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What do we need  
to make a tire?

Special Edition Three

real | real QUESTIONS  
real ANSWERS

 **BRIDGESTONE**

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# What do we need to make a tire

*We begin a new series of “By Popular Demand” articles, this time focusing on how a truck tire is made.*

*It’s a good topic, because truck tires are one of the most complex engineered products in the world. That’s especially impressive, because when you think about it, tires really have no moving parts – in the usual sense of that phrase.*

*First, we’ll look at materials. Not all of them, because it would take more pages than we have in this whole magazine – just the major ingredients.*

# Content Facts

Serving Size 1 Tire  
(About 117 lb for 295/75R22.5 size)  
Servings Per Tire: 1

Amount Per Serving	Calories from Rubber 0	Approx. % by Weight
<b>Total Rubber</b> approx. 46.8 lb		40%
Natural Rubber approx. 35.1 lb		30%
Synthetic Rubber approx. 11.7 lb		10%
<b>Carbon Black</b> approx. 35.1 lb		30%
<b>Iron</b> (as steel cord) approx. 23.4 lb		20%
<b>Zinc Stearate</b> approx. 4.1 lb		3.5%
<b>Antioxidant/ Antiozonant</b> approx. 2.9 lb		2.5%
<b>Sulfur</b> approx. 2.3 lb		2.0%
<b>Wax</b> approx. 0.8 lb		0.7%
<b>Accelerators</b> approx. 0.5 lb		0.4%
<b>Other Ingredients</b> approx. 1 lb		<1%

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### [natural rubber]

*One type of natural rubber is called smoked sheet, because the latex from the tree is coagulated by smoke, which acts as a preservative.*

#### Why so much natural rubber?

Trees still make great rubber. Natural rubber lasts a long time and tends to run cool. That makes it an important component in treads and any other part of the tire that must flex a great deal.

#### Why not make tires 100 percent out of natural rubber?

With natural rubber, you pretty much have to take what you get. When you make synthetic rubber, you can engineer it, to create rubber with particular performance characteristics.

### [synthetic rubber]

*A chunk of synthetic rubber, cut from a giant bale shipped to the plant.*

#### What kinds of characteristics?

Synthetic rubber can be engineered to have built-in cut resistance, for example.

That can be very valuable in treads and sidewalls. And, the synthetic rubber used in Bridgestone tires is specially formulated for irregular wear resistance, and for excellent wet traction.

It was difficult for us to come up with a number for the *overall* ratio of natural to synthetic rubber in a tire because each of the various components of the tire have a different “mix” of natural and synthetic. The composition depends on the job that needs to be done.

#### What is “carbon black” and why so much of it?

Carbon black is very finely powdered, very pure carbon, a bit like the soot that forms on the inside of an oil lamp.

It's very important in tire rubber. To begin with, it's a filler, making up about 30 percent of the tire, which is a lot when you consider how light carbon black is.

#### So a truck tire is mostly rubber?

That's right. By weight, roughly 40 percent rubber. And although this can vary, depending on the type of tire, the rubber is about three-quarters natural and one-quarter synthetic.

#### What does a “filler” do?

It adds enormous strength. One way to think of rubber is to compare it to the concrete in a modern building.

Often, we embed steel bars in the concrete, adding strength. Rubber reinforced with carbon black is much more abrasion-resistant than rubber alone, is stronger, wears more slowly, and is easier to process.

Carbon black also helps protect rubber against ultraviolet (UV) light from the sun.

#### Why is that important?

You might say that like our skin, tires can get a sort of “sunburn,” which can cause rubber molecules to break down and become brittle. That can make tires wear faster and cause surface cracks.

Carbon black tends to shield rubber molecules from UV light, like a sunscreen.

#### Plenty of steel, isn't there?

At about one-fifth of the tire by weight, steel is a major component, especially for the “Three Bs,” beads, belts and body. Just as the carbon black acts as a sort of “rebar” for the “concrete” of the rubber, the steel cord in a radial tire acts a bit like the steel frame of a modern building.

Different kinds of steel, different diameters of steel wire, and different types of cable are engineered for specific purposes.

As you can see from our photo, some steel cords consist of a large number of strands, wound together. On a smaller scale, they're like the cables that support suspension bridges.

#### Why is the cable that golden color?

There's a special coating on each individual strand to help it adhere to the rubber in the tire. Normally, rubber and steel don't stick together very well, and that's essential in a radial tire.

The coating is tightly bonded to the wire, and in turn, bonds tightly to the rubber during processing.

#### It doesn't take much sulfur, does it?

A little bit goes a long way. Sulfur, of course, is one of the most important vulcanizing agents. During curing, sulfur atoms actually connect different rubber molecules together, effectively making several smaller molecules into one big one.

If you imagine a plate of spaghetti, when it's warm, the strands of spaghetti slide past each other easily. It's easy to pull the whole thing apart. That's like uncured rubber when it's warm – soft, sticky, not very strong.

Likewise, when a plate of spaghetti is ice-cold, it's a solid, almost brittle lump, not very flexible at all. Again, uncured rubber is like that when it's cold.

But when rubber is cured with sulfur, the sulfur links the strands of "spaghetti" to each other, and the whole thing begins to behave very nearly the same – regardless of the temperature. That's what you want in a tire.

### **There isn't very much of most of these other things.**

It doesn't look like much, but they're all very important. In fact, as we said, we haven't begun to list *all* the materials that are in a tire.

A little bit of zinc stearate helps control cure rate and makes rubber a bit easier to process. Same thing is true of the wax, which also helps prevent oxidation.

### **What's the problem with oxidation?**

Oxygen, like UV light, can break down rubber molecules, making rubber brittle, causing cracks, and rapid wear.

Oxygen in the air can cause this, and ozone, a special type of oxygen molecule, is especially hard on tires. So, we add antioxidants and antiozonants.

These are special chemical compounds that help prevent those tiny cracks you sometimes see in the sidewalls of tires.


And by the way, here's a tip: Avoid washing tires too much, and especially avoid putting compounds on the sidewalls to make them shine.

The waxes, antioxidants and antiozonants are designed to protect the surface of the tire, and by cleaning them off, you're removing that protection, causing tires to age prematurely.

### **What does the "accelerator" do?**

As we said, there are lots of different kinds of rubber in a tire. But they all have to be cured together, in the same amount of time. Accelerators help control the speed of the cure, so everything ends up fully cured, without having to spend excessive time in the mold.

### **Are there other things in your tire recipe?**

Lots of them. Some are top secret, all are there for very special reasons. We won't go into them here. But as we've seen already, the modern truck tire is a long way from just being a mixture of rubber and steel. 

### **[steel cord]**

*Much of the steel cord in tires is wound together into cables, adding great strength.*



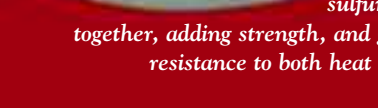
### **[carbon black]**

*Carbon black, a major component of truck tires, adds strength and abrasion resistance, while protecting rubber against UV light.*



### **[sulfur]**

*During curing, sulfur links rubber molecules together, adding strength, and giving the rubber resistance to both heat and cold.*



### **[zinc stearate]**



### **[wax]**

*Small amounts of zinc stearate and waxes can help control cure rates, prevent oxidation and make rubber easier to process.*



### **[accelerator]**

*Accelerators are used to control the cure rate, so different types of rubber can cure fully – in the same amount of time.*



*Antioxidants and antiozonants are added to rubber to fight degradation by oxygen and ozone, which can shorten the life of tires.*