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Remember  
“The Princess  
and the pea”?

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Bandag's Model 7400 INSIGHT Casing Analyzer can scan a complete truck tire – both sidewalls and innerliner – in about three minutes flat.

# Remember “The Princess and the pea”



*In Hans Christian Anderson's beloved fairy tale, a princess proves she's the genuine article by complaining of a sleepless night after spending it atop 12 mattresses and 12 feather beds. Under them all, a skeptical maid had placed a single dried pea.*

*Sometimes referred to as a “CAT-scan for truck tires,” shearography, as we'll see, is about as sensitive as that mythical princess.*

*We visited Bandag's factory to learn more about shearography and how it can help produce better retreads.*



### What is “shearography”?

Shearography is the latest and most sophisticated tool used by retreaders to determine whether casings can be made into successful retreats.

We’ve always said that skilled inspectors can sometimes “see” more with their hands than with their eyes. And, retreaders have, for a long time, used electronic testing to find tiny holes and ultrasonic tests to find flaws buried deep inside tire structures.

### What kind of “flaws”?

Tires are made of many layers of rubber, rubberized steel belts, casing plies, beads, fillers, liners and tread stock. One thing that can happen is that these components can become separated in spots.

These separations won’t heal themselves, and if they get larger, they can cause serious trouble. Ply-end separations can result in serious cracking near the bead, and belt-edge separa-



tions can lead to belts detaching from the casing.

*Tire components, including belts and ply-ends, are normally bonded together, but can become separated, possibly resulting in tire damage.*

### How does shearography find flaws?

It’s really too complicated to explain here, but we will say that shearography uses a combination of scientific tools, including lasers, holography, polarized light, an imaging technique called “interferometry,” TV cameras, computer image processing and something called “optical math” to “probe” deep inside a tire, but without injuring it in any way.

Hence the term, a “CAT-scan for tires.”

### How does it do that?

A “separation” in a tire is a “space.” Over time, air migrates through the rubber into that space, filling it. You may remember in physics class, putting a balloon inside a bell jar and using a vacuum pump to remove some of the air from the jar.

Pulling out the air makes the balloon expand. And the expansion changes the shape of the surface of the balloon.

It’s that expansion shearography detects.



*If you place a tire containing a separation into a vacuum, the air inside the separation expands, like this balloon. This creates a change in the outside surface that shearography can detect.*

### In what way?

Just as the balloon got bigger, the separation inside the tire gets bigger, and that causes the surface of the tire to change shape – slightly.

### Like a bubble or a blister?

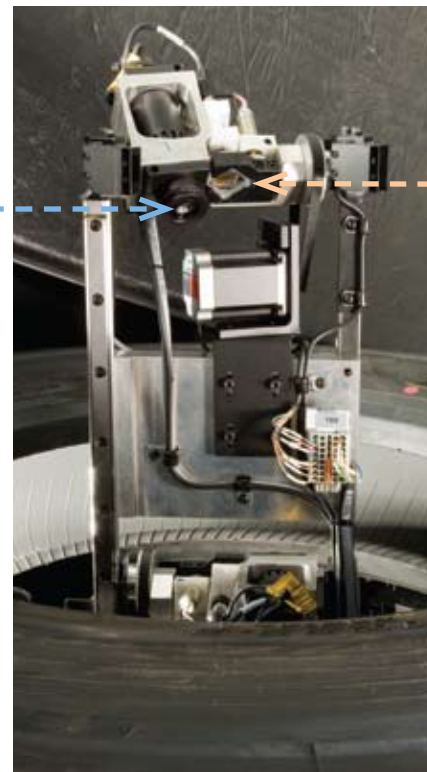
A bit, but much, much smaller. So small, in fact, that you probably could never see any surface difference with your eyes. That’s where the lasers and all those other things come in.

First, the Bandag 7400 unit scans the tire, both sidewall and innerliner (from bead to bead), with the tire “at rest,” so to speak.

Then, a vacuum pump starts drawing air out of the chamber, and the camera scans again, at 28 different vacuum levels. The analyzer uses complex optics and computer analysis

to compare the “at rest” image to the images at the various vacuum levels.

The result is an animated “video,” that “shows” the surface of the sidewall or the innerliner, “expanding” in the area where the flaw is.



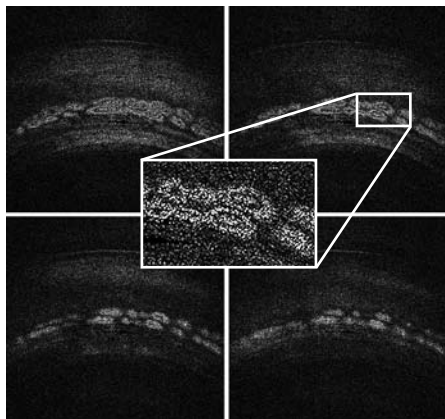
**In the Bandag 7400 shearography tester, a beam of invisible laser light illuminates the tire sidewall, while a special lens and TV camera feeds its image into a computer.**



**A second, identical laser and camera assembly captures an image of the tire’s innerliner, from bead to bead, while the other camera is scanning the sidewall.**

## Does it show what the flaw looks like?

Not exactly. Calculus is involved, but what you see is a display that shows pretty clearly where the flaw is and an indication of how large it is. Those two things are usually all the information a skilled inspector needs.



A few of the 28 separate images created in each scan. The flaw location is indicated by the set of “double bull’s-eyes,” and the number of rings indicates how large the separation is. (In the “shearographs” we see the separation with the



sidewall.) The separation is quite obvious in cross section, but was invisible before the tire was cut apart.

## How small a flaw can shearography detect?

Parameters can be changed to change the sensitivity, but the 7400 is usually set up to detect areas about a quarter-inch in diameter. About the size of a pea, in other words.

The Bandag 7400 is so sensitive that one demonstration consists of

closing the chamber with no tire inside, then lightly – and we do mean lightly – touching the outside of the chamber.

Even the lightest tap on the dome shows up on the display.

## Is something pea-sized a reason to reject a casing?

That’s where the skill and experience of the inspector come in. The answer is: maybe, maybe not. Remember that probably no casing is perfect.

## What’s an acceptable casing?

Among other things, that depends on how it’s going to be used. As the experts at Bandag pointed out, the demands on a casing used on a slow-moving refuse truck might be much less than on one that’s going to run at interstate speeds all day.

It takes judgment and experience. If you reject everything with any kind of separation, a fleet could end up having to buy way more new tires than it needs. And, if you let too many pass, you could have problems on the road.

## How is shearography better?

Shearography is better and faster than ultrasonic inspection, largely because you don’t have to buff the casing first, as you do with ultrasonic. You save the time and cost of that extra step.


Yet, shearography doesn’t detect leak-causing holes, the way electronic

testing can. Because a hole is open to the atmosphere, it won’t expand in a vacuum. So shearography won’t detect it at all.

Shearography doesn’t replace visual, tactile and other types of inspection. What it does is show things those other methods can’t, and do it very quickly.

When all is said and done, you probably don’t want to radically change the number of casings you accept or reject. But shearography can help your retreader analyze them faster and gain valuable insight into which casings will work best for you.

## How available is Bandag’s Model 7400 INSIGHT Casing Analyzer?

Bandag was the first to manufacture and offer shearography units in the United States, beginning in 2000. Today, about 90 percent of Bandag retreaders have either ultrasonic or shearography, and about 80 percent offer shearography. It’s a great tool for improving retread performance. 

## EDITOR’S NOTE:

*Our sincere thanks to Clay Timmons, product manager – global dealer systems and John Lindsay, senior controls engineer at Bandag, for their assistance in preparing this article.*



**John Lindsay and Clay Timmons of Bandag discuss the interpretation of a shearography image created by the model 7400 analyzer.**

