Advanced Titanium Alloy
Ti-6Al-2Sn-2Zr-2Mo-2Cr
(Ti-62222) for Commercial Aerospace Applications

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Commercial Aero Needs

Next generation commercial aero-structure and aero-engine requirements are pushing the Ti alloy needs beyond the upper limits of existing solutions.

**Aero-Structure Trends**
- Higher Performance
  - Better strength
  - Better fatigue & fracture resistance
  - Light weight
- Improved Producibility
  - Low buy-to-fly
  - Robust supply chain
- Reduced Costs
  - Development, build, & life-cycle costs

**Aero-Engine Trends**
- Greener Engines
  - Reduced noise
  - Reduced emissions
- Improved Fuel Efficiency
  - Higher temperature capability
  - Light weight
- Reduced Life-cycle costs
  - Reduced maintenance intervals
  - Reduced part count

Advanced Titanium Solutions are necessary to meet future challenges.
Ti-62222 Attributes

- $\alpha+\beta$ Ti alloy developed by RMI in 1970’s
- Ti-6Al-2Sn-2Zr-2Mo-2Cr-0.15Si-0.13O
- Superior strength plus fracture resistance
- No density penalty
- Heavy sections: up to 4”
- Superior elevated temperature properties
Ti-62222 Attributes (contd.)

❖ Robust manufacturability
  o Melting, Chemistry, Processing, Heat Treatment
  o Over 6M lb produced at RTI
  o Castings, Billet, Plate, Bar, Forging, Extrusion, Sheet
  o Formable
  o Machinable
  o Weldable

❖ Applications: F/A-22 Structures (10% of all Ti)
  o Aft fuselage, wing structure, engine mounts
Solution

Ti-6-22-22 is a matured solution for commercial aerospace demands

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Triplex Heat Treatment

I

II

III

β Anneal + (α+β) Anneal + Age

Damage Tolerance

Strength

Engineered microstructure to increase both strength & damage tolerance

Ref: Zhang et al., TMS 1997

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Two Variants

- Fracture toughness
- Fatigue crack growth rate

High Damage Tolerance
Basketweave

High Strength
Equiaxed

- Strength
- Ductility
- Fatigue initiation

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Ti-62222 Castings

- Good Castability
- Good Processibility
- 15% higher strength than Ti-64 without debit in fracture properties


Cast + HIP F-18 Ejector Block
# Ti-62222 Sheet

<table>
<thead>
<tr>
<th>Tensile Property (Design Minimum)</th>
<th>Annealed</th>
<th>Heat Treated</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ti-64</td>
<td>Ti-62222</td>
</tr>
<tr>
<td>Ultimate Strength, ksi</td>
<td>134</td>
<td>155</td>
</tr>
<tr>
<td>0.2% Yield Strength, ksi</td>
<td>126</td>
<td>150</td>
</tr>
<tr>
<td>Elongation, %</td>
<td>10</td>
<td>8</td>
</tr>
</tbody>
</table>

- Excellent cold and hot formability
- Superior Superplastic formability
- Superior oxidation resistance
- Superior thermal stability

Ti-64: AMS 4911, 4904
Ti-62222: AMS 4898
Ti-62222 Forgings

Bi-modal microstructure for optimum strength-fatigue-creep balance in engine components

Ref: G. Proske et al., TITANIUM ‘99
Ti-62222 Creep Resistance

Ref: Koike, MSEA 1999

Ti-62222 Creep Resistance Equal or Better than Ti-6246
Summary

❖ Next generation commercial aerospace systems demand advanced titanium
❖ Ti-6Al-2Sn-2Zr-2Mo-2Cr-0.15Si alloy meets the challenges
  • Judiciously balanced titanium alloy
  • Properties superior to Ti-64
  • Fully matured
  • Pervasive applications