allow for radiometer placement in all areas of the part.
- Some areas get under cured and other areas get over cured.
- On heat sensitive parts this can be a major problem.

A new 360 degree UV Curing Technology makes Real Time Dose Control a reality

DOCTORUV.COM™

RADTECH 2012 UV&EB

A new 360 degree UV Curing Technology makes Real Time Dose Control a reality

- Using highly efficient reflective chamber walls.

DOCTORUV.COM™

RADTECH 2012 UV&EB

A new 360 degree UV Curing Technology makes Real Time Dose Control a reality

- Using highly efficient reflective chamber walls.
- The chamber walls become the light source

DOCTORUV.COM™

RADTECH UV&EB 2012

A new 360 degree UV Curing Technology makes Real Time Dose Control a reality

- Using highly efficient reflective chamber walls.
- The chamber walls become the light source
- The walls surround the part being cured with uniform panels of light – up to 95% uniform

DOCTORUV.COM™

RADTECH 2012 UV&EB

A new 360 degree UV Curing Technology makes Real Time Dose Control a reality

- Using highly efficient reflective chamber walls.
- The chamber walls become the light source
- The walls surround the part being cured with uniform panels of light – up to 95% uniformity
- Part and lamp positioning is unimportant even for complex parts

DOCTORUV.COM™

RADTECH UV&EB 2012

A new 360 degree UV Curing Technology makes Real Time Dose Control a reality

- Using highly efficient reflective chamber walls.
- The chamber walls become the light source
- The walls surround the part being cured with uniform panels of light – up to 95% uniform
- Part and lamp positioning is unimportant even for complex parts
- No rotating part motion during cure

DOCTORUV.COM™

RADTECH 2012 UV&EB

A new 360 degree UV Curing Technology makes Real Time Dose Control a reality

- Using highly efficient reflective chamber walls.
- The chamber walls become the light source
- The walls surround the part being cured with uniform panels of light – up to 95% uniform
- Part and lamp positioning is unimportant even for complex parts
- No rotating motion during cure
- All points have virtual identical irradiance

DOCTORUV.COM™

RADTECH 2012 UV&EB

Other UV Cure benefits include

Other UV Cure benefits include

- Higher UV coating quality achieved by uniformly exposing the entire part at once.

Other UV Cure benefits include

- Higher UV coating quality achieved by uniformly exposing the entire part at once.
- Spreads light equally on all surfaces of part

Other UV Cure benefits include

- Higher UV coating quality achieved by uniformly exposing the entire part at once.
- Spreads light equally on all surfaces of part
- No over curing and better heat control

Other UV Cure benefits include

- Higher UV coating quality achieved by uniformly exposing the entire part at once.
- Spreads light equally on all surfaces of part
- No over-curing and better heat control
- Again no part or lamp motion needed

Other UV Cure benefits include

- Higher UV coating quality achieved by uniformly exposing the entire part at once.
- Spreads light equally on all surfaces of part
- No over-curing and better heat control
- No part or lamp motion needed
- No self-shadowing on the part

DOCTORUV.COM™

RADTECH UV&EB 2012

Other UV Cure benefits include

- Higher UV coating quality achieved by uniformly exposing the entire part at once.
- Spreads light equally on all surfaces of part
- No over-curing and better heat control
- No part or lamp motion needed
- No self-shadowing
- Chamber lining absorbs IR

DOCTORUV.COM™

RADTECH 2012 UV&EB

Other UV Cure benefits include

- Higher UV coating quality achieved by uniformly exposing the entire part at once.
- Spreads light equally on all surfaces of part
- No over-curing and better heat control
- No part or lamp motion needed
- No self-shadowing
- Chamber lining absorbs IR
- Lower heat transfer to the part

DOCTORUV.COM™

RADTECH UV&EB 2012

Precise 3D Dose Control

DOCTORUV.COM™

RADTECH 2012 UV&EB

Precise 3D Dose Control

- Irradiance on the part can be measured with the part in place

Precise 3D Dose Control

- Irradiance on the part can be measured with the part in place
- Compensates for Larger or Smaller parts by adjusting UV exposure time for same dose automatically

DOCTORUV.COM™

RADTECH 2012 UV&EB

Precise 3D Dose Control

- Irradiance on the part can be measured with the part in place
- Compensates for Larger or Smaller parts by adjusting UV exposure time for same dose automatically
- *Automatically* Stops the UV process when target dose achieved

DOCTORUV.COM™

RADTECH 2012 UV&EB

Precise 3D Dose Control

- Irradiance on the part can be measured with the part in place
- Compensates for Larger or Smaller parts by adjusting UV exposure time for same dose automatically
- *Automatically* Stops the UV process when target dose achieved
- Quality control, consistency, and optional cycle documentation are available

DOCTORUV.COM™

RADTECH UV&EB 2012

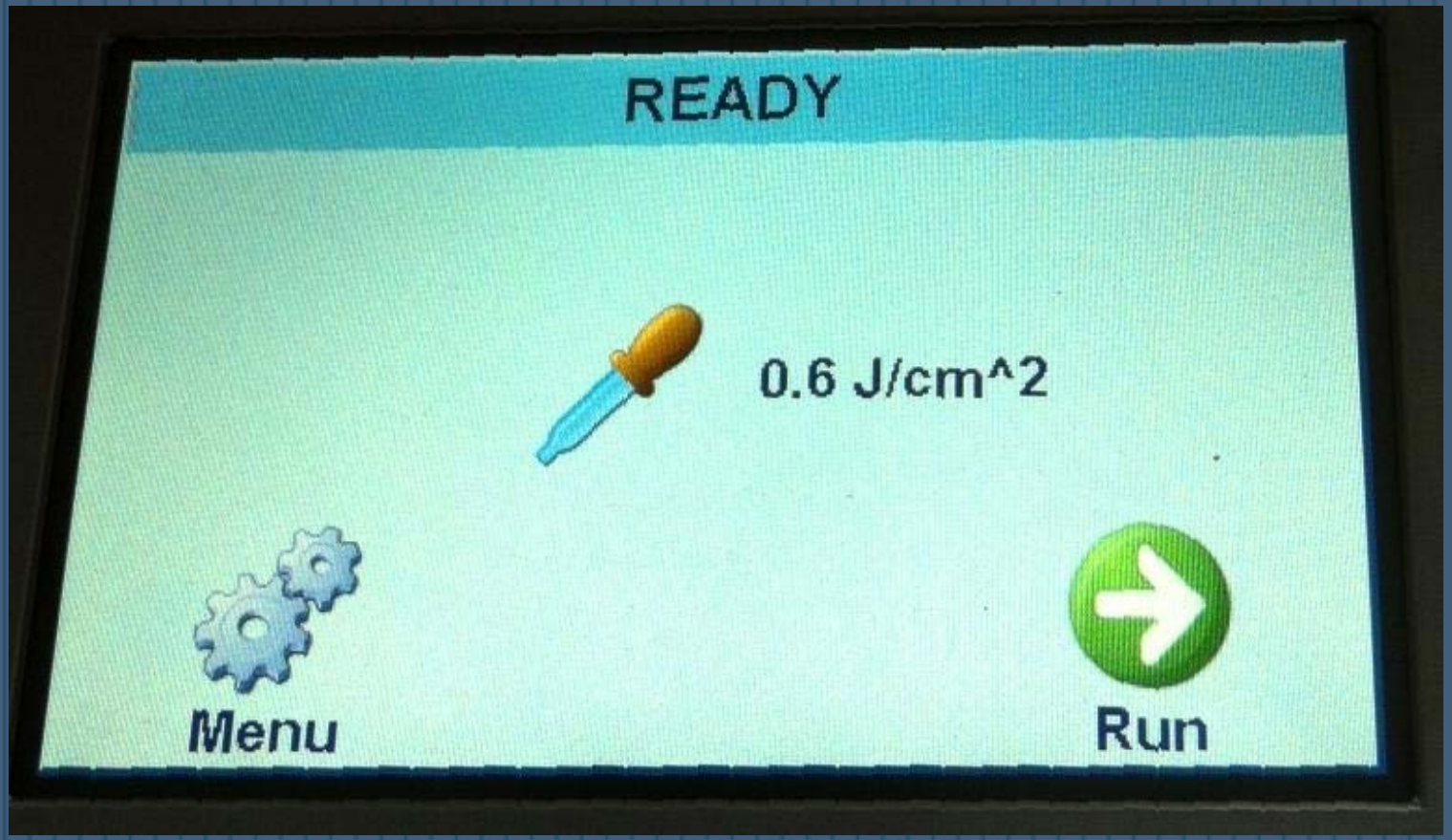
Now Precise 3D Dose Control

- Dose Control Module is calibrated with an EIT NIST Traceable Radiometer
- The excellent reflective properties of the proprietary interior coating allows single point measurement.
- The power is so homogenized the need for multiple point measurements is no longer needed

DOCTORUV.COM™

RADTECH 2012 UV&EB

Touch Screen Interface



DOCTORUV.COM™

RADTECH 2012 UV&EB

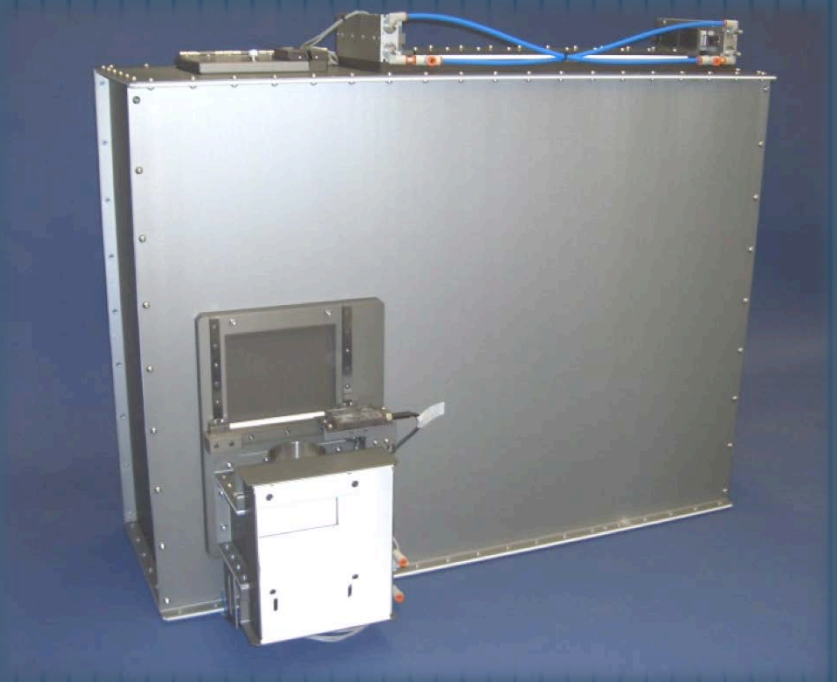
Dose Controlled Medical UV System for Adhesive Bonding

- Dose controlled 3D chamber for medical device curing
- 24/7, 3 shift operation
- Produces ~2,700 medical devices per day
- Automatically begins after door is closed & stops when desired UV dose is achieved

DOCTORUV.COM™

RADTECH 2012 UV&EB

Large 360 UV chamber

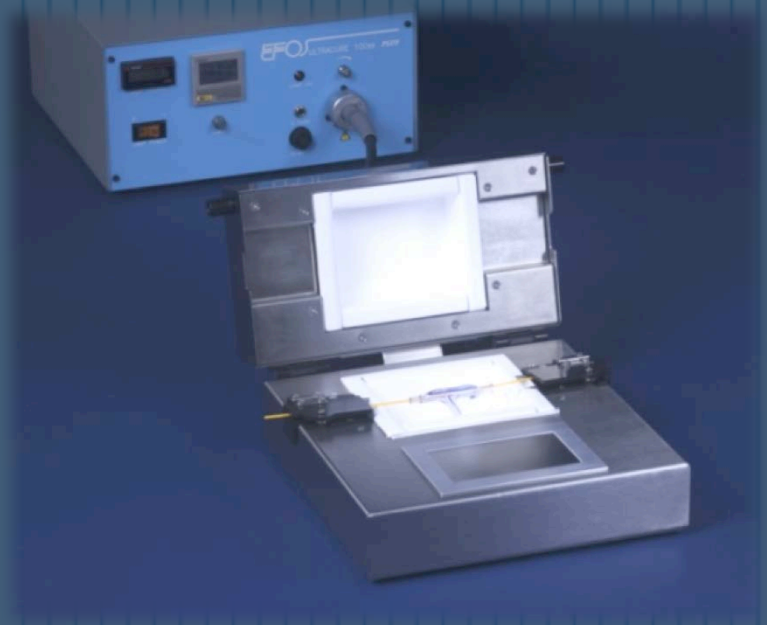


- 15 coated catheters cured using only one 6 inch Fusion lamp with no part rotation
- Completely eliminated curing-related scrap customer was experiencing
- Increased thru-put more than 10x
- Pneumatic entry door closes around each catheter
- Pneumatic shutter controls exposure and can include dose control option

DOCTORUV.COM™

RADTECH UV&EB 2012

Small Size Bench Top Dose Control 3D UV chambers

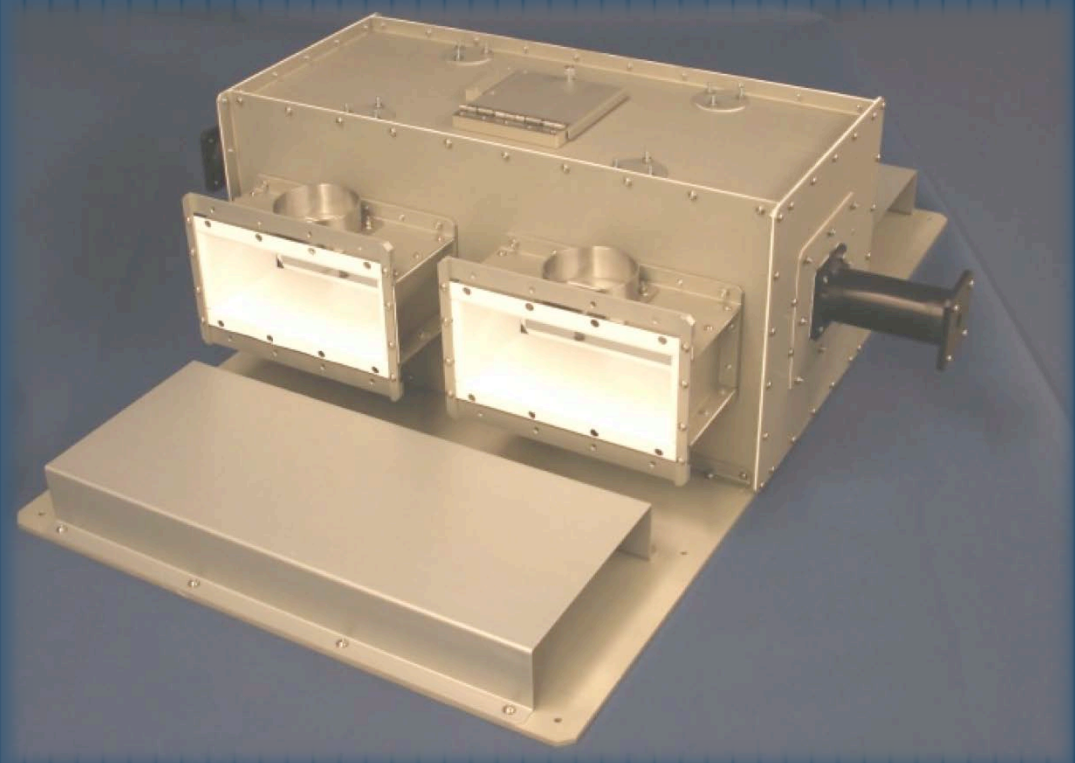


- For use with UV Spot Cure systems
- Eliminates need for multi leg light guides
- Low Heat to part
- Even cure with no part rotation.
- Used in 360 degree bonding joints. Even adhesive shrink
- For tubing, Lens bonding, medical balloon bonding
- Automatic dose control
- Compensates dose for lamp degrading output

DOCTORUV.COM™

RADTECH 2012 UV&EB

Ultra Uniform UV Curing on a plastic tube protective coating project



- This system eliminated uneven cure “stripes” on a special coating on extruded plastic tubing
- Four Microwave Powered UV 600 WPI 10 inch lamps
- 24,000 watts total
- Irradiance ~4 W/ cm^2

DOCTORUV.COM™

RADTECH UV&EB 2012

The Good and the Bad News

Good News:

- Over 88+ installations in operation today
- Many are used for medical coating & adhesives
- Smaller bench top systems available
- Available with or without Dose Control

Bad News:

- Cost $$$
- Lower UV peak may need reformulation

DOCTORUV.COM™

RADTECH 2012 UV&EB

Markets for Dose Control 3D UV Curing

- Heat sensitive Woods, Plastics, & Electronics
- Medical devices
  - Transducers
  - Catheters
  - Balloon bonding
  - Guide wire coating
  - Needle hub bonding
- Optical part curing like plastic lens and contacts
- Touch Screen lamination UV curing
- Sporting Goods
- Automotive trim parts
- Consumer Electronics

DOCTORUV.COM™

RADTECH 2012 UV&EB

Basically High Value products that need:

- ✓extremely Even UV Irradiance
- ✓extremely Repeatable UV Dose
- ✓extremely Verifiable UV Output
- ✓extremely Low Temperature UV curing
- ✓extremely Custom UV Cure Parameters

DOCTORUV.COM™

RADTECH UV&EB 2012

THANK YOU!

Douglas DeLong

DDU ENTERPRISES, INC.

UV SINCE 1987

REDONDO BEACH, CALIFORNIA 90277

SALES @ DOCTORUV.COM

DOCTORUV.COM™