R&D Q&A

COMPOSITE FORKS NUMBER TEN

FINE TUNING FORKS

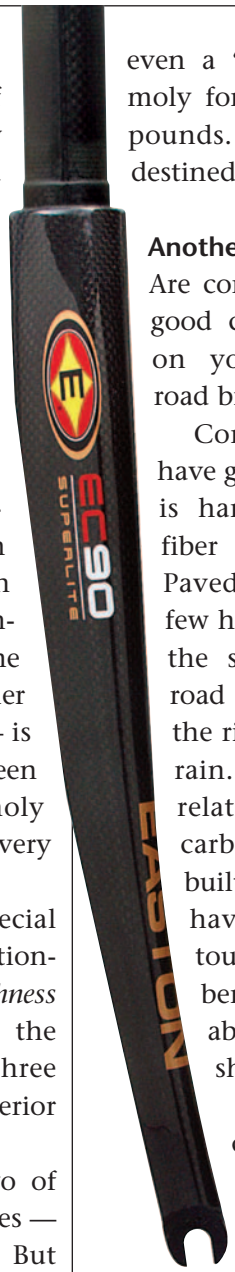
Advanced materials have caught the attention of bicycle designer's worldwide. It's only natural that those two-pronged devices that steer our bicycles would take a sweeping turn for the better.

In days gone by, forks were generally made of high-strength chromoly steel and weighed around two and a quarter pounds or about 1,020 grams.

Forks made from chromoly are comprised of a steering tube, a fork crown and two legs. These components are joined together by applying a paste to each joint and gently heating the components with an acetylene torch. When the metal is the right temperature, around 1,000°F, the addition of a filler — either silver, brass or bronze — is flowed into the gap between the components. Chromoly forks made this way are very strong and reliable.

Last months R&D special report talked about the relationship between *strength, toughness* and *weight*. It takes just the right balance of these three attributes to make a superior bicycle component.

Chromoly steel has two of the three necessary attributes — strength and toughness. But even a "lightweight" chromoly fork weighs over two pounds. Fork design was destined for a change.



Another Fork in the Road

Are composite materials a good choice for the fork on your top-of-the-line road bike?

Composites certainly have great strength, and it is hard to beat carbon fiber for saving weight. Paved roads offer very few hard knocks. Most of the stress applied to a road fork is induced by the rider rather than terrain. Because of these relatively low stresses, carbon forks can be built very light and still have the required toughness. An added benefit of carbon is it's ability to absorb road shock and vibration.

It's clear that composites are a natural choice for high-performance road forks.

This is even more obvious if you've shopped for a new high-end road frame lately. Almost all new frame designs include a carbon fiber fork. But are all these forks created equal? How does your fork measure up?

These new-age technological marvels of carbon come in a variety of styles. Sometimes it is hard to tell one style from the other. Let's explore the various methods used in the construction of carbon fiber forks. When you finish this article you will be a whiz at determining what type of fork you and your friends have.

"Chromoly steel has two of the three necessary attributes — strength and toughness. But even a "lightweight" chromoly fork weighs over two pounds."

There are three different methods of construction being used in the manufacture of carbon fiber forks. Lets start with the lowest cost and work our way up.

continued

COMPOSITE FORKS

Three's a Crowd

Similar to the chromoly fork described in the beginning paragraph, some carbon-fiber forks are also made using what is called *three-piece construction.* In a three-piece fork, the same components described for the chromoly fork are present. There is a separate steering tube, fork crown and set of legs. These are joined together by the use of an adhesive or glue.

> ***"The biggest advantage of the one-piece fork is the elimination of joints between the individual components."***

This is a low cost method that allows for a lot of flexibility. The fork manufacturer can supply the fork with a variety of steering tubes. A three-piece fork can be assembled using steering tubes made from steel, aluminum or carbon fiber with no additional tooling required. Three different price points from one set of tools! Pretty clever. But what about benefits for you, the rider? Are there any? Well, yes. You do get a carbon fiber fork with many of the great ride attributes you have come to expect from composite components. These forks are also affordable. So the issue, if any, is weight. A typical three-piece fork weighs in at around 600 grams. While this is less than a chromoly fork, we can do better.

Two for the Show

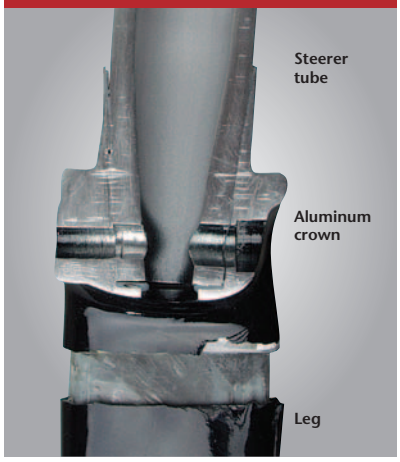
Which brings us to our two-piece fork. A two-piece fork is a fork that consists of only two pieces — a steering tube and a lower set of legs molded as one piece. The construction method in this case is a little more costly and eliminates the use of the alloy fork crown found in the three-piece forks. The steering tube is joined to the fork with strips of carbon fiber laminate.

The biggest advantage of this method of construction is the weight saved from not having an aluminum crown. Two-piece construction also allows for a variety of steering tubes usually alloy or composite. However, in these weight driven days, you are hard pressed to find metal steering tubes in two-piece forks. A typical two-piece fork weighs in at around 475 grams. This is a substantial savings over the chromoly and the three-piece forks. But we can go one better.

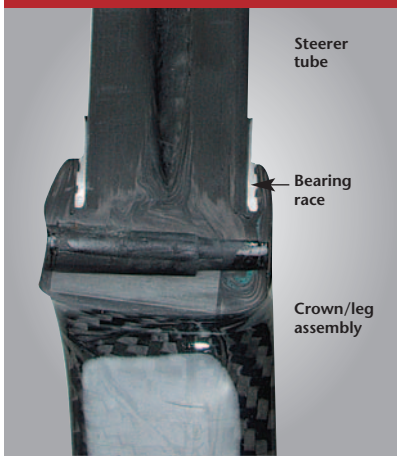
The Road to Monocoque

We have finally arrived at the one-piece fork, or what is affec-

THREE-PIECE CONSTRUCTION



TWO-PIECE CONSTRUCTION



ONE-PIECE CONSTRUCTION



Cross-sectional views of some popular forks showing three different construction techniques.

continued

tionately known to the few companies that make them as a *monocoque* fork. Why do so few companies make a one-piece or monocoque fork? It's the cost, complexity of the laminate and the difficulty in placing the laminate in the mold.

"Easton chose to design the EC90 as a monocoque fork because the one-piece design allows for the best combination of strength, durability and weight."

One-piece forks, as the name implies, are made as one continuous laminate. All components of the fork are molded and then cured at the same time.

This method requires more tooling, a higher level of skill in laminate design, and better process control. It takes longer to lay-up a monocoque fork than a two- or three-piece fork.

The biggest advantage of the one-piece fork is the elimination of the joints between the individual components. The fork is only as strong as it joints which are dependent on the integrity of the glue/adhesive.

The laminate in a one-piece fork starts at the bottom of the fork and builds all the way to the top of the steering tube. There are no joints to bond or join — or fail. Monocoque forks perform better in both impact and fatigue tests.

Best of all, Monocoque forks are light. How light? Easton's EC90 monocoque fork weighs about 350 grams. Many of the European forks weigh in at around 400 grams. In either case, this represents a substantial savings over forks made utilizing two- and three-piece construction.

Easton chose to design the EC90 as a monocoque fork because the one-piece design allows for the best combination of strength, durability and weight. Easton's one-piece forks offer the best of all worlds.

Fork IQ

How can you tell what kind of fork is on your bike?

Weight is a great indicator, as the metal content of three-piece forks really puts the weight up there. However, if you don't have the luxury of removing the fork from your frame, you can learn a lot by looking at the paint.

Since an aluminum fork crown is not the primary selling feature of a carbon-fiber fork, manufacturers usually try to disguise the aluminum by painting over the fork crown — hiding the joint between the crown and the legs. So if a fork is painted in the fork-crown area, it is probably of three-piece construction.

A two-piece fork is a little trickier to spot. Most often two-piece forks show carbon material in the fork crown area, as it is used as a badge of honor. To determine a two-piece fork you have to pull it from the frame and look at the joint between the steerer tube and the fork crown. Since these are two separate pieces, often you will find a metal ring for the fork-crown race of the head set.

"Monocoque forks perform better in both impact and fatigue tests."

It All Comes Down to One

Most of the popular frames sold today come with three-piece forks, a few come with two-piece forks and fewer still come stock with one-piece forks. When you are ready to take weight off your road bike and improve performance, a new fork offers a lot of bang for the buck.

Now ride lightly and be in (one) peace.