



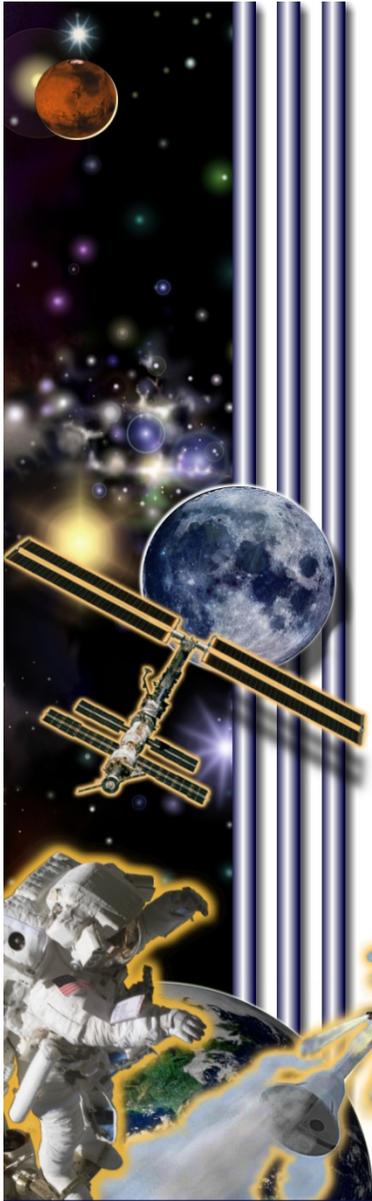
# Revision of ISO 15859 Aerospace Fluid Standards

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- Part 1: Oxygen
- Part 2: Hydrogen
- Part 3: Nitrogen
- Part 4: Helium
- Part 5: Nitrogen Tetroxide Propellants
- Part 6: Monomethylhydrazine Propellant
- Part 7: Hydrazine Propellant
- Part 8: Kerosine Propellant
- Part 9: Argon
- Part 10: Water
- Part 11: Ammonia
- Part 12: Carbon Dioxide
- Part 13: Breathing Air



# Background



- The NASA Johnson Space Center White Sands Test Facility (WSTF) has expert scientists and laboratory facilities for the analyses of aerospace fluids.
- WSTF was provided with, reviewed, and commented on ISO 15859 Parts 1-13 “Space Systems – Fluid Characteristics, Sampling and Test Methods” when these documents were in FDIS form.
- The comments were not incorporated when the documents were issued.
- WSTF proposed a revision effort, which was accepted by the NASA Technical Standards Program Office.
- The revision effort began with a comparison of ISO 15859 Parts 1-13 to their apparent source documents:
  - NASA SE-S-0073 “Space Shuttle Specification Fluid Procurement and Use Control”
  - SSP 30573 “Space Station Program Fluid Procurement and Use Control Specification. International Space Station Alpha”
  - SSP 50260 “Internal Space Station Medical Operations Requirements Documents (ISS MORD). International Space Station Program” for the Russian segment
  - SSP 41000AY “System Specification for the International Space Station” for the Russian segment
  - United States military and federal specifications and their referenced documents, which include Compressed Gas Association (CGA) commodity specification and ASTM International (formerly American Society for Testing and Materials) test methods.



# Summary Findings



- All Shuttle and ISS fluid specifications (with the exception of water) reference U.S. military or federal specifications for fluid procurement.
- The procurement specification for Shuttle water is a Johnson Space Center document; water “use” requirements for ISS are found in SSP 50260 “Internal Space Station Medical Operations Requirements Documents (ISS MORD). International Space Station Program” and SSP 41000AY “System Specification for the International Space Station” for the Russian segment
- The composition limits of Parts 1-9 and 11-13 generally match one of the following:
  - U.S. military or federal specifications (when NASA Space Station or ISS specifications do not exist)
  - A combination of U.S. military or federal specification composition limits and NASA Space Station or ISS specifications
  - One grade of MMH may be of French origin for an Ariane 5 rocket
- The composition limits of Part 10 – “Water” do not correspond to any of the above documents
- The test methods of Parts 1-9 and 11-13 lack the detail provided in the corresponding U.S. military or federal specifications, which affects the ability to perform a standardized, quality analysis.
- Where U.S. military specifications reference ASTM or CGA commodity specifications for test methods, the CGA test methods are closely duplicated. Additional mass spectrometric methods are allowed for Nitrogen and Argon, but are not likely technically feasible.
- ISO 15859 Parts 1-9 and 11-13 do not reference their source documents, therefore it may be not possible to perform a quality analyses where sufficient detail is not provided.
- ISO 15850 Part 10 “Water” stands alone sufficiently to perform the specified analyses, because it amply references the test methods methods. The generic allowances of “unless otherwise provided, directed, specified, agreed...” found in Part 10 (as well as all the ISO 15859 standards) allow flexibility as required.



# Revision Approach



- WSTF's goal was to revise the ISO 15859 standards in a manner that was as technically thorough and technically correct as possible.
- WSTF could not reconcile the intermingling of program-specific “use” specifications and military or federal procurement specifications in establishing international standards.
  - “Use” specifications are program-specific. Because programs are not standardized, standardized “use” specifications are neither realistic nor achievable.
  - Since all specifications are subject to change; where ISO 15859 standards use information from unreferenced source documents, there must be a mechanism or an equivalent solution to update them.
    - Example: ISO 15859 Part 8 “Kerosine Propellant” limits closely agreed with MIL-P-25576C Military Specification Propellant, Kerosene (February 1967), which was superseded by MIL-DTL-25576D Detail Specification Propellant, (May 2005, April 2006, and January 2011). ISO 15859 Part 8 shows only partial agreement with MIL-DTL-25576D, with the notable exception that MIL-DTL-25576D contains composition limits for RP-1 and RP-2 while ISO 15859-8 refers only to kerosine.
- WSTF recommended that the allowances of “unless otherwise provided, directed, specified, agreed...” were not appropriate for the revised standards.
- WSTF recommended ISO 15859 Parts 1-9 and 11-13 be aligned with their corresponding U.S. military or federal specifications, which are well-researched and validated; and by reference, would ensure the original source document pedigree is maintained.
- WSTF recommended that ISO 15859 Part 10 “Water” need not be re-written.
- WSTF recommended rather than copying the U.S. military or federal specifications, they be incorporated by reference. These documents are publically released. Where other voluntary consensus standards apply, they are also publically released.



# ISO 15859 Space Systems – Fluid Characteristics, Sampling and Test Methods Parts 1-9 and 11-13 (Revised)



- ISO 15859 Space Systems – Fluid Characteristics, Sampling and Test Methods – Part 1: Oxygen.
  - This document incorporates MIL-PRF-25508 Performance Specification Propellant, Oxygen and MIL-PRF-27210 Performance Specification Oxygen, Aviator's Breathing, Liquid and Gas by reference.
- ISO 15859 Space Systems – Fluid Characteristics, Sampling and Test Methods – Part 2: Hydrogen
  - This document incorporates MIL-PRF-27201 Performance Specification Propellant, Hydrogen by reference.
- ISO 15859 Space Systems – Fluid Characteristics, Sampling and Test Methods – Part 3: Nitrogen
  - This document incorporates MIL-PRF-27401 Performance Specification Propellant Pressurizing Agent, Nitrogen by reference.
- ISO 15859 Space Systems – Fluid Characteristics, Sampling and Test Methods – Part 4: Helium
  - This document incorporates MIL-PRF-27407 Performance Specification Propellant Pressurizing Agent, Helium by reference.
- ISO 15859 Space Systems – Fluid Characteristics, Sampling and Test Methods – Part 5: Nitrogen Tetroxide Propellants
  - This document incorporates MIL-PRF-26539 Performance Specification Propellants, Dinitrogen Tetroxide by reference.



# ISO 15859 Space Systems – Fluid Characteristics, Sampling and Test Methods Parts 1-9 and 11-13 (Revised)



- ISO 15859 Space Systems – Fluid Characteristics, Sampling and Test Methods – Part 6: Monomethylhydrazine Propellant
  - This document incorporates MIL-PRF-27404 Performance Specification Propellant, Monomethylhydrazine by reference.
- ISO 15859 Space Systems – Fluid Characteristics, Sampling and Test Methods – Part 7: Hydrazine Propellant
  - This document incorporates MIL-PRF-26536 Performance Specification Propellant, Hydrazine by reference.
- ISO 15859 Space Systems – Fluid Characteristics, Sampling and Test Methods – Part 8: Kerosine Propellant
  - This document incorporates MIL-DTL-25576 Detail Specification Propellant, Rocket Grade Kerosene by reference.
- ISO 15859 Space Systems – Fluid Characteristics, Sampling and Test Methods – Part 9: Argon
  - This document incorporates MIL-A-18455 Military Specification Argon, Technical by reference.
- ISO 15859 Space Systems – Fluid Characteristics, Sampling and Test Methods – Part 11: Ammonia
  - This document incorporates CGA G-2 Anhydrous Ammonia or SEMI C3.12 Specification for Ammonia (NH<sub>3</sub>) in Cylinders, 99.998% Quality by reference.\*
- \*O-A-445C Federal Specification Ammonia, Technical was cancelled without replacement.



# ISO 15859 Space Systems – Fluid Characteristics, Sampling and Test Methods Parts 1-9 and 11-13 (Revised)



- ISO 15859 Space Systems – Fluid Characteristics, Sampling and Test Methods – Part 12: Carbon Dioxide
  - This document incorporates BB-C-101 Federal Specification Carbon Dioxide (CO<sub>2</sub>): Technical and USP by reference.
- ISO 15859 Space Systems – Fluid Characteristics, Sampling and Test Methods – Part 13: Breathing Air
  - This document incorporates CGA G-7 Compressed Air for Human Respiration\*
  - \*BB-A-1034 Federal Specification Compressed Air, Breathing is optional but has been inactivated for new design.



# Summary and Conclusions



- A detailed review of ISO 15859 “Space Systems – Fluid Characteristics, Sampling and Test Methods” was performed
- An approach to revising Parts 1-9 and 11-13 was developed and concurred by the NASA Technical Standards Program Office.
- The approach was to align them with the highest level source documents, and not to program-specific requirements.
- The updated documents were prepared and presented.



# Discussion

