

Tragedy and Standards Development

A Case Study of the Space Shuttle Columbia



Chris Czaplak
CMGT 564

Thermal Protection System

- Approximately 24,300 tiles and 2,300 Flexible Insulation Blankets on the outside of each orbiter.
- Reinforced Carbon-Carbon on wing leading edges and nose cap
- High Temperature Reusable Surface Insulation Tiles
- Fibrous Refractory Composite Insulation
- Low-temperature Reusable Surface Insulation, later replaced by Advanced Flexible Reusable Surface Insulation

Thermal Protection System

- Temperature Range: -250 F to 3000 F
- TPS protects orbiter against temperatures above 350 F
- LRSI protects against temperatures less than 1200 F
- TPS is reusable for 100 missions

Development

- Mercury and Gemini
- X-15
- Apollo
- Lockheed and Lockheed



February 1st, 2003





SPACE SHUTTLE COLUMBIA BREAKS UP OVER TEXAS

NASA LOSES CONTACT WITH SHUTTLE AT AROUND 8 AM EST



Piece of orbiter tile

**Origin of debris
(aft edge of right nose gear door)**

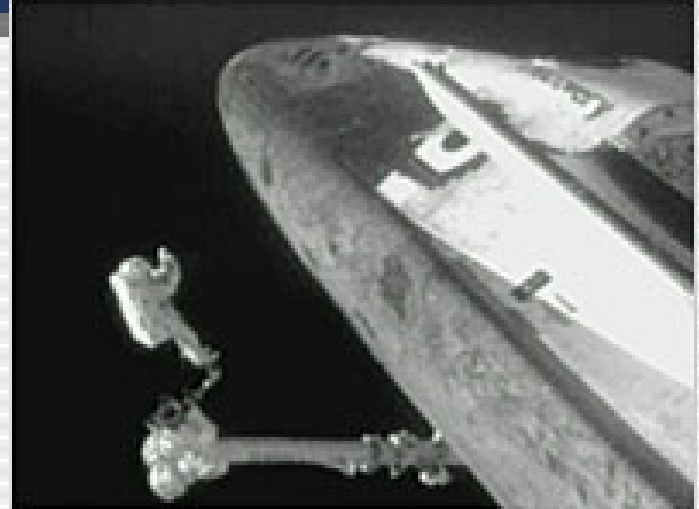
Accident Findings

- The physical cause of the loss of Columbia and its crew was a breach in the Thermal Protection System
- Superheated air penetrated the leading edge insulation and melt the aluminum structure of the left wing
- Root cause was organizational and cultural, rather than engineering and technical

“The Safety & Mission Assurance Pre-Launch Assessment Review process is not recognized by the Space Shuttle Program as a requirement that must be followed (NSTS 22778).”

Corrective Actions

- NASA Engineering and Safety Center
- In-orbit TPS Inspection
- Safety and Mission Assurance Independent Assessment Implementation Plan



The Cost of Non-Compliance



26 July 2006