ACJ E 810
Compressor and Turbine Blade Failure
See JAR-E 810 .

General

1.1 Compliance with the requirements of JAR-E 81O(a) may be shown in accordance with either (a), (b) or (c) –

(a) By compliance with the tests detailed in 2 and 3,

(b) By presentation of adequate evidence substantiating the strength of the Engine either by blade failure experience on Engines agreed by the Authority to be of comparable size, design and construction, or by blade failures which have occurred during the development of the Engine, provided that the conditions of engine speed, shut down period, etc., are sufficiently representative,

(c) By other evidence acceptable to the Authority.

1.2 Tests for containment are detailed in 2 and those for running following blade failure are detailed in 3, but where the most critical blade from the point of view of blade containment is the same as that for the subsequent out-of-balance running, it is acceptable to combine the test of 2 and 3.

2 *Containment*

2.1 *General.* Containment tests should be made, either –

(a) On the complete Engine, or

(b) On the individual stage concerned with the adjacent stators, where -

(i) The actual strength of casing under the anticipated operation conditions (e.g. temperature and pressure) is taken into account, and

(ii) Adequate evidence is available such as to indicate that the aircraft would not be endangered by the effect of the blade failure on subsequent blade rows.

2.2 *Test Conditions.* Separate tests on each compressor and turbine stage adjudged to be most critical from the point of view of blade containment (account being taken of blade size, material, radius of rotation, Rotational Speed and the relative strength of the adjacent Engine casing under

operating temperature and pressure conditions) should be carried out in accordance with the conditions of (a) and (b).

NOTE: Where the Engine design is such that potentially critical parts overlie the compressor or turbine casing (e.g. by-pass Engines, or reverse flow Engines where the combustion systems may be outside the rotors) consideration should also be given to possible hazardous internal damage caused by blades penetrating the rotor casings, even though they are contained within the external geometry of the Engine. Consideration should also be given to ACJ E 520(c)(2).

(a) *Number of Blades to be Detached.* One blade should be released at the top of the retention member.

(b) *Engine Conditions at Release.* The blade should be released at either -

(i) The maximum rotational speed to be approved (other than Maximum Engine Overspeed) and the associated maximum casing temperature, or

(ii) Any likely combination of non-transient rotational speed, intake temperature and casing temperature considered to be more critical.

NOTE: Any deficiency in the required casing temperature may be compensated for by means of a suitable increase of the Engine speed.

2.3 *Condition after Tests.* On completion of the tests, complete power failure is acceptable, but there should be –

(a) Containment by the Engine without causing significant rupture or hazardous distortion of the Engine outer casing or the expulsion of blades through the Engine casing or shield.

NOTE: Should debris be ejected from the Engine intake or exhaust, the approximate size and weight should be reported with an estimate of its trajectory and velocity, so that the effect upon the aircraft can be assessed.

(b) No hazard to the aircraft from possible internal damage to the Engine as a result of blades penetrating the rotor casings even though contained within the external geometry of the Engine.

3 *Running Following Blade Failure*

3.1 The tests should be conducted on a complete Engine, mounted in such a manner that the reactions induced by the out-of-balance on the Engine carcass and mounts will be representative of those which would occur in the installed condition. Alternatively, tests may be carried out on a rig but consideration should be given to the effects of shaft power input, further subsequential damage, heavy out-of-balance forces on other parts of the Engine, possible shaft failure etc., when interpreting the test results as being indicative that no hazardous damage would occur in a complete Engine.

3.2 *Test Conditions.* Separate tests should be carried out on each compressor and turbine stage adjudged to be most critical from the point of view of Engine damage subsequent to blade failure as a result of out-of-balance forces existing during the period prior to Engine shut-down.

(a) The Engine should be run, with an out-of-balance representative of the loss of a blade from the top of the retention member, at the maximum rotational speed to be approved (other than the Maximum Engine Overspeed) until either the Engine stops of its own accord, or a period of at least 15 seconds has elapsed.

(b) During the run the power setting should not be altered.

3.3 *Condition after Tests.* On completion of the tests the result should be such that there is no hazard to the aircraft. Complete power failure is permitted.