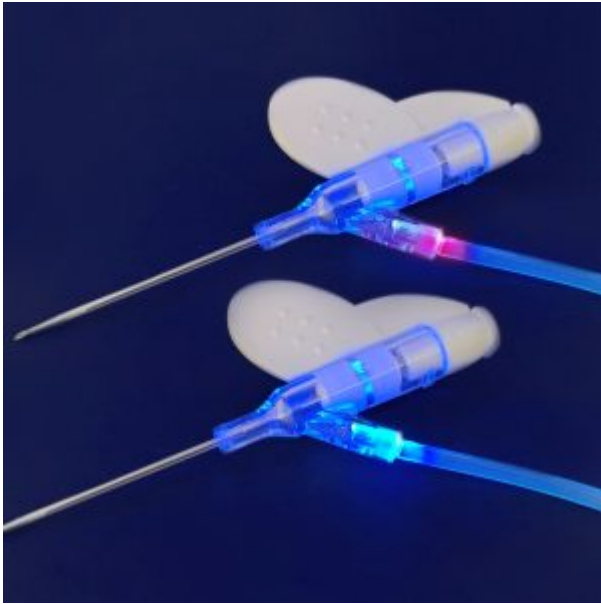


Bonding specialist medical device plastics



Medical device manufacturers are increasingly turning

to specialist plastics formulated to resist harsh chemicals and survive environmental end use conditions such as sterilisation. However, the properties that allow these materials to withstand such conditions can also make them difficult to bond with adhesives. Here Kevin Brownsill, our Head of Technical: Learning and Development, shares guidance on bonding specialist medical plastics.

Adhesives are frequently used to bond medical plastics in the manufacture of catheters, respirators, tube sets, injection needles, diagnostic testing equipment, and many other applications. In many cases, bonding with adhesives is an easier and more efficient approach than solvent welding or mechanical fastening, while offering minimal aesthetic changes to the device.

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Difficult to bond plastics

For adhesive bonding to be a success, the adhesive must first wet the surface of the substrate. The term “wetting” is used to describe the propensity of an adhesive to spread out over a given substrate, and it is a prerequisite to bonding success.

One of the key factors that determines whether an adhesive will wet is surface energy. If the plastic substrate has a higher surface energy than the adhesive, typically by around seven to ten dynes/cm², the adhesive droplet will spread out on the surface (wet). If the surface energy of a material is lower than the adhesive, the liquid will not wet, and will instead sit as a round droplet on the surface of the plastic. This leads to weak bond strength.

Many high-performance medical plastics, including PPSU, COC/COP, PP, PCTG, PEBA, SAN, and PEEK, have low surface energies (with many between 20 and 40 dynes/cm²), and are therefore difficult to bond with adhesives. To combat this, specialist adhesive manufacturers are formulating new materials to bond these high-performance medical plastics.

For example, **Dymax CTH-series adhesives** are formulated to meet the unique assembly challenges associated with the newest catheter materials, including Nylon 12 and PEBA.

Alternatively, **Dymax MD® 1172-M-UR** is an LED, UV, and broad-spectrum light-curable adhesive for bonding COC/COP film laminates and other difficult-to-bond plastics used in the assembly of in-vitro diagnostics, lab-on-a-chip, and other point-of-care medical devices.

Raising the surface energy

[Plasma surface treatment](#) is an effective way to create bond sites on specialist medical plastic

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surfaces and increase the surface energy, so that the adhesive can bond more easily. Atmospheric plasma technology involves turning a small number of gas molecules into energetic electrons and ions. These can accelerate to high energy and collide with gas molecules to produce short lived chemically active species.

Plasma can initiate a number of physical and chemical processes that treat the surface, without the use of additional chemicals. In a process known as functionalisation, plasma treatment can generate oxygen and hydroxyl groups on the surface of the substrate that act as bond sites, forming covalent bonds with molecules in the adhesive, improving bond strength. As well as increasing the surface energy of the substrate and, therefore, the wettability, plasma can clean the surface and remove contaminants on the surface that would otherwise impede bonding.

Bonding PEEK

PEEK is used in the manufacture of some disposable medical device components, such as connectors, tubing, housings and sensors. PEEK is non-toxic, sterilisable, and offers good temperature resistance, high strength and toughness, and good chemical resistance. However, PEEK has a surface energy of around 34-38 dynes/cm², which means adhesives tend not to wet. With plasma surface treatment, manufacturers can increase the surface energy of PEEK to approximately 60-70 dynes/cm², making it possible to bond PEEK successfully.

For example, **Dymax 1202-M-SC** is a UV-curable adhesive that is recommended for bonding PEEK to various materials, including metals, plastics, and composites, in combination. It is fast-curing, versatile, and, crucially, biocompatible. **Dymax 1121-M** is suitable for some applications, and may be recommended to trial.

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Bondline design

As well as establishing whether the surface energy of your substrate is, or can be, sufficiently high to ensure your adhesive will wet, you need to ensure the bond will survive the lifetime of the product. It is critical the materials used can tolerate the stresses that the medical device will be exposed to, perhaps high heat, humidity, or chemical exposure.

One particularly challenging situation many reusable medical devices will be subject to is sterilisation, most commonly by autoclaving. Many substrate choices are capable of resisting autoclaving, including PEEK, PPSU, and POM. However, the need to resist sterilisation may narrow down your choice adhesives considerably.

To address these trade-offs, adhesives manufacturers have started to introduce fast-curing medical adhesives designed to withstand repeated sterilisation cycles.

[Dymax 1040-M](#), for example, is a new UV/LED curing material capable of withstanding 100+ sterilisation cycles, with its low water absorption of 0.5%. It features exceptional bond strength to a variety of substrates including stainless steel, aluminium, glass, PP/PE, and PCBs. It brings many process advantages, as it cures “on demand” in seconds on exposure to the correct wavelength of UV light and, being single-part, does not require mixing.

Adhesives at the design stage

Building a successful adhesives application process goes far beyond the technical properties of the material. Those looking to bond medical plastics like PEEK, which have low surface energies, may find success from engaging with their adhesives supply early in the design stage. As well as helping to advise on the best materials and surface treatments to trial in your application, they can support you

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with building a process that offers good productivity and throughput, the required level of repeatability and sufficient process control.

For more information about adhesives in [medical device assembly](#), call us on 01865 842842.

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