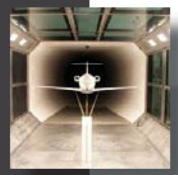
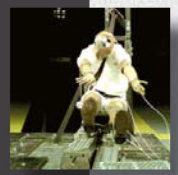
Wichita State University

National Institute for Aviation Research





John Tomblin, Ph.D.

Executive Director

john.tomblin@wichita.edu

316-978-5234

NIAR

www.niar.wichita.edu

NIAR

WICHITA STATE UNIVERSITY

Kansas Products


Diamond AIRCRAFT
Vought Aircraft Industries, Inc.
AIRBUS NORTH AMERICA
NASA
FEDERAL AVIATION ADMINISTRATION
CENTER INDUSTRIES CORPORATION
Gulfstream
THE NORDAM GROUP
ATK
ATK SPACE SYSTEMS
TENCATE materials that make a difference
GKN AEROSPACE
AERO INSTRUMENTS & AVIONICS, INC.
AERO-MACH labs, inc.
U.S. AIR FORCE
BURNHAM COMPOSITES
COLUMBIA
GENERAL ATOMICS AND AFFILIATED COMPANIES
Liberty AEROSPACE
NORTHROP GRUMMAN
Advanced Composites Group
umeco composites
nelcote®
'TORAY'
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www.pfabks.com
PlasticFab
The Premier Composite Company
1650 S. McComas • Wichita, Kansas 67213
TechniGraphicS
Piper
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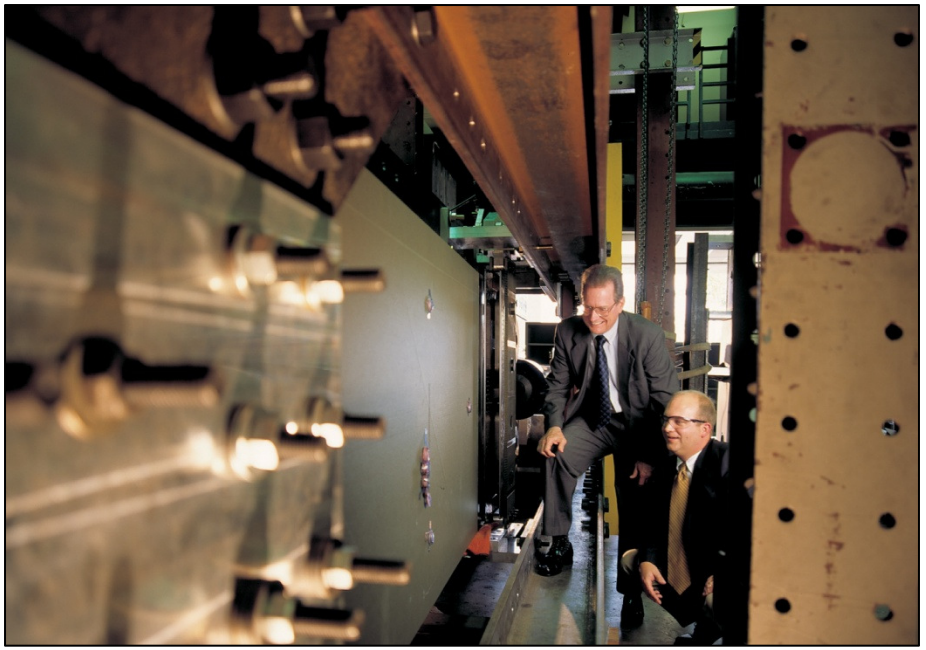
United Technologies
CIRRUS
CNH
Rocky Mountain Composites
EMBRAER
GM
GOODRICH
MOTOR HARLEY-DAVIDSON CYCLES
MILLENNIUM
SCALED COMPOSITES
Sikorsky A United Technologies Company
NAVAIR
Bell Helicopter A Textron Company
Epic
B/E AEROSPACE
SHERWIN-WILLIAMS
V5 ENGINEERING
LOCKHEED MARTIN We never forget who we're working for™
NEWPORT ADHESIVES and COMPOSITES, Inc.

The National Institute for Aviation Research…

- **provides research**
- **certification testing**
- **technology transfer**
- **training**

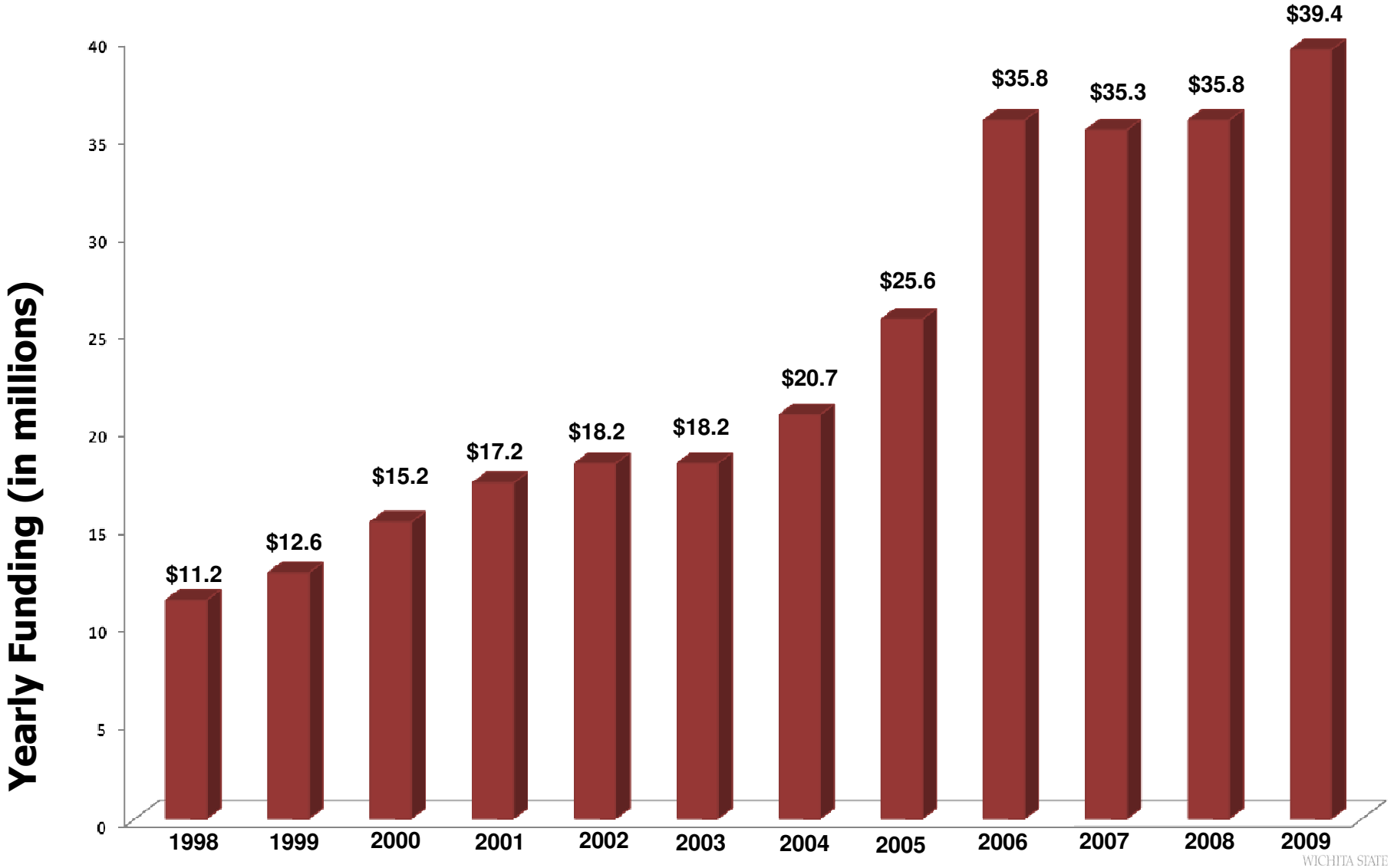


Mechanical Test Lab

to…

- aerospace industry
- aviation-related companies
- non-aviation companies
- federal aviation research sponsors

Operational Budget



The National Institute for Aviation Research ranks high among the nation's prestigious universities.

Source: National Science Foundation - FY07 - by Aero R & D Expenditures

1. The Johns Hopkins University $56 million
2. GA Institute of Technology $40.5 million
3. **Wichita State University/NIAR $32.4 million**
4. MA Institute of Technology $18.7 million
5. Texas A&M University $16.5 million
6. University of Colorado $16.2 million
7. University MD – College Park $15.4 million
8. University of Texas – Austin $11.1 million
9. Purdue University $11 million
10. Mississippi State University $10.2 million
11. University of Tennessee $10.1 million
12. Pennsylvania State University $9 million
13. University of Florida $8.6 million
14. Princeton University $8.2 million
15. Stanford University $7.9 million
16. Old Dominion University $7.6 million
17. Cornell University $7.5 million
18. University of Dayton $7.4 million
19. Ohio University $7.4 million
20. University of Michigan $6.3 million

RESOURCES

Human Resources

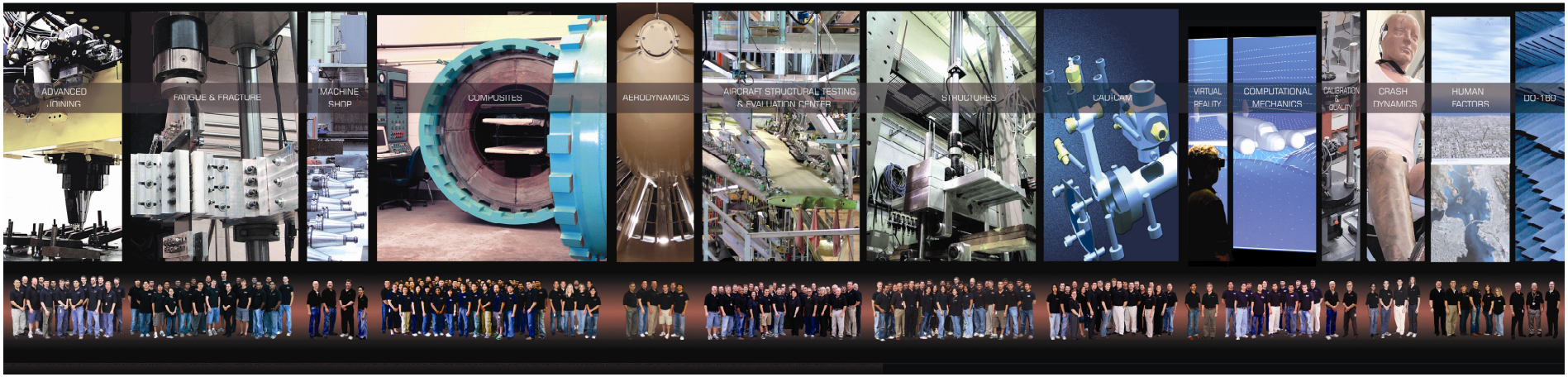
- 63 PhDs (including faculty associates)
- 40 Masters
- 115 Bachelors
- 20 Associates
- 4 Technical
- 105 undergraduate students
- 13 Administrative Staff

360 Total

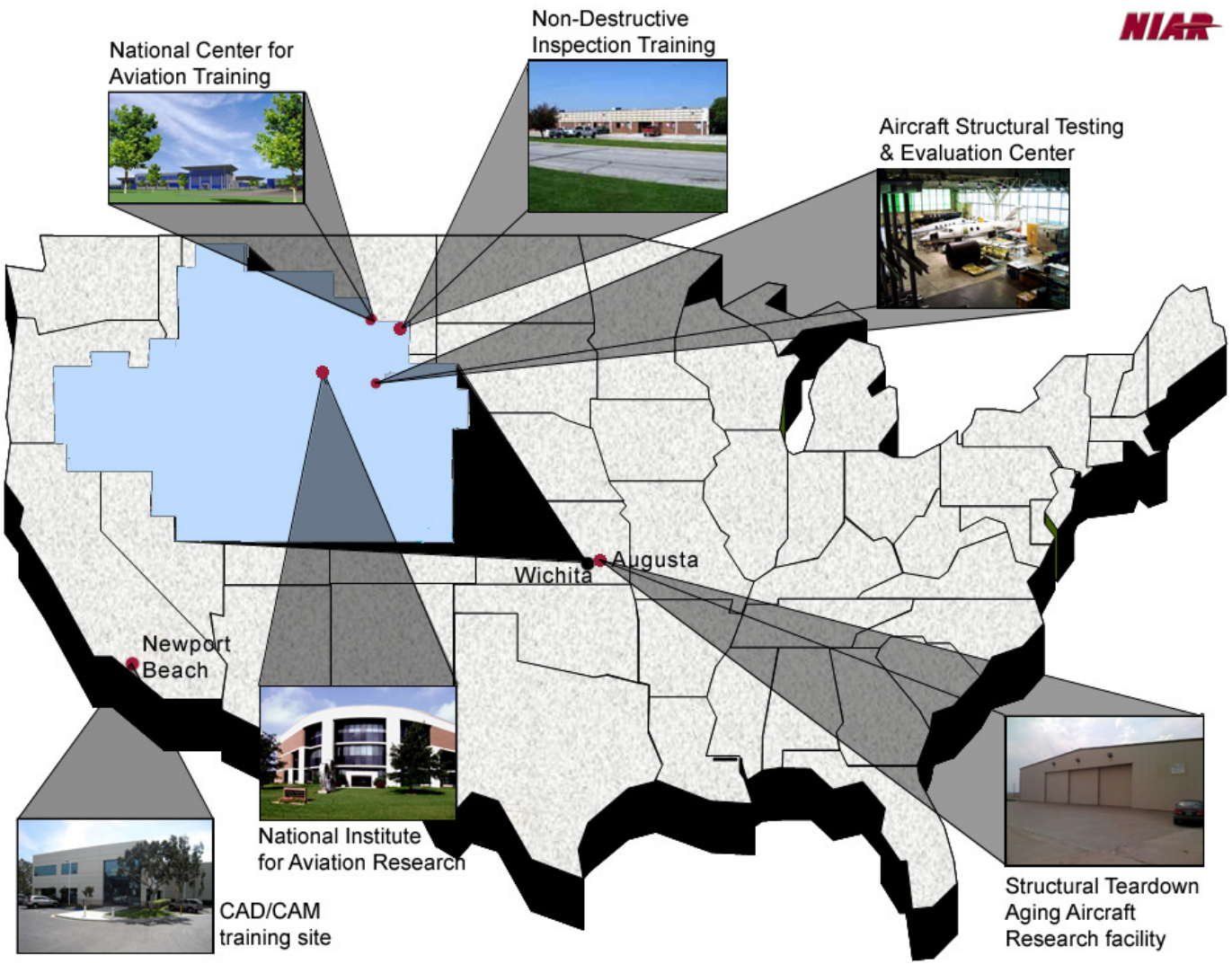
Funding

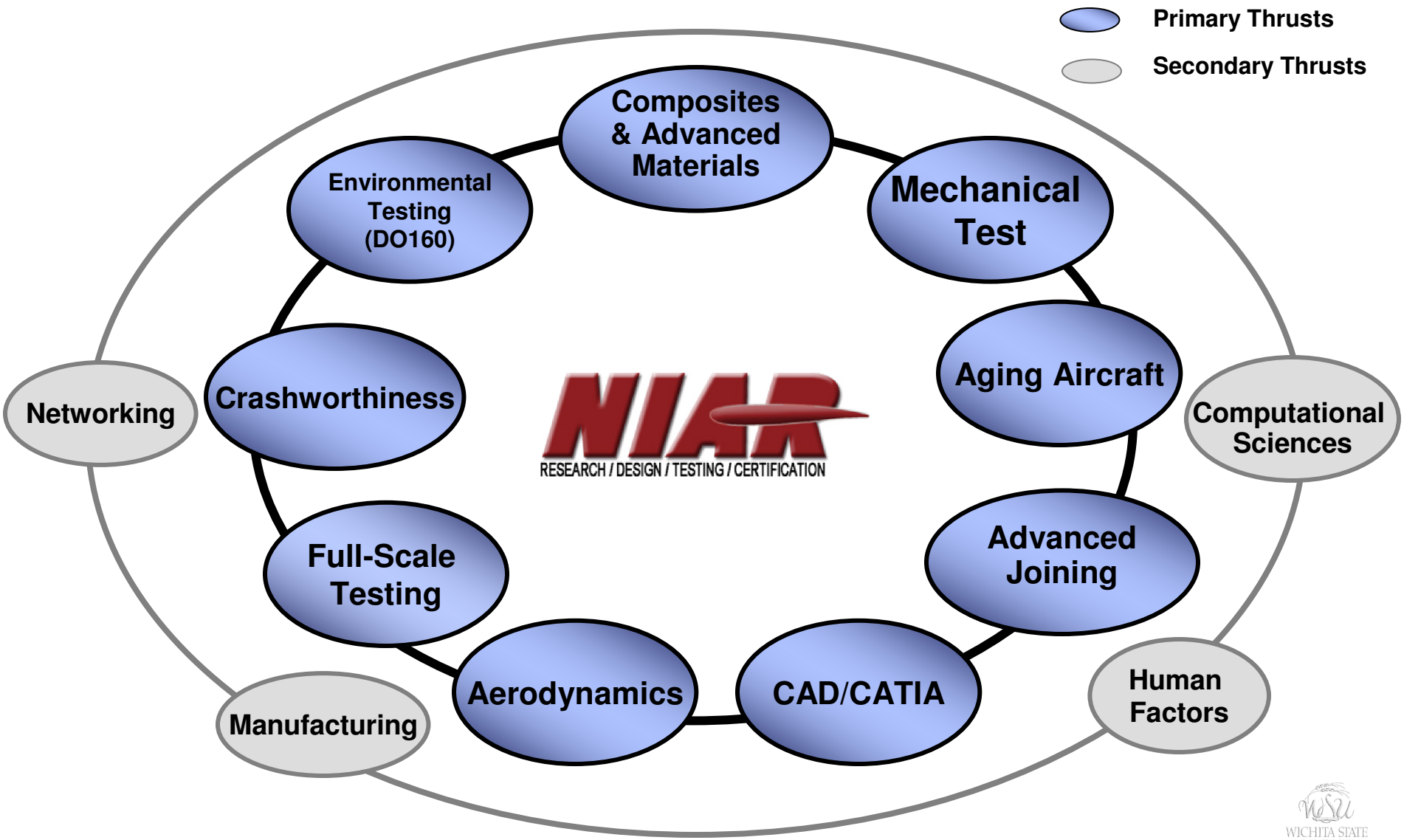
$39.4M for Fiscal Year 2009

- FAA
- NASA
- DOD
- Industry
- State/University



NIAR Locations




Primary Thrusts
Secondary Thrusts
Composites & Advanced Materials
Mechanical Test
Aging Aircraft
Computational Sciences
Advanced Joining
Human Factors
CAD/CATIA
Aerodynamics
Manufacturing
Full-Scale Testing
Crashworthiness
Networking
Environmental Testing (DO160)
NIAR
RESEARCH / DESIGN / TESTING / CERTIFICATION

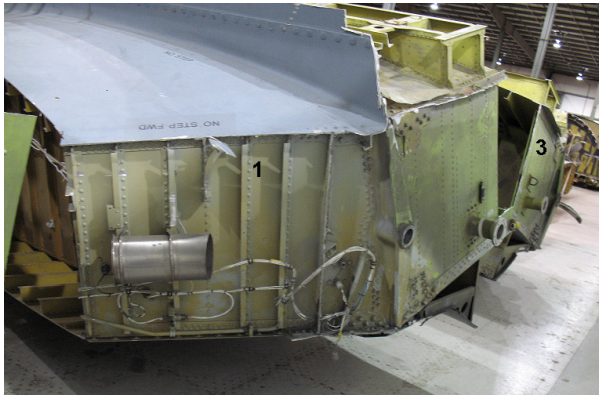
Aging Aircraft Research Laboratory

- Engineering evaluation of aircraft structures and systems
- Damage tolerance assessments of aircraft metallic structures
- Investigation of corrosion and corrosion-fatigue effects on aging aircraft metallic structures
- Nondestructive inspection techniques and methods for structures
- Metallic and composite repairs for aircraft metallic structures
- Survey of aircraft service usage and maintenance history
- Development and update of service life extension
    - Programs for specific types of aircrafts
- Examples of Research Projects:

B-52, C-5, KC-135, C-130, T-34 Trainer (wings), General Aviation Commuter Aircraft (FAA), F-16, Boeing 737 composite horizontal stabilizer, Beechcraft Starship

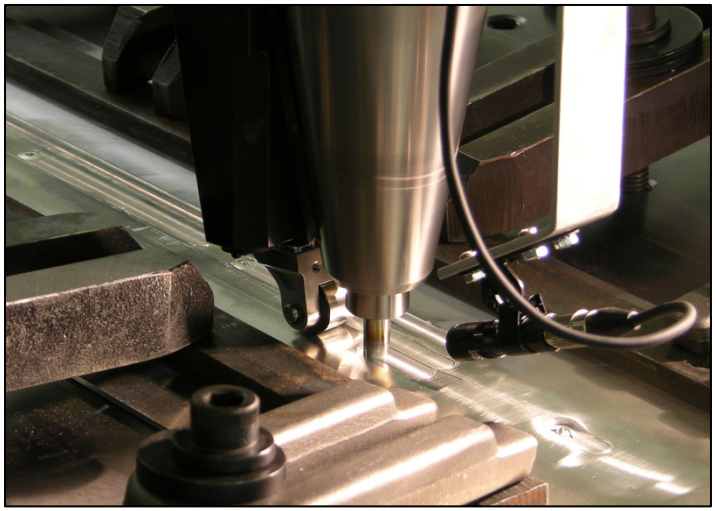
Aging Aircraft Laboratory

Structural Teardown Aging Aircraft Research (STAAR) Facility – Augusta, KS



Advanced Joining & Processing Lab

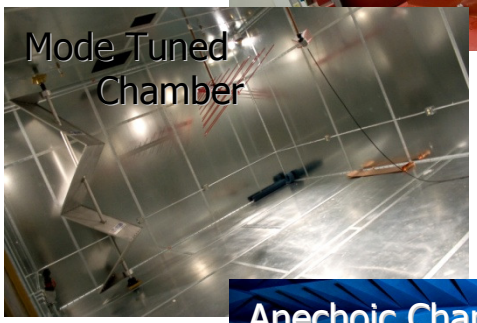
MTS ISTIR Process Development System



Friction Stir Welding

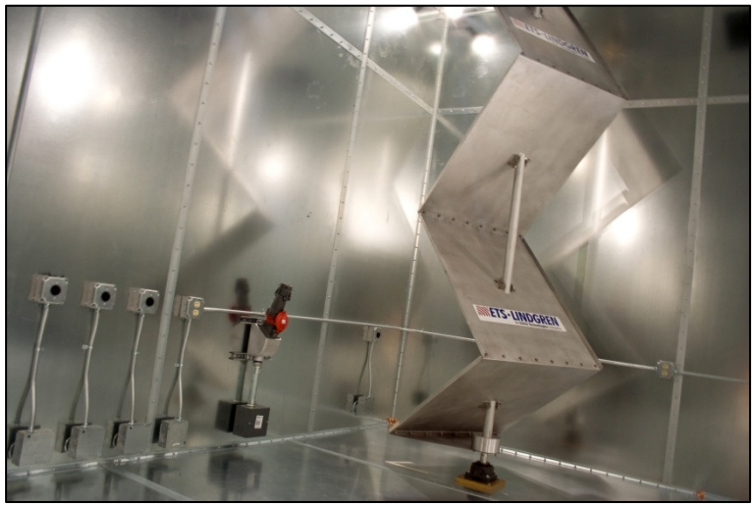
- **Performs research and prototype services using friction stir welding, friction stir spot welding and friction stir processing**
- **Lab has its own metallurgical lab and load frames**
- **Member of NSF's Center for Friction Stir Processing (CFSP)**
  - **Industry sponsors include: Bombardier, FAA, Hawker Beechcraft, General Motors, Embrear, Cessna, Spirit AeroSystems**

Environmental Testing Labs



- **RTCA/DO-160 Testing**
- **Design Assistance**
  - **On-Staff Engineers**
  - **Research Scientists**
- **Certification Support**
- **DER Services**

Environmental Testing Labs



Current Capabilities

- **Electrical Testing**
  - Sections 15 – 22, 25
  - Magnetic effects, power input, voltage spike, audio frequency, induced signal
- **Environmental Testing**
  - Temperature and altitude - Section 4
  - Temperature variation – Section 5
  - Humidity – Section 6
  - Operational shocks and crash safety – Section 7
  - Vibration – Section 8
  - Salt fog – Section 14
  - Icing – Section 24

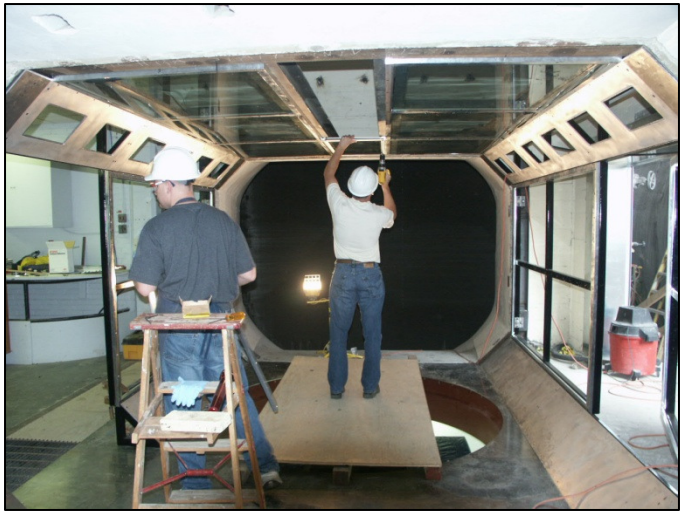
Environmental Testing Labs

Expanding Capabilities

- **Sand/Dust**
- **Fluid Susceptibility**
- **Lightning**

Walter H. Beech Memorial Wind Tunnel

- Upgrade in 2004
- Higher airspeeds
- Lengthy runs
- Better design
- Improved Data Analysis
- State-of-the-art Balance
- Sting Support System
- Active Cooling
  - Constant Reynolds number testing
- Still Needed
  - Internal balances
  - Upgraded probe traverse
  - Upgraded flow visualization and analysis software



Under Construction

Subsonic Turbine

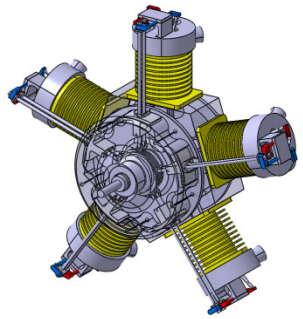
Subsonic Turbine

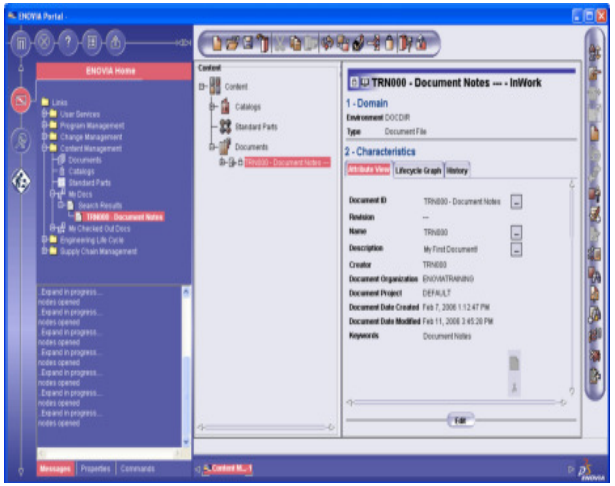
6 component underfloor balance –Aerotech ATE, Ltd.

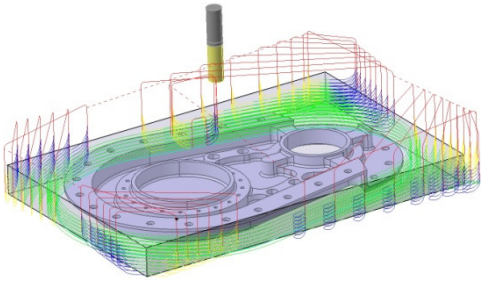
CAD/CAM, CATIA

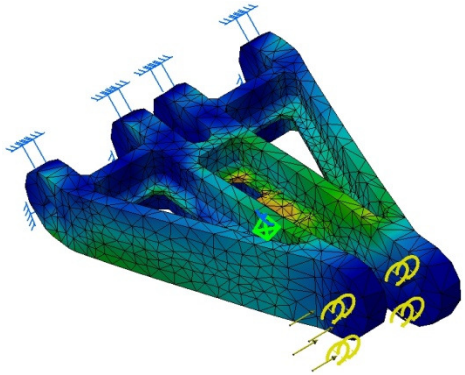
- **CATIA V5 Courses**
  - Part Design & Sketcher
  - Assembly Design
  - Drafting
  - Wireframe & Surfaces
  - Fitting Simulation & Kinematics
  - Prismatic Machining
  - Surface Machining
  - Functional Tolerancing & Annotation
  - Stress Analysis
  - Basic Concepts

- **ENOVIA Courses**
  - DMU
  - Basic Concepts
  - Advanced Concepts
  - Product Design



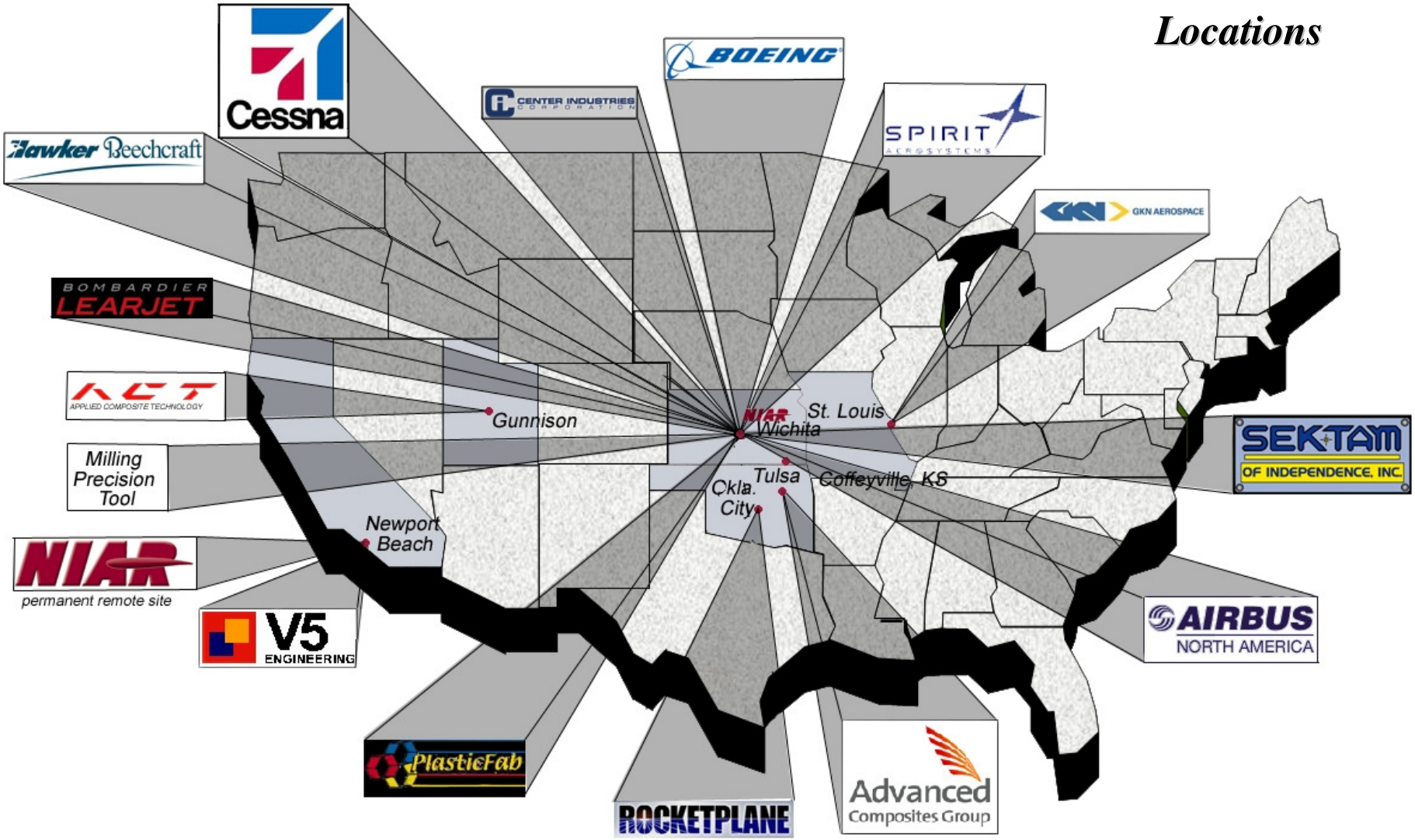




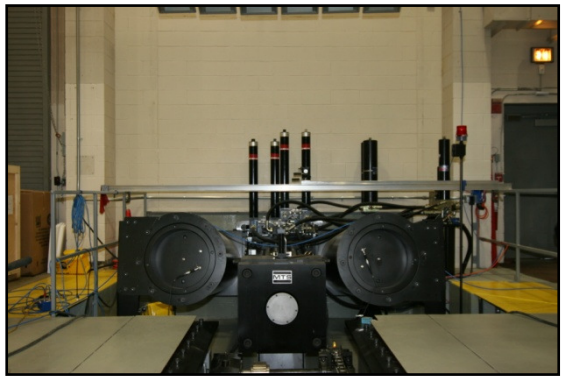


CAD/CAM, CATIA

National Training Locations

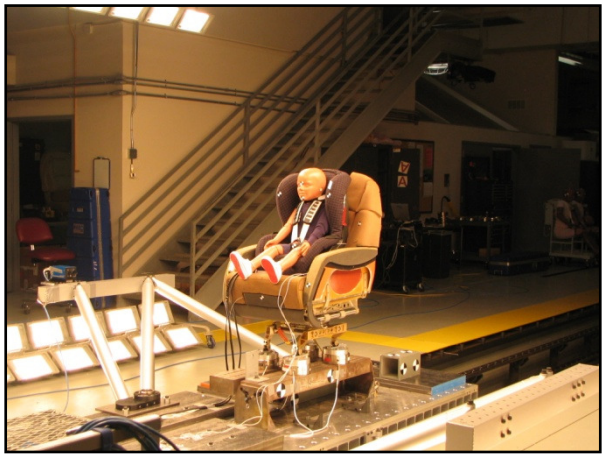


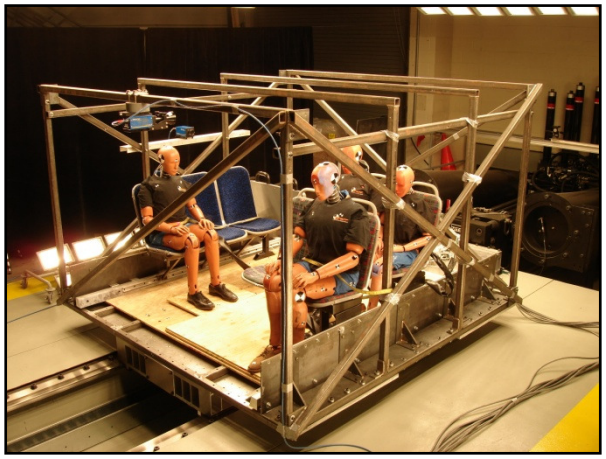
Crash Dynamics Laboratory

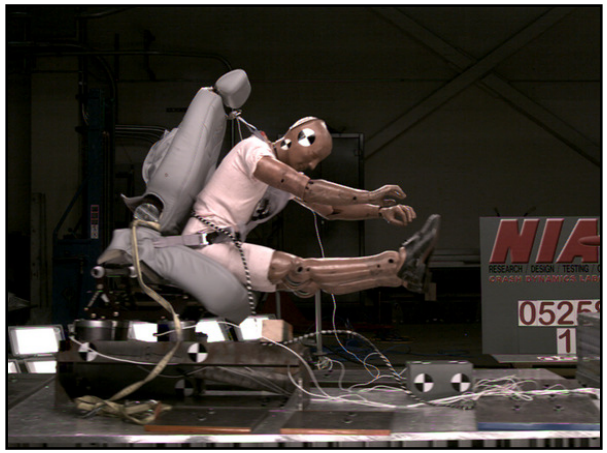


- The Crash Dynamics Laboratory is a premier dynamic testing facility providing research, testing and certification of aircraft and non-aviation components under dynamic impact conditions.
- Established in 1992, $3M update in 2005.
- 4500 square feet indoor controlled environment facility.
- MTS Model 888.20 crash simulator accelerator sled.
- Anthropomorphic Test Dummies (ATDs):
  - One HIII 5th, two 50th, and one 95th

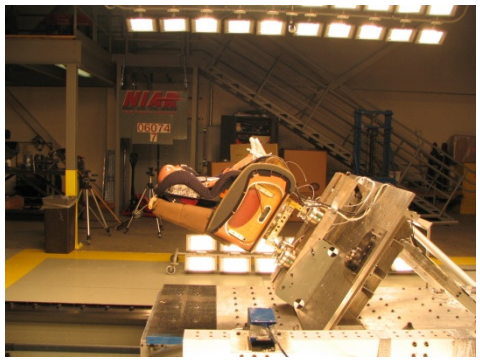
Crash Dynamics Laboratory

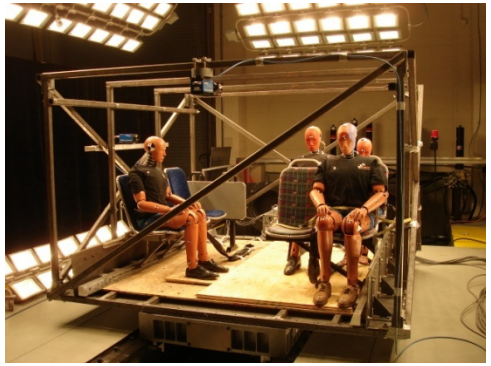






Crash Dynamics Laboratory





FAA Certification Capabilities:

- FAR 23.562
- FAR 25.562
- FAR 27.562
- FAR 29.562

Vehicle Safety-Sled Testing:

- FMVSS 208
- CMVSS 208
- ECE R94
- US NCAP
- Euro NCAP
- IIHS
- OSA

Areas of Research:

- Tests/research projects for FAA and SAMA (Small Aircraft Manufacturers Association)
- Energy absorbing seats, cushions
- Aircraft seat dynamics
- Computational modeling of seats and systems
- Aircraft interior fittings crash research
- Biodynamics
- Aircraft occupant protection research
- Implementation of child restraints in aerospace applications research
- Mass transit occupant safety research
- Aircraft component certification research

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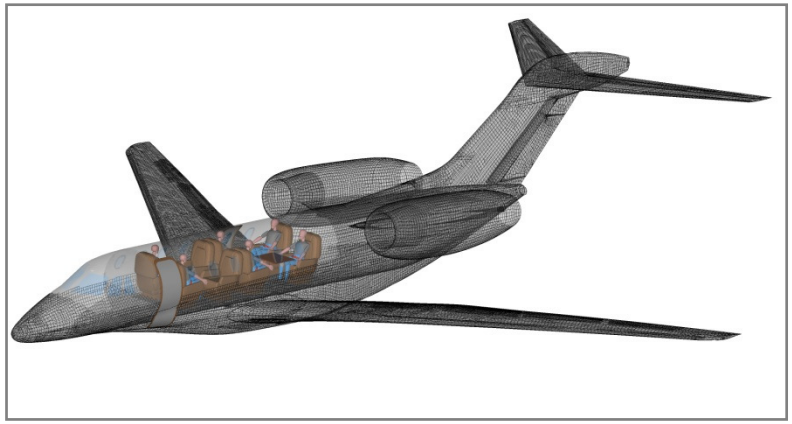
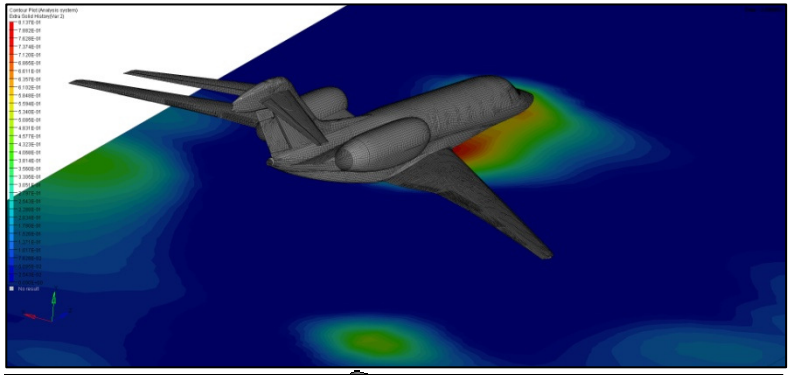
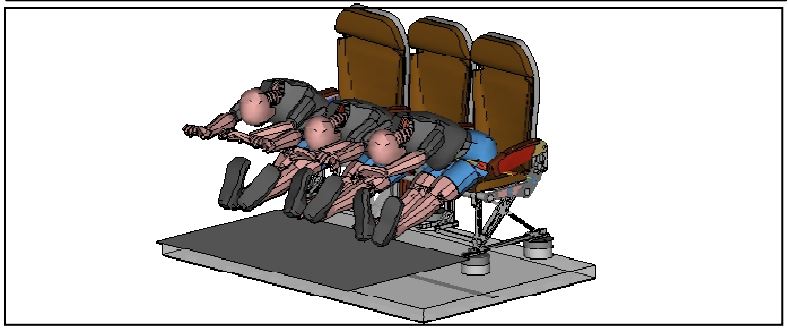
Computational Mechanics Laboratory

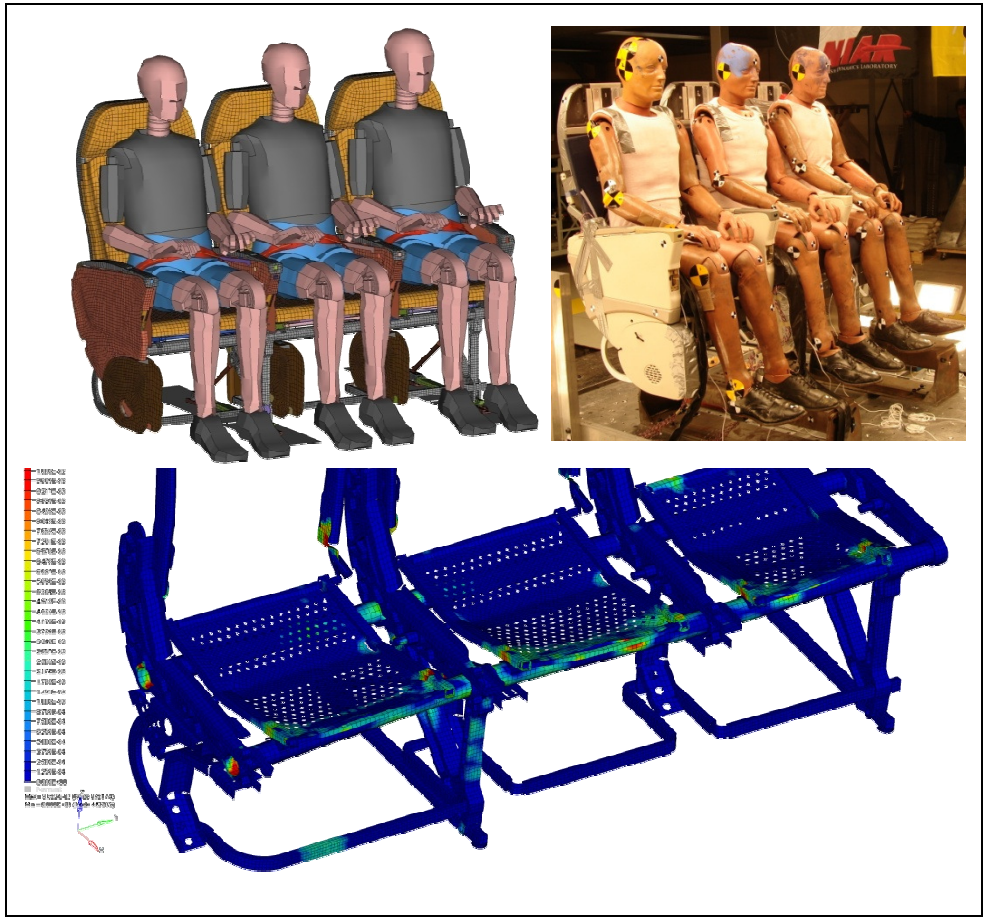


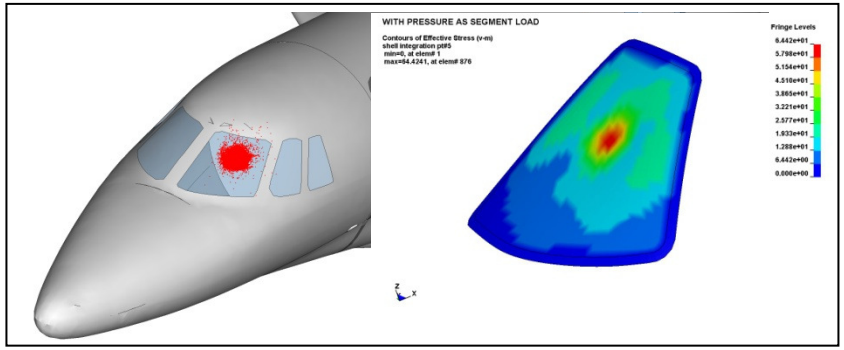


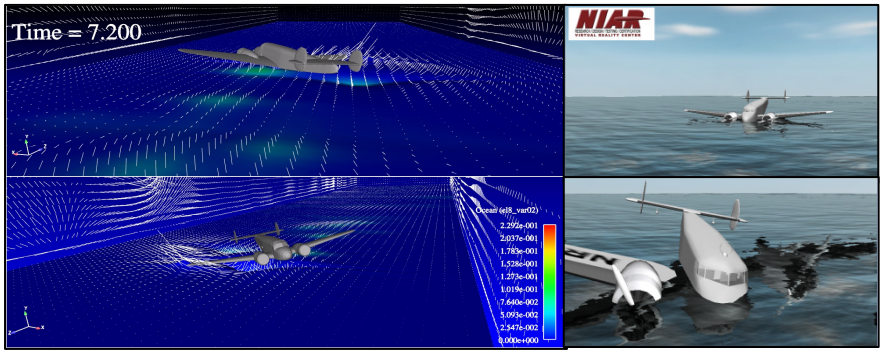


- Research focused on development and application of numerical methods in areas of crashworthiness, injury biomechanics, structures, numerical optimization techniques, virtual product development and certification
- Lab equipped with PC and UNIX-based workstations.
- University's Supercomputer Center (HiPeCC) Equipment Overview:
  - SGI Altix 3700 with 32 1.3GHz Intel Itanium2 (64 bit) processors
  - Two Clusters from Atipa Technologies, each with 17 dual 2.666 MHz Xeon (32 bit) processor nodes
  - Dell Cluster with a head node and 75 dual 3.6 MHz Xeon (EM64T) processor nodes, each with 4GB RAM and 2.1 TB Storage.

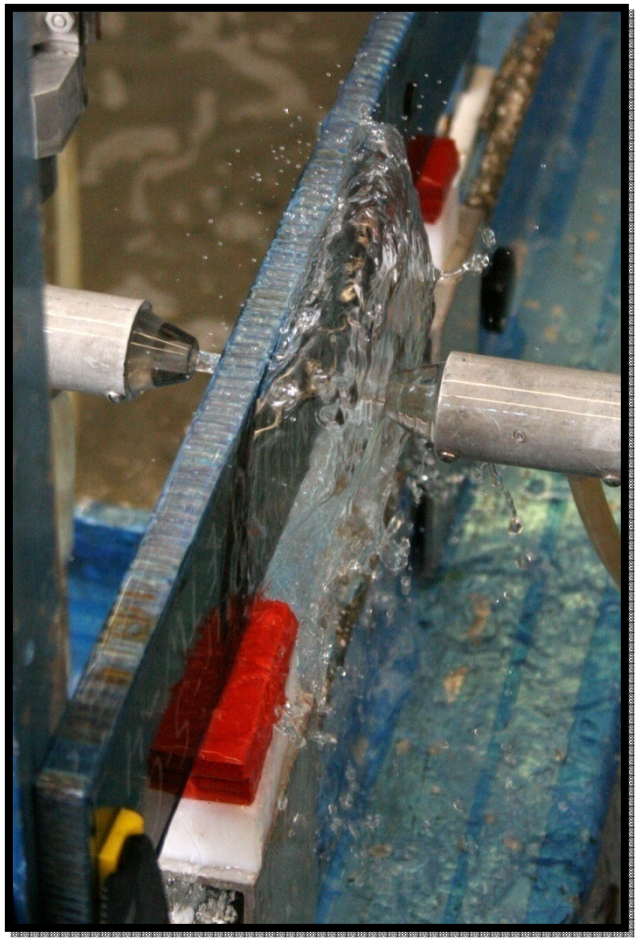
Computational Mechanics Aero Research





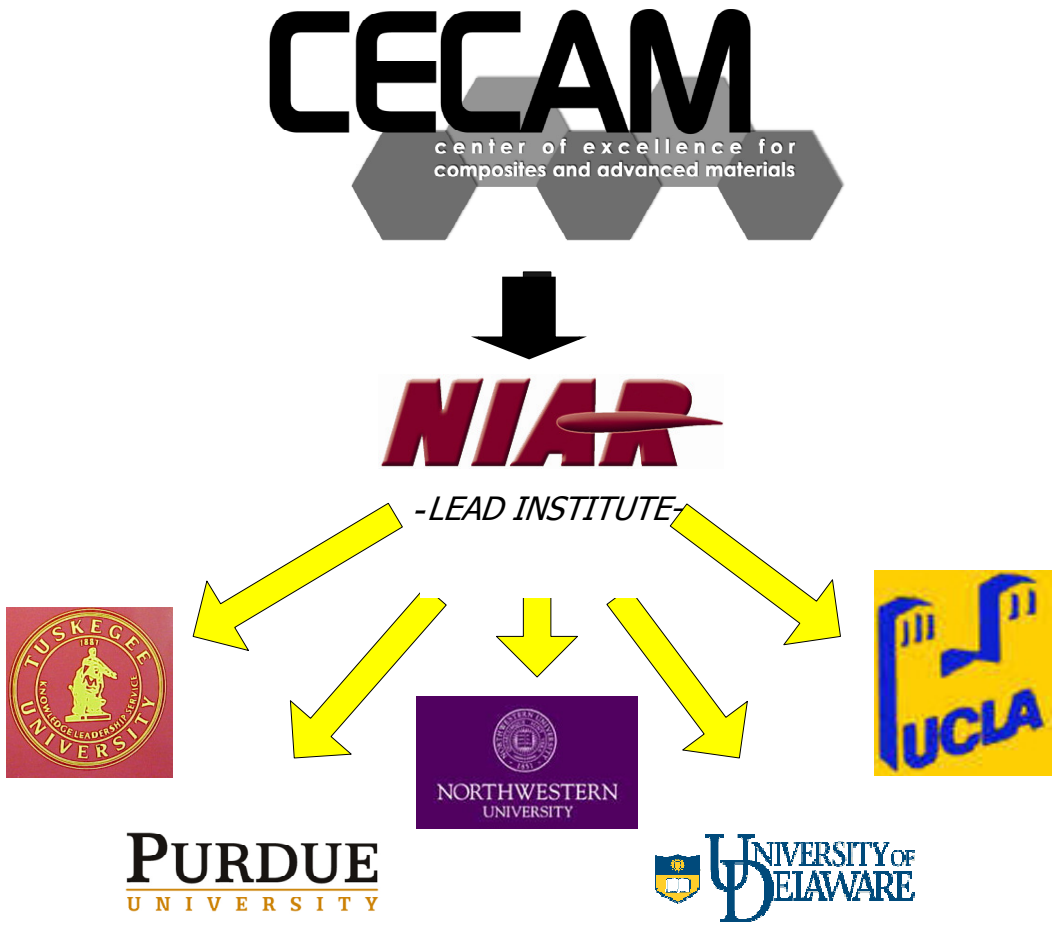


Composites & Advanced Materials



- Approx. 65 full-time staff and 90 part-time technicians
- 24 hour / 7 day per week operation
- Authored numerous FAA Technical reports involving composite materials and supported various FAA policy memorandums and Advisory Circulars
- Designated Engineering Representatives and Designated Airworthiness Representative services
- Other thrusts involve ways to improve cost and cycle-time reductions in the insertion of new advanced material into aircraft while also increasing safety (NCAMP)

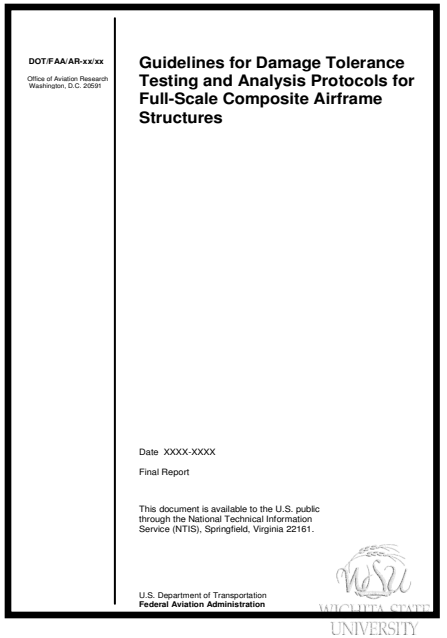
The FAA has designated the National Institute for Aviation Research as its newest Center of Excellence for Composites and Advanced Materials



Large-Scale Test Substantiation for Composite Aircraft Structures

Objective: *Demonstrate acceptable means of compliance for fatigue, damage tolerance and static strength substantiation of composite airframe structures*

Goal: Produce a guideline FAA document which demonstrates a "best practice" procedure for full-scale testing protocols for composite airframe structures with examples



CECAM
center of excellence for composites and advanced materials

Fluid Ingression Damage Mechanisms in Composite Sandwich Structures

Objective: characterize the fluid ingression phenomenon in composite sandwich structures as well as document the damage mechanisms which allow the fluid ingression to propagate and potentially degrade the structural performance. In addition, this research should be able to identify potential areas which should be monitored during routine aircraft service and provide awareness of the fluid ingression phenomenon as related to continued airworthiness.

CECAM
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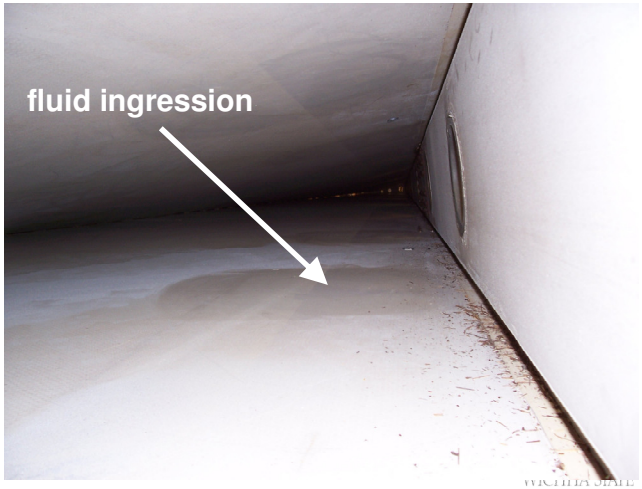

Aging of Composite Aircraft Structures

Objective: Provide industry with a better understanding of how composite aircraft structures age.

This investigation will use destructive inspection and mechanical testing compared to baseline data at the time of certification. Full-scale testing will assess remaining residual fatigue life after being in service for years.

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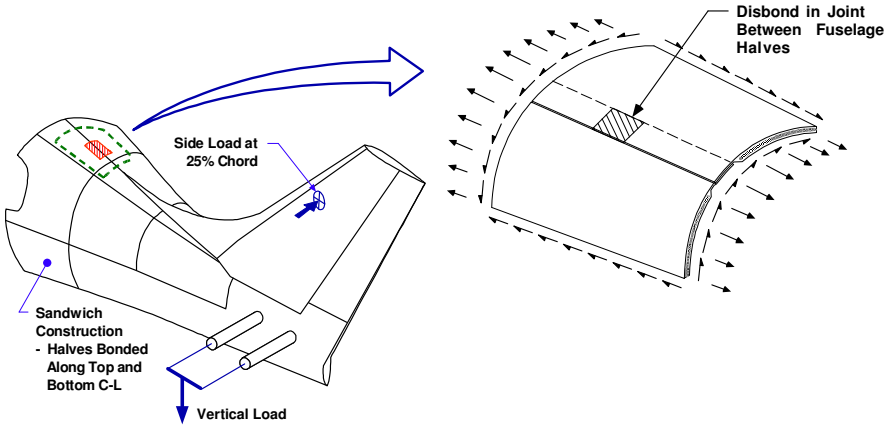
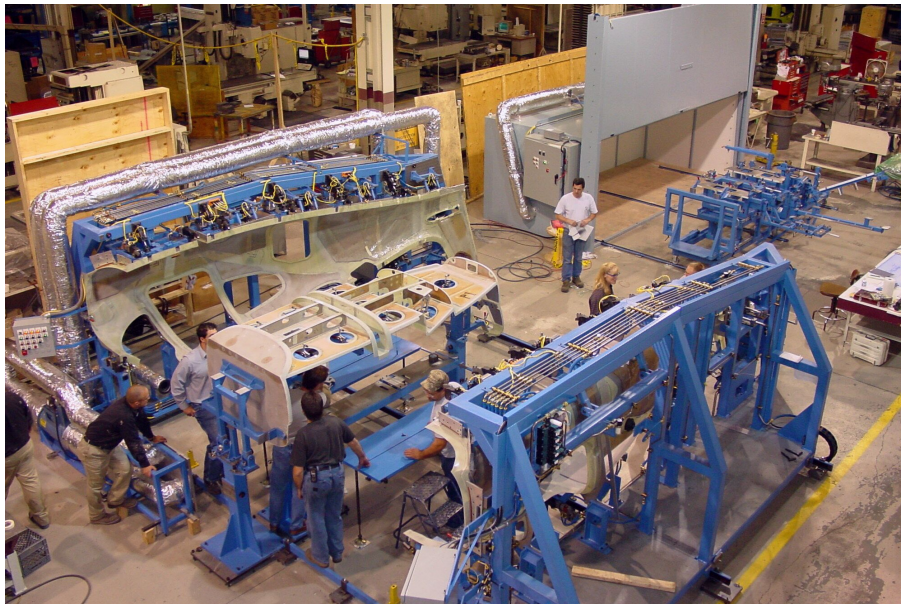
Adhesive Characterization and Element Testing of Fatigued and Damaged Bonded Joints

Objective: Investigate issues related to the structural integrity of bonded joints which may occur during manufacturing and operation.

Damage tolerance and effects of defects will be investigated. These integrity issues are categorized under concerns on the adhesive in the areas of adhesive, bondline and adherend.





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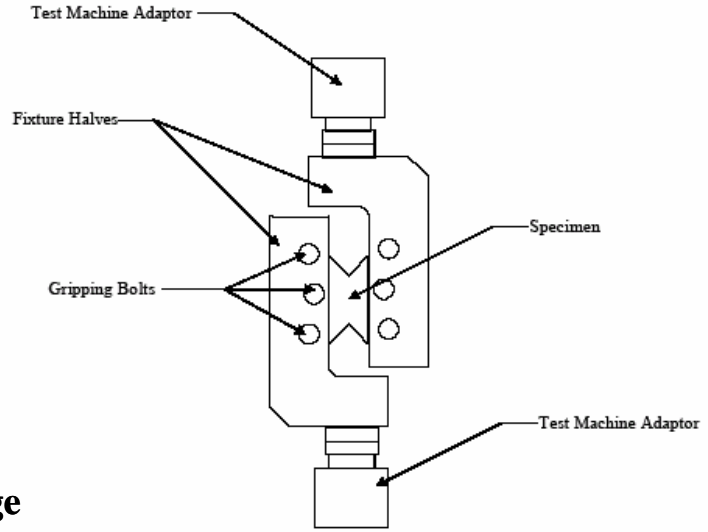
Production Control Effect on Composite Material Quality and Stability

Objective: Develop essential information on the nature of the controls required at the producer level to assure the continuation of stable and reliable composite raw materials for aerospace.



Cycle of Material Usage

Development

Application/ Drawing → Material & Process Screening/Downselect → Qualification(s)/ Design Allowables

Engineering Documentation

Material Specification w/ Approved Suppliers → Process Specification w/ Approved Processors

Material Procurement

Material Manufacture → Manufacturer Test of Material → Shipping/ Storage

Part Fabrication

User Test of Material → Part Fabrication → Traveler Coupon Test/NDT → Successful Application

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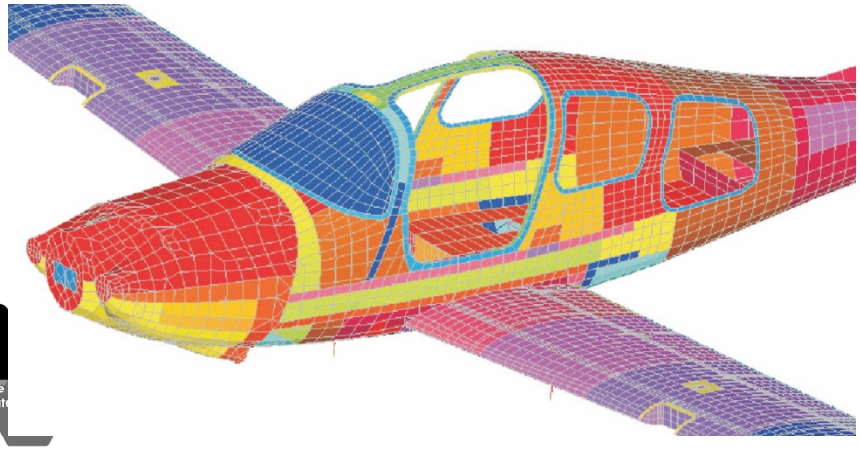
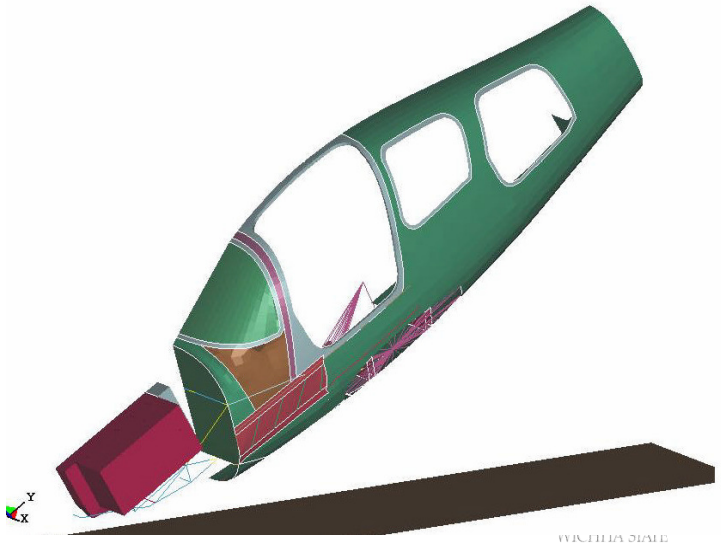
Crashworthiness of Composites - Material Dynamic Properties

Objective: Gain a multi-level understanding of strain rate sensitivity as related to crashworthiness.

The strain rate sensitivity will be generated at the materials level. These properties will be used in a crash analysis simulation. The ultimate goal will be to obtain a validated crash model for composite applications.





CECAM center of excellence composites and advanced mat

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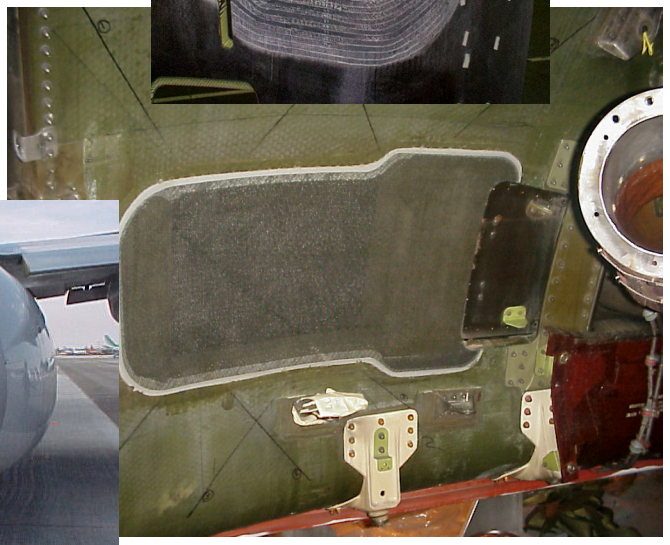
Effect of Repair Procedures Applied to Composite Airframe Structures

Objective: Assess the effects of different variables on the static and fatigue performance of scarf repairs applied to composite laminates and address flight standards need related to composite technician training requirements.



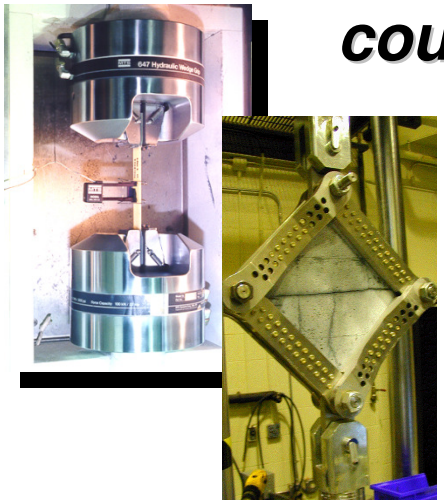
CECAM
center of excellence for composites and advanced materials

WICHITA STATE UNIVERSITY

Facilities and Capabilities

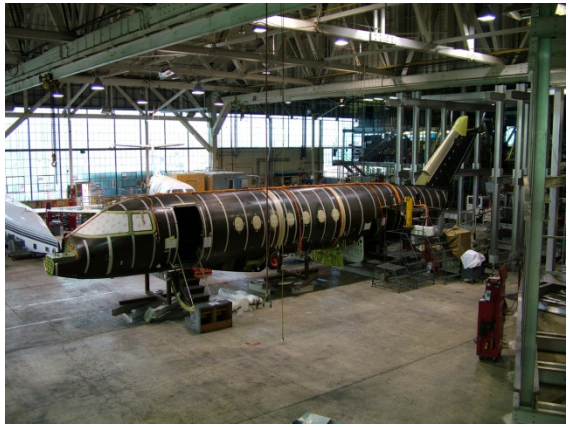
Material and Structural Characterization

coupon



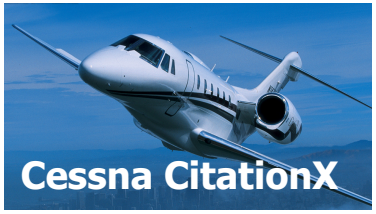
element

repair / damage tolerance



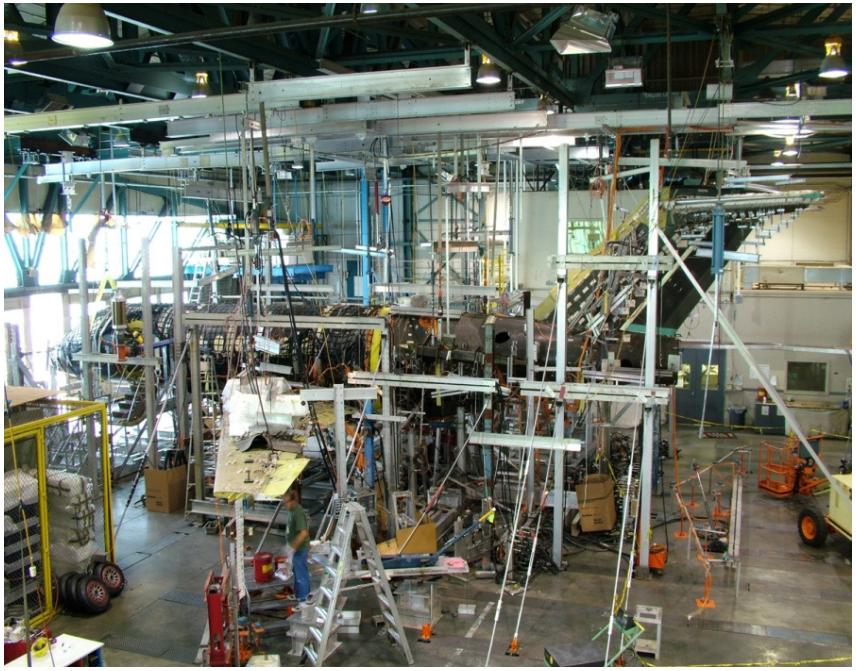
full-scale

Composites & Advanced Materials Lab



Full-Scale Testing Laboratory

- 46,340 sq. ft. facility
- 27 NIAR staff members with over 400 years of aircraft test and evaluation experience (one of the most experienced non-metallic testing staff in the world)



Full-Scale Testing Laboratory

- Full-scale and component testing
  - Static
  - Durability
  - Damage tolerance
- Pressure cyclic testing
- Hail strike testing
- Coupon test lab
- Aircraft and component instrumentation lab
- Tireburst/explosive effects

Full-Scale Structural Testing Lab


Beechcraft Premier


Beechcraft Starship


Boeing 787


Boeing B2


Boeing UCAS

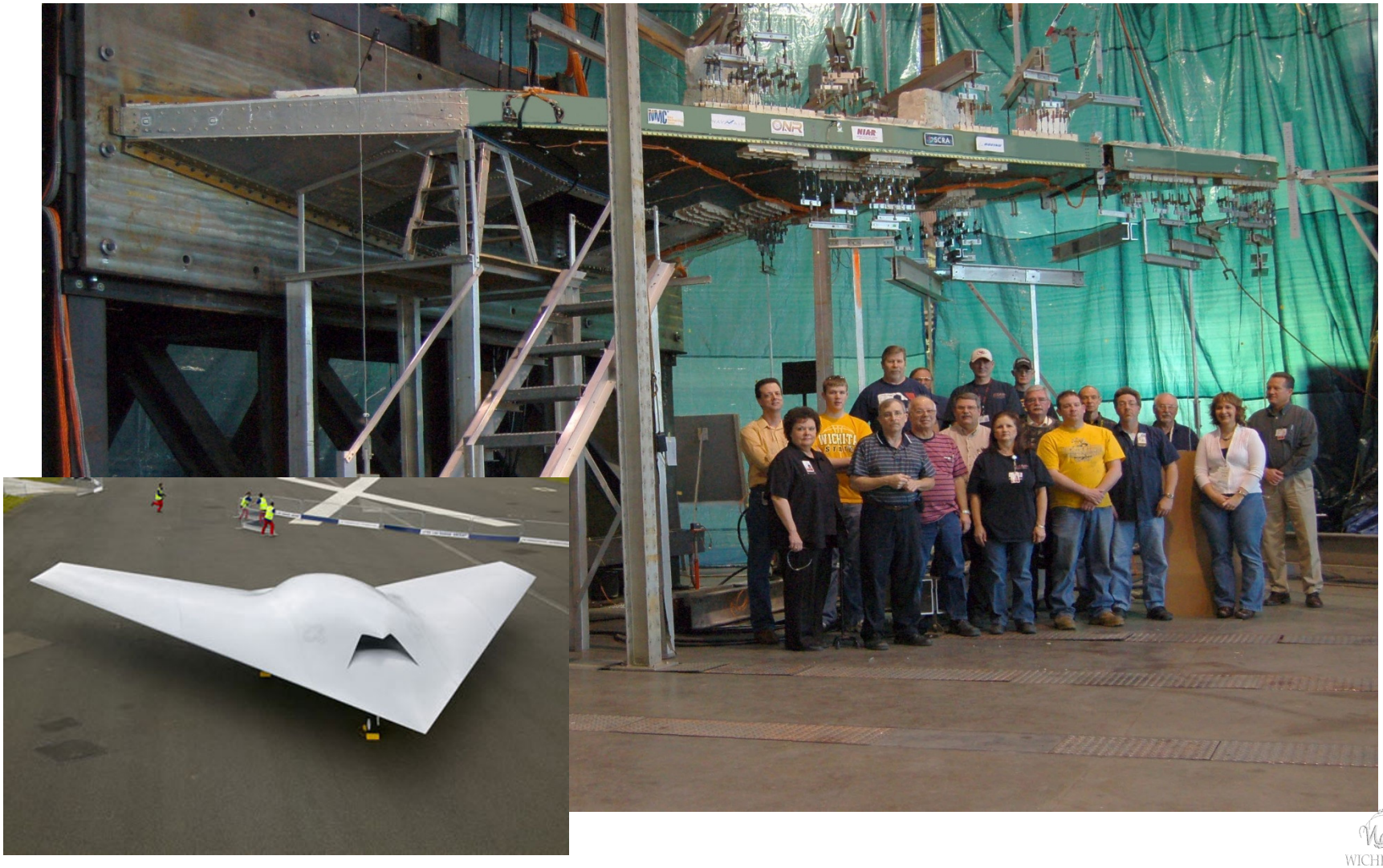

C5 Galaxy


Epic LT


Hawker Horizon


Liberty XL2


A10 Thunderbolt



U.S. AIR FORCE

NASA has designated the National Institute for Aviation Research as the National Center for Advanced Materials Performance to develop National Standards for advanced materials.

NCAMP
NATIONAL CENTER for ADVANCED MATERIALS PERFORMANCE

Focused on increasing the efficiency of advanced material implementation into new aircraft models while at the same time decreasing the cost of these materials