

Advanced Airfoils for Wind Turbines

New airfoils have substantially increased the aerodynamic efficiency of wind turbines

Blades are where the turbine meets the wind. Turbine blades take advantage of aerodynamics to extract the wind's energy, which can then be converted to useful electricity. Airfoils—the cross-sectional shape of the blades—determine the aerodynamic forces on blades. They are key to blade design.

In the seventies, the young and fast-growing U.S. wind industry used airfoil designs from airplane wings to design turbine blades because those airfoil designs were widely available, and engineers understood how they performed on aircraft. Airfoils specifically designed for wind turbines did not yet exist.

The industry quickly learned, however, how harsh the operating environment is for wind turbines as compared to that for airplanes. For example, wind turbine blades face much more variable (in-flow) conditions and

experience more turbulence resulting in higher fatigue loads.

Responding to the needs of the wind industry, U.S. Department of Energy (DOE) scientists at the National Renewable Energy Laboratory (NREL) in Golden, Colorado, began in 1984 to develop a series of airfoils designed specifically for wind turbine blades. The airfoils are designed to provide different performance

The Office of Power Technologies is part of the Office of Energy Efficiency and Renewable Energy

Highlights

- ***New airfoils developed at NREL substantially increase the aerodynamic efficiency of wind turbine blades.***
- ***The airfoil designs won a prestigious R&D 100 Award in 1991, and the Federal Laboratory Consortium Excellence in Technology Transfer Award in 1990.***
- ***Nine families of airfoils have been developed.***
- ***Using these airfoils, U.S. blade manufacturers have strengthened their competitive position in global markets for wind technology.***



NREL/PIX #00334

The NREL airfoils incorporated into turbine blades have been extensively tested in the field to verify their superior performance.

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“The NREL airfoils are the biggest technical improvement in wind technology in a decade.”

—Bob Lynette,
president,

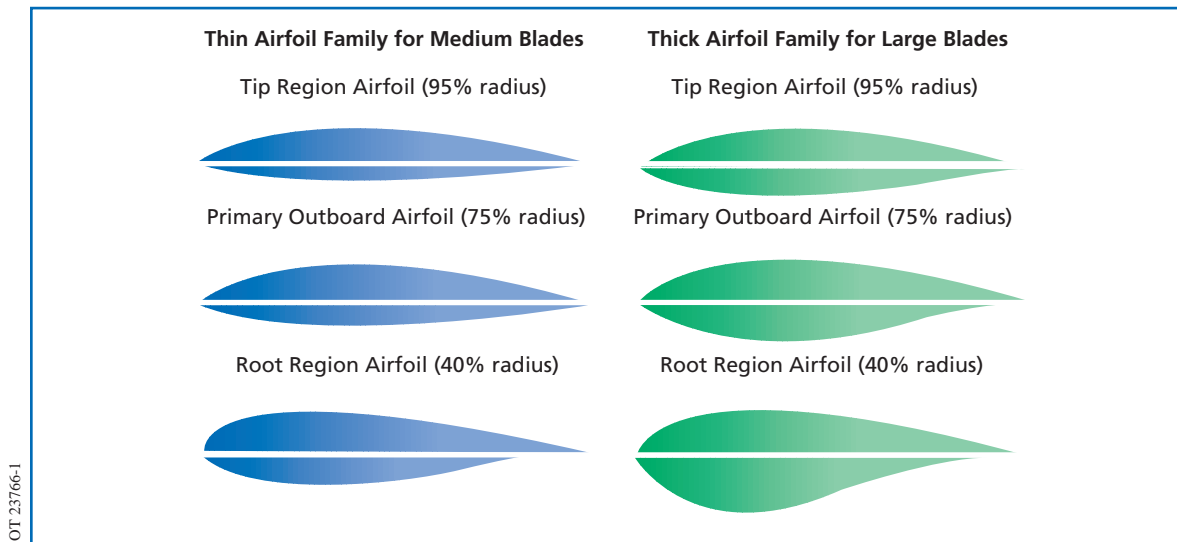
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characteristics from the blade root to tip while accommodating the structural requirements of the blade. The scientists rigorously tested the airfoils in wind tunnels, and then incorporated them into turbine blades for field-testing.

By the end of the decade, it was clear these new airfoils substantially increased energy output from wind turbines. The increases ranged from 10% to 35%. By 1993, DOE-funded scientists had tested and catalogued

the airfoils for commercial wind turbines and made this data available to the U.S. wind industry.

After several decades of research and development, the U.S. wind industry now makes blades that are among the best designed and most efficient in the world. And virtually all new blades built in this country today use these advanced airfoil designs.



Since their introduction in the market in the early 1990s, these airfoils developed by DOE have set the worldwide standard for efficiency in turbine blade design.

Project Partners

U.S. Department
of Energy

Airfoils, Inc.

Atlantic Orient
Corporation

Advanced Wind
Turbines, Inc.

National
Renewable Energy
Laboratory

Phoenix Industries

Zond Energy
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For More Information:

Wind Energy Program
U.S. Department of Energy, EE-11
1000 Independence Avenue, SW
Washington, DC 20585
<http://www.eren.doe.gov/wind/>

The National Wind Technology
Center is located at:
<http://www.nrel.gov/wind>
NREL Airfoil Families for HAWTS.
http://www.nrel.gov/wind/ab_airfoil.html

or contact:
Energy Efficiency and Renewable Energy
Clearinghouse (EREC)
P.O. Box 3048
Merrifield, VA 22116
(800)-DOE-EREC
www.eren.doe.gov/consumerinfo/
email: doe.erec@nciinc.com



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