EXPERIMENTAL STUDY OF STARTING FLOW PATTERNS OVER A MULTI-PYLON INTAKE INTEGRATED WITH A FOREBODY AT HIGH SUPERSONIC VELOCITIES

Yu.P. Gounko, I.I. Mazhul, and A.M. Kharitonov

Khristianovich Institute of Theoretical and Applied Mechanics SB RAS
630090, Novosibirsk, Russia

Results of an experimental study of a forebody–integrated multi–pylon intake are analyzed. Firstly, tests of the model intake were carried out at Mach numbers M = 4 and 6 in a blowdown wind tunnel T-313. Conditions of intake starting were determined with optical and oil-film visualization of the flow around the forebody and measurement of pressure distributions along the forebody and in the intake duct. Besides, intake starting was probed in testing the model with optical visualization at M = 6 in a hotshot wind tunnel IT-302M.

It was found from tests of the model in an initial configuration in T-313 that after its start-up the flow patterns around the intake corresponded to regimes without a bow shock in front of the intake entrance, the inflow into the intake duct was supersonic. At the same time these regimes were accompanied by a cross separation of the turbulent boundary layer which induced an oblique shock wave ahead of the duct entrance. Such regimes can be called the imperfect starting ones; they characterized by a reduced flow rate factor.

The same variant of the intake model was tested in IT-302M at M = 6. The test showed that a veritable starting of the intake occurred in this case, therewith the inflow into the intake duct was supersonic and there was no cross separation of the turbulent boundary layer ahead of the intake entrance.

An intake variant with the cross-sectional area of the throat enlarged by 41% was tested in T-313. In testing at M = 4 of this model variant the flow pattern corresponding to the imperfect starting was observed. At M = 6, a flow pattern with a supersonic inflow into the intake duct, without a cross separation of the turbulent boundary layer and without of a separation shock wave ahead of the intake entance was obtained. Nevertheless, there were local three-dimensional separations induced by glancing shock waves generated by the pylons. For this intake variant significant improvement in the characteristics was obtained: for example the flow rate and pressure recovery factors increased by 1.8-2.7 times at angles of attack α = 0-4°.

Key words: multi-pylon intake, experiments, supersonic speeds, starting conditions, flow rate factor, pressure recovery factor.