RUBBER COMPRESSION MOLDING

RPM INDUSTRIAL RUBBER PARTS

Rubber parts function to solve a problem. Generally, that problem is unwanted vibration or a sharp edge that could cause damage to another part; in these cases, a rubber piece serves to isolate, seal and protect. Rubber's elasticity, high resilience and tensile strength make it the perfect material to address structural and functional issues in physical systems across a wide range of industries. By creating the ideal rubber part to solve a particular problem, rubber parts manufacturers create value for companies, saving them time, money and additional processes.

From the automotive industry to the medical industry to the agricultural industry, rubber parts play an essential role in smooth operations. Both standard and custom rubber parts are manufactured through a process called molding. There are three main types of molding, which will be touched on in this article. Of these, rubber compression molding is arguably the fastest, most economical and best established method for producing simple, precise products. A tried-and-true method, rubber compression molding allows customers to get the rubber parts they need without wasting resources.

Whether you need a large run of standard parts, a preliminary run of custom parts or a prototype for your next big idea, **RPM Industrial Rubber Parts** is here to help. Interested in rubber compression molding? Our expert engineers can analyze your product model, choose the best molding method and manufacture it to the highest standard of quality.

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This guide to rubber compression molding will explore the following topics:

WHAT IS RUBBER COMPRESSION MOLDING?

Compression molding is among the **oldest techniques** for processing a wide range of industrial, commercial and consumer products. Essentially, rubber compression involves taking a chunk of rubber and applying heat and pressure on either side with two molds to create a shaped part — much like a waffle iron creates a waffle.

Although the actual compression process is fairly straightforward, engineers must take several steps and make complex calculations before the rubber compression molding can begin. The pre-compression process involves the following steps:

- **Prepare the molding equipment**
- **Ensure rubber compression molding compliance**
- **Vulcanize raw rubber**
- **Calculate vital characteristics and requirements**
- **Prototype the rubber compression mold**

After the pre-compression steps are complete, engineers are ready to subject the vulcanized rubber to compression on prepared molds. To perform the **rubber compression molding** process, engineers take the following steps:

1. **A carefully calculated mold is prepared by heating and sealing it.**
2. **Uncured rubber is placed in the mold cavity.**
3. **The mold is closed.**
4. **Heat and pressure are applied according to programmable logic controls (and in accordance to respective parameters).**
5. **The mold is opened and the cured rubber removed.**
6. **The cured rubber undergoes a post-molding process that includes deflashing, inspection, post-curing and more.**

HOW TO READ AN ASTM RUBBER SPEC

ASTM International (formerly known as American Society for Testing and Materials) is an international organization that develops and publishes technical standards for thousands of products, services, systems and materials. **ASTM rubber standards** help rubber manufacturers evaluate and ensure the quality and safety of their product.

ASTM rubber standards also help consumers communicate about rubber with manufacturers. For example, ASTM D2000 is a standard that allows buyers to describe rubber materials based on its physical properties in a standardized way. A full specification will have the standard, like ASTM D2000, followed by a series of numbers and letters that indicate last year revised, unit of measure, grade, durometer hardness, tensile strength and more.

Consider the example spec ASTM D 2000-4 M2BG714B14EA14EF11EF31 EO14 EO34 F17. When evaluating this spec, we can determine the following:

- **ASTM D 2000 is the standard**
- **The -4 after the standard indicates that the last year of revision was 2004**
- **The M after the -4 indicates that all units of measure are metric**
- **The 2 after the M is the grade of rubber**
- **The B after the 2 indicates type, which describes the rubber's temperature resistance**
- **The G after the B indicates class, which means a rubber's resistance to swelling in oil after 70 hours at the temperature corresponding to type.**
- **The 714 after the G indicates durometer, hardness and tensile strength, respectively**

HOW TO READ AN ASTM RUBBER SPEC

After the durometer, hardness and strength indicators, the remaining characters indicate required tests. The letter corresponds to a specific test; the first number after it indicates the duration of the test and the test method. The remaining number indicates the testing temperature.

Deciphering long ASTM rubber specs can be a challenge without the right materials. Luckily, there are many manuals available online for free, as well as for purchase through ASTM International. Find more information on how to **read ASTM rubber specs here**.

TYPES OF ELASTOMERS

An elastomer is an elastic polymer and is commonly used to describe materials with rubber-like qualities. Elastomers are ideal for molding because they're highly flexible, perform well after molding and have high failure strain compared to other materials.

Silicone Rubber
A silicone elastomer, also called silicone rubber, is a silicone-based polymer that has been vulcanized. Silicone rubber offers high temperature and abrasion resistance, chemical stability and durability, which is why it has many applications across industries.

Synthetic Rubber
Synthetic rubbers are polymers synthesized from petroleum byproducts. Synthetic rubbers are artificial elastomers, and they generally provide more thermal stability and resistance to oils than natural rubbers.

Natural Rubber
Natural rubber consists of polymers, primarily from the organic compound isoprene. Both uncured rubber and vulcanized rubber have many applications, although the latter has more.

Ethylene Propylene Diene Monomer (EPDM) Rubber
EPDM is a type of synthetic rubber that is more resistant to heat, light and ozone than many other natural and synthetic rubbers. EPDM is generally used to seal and protect, which is why it's a common component in roof membranes, car sealings, weatherstripping and more.

HOW TO READ AN ASTM RUBBER SPEC

TYPES OF MOLDING

The appropriate molding method for anything, including elastomers, is dependent on many factors, including the material used and the shape required. There are three main **types of rubber molding**, each with distinct characteristics.

Compression molding	Injection molding	Transfer molding
• A versatile process that can be used for simple shapes of different sizes • Ideal for large pieces • Ideal for low and medium series of large objects • Most economical process • Longer production time than injection molding	• Ideal for tiny and complex shapes, as well as shapes with an internal feature • More expensive due to the complexity of design • Ideal for high-quantity series • Generally has a shorter production time than compression molding; may be fully automated	• Hybrid process with characteristics of both compression and injection molding • Ideal for larger pieces that will undergo a secondary process • High cavity count • Design flexibility

WHAT IS A RUBBER COMPRESSION SET?

The rubber compression set is an important property to consider when molding elastomers. The term describes how well a **rubber holds its desired shape** when compressed for a specific time, at a specific temperature. Essentially, a rubber manufacturer uses a rubber compression set to determine how much force, temperature and time need to be applied in the molding process in order to prevent the rubber from deviating from the intended shape.

COMPRESSION MOLDING TOLERANCES

In the world of rubber molding, tolerances refer to allowable variations in a product's dimensions. Many factors affect tolerances, including shrinkage, mold design, inserts, trim and finish, distortion and environmental storage conditions. Shrinkage, which is perhaps the greatest variable to consider, happens to some extent with all rubber products as they're removed from heated molds and allowed to cool.

WHAT DO TOLERANCES MEAN?

There are four tiers of dimensional tolerances for rubber products, indicated by designations A1-A4. Rubber manufacturers and customers should work together to choose a tolerance based on which tier specifications most closely match the needs of the product in question.

- **A1: High Precision. This is the tightest tolerance classification. A1 indicates a high-precision rubber product and involves expensive molds, fewer cavities per mold, and tighter inspection and controls.**
- **A2: Precision. This designation also suggests a precision rubber product, but less so than A1. It usually requires careful inspection, but necessary measurement methods are simpler than A1's methods.**
- **A3: Commercial. This tolerance classification is commonly used for commercial products.**
- **A4: Basic. This is the loosest tolerance classification. Manufacturers use A4 tolerances when some dimensional control is required but is secondary to cost.**

The **Association for Rubber Products Manufacturers (ARPM)** publishes guidelines and tables for determining tolerance pertaining to fixed and closed dimensions. Fixed dimensions refer to dimensions that are machined onto the top and/or bottom molding presses. Closure dimension refers to the dimensions created when the two presses come together.

To conceptualize the difference between a fixed and closed dimension, it's helpful to visualize two empty picture frames of identical size and shape, placed on top of one another. When stacked against each other, face to face, their fixed dimension would measure the perimeter of the frames' outer edges. In contrast, the closed dimension would measure the perimeter of the open rectangular space inside the frames.

COMPRESSION MOLDING TOLERANCES

TOLERANCE TABLES

Metric Tolerances (mm)

Nominal Dimension		**A1**		**A2**		**A3**		**A4**	
above	up to and including	fixed	closure	fixed	closure	fixed	closure	fixed	closure
0	10	0.1	0.13	0.16	0.2	0.2	0.32	0.32	0.8
10	16	0.13	0.16	0.2	0.25	0.25	0.4	0.4	0.9
16	25	0.16	0.2	0.2	0.32	0.32	0.5	0.5	1
25	40	0.2	0.25	0.32	0.4	0.4	0.63	0.63	1.12
40	63	0.25	0.32	0.4	0.5	0.5	0.8	0.8	1.25
63	100	0.32	0.4	0.5	0.63	0.63	1	1.1	1.4
100	160	0.4	0.5	0.63	0.8	0.8	1.25	1.25	1.6
160 & over				x .004	x .005	x .005	x .005	x .008	x .010

Inch Tolerances (in)

Nominal Dimension		**A1**		**A2**		**A3**		**A4**	
above	up to and including	fixed	closure	fixed	closure	fixed	closure	fixed	closure
0	0.4	0.004	0.005	0.006	0.008	0.008	0.013	0.013	0.032
0.4	0.63	0.005	0.006	0.008	0.010	0.010	0.016	0.016	0.036
0.63	1.00	0.006	0.006	0.010	0.013	0.013	0.020	0.020	0.040
1	1.60	0.008	0.010	0.013	0.016	0.016	0.025	0.025	0.045
1.6	2.50	0.010	0.013	0.016	0.020	0.020	0.032	0.032	0.050
2.5	4.00	0.013	0.016	0.020	0.025	0.025	0.040	0.040	0.056
4	6.30	0.016	0.020	0.025	0.032	0.032	0.050	0.050	0.063
6.30 & over				x .004	x .005	x .005	x .008	x .008	x .010

HOW TO CALCULATE RUBBER COMPRESSION

A rubber band can be stretched many times its length and still snap back to its original shape because of its elasticity. Elasticity makes rubber a desirable material for many industrial products, but it also presents unique challenges to the molding process. Molding rubber to maintain a desired shape requires a large set of complex calculations.

To successfully complete a rubber compression molding, manufacturers must calculate a rubber compound's specific characteristics and requirements. Factors to consider include flexibility, weight, required pressure, mechanical properties, thermal decoupling, vibration dampening and more. Manufacturers must also calculate cost, which is directly related to the weight of a compression molded rubber part.

WHAT IS THE COMPRESSIVE STRENGTH OF RUBBER?

Compressive strength is the **maximum compressive load** that a particular material can bear before it fractures. Whereas tensile strength measures the maximum stress a material can withstand while being pulled apart, compressive strength measures the maximum stress a material can bear while being compressed, or pushed together.

INVESTIGATING THE COMPRESSION SET OF RUBBER COMPOUNDS

Compression set testing measures rubber's ability to return to its original thickness after being compressed for a specific amount of time, at a particular temperature and deflection. A loss of resiliency indicates that a particular rubber product may not make an effective gasket, seal or cushioning pad.

A particular rubber compound's compression set results are expressed as a percentage; the lower the percentage, the better the rubber resists deformation. There are a variety of ways to calculate and test compression sets. **ASTM International** provides methods and guidelines for testing many rubber compounds.

RUBBER COMPRESSION METHODS

One of the many benefits of compression molding is its ability to create rubber objects of various sizes, as well as complete large and small production runs. Another benefit is that once the mold is created, it's much easier to perform larger runs. However, rubber compression molding is not an ideal modeling method for every rubber part.

LOW VOLUME VS. HIGH VOLUME

The process of compression molding requires a manufacturer to create preforms, models that are roughly shaped like the desired product. This requires an abundance of materials to ensure a complete fill of the mold cavity. For this reason and others, rubber compression molding is ideal for low and medium volume applications and large parts that require a long cure time.

PRESSES AND CAVITY CONSIDERATIONS

The quality of both presses and cavities vary widely among rubber manufacturers. Multi-cavity presses can prevent the bottleneck in production that less efficient presses often encounter. Large rubber parts will require even larger cavities and powerful presses for successful production.

LARGE RUNS VS. SMALL RUNS

Rubber compression molding has lower tooling and setup costs, so it's ideal for small and medium size runs, though certainly capable of large runs as well. It's an effective method for creating prototypes before heading to large-scale production. However, the same amount of precision, time and effort go into a mold that will produce 50 parts as a mold that will produce 50,000 parts. As a result, very small runs can be less cost-efficient than large runs.

RUBBER COMPRESSION MOLDING PRODUCTS

One of the many benefits of rubber compression molding is its ability to produce parts from previously created molds or create entirely new parts. At RPM Industrial Rubber Parts, we not only provide a wide selection of standard rubber parts but also help create never-before-seen custom parts.

TYPES OF RUBBER PARTS

Industrial rubber manufacturers generally produce both standard and custom rubber parts. Standard rubber parts are ones that are already commonly produced and bought, meaning a manufacturer probably already has the mold. **Standard industrial rubber parts** generally fall into the following categories.

- Molded rubber products, like grommets, bumpers, pads, o-rings and caps
- Vibration control products, like mounts, bushings, isolators and couplings
- Precision mechanical components, like bearings, shafts, clamps, hubs and gears
- Industrial casters, including swivel and rigid casters

CUSTOM RUBBER PARTS

There are many reasons an individual or company might ask a manufacturer to create a custom rubber part. In some cases, a similar part is being discontinued, or a product is being updated and needs updated parts. In other cases, a custom rubber part is completely new and would fill a gap in the market. Whatever the reason, **RPM Industrial Rubber Parts** is happy to help companies pursue custom part manufacturing.

FAQS FOR RUBBER COMPRESSION MOLDING

Here are some frequently asked questions about rubber compression molding.

WHAT IMPACTS HOW LONG A COMPRESSED RUBBER PART LASTS?

Rubber parts don't last forever, and over time they will begin to degrade. The two main forms of rubber degradation are hardening and softening. Even in pre-production, manufacturers can get a good idea of how long a compressed rubber part will last by using a computer modeling technique known as Finite Element Analysis (FEA).

HOW TO CALCULATE THE SHELF LIFE OR RUBBER PARTS

Several factors impact how long a compressed rubber part lasts in storage, including polymer type, compound formulation and storage environment. Although some types of rubber, like commercial-grade neoprene and styrene-butadiene rubber (SBR), may only last three to five years in storage, other rubbers, like silicone, may last 20 years in storage. Regardless of type, rubber should be stored away from direct sunlight in a cool, dry place.

CAN YOU SWITCH SUPPLIERS FOR RUBBER PARTS?

Companies can — and do — switch rubber parts suppliers all the time. However, it's important to remember that switching rubber parts suppliers will mean creating new molds for any custom rubber parts you want produced.

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RPM RUBBER PARTS: SUPERIOR RUBBER COMPRESSION MOLDING FOR EVERY USE

As a well-established production method, rubber compression molding has stood the test of time. When you consider the many benefits of compression molding, it's not hard to understand why it's still a popular creation method. Rubber compression molding is a relatively simple process with low tooling costs; it's ideal for large, thick parts, but capable of crafting small parts, too. Rubber compression molding is as flexible as it is effective, but not on its own; the manufacturer's commitment, competence and care make the definitive difference.

At **RPM Industrial Rubber Parts**, we understand that the quality of one rubber part can have a tremendous impact on the overall efficiency and safety of a machine, product or tool. We also understand that meeting a customer's pricing goals and expectations is an important part of the manufacturing process. When you partner with RPM, you can be sure you're getting a high-quality design, composition and pressing, as well as thoughtful, transparent communication. Whether you need a large run of standard parts, a small run of custom parts or just want to explore a prototype, we're here to help. **Reach out to us online** or give us a call at 888.842.5668.

CONTACT US