

Discussion Paper by CAA UK for JAR22 Study Group Meeting No 43 - Oct 1998

### **Purpose of NPA**

The NPA was introduced as a result of a CAA test flight on a powered glider where the pilot deployed the airbrakes at  $V_{ne}$  and experienced a negative load factor of nominally  $-2g$ . The purpose of the NPA was to require the manufacturer to address the case of change of trim with airbrake deployment at all speeds up to  $V_{ne}$ , and it was therefore proposed as an addition to 22.161[c] (Longitudinal Trim). The NPA Consultative Draft was dated 23 Feb 96.

Two comments were received by CAA and sent to JAA HQ on 2 Oct 97:

- a) To the draft requirement add that any changes in load factor on deployment of airbrakes are *controllable within the structural limitations of 22.345 (0/+2g)* with normal pilot skill *and* alertness.
- b) To the ACJ add that if '*care in deployment at high speed*' is required, then this should be clearly stated in the flight manual. '*Care in deployment at high speed*' replaced '*special technique*'.

### **CAA Current Position**

- a) The manoeuvring load factor range with airbrakes extended as defined in 22.345(a) is 0 to  $3.5g$ . This steady state manoeuvring load factor envelope is applicable at all speeds up to  $V_d$ . It is noted that on the CAA test, a negative load factor of nominally  $-2g$  was achieved during rapid airbrake deployment. It has been shown possible, therefore, for a glider in the Utility category to produce transient load factors outside the design envelope, just by the simple act of deploying the airbrakes, without any other action. Exceedance of the design envelope, even if occurs infrequently, presents a serious risk of structural failure in flight. If negative load factors due to deployment of airbrakes at high speeds are normal, then we must revise 22.345.
- b) 22.143(a) specifies that it must be possible to make a smooth transition from one flight condition to another without exceptional pilot skill, alertness or strength, and without danger of exceeding the limit load factor. With the current 0 to  $3.5g$  limit load factors, air brakes that produce a negative load factor of  $-2g$  could not comply with 22.143(a), if it is assumed that the pilot takes no other action at the same time. However, appropriate revision of the limit load factor envelope in 22.345 would cover the structural case of airbrake deployment at  $V_d$  and make it unnecessary to make an additional reference to structural load factors in the proposed amendment to 22.161[c].
- c) 22.697[c](2) covers the issue of 'no structural damage' on deployment of airbrakes at any speed. The key point of the NPA is not that there should be no trim change, but that any such trim change should be 'readily controllable'.
- d) Although the subject of this NPA is the change of trim with airbrake deployment, 22.161 generally covers steady-state trim, and the issue here is a dynamic case and can be considered to be an issue of controllability. Therefore 22.161 may not be the most appropriate location for this revision.

## Other Comments:

At JAR22SG Meeting #42, industry comment was received:

- a) Tests show that load factors on airbrake deployment at Vne are typically -0.6 to -1.5g
- b) The NPA (as amended with zero to +2g) proposes load factors that cannot be met by state-of-the-art design.
- c) At Vne airbrakes are an emergency system.
- d) 22.697 already covers the safe operation of airbrakes (22.697[c](2)).
- e) NPA 22B-71 should be withdrawn.

## Discussion Points

- 1. CAA will not accept the withdrawal of NPA 22B-71.
- 2. There are two issues here; structural load factor and trim change/controllability:
  - a) Structural Load Factor

It is possible to produce negative load factors outside the flight envelope at high speed on deployment of airbrakes.

22.697[c](2) states that it must be possible to extend at any speed up to 1.05 Vne *without causing structural damage*.

22.143(a) specifies that it must be possible to make a smooth transition from one flight condition to another without exceptional pilot skill, alertness or strength, *and without danger of exceeding the limit load factor*.

There appears to be an inconsistency between the two requirements and actual experience which seems to accept that limit load factor can be exceeded as long as no structural damage is caused. This is a very dangerous philosophy. Since the aircraft is not designed for any loads that can occur outside the limit load factor envelope, there can be no guarantee that exceedance of the limit load factor envelope will not result in structural damage, or indeed, catastrophic structural failure. Therefore, it is unacceptable to have a situation where operation of the airbrakes causes the aircraft to exceed the flight envelope limitations. Compliance with 22.697[c](2) might be a non-compliance with 22.143(a).

In addition, if deployment of the airbrakes can result in negative load factors, then consideration should be given to revising the design case of 22.345(a)(1) where the current lower load factor limits is zero g.

This NPA was intended to address the controllability aspects of airbrake deployment at high speeds, not the structural implications. It is proposed that there should be a separate NPA to address the structural implications raised.

## b) Trim Change/Controllability

It is clear from Industry comment that at high speeds, trim changes and negative load factors are likely. The issue of making a smooth transition from one flight condition to another without exceptional piloting skill, alertness or strength is already addressed by 22.143.

Although it has been pointed out that 22.697 addresses airbrakes, it does so as a design and construction issue, and does not address trim change or controllability. Even 22.697[c](3) does not really address rate of airbrake deployment insofar as rate of application may affect controllability.

The initial proposal of this NPA was to introduce the issue of trim/controllability on airbrake deployment into 22.161. It is accepted, however that the issue is more one of controllability than of steady-state trim, and the proposal to amend 22.161 is therefore withdrawn.

It is acknowledged that the existing requirement of 22.143 should be interpreted as addressing the issue of controllability during airbrake deployment, albeit in a non-direct way, but 22.697 does not; 22.143 is a general requirement which may be regarded by some applicants as a summary of the more detailed requirements that follow. The fact that this requirement is the only one where the effect of airbrake deployment on trim and controllability is addressed may be lost.

It is therefore proposed that the issue can adequately addressed by some additional interpretative material to 22.143(a) to emphasise the point.

3. It is therefore proposed that following additional IEM is added:

### *IEM 22.143(a)*

*Compliance with the 22.143(a) should include the extension of airbrakes at speeds up to 1.05 Vne. The time to extend the airbrakes should not exceed 2 seconds.*

4. In addition, it is proposed that there should be a separate PNPA to address the issue of the inconsistency in the structural requirements of 22.143(a) and 22.697 [c](2) and the lower limit load factor design case of 22.345(a)(1).

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