



How is Sheet Rubber Made?

By Cody David

Sheet Rubber has for many years, represented one of the most reliable and versatile materials for gasketing and sealing applications, as it is both durable under physical or chemical stress, and resilient, able to retain its shape and flexibility under extreme pressures. Rubber seals and gaskets are fabricated in a multitude of ways and in innumerable shapes and sizes. Sealing applications requiring a flat gasket are typically cut from rolls of sheet rubber.

While sheet rubber too, is produced in a multitude of ways, calendering's greatest advantage is in its flexibility. A single machine can produce a host of variations depending on requirements including, thickness, length, width and with different surface finishes or inserts.

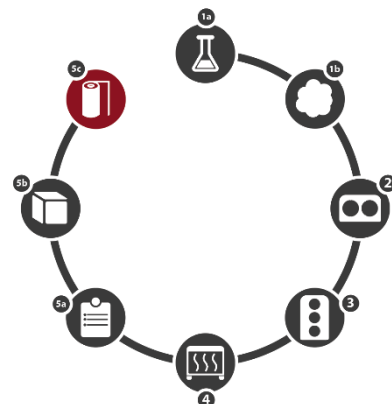
To see the various types of sheet rubber products visit warco.com/sheet or download this pdf. Calendered sheet rubber products can exhibit a wide range of dimensions including:

- Thicknesses: 1/64" to 1/2"
- Lengths: 12.5' to 360'
- Widths: Up to 55"

Additionally, the calender can enhance the roll with different surface finishes or cloth inserts. For more information sheet rubber products and their dimensions, visit warco.com/sheet or download this pdf.

This article breaks down the sheet rubber production process into 5 steps

1. Material Design
2. Mill Preparation
3. Calendering
4. Autoclave Vulcanization
5. Roll Inspection





Material Design - Mixing & Compounding

The first step in making sheet rubber is developing the formulation, aka recipe, to meet the application's requirements. Whether it needs to be extra soft, resistant to a specific chemical or colored a specific shade, chemists design a formula that meets both the end product requirements and possesses the necessary processing characteristics. While many manufacturers work with external development & mixing facilities, WARCO's operations are complete with a full-service lab and an internal Banbury mixer.

Rubber products are categorized by their base polymer, which go a long way in determining the material's final properties. Learn more about each rubber product's characteristics at warco.com/polymers.

The most common types of polymers used in sheet rubber manufacturing include [Neoprene rubber](#), [Nitrile rubber](#), [EPDM rubber](#), [Natural rubber](#), [SBR rubber](#), [Silicone rubber](#), and [Fluoroelastomer rubber](#).

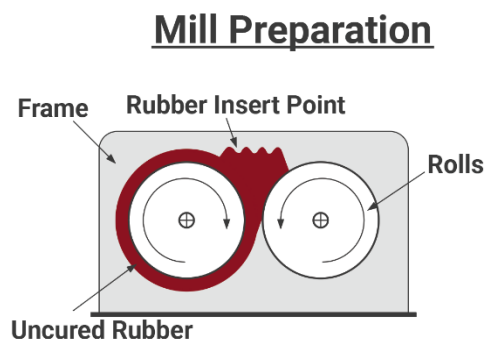
Assimilation of the ingredients called for in the formulation, known as compounding, is the first step followed by the mixing of these materials, including the base elastomer, key chemicals, oils, and other processing ingredients. Mixing is accomplished using mills or internal mixers. See a more detailed breakdown of rubber compounding at warco.com/the-art-of-rubber-compounding/ and rubber mixing at warco.com/rubber-compounding-and-mixing/.



Mill Preparation

After mixing, the uncured and unformed rubber compound is put onto a mill. The mill along with the heat generated, are critical in preparing the rubber for the calendaring process.

The speed and temperatures of the mill is carefully controlled in order to ensure that the rubber will process smoothly along the calendar when applied;



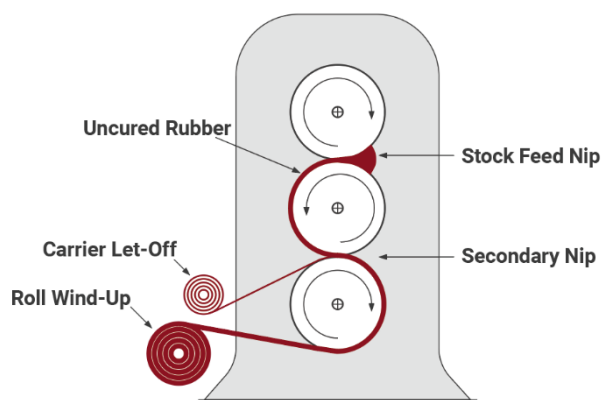
ensuring uniform consistency, and affords the first point of inspection where our trained operators perform a visual inspection of the material.



3-Roll Calenders - Uncured Sheet Rubber

This is a process of forming sheet through compression and shear to achieve uniform thickness of the rubber by passing it through a series of three heated rolls. Warmed uncured rubber compound is cut from the mill and fed between the top and center rolls of the calender - the Stock Feed Nip. The rubber then passes through the Secondary Nip between the center and bottom rolls where it is applied to a carrier that embosses the surface of the rubber while also serving as a barrier to prevent the sheet from sticking to itself prior to vulcanizing. Carriers include cellophane for Smooth Finish, Paper for Matte Finish and Fabric for a deeply embossed Fabric Finish. Finally, the material is rolled up on to a core via the calender's Roll Wind-Up.

3 Roll Calender



The distance between the rolls determines the thickness of the calendered sheet. Modern three-roll calenders are equipped with advanced capabilities, allowing for precise control over speed, temperature and tension of the roll through the process. The rolls' surface speed and temperature are tightly controlled to achieve the correct flow of material across the calender and avoiding scoring or sticking. As each compound will interact with the calender differently, effective communication between the material design experts and experienced operators is key to a material's calendering success.



Autoclave Vulcanization - Curing Sheet Rubber

After the rubber sheet is successfully calendered, it is placed into an autoclave for curing. An autoclave is an industrial steam vessel which exposes the rubber sheet to heat and pressure, allowing the rubber to vulcanize. This is the process that cross-links its molecular structure, giving rubber its stretchy nature and memory to retain its shape under extreme manipulation.

This process absolutely necessary to achieve the physical properties designed by chemists, such as durometer hardness, compression set, tensile strength, and resistance to environmental factors.

Once the autoclave vulcanization is completed, the embossing carrier is stripped from the roll. A liner or powder required for most rolls to reduce adhesion between the roll layers. The cured roll of sheet rubber will go through final inspection.



Final Inspection of the Roll

Before the sheet rubber is ready for shipment, it undergoes various levels of final inspection. While some jobs have specifications that require extensive laboratory testing, other rolls are tested simply for physicals and form. The final inspection can include:

- **Durometer:** this measures the hardness of the rubber, checking the rubber sheet has the correct level of hardness for its intended application.
- **Thickness:** this is conducted to ensure that the rubber sheet meets the specified thickness requirements. The proper thickness must be consistently within tolerance across the entire sheet.
- **Surface Consistency:** The surface consistency of the rubber sheet is examined to ensure that it is free from any defects or irregularities.
- **Visual Inspection:** A visual inspection is carried out to check for any visual defects, such as air bubbles, discoloration, or surface imperfections.

If the specification of the rubber material requires a test report, the sample is sent to our in-house laboratory and testing facility where application specific tests are applied, including flex cracking, oil swell, heat aging and much more. Learn more about rubber testing and the various methods at warco.com/trusting-your-rubber-parts-testing/.



Finished Goods – Rolls of Sheet Rubber

Calenders have the capacity to produce a wide range of industrial sheet rubber products applied in thousands of industries. Rubber's inherent flexibility, durability, and chemical resistance make it an excellent choice for many applications. Some common applications of sheet rubber include:

- Gaskets and seals
- Vibration damping or grip enhanced linings
- Oil & gas padding
- Automotive components
- Roofing materials & insulation
- Food/FDA safe & medical grade healthcare equipment
- Water & weather resistant Marine barriers
- Non-conductive electrical insulation

Additionally, sheet rubber is provided in accordance to a wide variety of specifications such as

- [Mil spec sheet rubber](#)
- [SAE AMS sheet rubber](#)
- [AASHTO sheet rubber](#)
- [ASTM D2000 sheet rubber](#)
- [FDA grade sheet rubber](#)

See the full list of specifications that WARCO's sheet rubber can be formulated to meet at warco.com/specifications.

Takeaways

From R&D and compounding to calendering, vulcanization, and final inspection, each step plays a crucial role in determining the economics, quality and characteristics of the final product.

Unlike many other sheet rubber manufacturers who are dependent upon external laboratories and testing facilities, WARCO develops, compounds, mixes, thoroughly tests and produces your rubber product in a single facility. Our wealth of experience in material design, catalogued formulations and multi-disciplined manufacturing capabilities, unique flexibility, and tight control over each step-in production, are among the key contributors to how WARCO became ***America's Choice for Quality Rubber.***

This is the fourth article of our new series, Stretching the Imagination: Ideas to Innovation,

where we break down the major steps of rubber production. Our next article will explore the enhancements that you can make to your sheet rubber such as colors, cloth inserts, surface finishes, cutting and slitting and much more. Stay informed of the latest articles by signing up for our newsletter at warco.com.