Supersonic wind tunnel testing

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1 Introduction

The paper presents the factors limiting proper, stationary work of Mach 2 supersonic wind tunnel and its identification by external load cell measurements on the validation 2-D model - NACA0014 airfoil. Flow visualization was utilized as a supplementary technique improving greatly the judgment of wind tunnel working regime. Supersonic, diamond-shaped model was used for a flow visualization comparison.

2 Wind tunnel examination

All experiments were carried out using IAAM supersonic wind tunnel. It is an open circuit, intermittent (steady flow maintained usually for 1.5 s), in-draft (suction) type of wind tunnel with Mach 2 de Laval nozzle. The test section has 100 mm width and 350 mm height. The NACA0014 model, 120 mm chord was mounted to the customized, aluminum circular disc - the housing of external load cell and put inside the test section through the cavity in the side wall. In this arrangement the change of angle of attack is realized only by disc rotation. The use of elastic reservoir was necessary to avoid the water vapor condensation from humid air as it proved to influence negatively the maximum allowable height of the model.

Forces & moments acting on a model were measured by the 6-component external load cell. The full time history for each test was stored to examine the flow behavior in the non-stationary phases (opening, closing) of wind tunnel operation as well as choking possibility determination.

The flow visualization was prepared by using a Schlieren photograph optical system with 270 mm diameter mirrors. The continuous light source paired with high-speed camera setup producing shadowgraph images contributed greatly to the identification of additional, blockage shock wave. Its presence manifested through the high-frequency oscillations of forces and moments combined with the reversal of normal and axial force component. The regulation of diffuser throat height extended the range of useful angles of attack.