Material Property Testing

Accredited through International Accreditation Services, Inc., the UMaine Composites Center offers a wide range of standard material property tests, including:

**Plastic Materials**

- ASTM D2556: Determining the Izod Pendulum Impact Resistance of Plastics
- ASTM D635: Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
- ASTM D638: Tensile Properties of Plastics
- ASTM D695: Compressive Properties of Rigid Plastics
- ASTM D696: Coefficient of Linear Thermal Expansion of Plastics Between -30 °C and 30 °C with a Vitreous Silica Dilatometer
- ASTM D790: Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
- ASTM D792: Density and Specific Gravity (Relative Density) of Plastics by Displacement
- ASTM D963: Bearing Strength of Plastics
- ASTM D2765: Standard Test Methods for Determination of Gel Content and Swell Ratio of Crosslinked Ethylene Plastics (Methods A and C)
- ASTM D3846: In-plane Shear Strength of Reinforced Plastics
- ASTM D4812: Unnotched Cantilever Beam Impact Strength of Plastics
- ASTM D6019: Flexural Properties of Unreinforced and Reinforced Plastic Lumber
- ASTM D6110: Determining the Charpy Impact Resistance of Notched Specimens of Plastics
- ASTM C393: Flexural Properties of Sandwich Constructions
- ASTM D3444: Short-beam Strength of Polymer Matrix Composite Materials and Their Laminates
- ASTM D2584: Ignition Loss of Cured Reinforced Resins
- ASTM D3039: Tensile Properties of Polymer Matrix Composite Materials
- ASTM D3410: Compressive Properties of Polymer Matrix Composite Materials with Unsupported Gage Section by Shear Loading
- ASTM D3479: Tension/Tension Fatigue of Polymer Matrix Composite Materials
- ASTM D3518: In-plane Shear Response of Polymer Matrix Composite Materials by Tensile Test of a ± 45° Laminates
- ASTM D4255: Standard Guide for Testing In-plane Shear Properties of Composite Laminates
- ASTM D5379: Shear Properties of Composite Materials by the V-Notched Beam Method
- ASTM D5766: Moduli of Elasticity for Bonded Polymer Matrix Composites
- ASTM D6766: Open Hole Tensile Strength of Polymer Matrix Composite Laminates
- ASTM D6115: Mode I Fatigue Delamination Growth Onset of Unidirectional Fiber-Reinforced Polymer Matrix Composites
- ASTM D6641: Compressive Properties of Composite Laminates Using a Combined Loading Compression (CLC) Fixture
- ASTM F1679: Using a Variable Incidence Tribometer (VIT)

**Composite Materials**

- ASTM D905: Strength Properties of Adhesive Bonds in Shear by Compression Loading
- ASTM D1101: Integrity of Adhesive Joints in Structural Laminated Wood Products for Exterior Use
- ASTM D2239: Strength Properties of Adhesives in Two-Ply Wood Construction in Shear by Tension Loading
- ASTM D3165: Strength Properties of Adhesives in Shear by Tension Loading of Single-Lap-Joint Laminated Assemblies

**Adhesives**

- ISO 1887: Determination of Combustible Matter Content
- ISO 1888: Determination of Linear Density
- ISO 2896: Determination of Water Absorption
- ISO 3344: Determination of Moisture Content
- ISO 3374: Determination of Mass per Unit Area
- ISO 14130: Determination of Apparent Interlaminar Shear Strength by Short Beam Shear Method

In addition, ISO and IEC standards within our accreditation scope are:

- IEC 61400-23: Full-scale Structural Testing of Rotor Blades
- ISO 62: Determination of Water Absorption
- ISO 178: Determination of Flexural Properties
- ISO 527: Determination of Tensile Properties, 1 - 5
- ISO 604: Determination of Compression Properties
- ISO 844: Determination of Compression Properties
- ISO 845: Determination of Apparent Density

Wind Blade Testing

**Design, Fabricate and Test Under One Roof**

The University of Maine Advanced Structures and Composites Center’s award winning research staff help clients take innovations from concept through design validation. The $100 m, $160 million laboratory employs more than 150 people with expertise in large-scale and coupon-level instrumentation and testing, composites manufacturing and analysis, finite element analysis and other modeling techniques. UMaine Composites Center faculty and staff may be engaged to jointly develop products, or may be contracted to fabricate and test composite or concrete products.

**Laboratories**

- Offshore Wind Lab with 605 m² strongfloor
- Structural Testing Lab with 240 m² strongfloor
- Kenway Composite Materials Lab with 126 m², environmentally controlled
- Mechanical Testing Lab with 110 m², environmentally controlled
- Polymer Characterization Lab 230 m²

**Blade Testing in Offshore Wind Lab**

- 605 m² strongfloor
- Blade lengths up to 70 m
- Reaction wall static capacity > 30,000 kN·m
- Reaction wall fatigue capacity > 20,000 kN·m
- MTS FlexDAC and AeroPro testing systems
- Six winch frames with 130 kN static capacity
- Servohydraulic actuators to 2000 kN capacity
- MTS inertial resonance excitation systems
- Complete fixtureing and instrumentation services

**Design Capabilities**

- Computer aided design in SolidWorks or AutoCAD
- Finite element analysis in ANSYS or ABAQUS
- Nonlinear material modeling including impact and fatigue
- Multiphysics simulation in LS-DYNA
- Aeroelastic wind turbine analysis in FAST
- Hydrostatic design and damage stability analysis in GHS
- Hydrodynamic analysis in Multisurf, WAMIT and Aquas
- Coupled analyses, floating offshore wind focus

**Manufacturing Technology**

- Prepreg, tape and fiber lay-up
- Vacuum assisted resin transfer molding
- SCRIMP
- Extrusion and filament winding
- Injection and compression molding
- Property enhancement using nanomaterials
- Low-logistics concrete formwork
- Hybrid concrete / composite structures

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Flapwise testing of a 56 m wind blade.  Photo courtesy of Gamesa Corporation.
The UMaine Composites Center is an ISO 17025 accredited laboratory with more than 20 years of testing experience meeting industry standards from coupon-scale to full-scale, including wind blade testing to IEC 61400-23. Our competence and responsiveness have led to more than 500 product development and testing projects. The Offshore Wind Laboratory includes fully equipped, integrated laboratories to develop and test durable, lightweight, corrosion-resistant material solutions for the emerging offshore wind industry.

**IEC 61400-23 WIND BLADE TESTING**
- Static proof loads to > 30,000 kN-m
- Fatigue loads to > 20,000 kN-m
- Natural frequency and damping measurements
- Blade rotation system with >150 kN-m brake system
- Digital image correlation to characterize surface buckling
- Rolling ultrasonic probe to inspect adhesive joints

**STRUCTURAL TESTING EQUIPMENT**
- Servohydraulic static and dynamic tests
  - MTS AeroPro control system
  - MTS FlexDAC data acquisition system
- Structural test frames (vertical reaction)
  - 3 x 1300 kN capacity
  - 1 x 450 kN capacity
  - 1 x 220 kN capacity
- Structural test walls
  - 6 x 3200 kN·m capacity
  - 1 x >30,000 kN·m capacity
- Winch frames
  - 6 x 130 kN capacity
- Servohydraulic actuators, including:
  - 2 x 1300 kN (2000 kN in compression)
  - 3 x 450 kN
  - 3 x 250 kN
  - 3 x 100 kN, 1 high-speed (1.2 m/s)
- Hydraulic power supplies:
  - 280 kW in Offshore Wind Laboratory
  - 170 kW in Structural Testing Laboratory

**NONCONTACT DISPLACEMENTS AND STRAINS**
- GOM ARAMIS optical 3D deformation analysis
- Displacement resolution 0.1 mm over large surfaces
- Strain distributions around joints
- up to 50 MegaPixel camera resolution

**MATERIAL COUPON TESTING EQUIPMENT**
- Servohydraulic tension-compression test frames
  - 1 x 500 kN capacity
  - 3 x 100 kN capacity
  - 1 x 25 kN capacity
- Servohydraulic axial / torsional test frames
  - 1 x 100 kN / 1100 N·m capacity
  - 1 x 25 kN / 100 N·m capacity
- Drop weight impact testing machine, 1.5-1250 J

**NON-DESTRUCTIVE TESTING**
- Phased-array ultrasonic inspection
- Acoustic emission testing
- Embedded fiber optic strain sensing

**MICROSCOPY**
- Optical microscopy
- Scanning electron microscopy (SEM)
- Environmental SEM
- Microtomography
- Laser scanning confocal microscopy

**ENVIRONMENTAL TEST CHAMBER**
- 300 m³ chamber (6.8 m x 6.8 m x 6.1 m high)
- Door opening 4.3 m x 4.25 m high
- Temperature range -40 to +50°C
  - Uniformity ±3.0°C, constancy ±0.2°C
- Relative humidity range 20 to 95%
  - Uniformity ±5%, constancy ±2.5%
- Ramp rate in thermal cycling ±10°C per hour
- Capability to conduct fatigue tests within chamber

**ONSET OF BUCKLING**
- Surface displacement by 3D digital image correlation

**SUBSTRUCTURE TESTING**
- Plastic, adhesive and composite property testing
- Multiaxial strength and stiffness of substructures
- Application-specific fatigue, creep and impact testing
- Multi-scale tests from constituents to structures

**TESTING CAPABILITIES**

Offshore Wind Laboratory reaction wall

Offshore Wind Laboratory blade rotation system

Wind blade fatigue testing with inertial resonance excitation

Fracture mechanics testing

Offshore Wind Laboratory environmental test chamber