NASA SBIR 2004 Phase I Solicitation

X1.01  In-Situ Manufacturing

Lead Center: JSC

Participating Center(s): ARC, KSC, MSFC

The Russian Mir space station and the current International Space Station have many lessons learned that can be applied to NASA's new human exploration vision. There are two lessons, however, that cannot be ignored: launching everything you need from Earth is expensive, and no matter how much you try, things break. The purpose of this subtopic is to identify and experimentally validate In Situ Manufacturing capabilities that include production of sub-element and replacement components, complex products, and assemblies and machines to reduce launch costs, reduce logistics and spares concerns, and enable self-sufficiency and infrastructure growth. In Situ Manufacturing can use either in situ or Earth supplied feedstock, however the long-term goal is to exclusively use in situ processed feedstock. In situ produced feedstock will be provided by processes developed in the SBIR subtopic, X1.03 In Situ Resource Processing & Refining. Technical areas included in the subtopic are:

- Metallic Parts Manufacturing
- Polymer/Plastic/Composite Parts Manufacturing
- Ceramic Parts Manufacturing
- Manufacturing Support Processes

To be able to make replacement or spare parts, structures, and complex assemblies and machines, manufacturing and assembly processes are required for the different materials parts and assemblies will be made from (metal, polymer, ceramic, and composites). Non-destructive evaluation (NDE) processes are also required to verify that the parts and assemblies manufactured have the required properties, and internal quality. Metrology processes will be required to ensure that parts meet dimensional and surface finish requirements. For in situ manufacturing and evaluation processes to be beneficial, compared to bringing everything from Earth, it must be capable of producing 100s to 1000s of times their own mass of product in their useful lifetimes, with reasonable quality, and be able to make a wide variety of parts and assemblies of different shapes and sizes for the feedstock material selected. Proposed manufacturing and assembly processes must also be easily transportable, require the minimum of power and Earth supplied processing consumables needed to perform its function, operate in microgravity or partial-gravity environments, and require the minimum of maintenance, human supervision, crew operation, and crew training.