Additive manufacturing (AM) technologies use a 3D Computer Aided Design (CAD) model to develop a component through a deposition and fusion layer process, allowing for rapid design and geometric flexibility of metal components, for use in the aerospace, energy and biomedical industries. Challenges exist with additive manufacturing that limits its replacement of conventional manufacturing techniques, most especially a comprehensive understanding of the anisotropic behavior of these materials and how it is reflected in observed tensile, torsional and fatigue mechanical responses. As such, there is a need to understand how the build orientation of as-built additively manufactured metals, affects mechanical performance (e.g. monotonic and cyclic behavior, cyclically hardening/softening behavior, plasticity effects on fatigue life etc.); and to use constitutive modeling to both support experimental findings, and provide approximations of expected behavior (e.g. failure surfaces, monotonic and cyclic response, correlations between tensile and fatigue properties), for orientations and experiments not tested, due to the expensive cost associated with AM. A comprehensive framework has been developed to characterize the anisotropic behavior of as-built additively manufactured metals (i.e. Stainless Steel GP1 (SS GP1), similar in chemical composition to Stainless Steel 17â€“4PH), through a series of mechanical testing, microscopic evaluation and constitutive modeling, which were used to identify a reduced specimen size for characterizing these materials. An analysis of the torsional response of additively manufactured Inconel 718 has been performed to assess the impact of build orientation and as-built conditions on the shearing behavior of this material. Experimental results from additively manufactured SS GP1 and Inconel 718 from literature were used to constitutively model the material responses of these additively manufactured metals. Overall, this framework has been designed to serve as standard, from which build orientation selection can be used to meet specific desired industry requirements.

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Approved for distribution by Ali P. Gordon, Committee Chair, on March 15, 2018.

The public is welcome to attend.