

Lightweight Mountain Bike Fork Suspension Improved Performance, Lower Cost

Cannondale Bicycle Corporation, a large bicycle manufacturer, incorporated a telescoping mechanism into their front suspension that allowed for vertical movement along with superior torsional stiffness, a desirable feature for serious mountain bike enthusiasts. The system incorporated a damping system with approximately 80mm of travel in a telescoping tube connected to the fork of the bicycle.



The telescoping tube was made of steel due to the high stress levels on the tube/fork interface resulting in a heavy product. The company had attempted to build an 80mm system from aluminum, but was unable to do so because of the stress at the tube/fork interface.

The telescoping mechanism was also very difficult and costly to manufacture. The system incorporated linear bearings whose preload was difficult to control. Individual component tolerances had to be critically controlled to make the product correctly. Assembly time was inexorably long as assemblies had to be rebuilt many times to achieve the desired preload.

Challenge:

Find a way to manufacture an 80mm Aluminum suspension system solving the fatigue life problem. Make the fork lightweight as well as keeping a shallow rake angle. Reduce the cost and develop a low-cost manufacturing methodology.

Solving the stress problem

Frank Roth Co. studied the fatigue failure problem and modified the design incorporating a slightly thicker wall telescoping tube coupled with a modified fork crown design with a large stress relieving radius. Fatigue life increased significantly above the ISO standards for bicycle suspension.

Damping system

To eliminate cost, reduce weight and keep a shallow rake angle, the design was modified to keep the telescoping tube as short as possible. An air spring was incorporated into the inside of the telescoping tube, eliminating components and reducing weight.

Manufacturing Methodology

Frank Roth Co. used its state-of-the-art equipment to tightly control the critical characteristics of the assembly components. Frank Roth Co. developed and designed a semi-automated assembly apparatus to measure and adjust the pre-load of the assembly making it easy to manufacture. The combination of consistent characteristics and easier assembly resulted in a 30% reduced cost of the assembly.

The end result:

A lightweight bicycle suspension system with a 25% weight reduction, a 30% reduced cost due to the elimination of components, improved process control and a proprietary assembly system and true 80mm of suspension travel.

This fork remains one of the lightest suspension forks on the market today.