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HUMAN FACTORS ENGINEERING OF GOVERNMENT IN-HOUSE PRODUCED FLIGHT HARDWARE

Abstract

Human Factors Engineering (HFE) at NASA has a vibrant, decades-long history for space operations that continues to thrive. Ground operations, such as vehicle assembly/integration and ground transportation/movement can directly affect launch and flight safety, thus have human factors requirements levied upon them. Although NASA recognizes that a thorough human factors program helps guarantee mission success for flight and ground operations, the human factors culture is not deeply rooted when designing for manufacturing and assembly. Programmatically, most vehicle components are procured as complete elements; therefore, it is beyond the scope of NASA to impose HFE requirements on its vendors' manufacturing processes. Many vendors, however, flow down their own in-house human factors requirements to ensure that their workers can safely and efficiently manufacture deliverables for shipment to NASA.

Recently, NASA's Marshall Space Flight Center (MSFC) decided to develop in-house, the largest Payload Adapter (PLA) and Payload Attach Fitting (PAF) ever built. This is being accomplished with MSFC designers for engineering and analysis and with MSFC technicians for building flight hardware. As an integrated member of this in-house team, MSFC HFE has been able to effectively influence manufacturing and assembly by providing inputs throughout the development process and by verifying that the products are compliant with HFE requirements.

The first step for HFE was to understand all the tasks involved in the manufacture, assembly, nondestructive evaluation (NDE), transportation, and integration of the PAF and the PLA hardware. After these tasks were identified for the applicable HFE requirements, each worksite was analyzed using physical mockups as well as virtual mockup tools to determine compliance. Observation of technicians using early development manufacturing tools and subsequent discussions with tooling designers revealed problem areas in the manufacture, assembly, NDE, transportation, and integration of the hardware. MSFC HFE personnel proposed improvements and enhancements that resulted in redesigns to the tooling which in turn resulted in an accessible and more usable assembly tool. In conclusion, the early and continual involvement of HFE as an integrated member of the engineering team improved the efficiency of the tooling and manufacturing development of this in-house build, while reducing potential damage to the flight article, thereby helping to ensure mission success.