

The NuVinci® Experience

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The arrival of *NuVinci* technology represents a sea change in transmissions for bicycles. Initially targeted for the cruiser, comfort, and commuter markets, *NuVinci* CVP transmissions will ultimately be applicable to other types of bicycles including mountain, road, and potentially even racing bicycles.



The Ride™ by Ellsworth with *NuVinci* CVP, is Popular Science Magazine's 2007 "Best of What's New" Grand Award-Recreation Winner

What Riders Think and Say

Virtually everyone who has ridden a bike equipped with a *NuVinci* CVP hub has described his or her initial riding experience with a *NuVinci* CVP drivetrain in a single word. "**Smooth.**"

Beginning with the first formal consumer testing of pre-production *NuVinci* CVP drivetrains in early 2006, Fallbrook has since criss-crossed the globe giving riders of all ages and experience levels the opportunity to experience *NuVinci* technology on a variety of bicycles. Whether a pre-production prototype or the latest, second generation commercial product, reactions to the revolutionary *NuVinci* Smooth Cruise CVP™ have been uniformly positive and consistent in any language.

“Smooth”... “Amazing”... “Fun” were frequently followed by statements like:

- “It takes the worry out of shifting”
- “It’s so easy to maintain the perfect cadence”
- “It’s so quiet”
- “I haven’t missed riding a bike until now”
- “I want it”

After echoing “*smooth, very smooth*” in their first words, experienced technicians, bicycle dealers and industry professionals went on to add comments like:

- “Best internal hub I’ve ever ridden”
- “This hub is solid; I can tell it’s very well made”
- “Commuter/Cruiser bike perfect”
- “A sure winner”
- “Lets you really enjoy riding”

Add to this, in its first two years as a commercial product, the *NuVinci* CVP received equally positive reviews from the press as well as captured five, prestigious international awards:

- 2008 iF Design EUROBIKE Gold Award at the EUROBIKE show, one of the largest international trade shows for the bike industry.
- 2007 “Bike of the Year” Award at FietsVak, The Netherlands for the Batavus Adagio-*NuVinci* commuter bicycle, the first European bike to offer *NuVinci*.
- 2007 “Innovation of the Year” Award at FietsVak, The Netherlands for the *NuVinci* CVP drivetrain.
- 2007 “R&D 100” Award chosen by Research & Development Magazine as one of the year’s most technically significant products.
- 2007 *Grand Award* for “Best of What’s New-Recreation Product” by Popular Science Magazine for the *NuVinci*-equipped Ellsworth Ride™ Performance Lifestyle bicycle, the first American bike to offer *NuVinci*.

A Drivetrain You Can Ride Every Day

It’s more than just talk; employees of Fallbrook and its partners have put the *NuVinci* CVP to work for them in their daily lives.

At Fallbrook’s Austin facility, one of our staff members has been riding a *NuVinci* equipped bike to and from work almost daily for over three years now. This was not an ordained part of his job – he started doing it and has never stopped. He also rode a *NuVinci* bike from Austin, Texas to Dallas, Texas (about 200 miles/320 km) in the searing heat of the Texas summer.



Fallbrook's Dan Dawe taking a break on a trip from Austin to Dallas

With *NuVinci*-equipped commuter and cruiser bicycles now rolling throughout The Netherlands, Germany, Switzerland, Denmark, the United States and other parts of the world, the *NuVinci* Smooth Cruise Revolution is definitely on the move and growing fast! With new believers joining riders like Dan every day.

Durability

Fallbrook has done extensive testing on *NuVinci* CVPs to insure durability. Additionally, a *NuVinci* hub is sealed, maintenance free, and will not require anything like the level of cleaning and adjusting that derailleurs need to maintain top performance.

We also know that some previous unsuccessful attempts at manufacturing a bicycle CVT had unacceptable reliability. Consequently, our endurance test stand is a bicycle drivetrain's worst nightmare. It never takes a water break, stops to admire the scenery or even sleeps. It just grinds away at testing to the limits and beyond. The testing simulates use by a rider weighing 270 pounds (123kg) riding uphill without rest for thousands of kilometers.



The Fallbrook test stand in Austin, Texas

Driven by a computer-controlled electric motor, with weights simulating a 123 kg rider, the test stand simulates the same sort of torque spikes that a top notch rider applies while pedaling.

Efficiency, Weight, and Ratio Range

We get periodic questions about the weight, efficiency, and ratio range of the *NuVinci* CVP hub.

Weight

By conventional standards, a *NuVinci* hub is no lightweight. The second generation model N171B weighs between 3.8 and 3.9 kilograms, including freewheel and mounting hardware. However, in the markets that Fallbrook is initially serving (cruiser, comfort, and commuter); rider feedback has generally favored the advantages and ride experience of *NuVinci* technology over its weight. Knowledgeable people who have not ridden a bike equipped with *NuVinci* technology tend to be skeptical, until they ride the bike. It typically takes just one ride on a *NuVinci*-equipped bike to make a believer as skeptics become advocates.

As *NuVinci* technology extends to other bicycle market segments and as volume production permits the cost effective use of lighter materials, the weight will decrease. The second generation N171B is lighter than its commercial predecessor and a third generation model that Fallbrook is already developing should weigh significantly less than the N171B.

Efficiency in theory and practice

Efficiency, while seemingly a straightforward measurement, becomes more complex when there is a sea change in technology. By conventional laboratory means of measuring efficiency of a single fixed ratio or a series of discrete ratios, no CVT, including ours, will ever measure up to a derailleur. Outside of the laboratory, however, other factors come into the equation.

- Serious riders spend a great deal of effort to learn optimum gears for every condition on derailleur-equipped bikes, and then still don't always get it exactly right. The inexperienced casual rider is often bewildered by derailleur shifting – some combinations of the front and back sprockets can be duplicates and the path from the lowest to the highest ratio is not straightforward.
- Anyone who rides with any frequency has been on a hill where one gear was too high, the next one down was too low, and you simply could not hit a cadence that felt good until you lost some speed to match cadence to road speed. Finding the right gear on a derailleur is a challenge, for all the reasons discussed above. This problem is made worse by the wide ratio gaps found in many internal gear hubs.
- The *NuVinci* CVP allows the rider to continuously optimize cadence, and that makes you, the rider, more efficient. This is a substantial offset to any losses in the bicycle's drivetrain efficiency because the rider is part of the total efficiency. To use an automotive analogy, major automakers are switching to CVTs to improve their total powertrain efficiency and hence fuel efficiency.

- The *NuVinci* CVP enables a simple, seamless, precise adjustment in ratio with no disruption in torque. The ratio change can be as small or as large as you need it to be without gaps – no more making an educated guess about what the right gear is. With the continuously variable *NuVinci* CVP, you are always in the right ratio, and there is always power transfer. You simply twist the *NuVinci* CruiseController™ until the cadence feels right. A casual rider can adjust cadence like a seasoned pro.
- If the chain falls off, efficiency over the course of a particular ride obviously drops dramatically. With *NuVinci* technology, as with internally geared hubs, the chain line is always straight. Even during the most demanding/rapid ratio changes, the chain will remain in line and will not jump off the chain ring or the cog.
- Because the *NuVinci* CVP can be shifted while stopped, it is not necessary to be pedaling to shift a *NuVinci* hub. If you come to a stop and either forget or do not have time to downshift, getting started again can be a challenge with a derailleur. This is particularly true for less skilled riders. The *NuVinci* CVP's ability to be shifted at any time, even while pedaling up hill, eliminates that problem.

Riders tell us that smooth shifting, the ability to find easily the right ratio and to be able to shift at any time really makes a difference.

A Fallbrook Experiment

In an attempt to determine how much the delta in traditional efficiency versus always being in the right gear would measure out under real world conditions, Fallbrook conducted an experiment.

Three different Fallbrook riders switched out between three nearly identical comfort bikes, one equipped with a 21-speed derailleur, one with an 8-speed internal gear hub, and one with a *NuVinci* CVP.

Four different routes were used, totaling 1,388 km, with all four routes traversing portions of the Central Texas Hill Country and its attendant rolling grade changes. Two of the routes had significant grades of 15% or more, the other two routes were more typical commuter routes with lesser grade changes.

We collected data on speed and ride completion time. At the end of it all, we found no significant difference in average speed or ride time between the internal gear hub and the CVP. Furthermore, the *NuVinci* CVP's performance was very nearly equal to the derailleur-equipped bike's, without the worry of struggling to find the right gear, or the associated noise and clatter.

The smoothness of the ride, the ability to easily find the rider's best/most efficient ratio, and the ability to shift while pedaling up hill, while coasting or stopped contributed to these results.



Fallbrook staff with derailleur, internal hub, and *NuVinci* CVP bikes



Two test riders somewhere in the Texas Hill Country

Based on the above experiment and for the reasons outlined above, we believe that the overall “ride” efficiency of a *NuVinci* CVP is potentially better than that of internal geared hubs and may in some circumstances exceed that of derailleurs.

In the future, we will expand our examination of overall ride efficiency and report further.

Ratio Range

The ratio range is currently 350%. The first *NuVinci*-equipped bicycles have a single chain ring/front sprocket. However, a bike technician who test rode a *NuVinci* bike – after he exclaimed Smooth! – asked about using a dual front sprocket. That will be up to the many manufacturers who will adopt *NuVinci* technology. The rugged *NuVinci* construction can accept a wide range of sprocket options. The ratio of front to rear sprockets may go as low as 2.0.

Changing a tire

It may take slightly longer to change a tire for both *NuVinci* CVP and internal geared hubs than for a derailleur. The *NuVinci* controller, however, disconnects and connects easily and without any tools or tricky adjustments.

Summary

Traditional concerns about weight and efficiency can be less significant to bicycles equipped with *NuVinci* technology particularly with respect to comfort, cruiser, and commuter bicycles. From the start of a ride to the end, the people who have had the *NuVinci* experience agree that it is the total smooth riding experience that is most significant. As *NuVinci* technology develops and advances, its applications will expand to more types of bicycles and to other vehicle types.

Don’t just take our word for it.

Our partners have tested the *NuVinci* CVP and are putting it on their bikes. Batavus B.V., Cadillac, Ellsworth, Hercules, Simpel and others are all companies associated with innovation and they have been on board for some time. Some more recent additions include Avenue and Centurion (Denmark), Cresta and TDS Velos (Switzerland), Kalkhoff and Winora (Germany) and Orcocicli (Italy) and The Chopperdome (The Netherlands).

- Few, if any, people are more knowledgeable about their bicycles and discriminating in their taste than Dutch bicyclists. Batavus, one of the two market leaders in The Netherlands, was the first European bike maker to

select *NuVinci* technology to differentiate itself from its competition. Its first *NuVinci*-equipped model, the *Adagio-NuVinci*, earned “Bike of the Year” honors.

- Ellsworth is at the leading edge of technology on all of their renowned bicycles and is utilizing *NuVinci* technology to continue that trend and drive into new bicycle markets. The Ride™ Performance Lifestyle model, powered by *NuVinci* and pictured on page one, also received top honors in Popular Science Magazine’s annual “Best of What’s New” review of significant new products.

Some of our partners were initially skeptical but now they have put their names behind the technology and plan to add additional *NuVinci* models. More bicycle makers will be announcing their *NuVinci*-based products in the future and various firms have expressed interest in adopting the technology for e-bikes.

We suggest you take the opportunity to ride a *NuVinci*-powered bike or e-bike and see why Fallbrook and its partners believe that the unequalled, smooth ride experience of the *NuVinci* CVP is nothing short of revolutionary.