

An aerial photograph of a desert landscape, likely in the Mojave Desert. The terrain is a mix of light brown and tan colors, with a winding road or path visible. In the center, there is a small, isolated red building. The overall scene is arid and open.

# **MATERIALS CONSIDERATIONS FOR MISSION TO TITAN**

**ENAE 788**

**MIA SIOCHI  
FEBRUARY 22, 2016**

The title slide features a background image of Titan, Saturn's largest moon, showing its hazy, orange-brown atmosphere and a large, dark, circular feature on the surface. The text "Titan Environment" is overlaid in a large, black, sans-serif font.

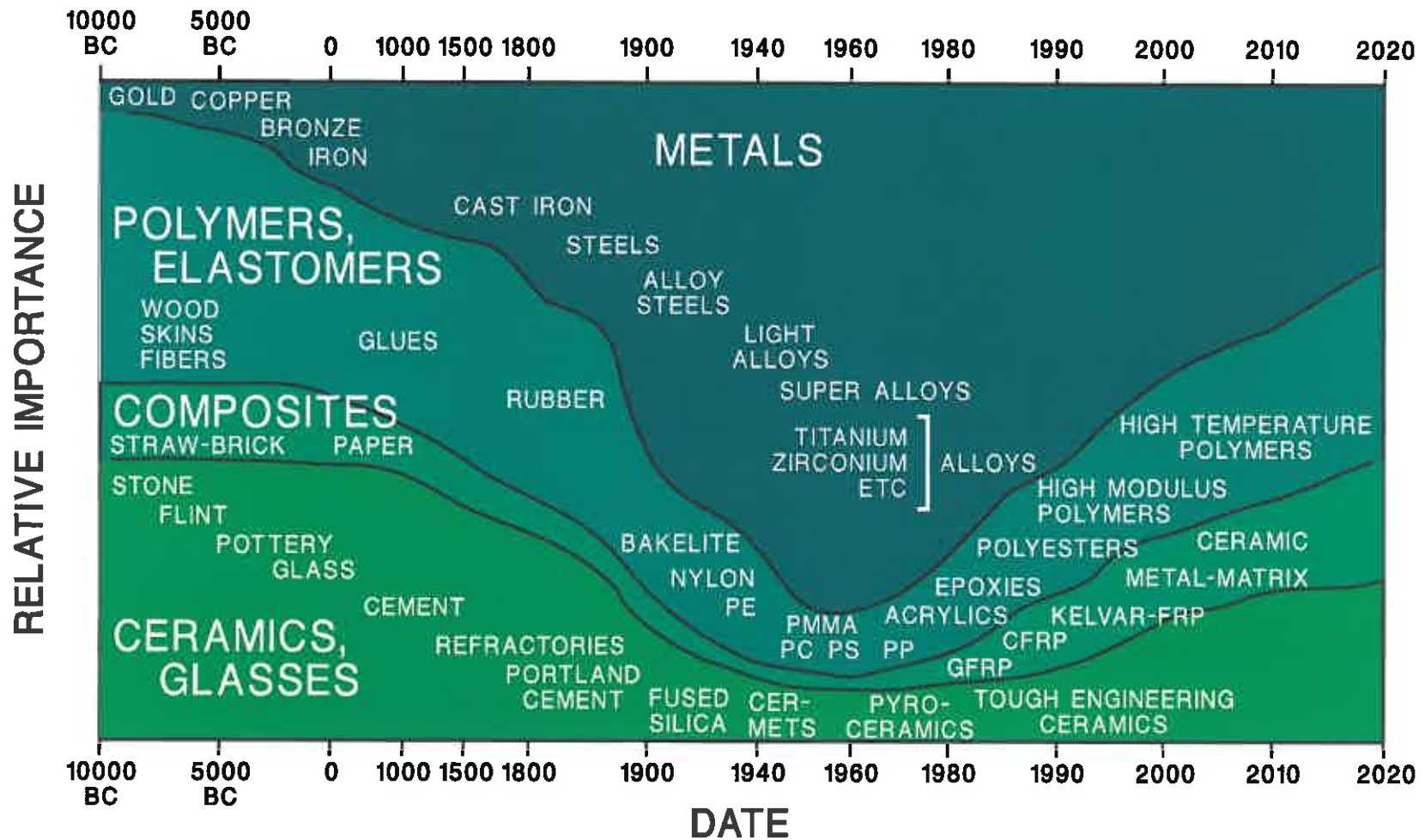
# Titan Environment

- Temperature:  $-180^{\circ}\text{C}$
- Atmosphere compared to Earth:
  - 1.5x pressure
  - 4x density
  - $1/7$  gravity
  - Nitrogen-methane

# Where are Materials Needed?

- Vehicle structures
- Power and propulsion
- Instrumentation
- Avionics

# General Classes of Materials



From: Ilhan Aksay, Princeton University, 2003

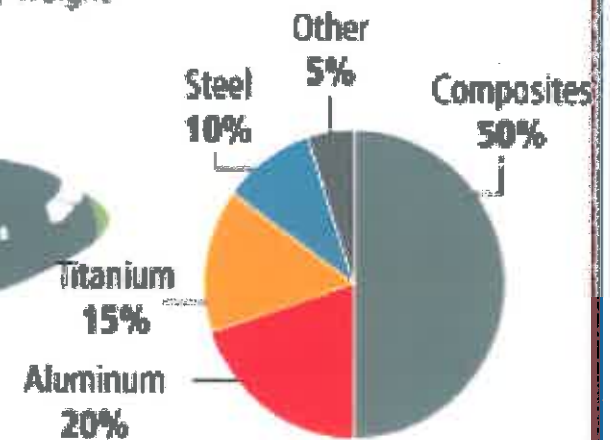
# Boeing 787

## Materials used in 787 body

- Fiberglass
- Aluminum
- Carbon laminate composite
- Carbon sandwich composite
- Aluminum/steel/titanium



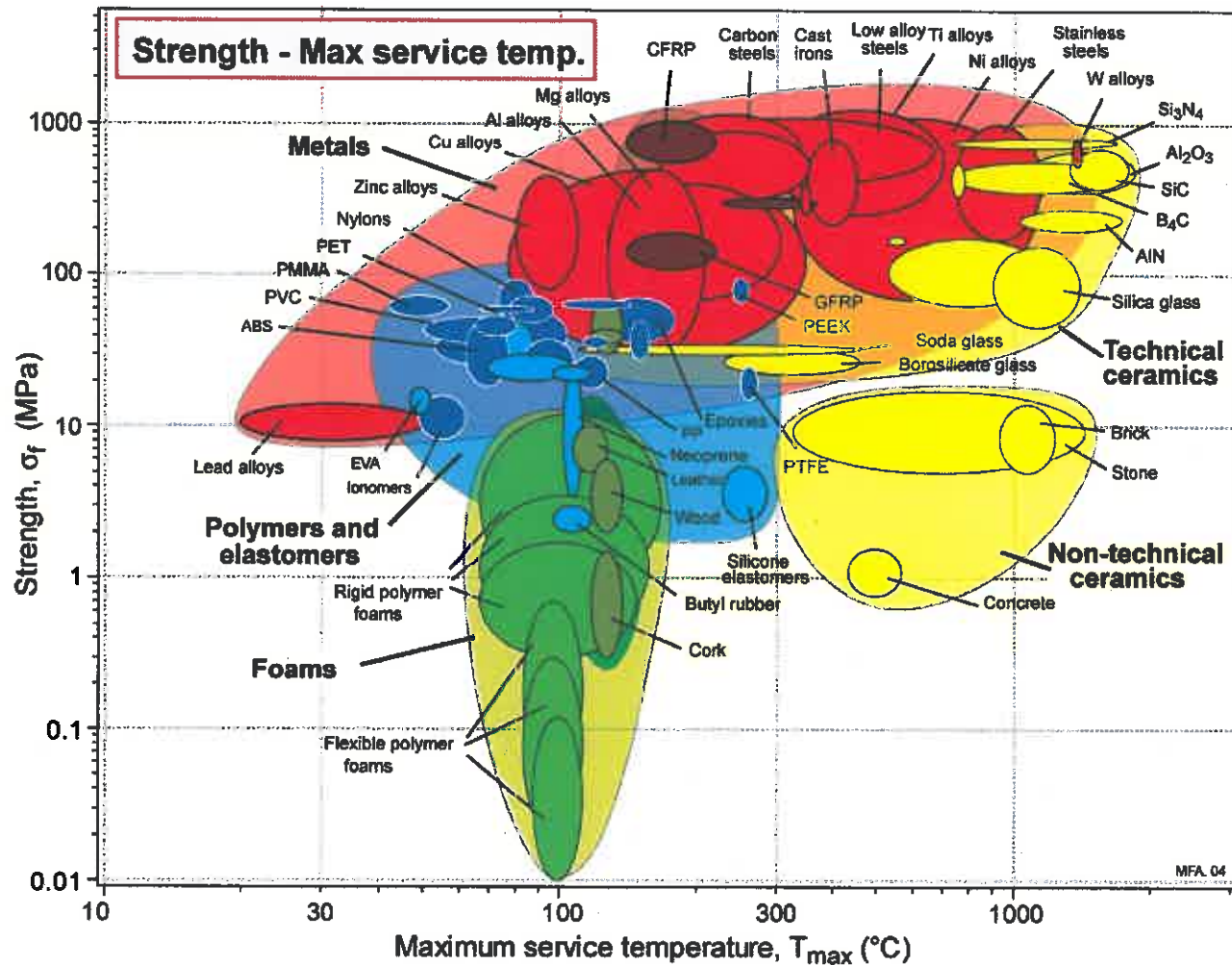
## Total materials used By weight



By comparison, the 777 uses 12 percent composites and 50 percent aluminum.

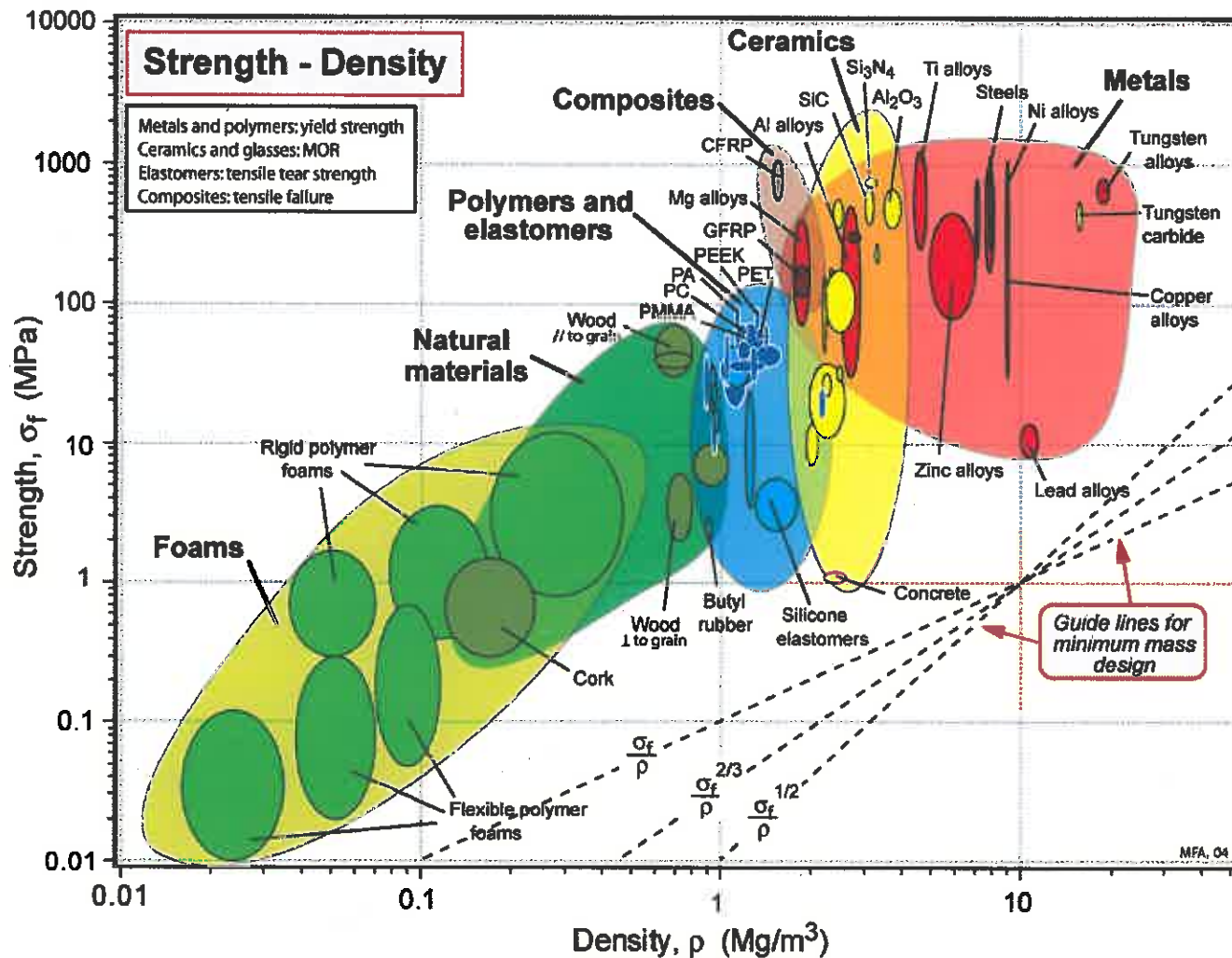
Courtesy of Boeing Commercial Airplane Group

# Effect of Temperature on Material Properties



[http://www.mie.uth.gr/ekp\\_yliko/2\\_materials-charts-2009.pdf](http://www.mie.uth.gr/ekp_yliko/2_materials-charts-2009.pdf)

# Trading Performance and Mass



[http://www.mie.uth.gr/ekp\\_yliko/2\\_materials-charts-2009.pdf](http://www.mie.uth.gr/ekp_yliko/2_materials-charts-2009.pdf)

# Evaluation – Lab vs Use Environment



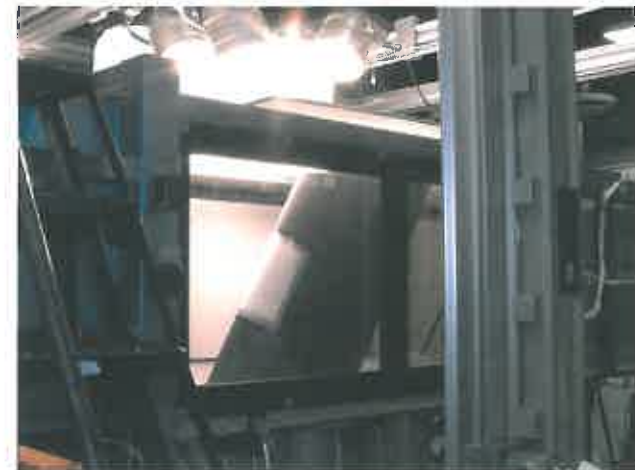
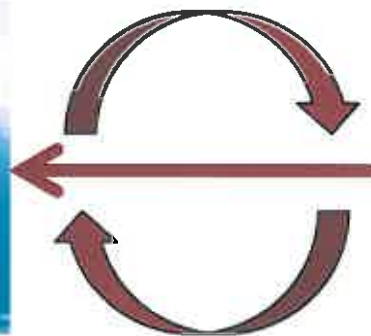
Fundamental Materials Screening



Bench Scale Testing



Testing in Relevant Environment



Simulation of Use Environment



# Design Considerations

- Enabling integrated functionality through advanced materials

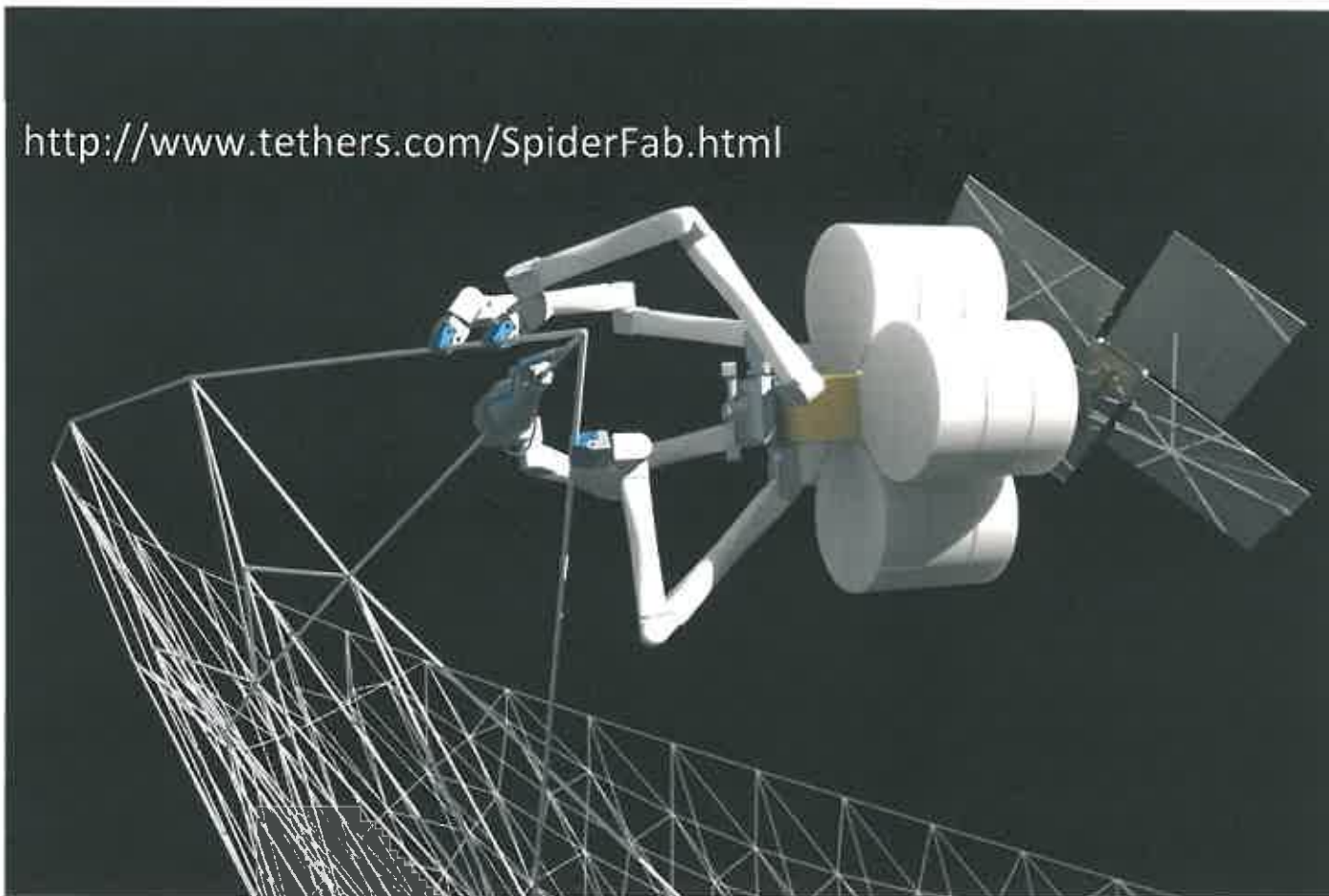


<http://icesat.gsfc.nasa.gov/icesat/photogallery/glas-itgallery.php>



Embedded  
Functionality

# Systems Designs Influenced by Materials



**Materials Driven Innovative Deployment Design Concepts**

An aerial photograph of a coastal region. The top half of the image shows a large body of water, likely a bay or inlet, with a dark, forested coastline. The bottom half shows a vast, flat, light-colored landscape, possibly a salt flat or a dry lake bed, with some faint, winding paths or roads. The colors are muted, with a mix of greys, browns, and light tans.

**THANK YOU**