# VESTAS Product sheet

# V136-4.5 MW™ IEC IIB

| | |
|---|---|
| **Power regulation** | Pitch regulated with variable speed |
| **Operating data** | |
| Rated power | 4,500kW |
| Cut-in wind speed | 3m/s |
| Cut-out wind speed | 32m/s |
| Re cut-in wind speed | 28m/s |
| Wind class | IEC IIB |
| Standard operating temperature range from -20°C* to +45°C with de-rating above 23°C | |
| *Subject to different temperature options | |
| **Sound power** | |
| Maximum | 103.9dB(A)* |
| *Sound Optimised Modes dependent on site and country | |
| **Rotor** | |
| Rotor diameter | 136m |
| Swept area | 14,527m² |
| Air brake | full blade feathering with 3 pitch cylinders |
| **Electrical** | |
| Frequency | 50/60Hz |
| Converter | full scale |
| **Gearbox** | |
| Type | two planetary stages and one helical stage |
| **Tower** | |
| Hub heights | 112m (IEC IIB) |
| **Nacelle dimensions** | |
| Height for transport | 3.5m |
| Height installed (incl. CoolerTop®) | 8.4m |
| Length | 12.96m |
| Width | 3.98m |
| **Hub dimensions** | |
| Max. transport height | 3.5m |
| Max. transport width | 3.7m |
| Max. transport length | 5.5m |

| | |
|---|---|
| **Blade dimensions** | |
| Length | 66.7m |
| Max. chord | 4.1m |
| Max. weight per unit for transportation | 70 metric tonnes |

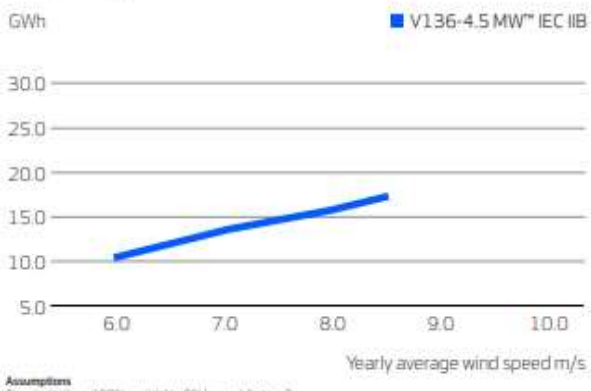
**Turbine options**

- High Wind Operation
- Condition Monitoring System
- Service Personnel Lift
- Vestas Ice Detection™
- Low Temperature Operation to -30°C
- Fire Suppression
- Shadow detection
- Vestas Bat Protection System
- Aviation Lights
- Aviation Markings on the Blades
- Vestas InteliLight®
- Nacelle Hatch for Air Inlet

| | |
|---|---|
| **Sustainability** | |
| Carbon Footprint | 4.9g $CO_2$e/kWh |
| Return on energy break-even | 5.2 months |
| Lifetime return on energy | 46 times |
| Recyclability rate | 87.4% |

Configuration 132m hub height and wind class IEC IIA. Depending on site-specific conditions. Metrics are based on a preliminary stream-lined analysis. An externally-verified Lifecycle Assessment will be made publicly available on vestas.com once finalised.

**Annual energy production**




**Assumptions**
One wind turbine, 100% availability, 0% losses, k factor = 2
Standard air density = 1.225, wind speed at hub height

# V150-4.5 MW™ IEC IIIB

| | |
|---|---|
| **Power regulation** | Pitch regulated with variable speed |

**Operating data**

| | |
|---|---|
| Rated power | 4,500kW |
| Cut-in wind speed | 3m/s |
| Cut-out wind speed | 24.5m/s |
| Re cut-in wind speed | 22.5m/s |
| Wind class | IEC S |

Standard operating temperature range from -30°C* to +45°C with de-rating above 23°C

*Subject to different temperature options

**Sound power**

| | |
|---|---|
| Maximum | 107.6dB(A)* |

*Sound Optimised Modes dependent on site and country

**Rotor**

| | |
|---|---|
| Rotor diameter | 150m |
| Swept area | 17,671m² |
| Air brake | full blade feathering with 3 pitch cylinders |

**Electrical**

| | |
|---|---|
| Frequency | 50/60Hz |
| Converter | full scale |

**Gearbox**

| | |
|---|---|
| Type | two planetary stages and one helical stage |

**Tower**

| | |
|---|---|
| Hub heights | 90m (IEC IIIB)<br>105m (IEC IIIB) |

**Nacelle dimensions**

| | |
|---|---|
| Height for transport | 3.5m |
| Height installed (incl. CoolerTop®) | 8.4m |
| Length | 12.96m |
| Width | 3.98m |

**Hub dimensions**

| | |
|---|---|
| Max. transport height | 3.5m |
| Max. transport width | 3.7m |
| Max. transport length | 5.5m |

**Blade dimensions**

| | |
|---|---|
| Length | 73.7m |
| Max. chord | 4.2m |

| | |
|---|---|
| Max. weight per unit for transportation | 70 metric tonnes |

**Turbine options**

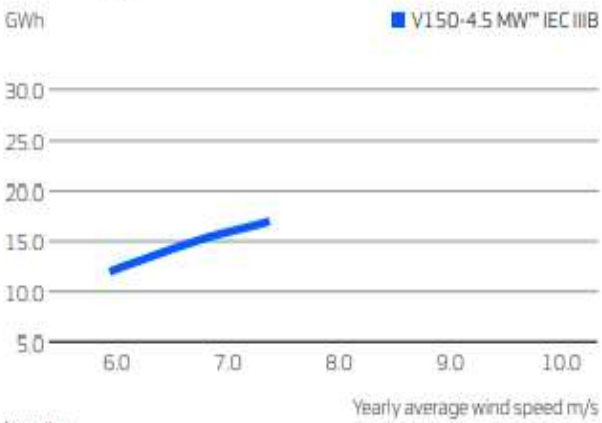
- Condition Monitoring System
- Service Personnel Lift
- Vestas Anti-Icing System™
- Vestas Ice Detection
- Low Temperature Operation to -30°C
- Fire Suppression
- Shadow detection
- Vestas Bat Protection System
- Aviation Lights
- Aviation Markings on the Blades
- Vestas InteliLight®
- Nacelle Hatch for Air Inlet

**Sustainability**

| | |
|---|---|
| Carbon Footprint | 5.6g $CO_2$e/kWh |
| Return on energy break-even | 5.9 months |
| Lifetime return on energy | 41 times |
| Recyclability rate | 82.8% |

Configuration: 105m hub height and wind class IEC IIIB. Depending on site-specific conditions. Metrics are based on an externally reviewed Life Cycle Assessment available on vestas.com

**Annual energy production**




**Assumptions**
One wind turbine, 100% availability, 0% losses, k factor = 2
Standard air density = 1.225, wind speed at hub height

# V162-6.2 MW™ IEC S

- Condition Monitoring System
- Oil Debris Monitoring System
- Service Personnel Lift
- Low Temperature Operation to -30°C
- Vestas Ice Detection™
- Vestas Anti-Icing System™
- Vestas Shadow Flicker Control System

Learn more about the available options and solutions

- Aviation Lights
- Aviation Markings on the Blades
- Fire Suppression System
- Vestas Bat Protection System
- Lightning Detection System
- Power Optimised Modes

6.2 MW

Connecting proven system designs from the 2 MW, 4 MW, and 9 MW platforms, EnVentus™ variants feature a nominal rating of 6.2 MW with additional power optimised modes.
IEC S

The V162-6.2 MW™ IEC S is designed for low to medium wind sites, with extensive application in high wind speeds.
40 years

With more than 181 GW of wind turbine capacity installed and 40 years of experience in relentlessly pursuing performance improvements, EnVentus™ is Vestas' next generation in the evolution of wind turbines.
Technical specifications

**Power regulation operational data**

| | |
|---|---|
| Pitch regulated with variable speed | |
| Rated power | 6,200kW |
| Cut-in wind speed | 3m/s |
| Cut-out wind speed | 25m/s |
| Wind class | IEC S |
| Standard operating temperature range | from -20°C* to +45°C |

**SOUND POWER**

| | |
|---|---|
| Maximum | 104.8dB(A)** |

**ROTOR**

| | |
|---|---|
| Rotor diameter | 162m |
| Swept area | 20,612m2 |
| Aerodynamic brake | full blade feathering with 3 pitch cylinders |

**ELECTRICAL**

| | |
|---|---|
| Frequency | 50/60 Hz |
| Converter | full scale |

**GEARBOX**

| | |
|---|---|
| Type | two planetary stages |

**TOWER**

| | |
|---|---|
| Hub heights<br>119 m (IEC S/DIBt S), 125 m (IEC S), 149 m (IEC S), 166 m (IEC S/DIBt S) and 169 m (DIBt S) | |

**SUSTAINABILITY METRICS**

| | |
|---|---|
| Carbon Footprint | 6.2g CO2e/kWh |
| Return on energy break-even | 6.5 months |
| Lifetime return on energy | 37 times |
| Recyclability rate | 84% |

Configuration: 149m hub height, Vavg=7.4m/s, k=2.22. Depending on site-specific conditions.
Metrics are based on an externally reviewed Life Cycle Assessment available on vestas.com

## V172-7.2 MW™ IEC S

- 6.5 MW Operational Mode
- 6.8 MW Operational Mode
- Oil Debris Monitoring System
- High Temperature Cooler Top
- Service Personnel Lift
- Low Temperature Operation to -30°C

- Vestas Ice Detection™

Learn more about the available options and solutions

- Vestas Shadow Flicker Control System
- Aviation Lights
- Aviation Markings on the Blades
- Fire Suppression System
- Vestas Bat Protection System
- Lightning Detection System

Technical specifications

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POWER REGULATION OPERATIONAL DATA
Pitch regulated with variable speed

| | |
|---|---|
| Standard rated power | 7,200kW |
| Cut-in wind speed | 3m/s |
| Cut-out wind speed | 25m/s |
| Wind class | IEC S |
| Standard operating temperature range | from -20°C* to +45°C |

*High wind Operation available as standard

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SOUND POWER

| | |
|---|---|
| Maximum | 106.9dB(A)** |

**Sound Optimised Modes available dependent on site and country

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ROTOR

| | |
|---|---|
| Rotor diameter | 172m |
| Swept area | 23,235m2 |
| Aerodynamic brake | full blade feathering with 3 pitch cylinders |

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ELECTRICAL

| | |
|---|---|
| Frequency | 50/60 Hz |

| | |
|---|---|
| Converter | full scale |
| GEARBOX Type | two planetary stages |

TOWER Hub heights*

114 m (IEC S), 150 m (IEC S), 164 m (DIBt), 166 m (IEC S), 175 m (DIBt) and 199 m (DIBt)

*Site specific towers available on request

SUSTAINABILITY

| | |
|---|---|
| Carbon Footprint CO2e/kWh | 6.4g |
| Return on energy break-even | 6.9 months |
| Lifetime return on energy | 34 times |
| Recyclability rate | 86.6% |

Configuration: 166m hub height, Vavg=7.4m/s, k=2.48. Depending on site-specific conditions. Metrics are based on an internal streamlined assessment. An externally reviewed Life Cycle Assessment will be made available on vestas.com once finalised.

# LEITWIND_LTW101 3000 kW

## LTW101 2,000 | 2,500 | 3,000 kW

| DESIGN DATA | |
|---|---|
| Rated power | 2,000 \| 2,500 \| 3,000 kW |
| Hub height | 80 / 93.5 m |
| Tip height max (upper end) | 130 / 144 m |
| Wind class | IIA / IIIA |
| Cut-in wind speed | 3 m/s |
| Cut-out wind speed | 25 m/s |
| Concept | Direct Drive 3-bladed upwind turbine with horizontal axis, variable speed and automatic pitch and yaw regulation |

| TOWER | |
|---|---|
| | Segmented tubular steel tower |
| | Transformer and converter station in tower bottom |

| ROTOR | |
|---|---|
| Rotor diameter | 101 m |
| Swept area | 8,012 m² |
| Rotational speed | 15 rpm |
| Tip speed | 79 m/s |
| Blade material | GFRP-EP |
| Power and rotor speed control | Active pitch control |

| GENERATOR Direct Drive | |
|---|---|
| Type | Permanent Magnet Direct Drive Synchronous Machine |
| Stator Winding | Modular coils with tooth concentrated winding, exchangeable |
| Rotor Topology | Modular Permanent Magnets with flux concentration, exchangeable |
| Cooling | Air cooled rotor and water cooled stator |
| Speed Range | Variable Low Speed Machine |

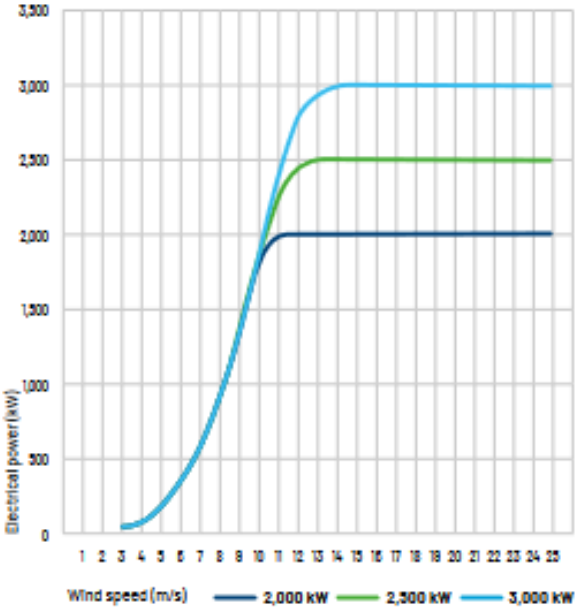
| CONTROL & SAFETY SYSTEM | |
|---|---|
| Pitch and yaw control | Active electrical LeitPitch system and active electrical yaw system |
| Remote control | Leitwind integrated SCADA |
| Safety system | Hardwired safety loop |
| Main brake | Aerodynamic, independent pitch control |
| Service brake | Electrical |
| Rotor lock | Hydraulic |

| POWER ELECTRONIC LeitDrive | |
|---|---|
| Converter type | 4Q full power - 3 phase IGBT |
| Arrangement | Multiple modular LeitDrive converter<br>- increase of technical availability<br>- partial load operation |
| Converter rated voltage and frequency (grid-side) | 690 V ±10%, 50-60 Hz ±5% |
| Converter power factor (grid-side) | 0.95 ind - 1 - 0.95 cap for reactive power compensation control, grid voltage control capability |
| Power quality and Grid codes | High quality output power in accordance with major grid code requirements. Integration into various grid systems worldwide<br>- Grid code compliance e.g. CEI 0-16, TERNA (incl. LVRT) and many other countries<br>- Power quality according to IEC 61400-21<br>- Emission limits according to IEC 61800-3 |

## AEP - ESTIMATED ANNUAL ELECTRICAL PRODUCTION

| | LTW101 2,000 kW | LTW101 2,500 kW | LTW101 3,000 kW |
|---|---|---|---|
| m/s | MWh/y | MWh/y | MWh/y |
| 4.5 | 3,067 | 3,108 | 3,151 |
| 5.0 | 4,008 | 4,134 | 4,248 |
| 5.5 | 4,874 | 5,217 | 5,428 |
| 6.0 | 5,821 | 6,315 | 6,552 |
| 6.5 | 6,822 | 7,387 | 7,872 |
| 7.0 | 7,656 | 8,403 | 8,930 |
| 7.5 | 8,406 | 9,338 | 10,151 |

## POWER CURVE




| | LTW101 2,000 kW | LTW101 2,500 kW | LTW101 3,000 kW |
|---|---|---|---|
| Wind speed (m/s) | Electrical power (kW) | Electrical power (kW) | Electrical power (kW) |
| 3.0 | 41 | 41 | 41 |
| 4.0 | 122 | 118 | 118 |
| 5.0 | 258 | 258 | 258 |
| 6.0 | 480 | 470 | 470 |
| 7.0 | 772 | 768 | 768 |
| 8.0 | 1,152 | 1,154 | 1,154 |
| 9.0 | 1,634 | 1,634 | 1,634 |
| 10.0 | 1,883 | 2,125 | 2,205 |
| 11.0 | 2,000 | 2,402 | 2,657 |
| 12.0 | 2,000 | 2,500 | 2,881 |
| 13.0 | 2,000 | 2,500 | 2,983 |
| 14.0 | 2,000 | 2,500 | 3,000 |
| 15.0 | 2,000 | 2,500 | 3,000 |
| 16.0 - 25.0 | 2,000 | 2,500 | 3,000 |