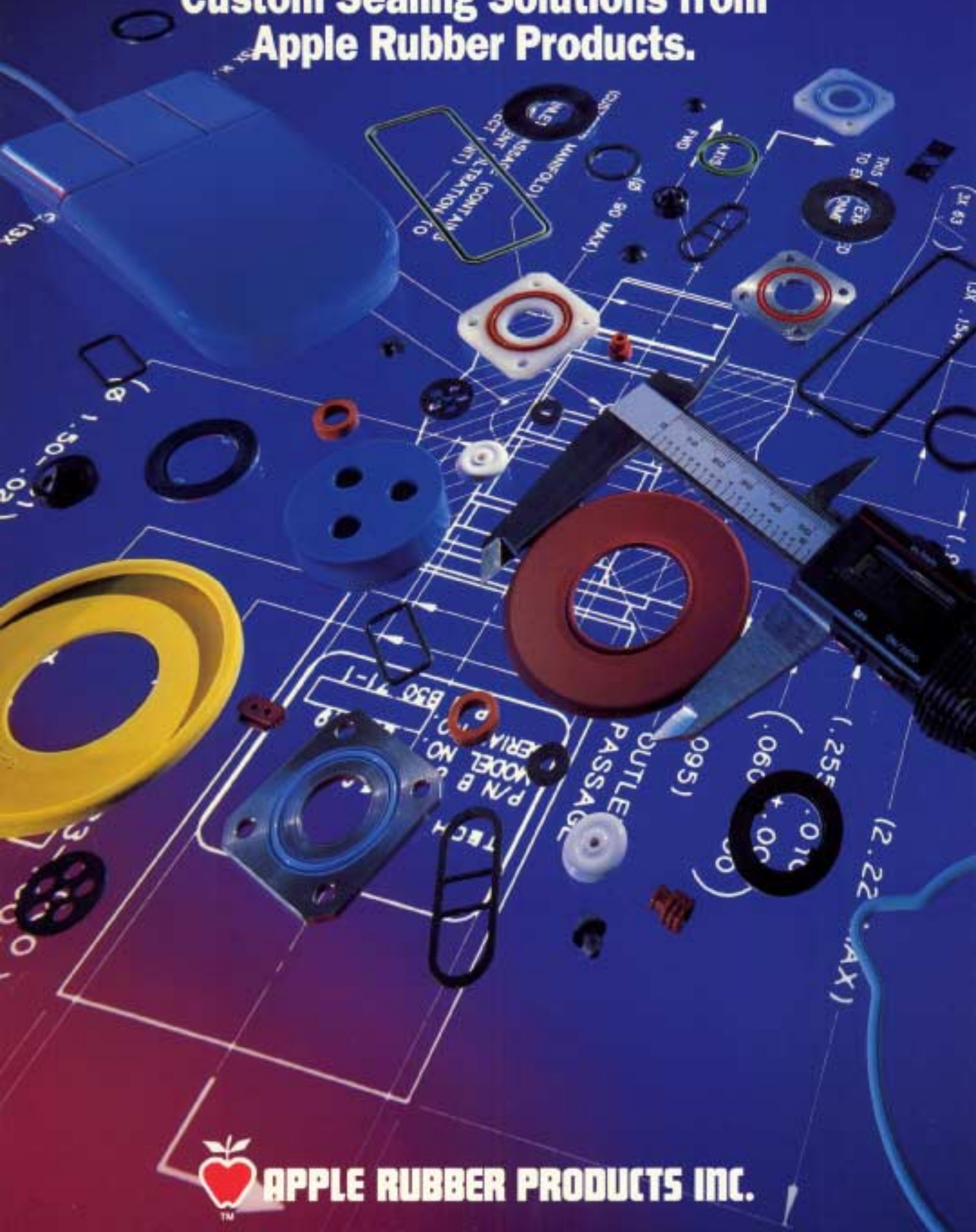


# SOLVED AND SEALED

Custom Sealing Solutions from  
Apple Rubber Products.



**APPLE RUBBER PRODUCTS INC.**

# Custom Sealing Solutions from Apple Rubber Products.

Presented here are some of the challenging seal problems solved by Apple Rubber engineers. These are just a few examples of our wide range of experience and expertise in custom engineering sealing solutions, and of what can be done to solve your sealing problems.

As you delve into these challenges, you'll begin to discover distinct advantages in the way we work. We aim a little higher to exceed your expectations. We drive a little harder to

offer you alternatives - from the practical to the ultimate solution.

We'll take extra design steps beyond the seal itself if it means reaching the best solution for your application.

And while we can work with you at any stage of your application - from

concept through validation of the finished seal - we are firm believers in the benefits of concurrent engineering. Our engineers work as a team, combining strengths and skills to offer you unequalled sealing experience and expertise.

When you have a sealing problem, Apple Rubber is ready to take on the challenge.



# SOLUTION 1

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## Filtering through

*“We designed a working prototype that other seal companies wouldn't even bother to quote on!”*

**The Problem:** An automotive components manufacturer needed an unusual filter and seal in one part.

**The Solution:** We designed a composite seal and delivered a prototype in 10 days!



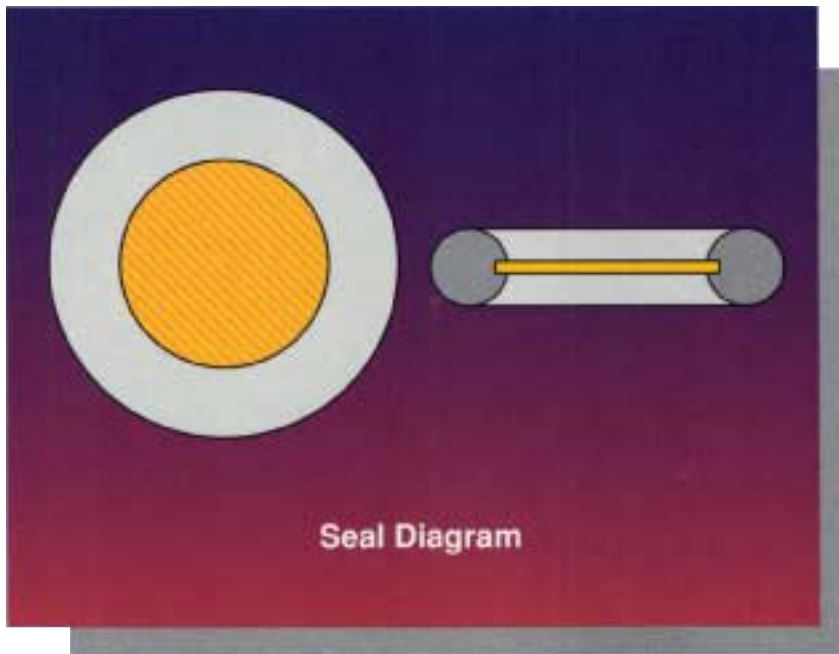
A manufacturer needed a unique seal that would filter while sealing areas in one of their automotive components. Other seal companies wouldn't even bother to quote on the part because of its complexity. Confident in our knowledge of plastics, elastomers, and composite seals, we eagerly accepted the challenge.

### **Analyzing the problem with a team approach**

We organized our team of engineers and flew to the manufacturer's design facility to see the component firsthand. There we learned that they had been using



*By utilizing our advanced molding processes we were able to deliver a working prototype in 10 days.*



### An effective and cost-efficient solution

The seal we designed was not only effective, it was cost-efficient as well. It will save the company money in a number of ways:

1. The redesigned solution uses a material that is approximately 10 times less expensive than the fluorosilicone that had been used.
2. The composite seal combines two parts into one, eliminating an assembly process and reducing installation costs.
3. The seal also eliminates a number of ports in the automotive component, simplifying its design and eliminating costly tooling requirements.

*We designed a diaphragm combining the flexibility of plastic screen with the sealability of an elastomer.*

two parts - a fabric filter and a seal configuration made of expensive fluorosilicone, costing up to \$20 a pound.

Working concurrently, and combining their automotive know-how with our sealing expertise, provided everyone with an objective point of view in approaching the problem.

Drawings in hand, we returned home the next day to immediately begin working on a solution.

#### A prototype combining plastic and an elastomer

We designed a diaphragm combining the flexibility of a fine mesh plastic screen with the sealability of a less expensive, but equally effective elastomer costing about \$2 a pound.

By utilizing our advanced molding processes we were able to deliver a working prototype in 10 days. **And it worked right the first time.**

To top it off, its one-piece design allowed a number of ports in the automotive component to be eliminated.



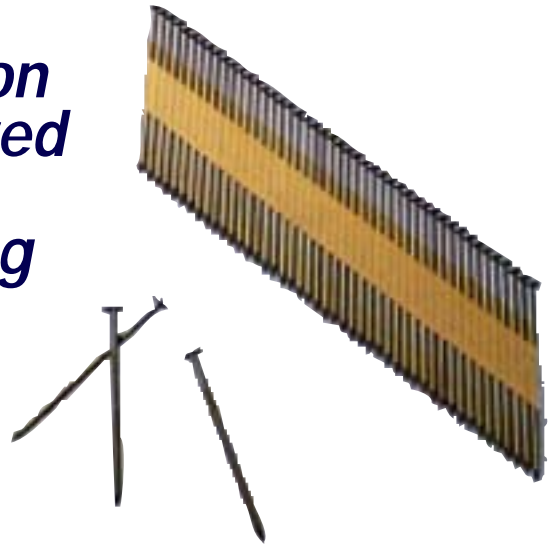
# SOLUTION 2

## Nailing the culprit

*“We received the call on Friday and hand-delivered two different working prototypes the following Monday!”*

**The Problem:** A piston seal in a nail gun kept failing.

**The Solution:** We designed two different prototypes and both solved the problem.



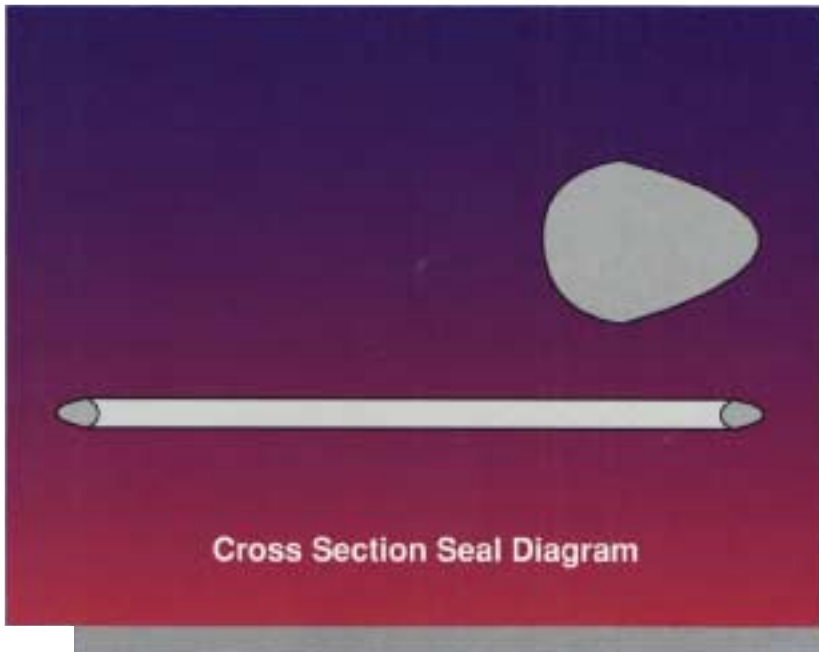
The phone call came on a Friday morning from a nail gun manufacturer. A piston seal used in the gun would disfigure and fail. As a result, the gun wasn't driving the nails in all the way.

### **Sealing a piston with a unique groove**

We faxed engineering drawings back and forth, detailing the specifics of the seal. The piston featured a unique groove which was very sensitive to the roundness of the O-ring. The slightest disfiguring of the O-ring would cause seal failure.



*Our exclusive ExpressSeal System<sup>SM</sup> allowed us to manufacture a precision custom seal in hours.*



material as the original O-ring. But we were not completely satisfied with it. Through our research we discovered another material that was even better suited to the high pressure of the piston. So we invested additional time and materials to offer an O-ring of a lubricated elastomer that will enhance the piston design. It was worth it.

**One solution leads to another**

After providing an initial order of more than 40,000 piston seals, we continued to work on additional aspects of the nail gun and on other projects. These included a seal for the gun's trigger mechanism, gas compression fittings for cylinders and seals for a variety of sensors.

*Using our CAD system, we had the new design in no time.*

**A teardrop shaped cross section was part of the solution**

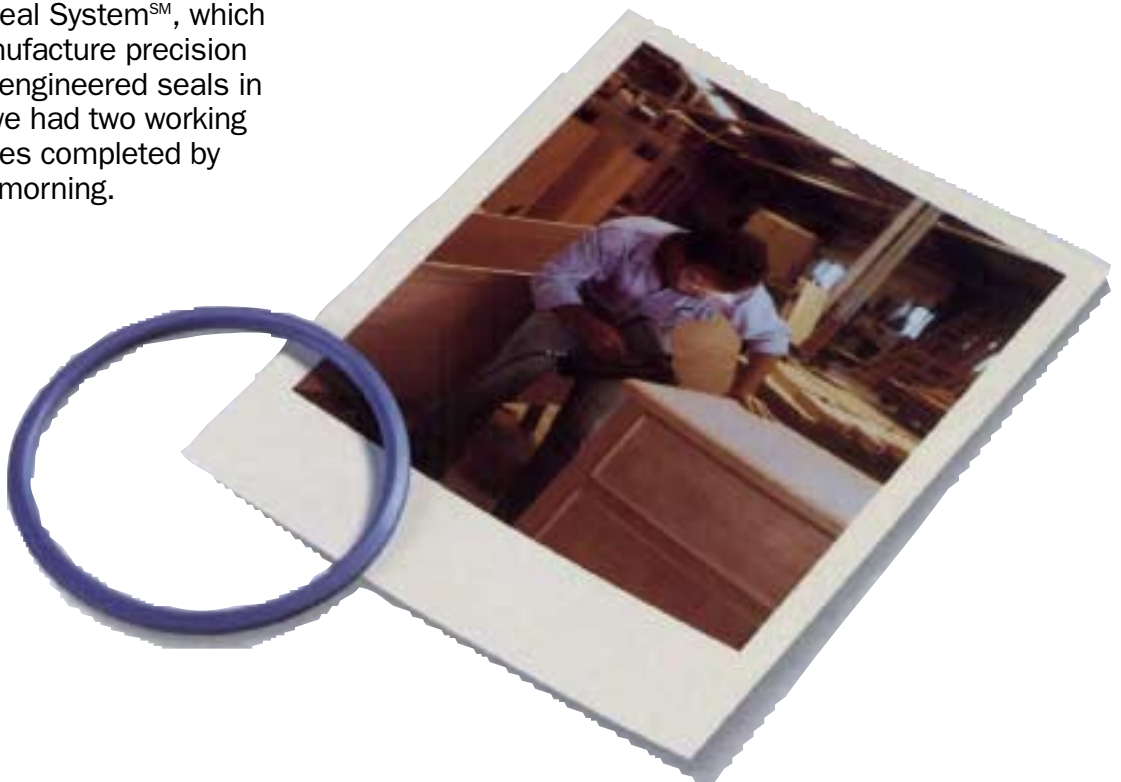
We worked as a team over the weekend. Using our CAD system, we had the new design in no time - a teardrop shaped cross section which would give the O-ring a better structural ability to stay round.

Utilizing our exclusive ExpressSeal System<sup>SM</sup>, which can manufacture precision custom engineered seals in hours, we had two working prototypes completed by Sunday morning.

**Delivering two prototypes and going one better**

We boarded a plane and hand delivered two prototypes the following Monday to the nail gun company. We even designed a custom shipping container to prevent the seals from disfiguring in transport.

The first prototype was made of the same



# SOLUTION 3

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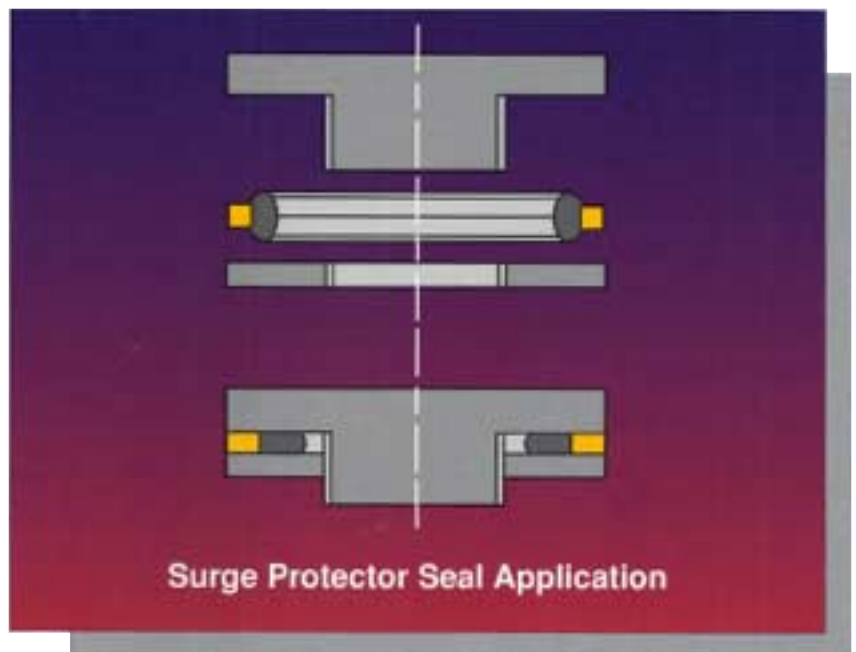
## Lightning speed

*"It took only two days to design a rubber-bonded-to-brass seal that compensated for varying tolerances of the mating components!"*

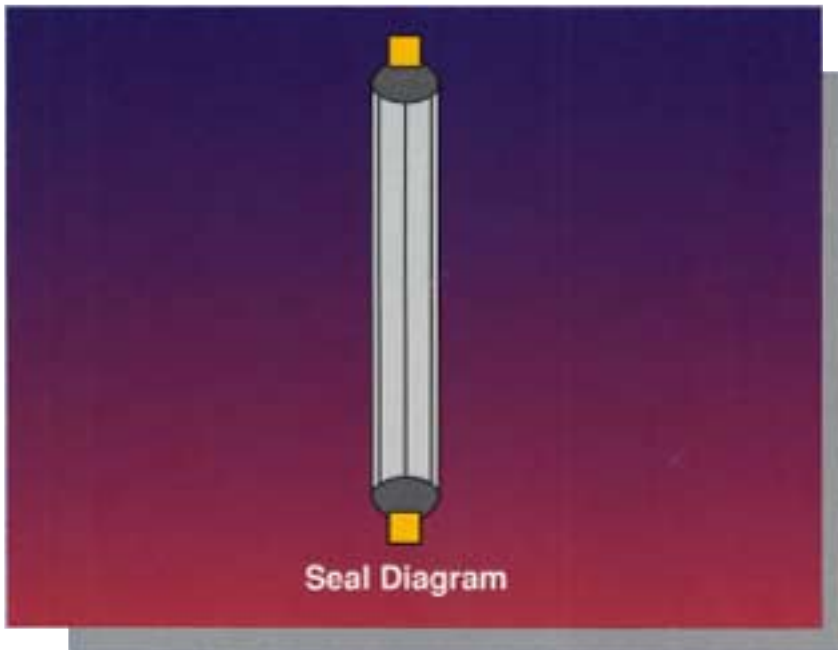
**The Problem:** A lightning surge protector needed to be waterproofed.

**The Solution:** We quickly delivered prototypes twice in a matter of days.

A company needed to waterproof a surge protector that protects lines inside a home from high voltage if lightning strikes outside. The project required extensive concept and design work and other seal companies had not come up with a solution. We saw a great opportunity to put our design engineering skills to work and we met to discuss the challenge.



*We went from drawing to prototype to full production in a matter of weeks.*



### **A timely, cost-effective solution**

We had worked with the company from drawing to prototype to full production in a matter of weeks. With our complete manufacturing capabilities, Apple Rubber has produced nearly 4 million parts to date. And, because we designed a composite seal, it is easier to install by automatic assembly, resulting in production cost savings.

*We designed a composite seal that was easier to install.*

### **A prototype in two days**

Two days after the initial phone call, we delivered a working prototype. The company tested the seal and found that it didn't completely seal moisture out. We had tested the prototype at our lab and knew it was to spec, so we took another look at the parts the prototype seal was to perform with. We discovered that the tolerances of the surge protector were off, causing the seal to fail.

### **A revised prototype the next day**

Knowing time was a critical factor and that it would be impossible to seal the part the way it was designed, we developed a rubber-bonded-to-brass part to compensate for the varying tolerances of the surge protector. And we delivered the seal the next day.

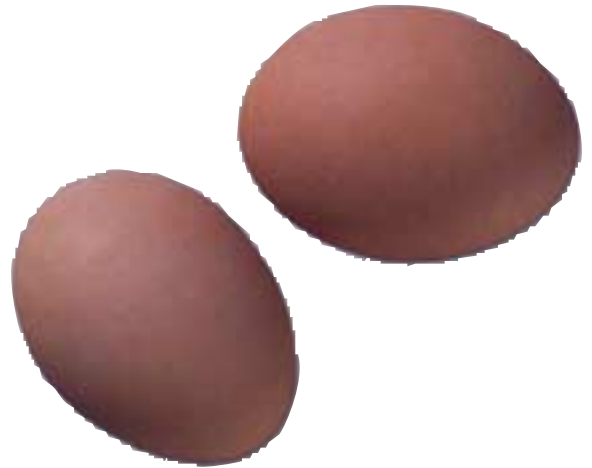




# SOLUTION 4

## Investigating fowl play

*“The seal we created performed better AND reduced assembly costs!”*



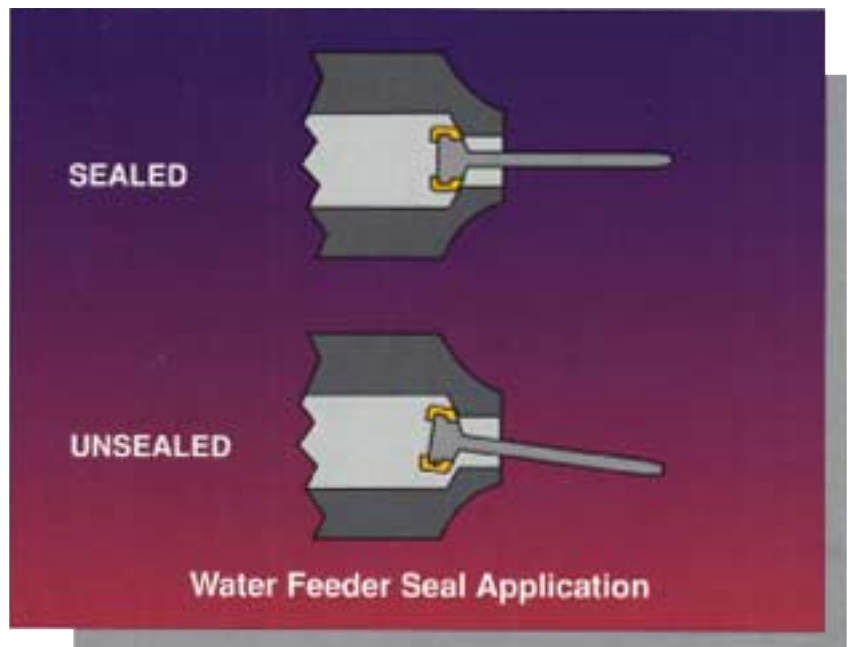
**The Problem:** Seal failure resulted in chickens being grossly underweight.

**The Solution:** We provided a working prototype and redesigned part of the equipment.

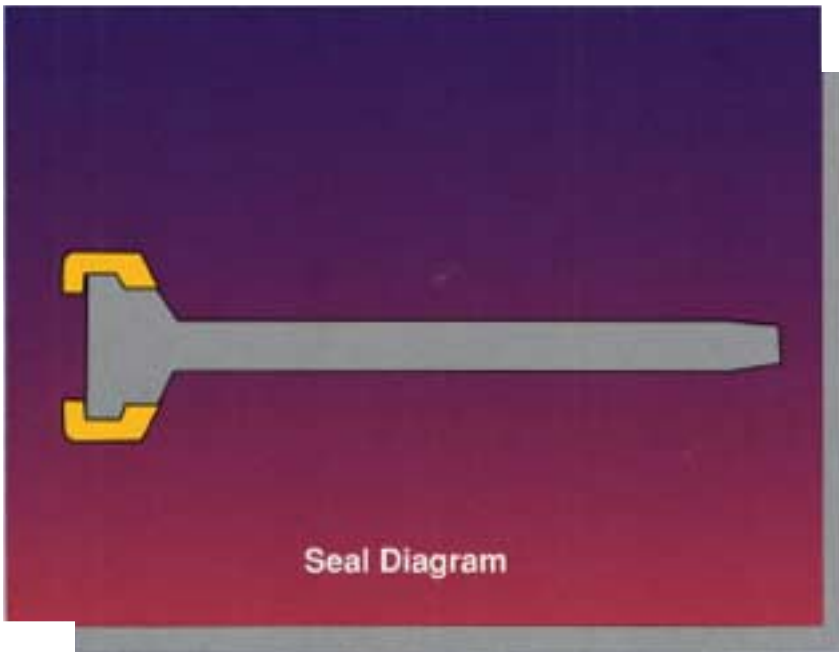
Chickens on several different farms were not drinking enough water due to a malfunctioning seal in the feeder. As a result, the chickens were not gaining weight and were underdeveloped - a costly situation for the farmers and the equipment manufacturer who guaranteed the feeders and had sold millions around the world. We went to the manufacturer's facility to investigate.

### **We found two potential sealing problems**

An O-ring configured around a small rod would often stick and not allow any water through. There



*A metal bond adds the necessary stability to the seal.*



But we knew seals generally aren't effective force limiters. So we also offered a rubber-bonded-to-metal seal in which the metal becomes the force limiter and the seal only has to seal. The metal bond adds the necessary stability to the seal, eliminating potential swelling and disfiguring.

### **A cost-effective solution in more ways than one**

They chose the second solution. Although it requires some tooling changes to the feeder, the seal combines two parts into one, completely eliminating an assembly process and reducing assembly costs. Therefore, they can purchase a better, more functional seal for the same amount of money.

*The seal combines two parts into one, eliminating an assembly process.*

was also the potential for the seal to be completely blown off the rod by the high pressure of the system, allowing too much water to spray through. Microminiature applications such as this are one of our specialties and we knew what had to be done.

### **First we considered the environmental factors**

We had to consider several factors in designing a new seal. Water differed dramatically in various areas - in some, water heavy in mineral content was used; in others, the water was heavily chlorinated. Feeders were regularly cleaned with high pressure water and solvents, so the seal had to withstand these factors. Nutrients and medicines are often administered through the water system.

### **A choice of two sealing solutions**

We provided two working solutions. In the first, we designed a microminiature seal made of fluorocarbon which would withstand the environmental factors and act as a seal and force limiter to eliminate the potential sticking and blow-off.



# SOLUTION 5

## Arresting a leak

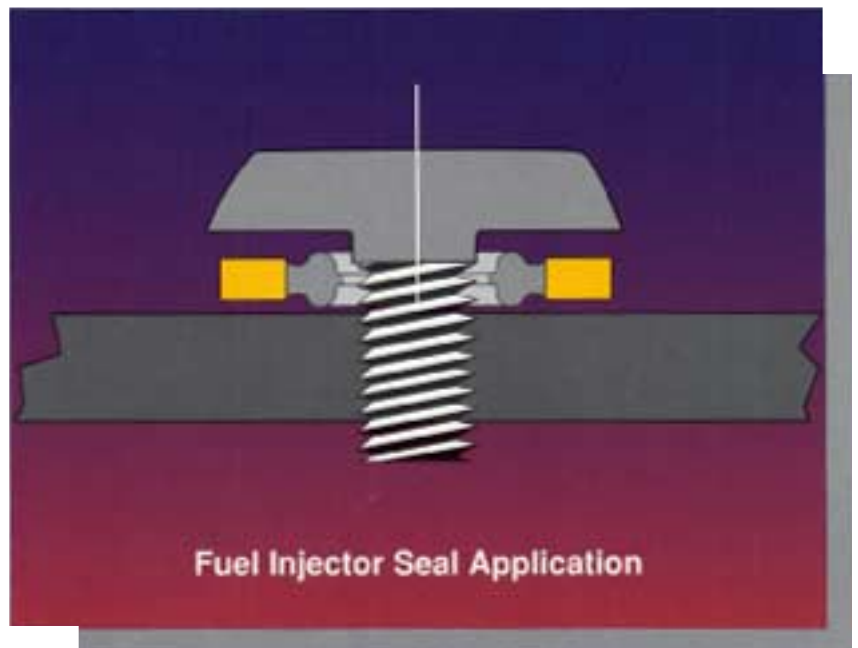
*“Superior seal quality solved the problem AND eliminated the need for incoming inspection.”*

**The Problem:** A seal in a fuel injector was leaking.

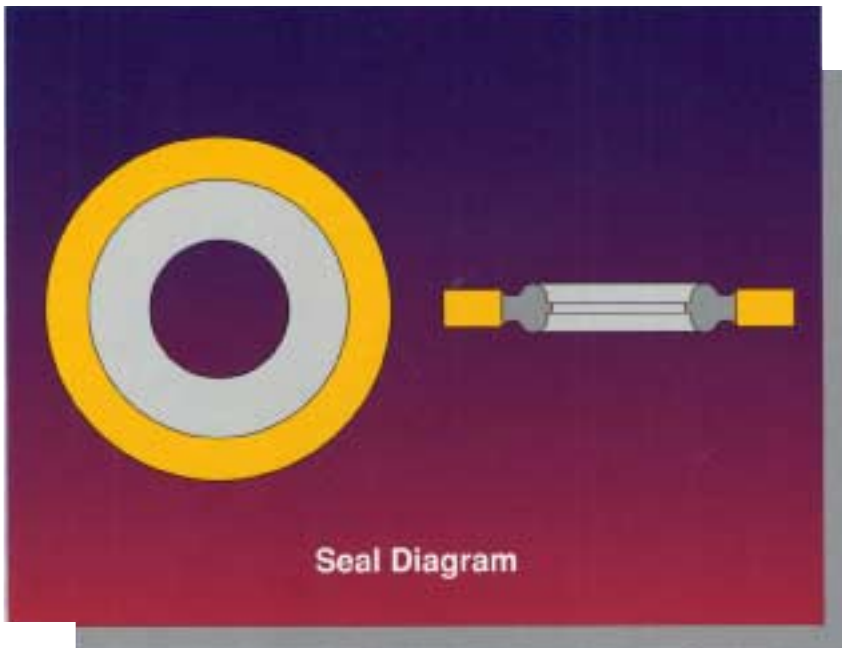
**The Solution:** We provided four different prototypes and each one passed testing on the first try.



A construction vehicle manufacturer was experiencing seal failure on an engine's fuel injector. They had state-of-the-art equipment on their production line to test the fuel injector seals, yet even seals that appeared to be to spec were continuing to leak. We met with the manufacturer's engineers at their facilities 300 miles away to discuss the problem....and returned home with the seal in question.



*We designed a new seal made of material that would stand up to harsh environments.*



and they were immediately taken to the production floor for testing. All four types were tested on the fuel injectors for four cycles and all four prototypes passed the test the first time.

**A cost-effective seal and a cost-effective testing alternative**

The company had been performing 100% inspection on the seals which was costing more than the actual parts themselves. It is now possible for the the company to eliminate the expensive on-line inspection of the seals by utilizing our customized QC programs.

*The prototypes were delivered to the production floor for testing and all passed the first time.*

**Advanced testing leads to a new material**

At AppleLab™, our advanced testing laboratory, we ran a myriad of tests on the seal to determine its physical properties and composition. We discovered that the high temperature of the application caused the seal material to change characteristics which resulted in the leak.

**Putting the prototypes to the test**

We designed a new seal made of material that would stand up to the harsh environment, and we bonded it to a metal washer for even greater stability.

Four different prototypes were delivered



# SOLUTION 6

## Getting to the root of it

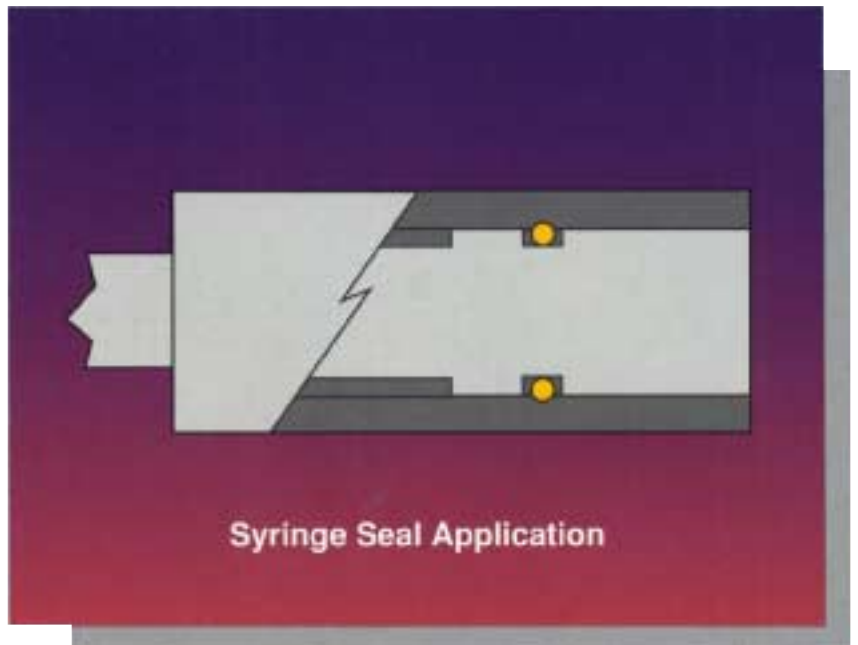
*“Our knowledge of plastics and elastomers helped create the ultimate sealing solution.”*

**The Problem:** A plastic syringe for adding nutrients to trees leaked.

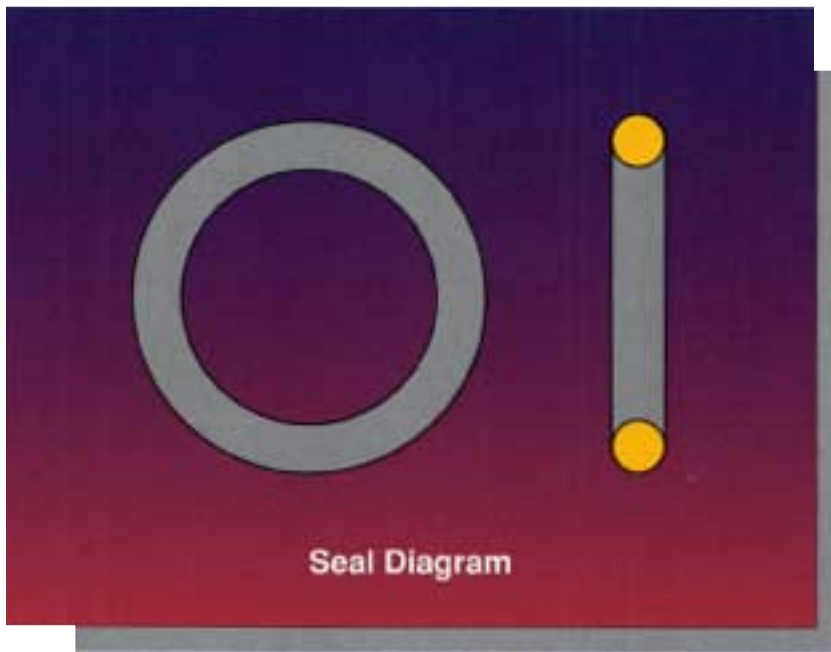
**The Solution:** We helped to completely revise the design of the syringe.



A company was developing an innovative syringe to add nutrients and pesticides to trees as an alternative to harmful chemical spraying. The syringe leaked when operated and even when it was stored in the trunk of a car. Having seen Apple Rubber product literature, the company gave us a call.



*The plastic syringe featured an O-ring between the plunger and the fluid cavity.*



knowledge of plastics, we took it a step further and redesigned the entire unit, doubling the wall thickness and reconfiguring the O-ring groove to better accept the seal.

### **A better solution and a better product**

We provided the solution and delivered more than 400 prototype seals in a matter of days. Not only did we deliver a better sealing solution, our knowledge of plastics also helped the company design a better, more efficient syringe.

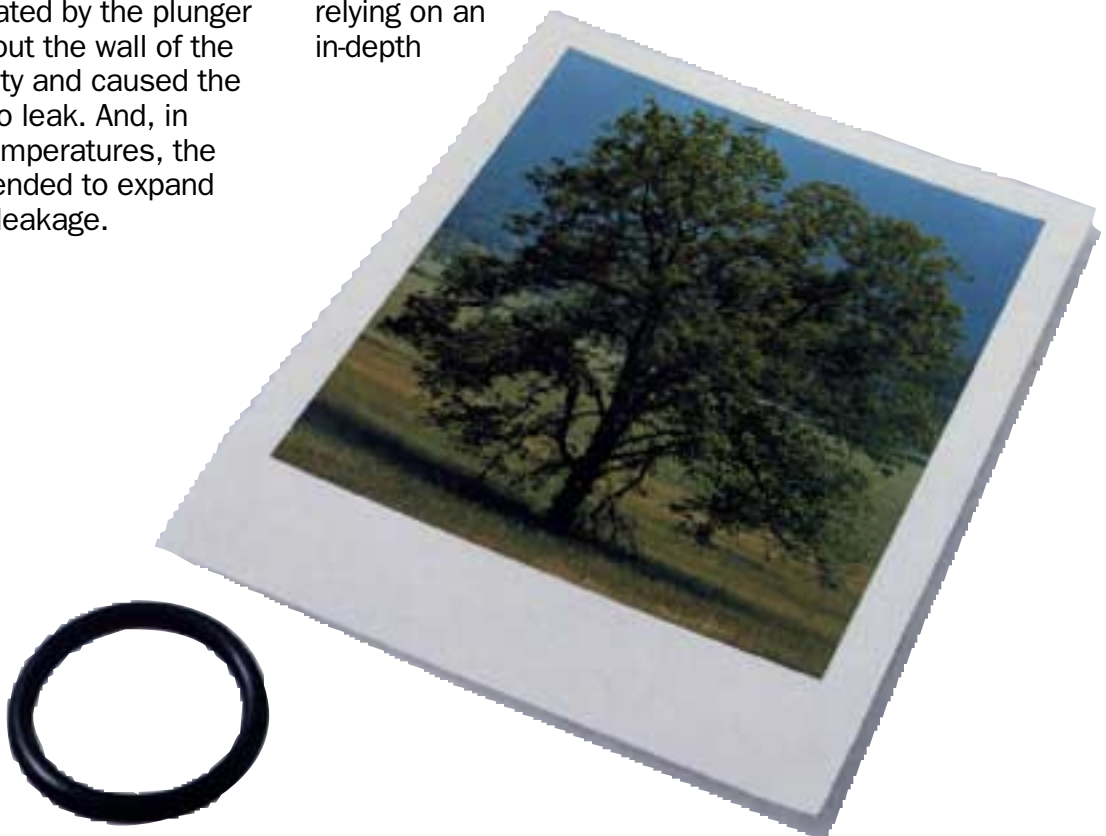
*We designed and delivered over 400 prototype seals in days.*

### **Finding the cause of the leak**

To use the syringe, a hole is drilled into the base of the tree and the chemicals are injected. The plastic syringe featured an O-ring between the plunger and the fluid cavity. The pressure created by the plunger pushed out the wall of the fluid cavity and caused the syringe to leak. And, in higher temperatures, the plastic tended to expand causing leakage.

### **Working with plastic to design the solution**

We discovered that the cavity wall and the O-ring were too thin. We initially prescribed a thicker O-ring made of 50 durometer Buna N which would stand up to the pressure. Then, relying on an in-depth



# SOLUTION 7

## Fixing a splat

*"We understood the effects of compression/decompression and how it affected the performance of the seal."*

**The Problem:**

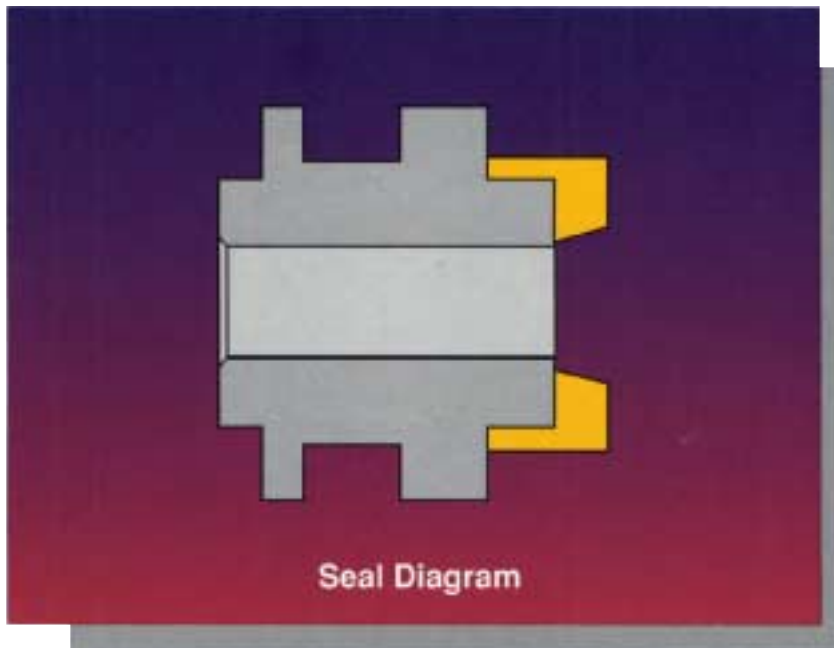
Compression/decompression in a splat ball gun caused a seal to fail and the gun wouldn't work.

**The Solution:** We designed a more stable, rubber-bonded-to-metal seal.

Splat ball is an exciting, recreational sport for people of all ages across the country and the guns that are used take a lot of abuse. A company that made these guns called us about a seal problem that made the splat go flat.



*We recommended a seal made of urethane material that could withstand the cold temperatures.*



### **Taking another shot at it**

We knew the material we chose would withstand the low temperatures. But we went a step further to add stability and reduce the effect of compression /decompression on the seal by bonding it to metal.

### **Keeping costs on target**

Our knowledge of materials and bonding capabilities assured a quick solution. But this knowledge also assured a cost-effective solution. The rubber-bonded-to-metal seal will simplify installation of the part and reduce assembly costs for the manufacturer. And the added stability of the seal will add to the operating life of each gun.

*We went a step further to add stability to the seal by bonding it to metal.*

### **Understanding the operating principles**

The guns operate with CO<sub>2</sub> to project the balls, and constant, fast compression/decompression resulted in the freezing of a seal made with carboxylated nitrile. We set our sights on improving the seal to compensate for these low temperatures.

### **Withstanding low temperatures**

The first step was to analyze materials that would withstand the temperatures better than carboxylated nitrile using cold testing equipment in our lab. We chose a urethane material with a temperature range that went well below -20° F.





# Work with Apple Rubber for your custom sealing solution.

When you're faced with a sealing problem, Apple Rubber has the resources to explore and develop new designs, materials and processes to deliver a solution.

We are continually adding to our experience, from a wide variety of industries, for countless applications. We are sealing engineers with the capabilities to deliver sealing solutions. Here are just some of the ways we can assist you:



## Prototypes are our specialty-

In all product development, time is the **critical** factor. By utilizing advanced processes, such as our ExpressSeal System<sup>SM</sup> and sophisticated CAD systems, we can help you drastically reduce the design and development cycle.



**We may already have your solution** - With access to one of the largest inventories of standard and metric size seals in the industry, our engineers often have the solution right at their fingertips. Microminiature seals (MicrOring<sup>TM</sup>). Oversized O-rings. Unusual sizes. And if we have your solution, it can be shipped immediately, saving you time and money.



**We can make it** - Apple's complete manufacturing capabilities mean fast response to your sealing needs, for large or small runs. Molding. Machining. Bonding. Whatever the requirement, we have the tools to get the job done.

## We know the materials -

Apple Rubber engineers understand polymer technology as well as plastics, metals and other materials. We know how they can work together to solve a sealing problem. And we can produce your seals in a wide variety of materials, including fluorocarbon, fluoro-silicone, polyurethane and TFE.



## We'll put it to the test -

We offer comprehensive, careful testing of your seals through AppleLab<sup>TM</sup>, one of the most stringent quality assurance programs in the industry. We are the only seal company to offer quality assurance that routinely includes **both** dimensional and material validation. And because we offer full documentation, our program allows you to eliminate costly incoming inspection.



- O-Rings - Standards, Metrics, MicrOrings™
- LIM (Liquid Injection Molding) • Custom Molded Seals
- Custom Molded Shapes • Rubber Bonded to Metal
- Rubber Bonded to Plastic • Standard & Custom Materials
- Prototyping & Production Runs • Design Capabilities
- Full QC Laboratory



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