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ISO 14624 Series – Space Systems – Safety and Compatibility of Materials

Flammability Assessment of Spacecraft Materials

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ISO TC 20/SC 14, Space Systems and Operations
Beijing, China, May 2007

No notes.

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Spacecraft Fire Safety

- General strategy: preventing fires
- Controlling materials
- Minimizing potential ignition sources and materials that can propagate a fire
- Controlling the quantity and configuration of flammable materials to eliminate fire propagation path

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Materials Flammability Test

- Major flammability test – NASA-STD-6001 Test 1, which is similar to ISO 14624-1
- Upward flame propagation
- Conducted under worst expected spacecraft conditions – mostly in 30 % oxygen at 10.2 psia
- Pass/fail test logic

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No notes.

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Impetus for enhanced materials flammability characterization

- During late 1990s upon the joint US/Russia microgravity testing, difficulties became apparent to WSTF correlating ISO 14624-1 data with MIR data obtained under unstable oxygen concentration conditions at approximately constant total pressures
- Probability of failure vs. oxygen concentration at a given total pressure
- Extinction boundary for a condensed fuel – oxygen concentration vs. total pressure

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Impetus for enhanced materials flammability characterization *(continued)*

- WSTF suggested determining flammability thresholds to allow quantitative correlations between ground and microgravity flammability data
- Existence of comprehensive materials flammability characterization would also allow flexibility for spacecraft environment selection
- The approach was published in 2002

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Exploration Atmosphere Working Group Recommendations

- "For the Constellation Program, the flammability threshold information will allow NASA to identify materials with increased flammability risk from oxygen concentration and total pressure changes, minimize potential impacts, and allow for development of sound requirements for new spacecraft and extravehicular landers and habitats."
- Excerpt from Recommendations for Exploration Spacecraft Internal Atmospheres, JSC-63309, NASA JSC, January 2006
- Also, Henninger and Campbell, Briefing to Constellation CxCB on Exploration Working Group Recommendations, NASA JSC, July 6, 2006

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Approach

- Self-extinguishment oxygen concentration limits were determined at constant pressures following ISO 14624-1
- The experimental approach consisted of concentrating the testing in the flammability transition zone following the Bruceton Up-and-Down Method. The method has shown to be very repeatable and most efficient for attribute data. Other methods for characterization of critical levels were also considered (Karber and Probit).

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Approach

- Bruceton is from 30 to 50 % more efficient than Probit for the same accuracy; estimate of precision
- The method is widely used for determining the limiting oxygen index as defined and accepted by the combustion community.
- Conducted a number of tests N at the highest oxygen concentration at which the material passes (MOC) (the material would fail in an environment with 1 % oxygen higher)

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No notes.

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No notes.