Customized Masking Solutions Don’t Require Customized Masks. Are Your Masking Solutions Failing?

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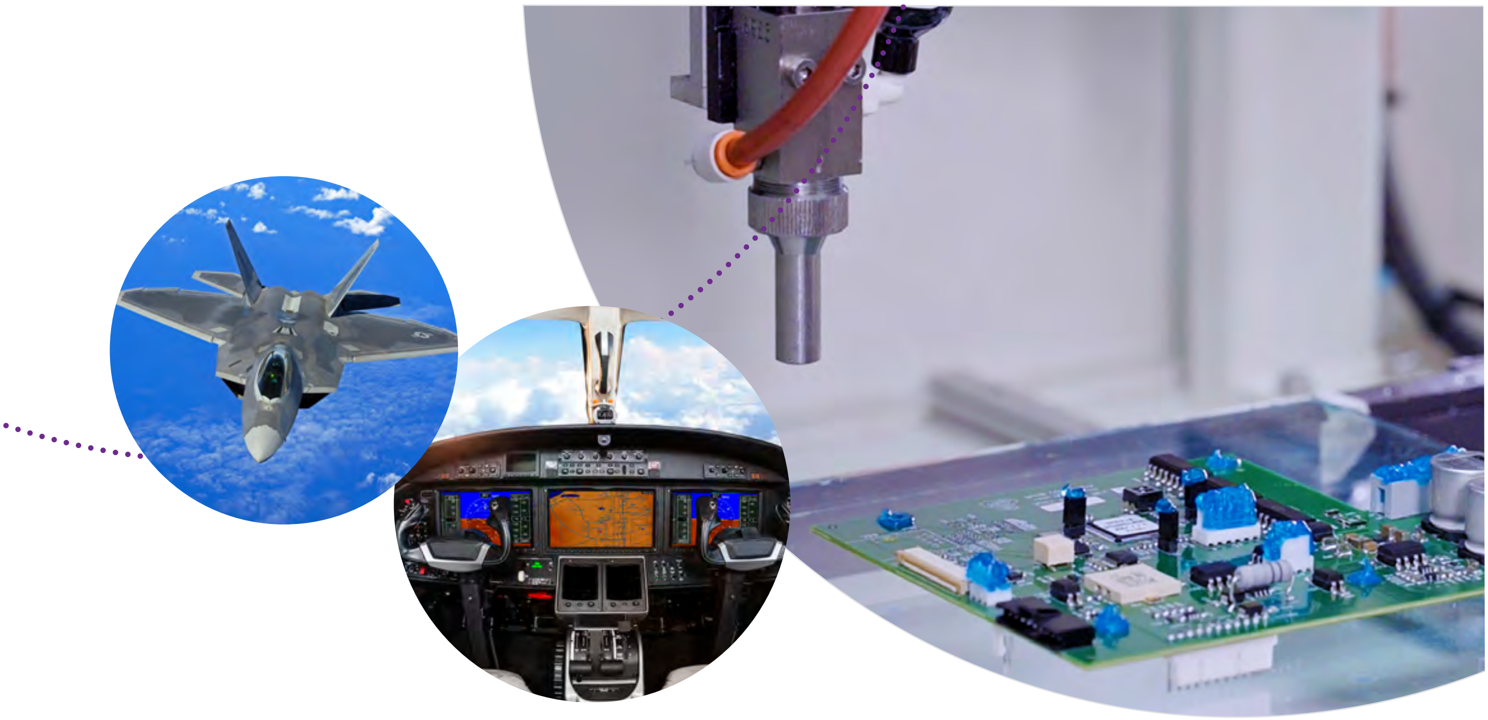


Introduction

If you're masking with conventional methods, you know the challenges associated with complex design configurations and the need for reliable protection from aggressive chemical processes, high temperature coatings, or other surface treatment processes. Even minute gaps or voids in coverage can result in edge-lift and leakage that can significantly compromise protection and adversely impact your bottom line.

Manufacturers, faced with the most challenging economic conditions in decades, have aggressively sought means to reduce costs without sacrificing product quality. Optimizing process efficiency and minimizing material consumption are viable pathways to significant reductions in manufacturing expense. Light-curable materials (LCMs) provide significant advantages over conventional masking methods such as lacquers, waxes, and tapes and costly customized boots, plugs, or caps, by offering several avenues to increase productivity, ensure reliable protection, and reduce waste.

Temporary UV-curable maskants provide reliable surface protection under harsh conditions and are an ideal choice for many coating, surface treatment and machining operations. These resins cure in seconds upon exposure to UV light and provide superior protection during conformal coating, plating, machining, grit blasting, shot peening, acid stripping, and laser drilling/splatter. They also offer surface protection during handling or transportation and from thermal spray coatings. UV-curable maskants are a better solution to the challenge of controlling scrap and rework caused by unreliable masking. These solvent-free masking resins simplify component-masking processes prior to surface preparation and finishing operations. Their ease of application, speed of cure, and consistent reliability surpass those of traditional masking products and provide substantial process savings. These UV masking resins are available in several viscosities and can be applied by dispensing dots or beads, jetting, spraying, dipping, or brushing. Methods of resin removal include incineration and manual, semi-automated and automated removal.

What is masking and why it is necessary?

A mask acts as a self-sacrificing barrier for surface protection and is an essential element of most surface finishing and enhancement processes. The mask protects parts during a surface treatment that is either abrasive, thermal coating or chemical solution. The concept of protecting a surface with a mask may appear simple enough, but after thorough review and analysis, it becomes apparent that masking can add significant costs to any operation. UV-curable masking resins simplify component-masking processes prior to surface treatment and finishing operations.

How do UV-curable maskants work?

Light-curable masks (LCM) are typically comprised of five basic elements: the photoinitiator, additive, modifier, monomer, and oligomer (Figure 1). The ultraviolet (UV) light-curing process begins when the photoinitiator in the LCM is exposed to a light-energy source of the proper spectral output. As illustrated in Figure 2, the molecules of the LCM split into free radicals (initiation), which then commence to form polymer chains with the monomers, oligomers, and other ingredients (propagation), until all ingredients have formed a solid polymer (termination). Upon sufficient exposure to light, the liquid LCM is polymerized, or cured.

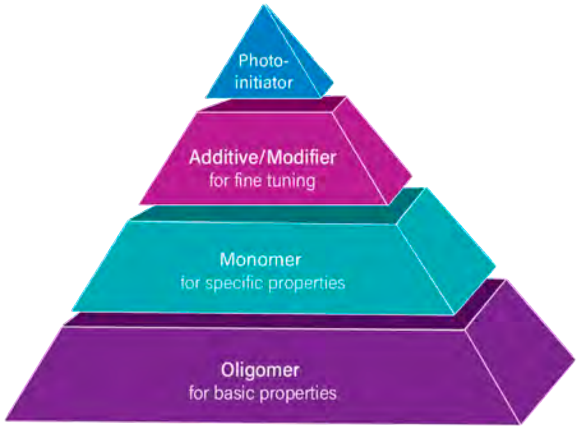
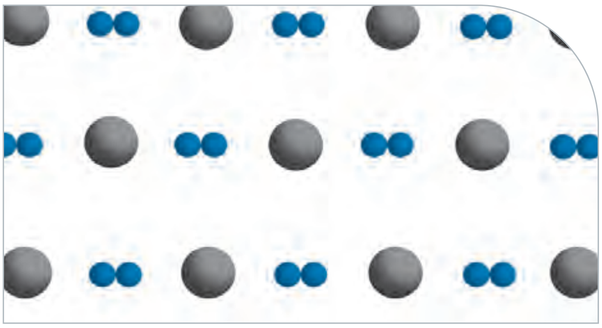
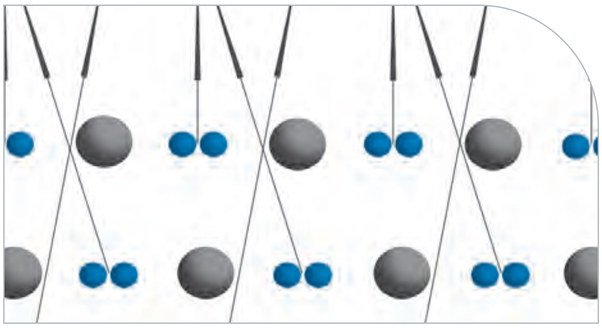


Figure 1. Typical Light-Curable Urethane Acrylate Maskant

Figure 2. Polymerization Process

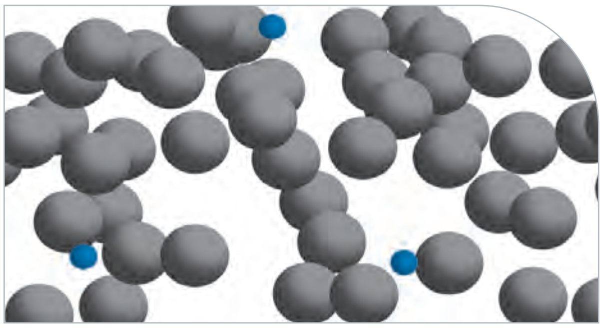


1. Liquid "unreacted" state



2. Photoinitiators generate free radicals

3. Polymer propagation



4. Polymer termination

UV-Curing Systems

The ultraviolet-light energy source is critical to the UV-mask curing process. UV-curing lamps and systems of various configurations and styles are commercially available. Spectral output of the lamp, intensity, component configuration, desired production throughput, and budget are all factors that help determine which type of light curing system is appropriate.

Once a curing process for a masked component is established, re-qualifying it is recommended to validate all performance requirements have been met. This ensures complete cure of the UV masking resin each and every time, which is essential for achieving reliable and repeatable protection of the masked surface. The best source for assistance in selecting a curing system and qualifying a curing process is the manufacturer of the UV masking resin. Their expertise with both UV masking resins and curing systems can help implement a complete optimized system that supports the masking process with minimal time and expense.

UV-Curable Masking Resins

For electronic mobile devices, PCB assemblies, aerospace engine components, orthopaedic implant, or other metal, plastic, or glass surface protection masking needs, these UV masking resins are viable options for reliable and consistent surface protection.

Advantages of Light-Curable Masking Resins

Light-curable masking resins can enable numerous process improvements in the areas of throughput, quality, durability, labor costs, and improved work safety as shown in Table 1.

Removal Options

Burn-off masking resins typically offer superior surface adhesion while providing resistance to heat and aggressive chemical solutions such as acid baths. The burn-off-grade resins are typically used to mask hot-section aerospace components made from high temperature resistant alloys such as nickel alloys and some steels. prior to surface treatment operations.

Table 1. Possible Process Improvements Achieved by Using Light-Curable Masking Resins

LCM Process Improvement	Achieved by:
Enhancing Productivity	• Fast curing and the ability to automate • One layer protection • Non-slumping formulations for vertical, horizontal and complex surfaces
Enhancing Quality	• Toughness, durability, and reliability of the UV-curable maskant • Immediate in-line inspection • Formulations matched to specific performance needs
Customized Maskant	• Masking resins conform to the most intricate designs • Accommodate design changes immediately
Customized Curing	• "Instant cure" property, but only "on-demand" when exposed to light
Profitability	• Lower per-unit labor content • Smaller footprint of light-cured process • Compatible with J.I.T. and production flexibility requirements • Improved quality that reduces opportunity for returns for defects • One-part formulations that reduce waste and disposal costs
Compatible with Gold and Copper Connector Pins	• Non-corrosive to board level components when properly used • Able to be used on many types of board and connector designs
Pass SIR Testing per IPC-TM-650	• Residue free board surface after removal of maskant when properly cured.
Resistant to Solvent-Based Conformal Coatings and Primers	• Usable with a wide variety of conformal coating options • Allows for zero keep-out violations
Solvent Free, Halogen Free, RoHS & REACH Compliant	• No non-reactive solvents • Reduces environmental concerns and waste

For masking areas where UV light cannot penetrate, some burn-off grades also offer a secondary heat-curing capability for shadow or internal areas. The removal process for a burn-off-grade mask requires baking the components in an air-enriched furnace 650°C or higher. The composition of the mask allows it to completely combust and be exhausted from the furnace without the metallurgy of the heat-treated component being affected.

Peelable Masking Resins

Peelable masking resins, the most versatile maskant provide reliable protection through good adhesion to a variety of clean metal, glass, and plastic surfaces. The peelable-grade resins are resilient enough to withstand a variety of surface treatment processes used as a process aid during the manufacturing of aerospace turbine components, orthopaedic implants and other metal finishing operations. A simple peeling process removes the maskants. Curing after a few seconds of exposure to the proper light source, peelable maskants have been successfully qualified for surface protection in processes such as conformal coating, grit blasting, shot peening, acid stripping cleaning, plating, anodized coating, and thermal coating.

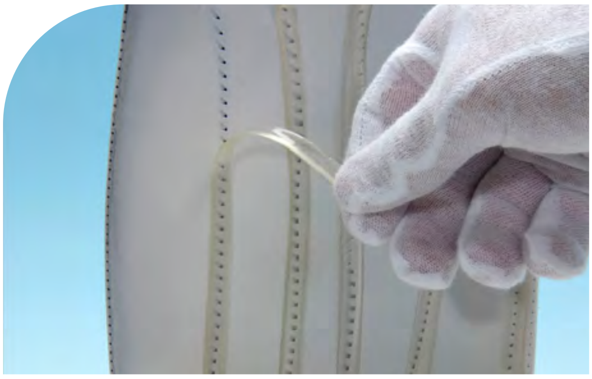


Figure 3. Peelable Light-Curable Maskants

The adhesion between the mask and substrate is strong and durable, possessing sufficient strength to survive through multiple surface cleaning and processing operations, while eliminating the need to strip and re-mask between processes. Peelable UV masking resins offer uniform adhesion from edge to edge, preventing processing media or chemical solutions from creeping underneath. Remove these maskants by prying up an edge manually or with the help of a non-abrasive tool, then pull. The elasticity and flexibility of the material typically permits fast removal in one piece rather than in fractured segments. Mechanical methods such as embrittlement with cold, dry ice blasting, ultrasonic bath, water jet, vacuum tweezers, air knife and/or warming to aid in the removal. The peeling process is made even easier by warming the cured mask to 60-85°C (120-150°F) in a warm water bath, oven, or using a localized heating element. The surface is residue free after the mask is removed from non-porous surface. The peeled material, essentially a plastic resin, is non-hazardous and may be disposed of in accordance with local regulations for industrial scrap plastic.

Savings

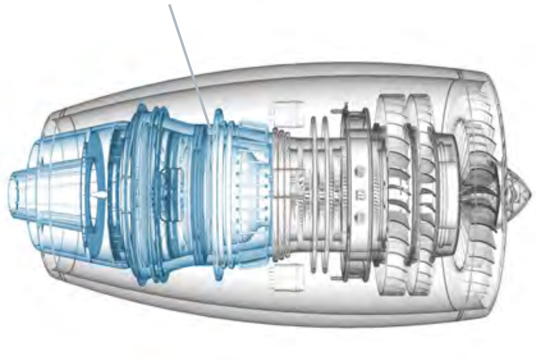
The costs associated with masking may not be clearly visible at first, as the masking material is traditionally low in cost and not the major contributing element to the overall cost of the task. Rather, it is the actual masking process itself, more specifically, the labor to apply and remove the maskant from the component, which can be the most significant cost factor. The more complex and intricate a component is, the longer it takes to apply and remove traditional masks such as tapes, waxes, and solvent-based lacquers. In addition to the application of the mask, there are other hidden costs associated with using these masks. These costs can include scrap, component rework, production bottlenecks, specialized ventilation, hazardous waste disposal costs, and higher insurance premiums. Factoring in the cost of labor with the other hidden costs, it becomes evident that simply using a lower-priced masking material will not provide the sought-after cost savings which are essential to maintain a competitive position in the market.

A detailed cost analysis comparing an existing masking process for surface protection on an aerospace engine component with a proposed UV masking process, can bring actual cost savings into clear focus.

Masking in High-Temperature Applications

Maskants are used in applications in a number of industries including aerospace, orthopedic, and electronic. UV light-curable maskants are ideal because they can withstand the high temperatures of metal finishing processes like air plasma spray and some HVOF.

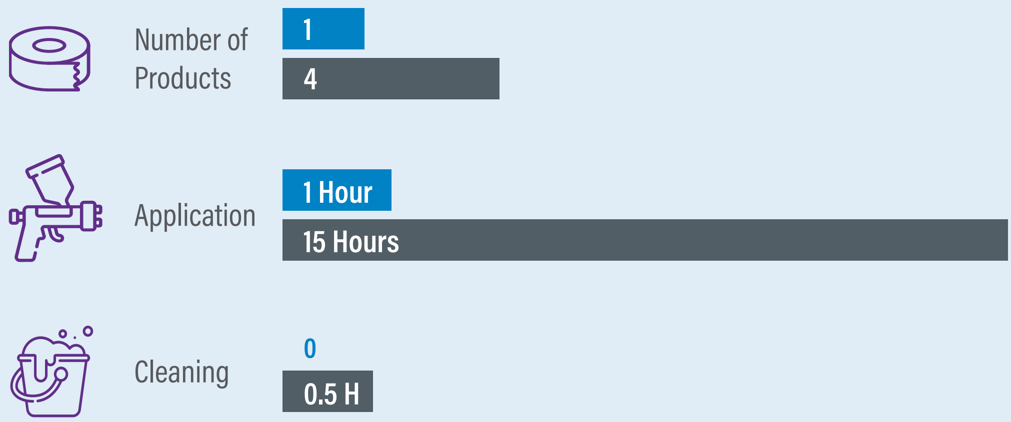
CUSTOMER APPLICATION: A maskant was needed that would protect selected areas on the outside surface of a combustion liner during plasma spray.



Substrate: Nickel Superalloy
Can withstand the high temperatures needed during combustion

Process Comparison

- Process Using SpeedMask® Maskant
- Process Using Thermal Tape



Summary:

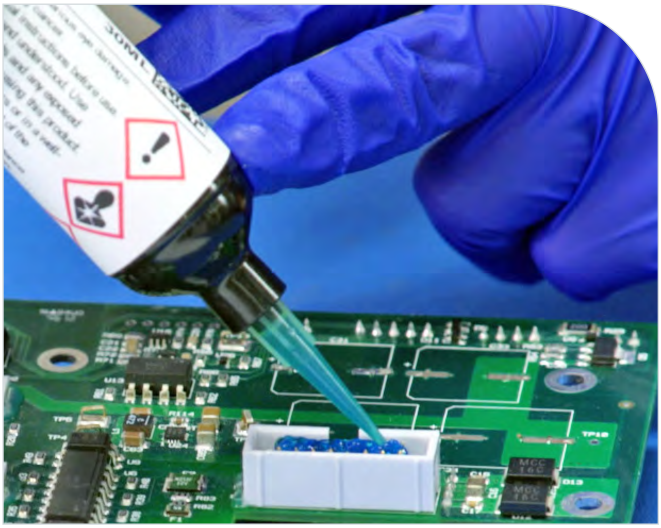
- Streamlined number of products used
- Reduced application time drastically
- Eliminated cleaning step
- Saved time, freeing up labor to expand business

Total Time Savings per Year

40,000 Hours

Electronic Component Masking Application

CUSTOMER APPLICATION: A large global industrial electronics company who manufactured PCB assemblies for an array of industries needed to increase process throughput and improve quality to counter increased production demands and raised costs from rework. Their goal was to find an alternative to their latex-based masking process that would allow them to support a 30% increase in demand while reducing overall operating costs.



Process Comparison

	Process Using SpeedMask® Maskant	Process Using Latex-Based Maskant
Number of Products	1	1
Application Process	3 Minutes	8 Hours
Rework	0%	40%

Summary:

- Reduced application/drying time drastically, freeing up labor to expand business
- Increased mask reliability and reduced keep-out violations to zero
- Created a more efficient process that met the planned 30% increase without increasing floor space

Production Increase of

30%

Conclusions

In today's environment, process cost reduction has taken on greater meaning. Competitive pressures in the market are forcing manufacturers to evaluate every aspect of their processes for cost reduction opportunities. Now, there is a better solution to an old issue of scrap and rework caused by unreliable masking.

Alternative masking methods such as UV-curable temporary masking resins simplify component-masking processes prior to surface preparation and finishing operations. This new alternative opens the door to savings never before possible. Masking labor costs can be reduced, if not cut in half, scrap can be eliminated, and overall component processing time reduced by 30% or more. In addition to cost-cutting opportunities, UV-curable masking resins improve the quality of the environment in the workplace by removing health hazards and reducing the risk of operator injury. Benefits of this nature can lead to improved employee morale, which contributes to higher productivity.

A very positive case has been made for today's UV-curable masking resin technology. Undoubtedly, manufacturers will identify more and more masking applications suitable for these masks. The one constant that will continue to drive these applications will be cost reduction and improved productivity in the workplace. UV-curable maskants are a customized solution without the price tag of a customized mask.

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