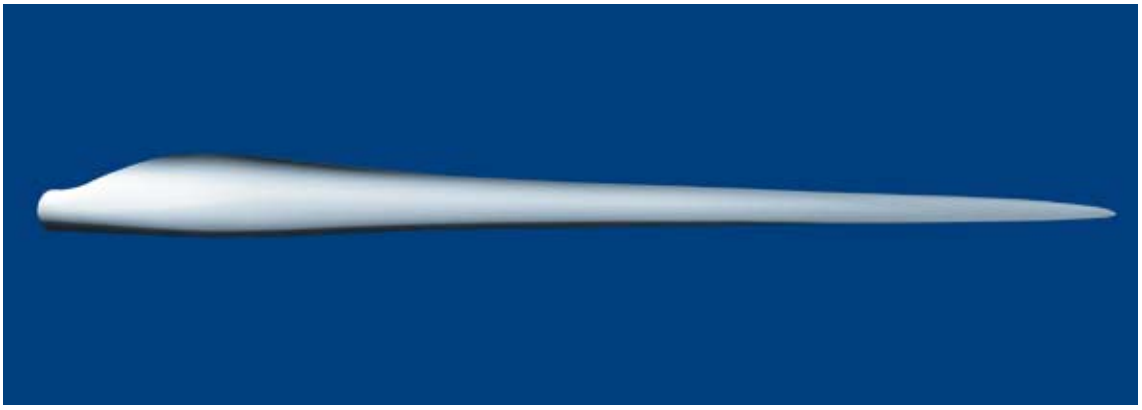
V90-3.0 MW

An efficient way to more power



Innovations in blade technology

3×44 meters of leading edge

In our quest to boost the efficiency of the V90, we made sweeping improvements to two aspects of our turbine blades: their material composition and their structure.

At Vestas we have long enjoyed a reputation for making some of the lightest blades on the market, and with the V90 we have once again raised the bar. We began by introducing several new lightweight materials, most notably carbon fibre for the load-bearing spars. Not only is carbon fibre intrinsically lighter than the fibreglass it replaces, but its strength and rigidity also reduce the quantity of material needed – thus cutting overall weight even further. So that even though the V90 has a swept area that is 27 percent more than the V80, the new blades actually weigh about the same.

The new profile of the V90 blades also represents a significant aerodynamic advance. In collaboration with Risø National Laboratory in Denmark, Vestas engineers worked on optimizing the relationship between the overall load impact on the turbine and the volume of energy generated annually. Their final blade design features an entirely new plane shape and a curved back edge.

The resulting airfoil improves energy production, while making the blade profile less sensitive to dirt on the leading edge and maintaining a favorable geometrical relationship between successive airfoil thicknesses. This translates into an increase in output combined with a decrease in load transfers, as well as improvements on the bottom line.

Reduced need for service and maintenance

A series of improvements to the V90 have made service and maintenance calls less demanding, and less frequent. Turbine access has been simplified and working areas expanded, while the arrangement of tower and nacelle components has been optimized to facilitate service procedures.

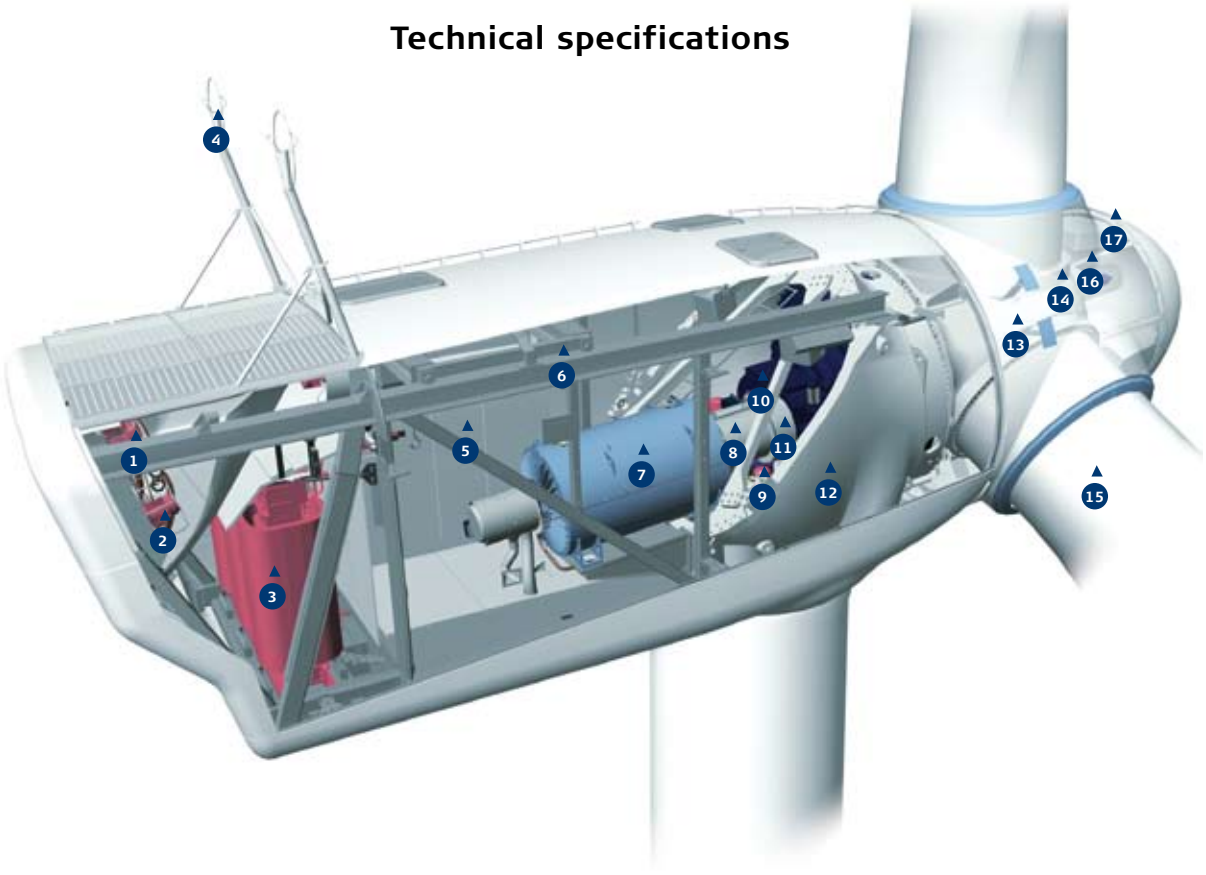
Moreover, a variety of new features, ranging from automatic blade-bearing lubrication to an oil-lubricated yaw system, have made it possible to reduce the number of preventive maintenance visits to one a year. This means considerable savings in turbine downtime and personnel costs, and is a particularly welcome development in the context of hard-to-reach offshore installations.

Proven Performance

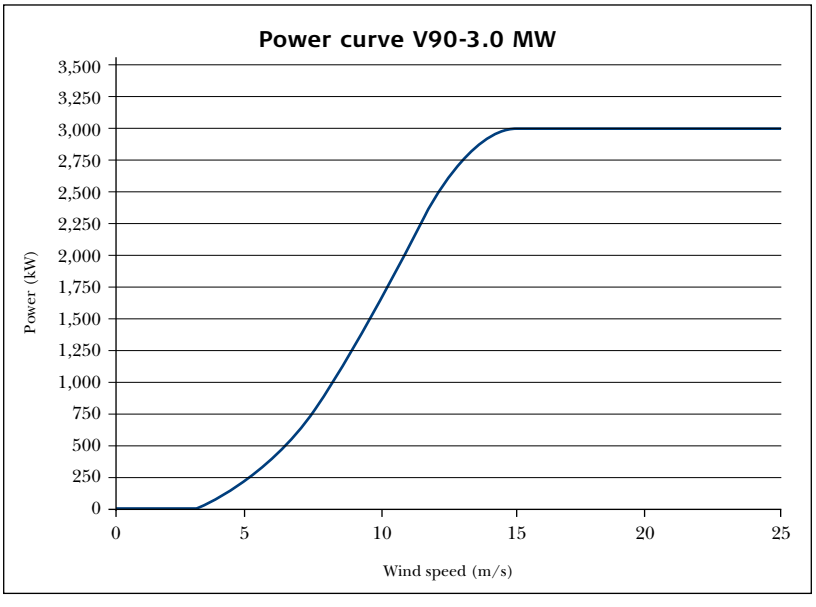
Wind power plants require substantial investments, and the process can be very complex. To assist in the evaluation and purchasing process, Vestas has identified four factors that are critical to wind turbine quality: energy production, operational availability, power quality and sound level.

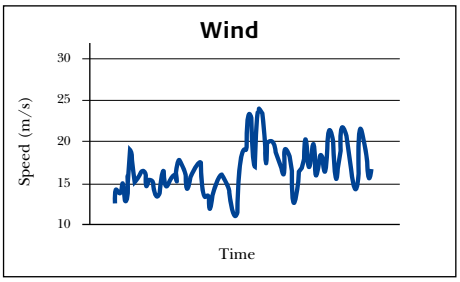
We spend months testing and documenting these performance areas for all Vestas turbines. When we are finally satisfied, we ask an independent testing organisation to verify the results – a practice we call Proven Performance. At Vestas we do not just talk about quality. We prove it.

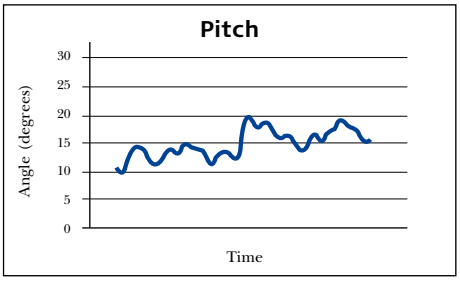
Technical specifications

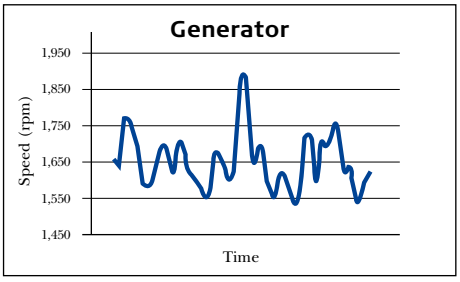


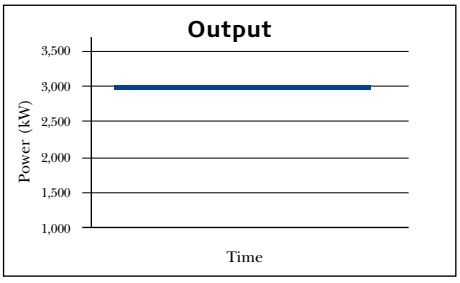
1. Oil cooler
2. Water cooler for generator
3. High voltage transformer
4. Ultrasonic wind sensors
5. VMP-Top controller with converter
6. Service crane
7. Generator
8. Composite disc coupling
9. Yaw gears
10. Gearbox
11. Mechanical disc brake
12. Machine foundation
13. Blade bearing
14. Blade hub
15. Blade
16. Pitch cylinder
17. Hub controller











V90-3.0 MW allows the rotor speed to vary within a range of approximately 60 percent in relation to nominal rpm. Thus the rotor speed can vary by as much as 30 percent above and below synchronous speed. This minimizes both unwanted fluctuations in the output to the grid supply and the loads on the vital parts of the construction.

Rotor

Diameter:	90 m
Area swept:	6,362 m²
Nominal revolutions:	16.1 rpm
Operational interval:	8.6-18.4 rpm
Number of blades:	3
Power regulation:	Pitch/variable speed control
Air brake:	Full blade pitch by three separate hydraulic pitch cylinders

Tower

Hub height:	80 m, 105 m

Operational data

Cut-in wind speed:	4 m/s
Nominal wind speed (3,000 kW):	15 m/s
Cut-out wind speed:	25 m/s

Generator

Type:	Asynchronous with converter
Rated output:	3,000 kW
Operational data:	60 Hz 1,000 V

Gearbox

Type:	Two planetary and one helical stage

Control

Type:	Microprocessor-based control of all the turbine functions with the option of remote monitoring. Output regulation and optimization via variable speed control and OptiTip® pitch regulation.

Weight

Nacelle:	70 t
Rotor:	41 t

Towers:

Hub height:	IEC IA	IEC IIA	DIBt II	DIBt III
80 m	160 t	–	–	160 t
105 m	–	285 t	235 t	–

t = metric tons

DIBt towers are only approved for Germany

All specifications subject to change without notice.

An efficient way to more power

When Vestas set out to establish a new benchmark for efficiency with its development of the V90-3.0 MW turbine, high priority was given to keeping weight down. That is because wind turbines are heavy, and the heavier the turbine, the greater the costs – for production, material, transport and installation.

Our engineers therefore rethought every aspect of turbine design – from foundations to blade tip – seeking ways to minimize the cost per kWh over the design lifetime of the V90. The result is a showcase of innovative engineering – particularly in relation to the weight saved. In fact, despite a larger rotor and generator, the new V90 actually weighs less than the V80-2.0 MW.

The biggest reduction has come from strengthening the tower. To increase fatigue strength, we have pioneered the use of magnets to fasten internal components to the tower walls. In addition, using a stronger steel means less is needed. The decreased weight lets us construct the new towers in fewer sections, with significant savings in material, transport, and installation costs.

The most radical redesign centred on the new nacelle. Even though the 3 MW generator is 50 per cent larger than the corresponding generator in the 2 MW wind turbine, we kept overall nacelle weight almost the same. We did this by integrating the hub bedplate directly into the gearbox, eliminating the main shaft and thus shortening nacelle length. The result is a nacelle that can generate much more power without any appreciable increase in size, weight or tower load.

Together with new low-weight blades, these breakthroughs have made the V90 remarkably light for a turbine of its size – and remarkably efficient for a turbine of any dimension.

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