



Tony Ellsworth on Engaging Hub Conversations:

By Tony Ellsworth, July, 2008

- 1. What is a point of engagement?**
 - a. This is the point where a ratchet is available for a pawl to engage when pedaling a bike.
- 2. What is a pawl?**
 - a. A pawl is the tooth that engages in the ratchet.
- 3. How many points of engagement are in an Ellsworth Hub?**
 - a. At any given time, 3 points of engagement
 - b. Ellsworth wheels use a 3 dimensional engagement mechanism (pawls, 3 pawl system). Because three pawls are like a tripod, and even if there were four, only three would engage, much like a stool that rocks on uneven surfaces, but with three legs it would not rock, it is multi-dimensionally stabilized.
 - c. If there were two pawls (as on other hubs) both would engage, but the cassette driver would jamb or wiggle as it rotated because it's only engaged in two places, or two dimensionally. Additionally, two points of engagement is 30% less engaged than 3 points of engagement, anon.
- 4. How many possible points of engagement exist on and Ellsworth hub? (or a less specific and more common question is posed like this "how many points of engagement does your hub have?")**
 - a. Ellsworth Hubs have 24 LARGE and ROBUST points of engagement within the hub.
 - i. I chose the 3 pawl system for its proven durability and its measurable lack of freewheeling friction.
 - ii. The more ramps the pawl have to skip over the more freewheel friction.
 - iii. The bigger the ramps the pawl can engage with, the more durable and reliable the hub.

- iv. More ramps mean smaller weaker ramps, and more freewheeling friction.
- v. The more ramps, however, the less rotation before power delivers to the rear wheel while restarting your pedal cadence after freewheeling.
- b. Is this minor unengaged rotation a “waste of energy”?
 - i. Not really as your legs (motors) are unengaged, and thus the caloric burn, or wattage of those legs, or motors are not being expended, until it is “in gear” or engaged so to speak.
 - ii. Also, the loss of optimum pedal stroke position on one crank is offset by the speed at which the other crank enters it’s optimum stroke position while turning unengaged.
 - iii. I have seen Trials riders, in highly technical position, need the pedal in a specific position for clearance and power to hop or step up the bike. But other than this the immediate engagement feature is very cool, and feels very good, but to trade it for freewheeling friction makes no sense.

5. Is there a trade off in using a hub with only 24 possible points of engagement vs 48 or more points of engagement?

- a. Yes. You trade the feeling of immediate engagement for a lower friction freewheeling hub.
- b. Yes. You trade more durability with larger ratchet teeth, for less durability for more ratchet teeth.
 - i. I chose the 24 tooth, 3 pawl system for durability and low rolling friction.
 - ii. As material qualifications and designs go years and years without failure, an Ellsworth hub with more ratchet teeth affording more engagement possibilities to quicken engagement in rotation, we will employ that technology. Right now, we are going for proven fast rolling durability.
- c. The springs or method of reliably and repeatably pushing that pawl into it’s ratchet tooth is also a consideration.
 - i. A 6 pawl, individual spring hub, has to sorry about eh strength and fatigue characteristics of 6 separate springs. Non of which will fatigue or even start with the same characteristics, and certainly those characteristics will change during use.
 - ii. This individual spring system will likely result in less than three of the 6 pawls engaging in the smaller than standard ratchet teeth, leading to premature rocking, binding etc, as fewer than 3 pawls engage due to variations in spring strength and life being different. When the hub engages, will all three pawls have responded equally fast so that all three get engaged exactly the same at the same time? Or will only two get engaged, or even only one engage on those little teeth when you start to pedal.

6. **Did Ellsworth carefully consider the magic balance of ratchet tooth size and durability, pawl engagement, engagement rotation, and freewheeling friction in it's selection of the triple pawl, single spring, 24 substantial tooth engagement hub mechanism?**
 - a. You bet. We feel the 3 pawl system provides reliable peak performance for the most miles with the least amount of energy and most secure engagement and lowest freewheeling friction. Ride and Know.