Since 1997, the Product Testing and Evaluation Laboratory, formerly part of the Furniture Manufacturing and Management Center (FMMC) at North Carolina State University, has provided the furniture and related industries with answers to questions about furniture design, construction, and reliability. The lab is currently equipped with three computer-controlled pneumatic flexible furniture testing frames (affectionately known as The Bifmatics), a universal materials testing machine, and two programmable environmental chamber.

Physical tests have been performed on finished goods such as office chairs, side chairs, classroom chairs, outdoor chairs, sofas, loveseats, ottomans, tables, storage units, TV stands, and even exercise benches. Sofa and chair frames have been evaluated to determine the effects of changes in materials or joint designs. Data obtained on raw material has helped manufacturers with supplier issues. Environmental tests have been conducted to determine the stability of veneer and joint constructions, or to evaluate the effectiveness of packaging methods. The facilities have also been used to assist with other materials-related issues such as the metallurgical analysis of hardware, scanning electron microscopy of surfaces, or elemental identification of unknowns via X-ray spectroscopy.

All of the above has evolved under the watchful eye of the CAMAL Testing Lab Manager, Dr. Harvey West, who draws on all of NC State to solve the many technical challenges faced in maintaining a state of the art testing facility. Since the beginning of testing, Harvey has completed over 800 testing projects for a wide range of furniture companies, and the demand for the Testing Lab is as high as ever.

If your company has any testing needs that the CAMAL staff can help you with, don’t hesitate to contact Harvey West at: 919-515-8527, or email him at: hawest@ncsu.edu.

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**Inside:**

- ANSI/BIFMA 5.1, 5.4; a taste of the tests
- Hot, cold, wet, or dry in the Environmental Chambers
- State of the art microscopy
- Some other ways to break stuff...
- Meet Dr. Harvey West
The Business and Institutional Furniture Manufacturers Association (BIFMA) in association with the American National Standards Institute (ANSI) have developed a series of performance standards that have been widely accepted by the furniture industry. The CAMAL Testing Lab has been able to become highly proficient at providing 3rd party testing to portions of those standards, specifically portions of ANSI/BIFMA Standards 5.1, 5.4, and 5.5 for the extendable member cycle test. Our testing capabilities include the following:

**BIFMA 5.1**
- Arm Durability
- Arm Strength - Horizontal
- Arm Strength - Vertical
- Back Durability
- Back Strength - No Tilt
- Drop Test
- Leg Strength - Front / Side
- Load Ease
- Out Stop
- Seating Impact
- Stability - Front
- Stability - Rear
- Tablet Arm
- Tablet Arm Load Ease
- Tilt (Seat) Mechanism

**BIFMA 5.4**
- Arm Durability - Horizontal
- Arm Durability - Vertical
- Arm Strength - Horizontal
- Arm Strength - Vertical
- Back Durability - Horizontal
- Back Durability - Vertical
- Back Strength - Horizontal
- Back Strength - Vertical
- Drop Test
- Leg Strength - Front / Side
- Seating Impact
- Stability - Front
- Stability - Rear
- Structural Durability
- Unit Drop Test

Above are examples of ANSI/BIFMA 5.4 tests in progress. The first picture is the Back Durability-Vertical test. The second picture is the Seating Impact test. The third picture is the Leg Strength-Front test. All testing is documented with video and/or digital photography, and a sophisticated system of electronic sensors enable the detection of exactly when and where any failure occurs during the testing process.

Below are examples of ANSI/BIFMA 5.1 tests in progress. The first picture is the Back Strength test. The second picture is the Arm Strength-horizontal test. The third picture is the Arm Strength-vertical test. Since the Furniture Manufacturing and Management Center Product Testing and Evaluation Lab started testing in late 1997, over 800 tests had been conducted by September, 2014 for more than 180 different companies.
Since 2011 we have had two Environmental Chambers, which enables us to provide a wide range of temperature and humidity related testing options. Fully programmable, the chambers can hold temperatures ranging from 15° F to 150° F, and the relative humidity can be controlled from 10%RH to 95%RH. The chambers allow us to duplicate some of the most challenging environments your products will face, and to cycle between hot and cold, wet or dry to see if your products can take it. Right and below are the walk in chamber.

Is a piano furniture? Well, maybe not, but this one has lots of wood, and the effect of humidity on a finely tuned musical instrument can be disastrous. Once again, the Chamber helped a client find the answers they needed. All furniture manufacturers have had to deal with joint or split problems more than they care to admit, but carefully controlled tests in the Chamber can give you the information needed to make those problems go away.

The Bifmatics and the Environmental Chamber are not the only tools at our disposal. To the left is a piece of Maple as viewed under an electron microscope, used to help us provide a client with needed information regarding glue adhesion. We regularly work with other parts of NC State to find the answers our clients are looking for.

We do have our own high powered microscope, however. Right is a Hirox KH-7700 Advanced 3D Digital Microscope that provides us with the ultimate in high performance observation, measurement, analysis, recording, management, and output of testing specimens that allows us to be an excellent resource to clients.

Left is our Model 910LX15 Axial Fatigue Test machine from Testresources. This 3300 lb. capacity equipment can produce high test loads at high test speeds, and is great for finding out where and when a part will wear out. The monitoring and control technology that’s a part of the 910LX15 is state of the art, and when used in conjunction with our strain gauge technology from MicroMeasurements we can set it, forget it, and still tell you exactly what happened.

Our ATS Series 1620 20,000 lbs. Universal Materials Testing Machine can be used in a wide variety of ways. Above, a screw holding strength test is under way. Below, a joint is being put through the paces to see just how much it can take. Our Parameter Generation and Control 30 cubic ft. chamber, below, is designed to accurately produce the temperature and humidity conditions required for applications including stability studies, package testing, vapor transmission, and many other variables that arise in the world of manufacturing. We use this unit frequently for testing plywood and other manufactured wood products.
Dr. Harvey West, Ph.d., P.E.

Dr. Harvey West joined the ISE staff in August, 1997, bringing an impressive background in materials science and testing research to the task. West earned his doctorate in the Department of Materials Science and Engineering at NCSU and is a registered engineer in North Carolina. He has been manager of the Raleigh branch of Materials Analytical Services, a private testing laboratory. Before that, he was in charge of the testing facilities in the Materials Science and Engineering department at NCSU and taught courses on the characterization of the mechanical behavior of materials, including composites.

Harvey has conducted more than 800 tests for over 180 different companies at the Product Testing and Evaluation Laboratory. He also manages to find time to participate in extensive research activities, and along with Dr. Denis Cormier and Dr. James Taylor, secured U.S. Patent No. 6,324,438 having to do with the "Methods and Apparatus for Rapidly Prototyping Three-Dimensional Objects from a Plurality of Layers." This impressive background has enabled Harvey to become a tremendous resource for all industries, and he is eager and willing to work with your company to identify testing and evaluation opportunities that can help you improve your products and services for your customers. Call Harvey today at 919-515-8527, or email him at hawest@ncsu.edu.

The Center for Additive Manufacturing and Logistics

Established in 2014, the Center (CAMAL) conducts a program of applied research and technical assistance in support of additive manufacturing and logistics, along with a program of sophisticated furniture testing recognized nationwide. The Center is part of the NCSU College of Engineering and is located in the Edward P. Fitts Department of Industrial and Systems Engineering (ISE). CAMAL is funded by the state of North Carolina, and by revenues generated from research projects, extension activities, and testing services. CAMAL was formerly the Furniture Manufacturing and Management Center, or FMMC.

CAMAL offers a full range of extension services to manufacturing industries in addition to the Testing and Evaluation Lab. These services are supported by a veteran extension staff with years of manufacturing experience, as well as the entire N.C. State faculty. We have been conducting in house projects and training classes throughout industry since our beginning as the FMMC and welcome any inquiries regarding how we can help your company compete in a challenging global economy.