Satellite Body Construction

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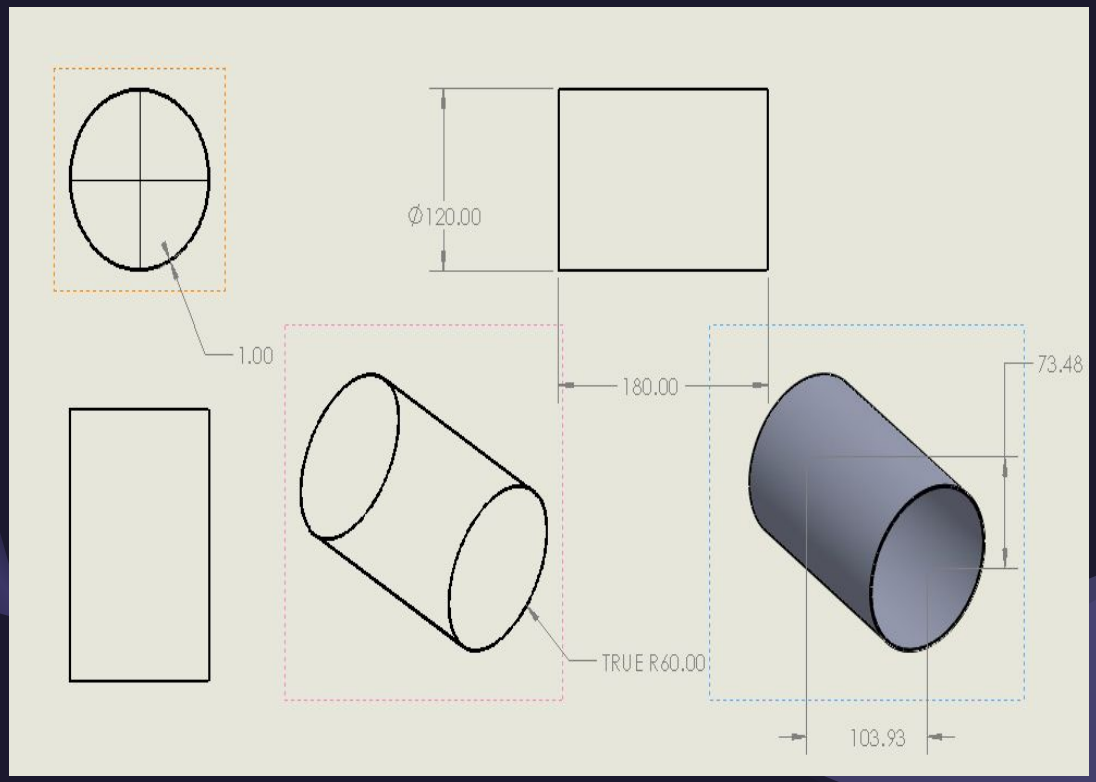
Schematic of Satellite Body



Design Factors

Function	Constraints	Objective	Free Variable
Find best material for satellite body construction	Fixed Length Fixed Diameter Maximum 6 ton weight Service temp. between -65C - 125C Low Electrostatic Conductivity Withstand “reasonable” torsion	Maximize Fatigue Strength Minimize Cost Find Mass Determine Material	Material Cost Thickness

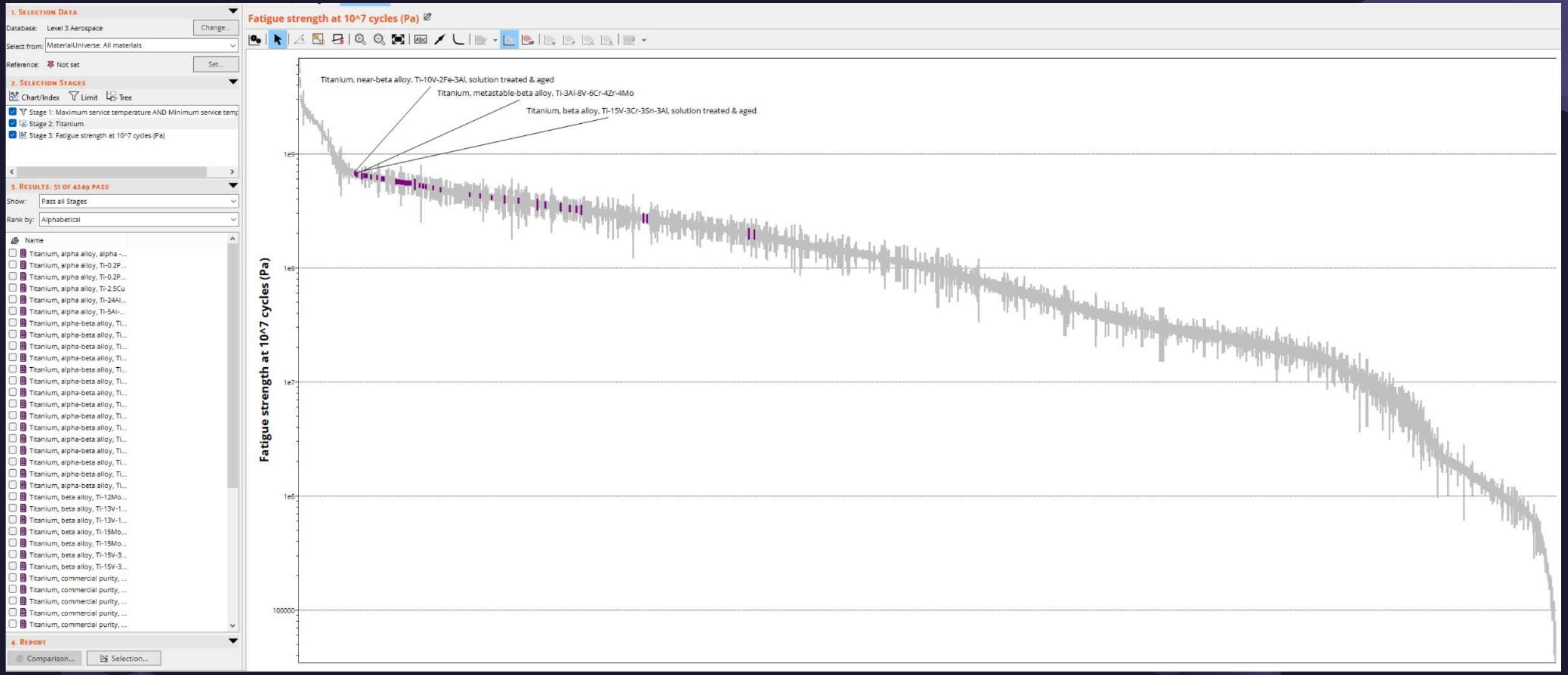
Graph of Material Selection

Service temp. -65 - 120C

Low electrostatic conductivity

Poor conductor

Specific Titanium Alloy Selection



1. Titanium, near-beta alloy, Ti-10V-2Fe-3Al, solution treated and aged
2. Titanium, metastable alloy, Ti-3Al-8V-6Cr-4Zr-4mo
3. Titanium, beta alloy, Ti-15V-3Cr-3Sn-3Al, solution treated and aged

Selected Material: Titanium Alloy

Density: 4.43e3 kg/m^3

Cost: 28.8 Usd/kg

Yield strength: 1.09e9 Pa

Fatigue strength at 10^7 cycles: 6.36e8 Pa

Service temperature: -273 - 487 C

Electrical conductor: Poor conductor

Young's modulus: 1.2e11 Pa

Equations

$A=\pi[(ro^2)-(ri^2)]$

$V=A*L$

$M=PV$

$C=Cm*A$

$K=(\pi/2)*[(ro^4)-(ri^4)]$

$Tf=(K\sigma y)/do$

Results and Variables

T=1in(0.0254m)

ro=1.524m

ri=1.4986m

A=0.24m^2

V=1.1027m^3

M=4885.11kg=5.38tons

C=$140,691.17USD

K=0.55m^4

Max Tf=196.69MPa

References

- Materials Selection in Mechanical Design, 4th ed. Michael F. Ashby, Elsevier: Butterworth-Heinemann, ISBN 1856176637, 2010
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