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Dear Colleagues,

It’s been another great year for the National Institute for Aviation Research at Wichita State University. With the help of the local aircraft industry, the Kansas State Legislature and organizations like the Federal Aviation Administration and the Kansas Technology Enterprise Corporation, NIAR continues to grow at a rapid rate.

We welcomed the addition of several new staff members this year including Tom Aldag, Director of Research and Development; John Moore, Senior Advisor to the Executive Director; Wade Davis, Environmental Lab Manager; Allison Crockett, Research Engineer in the Composites Lab and Dr. Udo Schultheis, Research Scientist in the Human Factors Lab.

And with internal growth comes the need for more space. A new 14,000 square-foot laboratory facility is being completed behind NIAR's primary building on the WSU campus. The facility will provide additional space for the Composites and Structures Laboratories and the new Environmental Test Laboratory.

The addition of the Environmental Test Laboratory gives NIAR the ability to provide RTCA DO-160 certification services to the aircraft industry. Currently the lab is able to perform testing in the areas of: temperature and altitude variation, humidity, sand and dust, salt spray, icing and electrically-induced effects. In the coming year, the lab will add the following capabilities: operational shocks and crash safety, vibration, explosion proofness, fluids susceptibility, radio frequency susceptibility, emission of radio frequency energy and fire and flammability. This combination of laboratories enables aircraft manufacturers and parts manufacturers to perform all DO-160 testing in one location instead of performing tests at various locations throughout the country.

These are only a few of the many significant events that occurred at NIAR this year. Take a look at the rest of the report for more news and updates on all of the labs. NIAR's continuing relationship with and commitment to the aircraft industry will ensure another successful year of ground-breaking research, design, testing and certification. Thank you for your support.

Sincerely,

John Tomblin, Ph.D.
NIAR Executive Director,
Sam Bloomfield Distinguished Professor of Aerospace Engineering
The NIAR Industry Advisory Council provides NIAR researchers with input from the local aviation industry regarding research and development needs. This information is used to determine future research topics, equipment updates and laboratory additions at NIAR. The IAC is made up of senior level management at Boeing Integrated Defense Systems, Bombardier/Learjet, Cessna Aircraft Company, Hawker Beechcraft Corporation and Spirit Aerosystems.
FY 2007 OPERATING BUDGET: $35,300,000
The ground-breaking aviation research, design, testing and certification that occurs at NIAR on a daily basis wouldn’t be possible without the dedication of NIAR’s qualified staff of researchers, administration, support staff and students. This year our staff reached a total of more than 350 employees. This diverse staff holds a variety of degrees relevant to their individual job responsibilities. See the breakdown to the right.

- 61 Ph.D.s
- 22 Masters degrees
- 64 Graduate research students
- 112 Bachelors degrees
- 13 Associates degrees
- 4 Technical degrees
- 13 Administrative staff
- 70 Undergraduate students
NIAR does business with many local, national and international aviation businesses, government agencies, educational entities and other organizations each year. The following is a list of organizations NIAR provided services for during our 2007 fiscal year. Some involved $100 contracts. Others involved $1 million contracts. All are important to our continued growth and success.

3 TEK Inc  
AAR Composites  
Adam Aircraft Industries  
Advanced Composites Group  
Aero Electric  
Aero Instruments  
Aero Twin Inc.  
Aero-Tech Engineering  
Agilent Technologies  
Air Capital Equipment  
Airbus North America Engineering  
Aircraft and Commercial Enterprises  
Aircraft Belts  
Airtrain  
ALCOA  
Amarillo Foundry and Steel  
Apex Engineering, International  
Applied Composite Technology  
Appreciated Advertising  
Arizona Paradeogrope Systems  
AV Data  
Avcon Industries  
Aviation Technology Group  
B/E Aerospace  
Badencor  
Baja Electrical  
BCI Wireless  
Bell Helicopter Textron  
Benecor  
The Boeing Company  
Boeing Military Aircraft and Missile Systems  
Bombardier Aerospace  
Britax Child Safety  
Bruckner Supply Company  
Bryte Technologies  
Buell Racing  
Burnham Composites  
Case New Holland  
Center Industries  
Cessna Aircraft  
CG Tech  
Cirrus Design Corporation  
Coffeyville SEKTAM  
Composite Solutions Corporation  
Composites Universal Group  
Confederation College  
Connoisseur Records  
Critical Materials  
CSI Aerospace  
Cytec Engineered Materials  
D-J Engineering  
Dassault Systemes Services  
de Havilland  
Defense Research Associates  
DEN/PMC  
DIAB  
Electromech Technologies  
Embry-Riddle Aeronautical University  
EMS Technologies  
EngineeringCom  
The Engineering Institute  
Epic Air  
Fiber Dynamics  
FiberCote Industries  
Garmin International  
General Atomics Aeronautical Systems  
GKN Aerospace Service  
Glenn Hepfner  
Goodrich Corporation  
Gulfstream Aerospace Corporation  
Harley-Davidson Motor Company  
Harper Trucks  
Hawker Beechcraft Corporation  
Hexcel Corporation  
ICAM Technologies Corporation  
Integrated Aerospace  
J B Dwerlkotte Associates  
Kinedyne Corporation  
Koch-Glitsch  
KWP H2 Corporation  
Labinal - Corinth  
Lampton Welding Supply  
Lancair Company  
Lee Aerospace  
Liberty Aerospace  
Lockheed Martin Corporation  
M & P Engineering  
Manufacturing Support Technologies  
Marketing Serv and Exhibits  
Mid-Central Manufacturing  
Mid-Western Aircraft Systems  
Millennium Concepts  
Milling Precision Tool  
MSC Software  
MTS Systems  
National Transportation Safety Board  
Naval Surface Warfare Center  
Nelcote  
Netec  
Newport Adhesives and Composites  
Nikon  
Noble Enterprises  
The Nordam Group  
North American Aviation  
Northrop Grumman Corporation  
O.C.T. Fiberglass Products  
Old Dominion University Rsrch. Fdtm.  
Orion America Technologies  
Paragon Services  
Parks College of St. Louis University  
PCI Newco  
Pepin Associates  
Phantom Hill Productions  
PlasticFab  
Polaris Industries  
Precision Aerospace and Composites  
Precision Air  
Quality Plating Company  
QuikService Steel Company  
Race Cars of the Future  
Radiance Technologies  
Raytheon Missile Systems  
RECARO Aircraft Seating  
Reinhold Industries  
Rocketplane Limited Corporation  
Rockwell Collins  
Rockwell Scientific Company  
Rocky Mountain Composites  
Royal Plastic Manufacturing  
Royal Window Coverings  
RV Products  
Sandia National Lab  
Scaled Composites  
Schröth Safety Systems  
Sedgwick County Workforce Development  
Senior Aerospace Composites  
Sierra Designs  
Sikorsky Aircraft  
Sinclair Technologies  
Sino Swearingen Aircraft Company  
Social and Rehabilitation Services  
Specialty Materials  
Specialty Metals  
Speed Sport Engineering  
Spirit AeroSystems  
Square One Armoring Services  
Strongbow-Chatfield Division  
STW Composites  
Syndetix  
TDA Research  
TENCATE Advanced Composites  
Textron Systems Corporation  
Thermal Solutions  
Toray Composites America  
Toyota Motor Sales, USA  
Tridaq  
V5 Engineering  
Vatterott Educational Centers  
Virtual Product Definition Group  
Vought Aircraft Industries  
Web Converting of Atlanta  
Wetzel Engineering  
Wheatland Industries  
Wichita Technology Corporation  
Winlet Technology  
Winstead Sechrist & Minick  
Work Force Alliance  
York Unitary Products Group  
ZTM
ABOUT THE ADVANCED JOINING & PROCESSING LAB

The Advanced Joining and Processing Laboratory focuses on friction stir welding and its variations: friction stir spot welding and friction stir processing (FSP). The lab offers high quality, reliable welding solutions and energy-efficient and environmentally friendly technology that eliminates the need for filler metals or shielding gases.

IN 2007

The Advanced Joining & Processing Laboratory has seen tremendous growth. In addition to installing a MTS 22 kip servo-hydraulic load frame and a metallurgical evaluation laboratory, the lab is now officially a research site for the National Science Foundation’s Center for Friction Stir Processing (CFSP).

The CFSP is a multi-institutional Industry/University Cooperative Research Center (I/UCRC) started in October 2004. The center brings together premier academic institutions in the United States that focus on friction stir processing and addresses the needs of aerospace, aeronautic, automotive, naval, energy, military and commercial industries in developing FSP.

The existing CFSP university research sites in addition to Wichita State are the South Dakota School of Mines, the University of South Carolina, Brigham Young University and the University of Missouri–Rolla.

The following organizations have joined the CFSP as sponsors of the WSU research site. They will support the Advanced Joining & Processing Lab’s CFSP research projects.

• Bombardier/Learjet
• Cessna Aircraft Company
• Federal Aviation Administration
• General Motors
• Hawker Beechcraft
• Spirit AeroSystems

The lab is also funded by the Federal Aviation Administration, NIAR/Industry/State and industry contracts from aerospace companies.

The following innovative tooling designs were developed and trademarked in the lab this year:

• Wiper™ (patent pending)
• Counterflow™ (patent pending)
• Psi™
• Containment Ring™

Researchers also attended conferences throughout the U.S and in Canada and Europe to present and exchange ideas.

Friction stir processing of a nickel-aluminum-bronze alloy to enhance mechanical properties.

Dwight Burford, PhD
Director
Sr. Research Scientist
(316) 978-3204
dwight.burford@wichita.edu

WWW.NIAR.WICHITA.EDU/ADVANCEDJOINING
ABOUT THE AERODYNAMICS LAB

The Aerodynamics Laboratories consist of a flow visualization tunnel and the Walter H. Beech Wind Tunnel, a premier seven foot by ten foot subsonic tunnel. The lab also has access to WSU’s three by four foot wind tunnel and two supersonic wind tunnels.

IN 2007

The Aerodynamics Lab performed proprietary wind tunnel tests for several companies including an aircraft refueling system manufacturer and an ATV manufacturer. The lab also provided research assistance in a legal case involving a private aircraft and supported aircraft icing research for Dr. Michael Papadakis, Wichita State professor of aerospace engineering.

The lab employed four undergraduate research assistants and one graduate research assistant, two of which obtained summer internships at NASA.

Also in 2007, plans, designs and construction of the lab’s newest equipment upgrade were finalized. A new sting system and internal balances will be installed, on-line and ready for testing in January 2008. This new equipment, which was built by Aerotech ATE Ltd., finalizes the upgrade of the Walter H. Beech Wind Tunnel that began in 2003. This system enables the wind tunnel to achieve model pitch positions in greater ranges than any other university-based commercial subsonic wind tunnel. In addition, the three new internal balances will enable robust and repeatable testing of three-dimensional aircraft wind tunnel models.

John Laffen  
Director  
(316) 978-3569  
john.laffen@wichita.edu

Above: Undergraduate students David Jaeger and Kevin Kelly prepare the wind tunnel for a research project. Below: The 2,500 horsepower electric variable frequency drive unit is the powerhouse of the Walter H. Beech Wind Tunnel.

WWW.AERO-LABS.ORG
ABOUT THE AGING AIRCRAFT LAB

The Aging Aircraft Laboratory investigates the effects of age on passenger, commercial and military aircraft. Lab technicians use sophisticated equipment and techniques to detect problems such as cracks and corrosion. The lab is located at NIAR’s Aircraft Structural Testing and Evaluation Center (ASTEC) on the campus of Hawker Beechcraft.

FY 2007 PROJECTS

Teardown Evaluation of 1993 Beechcraft Model 1900D and a 1975 Piper Navajo Aircraft

In order to determine if potential continuing airworthiness problems exist for the general aviation fleet as a function of the aging process, the FAA established a two-phase research program to conduct a destructive evaluation of four aged airplanes (two Cessna 402s, a Piper Navajo Chieftain, and a Beechcraft 1900D) used in commuter service. This destructive evaluation will generalize recommendations on inspection programs and aircraft conditions to the entire commuter/general aviation fleet, as opposed to making specific recommendations on a particular model.

FAA Demographic Database Project

This program involved collecting pertinent demographic data related to the general aviation fleet for future risk assessment, particularly pertaining to aging aircraft issues. NIAR conducted a comprehensive analysis of the small airplane fleet in order to determine fleet distribution by type, manufacturer, model, calendar year and aircraft usage.

Teardown and Inspection of F-16 Static Test Article

Sponsored by Lockheed Martin, this project evaluated the structural integrity of an F-16C static test article by a comprehensive teardown and inspection. One objective of the teardown and inspection was to find any unexpected damage in areas that were previously not accessible. The inspection also examined areas with expected damage and confirmed the extent of the damage.

WWW.NIAR.WICHITA.EDU/AGINGAIRCRAFT
ABOUT THE CAD/CAM LAB

The CAD/CAM Laboratory specializes in the instruction of CATIA and ENOVIA courses for the aircraft industry. NIAR’s CAD/CAM instructors teach courses on NIAR’s third floor and on-site at local aircraft manufacturing companies. The lab also develops course manuals for all of the courses it offers, which are available for purchase. The Visual Technology Lab, a division of the CAD/CAM lab, teaches courses in Maya computer animation.

IN 2007

The CAD/CAM Lab held a total of 69 academic sessions with more than 675 students including training for Bombardier/Learjet, Spirit AeroSystems, Boeing, Cessna and Hawker Beechcraft.

CAD/CAM Lab Associate Director Brian Brown took first place in the Top Gun Competition at the 2007 COE conference. This is the second consecutive year Brown has placed in the competition.

The lab entered an agreement with Engineering.com to sell CATIA instructional textbooks through the site’s CATIA education center at www.catiastudent.com. The lab is also in the Education Partner Program with Dassault Systemes.

PARTNERSHIPS:
• Dassault Systemes
• V5 Engineering
• Technigraphics
• MSC
• CGTech Vericut
• ICAM

COURSES IN DEVELOPMENT:
• CATIA Composites
• CATIA Tubing and Piping
• CATIA Advanced Machining

COURSES OFFERED:
• CATIA Basic Concepts
• CATIA Part Design & Sketcher
• CATIA Assembly Design
• CATIA Drafting
• CATIA Wireframe & Surfaces
• CATIA Prismatic Machining
• CATIA Surface Machining
• CATIA Fitting Simulation & Kinematics
• CATIA Functional Tolerancing & Annotation
• CATIA Stress Analysis
• CATIA Knowledgeware
• CATIA Sheet Metal Design
• CATIA Electrical Space Reservation
• CATIA Electrical Design
• CATIA Electrical Harness Design
• ENOVIA DMU Viewer
• ENOVIA LCA Basic Concepts
• ENOVIA LCA Advanced Concepts
• ENOVIA LCA Product Design
• ENOVIA VPM Navigator
• Maya

WWW.VISTECHLAB.COM
WWW.CADCAMLAB.ORG
ABOUT THE COMPOSITES AND ADVANCED MATERIALS LAB

As NIAR’s largest and most well-known lab, the Composites and Advanced Materials Laboratory performs 70 percent of the FAA’s composites research and certifies composite materials for numerous composite material manufacturers. The lab employs 32 full-time staff members, 19 of which are lab managers. It also employs more than 100 undergraduate/graduate students.

IN 2007

The Composites and Advanced Materials Laboratory served more than 50 aerospace companies, increasing industry support of the lab by 80 percent in one year. In order to accommodate this increase in business, the lab’s staff increased by 35 percent.

In addition to the certification services provided for the composites manufacturing industry, the lab also performed several research projects including the following:

• Bonded Repair of Composite Laminate and Sandwich Structures
• Effects of Process Parameters on the Performance of Repairs Applied to Solid Laminate and Sandwich Structures
• Aging of Composite Airframe Structures: Aging Effects Evaluation of a Boeing Decommissioned CRFP 737 Horizontal Stabilizer
• Aging of Composite Airframe Structures: Beechcraft Starship Teardown
• Full-Scale Damage Tolerance of Sandwich Structures
• Fluid Ingression Damage Mechanism in Composite Sandwich Structures
• Blind or One-Sided Fastener Usage in Composite Structures (Production and Repair Application)
• Effects of Manufacturing Defects in Composite Structures
• Production Control Effect on Composite Material Quality and Stability
• Technology Assessment of the Airworthiness of Unmanned Aerial Systems
• Composite Material Qualification and Allowable Generation

Research engineer Allison Crockett (far right) assists engineers from Bombardier/Learjet in preparing composite panels in the recently updated lay-up room of the Composites and Advanced Materials Lab.

John Tomblin, PhD
Director
(316) 978-5234
john.tomblin@wichita.edu

Janna Sherraden
Associate Director
(316) 978-5235
janna.sherraden@wichita.edu

WWW.NIAR.WICHITA.EDU/COMPOSITES
The Crash Dynamics Laboratory performs testing and certification for transportation seats and restraint systems. The backbone of the lab is a MTS model 888.20 horizontal crash simulator. In addition to its state-of-the-art sled system, the lab has a family of 17 anthropomorphic test dummies including a FAA Hybrid III 50th percentile male, Hybrid III 50th and 95th percentile males (used in automotive tests), Hybrid II 50th percentile males, a EuroS.I.D. II, 5th percentile female, six-year-old, three-year-old and 12-month-old Child Restraint Airbag Interaction (CRABI) dummy.

**About the Crash Dynamics Lab**

In 2007

In addition to performing various FAR 23, 25, 27 and 29 seat certifications for aircraft companies and suppliers, the Crash Dynamics Lab was involved in the following research projects:

**Mass Transit Bus Crashworthiness - Federal Transit Administration, U.S. Dept. of Transportation**
Evaluates the crashworthiness of mass transit buses and recommends interior design guidelines in order to decrease the fatalities and injury severity to bus occupants during a crash event.

**Aerospace Child Seat Provisions - NIAR/Industry/State**
Development and testing to determine the optimum means of child restraint in aircraft during emergency landing conditions for 12-month-old, three-year-old and six-year-old occupants.

**Performance Evaluation of Child Seats in Lateral Sled Tests at Varying Speeds - National Science Foundation, CChIPS**
Proposes to address a problem that is critical to child passenger safety by conducting a systematic assessment of changes in performance of child safety seats through a series of sled tests at varying speeds in a far side impact configuration.

**WWW.CRASHSTUDIES.ORG**
ABOUT THE ENVIRONMENTAL TESTING LABS

Currently, NIAR is home to three environmental testing laboratories. By mid 2008, NIAR will provide a full range of RTCA DO-160 testing.

IN 2007

The Susceptibility Test Lab opened in May and hosted its first client, ICE Corporation. The lab offers DO-160 certification for sections 15-19 and 25 as shown below.

• Section 15 Magnetic Effects: Insures aircraft equipment can operate properly within the magnetic field of equipment or another aircraft system.
• Section 16 Power Input: Performs various tests to identify susceptibility of the AC or DC power inputs for aircraft systems and equipment.
• Section 17 Voltage Spike: Determines whether the aircraft systems or equipment can withstand the effects of voltage spikes arriving at the equipment power leads.
• Section 18 Audio Frequency Conducted Susceptibility: Determines whether the equipment will accept frequency components of a magnitude normally expected when the equipment is installed in the aircraft.
• Section 19 Induced Signal Susceptibility: Determines whether the equipment interconnect circuit configurations will accept a level of induced voltages caused by the installation environment.
• Section 25 Electrostatic Discharge (ESD): Determines the immunity or the ability of the equipment to perform its intended function without permanent degradation of performance as a result of an air discharged electrostatic pulse.

The Indirect Lightning Lab opened in June 2007. It provides DO-160 section 22 certification for lightning induced transient susceptibility. For its first client, Electromech Technologies, the lab performed tests on a flap system designed for the Quest Kodiak.

www.niar.wichita.edu/environmental
ABOUT THE FATIGUE & FRACTURE LAB

The Fatigue & Fracture Laboratory conducts fatigue experiments to generate S-N curves and fatigue crack propagation data to assess the fatigue characteristics of materials used in metal and composite structures. The lab also tests materials to quantify fatigue damage accumulation and residual fatigue life in older aircraft.

FY 2007 PROJECTS

- Data and Methodologies for Structural Life Evaluation of Small Airplanes Phase II
- Effects of Laser Beam Weldments on the Mechanical Properties of Titanium Specimens
- Evaluation of Friction Stir Weld Properties for Aircraft Application
- Crashworthiness of Composites - Material Properties Under Dynamic Loading
- Blind Fastener Usage in Composites Structures
- Composite bonded repair variable investigation
- Composite effects of defects program: effects of ply wrinkling, expired materials, alternate cure cycle and allowable damage limit investigation
- Effects of Porosity on Mechanical Properties of Graphite Epoxy Cloth, Unitape and Astroquartz Laminates
- Composite investigation of stress concentrations under fatigue loading

Above: A MTS load frame performs a fatigue test on an aluminum 7075 sample in the Fatigue & Fracture Lab. Below: A student checks the resistance of the crack detection system on a specimen prior to testing.
The Full-Scale Structural Test Laboratory is located at NIAR’s Aircraft Structural Testing & Evaluation Center (ASTEC) on the campus of Hawker Beechcraft. The lab performs full-scale static and fatigue tests for aircraft manufacturers, government agencies and other organizations to assess structural performance and durability.

IN 2007

The Full-Scale Structural Test Lab performed a wide variety of tests and certifications, several of which were proprietary and can not be mentioned in this report. Some examples of non-proprietary tests conducted in the past year include the following:

**Liberty Aerospace XL2 Fuselage DDT**
Completed three lifetimes of durability and damage tolerance cyclic testing on the Liberty XL2 fuselage full scale article in support of the Liberty XL2 fuselage certification per 14 CFR Part 23.

**Hawker Beechcraft Corporation Projects**
- T-6A Nose Gear Spring Strut Test – conducted cyclic testing on five articles.
- Model 4000 (FT-689) – Spigot inspection and instrumentation rework.
- T-6A Inboard Gear Door Testing – completed initial phase and initiated second phase for FAA certification

**Big Crow (KC-135) Aircraft Seat Tests**
Tested load conditions.

The lab also supported various NIAR/Industry/State programs by conducting static and fatigue tests.
ABOUT THE HUMAN FACTORS LAB

Human factors psychology deals with work-related tasks in the context of human-machine system operation and the identification of variables that affect operator performance. Human factors research is driven by the need for pragmatic solutions that minimize human error and optimize user performance in the face of increasingly complex technology. The Human Factors Laboratory conducts applied and basic research projects designed to meet the immediate needs of the aviation and aerospace industries.

IN 2007

The Human Factors Lab was contracted by General Atomics to assist with design of a new pilot and sensor operator’s station to replace their existing ground control stations (GCS). The lab was tasked with validating the cockpit’s anthropometric/ergonomic design and with the development of a novel and intuitive software interface. Development of the GCS was commissioned by the U.S. Air Force. Completion is expected in 2009.

The lab is working on a project funded by Telerobotics Corporation involving the evaluation of an interface for remotely controlled defensive weapons. They have also begun a project for the U.S. Air Force that seeks to identify the most significant human factors-related problems associated with the failure of aircraft mechanics to detect cracks in bolt holes when performing non-destructive eddy current inspection.

Lab personnel are involved in several additional projects including investigations concerning pilot decision making styles and the effects of aging on pilot performance.
ABOUT THE STRUCTURES LAB

The Structures Laboratory supports numerous research projects funded by the FAA and the NIAR/Industry/State program, and generates advanced composite material design allowables for a broad range of aviation companies.

FY 2007 PROJECTS

- Data and Methodologies for Structural Life Evaluation of Small Airplanes Phase II
- Effects of Laser Beam Weldments on the Mechanical Properties of Titanium Specimens
- Evaluation of Friction Stir Weld Properties for Aircraft Application
- Crashworthiness of Composites - Material Properties Under Dynamic Loading
- Blind Fastener Usage in Composites Structures
- Composite bonded repair variable investigation
- Composite Effects of Defects Program: effects of ply wrinkling, expired materials, alternate cure cycle and allowable damage limit investigation
- Effects of Porosity on Mechanical Properties of Graphite Epoxy Cloth, Unitape and Astroquartz Laminates
- Composite investigation of stress concentrations under fatigue loading

WWW.NIAR.WICHITA.EDU/STRUCTURES
ABOUT THE CALIBRATION & QUALITY LAB

The Calibration & Quality Laboratory consists of two sections. One section focuses on the calibration of MTS and other equipment used in the Fatigue & Fracture, Structures, Full-Scale Structural Testing, Advanced Joining & Processing, Composites & Advanced Materials and Environmental Testing Laboratories.

The other section is used to calibrate anthropomorphic test dummies used for seat testing in the Crash Dynamics Lab.

IN 2007

The Calibration & Quality Lab began performing in-house calibrations for NIAR's laboratories, eliminating the need for NIAR to use external calibration companies. The presence of the Calibration & Quality lab has made research and testing at NIAR more cost-efficient and timely.

In FY07 the lab added the following equipment for calibration:

- Tovey 11-kip frame for ASTM E-74 for force calibrations
- Tovey 110-kip frame for ASTM E-74 for force calibrations
- Tovey Portable System for ASTM E-4 for force calibration of load frames
- Boeckeler Model 1338 digital micrometer for ASTM E-83 calibration extensometers
- Boeckeler Model DLG-310 digital linear gage for calibration of load frame LVDTs
- Fluke 5520A/6 Multi-Product calibrator, w/ METCAL & MET/Tracking for calibration of voltmeters, oscilloscopes, temperature devices, etc.
- G.E. Hydraulic Deadweight Tester (200 to 20,000 psi) for calibration of pressure gages and transducers.
- Starrett HE400 Optical Comparator for checking the gage length of extensometers. (Also used by Research Machine Shop for checking the dimensions of in-house designed cutting tools and Advanced Joining & Processing Lab for measuring mandrel wear.)

WWW.NIAR.WICHITA.EDU/CALIBRATION
Researchers and faculty associated with the Computational Mechanics Laboratory engage in research in the areas of crashworthiness, aerospace structures, biomechanics, virtual testing, virtual product development and applied numerical methodologies.

**FY 2007 PROJECTS**

**Mass Transit Bus Crashworthiness - Federal Transit Administration, U.S. Dept. of Transportation**
Evaluates the crashworthiness of mass transit buses and recommends interior design guidelines in order to decrease the fatalities and injury severity to bus occupants during a crash event.

**Certification by Analysis: Numerical ATD Validation - Federal Aviation Administration**
Provides guidance on how to validate the ATD numerical models and under what conditions the numerical models may be used in support of certification or TSO approval/authorization.

**Certification by Analysis: Material Database - Federal Aviation Administration**
Focuses on determination of the mechanical properties of the typical aircraft seat materials as a function of strain rate.

**Aerospace Child Seat Provisions - NIAR/Industry/State**
Development and testing to determine the optimum means of child restraint in aircraft during emergency landing conditions for 12-month-old, three-year-old and six-year-old occupants.

**Amelia Earhart July 2nd 1937 Pacific Ocean Crash Reconstruction - National Geographic Channel**
Evaluation of whether or not Amelia Earhart would have survived ditching her aircraft in the Pacific Ocean. Included development of a finite element model of Earhart’s Lockheed Electra, simulation of the ditching event using ALE techniques, a survivability assessment and photorealistic rendering of the numerical model.
ABOUT THE RESEARCH MACHINE SHOP

The Research Machine Shop is a state-of-the-art facility capable of meeting the research needs of the aviation industry. The shop provides high quality machining support and expertise for research activities at NIAR, WSU and beyond.

FY 2007 PROJECTS

• Worked on several icing research projects for WSU College of Engineering.
• Provided test support, repairs and upgrades for Walter H. Beech Wind Tunnel.
• Provided test support, seat track modification and camera mounts for the Crash Dynamics Lab.
• Provided ALCOA FSW research, test coupons and pen tools for the Advanced Joining & Processing Lab.
• Machined parts for a research system for WSU College of Engineering.
• Provided support for research on aircraft coatings for WSU chemistry department.
• Machined test coupons and tooling for Nordam Transparency Div. - Tulsa, Okla.

Above: Machining of vortex generators used for dispersing water droplets in icing research performed in the Walter H. Beech Wind Tunnel. Below: A friction stir welding pen tool designed by NIAR’s Advanced Joining & Processing Lab undergoes precision CNC machining in the Research Machine Shop. Inset: detailed view of pen tool as seen with the Research Machine Shop’s new bore scope.
ABOUT THE VIRTUAL REALITY CENTER

The Virtual Reality Center performs interactive visualization and simulation for design decision and collaboration in areas such as conception, engineering, certification, manufacturing and marketing. The center houses full- and semi-immersive visualization equipment, seating for 25, an active stereoscopic 15 x 7 foot flat screen driven by rear projectors, 3D glasses, manipulation gloves, a head-mounted display and optical and electromagnetic motion tracking systems.

In-house customizing of commercial run-time software is used to visualize and simulate data sourced in CAD/CAE/CAM of the main Product Lifecycle Management providers. The VRC provides services to aviation and non-aviation industries as well as other NIAR labs.

FY 2007 PROJECTS

• Full immersive simulation for a pilot and control station in order to support human factors evaluation of first person perspective and basic interaction.
• Continued support for NIAR’s Computational Mechanics Lab involving real-time post-processing of several FTA and FAA crash simulations.
• Collaborative design review for a new line of Case New Holland skid steers.
• Technical support and virtual environment simulation for “Virtual Reality System with Haptic / Auditory Devices for Assembly and Maintenance Training and Certification” (ADMRC project) with WSU Industrial Engineering Department.
• Partnered with Computational Mechanics Lab to create a simulation for a National Geographic documentary involving Amelia Earhart’s disappearance.
• Provided several technology showcases for organizations including Hawker Beechcraft, Cessna, Spirit Aerosystems, Bombardier/Learjet and Airbus.

CAPABILITIES

• Virtual Prototyping: conception & design phases from any Computer- Aided Design (CAD) or Computer-Aided Industrial Design (CAID) data
• Digital Engineering: pre- and post-processing massive Computer Aided Engineering (CAE) data sets for analysis and certification purposes
• Ergonomics and Human Factors: real-time anthropometrical analysis in first person perspective for assembly, accessibility and training evaluations
• Digital manufacturing: real-time process plan and work cell simulation
• Sales/Marketing: real-time product customizing and realistic demos for clients

Virtual Reality Center Lab Manager Fernando Toledo observes a 3D computational simulation of the crash of Amelia Earhart’s Lockheed Electra.
ABOUT THE FAA AIRWORTHINESS ASSURANCE CENTER OF EXCELLENCE

MISSION:
To work in partnership with academia, industry and government to provide timely, cost-effective, validated, advanced technologies and a skilled workforce to improve airworthiness assurance over the short, mid and long-term. AACE will maintain a repository of knowledge and build a talent pool that will improve aviation safety and strengthen the competitive position of the U.S. aviation industry.

The FAA established the Airworthiness Assurance Center of Excellence (AACE) in September 1997. NIAR is a core member of AACE, along with 29 other universities.

The AACE team is designed to address the full spectrum of research, from basic research through applied research, validation and technology transfer. This unique center has attracted research in the areas of aviation safety, including composites and advanced materials, crashworthiness, icing and aging aircraft.

FY 2007 PROJECTS

- Evaluation of Airworthiness for Aging Small Airplanes
- Dynamic Seat Cushion Replacement for Aircraft
- Aging of Composite Aircraft Structures: Decommissioned Boeing 737 Tail
- Development of a de facto Standard for Tool Calibration Program
- Data and Methodologies for Structural Life Evaluation of Small Airplanes
- Operational Loads Monitoring of FAR Part 23 Airplanes
- Fatigue Crack Growth Testing to Quantify the Effects of Shot Peening for Metallic Rotorcraft Components
- Implementing Usability Techniques in the Development of Aviation Maintenance Manuals
- Exploring Critical Flight Conditions, Controller Modes and Parameter Estimation for Adaptable Flight Controls in General Aviation Aircraft
- Testing of Full-Scale Composite Sandwich Fuselage Panels
- Continued Electromagnetic Protection Integrity for Aircraft and Systems

Research technicians dismantle a Piper Navajo Chieftain in NIAR’s Aging Aircraft Laboratory
ABOUT THE FAA CENTER OF EXCELLENCE FOR COMPOSITES AND ADVANCED MATERIALS

MISSION:
To provide the nation with a center for the validation and quality assurance of composites and advanced materials to be applied in the construction of large commercial transport aircraft through (1) research, testing, certification and technology transfer; (2) coordination and cooperation with the FAA, large commercial transport aircraft manufacturers, materials suppliers and airline companies; and (3) education of the aircraft manufacturing and maintenance work forces.

CECAM is part of the FAA's Joint Advanced Materials and Structures Center of Excellence (JAMS) and focuses primarily on the safety and certification of emerging applications of composites and advanced materials in commercial transport aircraft.

CECAM is led by Wichita State University with core members from Northwestern University, Purdue University, Tuskegee University, the University of Delaware and the University of California at Los Angeles.

OBJECTIVE:
Perform basic and applied research within specific technology areas and facilitate growth and education of the use of advanced materials with emphasis on the needs of the large transport aircraft industry while supporting the safety and certification issues involved with airworthiness assurance.

FY 2007 PROJECTS

WICHITA STATE UNIVERSITY
• Crashworthiness of Composites - Material Dynamic Properties
• Production Control Effect on Composite Material Quality and Stability
• Evaluation of Friction Stir Weld Process and Properties for Aircraft Application
• Aging of Composite Airframe Structures: Aging Effects Evaluation of a Boeing Decommissioned CRFP 737 Horizontal Stabilizer
• Aging of Composite Airframe Structures: Beechcraft Starship Teardown
• Damage Tolerance Testing and Analysis Protocols for Full-Scale Composite Airframe Structures under Repeated Loading
• Methods for the Evaluation of the Fitness of Fiber Reinforced Composite Surfaces for Subsequent Adhesive Bonding
• Effect of Repair Procedures Applied to Composite Aircraft Structures
• Technology Assessment of the Airworthiness of Unmanned Aerial Systems
• Certification by Analysis
• Full-Scale Damage Tolerance of Sandwich Structures
• Fluid Ingression Damage Mechanism in Composite Sandwich Structures

PURDUE UNIVERSITY
• Damage Tolerance and Durability of Adhesively Bonded Composite Structures

UCLA
• Damage Tolerance and Durability of Fiber-Metal Laminates for Aircraft Structures

NORTHWESTERN UNIVERSITY
• Structural Health Monitoring for Life Management of Aircraft

UNIVERSITY OF DELAWARE
• VARTM Variability and Substantiation
ABOUT THE NATIONAL SCIENCE FOUNDATION CENTER FOR FRICTION STIR PROCESSING

MISSION:
To advance, develop and promote research into the principles and technology of Friction Stir Processing science and engineering through research, development, education and technology exchange among academic, industry and government entities. It is also the mission of the center to increase the quantity and quality of the professionals prepared to work in the area; to involve the faculty of the University(s) in research in areas of common interest to Sponsors and the University(s); and to perform research which will allow global Friction Stir Processing facilities to be competitive in the world economy.

Wichita State University is now a research site for the National Science Foundation Center for Friction Stir Processing. The WSU research site is headquartered in NIAR’s Advanced Joining & Processing Lab.

The CFSP is a multi-institutional Industry/University Cooperative Research Center started in October 2004. The center brings together the premier friction stir processing academic institutions in the United States and focuses on addressing the needs of aerospace, aeronautic, energy, military and commercial industries in developing friction stir processing.

The other CFSP research sites are:
• South Dakota School of Mines & Technology (headquarters)
• University of South Carolina
• Brigham Young University
• University of Missouri-Rolla

In order to become a CFSP research site, Wichita State was required to obtain at least five industry and/or government sponsors who would contribute at least $150,000 in yearly membership fees. These sponsors include:
• Bombardier/Learjet
• The Cessna Aircraft Company
• The Federal Aviation Administration
• General Motors
• Hawker Beechcraft
• Spirit AeroSystems

WSU students Jeremy Brown and Kevin Pham perform friction stir welding research in NIAR’s Advanced Joining & Processing Laboratory, which was recently declared a CFSP research site.
ABOUT THE FAA CENTER OF EXCELLENCE FOR GENERAL AVIATION RESEARCH

MISSION:
To enhance aviation-related research, education, technology transfer and utilization in mission critical areas; to respond to the research interests and needs of the aviation industry through synergistic relationships developed between academia, industry and government.

In April 2001 NIAR became a core member of the FAA Center of Excellence for General Aviation Research (CGAR).

The three major criteria of success are:
1. The ability of the center to provide national leadership in resolving air transportation problems.
2. The ability to disseminate results through a continuing education program.
3. The ability to create self-sufficiency so the center is not reliant upon funding support from the FAA.

Participating universities include Wichita State University, Embry-Riddle Aeronautical University, the University of North Dakota, Florida A & M University and the University of Alaska. Embry-Riddle is the lead university and handles the management of the organization. NIAR has a leadership role in composite materials and crashworthiness in this center, however, all universities are viewed as equal contributors to research activities.

WWW.CGAR.ORG

FY 2007 PROJECTS

WICHITA STATE UNIVERSITY
- Detection and Prevention of Carbon Monoxide Exposure in General Aviation Aircraft
- Enhanced Jet Exhaust Mixing to Reduce Jet Aircraft Engine Noise

EMBRY-RIDDLE AERONAUTICAL UNIVERSITY
- Course Development for Qualification Training for Technically Advanced Aircraft
- Evaluation Instructor Training Course
- GA-COE Management Project
- General Aviation Aircraft: In-flight Load Data Collection and Analysis
- Joint Training Standards Development for New Technology GA Aircraft
- Wildlife Strike Database and Website Maintenance and Expansion of Graphics Applications to Web Search For General Aviation
- Compression Ignition (Diesel) Engine Certification Issues
- Technology Survey on UAS Propulsion Systems
- ASI Course Development
- Training Standards Development for General Aviation Aircraft
- Evaluating the Effectiveness of ADS-B in the Collegiate Flight Training Environment

UNIVERSITY OF ALASKA - ANCHORAGE
- Remote Airport Lighting Systems (RALS)
- UAS Detect, Sense & Avoid
- Regulation Study on Commercial UAS Vehicle Design

UNIVERSITY OF NORTH DAKOTA
- Aviation-Grade Ethanol for Improved Performance and Safety in Civilian and Military Aircraft
- Helicopter Terrain Awareness Warning System and Enhanced Vision Systems Flight Testing
- Business Jet Loads Data Acquisition
- Helicopter Advanced Navigation Research Flight Training
- Evaluating the Effectiveness of ADS-B in the Collegiate Flight Training Environment
ABOUT THE NATIONAL CENTER FOR ADVANCED MATERIALS PERFORMANCE

Stemmed from the NASA AGATE shared composite material property database program, NCAMP's goal is to take the composites industry to a self-regulating level similar to that achieved by the metals industry. This involves working with industry organizations such as the Composite Materials Handbook 17 on data archival, the American Society for Testing and Materials D30 committee on composite test methods, the Society of Automotive Engineers on aerospace material specification development, the Performance Review Institute on product assessment and certification, and Nadcap on audit criteria; all aiming at creating a framework covering material property data acquisition, qualification and property control that will be acceptable to the FAA and Department of Defense. This framework must be self-sustaining, both financially and technically, while being managed by the aforementioned non-profit organizations with minimal FAA and DoD oversight. This ambitious goal requires a strong level of support and participation from industry and government.

IN 2007

Industry and government support for NCAMP has been strong and the progress made has been significant.

NCAMP researchers started the material property acquisition and qualification program of ACG MTM45-1 G30-500 plain weave fabric prepreg. A final report will be created when the equivalency portion is complete. The companies participating in the ACG MTM45-1 6781 glass prepreg and ACG MTM45-1 HTS unidirectional prepreg programs have started fabricating qualification panels. Testing for these programs will start when all of the panels have been received by NCAMP.

The test plans and material and process specifications for Hexcel 8552 were approved by the FAA and the prepregs were shipped to the aircraft companies. The Cytec 5250-5 and Cytec 5215 documents were approved in September. Production of Cytec prepreg materials has begun.

COMPANIES FABRICATING TEST PANELS
- Gulfstream Aerospace
- Adam Aircraft Industries
- Texas Composite, Inc.
- ATK Space Systems
- Boeing Helicopters
- Scaled Composites
- Goodrich Aerostructures
- Bombardier Aerospace
- AAR Composites
- Cirrus Design Corporation
- Hawker Beechcraft
- Spirit AeroSystems, Inc.
- Cessna Aircraft Company
- Bell Helicopter Textron, Inc.
- Northrop Grumman Corporation
- Israel Aircraft Industries, Ltd.
- General Atomics Aeronautical Systems, Inc.
- Lockheed Martin Aero
- Comtek Advanced Structures
- Quickstep Technologies
- Cytec Engineered Materials
- Burhnam Composites
- EDO Fiber Science

To learn more about NCAMP, sign up for the e-bulletin by sending an email to tracee.friess@wichita.edu.

WWW.NIAR.WICHITA.EDU/NCAMP
ABOUT THE AIRCRAFT DESIGN AND MANUFACTURING RESEARCH CENTER

The Aircraft Design & Manufacturing Research Center was established in October 1995 as a state/industry/university partnership. Envisioned was a consortium of university and industry partners who, working together, would apply their collective expertise to address the technology needs of aircraft manufacturers and subcontractors.

ADMRC combines the talents and support of The Boeing Company, Bombardier/Learjet, Cessna Aircraft Company, Hawker Beechcraft, Spirit AeroSystems, several small businesses and university researchers from Wichita State University, the University of Kansas, Kansas State University and Pittsburg State University. Together, faculty members and researchers can focus on industry problems in Kansas.

ADMRC, partially funded by the Kansas Technology Enterprise Corporation, is a successful state/university/industry partnership. It is recognized nationally as a model for cooperative research.

FY 2007 PROJECTS

WICHITA STATE UNIVERSITY
• Virtual Reality System with Haptic / Auditory Devices for Assembly and Maintenance Training and Certification
• Thermal Spray Coatings for Composite Structures in Aviation
• Drilling of Composite Materials
• Correlation of Key Variables in the Composite Cure Process
• Application of Virtual Reality and Simulation for Assembly Planning and Costing
• Aircraft Interior Noise Reduction by Electrospun Polymeric Nanofibers

KANSAS STATE UNIVERSITY
• Effects of Cladding and Anodizing on the Fatigue Behavior of Varying Gage Aluminum Sheet

UNIVERSITY OF KANSAS
• Analysis of IEEE 802.11a/b/g Protocol Robustness for Essential Data Applications
The NIAR/Industry/State (NIS) research program was created by the Kansas State Legislature in 2004 to support the efforts of the Kansas aviation manufacturing industry to compete in the global environment.

While this research program is operated through NIAR, all research projects are identified and selected by an executive committee composed of representatives from The Boeing Company, Bombardier/Learjet, Cessna Aircraft Company, Hawker Beechcraft Corporation and Spirit AeroSystems. WSU’s associate vice president for research, the executive director of NIAR and the dean of the College of Engineering serve in a project management capacity.

N-I-S received $2 million for the 2007 fiscal year to support thirteen research projects.

FY 2007 PROJECTS

- Design Philosophies for Structures Utilizing Metal and Composites with Large CTE Differences
- Repair of Composite Structures (including sandwich)
- Blind or One-Sided Fastener Usage in Composite Structures (Production and Repair Applications)
- Quiet Interiors Development
- Friction Stir Welding and Related Topics
- Potting Compound Strength/Density Enhancement
- Adhesive Joint Characterization and Testing
- Aviation Network Security
- Icing Tanker Spray Nozzle Characteristics and Performance Evaluation
- Integrated Vehicle Health Monitoring Requirements Definition
- Composite Bearing Allowables Baseline
- NDE Simulations of Aircraft Structure
- Quiet Composite Fuselage Panels

WWW.NIAR.WICHITA.EDU/NIS
ABOUT THE KANSAS SMALL BUSINESS DEVELOPMENT CENTER

Established in 1983, the WSU Regional Kansas Small Business Development Center (KSBDC) provides free consultation services and affordable training in a 24-county region of north and south-central Kansas. The center serves both entrepreneurs ready to start new businesses and owners of established businesses ready to grow.

Three full-time and two part-time professional consultants provide expert assistance with the three M’s: marketing, management and money. They work individually with clients in areas that include business planning, access to capital, cash flow development, marketing, human resource issues and strategic planning.

The center offers workshops on topics that include starting a business, writing a business plan, state and federal taxes, choosing a business legal structure, QuickBooks, low and no cost marketing, business contract basics, winning government contracts, customer service and strategic planning.

Dr. Marcia Stevens provides oversight for a budget that is funded by WSU and Cloud County Community College and by grants from the U.S. Small Business Administration and the Kansas Department of Commerce. Since starting as regional director in 1999, Dr. Stevens has significantly increased the service area and output of the Center. She received the 2006 State Star Award from the Kansas Small Business Development Center Network.

FY 2007 PROJECTS

ECONOMIC IMPACT OF WICHITA STATE REGIONAL KSBDC CY 2006

Clients served ....................................................687
Workshops Offered ...........................................155
Workshop Attendees ...........................................1,610

New businesses started ........................................59
Full-time jobs created ...........................................143
Part-time jobs created ...........................................154
Full-time jobs retained ..........................................170
Part-time jobs retained ..........................................329
New sales generated ...........................................$16,960,000
Economy investments ..........................................$1,740,000
Secured 129 loans .............................................$8,700,000

WSU KSBDC CLIENTS

Job growth 2005 - 2006 .....................................31.5%
compared to:
Job growth KS Business 2005 - 2006 .......... 1.0%

Sales growth 2005 - 2006................................. 25.1%
compared to:
Sales growth KS Business 2005 - 2006 ....... 5.2%
WICHITA STATE UNIVERSITY

As the official home to the National Institute for Aviation Research, the campus of Wichita State University is the perfect setting to foster top-notch education, cutting-edge research and the people who make it happen.

WSU’s sprawling 330 acre campus, boasting one of the largest university sculpture collections in the nation, is located within the city of Wichita, Kansas, known as the “Air Capital of the World.” Each year almost 15,000 students from 48 states and more than 100 countries come to Wichita to study as Wichita State Shockers within the University’s six colleges.

In addition to its main campus, Wichita State features two full-service satellite facilities located throughout the city. And, as the state of Kansas’ only metropolitan university, WSU offers its students a virtually endless array of opportunities ranging from the availability of experts in practically every industry to one of the region’s largest cooperative education internship program.

All of this, combined with the people and expertise of NIAR, makes the WSU community one of true Thinkers, Doers, Movers & Shockers.
The National Institute for Aviation Research is funded in part by the Kansas Technology Enterprise Corporation. NIAR is an unincorporated division of Wichita State University, which is a state owned entity separately managed and distinct from the Kansas Technology Enterprise Corporation.

NOTICE OF NON DISCRIMINATION
Wichita State University does not discriminate in its programs and activities on the basis of race, religion, color, national origin, sex, age or disability. The following person has been designated to handle inquiries regarding non-discrimination policies: Director, Office of Equal Employment Opportunity, Wichita State University, 1845 Fairmount, Wichita, Kansas, 67260-0145. 316.978.3371