

The analysis of a reverse jet influence on an engine inlet flow parameters and particles ingestion

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The low under-wing engine mounting is typical for modern civil airplanes. But such location is interfaced with a number of negative factors. Increased probability of big particles ingestion to the engine inlet is one of them. There are a number of leading to a big particles scattering and hitting it to engine reasons. The motion of the chassis wheels along surfaces, action of a reverse jets from operating engines during landing and powerful vortex flow which take place near the engine inlet on the on-surfaces regime among them.

The thrust reversing regime which used for airplane breaking on airdrome is critical for safety and reliability of aviation engine. On the reversing regime the exhaust reverse jet propagates before the airplane. Therefore probability of big particles ingestion which can lead to the blade damages is significantly increased.

At the base of numerical results conditions which realized in a near-surface layer in the reverse jets turn region for particles accumulation and interaction of this zone with vortex are analyzed. For numerical integration of stationary Navie-Stoks equation with Spallart-Almaras turbulent model the developed in CIAM Godunov methods realization was used.

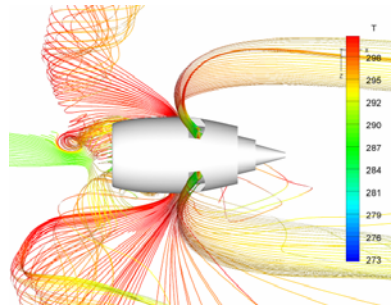


Figure 1. Reversive jets propagation.

The flow structure for one of calculated regimes is illustrated at Fig.1. A reverse jets which propagates against the motion direction along the runway permanently loses an axial velocity component. In some moment this component passes through zero and change sign. The area of flow lines turn generates the continuous front moving before the engine.

Directed to the runway high-energy reversing jet lead to motion along the surface all size of particles including large enough. Near engine and its symmetry plane the axial velocities component makes to 90% of absolute velocities. In the turn area it is equal zero. Therefore moving particles originally lifted by a jet return again to the surface that leads to formation of a zone of increased particles concentration.

During the airplane motion along the runway the permanent particles accumulation in a reversing jets turn zone will take place. When reversing jets has a long range this zone locates on a safe distance far from engine inlet. And this distance increases in process of a airplane velocities decreasing.

At movement of the plane along a strip there is a gradual accumulation of particles in this zone. Moving in front of the engine the front of a turn of a stream will collect more and more particles. On a mode when the reversive stream has high дальнобойность, this front is located on safe enough distance from an input in the engine.

After revers deactivation the particles accumulation zone approached to engine inlet. The vortex flow which exists at the engine inlet appeared behind this zone they behind in conditions when initial particles concentration near surface is large. It is enough to suggestion of big particles

At the base of calculations and experimental dates range of dangerous modes under thrust reversal was defined.