Belt Driven Wind Turbine Requires Tougher-than-Ordinary Belt

Innovative rooftop wind turbine incorporates belt drive to generate affordable power for small enterprises and communities

Urban Power USA of Easthampton, Massachusetts, doesn’t build the kind of wind turbine that comes immediately to mind. These wind turbines don’t rise hundreds of feet in the air, nor will you find them clustered on wind farms. But you might see one sitting atop a building, busily generating power from even the slightest breeze.

One thing that distinguishes the Urban Turbine from the towering giant variety is the ability to generate power in light to moderate winds using a belt drive. The units are compact, easy to assemble, and can be stacked one upon another to increase power generating capacity. The smallest unit, the UT-2, can generate up to 7,500 kWh of electricity annually, while the largest built to date, the UT-10, can generate up to 100,000 kWh per year. The UT-25, currently under development, will be classified as a small utility grade turbine for municipalities or large factories.

In designing the Urban Turbine, Mark Maynard, the engineer who founded Urban Power, needed a reliable drive system with the ability to change speed ratios. He also wanted a drive with low to zero maintenance. That forced him to look beyond gearboxes, which would require regular lubrication. At first, Maynard tried a serpentine belt drive. A belt drive appealed to him because belts were easy to find anywhere in the world and cost little to replace.

He discovered, however, that conventional toothed belts could not withstand the torque needed for this application. In the Urban Turbine, the vanes turn slowly, and as they catch shifting winds, they move backward and forward, constantly changing direction. As Maynard says, “There might be 190 ft/lbs of torque generated in one direction, then a wind change that generates 190 ft/lbs of torque in the other direction. Combined, that’s nearly 400 ft/lbs of torque. It requires a tough belt to avoid snapping.”

Maynard turned to Gates to find a belt that would work. That’s when he learned about Gates Poly Chain® GT® Carbon™ synchronous belts. Reinforced with carbon fiber tensile cords, these belts provide high load-carrying capacity in a compact drive.
Although these belts were designed for high speed drives, the Gates District Sales Manager thought they would work in this application, where speeds and horsepower were low and torque correspondingly high.

The belt drive system on the Urban Turbine is a two-stage drive. The primary drive goes from the turbine to a jackshaft. The secondary drive goes from the jackshaft to the alternator. Maynard wanted identical belts for both drives, to simplify the bill of materials.

Gates solution was to use a 37 mm wide Poly Chain GT Carbon belt on both stages. The first stage, which transmits the rotational power from the turbine to the jackshaft, called for a 4:1 speed-up ratio, taking turbine shaft speed up to 48 rpm. The second stage called for a 3.26:1 speed-up ratio, taking the speed up to 156 rpm and transmitting that energy to the alternator to generate power.

The belt drives have been operating on one turbine now for over a year, and Maynard says that he has had no problem with belts breaking due to torque loads, notwithstanding that they’ve been through some storm situations that generated high, variable winds.

**Maynard likes the Poly Chain GT Carbon belts on his Urban Turbines for several reasons:**

- Maintenance free
- Reliable
- Long lived
- Quiet
- Widely available

**What can Gates do for you?** For help with your application, speak with a Gates Product Application Engineer at 303-744-5070.

For information about Urban Power, visit www.urbanpowerusa.com.

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