Wind Turbine Testing Solutions
Wind Turbine Testing Solutions

» Energy Megatrend: The Promise of Wind Power

» Wind power is one of the technologies the world is counting on to provide a source of sustainable, non-polluting energy.

» Many government supported programs exist:
  » United States: 20% of electricity from wind power by 2030
  » Europe: The European Strategic Energy Technology (SET) Plan sets a goal of increasing alternative energy usage to 20% by 2020.
  » China: National Energy Administration sets a goal of producing 100 GW of wind power by 2020.

» The need for green energy and government supported initiatives are driving high growth rates.
Wind Turbine Testing Solutions

» An Expanding Global Infrastructure

» By 2014 the global wind power infrastructure is expected to grow to more than 400GW of installed capacity

» The industry growth rate is projected to be 15% or higher until 2020 and beyond.
Wind Turbine Testing Solutions

» Reliability and Uptime

» If a wind turbine design does not achieve a 20 year operational life span and/or significant maintenance, repair and overhaul (MRO) costs are incurred, overall economic viability is compromised

» Larger wind turbine structures and increasing deployment in harsher off-shore environments will continue to drive up potential MRO costs

» Improving wind turbine reliability and durability is critical to realizing the promise of a clean, sustainable and efficient global wind power infrastructure

» Manufacturers and suppliers who successfully optimize their wind turbine and component designs to minimize costs and maximize uptime will emerge as industry leaders
Wind Turbine Testing Solutions

» Improving Reliability through Mechanical Testing

» As a global provider of test and simulation solutions for numerous industries, MTS stands uniquely qualified to deliver the technology and expertise required to improve wind turbine reliability and durability.
Wind Turbine Testing Solutions

» Improving Reliability through Mechanical Testing

» Advanced MTS solutions are deployed worldwide, simulating the complex and extreme loading environments of wind turbine drive trains, blades, bearing systems, towers and materials:
Wind Turbine Testing Solutions

» Improving Reliability through Mechanical Testing

» MTS supports leading wind turbine manufacturers, suppliers and research facilities with state-of-the-art technology and testing solutions, facilities planning, test consulting, complex systems integration, and system life-cycle management.

» Centro Nacional de Energías Renovables (CENER), Spain
» Fraunhofer-Gesellschaft, Germany
» Gamesa Corporación Tecnológica, Spain
» National Renewable Energy Lab (NREL), USA
» Wind Technology Testing Center (WTTC) – USA
» National Renewable Energy Centre (narec), UK
» SGS, China & Germany
» TPI Composites- USA
» SKF- multiple locations
» Siemens Energy- USA, Denmark
» Vestas- Denmark
» Danish Technical University (DTU), Denmark
» WUXI Wind Power Institute, China
» Timken- USA

Wind Technology Testing Center (WTTC) - Boston
NAREC Test Facility - Blyth, Northumberland
SGS Blade Testing Facility - China
Wind Turbine Testing Solutions

» Improving Reliability through Mechanical Testing

» Blade Static Test Solutions
Wind Turbine Testing Solutions

» Improving Reliability through Mechanical Testing

» Blade Static Test Solutions

» Applies tightly controlled static loading to blades for performing stiffness and strength tests required for FEM model validation and/or certification to International Electrotechnical Commission (IEC) Technical Specification 61400-23

» Vertical and horizontal pull configurations

» Integrates robust hydraulic winch and/or linear actuation systems to achieve coordinated loading at multiple pull points on blade

» State-of-the-art FlexTest® digital controllers and advanced AeroPro™ software provide tightly integrated control and data acquisition
Wind Turbine Testing Solutions

» Improving Reliability through Mechanical Testing

» Blade Fatigue Test Solutions - Ground Resonance Excitation (GREX) System

- Loading Fixture
- GREX System
- Hydraulic Service Manifold
- Reaction Block
Wind Turbine Testing Solutions

» Improving Reliability through Mechanical Testing

» Blade Fatigue Test Solutions - Ground Resonance Excitation (GREX) System

» Applies automated cyclic loading to blades at resonant frequency for meeting the fatigue testing demands of International Electrotechnical Commission (IEC) Technical Specification 61400-23

» Easy-to-implement, floor-coupled load application system features versatile base and swivel design to accommodate wide variety of loading fixtures and blade angles

» Well suited for large (40+ meter) blades, including low stiffness blades where inertial based devices have reduced effectiveness

» Lower equipment mass added to blade affords faster testing

» Multiple GREX units can be deployed in a single test without slowing test frequency

» Integrates MTS 244 Actuator and Model 249 swivels

» Performs both flap-wise and edge-wise fatigue testing; requires change in blade orientation on reaction mass

» Capable of dual-axis resonant blade testing – in combination with IREX system or additional actuator inputs

» Features automated control of test end-levels and test frequency

» Combines state-of-the-art FlexTest digital controls, 793.86 Blade Resonance Search & Tracking software, advanced AeroPro software, and data acquisition hardware to provide a tightly integrated control and data acquisition solution
Wind Turbine Testing Solutions

» Improving Reliability through Mechanical Testing

» Blade Fatigue Test Solutions - Inertial Resonance Excitation (IREX) System

[Diagram of IREX System with labeled components: Hydraulic Service Manifold, Reaction Block, Hose Stands, Loading Fixture, IREX System]
Wind Turbine Testing Solutions

» Improving Reliability through Mechanical Testing

» Blade Fatigue Test Solutions - Inertial Resonance Excitation (IREX) System

» Applies automated cyclic loading to blades at resonant frequency for meeting the fatigue testing demands of International Electrotechnical Commission (IEC) Technical Specification 61400-23

» Flexible, energy-efficient blade-mounted load application system, developed through a Cooperative Research and Development Agreement (CRADA) between the U.S. DOE’s National Renewable Energy Laboratory (NREL) and MTS Systems Corporation

» Well suited for shorter, stiffer blade specimens

» Integrates MTS 244 Actuators, linear bearings and adjustable masses

» Performs both flap-wise and edge-wise fatigue testing; does not require change in blade orientation on reaction mass

» Capable of dual-axis resonant blade testing – with one or multiple IREX systems, or in combination with GREX system

» Features automated control of test end-levels and test frequency

» Combines state-of-the-art FlexTest digital controls, 793.86 Blade Resonance Search & Tracking software, advanced AeroPro software, and data acquisition hardware to provide a tightly integrated control and data acquisition solution
Wind Turbine Testing Solutions

» Improving Reliability through Mechanical Testing

» Drive Train Test Solutions

Prime Mover: Rotation input with torque, $M_z$

Drive Coupling

NTL: $F_x, F_y, F_z, M_x, M_y$

Non-torque Input Loads
Wind Turbine Testing Solutions

» Improving Reliability through Mechanical Testing

» Drive Train Test Solutions

» Applies real-world rotational and off-axis loading for optimizing the reliability of complete nacelle assemblies, complete drive train systems, and components such as gear boxes and bearings.

» High performance

» Low cost of ownership (COO), high uptime and long life

» Applications include:
  » System simulation and verification
  » Performance and durability testing

» Employs innovative 5DOF MTS Non-Torque Loading (NTL) System
  » Off-axis loads (3 forces, 2 moments) via MTS NTL System
  » Features low-friction hydrostatic bearing

» Rotation/moment input via prime mover
Wind Turbine Testing Solutions

» Improving Reliability through Mechanical Testing

» Multi-Purpose Bearing Test Solutions
Wind Turbine Testing Solutions

» Improving Reliability through Mechanical Testing

» Multi-Purpose Bearing Test Solutions

» Accurately replicates rotor hub and blade loading for performing mechanical tests on a wide array of wind turbine bearings, including pitch, yaw and main bearing systems.

» Highly flexible

» Low COO, high uptime and long life

» Applications include:
  » Performance under load
  » Static deflection and stiffness measurements
  » Durability/fatigue

» Employs innovative MTS Non-Torque Loading (NTL) System (5 DOF)
  » Rotation/moment input via actuator or motor
  » Off-axis loads (3 forces, 2 moments) via MTS NTL System
  » Features changeable specimen adapters
Wind Turbine Testing Solutions

» Improving Reliability through Mechanical Testing

» Blade Pitch Drive/Bearing Test Solutions
Wind Turbine Testing Solutions

» Improving Reliability through Mechanical Testing

» Blade Pitch Drive/Bearing Test Solutions

» Accurately replicate blade loading (Fx, Fy, Fz and Mz) for performing mechanical tests on blade pitch bearings and blade pitch drive systems.

» Available in multiple configurations

» Applications include:
  » Performance under load
  » Static deflection and stiffness measurements
  » Durability/fatigue

» Features changeable specimen adapters

» Precision control achieved with state-of-the-art FlexTest® digital controls and Multipurpose TestWare® software
Wind Turbine Testing Solutions

» Improving Reliability through Mechanical Testing

» Seismic Simulators (Shake Tables)

» Subject full wind turbine structures, towers and substructures to forces and motions in up to six degrees of freedom to simulate real-world earthquake conditions and perform modal testing.

» Available in multiple configurations
  » Six degree-of-freedom systems for subjecting full structures to real earthquake conditions
  » Special-purpose configurations for evaluating extremely large specimens that require fewer degrees of freedom
  » Affordable standard uniaxial and bi-axial seismic simulators for testing substructures and components in more compact laboratory environments
Wind Turbine Testing Solutions

» Improving Reliability through Mechanical Testing

» Materials Test Systems

» Accurately apply uniaxial static and dynamic loading to determine the mechanical properties of a wide variety of advanced materials, including:
  » Glass fiber reinforced polymer matrix composites
  » Composite materials that will be used in self-feathering blades (anisotropic properties)
  » Carbon fiber composites under consideration for longer (100+ meter) turbine blades
  » Advanced alloys and ceramics

» Combine high-performance load frames, high-resolution controls, versatile application software and a full complement of grips, fixtures, extensometers and environmental simulation systems.
Wind Turbine Testing Solutions

» Improving Reliability through Mechanical Testing

» Facilities Planning Expertise

» MTS can help ensure that your test laboratory is properly configured at the outset to readily accommodate all your foreseeable wind turbine testing activities. This planning spans a wide range of considerations, including:

» Hydraulic power supply and distribution
» Foundation and strong floor design
» Floor plan efficiency
» Hose and cabling schemes
» Electrical power requirements
» Materials and equipment handling capabilities
Wind Turbine Testing Solutions

» Improving Reliability through Mechanical Testing

» Unrivaled Test Equipment Life-Cycle Support

» Upon facility completion, MTS will coordinate the installation and integration of test systems and train your laboratory personnel to operate them safely and efficiently.

» During the installation phase, MTS personnel can work with you to determine the best Routine Maintenance and Fluid Care Program plan to match the expected operation of your test equipment.

» Once your laboratory is fully operational, MTS lifecycle management programs can serve to maximize system uptime and productivity to help you complete test programs as quickly as possible.