How can a 30cc 2-Stroke engine be less than 200 Watts *output* ?

Many people have asked us how can our engine produce less than 200 Watts output and how is it measured ?

The answer is quite simple, but first we must agree on some basics:-

Point of Output. If you have an Electric Hub Motor that is internally geared, as most are, you cannot measure the output at the armature (or stator). The same is with the Rotary Hub Engine. ***The point of output of both power units is the wheel rim***. ***If*** we were measuring in Imperial H.P , there are various terms; shaft, net, observed or effective. These are all terms that represent ***actual usable power***, after internal losses, not a theoretical maximum figure used many years ago under terms such as; taxable, gross or indicated. At this point we should probably clear up the term 'rated power'. This is usually an abbreviation of 'Continuously Rated Output' or simply; 'can do all day long'. Don't confuse 'rated power' with 'maximum power'. Australian legislation uses the term ***maximum output***.

Power Output in Watts. The modern term of quoting 'rate of work' about a rotating axis under the SI system is the Watt (W). To observe any ***output*** we must have a value for both Torque (τ) and Angular Velocity ($\acute{\omega}$). When measuring ***output*** the method is the same for both internal combustion & electric motors, it makes no difference 'how' Torque or Angular Velocity is produced. This should clarify the confusion of ***power consumption in Watts***. We have heard many say 'my hair drier is 1000Watts, it won't power a bicycle!'. Your hair driers power ***consumption*** is 1000Watts , not its ***output***.

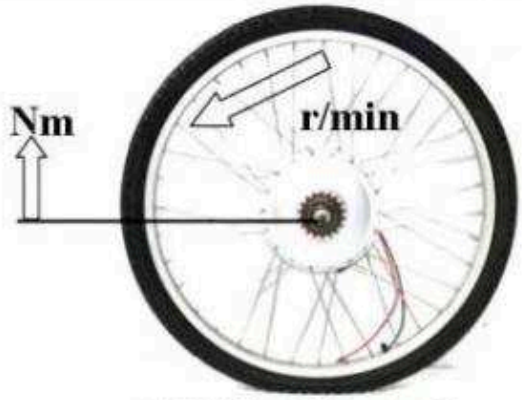
Under the SI system Torque is measured in Newton Meters (N m) & Angular Velocity measured in Radians per Second (rad/s), then power ***output*** in Watts is calculated with the formula:- **$W = \tau$ (Nm) $\times$ $\acute{\omega}$ (rad/s),** or if we want to input r/min & measure in kW we use:- **$kW = \tau$ (N m) $\times$ $\acute{\omega}$ (r/min) $\div$ 9549.** The (rounded) constant 9549 comes from 60 (s/min) x 1000 (W/kW) / 2π (radians/revolution).

A dynamometer is just a device that measures & calculates all these parameters for you. Given the unique mounting of an Auxiliary Hub Power Unit for a bicycle, there is no shaft poking out to drive a dynamometer, so (while under controlled load) Reactive Torque (in Nm) is carefully measured at the axle & Speed (in r/min) is measured at the wheel. ***Power output in Watts can then be calculated and graphed***.

Low Power High Torque. Now we can see that basically power is the product of torque × rotational speed, a massive reduction in output rotational speed results in a massive reduction in power, as-is the case with Internally Geared Hub Engines. We don't know what the output is at the crankshaft (could calculate), it's not usable & non-relevant, the same applies to Electric Hub Motors, the armature (stator) power is inaccessible, not usable & non-relevant.

IF YOU WERE TO IMPLY THAT POWER BE QUOTED AT THE CRANKSHAFT OF THE RH-01 UNIT THIS WOULD MEAN POWER HAS TO BE QUOTED AT THE ARMATURE (or stator) OF ANY INTERNALLY GEARED ELECTRIC HUB MOTOR AS WELL.

EXAMPLE 1. Internally Geared Hub Motor (electric)

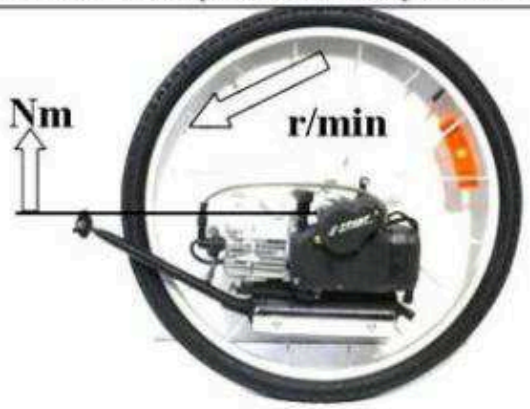


OUTPUTS at 100% system V

Max Speed - 220 r/min (no load)
Max Torque- 29Nm @ 30 r/min (91Watts)
Max Power- 205Watts @ 127 r/min
Torque@Pmax- 15.2 Nm

AT THE ARMATURE (stator):
'can't be measured'

EXAMPLE 2. Rotary RH-01 Internally Geared Hub Engine



OUTPUTS at 100% throttle

Max Speed - 210 r/min (no load)
Max Torque- 24Nm @ 40 r/min (100Watts)
Max Power- 197 Watts @ 130 r/min
Torque@Pmax- 14.5 Nm

AT THE CRANKSHAFT:
'can't be measured'