MATERIALS CONTROL FOR AEROSPACE APPLICATIONS

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The distant future of mankind and the ultimate survivability of the human race, as it is known today, will depend on mans ability to break earthly bonds and establish new territorial positions throughout the universe. Man must therefore be positioned to not only travel to, but also, to readily adapt to numerous and varying environments. For this mass migration across the galaxies nothing is as import to the human race as is NASA's future missions into Low Earth Orbit (LEO), to the moon, and/or Mars. These missions will form the building blocks to eternity for mankind. From these missions, NASA will develop the foundations for these building blocks based on sound engineering and scientific principles, both known and yet to be discovered. The integrity of the program will lead to development, tracking and control of the most basic elements of hardware production: That being development and control of applications of space flight materials.

Choosing the right material for design purposes involves many considerations, such as governmental regulations associated with manufacturing operations, both safety of usage and of manufacturing, general material usage requirements, material longevity and performance requirements, material interfacing compatibility and material usage environments. Material performance is subject to environmental considerations in as much as a given material may perform exceptionally well at standard temperatures and pressures while performing poorly under non-standard conditions. These concerns may be found true for materials relative to the extreme temperatures and vacuum gradients of high altitude usage. The only way to assure that flight worthy materials are used in design is through testing. However, as with all testing, it requires both time on schedule and cost to the operation.

One alternative to this high cost testing approach is to rely on a materials control system established by NASA. The NASA community relies on the MAPTIS materials control system founded at MSFC and supported by the other NASA Centers. This system is a data bank of all materials used in space flight operations. These materials are rated for several characteristics that are common concerns in high altitude or deep space usage: Odor, off gassing, material fluid compatibility, toxicity, corrosion susceptibility, stress corrosion susceptibility, etc.

All future space operations will require that consideration be given to the use of materials in both low earth orbit and/or deep space operations relative to their ability to contaminate the immediate controlled environment of a vehicle, station or orbital/operational platform. For example, many materials off gas or out gas in low pressure applications; this can lead to nauseating odors or deadly contaminates being released from materials to circulate though out the contained habitable environment.

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Also, many materials are subject to giving off toxic fumes if heated beyond application limits; this issue of flammability routinely occurs with the usage of electronic wiring, wiring assemblies and connectors and the like when high resistance joints cause the generation of heat beyond design limits. Similar types of contamination or adverse reactions can occur with the usage of interfacing of materials that are not compatible with each other. Materials used for structural applications may become brittle, or malleable, depending on the exposure limit extremes. Materials studies dealing with long-term radiation exposure of materials in space operations are still in their relative infancy.

All materials and associated properties used in space flight operations, where contained, controlled and habitable environments are required, must be thoroughly understood and controlled down to the piece part level. Ultimately, materials control lies within engineering. Engineering has to clearly and concisely define specific materials to be used on products. These engineering specifications have to be clearly transmitted to vendors and sub vendors to assure that only designed materials are to be used in production operations. The only way to know how materials will respond when used at extreme limits is to test the materials at those limits. Materials testing should be performed during the preliminary stages of design to avoid adverse engineering and schedule impacts.

Initial design goals should rely heavily on materials tested by NASA. The prime contractors are held responsible for assuring only flight worthy materials are actually used in design; consequently, there should be a materials control and monitoring program in place at all prime space contractors. Without a monitoring program in place, materials can slip into design in numerous ways: Off the shelf purchase of hardware (piece parts or assemblies) particularly related to modern commercial electronics; also, in this day and age, obsolete spec control is a huge issue relative to exact identification materials and avoiding intentional or unintentional material substitution at some remote level of vendor control. Ideally, only materials that perform acceptability when tested by NASA should be used for space flight design.