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Comparative Shock Response of Additively Manufactured Versus Conventionally Wrought 304L Stainless Steel* J.L. WISE, D.P. ADAMS, E.E. NISHIDA, B. SONG, M.C. MAGUIRE, J. CARROLL, B. REEDLUNN, J.E. BISHOP, Sandia National Laboratories — Gas-gun experiments have probed the compression and release behavior of impact-loaded 304L stainless steel specimens machined from additively manufactured (AM) blocks as well as baseline ingot-derived bar stock. The AM technology allows direct fabrication of metal parts. For the present study, a velocity interferometer (VISAR) measured the time-resolved motion of samples subjected to one-dimensional (i.e., uniaxial strain) shock compression to peak stresses ranging from 0.2 to 7.5 GPa. The acquired wave-profile data have been analyzed to determine the comparative Hugoniot Elastic Limit (HEL), Hugoniot equation of state, spall strength, and high-pressure yield strength of the AM and conventional materials. Observed differences in shock loading and unloading characteristics for the two 304L source variants have been correlated to complementary Kolsky bar results for compressive and tensile testing at lower strain rates. The effects of composition, porosity, microstructure (e.g., grain size and morphology), residual stress, and sample axis orientation relative to the additive manufacturing deposition trajectory have been assessed to explain differences between the AM and baseline 304L dynamic mechanical properties. *Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under Contract DE-AC04-94AL85000.

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