

Sub-scale Testing and Development of the J-2X Fuel Turbopump Inducer

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In the early stages of the J-2X upper stage engine program, various inducer configurations proposed for use in the fuel turbopump (FTP) were tested in water. The primary objectives of this test effort were twofold. First, to obtain a more comprehensive data set than that which existed in the Pratt & Whitney Rocketdyne (PWR) historical archives from the original J-2S program, and second, to supplement that data set with information regarding the cavitation induced vibrations for both the historical J-2S configuration as well as those tested for the J-2X program. The J-2X FTP inducer, which actually consists of an inducer stage mechanically attached to a kicker stage, underwent 4 primary iterations utilizing sub-scaled test articles manufactured and tested in PWR's Engineering Development Laboratory (EDL). The kicker remained unchanged throughout the test series. The four inducer configurations tested retained many of the basic design features of the J-2S inducer, but also included variations on leading edge blade thickness and blade angle distribution, primarily aimed at improving suction performance at higher flow coefficients. From these data sets, the effects of the tested design variables on hydrodynamic performance and cavitation instabilities were discerned. A limited comparison of impact to the inducer efficiency was determined as well.