

Vector Composites, Inc.



GE Aviation Systems

July 23rd, 2010



Vector Composites, Inc.

Company Profile

- **Market Sector:**

Aerospace & Defense Manufacturing of Composite Structure Components

- **Current Customers:**

- | | |
|--|-----------------------------------|
| * Air Force Research Laboratory (AFRL) | * US Air Force - ManTech |
| * Missile Defense Agency (MDA) | * US Navy |
| * Robinsons Helicopter | * National Composite Center (NCC) |
| * GE Aviation Systems (GEAS) | * Tracewell Systems |
| * BAE Systems | * Lockheed Martin |
| * ITT | * Quickstep Composites, LLC |

- **Financial Projections:**

Sales: \$1.5M in 2010; and \$10M in 2015

EBITDA: \$0.07M in 2010; and \$1.6M in 2015

- **Facilities:**

Vector Composites, Inc - Dayton, OH

- 30,000 Sq ft full service manufacturing, and research and development facility.
- Certified ISO9001:2008 and AS9100 Registered (Lloyds Register)



Vector Composites, Inc.

Mission Statement

- **Vector's Mission:**

Vector Composites is committed to become a leader in the research, development and manufacture of composite structural aerospace parts and sub-assemblies for both military and commercial applications.

The Vector team is dedicated to providing innovative, high technology, high quality, low cost composite solutions that both meet and exceed customer demands.

Vector Composites is committed to utilize its state-of- the-art 30,000 square foot facility in a way that provides safe, flexible manufacturing capabilities that utilizes Lean manufacturing concepts to provide the best overall value for the customer.



Vector Composites, Inc.

Company History – Ohio

- **Our History**

- December, 18th 2003**

- Established / National Composite Center: October, 2003 Kettering, OH
 - Developing VARTM and P4A Technologies
 - 5000 Sq/Ft Facility

- July, 10th 2006**

- Acquired by DR Technologies, Inc (San Diego, CA) Kettering, OH

- May 28th , 2008**

- Relocated to the Advanced Materials Technology Center Dayton, Ohio
 - 30,000 Sq/Ft Facility

- June 4th, 2010**

- Acquired by Composite Technology Investors, LLC
 - Vector Composites, Inc. – Wholly Owned Subsidiary Dayton, OH

- **The Ohio Advantage**

- Located within Ohio “Aerospace HUB” Technology Corridor
 - HUB Zone, Small Business



Vector Composites, Inc.

Services / Capabilities

- **Advanced Materials Research & Development**
- **Composite Prototyping**
- **Materials Development**
 - Carbon Nano Fibers
 - Carbon Nano Fillers
 - Nano Adhesives
 - Thermally Conductive Materials
- **Manufacturing Services**
 - Quickstep – Out of Autoclave Processing
 - Ply Cutting, Kitting & Fabrication Services
 - Resin Transfer Molding (RTM)
 - Composite Fabrication
 - Room Temperature, Autoclave , Oven, Press Cures
 - Composite Machining
- **Design Capability**
 - Conceptual, Preliminary Thru Final Product Design
 - CATIA V5 w/ & SolidWorks CPD
- **Analysis Capability**
 - Structural
 - Thermal
 - Acoustic
 - Electrical
 - Impact



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Facility & Manufacturing Capability



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Facility - Manufacturing & Development Workspace



- Facility Accommodates Large Hardware & Large Tooling
- Open Floor Plan
- Large Aisles



- Safety Program
- Maintenance Cage
- Secure MRB Control Area



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Facility - Manufacturing & Development Workspace



- Shipping / Receiving



- Quality Lab



- Large Loading Docks (2)



- Employee Break Room



- Leased Expansion Space



- Leased Expansion Space



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Facility - Manufacturing & Development Equipment



- **Auto Clave**
 - 4' x 6' Capacity, 600F



- **Job Shop**
 - Milling, Drilling, Cutting, Grinding



- **NC Router**
 - 5 Axis, Vacuum Table



- **50 Ton Platen Press**
 - Size: 45"x24"x22", Temp 550F



- **Large Clean Room**
 - Size: 2,500 Sq Ft, Class 100K
- Vector Composites, Inc. - Proprietary



- **Ply Cutter**
 - NC Controlled, Table = 5' x 20'



Vector Composites, Inc.

Facility - Manufacturing & Development Equipment



- **Small Oven**

- Size: 6'x4'x3', Temp: 550F



- **Medium Oven**

- Size: 10'x 8'x 12', Temp: 550F



- **Large Oven**

- Size: 8'x 8' x 30' Temp 550F



- **Paint / Mixing Booth**

- Size: 14'x 18'x 9'



- **Large Walk In Freezer**

- Size: 9'x 7'x 7' Temp: -10F

Vector Composites, Inc. - Proprietary



- **RTM System**

- Size: 2.5 Gal



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Research & Development Programs



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Teammates & Project Roles

**Applied Sciences,
Inc.**

Supplier of CNFs, Milled, Unmilled, and Functionalized

NanoSpense, LLC

Supplier of Formulated Dispersed Resins

**Renegade
Materials**

**Supplier of Resins to NanoSpense for Disbursement and
Fabricator of Films and Nanopreg**

**University of
Dayton Research
Institute**

**Nano-Particle Recommendations and Testing of Multi-
Functional Properties**

**GE Aviation
Systems**

**User Provider of electronic enclosure design i.e. cost,
weight, producibility & operational needs**



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Ohio RCP for Protective Coatings

- **UDRI leading multi-faceted program for Ohio technology development**
- **Several companies tasked to develop technology using protective coatings**
- **Vector addressing EMI protection for composites via coatings**

- **Vector Tasks**
 - Design requirements and coatings development
 - Nano-material structural development
 - Nano-material composite electronic enclosure demonstration
 - Market development for electronic enclosure products

Vector is working with Dayton RCP team to develop materials and manufacturing technology in a way that promotes our regional supply chain & manufacturing strategy.



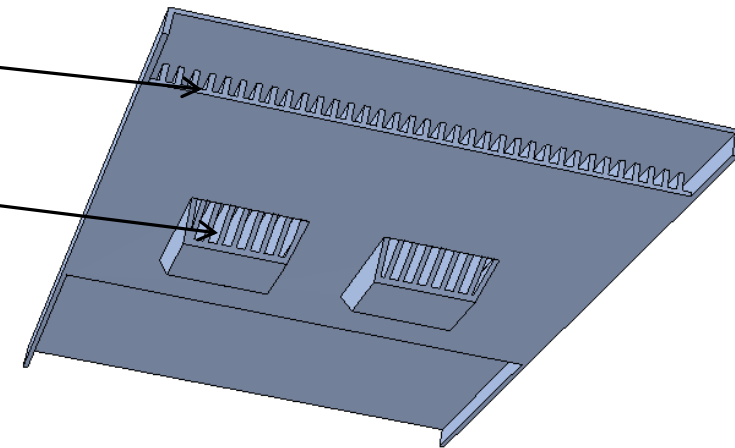
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Design Concept for Tracewell Application

Full composite concept includes:

- Highly conductive materials
- Upper sandwich with cooling fins
- Cup integrates composite finned heat sink to maximize convective cooling
- Base plate → Stiffness

Upper Sandwich



Cut-Away of Full Assembly
(Design Option)



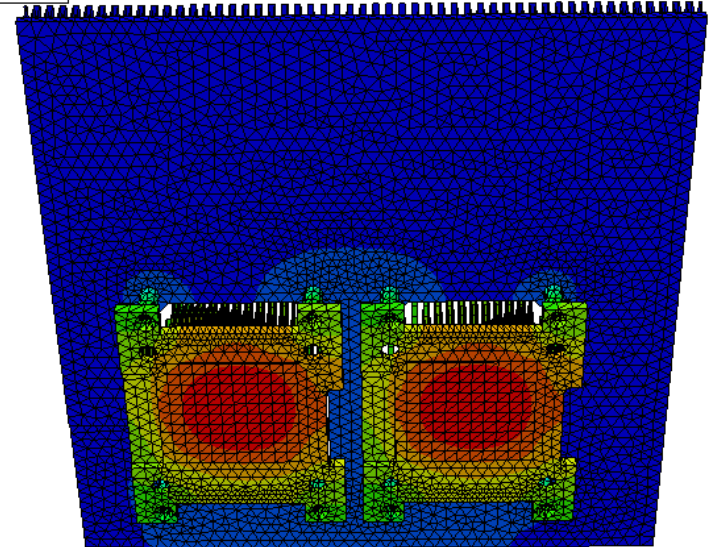
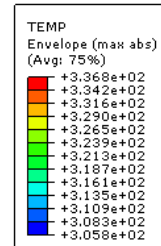
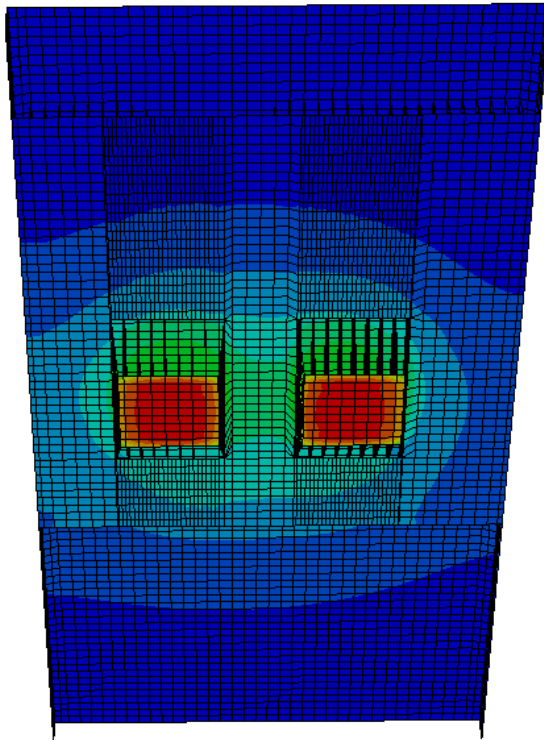
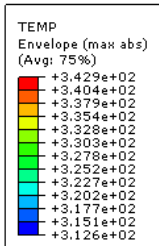


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Thermal Modeling for Tracewell Application

Max temp: 342.9° K (69.75° C)

Max temp: 336.8° K (63.65° C)

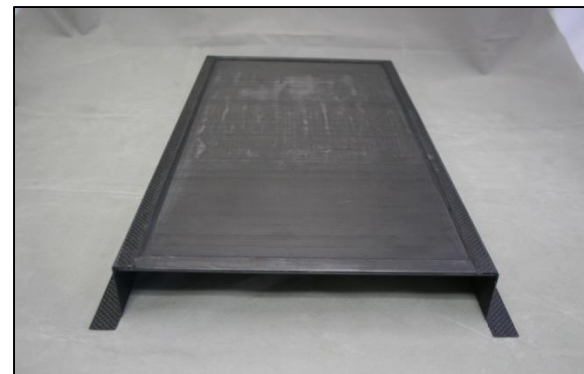
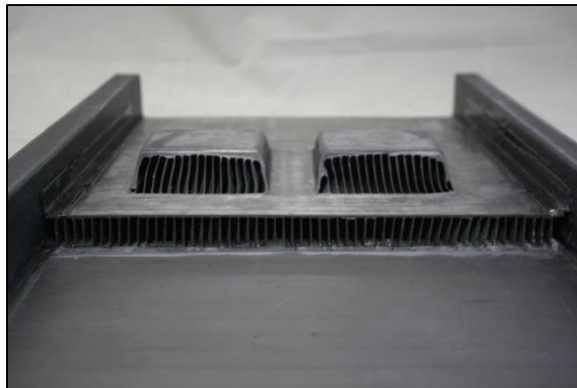
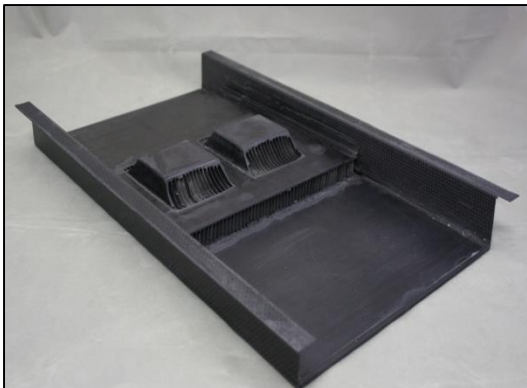


Co-eff of heat transfer: 25 W/m²K



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Tracewell Prototype





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AFRL Nano-Composite Manufacturing Technology Project

Project Title: Nano-Composite Structures Manufacturing Technology Development

Project Objective:

Develop and demonstrate affordable composite structures manufacturing technology for application to multifunctional integrated electronic and structure components for aerospace and defense system applications.

Project Scope:

- MFG processes development using nano-materials and lower cost composite structures mfg processes
- Characterization testing of composite structures to used in developing a design database
- Fabrication of full-scale structures to demonstrate mfg processes
- Include system users to insert technology into production

Project Task Elements:

- # 1) MFG development of multi-functional nano composite structures using low cost composite mfg processes.
- # 2) Characterization of multi-functional nano-composite structures using low cost composite mfg processes.
- # 3) Development of nano-composite structures technology for use in aircraft electronics packaging applications.

Project Schedule: 18 Months

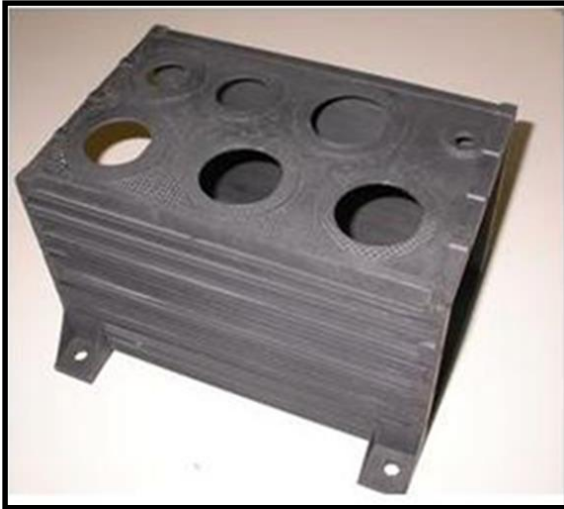
Fiscal Year Funding: GFY09- \$800,000 Appropriated
\$635,000 Vector contract awarded to UDRI, from AFRL with Vector as a subcontractor



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Application Focus

- Insertion application identified on F-35 platform



- Experience with manufacturing of electronics enclosures, including above enclosure with application requirements from F-35 application
- Leveraging intellectual property, mfg tooling, mfg processing technologies, and production systems to aid nano-technology development



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Development Program Deliverables – Electronic Enclosures



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Multi-Functional Composite Electronic Enclosures - Missile and Aircraft

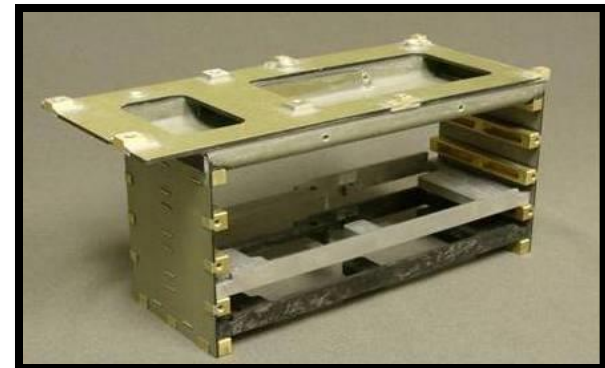


<u>Design Element</u>	<u>Baseline Aluminum</u>	<u>Advanced Composites</u>
• Weight	0.1 lb/in ³	~45% reduction
• Thermal Management	170 W/m ²	160-300 W/m ² with high conductivity fibers
• EMI	>60 dB	>60 dB; (aluminum plating baseline)
• Stiffness	10 Msi modulus	8-15 Msi modulus
• Cost	\$250-\$500/lb	\$500-1,500/lb



Design Notes

- Thinnest laminate construction
- Eliminated stiffeners
- 46% weight reduction vs. aluminum
- Meets all structural/mechanical requirements
- Meets EMI requirements via aluminum plating



Design Notes

- 35% weight reduction vs. beryllium baseline
- Co-cured aluminum mesh for ESD
- Co-cured fasteners for assembly and system integration

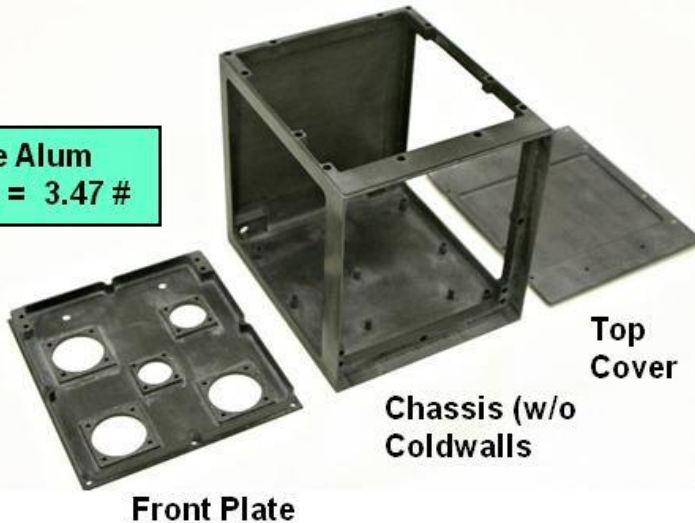


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Multi-Functional Composite Electronic Enclosures

Military Aircraft Composite Chassis

**Baseline Alum
Chassis = 3.47 #**

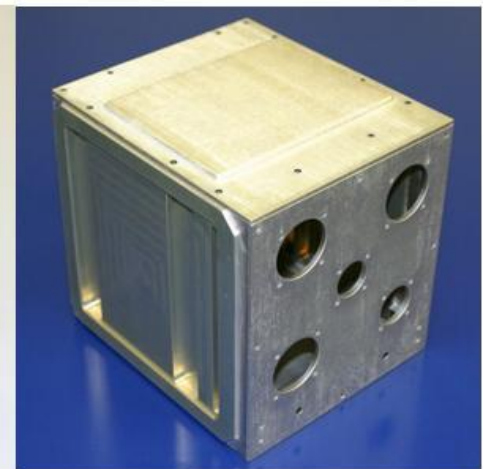
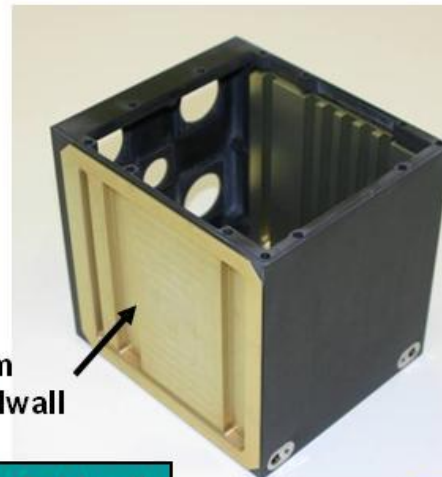


Molded Composite Details

- Improved Producibility – Bladder & Compression Molding
- Utilized Hi-E Gr fibers to reduce wt
 - Thinnest laminate
 - Eliminated stiffeners
 - Wt reduction vs alum
 - 63% (bare)/ 60%(plated) – Chassis w/o coldwall
 - 61%(bare)/56%(plated) – Front Plt
 - 62%(bare)/56%(plated) –Top Cover
 - 30% (plated) w/ alum Coldwall
 - 40%(plated) w/ composite Coldwall
- Meets all Structural/ Mechanical Req'm'ts
- Meets EE Req'm'ts via alum plating



Assembled Composite Chassis with Aluminum Coldwall



Plated Composite Chassis Assy



Aircraft Electronic Enclosure- Assembly & Cold-Wall

Assembled Composite Chassis with Carbon-Carbon Coldwall

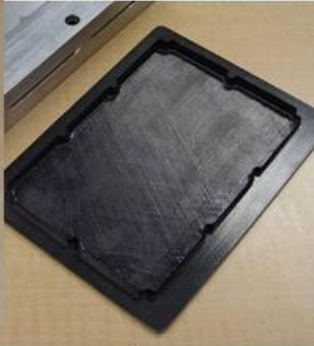


**Plated Structural Chassis with
post-bonded C-C Chassis (Ni-
plated)**



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Aircraft Composite Module & Rack Covers

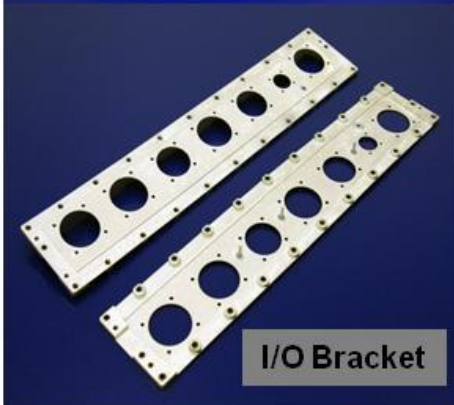


Module Cover

- Improved Producibility – Compression Molding
- Utilized Hi-E Gr fibers to reduce wt
 - Thinnest laminate
 - Eliminated stiffeners
 - 65% (bare)/56% (plated) Wt reduction vs alum
 - 30% Lighter than chopped fiber technology
- Meets all Structural/ Mechanical Req'm'ts
- Meets EE Req'm'ts via alum plating



Access Cover



I/O Bracket



Rear Cover

Rack Covers

- Improved Producibility – Bladder & Compression Molding
- Utilized Hi-E Gr fibers to reduce wt
 - Thinnest laminate
 - Eliminated stiffeners
 - Wt reduction vs alum
 - 58% (bare)/ 46%(plated) – Access Cover
 - 47%(bare)/37%(plated) – I/O Bracket
 - 46%(bare)/40%(plated) – Rear Cover
- Meets all Structural/ Mechanical Req'm'ts
- Meets EE Req'm'ts via alum plating



Vector Composites, Inc.

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