CSM RCS Design Considerations & Failure Modes
Lesson Objectives

- Define major Command and Service Module (CSM) design considerations
- List Command Module (CM) RCS failures and lessons learned
- List Service Module (SM) RCS failures and lessons learned

For more information about CSM RCS system please see

CSM RCS Overview
CM Design Considerations
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CM Failures and Lessons Learned
- Apollo 7 - damaged bellows
- Apollo 10 - ruptured oxidizer burst diaphragm
- Apollo 12 - damaged bellows
- Apollo 13 - fuel valve coil miswiring
CM Propellant Isolation Valve Lessons Learned

- Proper procedures
- Caution notes and leak checks
- Resistance checks
Anomaly: Helium manifold pressure drop discovered before launch of Apollo 10; no measurable leak was found.

Conclusion: Fuel leg helium manifold was indeed leaking but at an acceptable rate for the mission.

Solution: Pressurized system to 100psi 30 days prior to launch to insure detection of any leak.
Anomaly: Faulty terminal board sending erratic firing signals through automatic coils

Conclusion: Two loose pins causing intermittent continuity to coils
- Found in all pre-November 1967 terminal boards

Solution: No corrections made since terminal boards did not affect circuits that jeopardized crew
CM Propellant Dump

- Apollo 15 - Deflated parachute due to CM RCS depletion firing
  - Correction: Procedures changed to allow propellant to remain onboard at landing
- Apollo 16 – Small burn holes caused by yaw engine firings
  - Tests determined maximum pressure and planned for on-the-water operation of the system if required
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SM RCS Failures and Lessons Learned
- Apollo 9 - Valves shocked closed
- Apollo 11 - Valves closed during CSM separation from S-IVB
- Apollo 13 – Valves closed due to oxygen tank anomaly
- Apollo 15 - Degaussed magnets due to reversed polarity
SM Isolation Valve Lessons Learned

- Apollo Operations Handbook changed to ensure that the crew would check isolation valves after separation and reopen any that closed.
- A test was performed on all post-Apollo 15 flights to verify acceptable valve latching forces.
Apollo 12: Helium manifold pressure transducer malfunction

Apollo 14: Oxidizer manifold pressure out of nominal limits
Define major Command and Service Module (CSM) design considerations

List Command Module (CM) RCS failures and lessons learned

List Service Module (SM) RCS failures and lessons learned

For more information about CSM RCS system please see

• Apollo Mission Reports 6-17
• Apollo Experience Report – Command and Service Module Reaction Control Systems

Use References link below for more information