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National Aeronautics and
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George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

Solid Rocket Propulsion

Briefing To:
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Solid Rocket Propulsion

NASA'S Commitment to SRM use

- Planned use well into 21st Century
- Typically launch about 300 SRM's over 5 year period
- Approximately $30B of hardware-depend on successful SRM operation during 5 year period
- Historical success rate has proven to be about 98%

Improvements Needed

- Success rates must be improved for manned flight and high-tech hardware launches
- Costs must be controlled to remain competitive

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Shortfalls

Cultural

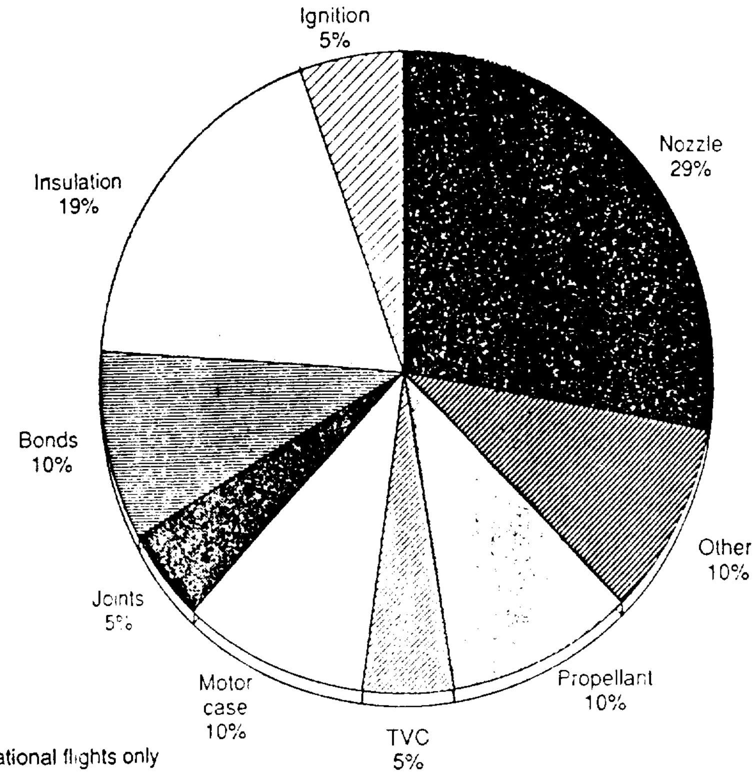
- Based on empirical approach – hot firings to prove success vs. technical understanding
- Extensive assumptions used in invalidated analytical models
- Designs based on tactical and strategic systems where 98% success rate is adequate
- Lack of fundamental understanding of engineering principals for design and analysis, processing and verification

Managerial/Leadership

- Absence of focused, continuous, coordinated government commitment and leadership during past two decades
- Major IR&D efforts in ballistics areas

Solid Rocket Motor Failure Database

Cause of Failure, %



Note: Operational flights only

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Current Programs

Solid Propulsion Integrity Program (SPIP)

Improve the success rate of the Nation's Solid Rocket Motors through

- Development of engineering base
- Generation of fundamental technical understanding of current SRM Technologies
- Providing tools for design, margin of safety prediction, process control, inspection and performance validation
- Controlled product variability with process sensitivity knowledge

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Current Programs (Continued)

- Redesigned Solid Rocket Motor Enhancements
  - Facilitization
  - Contamination Control

- Advanced Solid Rocket Motor Development
  - Specific components and system
  - Improved materials
  - Production automation

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Current Programs (Continued)

ALS/Low Cost Case, Insulation And Nozzle (LOCCIN)

- Attacking High Cost of SRM's
  - Innovative Designs
  - Low Cost Materials
  - Reduced Manufacturing/Fabrication Labor
  - Efficient Assembly/Checkout
  - Competition
  - Track Materials and Manufacturing Cost Savings

- Improving Reliability Through
  - Robust Designs
  - Verify Safety Margins
  - Define and Demonstrate Materials and Process Sensitivities
  - Set Materials and Process Specifications Based on Sound Accept/Reject Criteria

- Technical Maturity Achieved By
  - Laboratory Development
  - Sub-Scale Demonstration
  - Provide Technology for Full Scale Development

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Current Programs

Solid Propulsion Integrity Program – Engineering Base

	Predictive Capability	Materials Properties & Performance	Test Techniques	Process Understanding	Process Monitoring & Control	Improved Materials & Process	Instrumentation Development	NDE & Effects Of Defects
Composite Cases								
Propellant	X	X	X					
Nozzles	X	X	X	X	X	X	X	X
Bondlines	X	X	X	X	X		X	X
Internal/Flow	X		X				X	
Joints & Seals								
Integration & Verification	X	X	X	X		X	X	X

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Summary

- Progress being made in
  - Cultural
  - Managerial
  - Engineering base development
- Commitment is continuous through 1990's
- New initiatives that reduce cost and enhance reliability needed
- Solutions to environmental and flight safety issues should be aggressively pursued

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Additional Critical Issues/Recommendations

- Expand SPIP to complete matrix
- NASA involvement in clean propellant
- Develop thrust termination/restart SRM capability