RUSSIAN FEDERATION
MINISTRY OF TRANSPORT OF THE RUSSIAN FEDERATION
FEDERAL AIR TRANSPORT AGENCY

AIRWORTHINESS DIRECTIVE

November 21, 2024 Ref. No. 2024-FATA-01020A-010

Applicability - RRJ-95B, RRJ-95B-100, RRJ-95LR-100 aircraft

State of Design – Russian Federation

Corrective actions described herein are mandatory. No operator may operate an aircraft to which this AD applies, except in accordance with the requirements hereof.

Pursuant to paragraph 3.1. of the "Action Plan for the implementation of the recommendations of the subsequent report on the crash of Gazpromavia RRJ-95LR-100 aircraft serial number RA-89049 on July 12, 2024 in the Kolomenskoye district of the Moscow Region" approved by the Federal Air Transport Agency on September 17, 2024 (No. 555/02-PR) and based on PJSC Yakovlev letter dated November 19, 2024 No. 37663 to ensure flight safety of the RRJ-95 aircraft fleet

IT IS REQUESTED:

1. Entities operating RRJ-95 type aircraft, when planning their flight operations, shall be guided by PJSC Yakovlev recommendations No. 37663 dated November 19, 2024 (hereinafter referred to as the "Recommendations").

A verification of these Recommendations with the flight crews adopting pass/fail tests shall be arranged by December 1, 2024,

Further assessment of flight crews' actions in failure conditions in flight shall be carried out when arranging flight engineering conferences regarding the transition of the aircraft to winter (summer) and vice versa operation.

2. This Airworthiness Directive shall become effective upon its signing and shall be valid pending PJSC Yakovlev decision.

Appendix: PJSC Yakovlev Letter dated November 19, 2024 No. 37663, on 7 pages.

Deputy Head	[*signature*]
Federal Air Transport Agency	Dobriakov A.A.

GENERAL PROVISIONS

1. The occurrences in flight and the understanding of the processes occurring to the aircraft operating and having failures, malfunctions and other events like maintenance errors leading to abnormal conditions is closely associated with the understanding of the aircraft flight envelope capability and the operation principles of the automatic devices within it, the flight performances specified in the entire range of angles of attack, altitudes and aircraft speeds.

2. Aircraft spatial motion (i. e. flight) shall be considered as a continuous dynamic process.Within this process with a particular configuration there are no separate spatial positions with constant motion parameters (state). Each subsequent state is very closely linked to the previous one and derives from it, including changes in the spatial position (pitch, roll, heading), parameters (angle of attack, overload, speed, angular speed, altitude) and flight path motion (change in the spatial position of the center of gravity under the influence of forces and torques acting on the aircraft).

3. An important element for safe completion of abnormal cases in flight is the knowledge and acknowledgment of the operation principles related to the automatic devices ensuring that the flight performance within the specified entire range of angles of attack, altitudes for the aircraft is achieved. The AoA limiter within the Air Data System computer interfaces with FCS in NORMAL MODE and any action of the crew will not cause the aircraft to stall at high angles of attack, providing that pitch control is in the range of angles of attack from α_{prot} to α_{lim}. Control in this range is performed with significant pull force, which is different from conventional piloting. This must be taken into account in training and verification related to the actions in abnormal conditions.

4. Performance of the aircraft control procedures set out in the operational documentation is an important factor in the safe completion of the flight. Procedures in the flight documentation are a set of actions to be performed by the crew, the correct execution of which sequentially changes the physical parameters of the aircraft spatial motion, its configuration and the possibility of further flight performance (motion).

5. During the certification work, each procedure in the flight documentation is repeatedly checked for the considered aircraft abnormal condition for which it was developed, including recommendations for the aircraft

complex failure conditions taking into account the dynamic of their development.

6. The list of procedures is developed for all types of failure conditions considered in the process of aircraft development and certification. The probability of abnormal situation is determined based on a comprehensive system analysis of systems operation and their components on the aircraft. Procedures for crew actions in failure conditions cannot include failure conditions resulting from unpredictable external influences.

7. Any control action applied to the aircraft controls is not a movement of the controls in the cockpit with instantaneous reflection on the indication and warning, but a change in the dynamics of the aircraft spatial motion with corresponding reflection on the indication and warnings associated to dynamically changing parameters. When performing the failure procedures, the piloting technique may differ from the standard one used in normal operation. These peculiarities must be discussed during the ground training in the process of crew briefing, during training in the Aviation Training Centre and shall be taken into account during the verification including the FFS training.

8. During the training and verification for complex failure procedures, it is necessary to take into account the conditions of the complex failure procedures and its recognition. The understanding leads to finding the right solution to stabilize the aircraft or its systems. This will allow the crew to improve the situation as well as to perform the subsequent procedures to complete the flight safely.

9. During the training and verification, the crew must be trained not only to be prepared to carry out a standard flight safely, but also to be able to assess correctly the aircraft behavior, associated warning and signs of minor and major situations in flight. The crew must have a clear understanding not only of the order and sequence of actions in the existing situation, but also of the physics of the phenomenon and the processes occurring with the aircraft, that are recognized by the in-cockpit indication, warnings and aircraft behavior.

10. The angle of attack is an important element in the safe flight performance and compliance of the parameters with the specified mode. Pilots' knowledge of the appropriate range of angles of attack for each flight phase provides the crew with the information on the correct and safe completion of this phase.

PECULIARITIES OF AIR DATA AND FLIGHT CONTROL SYSTEMS OPERATION UNDER CONDITIONS OF SENSORS DATA DISCREPANCIES «COMMON CAUSE FAILURE»

1. **Operation of the systems indications and determination of validity of the angle of attack logic for the generation of CAS messages "NAV ADS DISAGREE, NAV ADS 1(2)(3) FAULT" and data analysis of the angle of attack sensors signals in the flight control system**

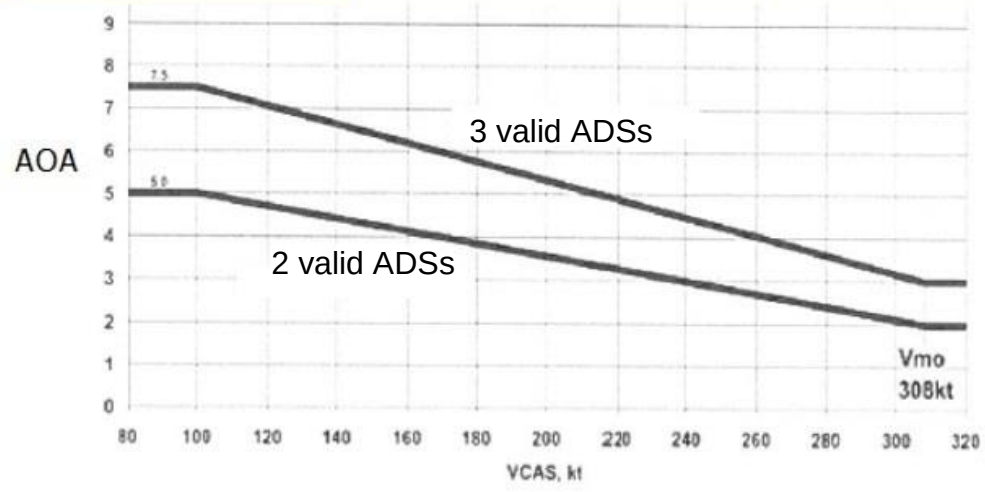
   For indication of the angle of attack on the PFDs of the pilot in command and second pilot, a consolidated value calculated from the angle of attack readings from three ADS computers (or two ADSs) is used, i.e., as long as two or three angle of attack sources are valid, the same average value is displayed on the PFDs of the pilot in command and second pilot.
   When all three ADSs are valid, the output parameters are compared with the threshold values. The threshold value is calculated as a difference between middle value from the three values and the two remaining ones. If one of the ADSs exceeds the threshold, it is recognized as invalid leading to the corresponding CAS message (NAV ADS 1(2)(3) FAULT).
   When only two ADSs are valid, the difference in readings between the two ADSs is compared. If the difference is beyond the threshold, both ADSs are considered invalid.

Threshold values for two valid ADSs

Speed, kts	0	100	308
Divergence threshold	5°	5°	2°

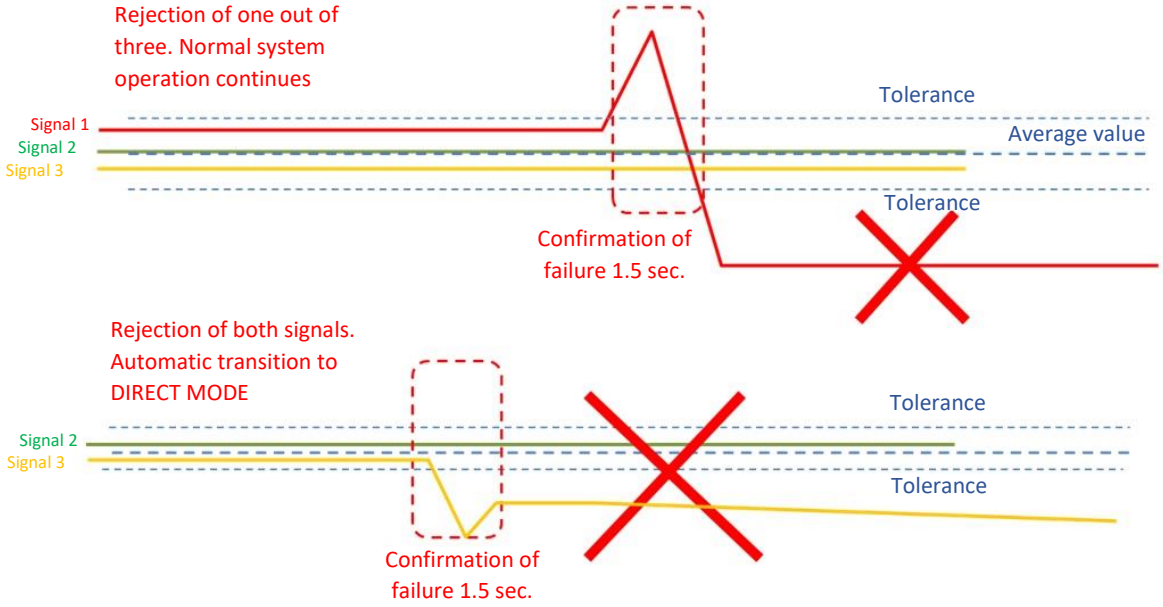
Threshold values for three valid ADSs

Speed, kts	0	100	308
Divergence threshold	7.5°	7.5°	3°



Dynamic change of the threshold depending on the speed

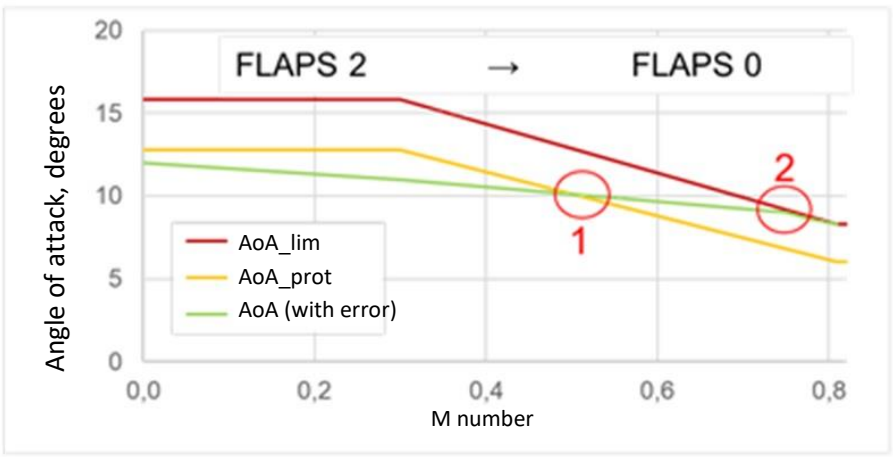
- FCS, autopilot (operates via FCS) and avionics use the same control algorithms:
  - A two-stage scheme is used



2. **Indication and Warning when the AOA Sensor is Set Erroneously**
   During flight, an intermittent CAS message of CAUTION NAV ADS DISAGREE (and the associated warning) may appear. Due to impossibility under these conditions to determine, by way of comparison, the readings of the failed ADS, performing the procedure for NAV ADS DISAGREE leads to “INVALID INDICATION OF SPEED” procedure.
   Depending on the current indicated air speed and the corresponding divergence threshold limits for the erroneous angle of attack sensor setting, conditions may result in a CAS message CAUTION NAV ADS 1 (2) (3) FAULT (and the associated warning).
   In general, the invalid readings from the angle of attack sensors will result in a sudden change in the indication on the PFD angle of attack scale to other than near-zero stable values during the takeoff run at speed above 60 kts.

3. **Algorithm for AoA and Flight Speed Limits**
   In FCS NORMAL MODE, if two or three ADSs provide the same invalid (erroneously high) angle-of-attack signals to the aircraft control system, slat/flap retraction and the increase of M number may result in activation of the AoA limiter.

This happens because the AoA_prot and AoA_limit values decrease as the flaps/slats retract and the M number increases.



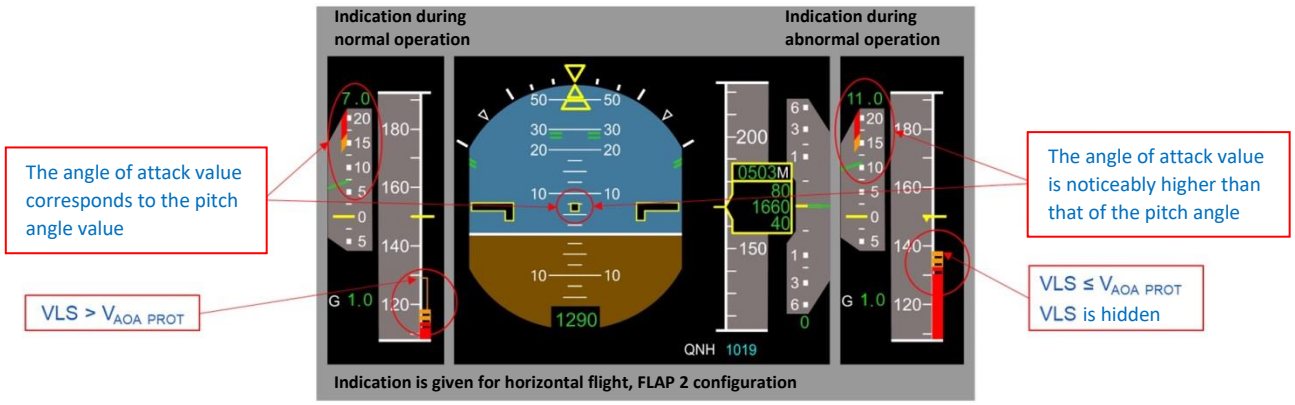
1 When the angle of attack limitation function starts (AoA_prot is reached), the nose-up pitching control input from the SIDE STICK starts to be limited.

2 When the angles of attack close[*1] to AoA_lim are reached, the nose-up pitching control input from the SIDE STICK is completely absent.

[*1] The acceptable value of proximity of the angle of attack to AoA_lim depends on specific motion parameters (including rapidly changing ones) and the aircraft configuration, which is depending on the requirements of the aviation regulations to the algorithmic angle of attack limiters and confirmed within the entire range of expected operating conditions of RRJ-95 aircraft during certification flight tests.

The symmetrical extension of spoilers in flight due to the flight speed limitation algorithm, just as on the ground, leads not only to an increased drag, but also to a significant loss of wing lift, that in turn, when flying at a constant angle of attack, leads to a change of the aircraft flight path to nose dive.

4. Example of Indication in Case of Erroneous AOA Sensor Settings



If the angle of attack values are overestimated, the indicated speeds $V_{AOA\ PROT}$, $V_{AOA\ MAX}$ increase abnormally, while the VLS speed value remains unchanged.

5. **Indirect indicators of Erroneous AOA Sensor Settings**

indicators of incorrect AOA indications may be:

- stable AOA values exceeding 2 degrees during takeoff run at speeds from 60 kts to the liftoff of the Nose Landing Gear;
- indication of messages NAV ADS DISAGREE, NAV ADS 1(2)(3) FAULT;
- significant (over 4 degrees) difference between the pitch angle and the AOA in the steady horizontal flight;
- abnormally large (close to the α prot zone) AOA value at speed above VLS, without flight maneuvers (increase in acceleration);
- increase of the boundary value $V_{AOA\ PROT}$ in the steady flight above the VLS value, and approaching the value of the current speed;
- quick significant increase (over 30 kts) of the $V_{AOA\ PROT}$ when maneuvering (at increase in overload), with activated autopilot and stowed SPEED BRAKES;
- transition of the aircraft into a steady descent, which cannot be countered by a full stroke of the SIDE STICK for nose-up pitching.

Erroneous data from the angle of attack sensors may have a negligible effect on the indication of the current speed, while the indicated speed may be less than the actual value by up to 10 kts.

INFORMATION ON TIMELY DETECTION OF A SITUATION WITH IDENTICAL MISREADINGS OF TWO OR MORE ANGLE OF ATTACK SENSORS DATA

1. From the point of view of the recommendations related to the procedures to counter an abnormal situation, actions in accordance with it are in the QRH of RRJ-95 aircraft, provisioned by the INVALID SPEED INDICATION procedure and OVERSPEED warning, they allow to prevent further development of a catastrophic failure condition and to mitigate the condition to the degree of no worse than major failure condition when dealing with the particular case related to incorrect setting of the AOA sensor in a relatively small range of angles. The main point of carrying out a part of the INVALID SPEED INDICATION procedure from memory - is the stabilization of the aircraft motion for subsequent actions set in the QRH.

2. It is recommended to flight and methodological departments of operators, educational and training organizations to pay attention, especially during flight preparation and flight operations (ferry flights) after completion of different forms of heavy maintenance checks, to the assessment of the angle of attack (no more than 2°) by pilot monitoring at takeoff at a speed of

80 kts and, accordingly, to training of pilots during piloting at takeoff rejection at speeds up to V1, and also in FCS backup control mode DIRECT MODE at continuation training of pilots, regular Continuation Training Courses in Aviation Training Centers, and the FFS trainings. Early detection of an error in the settings of the angle of attack sensors at speeds up to V1 will allow the crew to abort takeoff, thereby preventing more serious consequences of these errors missed by the technical personnel.

3. An important element of flight safety is to know the range of operational angles of attack at all flight stages and compare these values with the pitch angles which are practically the same in horizontal flight. This habit and knowledge will help in case of abnormal conditions in flight to identify the system operating incorrectly and safely complete the flight. This also should get into the focus of the flight and methodological departments of operators, training and simulator organizations when preparing for flights during education and training of crews.