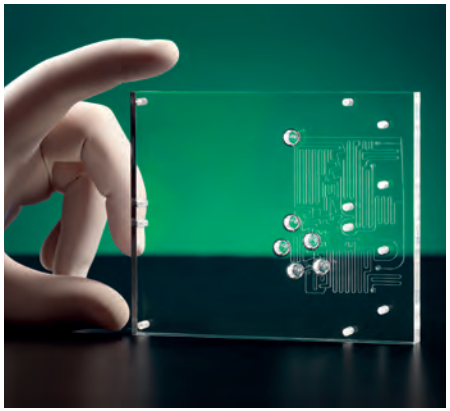
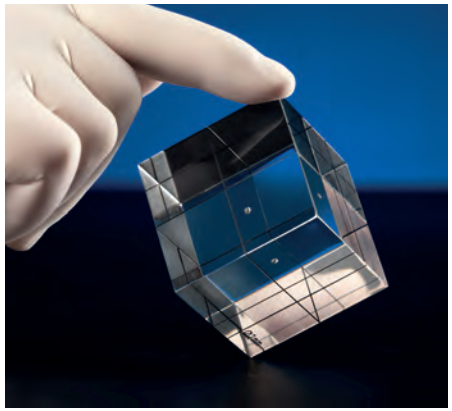
FROM CONCEPT
TO PROTOTYPE
TO PRODUCTION

Medical Manifolds

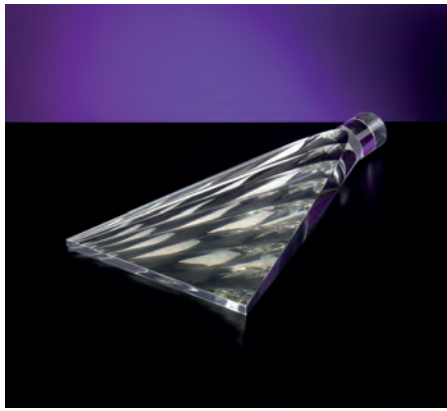
Fine Writing Instruments



Micro Fluidics



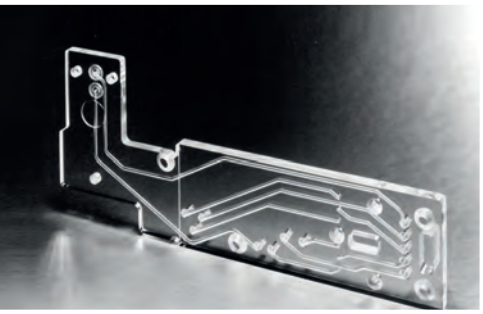
Quality Assurance Phantoms



Lenses & Light Guides

CARVILLE

PRECISION MACHINING IN PLASTICS



Why choose Carville

Carville was established in 1928 as an engineering manufacturing company. We are one of the world's oldest and most experienced plastic machining companies.

Plastic Materials

Carville began to produce machined acrylic (PMMA - Plexiglas) components in the 1930's. With over 80 years of experience, we produce components in a wide range of engineering grade plastics including:

- PolyMethyl MethAcrylate (PMMA)
- PolyCarbonate (PC)
- Polyester (PET)
- Polyethylene (PE)
- PolyOxyMethylene (POM - Delrin)
- PolyPropylene (PP)
- PolySUlphone (PSU)
- PolyEtherImide (PEI - Ultem)
- PolyEther Ether Ketone (PEEK)
- Aluminium (AL)
- Boron Carbide (B4C)

Quality

The Carville facility was accredited with ISO9001 in 1992 and is equipped with a range of modern multi-axis CNC machining centres.

Material Heat Treatment

Carville fully heat treat (normalise) our raw materials to remove material stress prior to machining operations. Component parts are post machine annealed to remove stresses which may have been introduced during the manufacturing operations.

Machining Techniques

Carville produce our components with a combination of high speed steel (HSS) and natural diamond tools. These tools, with the correct clearance angles, ensure a good quality surface finish on internal and external features.

Plastic Polishing

Carville have specialist techniques for the polishing of acrylic and other plastics.

Schedule Agreements

When dealing with larger production volumes and repeat parts, Carville can operate schedule agreements to smooth production, reduce lead times and minimise customer stock holdings.

Customer FAQ's

Can Carville help with Concept Development?

Carville has a successful track record in supporting new and established businesses to resolve engineering and manufacturing problems. When the precise knowledge is not available within Carville, we have working relationships with leading specialists who can support client's design and development requirements.

What is the minimum order quantity (prototypes)?

Carville recognise the need for prototypes to support both new product development and proof of concept(s). We would suggest that the minimum economic order quantity would be 10 pieces.

Is there a maximum order quantity (production)?

Carville have a number of medical and industrial customers who require tens of thousands or parts per year. The largest quantity produced for a single order was 300,000 pieces.

What are the preferred drawing formats?

Carville operate both AutoCAD and Autodesk Inventor software packages. The preferred drawings formats are:

- 2D manufacturing drawings as a .DWG or PDF.
- 3D models as a .STP file, (Protocol 214).

CARVILLE

Machining and Polishing

Machining and Polishing

Different levels of machining and polishing will offer different results. Blocks 1 to 5 demonstrate the benefits and costs.

Process	1	2	3	4	5
Conventional Machining	•	•			
Diamond Machining			•	•	•
Super Finishing		•		•	•
Polished					•
Typical Surface Finish (Ra µm)	1.7	1.5	0.1	0.05	0.03
Polished Clarity (scale 1 to 5)	1	3	2	4	5
Cost (scale 1 to 5)	2	3	3	4	5
Carville Recommend		•		•	

The level of polishing and finishing applied to a machined component will be dictated by the end application and the customer's budget.

Super-finishing (vapour polishing) is an economic way to enhance a components appearance. This is shown in the example opposite.

Machined

Super-Finished

Super-Finishing

Bonded Plastic Manifolds

Carville have manufactured and supplied thousands of manifolds for different applications to customers across Europe, Asia and North America.

The majority of manifolds produced by Carville are manufactured in acrylic (PMMA). Acrylic is the lower cost option. It is a clear and inert material which makes it ideally suited to most applications.

When the operating environment for a manifold restricts the use of acrylic, Carville can also offer bonded manifolds in high performance engineering grade plastics such as polycarbonate (PC), polysulphone (PSU) and polyetherimide (Ultem – PEI).

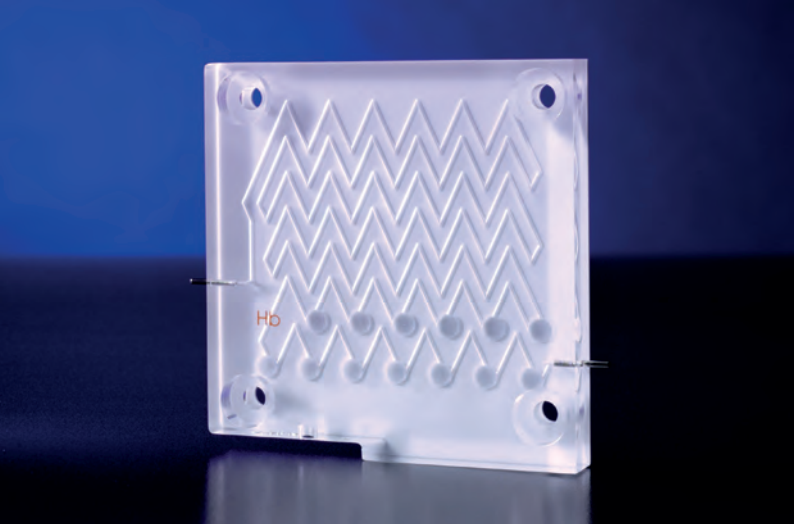
Carville manufacture manifolds using two main proprietary techniques.

Diffusion Bonded Manifolds

Diffusion Bonding was developed by Carville to produce the world's first medical manifolds in 1980. The material is heated and fused together at a molecular level without the requirement for solvents or adhesives. In addition to being very strong, diffusion bonded joints are clean and will remain stable over long periods of time. Unlike cemented joints, they will not discolour or shrink.

Laboratory Test Method	Diffusion Bonded Strength	Acrylic Cement Strength	Parent Material Strength
Torsional Sheer Strength	96%	77%	100%
Tensile Strength	97%	70%	100%
Bending Strength	45%	47%	100%

Carville developed and manufactured the world's first diffusion bonded manifold in 1980.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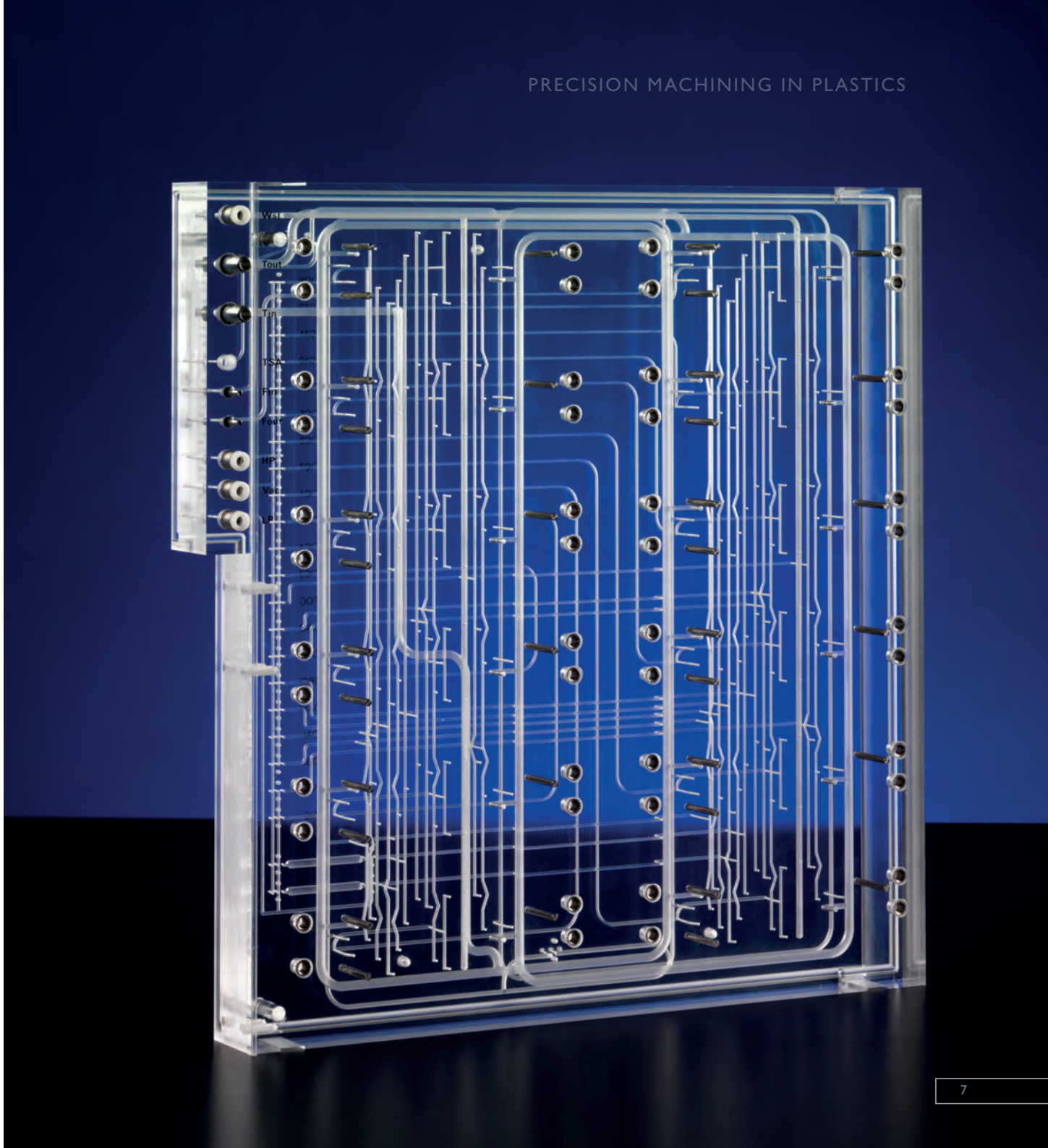
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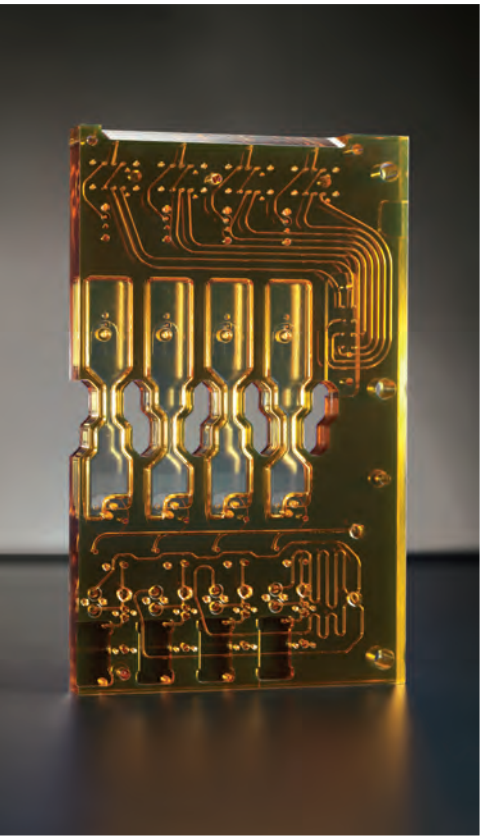


High Accuracy Bond (HAB)

Carville have witnessed a number of changes in the applications and environments where manifolds are used. Some customer applications now require:

- High performance plastics
- The ability to process more aggressive chemistries
- Smaller internal track sizes
- Improved feature alignment
- The ability to process smaller sample sizes
- Reduced material stress

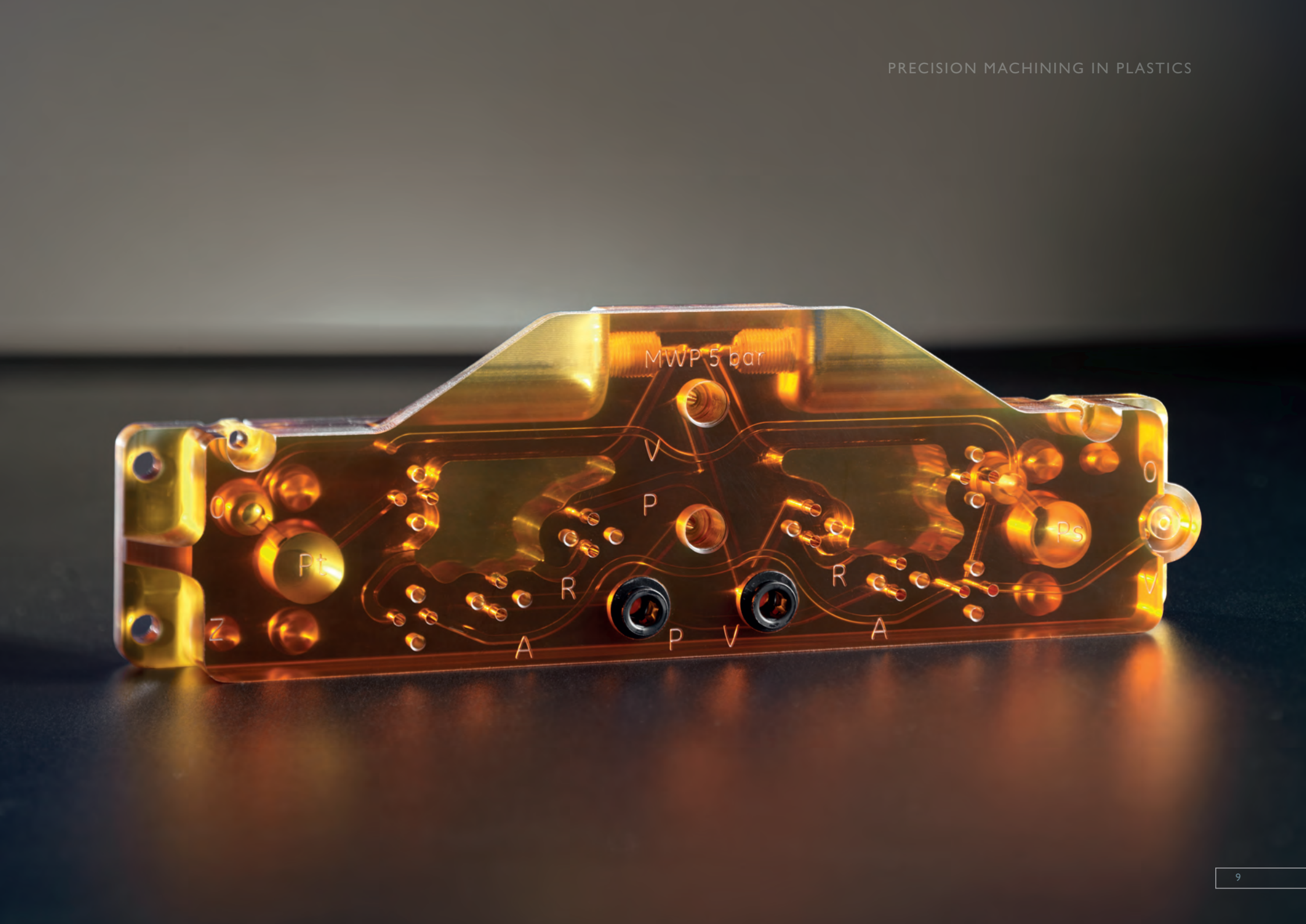
HAB development was completed by Carville in 2009. HAB is an extension of Carville's diffusion bonding process and it allows manifolds to be manufactured to perform in more critical environments and applications.

HAB manifolds have been independently qualified and approved by Carville customers and are currently being used in medical diagnostic, clinical chemistry and industrial applications.

HAB manifolds are available in high performance plastics such as:

- PolyMethyl MethAcrylate (PMMA - Acrylic)
- PolyCarbonate (PC)
- PolySUlphone (PSU)
- PolyEtherImide (PEI - Ultem)

Alpha numeric characters can be engraved on component parts to show port identifications, part numbers or manufacturing date codes.


MWP 5 bar
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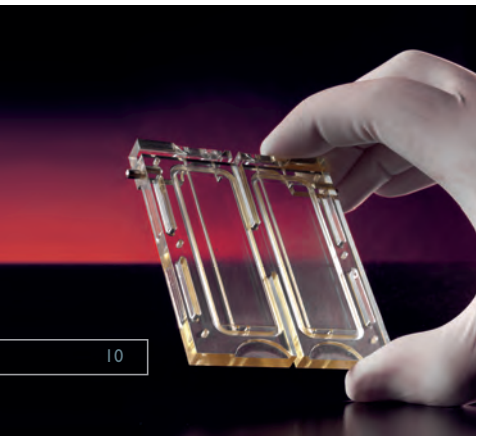
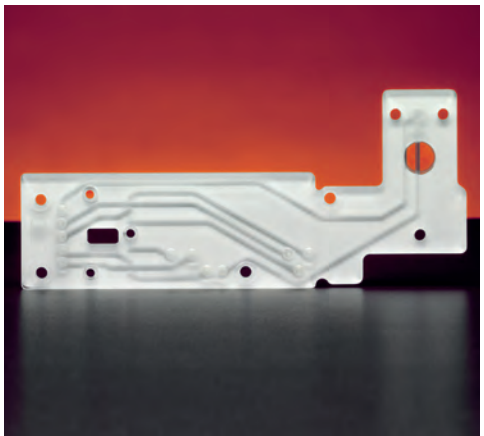




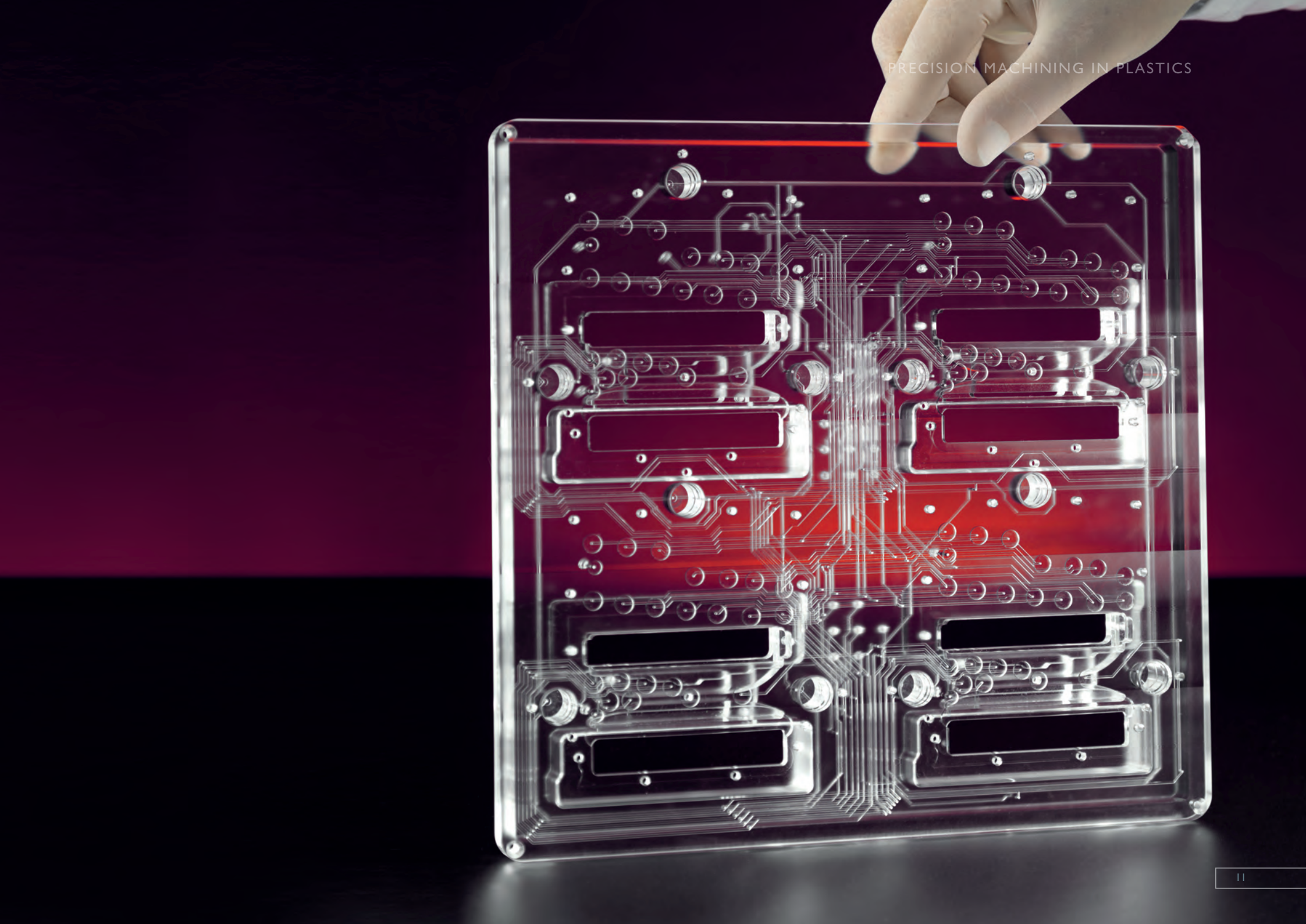
Medical Manifolds

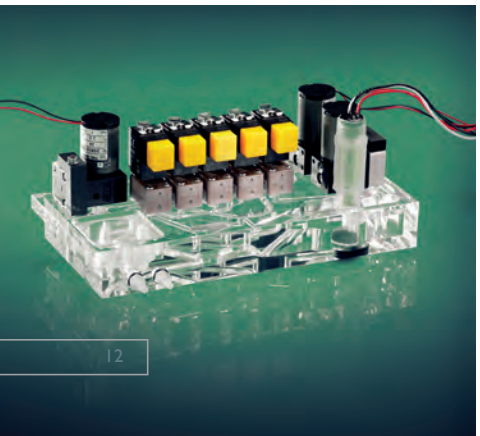
Bonded manifolds have become a standard in the medical industry. They are typically used to handle fluids, gases and reagents within clinical diagnostics, point of care or laboratory equipment applications. Manifolds can be enhanced with a number of additional items such as pumps, valves, solenoids, heater modules, electrical circuitry, filters, etc.

There are many attractive properties that encourage medical companies to use acrylic manifolds. These include:

- Ease of assembly
- Reduced cost of assembly
- Improved reliability
- Visualisation of system operation
- Ease of maintenance

When using small thread sizes, it is possible to fit either brass or stainless steel thread inserts.





Valve Manifolds

Carville manufactures and supplies plastic manifolds to many of the world's leading valve manufacturers. Subject to the demands of a particular application, these manifolds may be produced using materials such as Acrylic, Polycarbonate, Polysulphone, Ultem (PEI) or PEEK.

When compared to a conventional cross-drilled or laminated assembly, bonded plastic manifolds offer the end customer many attractive features.

Plastic manifolds offer significant weight advantages. Also, the use of Carville's Diffusion Bonding and HAB processes allow manifolds to be assembled in layers without the need for gaskets to form seals. This ensures a more reliable product which will not leak or fail on a bond line.

As manifolds can be manufactured in multiple layers, the design engineer is offered a greater degree of flexibility when dealing with complex issues such as footprint size, dead volumes and internal functionality.

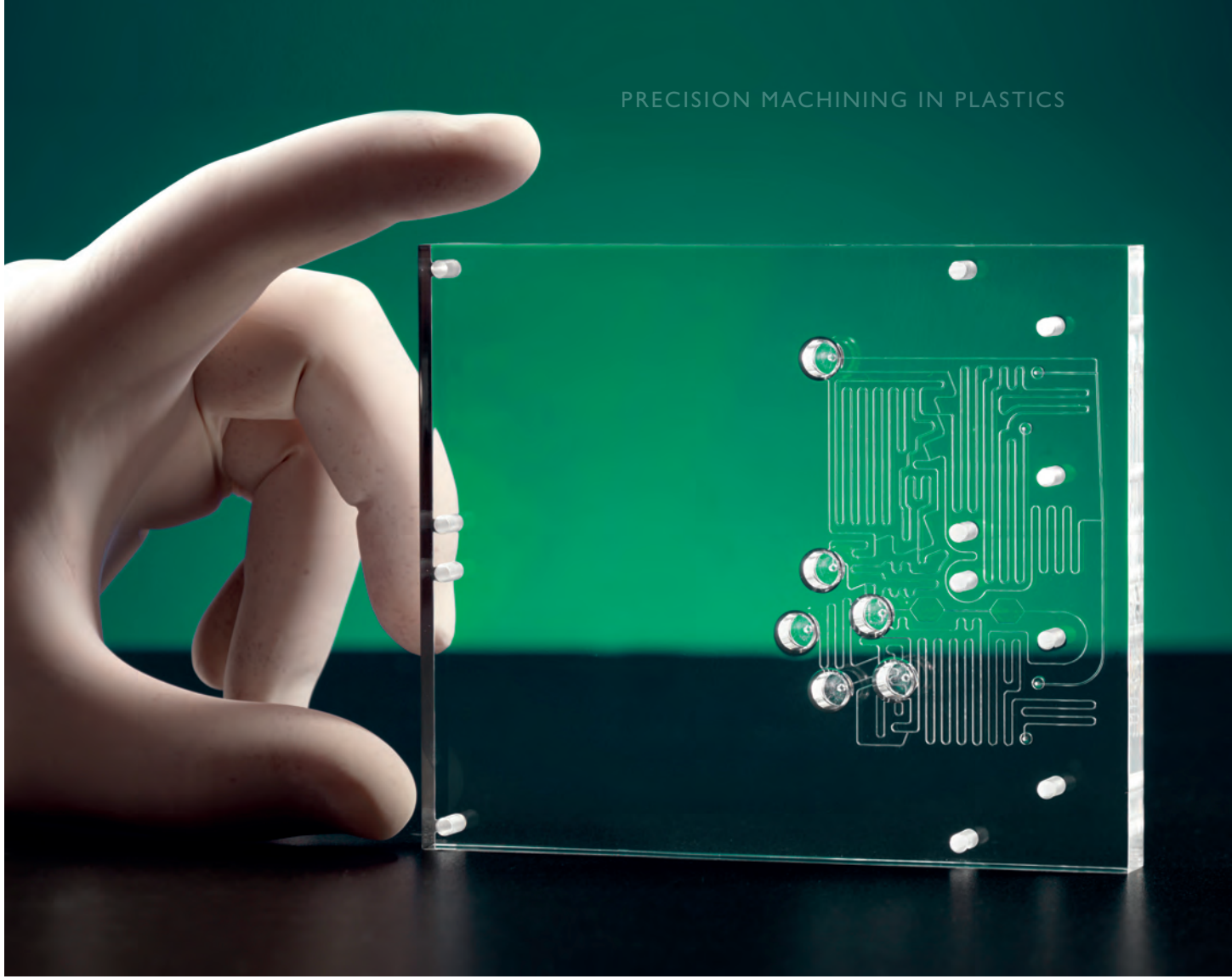
The use of clear acrylic allows the user to view the behaviour of samples and reagents as they are processed within a manifold. As it is possible to view the internals of the manifold, it is easier to identify blockages which may impact system performance or require the attention of a technician or engineer.

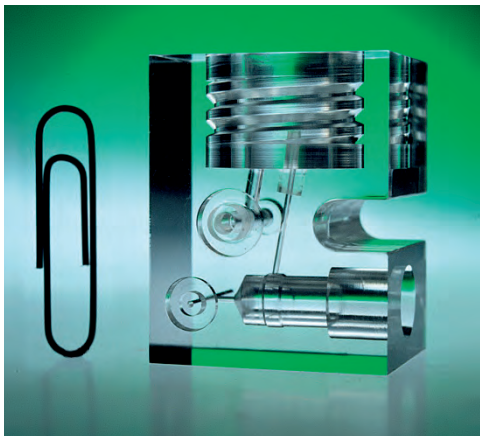
Manifolds offer the design engineer a greater degree of flexibility along with improved reliability.

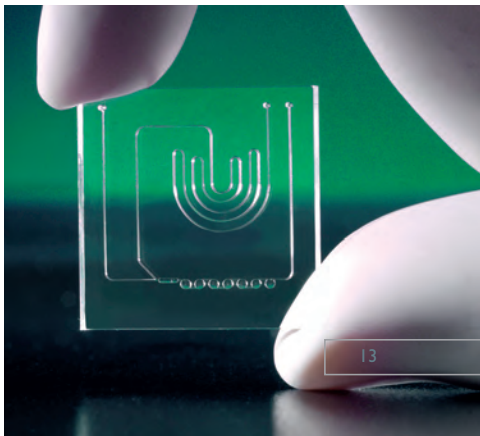
Micro Fluidic Devices

Working with many of the world's leading biotech, medical diagnostic and drug development companies, Carville has experienced a demand for manifolds and chips which can be used to process smaller sample and fluid volumes.

To support these customer applications, Carville has successfully developed new manufacturing and bonding techniques (HAB) which allow chips to be manufactured with complex internal tracks and features down to 150 microns in size.







Fluidic chips may utilise tracks down to 150 microns.

Lenses and Light Guides

Acrylic light guides and lenses offer design engineers many attractive properties.

- Acrylic is half the weight of glass of the same thickness
- Acrylic has excellent optical clarity and light transmission properties
- Acrylic has good resistance to breakage

Carville produce CNC machined acrylic light guides and lens components for use in the automotive, aerospace, medical and industrial sectors. Lenses may have concave, convex or aspheric profiles.

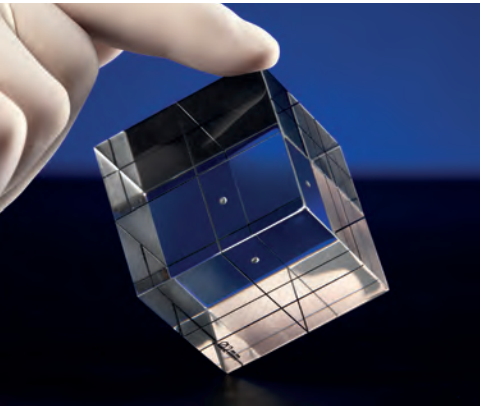
Light guides can be simple components such as round acrylic light pipes or may be more complex components which have been fabricated, formed and wrapped to guide a light source to a particular area within a larger assembly.

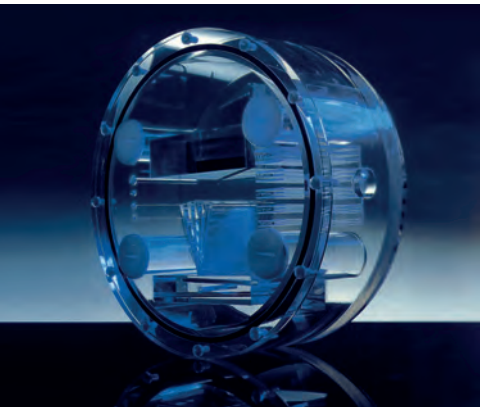
Carville also have extensive experience with fibre optic light guide detectors. Carville manufacture large fibre optic detector assemblies for use on synchrotron target stations. These detectors contain thousands of individual fibre optic light guides which are cast in to Boron Carbide (B4C) and individually coded.

Carville have produced acrylic lenses and light guides for customers operating in the following markets:

- Aerospace
- Automotive
- Flight Simulation
- High Definition Displays
- Industrial
- Nuclear Power

Acrylic has excellent optical clarity and light transmission properties.





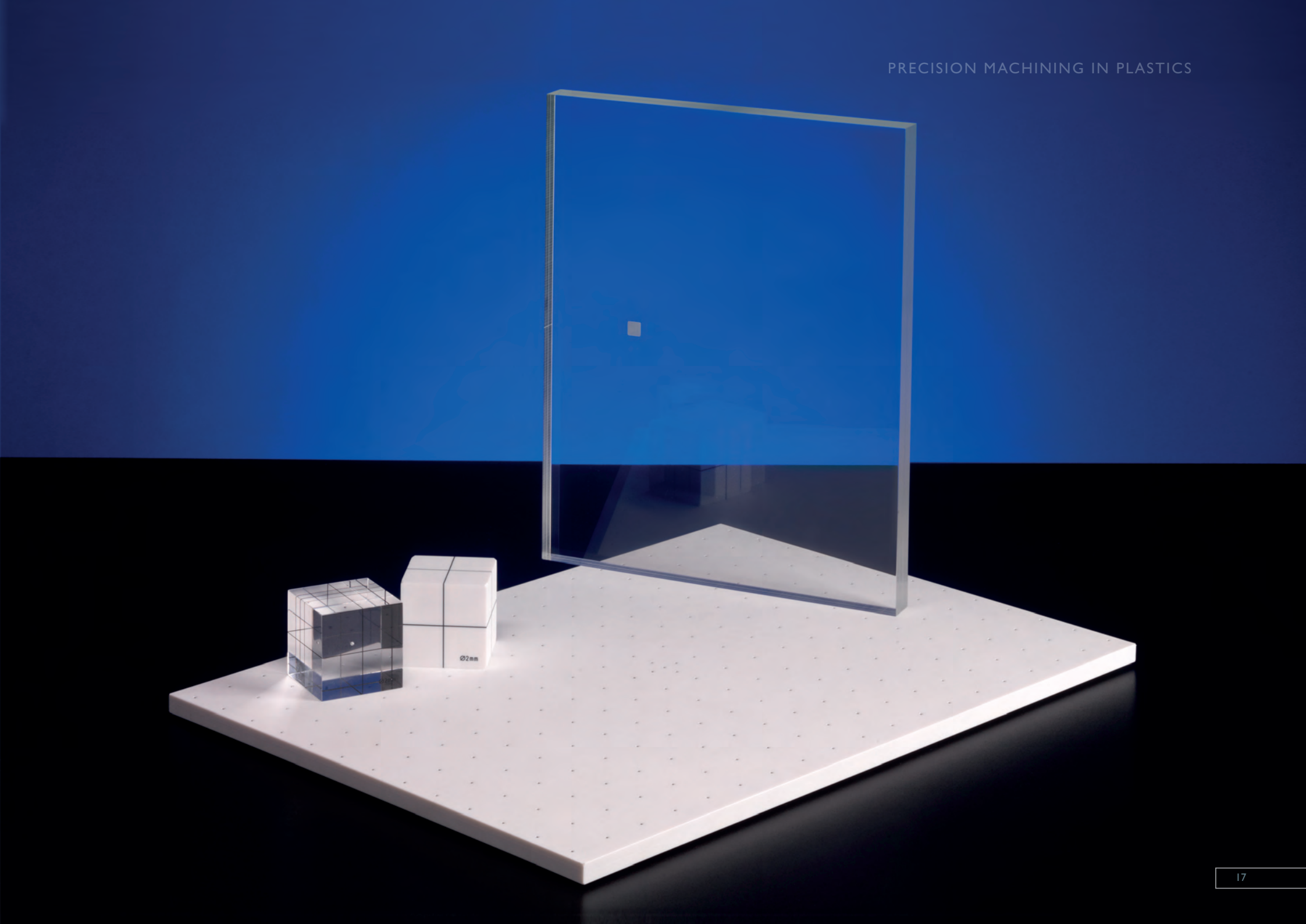
Quality Assurance Phantoms

Success within the Radiology and Oncology markets can be linked to the advances in clinical screening techniques such as X Ray, CT and MRI Scanning. These diagnostic machines assist medical professionals in the identification and treatment of life threatening medical conditions.

It is essential to the medical profession that equipment can be calibrated in an approved, reliable and repeatable way. Calibration of equipment requires the use of Quality Assurance Phantoms which either simulate human tissue or assist in equipment set-up.

Carville produce a range of phantoms in acrylic and other engineering grade plastics which are used to calibrate both static and mobile screening and treatment systems.

Phantoms can encapsulate other materials such as steel balls or aluminium foil.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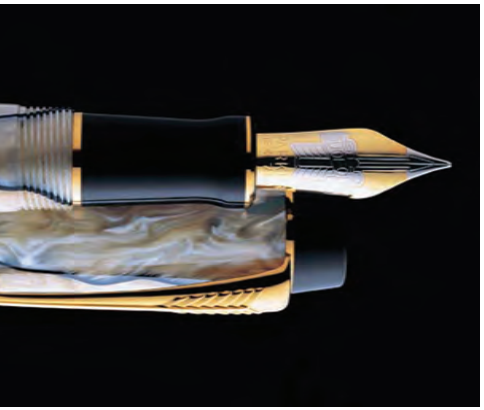

Writing Instruments

Many of the world's historic writing instrument brands date back to the late 19th and early 20th centuries. Although it is still possible to locate original examples of these products, the materials used are no longer suited to the demands of the 21st century.

Due to its weight, warm feel and attractive appearance, acrylic has become a very popular replacement for use in the manufacture of writing instruments.

Carville first began to work in this market in 1991. An initial approach by the Parker Pen Company resulted in a joint development project to create new materials and manufacturing techniques. This initial project resulted in the relaunch of the 1920's Duofold Pearl & Black Collection.

Today, using manufacturing techniques which were originally developed to support the aerospace and medical markets, Carville produce a range of new material designs and precision machined components for use by many of the worlds leading luxury brands.

Acrylic is a warm and attractive material suited to the manufacture of fine writing instruments.

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