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# Turbine -: Bergey Excel 10

SIAC Wind Energy Ltd are the sole distributors for the Bergey range of small wind turbines in the UK and Ireland.

Bergey Windpower have been building turbines for over 30 years and are the longest established manufacturer of small scale turbines in the world. They have a proven track record with the longest accumulated operational hours of any manufacturer worldwide. Their turbines are built for a 50 year life and come with a 10 year warranty.

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| **Reference Power** | 10 kW at 12 m/s |
| **Rotor Diameter** | 7 m |
| **Rotor Area** | 38.5 m2 |
| **Start-up Speed** | 2.2 m/s |
| **Cut-out Speed** | None |
| **Max. Design Speed** | 60 m/s |
| **Furling Wind Speed** | 15.6 m/s |
| **Warranty** | 10 years |
| **Annual Maintenance** | None |
| **Years in Production** | 28 |
| **Configuration** | Upwind HAWT |
| **Rotor** | 3-blade, fixed pitch |
| **Generator** | Permanent Magnet, direct drive |
| **Governing System** | Passive, furling |
| **Shutdown System** | Crank out tail |
| **Turbine Weight** | 495 kg's |
| **Temperature Range** | -40 to +60 Deg. C |
| **Inverter(s)** | 2 x Aurora 6 kW, 1-Ph<br>3 x Aurora 3.6 kW, 3-Ph<br>DTI Gale 12, 1-Ph TBC |
| **Blade Pitch Control** | None, Fixed Pitch |
| **Gearbox** | None, Direct drive |

## Detailed Technical Review of the Excel 10kW Turbine

The 10kW EXCEL is a 7 meter diameter three-blade upwind turbine that achieves high reliability through rugged construction and a minimum of moving parts.

The rotor on the EXCEL has three pultruded fibre reinforced plastic (FRP) blades which are rigidly attached at their hubs. Pultrusion is a continuous forming process that allows for a very high glass fibre content, which results in a very high strength, yet flexible rotor blade. The basic material strength in ~ 100,000 psi or approximately twice the strength of low carbon steel.

Though the blades are not tapered or twisted, they nonetheless operate at ~ 80% of the maximum theoretical aerodynamic efficiency and produce very low sound levels due to the proprietary Bergey SH3035 airfoil. The SH3035 airfoil was developed using advanced computer modeling verified by wind tunnel testing by the National Renewable Energy Laboratory (NREL). The blades are protected from abrasion with a special polyurethane leading edge tape and the blades are painted with an aircraft-quality polyurethane paint after being very carefully balanced. The blades are typically painted white, but are often painted black for cold climates to promote ice-shedding.

The blades attach directly to the outside shell of the EXCEL's purpose-built direct drive 38-pole permanent magnet (PM) alternator. The alternator has an "inside-out" configuration in that the outer shell (containing the magnets) rotates about the fixed internal stator structure. Thus, the alternator incorporates the rotor hub, has no central rotating shaft, puts the front bearing in the rotor plane, and has no brushes. The output is a sinusoidal three-phase alternating current that varies in voltage and frequency with wind speed.

The turbine is aligned into the wind by a tail assembly. The tail boom and integrated rotor/alternator assembly attach to the mainframe assembly, which incorporates the yaw-axis slip-rings and the tower interface. The geometry of the mainframe creates the passive Autofurl® high wind speed protection. The mainframe offsets the rotor and yaw axes such that rotor thrust produces a furling moment about the yaw-axis. The weight and inclined pivot of the hinged tail provides a preset resistance to the rotor furling moment. Over speed control is initiated at 13-15 m/s (30-34 mph) when rotor thrust overcomes the tail resistance and restoration is caused by gravity as the wind speed subsides. The EXCEL has no shut-down wind speed. The turbine can be manually shut-down using a furling winch installed at the base of the tower.

Corrosion protection for the EXCEL is provided by hot-dip galvanizing (mainframe, tower adapter, and tail boom), electro-zinc plating, and polyurethane paint systems. FRP components, such as the blades, are protected by ultraviolet-inhibiting resin additives and sub-surface "scrim cloth" UV barrier. The blades have polyurethane leading edge tape for protection against erosion.

The EXCEL has only four moving parts, no adjustable elements, and no grease fittings. No scheduled maintenance is required beyond biannual inspections and replacement of the outer three feet of blade leading edge tape every 4-10 years. From the assessment of the turbines that have been operational for 30 years, Bergey can declare a design life of 50 years.



## Dimensions of Bergey Excel 10 turbine

