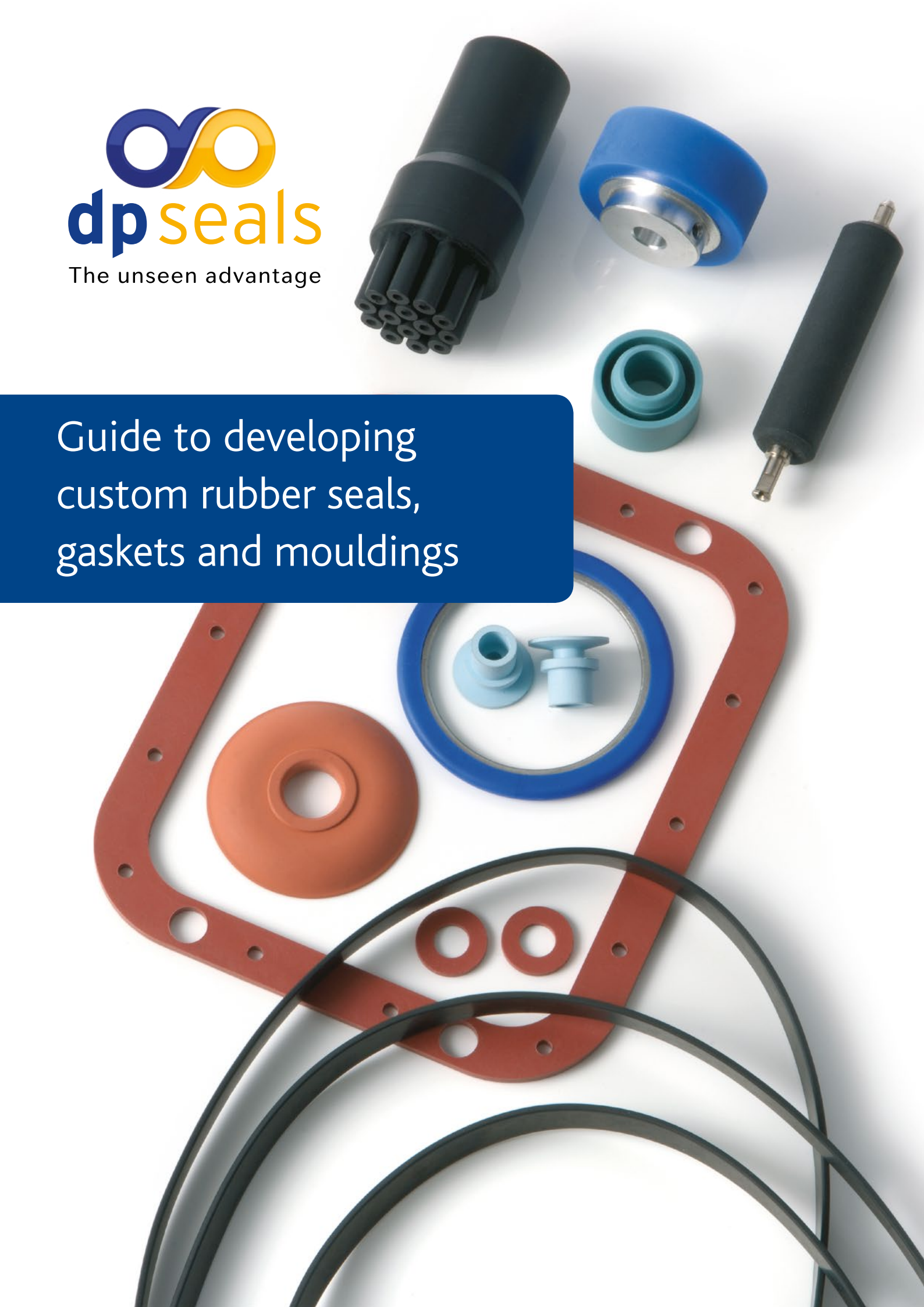
dp seals

The unseen advantage

Guide to developing custom rubber seals, gaskets and mouldings



Content:

Introduction

This guide has been put together to help you when considering the use of custom rubber seals, gaskets or mouldings as part of product development.

We'll first look at why you might choose a custom over a standard part and some of the benefits of doing so. Next we'll outline the importance of early communication with your rubber part manufacturer, including some of the key considerations they'll be keen to discuss with you. Finally we'll look at moulding techniques, the importance of material selection and summarise with our top tips. We hope you find the guide useful.

Why choose custom over standard rubber mouldings?

Rubber mouldings turn up in innumerable applications, from exotic F1 Grand Prix engines to humble electric kettles. Often, the seal is seen as a simple O-ring designed to keep something in or out and the only real decisions are on material and cross-section. For many general applications standard seals, gaskets and mouldings are fine.

Of course there will also be those occasions when a standard part just won't do what is required and it's clear that a custom part is needed. For example, when the moulding is a major part of the end product, such as the rubber boot for this sub-sea cable connector, its design is high on the engineer's agenda.

There may also be times when it is easy to continue using a standard rubber part based on price alone. However it may be more cost effective to use a custom solution over the longer term.

Here are some of the reasons you might like to consider choosing a custom designed alternative.

- **Intricate applications** – A standard product just won't do!
- **Greater sealing surface** – custom seals can be designed with multiple point contact offering greater seal protection.

- **Lower friction** – custom seals can be designed so that less 'squeeze' is required to maintain an effective seal. This results in reduced friction and can be combined with Fluorination techniques.
- **Longer life** – customised materials and design can result in seals lasting longer.
- **Reduced maintenance and operational costs** – This resulting longer seal life can lead to lower maintenance and operational costs.
- **Quality of finish** – tooling is designed to ensure finish and the ability to hold tolerances as required, including flash removal techniques.
- **Environmental** – criteria like temperature, pressure, liquids, contaminants, exposure to processes, light, outgassing and just plain old water may necessitate a custom solution.
- **Regulations** - Occasionally, the introduction of new regulations will extend the role of the seal; for example, a seal originally designed to prevent ingress of dirt and fluids into a ruggedised electronics unit can be enhanced to shield against EMI.
- **When you're not even sure what you want!** – Sometimes the requirement for a seal, gasket or moulding is only recognised late in the design process or perhaps you know you need a seal or moulding but aren't exactly sure how it could work. Reach out and get in touch. We can help.

If you've made the decision to use a custom rubber seal, gasket or moulding early communication with your manufacturer is advised. Let's take a further look at this.

The importance of early communication

Given the number of rubber seal, gasket and moulding companies around, it's easy to see why engineers leave selection until late in the design cycle. All too often, this forces engineers to choose an out-of-the-catalogue product that compromises product performance, or into eleventh-hour development of a specialised moulding, delaying market entry.

The time and cost pressures on design engineers today mean compromise is inevitable. With seals and gaskets there is a tendency to leave the choice of material, profile and manufacturing process until too late in the design cycle. We can't emphasise the importance of early communication enough.

So what are some of the things a custom rubber seal, gasket or moulding manufacturer will want to know?

Key considerations to discuss with your manufacturer

We've covered some of the areas your manufacturer will want to discuss with you in the previous section on why you might choose a custom rubber moulding over a standard solution but let's take a look in a little greater detail.

We like to consider two key questions when discussing your requirements. What needs sealing and why.

What needs sealing?

Asking this question helps point the way towards choice of manufacturing process. For example, the gasket seal on a radiator cap is flat and easily die-cut from sheet, whereas the rubber drive wheels for a printer or copier need to be moulded and bonded.

However, there are pitfalls in assuming that any flat rubber moulding can be simply cut from sheet; most notably, accuracy tends to drift and the cut edge to 'apple-core'. In demanding applications neither of these is acceptable.

Moulding the component ensures greater accuracy but isn't there a penalty in tooling costs? This is true but in most cases there is no need to go to full injection mould tooling and its attendant high process control costs. Transfer and closed cavity moulding are capable of creating a wide variety of complex 3D shapes and offer precision without the high tooling cost.

Why does it need sealing?

Having identified what, it is important to know why the product needs a rubber seal or moulding: simple feet, boot seals, drive wheels bonded to a shaft in a printer or copier, or to keep liquids and/or gases separate. Rubber comes in a wide variety of forms and compounds, all with different performance characteristics and this helps to make initial material choices.

Unsurprisingly, the softer the rubber (the lower the Shore or I.R.H.D. number) the more a seal or gasket will deform under pressure and fill the groove when the parts of a unit come together.

Natural rubber for example, offers good low temperature performance, down to -50°C, and high tensile strength with a wide hardness range from 30 to 90 Shore A. This makes it ideal for a wide range of simple applications. However, it does not perform well at high temperatures and offers poor resistance to hydrocarbons, eliminating it from many environments involving fuel, oils and similar solvents.

Synthetic rubbers can offer a wider temperature range and are resistant to attack from acids, mineral oils and petroleum solvents. Silicone rubbers offer an even wider temperature range, from -100°C up to 300°C, and excellent protection against water and gas permeation. This makes them ideally suited for food and drink manufacturing installations but poor performers in the presences of oil, petrol and similar solvents. But what do you do if you want a seal in a fuel system that runs very hot?

Know your product

Specialised synthetics such as a hydrogenated nitrile rubber offer a better combination of temperature range, solvent resistance and durability. This means they are ideal for fuel systems in rally or Le Mans car engines but not for the extremes of F1 engines. The key to the F1 situation is to remember that the seal only has to perform at its peak for less than two hours, not the 24 hours demanded by a Le Mans engine. An application-specific blend of silicone rubber can be tailored to be petroleum resistant at the upper end of its temperature specification for the duration of a Grand Prix.

This clearly demonstrates why it is important to understand all the parameters that might influence your seal or moulding design.

With the increasing variety of rubber compounds available, and the ability to tailor them to specific requirements, engineers are continually finding new and innovative uses for rubber mouldings. In some applications it is the environment that is demanding. In others it is the precision required, such as this novel ink-jet print head bulkhead designed to carry signal cables and ink lines.

The key is to challenge your custom moulding supplier to come up with a solution that meets your needs in terms of performance, timescale and cost. But be prepared to answer the key questions: what is it for, why it's needed, and where is it going to go - and don't leave it late on in the design cycle. The more time you give your supplier, the better the solution.

Here's a summary of a few key points for your consideration:

- **Type of motion experienced by the application.** Which of the following conditions will the seal work under?
  > Static
  > Dynamic
- **Fluids.** What fluids will the seal be exposed to in both its primary use but also when being cleaned or lubricated, for example?
- **Temperature.** What temperature extremes will the seal need to work under, both hot and cold?
- **Contaminants.** What abrasive external contaminants might the seal be exposed to?
- **Ozone.** Will there be a presence of ozone which can attack rubber?
- **Processes.** Will the rubber be exposed to processes such as sterilisation by gas, autoclaving or radiation?
- **Light.** Will the rubber be exposed to ultra-violet or direct sunlight?
- **Outgassing.** Will the rubber be exposed to the potential for outgassing in vacuum applications?
- **Water.** What will be the seals exposure to water?
- **Pressure.** What pressures will the seal work under, both low and high?
- **Friction.** What level of friction will the seal be exposed to?

Moulding techniques

There are various moulding techniques available. As outlined earlier in the guide at DP Seals we believe that in most cases there is no need to go to full injection mould tooling and its attendant high process control costs. We find the combination of specialised compression and transfer moulding that we offer allows us to cater for both high and low volume custom solutions achieving the excellent levels of precision and quality for which we are known.

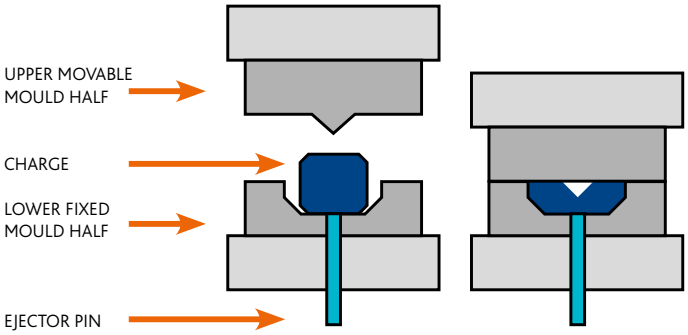
At DP Seals we have also been granted a UK patent for our unique tooling and moulding system.

Originally developed by the company's founder, David Piper, almost 40 years ago, the basic concept was for a moulding tool incorporating locating plates allowing free and easy movement during assembly and disassembly that could also be locked into position to ensure the closed cavities remained closed. This results in drastically reducing and even removing any potential for flashing.

The combination of practicality and ingenuity immediately gave DP Seals an advantage over competitors and enabled us to produce small, close tolerance, flashless mouldings that no-one else could match.

Compression moulding

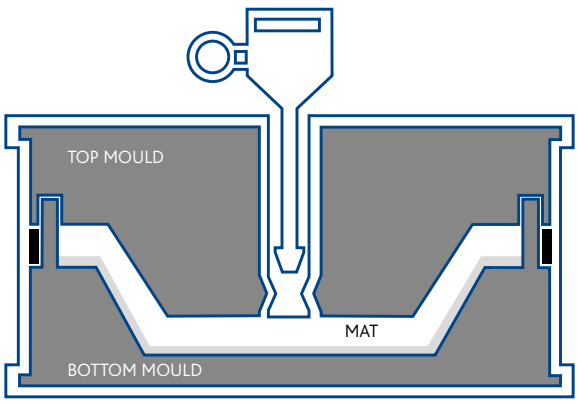
The rubber material is placed in an open, heated mould cavity. The mould is closed and pressure applied to force the material into contact with the mould area. Heat and pressure are maintained until the moulding material has cured. This is shown on the diagram below.



This technique is useful for small to medium volume, straightforward and precision components, particularly where metal parts are required. Great for expensive materials like FFKM/ perfluoroelastomers as there is very little wastage and it is the lowest cost tooling option.

Transfer moulding

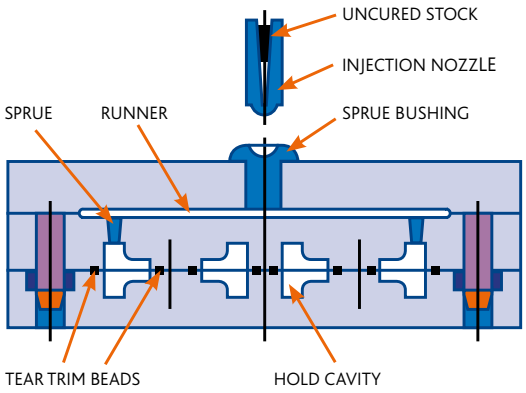
The amount of moulding material is measured and inserted to the transfer moulding in, what is called, a transfer chamber. Once the raw material is in the chamber it is forced through runners and into the mould cavity or cavities. The mould remains closed until curing has taken place.



This is a great technique for high quality, precision and intricate designs in larger volumes. It is also particularly useful where less flash is required.

Injection Moulding

Components are produced by injecting raw material into a mould. Material for the part is fed into a heated barrel, mixed, and forced into a mould cavity.



This extremely versatile process is useful for varied sizes of components. However there are higher set up and tooling costs compared to transfer or compression moulding so it is ideal for high volume production of the same part where the per-unit cost can be reduced. As outlined previously this is not a process we offer but we'll happily recommend a supplier should this be the best process for your particular requirements.

Materials expertise

Should you wish to get an initial view of which material might be best for your design we have developed our chemical compatibility database (CCD) app to check over 1,600 chemicals against all the major polymers.

At DP Seals we pride ourselves on being able to provide specialist advice in selecting and developing exactly the right blend of materials to meet a vast range of performance requirements. We're continually investigating new rubber polymers through our on-going R&D programme and actively encourage you to challenge us so that together we can find new and innovative uses for rubber mouldings.

We also maintain a large quantity and variety of quality raw materials in stock, enabling us to offer fast turnaround and provide for tight deadlines.

Top tips

Now we're coming to the end of the guide we thought it would be useful to summarise some top tips to help in your planning and designing'.

At initial design stage

1. Use our chemical compatibility database app to consider your initial material specifications. Then get in touch so we can help you with our expert advice.
2. Think about the quality of finish you require. What do you mean by quality? Less flash, split line, integrity, surface finish, appearance. Prioritising your requirements will really help in discussions about material selection and design considerations.
3. When sizing a seal design it to work in the worst case scenario.
4. To build speed and flexibility into the manufacturing process choose a manufacturer with expertise in design and toolmaking.
5. Avoid defaulting to tolerances that can be biased to metallic, machined or turned parts. Rubber is a very different material!
6. Don't unduly discount FFKM or other high cost materials because of cost without talking to us first. At DP Seals we can often utilise these rubbers and create a much more effective solution offering significant savings.

Communicating with your manufacturer

7. Communicate as early as possible with your rubber seal, gasket or moulding manufacturer.
8. Use the handy checklist we shared earlier in the guide to think about things you'll need to talk through with them.
9. Sharing what you don't need can be as important as what you do need. Do you need certain quality, tolerances etc. for the whole design or just for parts of it?
10. Provide detailed seal installation and assembly instructions, especially if the unit could be serviced by the end-user of the product. When appropriate or required, specify the use of OEM sealing parts.

Production

11. Use a manufacturer with 3D printing and prototyping facilities to ensure you can quickly test and refine the quality of design required.
12. When designing an application which will be sensitive to seal friction, testing will probably be required to determine the effect early in the process

Post production

13. Ensure your manufacturer records details of the component materials and manufacturing process for easy retrieval and future production of the parts you require.

Choosing the best partner for your project can be a key factor in its success. So when you decide we're the people for the job, what can you expect from us?

On time, every time

- In-house project management to keep things on track
- On-line data exchange and CAD/CAM links to speed up communication
- In-house tool room for faster production
- 3-D printing of prototypes to speed up testing and quickly iron out problems

Quality without compromise

- One of the UK's first custom rubber moulding manufacturers to achieve ISO9001
- Accredited to ISO 14001, OHSAS 18001, AS 9100 and BAE systems approval.
- Unique closed cavity moulding process
- Automated cryogenic cleaning systems for flashless mouldings

Specialist expertise

- In-house tool making and complete design process to solve your most difficult issues
- Unrivalled materials expertise in advanced rubber technology for extreme environments
- Pioneers in precision moulding extremely soft rubbers down to 10 Shore
- In-tool rubber-to-metal bonding

Added value, extra support

- Chemical Compatibility app to help you research rubber material suitability any time, anywhere
- Exclusive 'Masterclass' videos for invaluable advice on designing custom rubber seals and mouldings
- Unique Guide to custom rubber seals to broaden your knowledge still further
- No obligation, expert advice from our materials technologists

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dp seals

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