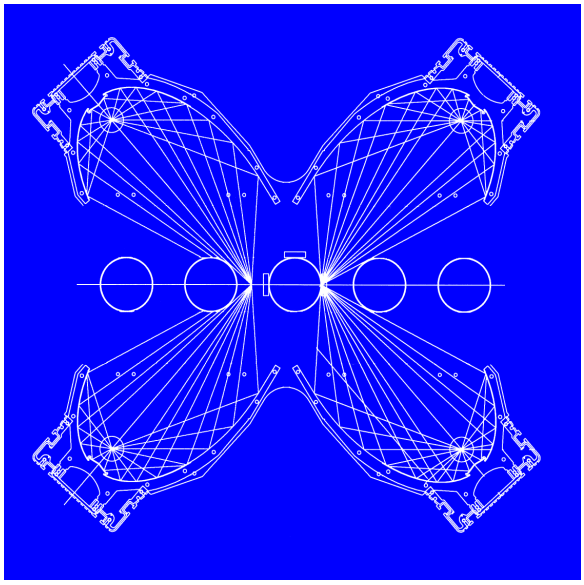

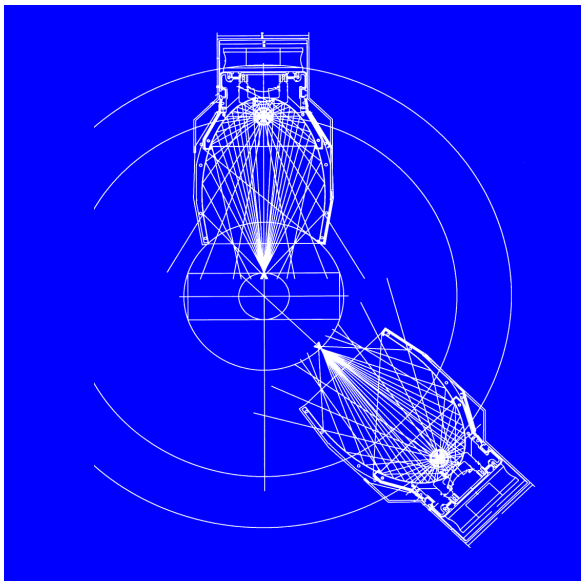

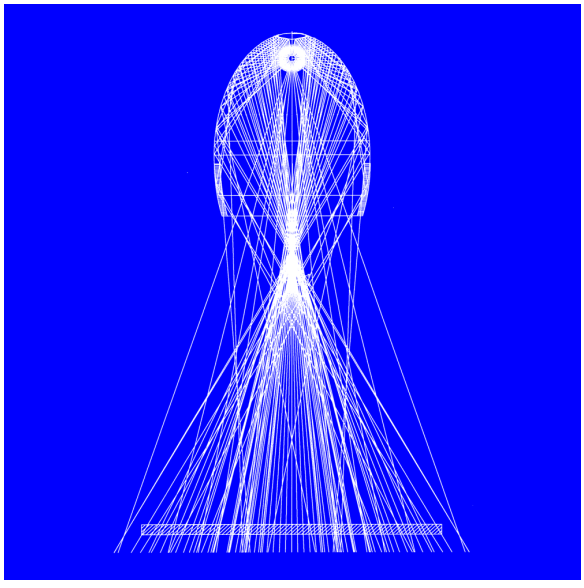

Three-Dimensional Ultraviolet Curing of Liquid and Powder Coatings

EQUIPMENT and APPLICATION

UV PROCESS SUPPLY, INC.
1229 W. Cortland Street • Chicago, IL 60614 USA
1-800-621-1296 • 773-248-0099
Fax: 1-800-99FAXUV • 773-8806647
info@uvps.com • www.uvprocess.com

3-D CURING - NEW TECHNOLOGIES AND APPLICATIONS

Based on its 20 years of innovative development and experience in the UV curing industry, **UV Process Supply** recently channeled that accumulated knowledge and expertise into a development program for a new generation of three-dimensional curing systems. Rather than trying to make an existing product fit a new application, UVPS began by defining the desired result, in this case uniform curing within a large depth of field, and then worked backward to develop the hardware necessary to achieve consistent curing success. The resulting **Lighthouse VL UV Curing System** is the first system designed expressly for 3-D applications.

BACKGROUND

Since industries such as flexography, screen printing and woodworking were the first to embrace UV curing technology, their two-dimensional curing requirements drove the development and design of virtually all curing equipment. Because of the perfectly flat substrates, and the application of comparatively thin coatings, curing was best achieved by a tight focusing of the energy source with a short focal length. This compact design was well suited to curing two-dimensional objects and it simplified the retrofitting of the equipment into the close quarters of equipment not originally designed to include UV lamp housings. As a result, systems with focal points of 3-4 inches from the energy source quickly became the industry standard. Half-ellipse reflector designs were used to deliver a tight energy focus and keep the equipment compact (see diagram #1). Although the half-ellipse did deliver tightly focused energy to the curing plane, it delivered only a portion of the available energy; a significant amount of the total energy was reflected out

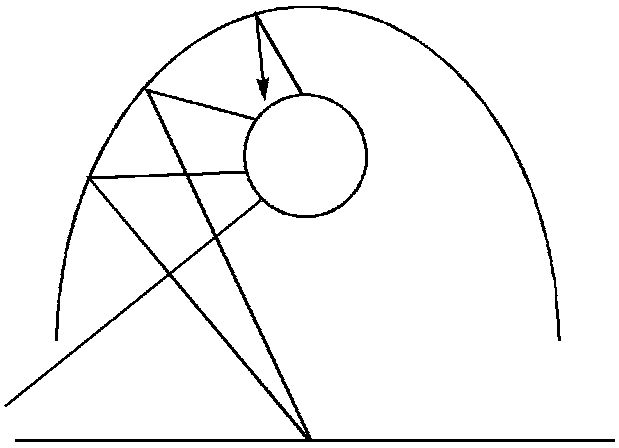

Diagram #1: Standard 1/2-Ellipse Reflector

the sides of the lamp housing, unfocused, and, as a result, wasted. The energy loss inherent in the half-ellipse reflector was adequate for two-dimensional curing but is not acceptable for three-dimensional curing where the energy depth of field is significantly greater and requires maximum curing energy.

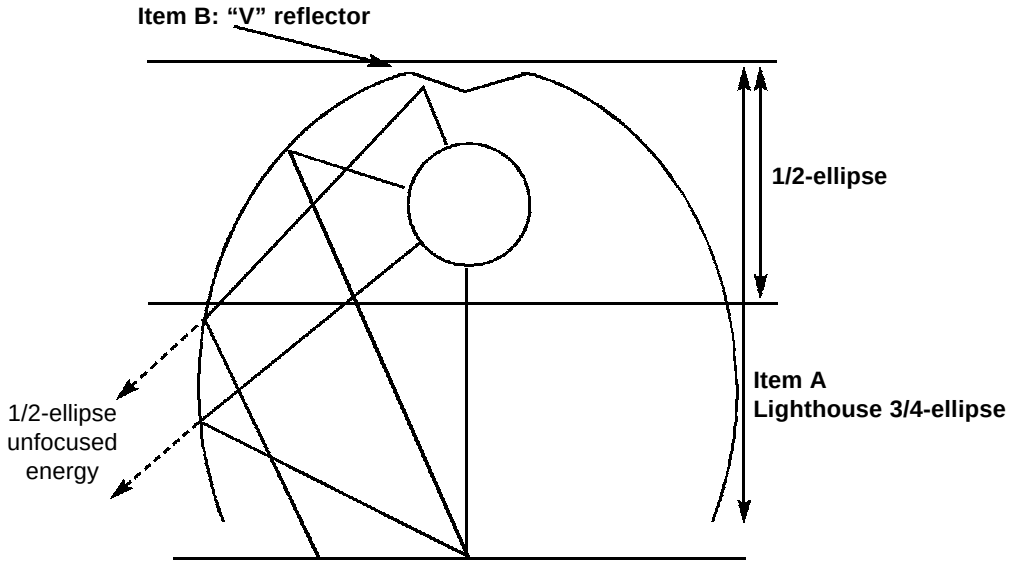

Diagram #2: Lighthouse 3/4-Ellipse Reflector

The Lighthouse UV lamp housing uses a new, 3/4-ellipse reflector geometry that reflects up to 20% more focused energy than the older, more traditional designs by focusing more of the available light from behind and beneath the lamp (diagram #2) . The extended length of the main reflectors (diagram 2, item A) and the unique Lighthouse "V" reflector (diagram 2, item B) positioned directly above the lamp capture and focus up to 20% more curing energy than the traditional 1/2-ellipse reflector systems. A new cooling system for the Lighthouse lamp housing that assures optimum lamp temperature, extends lamp life and maintains peak operating efficiency completes the new, high efficiency design.

APPLICATIONS FOR THREE-DIMENSIONAL CURING

The use of UV curable liquid and powder coatings offers significant production efficiencies and cost savings, particularly for three-dimensional products which can be coated at higher rates of speed and in significantly less floor space than with infrared coating systems. Users preparing for a transition to UV curing have expressed their concern in finding reliable and cost effective UV curing alternatives.

Curing systems using half-ellipse reflector designs offer less than a one inch depth of field for 3-D curing. As a result, successful 3-D installations using these systems require banks of lights to deliver adequate energy levels and to uniformly cover a 3-D curing area. Additionally, such installations generally must operate with lamps of higher wattage.

Based on the above information it becomes obvious that uniform curing of three-dimensional product requires a departure from the narrow focused, half-ellipse systems originally designed for two-dimensional curing. To uniformly and economically cure a wide range of 3-D product, a useable level of curing energy must be focused with a depth of field as wide as possible. Development began with Lighthouse's higher efficiency reflector approach and then we improved it with variable length geometry to deliver high energy concentration with a significantly increased depth of field. By varying the length of the curing energy focus, the light within the UV lamp is initially reflected in wider angles resulting in a more vertical concentration of energy below the lamp in the curing zone. This concentrated focus and increase in energy combine to deliver an optimal 3-D curing envelope. In addition, since the curing energy delivered to the product is closer to perpendicular than other systems, more energy will penetrate and cure the coating, and less energy will be reflected by the coating. The accompanying diagram shows a Lighthouse LV lamp using a variable length reflector to achieve a 10" energy focus (see diagram #3). By extending the focus, the effective curing depth of field has been increased to more than five inches (diagram 3, item A), an increase of almost 500% when compared to the traditional half-ellipse reflector system. Using the variable length reflector system, a curing system can be constructed with a specific depth of field to deliver maximum curing energy custom suited to a customer's application.

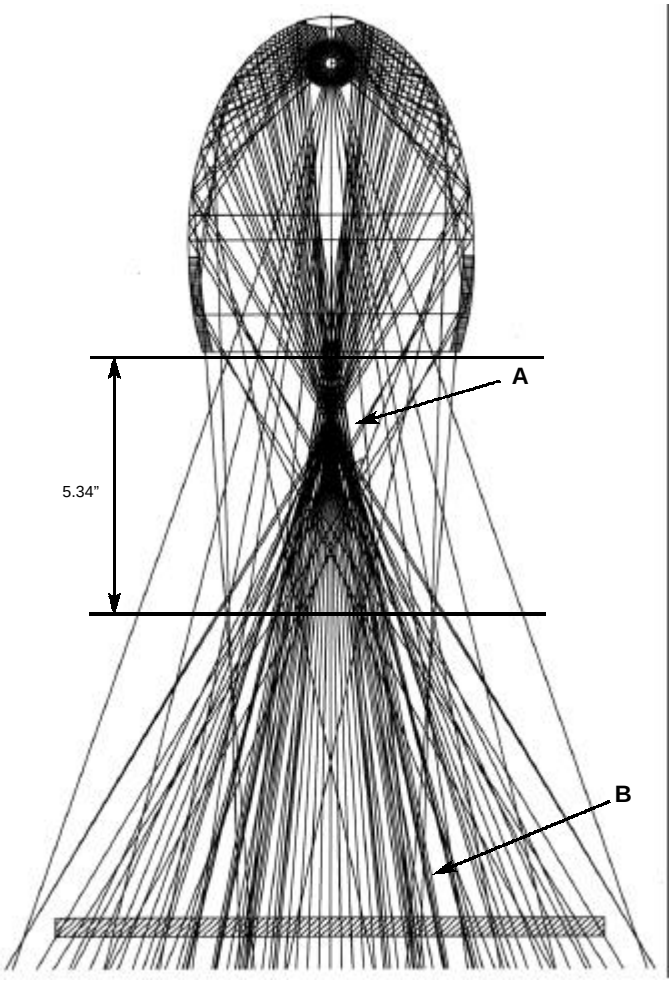

Diagram #3: 10" Focused Housing

SOME APPLICATIONS

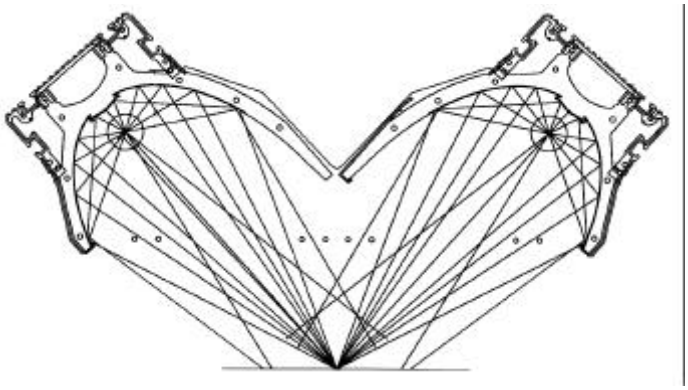

Diagram #4: 2 Asymmetrical Housings on Conveyor

For applications where higher energy levels are required, for example, when curing opaque whites, two Lighthouse VL curing systems using asymmetrical reflectors can be installed in tandem to focus the energy of the two lamps onto a single curing point (see diagram #4). In this way, the effective curing wattage is doubled; for example, if each lamp is delivering 750 watts/in., a dual system will uniformly deliver 1500 watts/in.

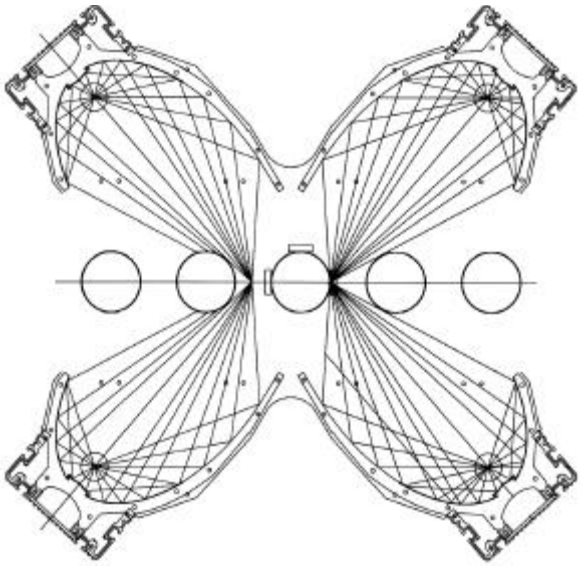

Diagram #5: Four Asymmetrical Lamp Installation

For high speed conveyor applications, a four lamp installation with asymmetrical reflectors can cure simple 3-D objects at extremely high rates of speed without the need to rotate the product as it travels through the curing zone (see diagram #5). This Lighthouse application has been successfully field tested on an aluminum can coating line running at over 1,300 cans per minute. It is also interesting to note that only 2" of space between cans was required for complete curing to be accomplished.

For the curing of larger or intricately shaped product two lamps can be located around a fixed point of rotation (see diagram #6). The two lamps are positioned with staggered focuses so the entire product is covered with an adequate level of curing energy. This staggered focus application is also well-suited for product with sides of uneven dimension, or product with complex shapes requiring curing on several planes.

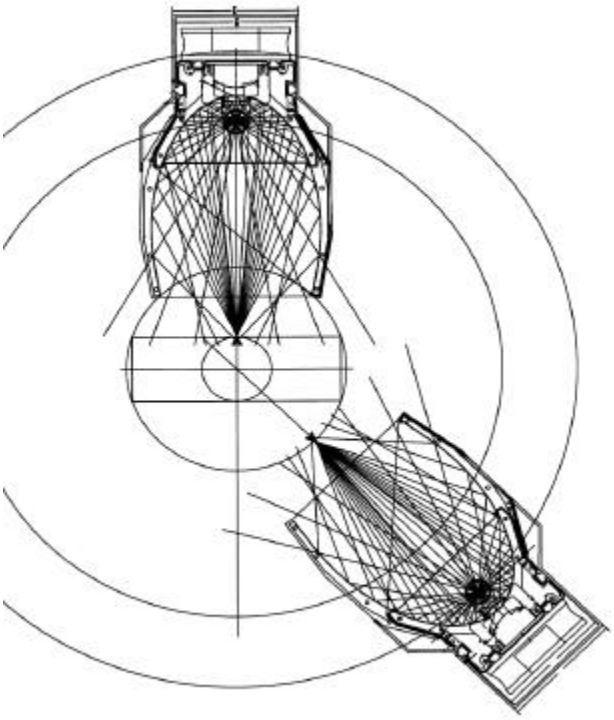

Diagram #6: Two Variable Focus Lamps w/Product Rotation

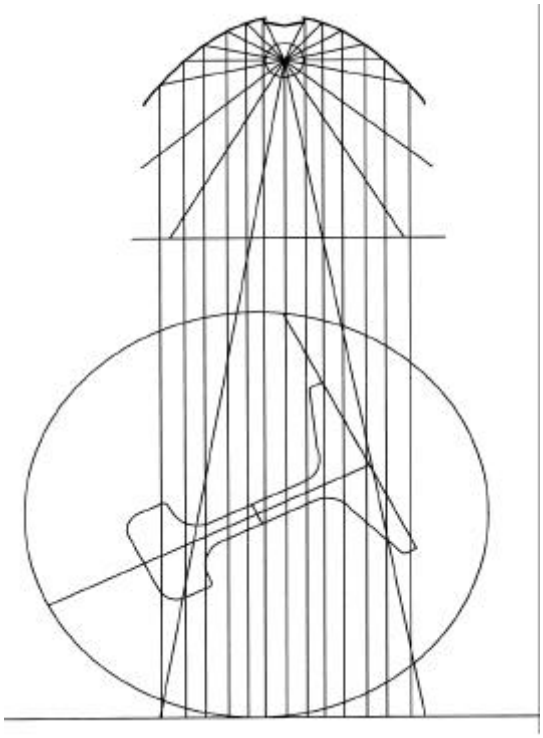

Diagram #7: Parabolic Reflector System

Because of its unique flexible reflector system UVPS can also offer special application curing systems that deliver an unfocused curtain of curing energy using a parabolic geometry in place of standard elliptic geometry (see diagram #7). Product of large size or small quantity can be ideal candidates for this special curing application.

LIGHTHOUSE VL SYSTEM FEATURES

Maintain optimal lamp temperature - If a lamp's operating temperature is allowed to fluctuate its efficiency can be significantly affected. Changing temperatures will vary the amount of vaporized mercury within the lamp and, as a result, the amount of available curing energy. Small changes in the energy level delivered to the product can significantly effect the completeness of the cure. The Lighthouse reflector system is uniquely designed to stabilize temperatures by reflecting less energy directly back toward the lamp. The lightweight reflector material together with its ribbed supports allow heat to radiate away from the lamp area. The lamp housing's open architecture permits unobstructed air flow throughout the entire housing.

Easy to install - The Lighthouse lamp housing extrusion has "T" slots on three sides which accept the heads of 1/4" screws. The slots run the complete length of the housing. This built-in mounting feature simplifies lamp housing mounting on both new and retrofit installations.

Easy to maintain - The Lighthouse lamp housing has been designed for optimum operating efficiency. Since the reflector accounts for 60% of the energy focused for curing it must be kept clean and replaced at the first signs of deterioration. Cleaning and replacement of both lamps and reflectors is quick and easy. Unlike other systems that require significant disassembly for reflector changes, Lighthouse reflectors can be changed in less than five minutes by simply removing the two screws holding the side shield and sliding out the old reflector and sliding in the new. Lamp changing is likewise simple and quick.

Lower initial investment - Unlike other systems with fixed lamp housing dimensions, the Lighthouse VL system is available in lengths from 2" to 77". It is not necessary to buy banks of shorter lights to cover the curing area because one Lighthouse housing can be sized to cover the entire curing area. This results in significant savings in initial equipment investment and in regular maintenance costs.

CONCLUSION

Companies presently using liquid and powder coatings have begun to appreciate the efficiencies and economies of UV curing. Savings in capital equipment expenditures and floor space requirements together with significant increases in production speeds are the compelling factors that are driving the growing interest in new coating applications for UV curing.

We have developed, manufactured, and successfully tested all of the Lighthouse lamp configurations that have been described above. The built-in design flexibility of the Lighthouse lamp housing and reflector allows us to provide users with a broad range of curing alternatives that, to this point, have been unavailable in three-dimensional UV applications. Our patented reflector geometry allows us to start with a customer's specific application and, working backward, design a curing system with a unique energy focus length and curing depth of field that is ideally suited to the size and shape of the coated product. Most importantly, the flexibility of our basic design allows us to offer our customers these purpose-built three-dimensional curing systems at reasonable prices, because our system flexibility eliminates the tremendous added costs generally associated with a custom equipment design.

