

We chose to compare all of our transmissions at 200 watts average load or less and at a constant cadence of 75 RPM. Ordinary hub gears are never used in bicycle racing and are seldom even in recreational cycling. They are, however, commonly used on European city commuter bikes where speeds are almost always below 25 km/h. Power requirements for low speed commuting are normally less than 150 watts. 200 watts average power is sufficient to propel a bicycle at over 32 km/h on level ground with no wind. Therefore except in laboratory experiments, hub gears are almost never subjected to the high loads that derailleur transmissions are. Rohloff is correct in saying that efficiency improves as the load increases. They tested at 400 watts, double what we did and found efficiencies approaching 98%. We tested only one transmission at more than 200 watts and found the Shimano derailleur transmission in 25th gear, under loads from 307 to 370 watts input, was about 98% efficient (our Figure 14).

Because of the high inertia of the bicycle rider system, the speed variation due to variable torque (pedal force) at the crank is very small. At racing speeds a computer simulation shows speed variation is less than plus or minus 0.13% due to the variable torque of the crank. We therefore felt that testing at a constant speed of 75 RPM was realistic. Racers pedal at a higher cadence, but the purpose of our tests was to approximate more normal riding conditions.

Simulating variable crank torque is not practical with an electric motor dynamometer and as far as I know, no current or past transmission test apparatus has successfully used this technique. Rohloff applied a much higher constant torque than our average to simulate maximum chain tension and gear and chain wear, but this also is not realistic. Transmission efficiency varies continuously around the crank cycle - it is high under high torque and lower under low torque. The average efficiency is somewhere in between. Testing only at high torque as Rohloff did, does not give an accurate comparison. Unless transmissions are tested on the road or in the laboratory using a precision research crank dynamometer with an actual cyclist, there is really no certainty which of the laboratory test methods is more valid. Unfortunately highly accurate laboratory crank dynamometer tests have not yet been developed.

To summarize, we are reasonably confident that the rank order between transmission efficiencies that we found would not change appreciably as load is varied within a normal range. In other words, transmissions should rank about the same at either low or high loads. We feel that the loads we tested under are typical of the actual conditions under which hub gears are used and represent a reasonable average efficiency. In our article we therefore concluded that hub gears are about 2% less efficient than derailleur transmissions under typical field conditions. We see no reason to change that conclusion.

The Rohloff is an excellent transmission - in fact it is quite elegant in its function - it shifts sequentially from gear 1 through gear 14 easily and logically - unlike triple chainring derailleur transmissions. The Rohloff would probably serve well for HPV racing since it would much simplify the chain line.

— Chester Kyle

[Ed. Comment, also applying to the article by Vernon Forbes on the next page: As an occasional driver of the Thuner Trampelwurm (described in HP54) I am amazed at the extremely high torques hub gears will stand. When it is empty apart from the driver, this human powered road train has a single hub gear in a 26" wheel in use and weighs 550 kg + driver. The torque on the hub is enormous when going up any incline, yet it never seems to break. The same is true with my Velocity Dolphin electric bicycle: this uses a standard hub gear which takes up both the torque from a 250 W electric motor and from a 24 speed derailleur drive. Even though used at a considerably higher torque than on a normal bicycle, this gear lasts and lasts without failing.]

#### **NEWS RELEASE**

A new organization, Human Power International (HuPI), has been formed in order to promote the development and use of human power for an environmentally sustainable and socially just society. Launched in January, 2004, HuPI is an information organization which publishes in a range of media, maintains a website information database and archive, and fosters the international exchange of information between groups, municipalities, and other parties inter-

ested in the technologies and benefits of human power.

HuPI has primarily a virtual presence on the internet as the most economic means of making information and resources available world-wide.

However, HPI will also produce CD-ROMs and limited edition print publications.

HuPI is a locus for research and development in all areas of human power in a scientific and engineering context. Much of this work is technological in nature and has to do with specific tasks, such as the design of machines for transport. As well, HuPI is devoted to exploring and understanding how human power technology benefits society across a wide range of areas, including economics, agriculture, social rubric, psychology, and general well being.

In mid-2004, HuPI will launch Human Power International Journal, a web-based open electronic journal. Initially edited by Theo Schmidt, Human Power International Journal will be available for free via the HuPI website: <http://www.hupi.org> which is also the primary contact to HuPI.

Also available freely on the HPI website will be a complete archive of past issues of Human Power from 1977 to 2003. The archive is fully indexed and searchable, and will also be published as a CD-ROM complete with programs for accessing the issues and indexes, plus additional material including historical notes by Chester Kyle and others.

In late 2004, HPI will launch HPN News (Human Power Network News), an electronic news publication linked to human power and general news web sites around the world. HPN News will carry topical news, and reports on events and developments with human power organizations and projects.

HPN News will be the official publication of the Human Power Network (HPN), a free association devoted to international exchange of information and resources for implementing human power technologies. HPN will be structured to operate in different languages and cultures, to facilitate involvement and participation by groups in all parts of the world.

Founders of HuPI are: Richard Ballantine; Theo Schmidt; John Snyder; Elrey John Stephens; Brian Wilson; David Gordon Wilson.

— Richard Ballantine