Titanium 2016 - Scottsdale

Titanium in Flight

Joe Phillips
Director of Structural Integrity
Textron Aviation
Textron Aviation Inc. is the leading general aviation authority
Home to the Beechcraft, Cessna and Hawker brands
- Citation business jets
- King Air and Caravan turboprops
- T-6 Military
Account for more than half of all general aviation aircraft flying.
## TEXTRON AVIATION

### Power in numbers

<table>
<thead>
<tr>
<th>Category</th>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aircraft in production</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>Delivered over</td>
<td>250,000</td>
<td>Aircraft throughout more than 80 years</td>
</tr>
<tr>
<td>Combined fleet exceeding</td>
<td>100</td>
<td>Million flight hours</td>
</tr>
<tr>
<td>Announced, certified &amp; delivered</td>
<td>10</td>
<td>New products in the last five years</td>
</tr>
<tr>
<td>More than</td>
<td>12,500</td>
<td>Employees worldwide</td>
</tr>
<tr>
<td>Over</td>
<td>10,000</td>
<td>Employees in Wichita</td>
</tr>
<tr>
<td>Company-owned service centers</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>Textron Aviation locations worldwide</td>
<td>27</td>
<td></td>
</tr>
</tbody>
</table>
**TEXTRON AVIATION**

The broadest product lineup in the industry

<table>
<thead>
<tr>
<th>JETS</th>
<th>TURBOPROPS</th>
<th>PISTONS</th>
<th>DEFENSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Citation Hemisphere</td>
<td>King Air 350i/ER</td>
<td>Baron G58</td>
<td>AT-6</td>
</tr>
<tr>
<td>Citation Longitude</td>
<td>King Air 250</td>
<td>Bonanza G36</td>
<td>T-6C</td>
</tr>
<tr>
<td>Citation X+</td>
<td>King Air C90GTx</td>
<td>TTx</td>
<td>Scorpion</td>
</tr>
<tr>
<td>Citation Sovereign+</td>
<td>Grand Caravan EX</td>
<td>Turbo Stationair HD</td>
<td></td>
</tr>
<tr>
<td>Citation Latitude</td>
<td>Citation M2</td>
<td>Caravan</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Citation Mustang</td>
<td>Denali</td>
<td></td>
</tr>
</tbody>
</table>

**TEXTRON AVIATION**

Carlisle, Massachusetts | Wichita, Kansas | Camarillo, California | West Palm Beach, Florida
TEXTRON AVIATION SERVICE NETWORK
Extending to all corners of the globe

- 60 Mobile Service Units
- 3 Dedicated Citations for AOGs
- 24/7/365 Support
Current Use of Titanium

• Primarily on Jet Models (Citations)
• Targeted use:
  ➢ Strength-to-Weight Ratio
  ➢ Corrosion Resistance
  ➢ High Temperature Applications
• Types of Components:
  ➢ Engine Mounts, Pylon Firewalls
  ➢ Bleed Air & Hydraulic Lines
  ➢ Fasteners, Bolts, Fittings
• Titanium Components
  ➢ 4 - 5% by part count
  ➢ 1% by weight
Sovereign Flap tracks
- Reduced process time from 58 hrs to 30 hrs (46.2 % improvement)
- Saving 1804 hrs - $72000 per year

Cam
- Reduced process time from 295 min to 59 min (81.5 % improvement)
- Saving 256 hrs - $12000 per year

Door Hinge
- Reduced process time from 20.5 hrs to 8.5 hrs (58.6 % improvement)
- Saving 768 hrs - $35000 per year
Research in Processing of Titanium Components

• Optimizing Complete Machining Process
  - Finding efficient speeds and feeds per application
  - Enhancing material removal rate
  - Reducing cycle time
  - Finding most efficient tools per application

• Maximize first-pass yields
  - Minimize part damage & scrap rates
  - Stable machining & low vibrations

• Maximizing the utilization of machine capacity
Future Use of Titanium

• Increased use of Composite Material Systems
  ➢ Corrosion Control at Interfaces

• Additional Types of Components:
  ➢ Structural Bulkheads, Brackets, Clips
  ➢ Exhaust Nozzle, Panels, Firewalls

• Titanium Components:
  ➢ 12 - 15% by part count
  ➢ 5 - 10% by weight

• Tomorrow’s Titanium
  ➢ Improved Material Properties
  ➢ Manufacturability & Formability
  ➢ Process Compatibility
  ➢ Stable Supply Infrastructure