

Electric-Assist Copenhagen Wheel from Superpedestrian

By Charles Coyne



It was exciting to take delivery of a Copenhagen 'Pedelec' wheel from Superpedestrian for this review recently. However, it took a few weeks before I had the time to mount it to RTR Magazine's venerable Lightning Project P-38 test bike and do some riding.

The 'ol P-38 has been used to test a variety of recumbent components and accessories over the years. It was still fitted with a SRAM Dual Drive rear hub, laced to a carbon fiber HED 700c-28 rim, (with a matching 20-inch HED wheel in front) from previous review articles. Additionally, the Efneo GTRO 3-Speed internally geared crankset we reviewed in RTR #59 was also still fitted to the Lightning. Love that Efneo GTRO, so it stayed on for this review, but of course the HED/SRAM rear wheel combo had to be switched out.

The Basics

The word Pedelec describes a bike or trike where the rider's pedaling effort is assisted in some way by an electric motor. Several styles have been developed in recent years, including rear hub-mounted motors such as Superpedestrian's Copenhagen wheel (and the Falco e-Motor, also reviewed in this issue). Unique to the Copenhagen wheel, its batteries are co-located in the hub with the 350 Watt motor; other hub-motor designs (such as the Falco) are engineered with external batteries. (The original design and prototype for the Copenhagen Wheel was invented at MIT's Senseable City Lab in partnership with the city of Copenhagen, Denmark; hence the name Copenhagen Wheel.) With an external battery pack, external wiring must be used to route power from the battery to the motor. Some electric hub/external battery systems also have the controls external wired to the hub. External battery packs can be of larger physical size and capacity than might be found in the Copenhagen wheel; they also can better support a 'throttle' system allowing motor-only power to the drive wheel.

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The production Copenhagen pedelec wheel was introduced to the recumbent industry at the 2017 Recumbent Cycle-Con. Superpedestrian had several Copenhagen wheel-equipped trikes available for test riding on the show's Outdoor Demo Riding Arena. My riding time at the annual RC-C is limited, and it seemed that every time I passed the Superpedestrian booth the demo trikes were out being ridden. So my chance didn't arrive

until the UPS truck pulled up in front with a box containing a Copenhagen wheel ready for installation.

The Copenhagen wheel has three power levels; Eco, Standard and Turbo, and it can also be ridden with no power boost. Power selection is made via an app on your smart phone, and the power level can be changed on the fly. The 48-volt, lithium-ion battery pack is integrated into the hub. The

battery pack is charged by plugging the Superpedestrian-supplied charger into the magnetic connector on the left side of the hub, next to the rotary On/Off switch. A series of LED lights on the hub indicates the charge status of the battery.

One of the beauties of the wireless Copenhagen wheel is its easy installation; simply remove the old rear wheel from your bike or trike, bolt in the Copenhagen

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wheel, and you're pretty much done with the "hard" mechanical work. Unlike most wheel assemblies, the Copenhagen is not fitted with a quick-release skewer, so two 15mm axle nuts are used to affix the wheel into the 135mm dropouts. The very complete installation kit provided with the wheel even includes the two wrenches needed to tighten the axle into the recumbent bike's (or trike's) frame. An adjustable torque arm also needs to be fixed to the frame's chainstay using a worm drive clamp, also included in the kit.

Right: Unique V-shaped spokes are fitted into reliefs machined into the hub body. This allows spoke attachment to the hub without needing to put holes through the hub, making for a secure and water-tight assembly. Maximum weight shouldn't be a problem, it's unlikely that anyone touring with fully loaded panniers would fit their rig with Superpedestrian's Copenhagen wheel, that's not at all what it was designed for.



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Superpedestrian supplies the built-up wheel in a number of configurations, not all of which will be of interest to recumbent enthusiasts. The laced-up wheels are available with rim brakes only, with either 120mm or 135mm dropouts. Wheel sizes offered include 622mm, 700c, 29er, 559mm, and 26-inch. When ordering, you will have the choice of 7, 8, 9, or 10-speed SRAM or Shimano gearing (single-speeds can also be fitted). Superpedestrian also markets complete diamond-frame bikes of their own as well, as from bikes from other manufacturers such as Cinelli, Marin, Tern and others.

Those Spokes

Depending on your philosophy, there are either 18 or 36 spokes lacing the hub to

the 26" Aeroheat wheel. Four spoke sizes are used, depending on the size of the rim the Copenhagen motor is being mated to. As can be seen in the photos, the spokes are not individual spokes, but rather 'V' shaped units, the ends of each which are laced to the rim. The 'V' shaped portion of each spoke is hooked into a recess machined into the hub. This secures the spokes to the hub without the need for holes, helping keep the inside of the hub dry and unaffected by rain and moisture.

That Color

If you like red, you are in luck. To paraphrase Henry Ford, "You can have any color you want, as long as it's red." That being said, it is a very bright and distinctive red which will go a long way in helping easily

identify the Copenhagen-equipped bikes and trikes out on the road.

The App

The 'brain' controlling the Copenhagen wheel is contained in a free 'app' that is installed on any iOS or Android smart phone. The phone communicates with the wheel via a Bluetooth Low Energy short-range wireless connection. (Bluetooth Low Energy provides a lower energy consumption compared to classic Bluetooth.) The use of wireless communications between the 'brains' of the system (your smart phone), and the 'brawn' of the system (the wheel-mounted hub containing the battery and motor), is another of the beautiful aspects of the Copenhagen's design. There is no need to route wires or

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cables throughout the bike or trike, leading to and from the motor to the battery and controller. The smart phone connection is also the 'key' to activate the Copenhagen wheel – without the smart phone app and the wheel each being activated and in sync, the electric motor will not provide any power. A fully charged phone will outlast the duration of the Copenhagen wheel's batteries – unless you ride really, really slowly.

If you order a Copenhagen wheel online, you get an account while as part of the process, and you can log into the Wheel app using the same email address and password that you used for the site. If you have never used the Wheel app before, and you don't have a Superpedestrian account, you'll need to create one before you can connect to your Wheel. This would be the case if you bought the wheel from a dealer, and they could also help set up the app.

The 'Wheel' app controls the hub and records and displays current and historical ride information. Your online Superpedestrian

account holds all the information related to you and your Copenhagen Wheel. Logging into the Wheel app with your account lets you manage your Wheel and track your rides.

The app's display will provide the level of battery charge, the percent of power being applied by the rider and the motor, speed in mph, and distance ridden. The history of each ride's distance, duration, average speed, calories burned, and a map of each ride can be selected. Plus the total duration and distance of all trips accumulated can be displayed.

The Ride

A flick of the rotary switch on the hub energizes the drive system, and few taps on the smart phone's app connects the phone to the hub wirelessly. Once the app and the hub are connected, a simple swipe up or down on the phone's screen allows choosing from three power settings; Turbo, Standard and Eco. Turbo makes it especially easier to take off while heading uphill, gives the

most assistance when cruising, and will also provide the least amount of running time. You'll feel the motor's effect coming into play as soon as you begin to apply any power in any of the power settings. It does take the most pedal effort to get going in the Eco mode than Turbo or Standard; as with all electric motors, getting a load into motion draws more amps than it takes to maintain motion. Requiring the rider to apply more energy when starting in the Eco mode helps minimize the drain on the battery and helps extend the range.

According to the designers, the wheel senses, analyzes and responds to the rider's torque, power, speed and pedal position over 100 times per second. When pressed, it can deliver over ten times the power to the pedals than the rider's own power. The power assist comes on gradually; it's not like flicking an on/off switch.

The more power you provide through the cranks, the more power the hub contributes. Swiping the smart phone's display to switch





from one power mode to another can be done while underway, as well as switching the power assist off. The change in power delivery can be felt in the pedals while moving up the range from Eco to Standard to Turbo, but it is a smooth, steady increase, taking a few moments. Switching from Eco to Off is also a smooth transition. The app displays a bar graph which shows the percent of power being provided by the motor compared to the amount of power being generated by the cranks.

Backpedaling will automatically switch the motor to the "Regen" mode, which causes the electric motor to switch over to be an actual electric energy generator. The Regen mode will cause a decent amount of drag, which can be put to use slowing the bike down; this is especially a nice feature on long downhill when you would like to moderate your speed without having to ride the brakes. In theory, battery endurance on a ride could be extended by using the Regen mode while stopping and when possible going downhill. In reality, the amount of regeneration seems to be pretty minimal.

Be forewarned, even in the Eco mode, you do seem to get very used to the easy speed attained with the wheel's aid. After switching from Eco to Off, it feels as though the motor



has been switched to the Regeneration mode and that a lot of drag has been induced. Fear not, there is only a very tiny fraction of drag from the brushless motor when coasting.

Testing the range of the system wasn't possible in time for this review to be

Above: Dissected view of the wheel shows the batteries (blue cylinders, center) and other components. Rim, spokes and cassette will vary according to the buyer's needs.



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completed. We've heard reports of trike riders getting more than 30 miles to a charge when using the Eco setting, and that fits in pretty well with Copenhagen's specs. Several factors are involved with the system's potential range; weight of the bike/trike and rider, tailwinds/headwinds, proper tire inflation, acceleration rate, and even the installation of a fairing or other method of streamlining will affect overall range. Superpedestrian recommends a total rider and cargo weight to not exceed 330 lbs.

Conclusion

Superpedestrian's Copenhagen wheel is perfect for any rider who wants to increase their speed and extend their riding range – provided the range is not much beyond 30 miles. And that may be exactly what a surprisingly large number of riders – and potential riders – are looking for. Not everyone has the time, energy and training to ride further than 30 miles regularly. For them, and others with physical limitations, the Copenhagen wheel can help open a new and exciting riding experience.



Battery charging port is on the left, five LED lights indicate level of charge, rotary switch to the right of that is the On/Off switch. (The On/Off icons are difficult to see in the photo.) The cap shown flipped up out of the way of the charger connection is held closed magnetically when charging is completed.



Other electric assist units we have tested in recent past issues of the magazine include the Shimano STEPS system on an HP Velotechnik trike and the GO Swiss system on another HP Velotechnik trike in RTR #57. In RTR #60, we had a review a Circe tandem equipped with the Shimano STEPS system. In RTR #54, we reviewed the Bafang 8FUN electric assist on a TW Bents Artifice trike. Back issues can be ordered elsewhere in the issue, or online from the magazine's website: www.rtrmag.com

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