Titanium 2010

Ducommun Incorporated

Presented by: Jeff Masingill
Director of Sales & Marketing
Ducommun Discussion Agenda

• Ducommun Overview
• Titanium Military Structures Capabilities Brief
• Titanium Solutions Initiatives
• Future Military Market Expectations
Ducommun, Incorporated

Design - Development - Fabrication - Integration - Test - Production

Ducommun Team Provides Total Product Solutions
Major Customers
Serving Global Aerospace Markets (Commercial, Military and Space)
2009 Sales: Approx. $500 Million
AeroStructures: Approximately $300 Million
  • Titanium Processing Accounts for more than 1/3
    • Ti segment >15% growth in each of the past 5 years
    • Approximately $65M in Military Direct
    • Over 250,000 sq. ft. dedicated to Ti manufacturing
    • 2000+ employees, 500 directly supporting Ti growth
  • Growth & Acquisition Focused
DAS Centers of Excellence

- Stretch, brake & roll forming
- Hot press
- Tooling design & fabrication
- Major assemblies

- Composite & Metal Bond
  - Composite & Metal Bond Assemblies
  - Machining
  - Chemical processing & Paint
  - Rotary wing blades

- Metal Forming & Assembly
  - Chemical milling
  - Machining
  - Metal forming
  - Sub-assemblies
  - Engine ducts

- Titanium & Aluminum Forming & Assembly
  - Precision Sheetmetal Components and Assemblies
  - Ti & Alum Hot Forming
  - Finishing
  - Brake, Roll, Hydro and Stretch Form

- Low Cost Off Shore
- Metal bond final insp
- Assembly & Paint

- Composite & Metal Bond & Assembly
  - Ti SPF & Hot Forming
  - Ti Assemblies
  - Chem milling
  - Processing & Paint

- Titanium Forming & Assembly

- Guaymas
  - Metal forming & Assembly
  - Chemical milling
  - Machining
  - Sub-assemblies
  - Engine ducts

- Orange & El Mirage
  - Chemical milling
  - Machining
  - Metal forming
  - Sub-assemblies
  - Engine ducts

- Parson, KS
  - Precision Sheetmetal Components and Assemblies
  - Ti & Alum Hot Forming
  - Finishing
  - Brake, Roll, Hydro and Stretch Form

- Orange, CA
  - Metal forming & Assembly
  - Chemical milling
  - Machining
  - Sub-assemblies
  - Engine ducts

- El Mirage, CA
  - Metal forming & Assembly
  - Chemical milling
  - Machining
  - Sub-assemblies
  - Engine ducts

- Gardena, CA
  - Metal forming & Assembly
  - Chemical milling
  - Machining
  - Sub-assemblies
  - Engine ducts

- Monrovia, CA
  - Metal forming & Assembly
  - Chemical milling
  - Machining
  - Sub-assemblies
  - Engine ducts

- Albany, NY
  - Metal forming & Assembly
  - Chemical milling
  - Machining
  - Sub-assemblies
  - Engine ducts

- Ducommun Incorporated

DAS Centers of Excellence
Ducommun AeroStructures - Gardena
268 E Gardena Blvd
Gardena, CA 90248-2814
O:(310) 380-5390   F:(310) 380-5390

Headquarters & Center of Excellence
Stretch and Thermal Forming/Machining

437,000 sq. ft.

Ducommun Incorporated

Core Competencies

- Design & Value Engineering Expertise
- Large Aerostructure Assembly
- Stretch Forming
- Thermal Forming
- Tool Design & Manufacturing
- NC Machining
- Final Assembly/ATA Manuf.
- Chemical Milling
- Brake Forming
- ISO / AS / NADCAP

Typical Programs
- Fuselage Panel Assy.
- Skins & Panels
- Abrasion Strips
- Leading Edge
- Trailing Edge
- Engine Ducts
Ducommun AeroStructures - Parsons
3333 Main St
Parsons, Kansas 67357-3632
O:(620) 421-3400  F:(620) 421-3400

Core Capabilities
- Design & Value Engineering Expertise
- SPF, Hot Form, Hot Joggle
- CNC Machining Ti / Inconel / SS / AL
- Assembly, Sub-Assembly and Kitting
- Titanium Welding: Spot / TIG / MIG
- Tool Design & Manufacture
- Titanium Chemical Milling & Processing
- Hot Vacuum Forming
- Stretch Forming
- Hydro forming
- Five Axis Water Jet Cutting
- ISO / AS / NADCAP

Typical Programs
- Pylons
- Nacelles
- APU
- Heat Shield
- Tail Cone
- Exhausts/Ducts
- Firewalls
- Firebox

Center of Excellence
Titanium SPF & HOT Forming

120,000 sq. ft.
Coxsackie, New York

Ducommun AeroStructures - Coxsackie
2 Flint Mine Road
Coxsackie, NY 12051-2801
O:(518) 731-4600  F:(518) 731-6333

121,000 sq. ft.

Center of Excellence
Titanium and Aluminum Forming & Assembly

Typical Programs
- Firewalls
- Nacelles
- Exhaust / Ducts
- APU / Tailcone
- Door Surrounds
- Floor Structures
- Bulkheads
- Longerons / Stringers

Core Capabilities
- Design & Value Engineering Expertise
- Precision Sheet Metal Ti / Al Assembly
- Titanium & Aluminum Hot Forming
- Titanium Hot Brake / Joggle / Roll
- Hydroform
- Titanium & Aluminum Processing
- Five Axis Water Jet
- CNC Machining Ti / Al
- Stretch Forming
- ISO / AS / NADCAP
Ducommun AeroStructures - El Mirage
4001 El Mirage Road
Adelanto, California 92301-9489
O:(760) 246-4191  F:(760) 246-4191

Center of Excellence:
Chemical Milling and Processing

Typical Programs
• Engine Ducts
• Domes

Core Competencies
• Large Scale Titanium Chemical Milling
  • 9 Tanks, 15 Ft. Deep, 5K to 50K gallon tanks
• Cleaning
• Masking
• Scribing
• Line Sealing
Principle Titanium Materials

Alpha/Beta
  - Ti-6Al-4V
  - Ti-6Al-6V-2
  - Ti-8Mn
  - Ti-6Al-2.5V-1.5 Near Alpha
  - Ti-6Al-2Sn-4Zr-2Mo
  - Ti-3Al-2.5V ASTM Grade 9

Beta
  - Ti-15V-3Cr-3Al-3
  - TI-CP-1 Grade 4
  - TI-CP-2 Grade 3
  - TI-CP-3 Grade 2
  - TI-CP-4 Grade 1

New Alloys in Development
Core Titanium Production Capabilities

- Concurrent Engineering & Design
  - Super Plastic Forming
    - EB Welding
    - Hot Size Forming
  - Ti Welded Assembly
- Ti Mechanical & Electro-Mechanical Assembly
  - Hot Brake Forming
  - Ti Chemical Milling
  - Ti Machining-multi-axis & conventional
- Tool Design & Fabrication

Complete components, and subassemblies production
## Expanded Titanium Capabilities

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Product: Titanium Engine Ducts
Solutions: Gardena/El Mirage Titanium Engine Ducts

- Various military applications – light weight / high strength / high temp
- Typically too high of a cost for commercial applications
- Supplied to Engine OEM’s
- Duct capabilities compliment our broader market (mixers, thrust reversers, exhaust nozzles, etc.)
- Include: Roll Form, Machining, Forming, Chem-Mill, EB weld

Compressor Fan Case

FWD Augmentor Duct

AFT Augmentor Duct (CTOL)
Solutions: Selective Gauge Reduction Superplastic Forming (SGR-SPF)

- **SGR-SPF** is a process in which the finished part configuration is controlled prior to and throughout the superplastic forming process rather than being dictated solely by the part geometry and the tool configuration. By selectively reducing areas of the starting blank thickness, the final part configuration can be more accurately controlled.
Bell H1Z Threshold
Threshold Example

.090 Stock

Selective Gauge Reduction Flat Blank

Gauge Reduced to .060
Threshold Example  (continued)

Starting gauge thickness uniform.  
Close up of finished part area.  
Drastic variation in part thickness.  
Thickness in area of part ranges from .046 - .072

Starting blank selectively reduced.  
Close up of finished part area.  
Uniform part thickness.  
Thickness in area of part ranges from .068 - .074
Threshold Example  (continued)

Thin in area adjacent to part surface

Finised Part
Typical Titanium SGR-SPF Benefits

- Selective Gauge Reduction SPF forming:
  - Infinite control over thinning areas
  - Die size is NOT dictated by part geometry and material thickness allowable. (Non-recurring costs reduced)
  - Part blank size can be reduced based on smaller die configuration. (Recurring cost reduced)
  - Starting part thickness not dictated by part geometry. (Recurring cost reduced)
  - Substantially reducing post form selective chemical milling. (Recurring cost reduced)
Solutions: Upper Cowl Walkway CH-53K: Design for Manufacturability

**Problem Statement:** Cost & weight of utilizing SPF processes & tooling

**Objective:** Find a way to minimize piece part costs, NRE and weight of the walkway

**Concerns:** Developing acceptable design alternatives that still meet weight & stress specifications

**Solutions:** Offered a 2 pc design, 2 single stage hot form dies were produced, eliminating the need for a large SPF Form Die, added a double row of fasteners for assembly, redesigned doublers from 3 piece design to 1, and eliminated over 1000 pieces of hardware through spot welding of details,

**Benefits:** 2 pc. Hot form design yielded $300K reduction in tooling
20% reduction in piece part costs
Eliminated assembly weight over 6 lbs.
DASNY achieved long-term contract
Built long-term relationship with partner
Problem Statement: Composite & Stainless Steel Assembly was Failing Strength & Corrosion Requirements

Objective: Provide a Titanium Welded Pan & Retro fit fleet with Titanium Solution in 3 Months

Concerns: Significant weld distortion and holding tolerance parameters

Solution: Designed & developed a titanium welded assembly constructed out of 2 welded details. Developed precision hot size, weld & stress relief tools to compensate for material shrinkage, material thickness variations and weld distortion. In addition, integrated all titanium hinges, doors and composite stringers complete with electro-mechanical integration to eliminate assembly stack up issues. DASNY identified; material type, profile, tolerances, weld requirements, assembly parameters, etc)

Benefits: Customer achieved a 30% cost reduction
Customer minimized engineering development resources
Customer reduced their purchased part content 80%
Solutions: Heat Shield Weight & Lead Time Reduction

**Problem Statement:** Over weight forging design coupled with a 52 week lead time.

**Objective:** Provide a Titanium sheet metal & machined assembly capable of meeting the stress & strength requirements of existing design, while reducing the aircraft by a minimum of 40 lbs. and do it within 16 week recurring lead time.

**Concerns:** Significant challenges meeting strength and weight expectations.

**Solution:** Designed & developed a titanium welded & fastened assembly constructed of 34 sheet & machined details. Utilized FEA analysis to identify capable processes & tolerances to identify; SPF, hot formed, machined details and rivet & fasten technologies to support a design for manufacturability solution. Utilized 6-4 plate, CP-3 & 6-4 sheet ranging from .080 to .120 thick material, .020 tolerances, weld requirements, assembly parameters, in conjunction with supporting customers stress requirements.

**Benefits:** Customer achieved a 70% reduction in lead time
Customer realized a 17% reduction in weight
Customer reduced their purchased part content 40%
Solutions: Air Mixer Chinook: Vertical Integration

**Problem Statement:** Find a vendor that can completely integrate the necessary processes into the air mixer assembly and still reliably meet tolerance schemes.

**Objective:** Provide a Titanium Welded Air Mixer assembly that met all design parameters within 4 months.

**Concerns:** Significant weld distortion, stack up tolerances of assembly and identifying manufacturing methods

**Solution:** Designed & developed a titanium welded assembly constructed out of 46 details, processes utilized; spin forming, hot form, hot roll, SPF, hot brake, argon chamber welding, and precision assembly. DASNY identified; Ti 6-4, 6-2-4-2, CP-3, CP-1 material types, stack up tolerances, weld requirements, assembly parameters.

**Benefits:** Customer achieved a precision assembly on-time
One Stop Shop to control all manufacturing tolerances
Customer minimized engineering development resources
Future Military Market Needs & Expectations for Structural Titanium Products

• Expanded use in Military Applications-Growth Market
  – Composite integration, Fleet Retrofit, New Aircraft

• Continued Innovation from the Titanium Industry
  – Basic Research with DARPA and Others

• New titanium alloys
  – Higher temperature requirements – Displace Inconel
  – Weight reduction
    • Green initiatives & performance improvements
  – Cold forming & warm forming with similar mechanical properties to traditional hot & SPF materials
    • lowering the total cost of processing
      – Tool costs, setup, forming time, alpha-case removal, lead-time reduction

• Threat of commodity driven expectations as volumes expand