Proposed Equivalent Safety Finding on CS 25.255 at Amdt 13 – "Out of trim characteristics"

Applicable to Gulfstream GVII - G500/G600

Introductory note:

The following Equivalent Safety Finding shall be subject to public consultation, in accordance with EASA Management Board decision 12/2007 dated 11 September 2007, Article 3 (2.) of which states:

"*2. Deviations from the applicable airworthiness codes, environmental protection certification specifications and/or acceptable means of compliance with Part 21, as well as important special conditions and equivalent safety findings, shall be submitted to the panel of experts and be subject to a public consultation of at least 3 weeks, except if they have been previously agreed and published in the Official Publication of the Agency. The final decision shall be published in the Official Publication of the Agency.*"

Statement of Issue

The Gulfstream GVII aircraft have an Electronic Flight Control System (EFCS) which does not allow direct pilot control of the horizontal stabilizer when operating in the Normal mode. The EFCS will automatically position the horizontal stabilizer to maintain a nominal long-term relationship between longitudinal stick deflection and elevator deflection command, and under certain circumstances, restricts the out-of-trim condition that can be achieved. In addition, the High Speed Protection function of the EFCS may restrict the maximum Mach number and airspeed achievable to less than V_{DF}/M_{DF}. Therefore, direct compliance with CS 25.255 in the conventional sense cannot be shown with the EFCS operating normally.

Requirements of CS 25.255(a) through (e) define the flight envelope and the amount of mistrim to be considered when demonstrating the manoeuvring stability and controllability of the aircraft and CS 25.255(f) defines the minimum controllability at V_{DF}/M_{DF} with a nose-down out-of-trim condition.
For the GVII aircraft, direct compliance with CS 25.255 is restricted by the EFCS in Normal Mode, as follows:

1) Nose-down mistrim at and beyond V_{MO}/M_{MO} is not achievable due to the trim reference speed limit of V_{MO}/M_{MO}

2) The maximum Mach number and airspeed above V_{MO}/M_{MO} are restricted by the High Speed Protection function such that V_{DF}/M_{DF} may not be achievable in flight.

Gulfstream believes that, even with the EFCS design, the stick force gradient, g-capability and control reversal principles of CS 25.255 are expected to be observed in an equivalent fashion when the airplane is tested in the normal and overspeed region, and that the design of the EFCS meets the intent of CS 25.255 and provides an equivalent level of safety

Equivalent Safety Finding B-12 on CS 25.255 at Amdt 13

- Applicable to Gulfstream GVII G500/G600 -

Applicant Safety Equivalency Demonstration:

- Gulfstream proposes to show compliance with the intent of CS 25.255 requirements during flight testing consistent with FAA AC 25-7C with EFCS Normal Mode fully operational.

- The level of mistrim in the nose-up and nose-down directions will be achieved using trim switch deflection followed by sufficient delay to assure the horizontal stabilizer has achieved a steady-state mistrim condition. The level of physical stabilizer-elevator mistrim will depend on the flight condition and the elevator offload function design.

- For conditions at or above V_{MO}/M_{MO} where no nose-down mistrim can be achieved, the prescribed flight testing will be conducted with the trim reference speed set to V_{MO}/M_{MO}.

- For manoeuvring stability and controllability tests to be conducted above V_{MO}/M_{MO}, the Applicant proposes to demonstrate the characteristics up to the lesser of V_{DF}/M_{DF} and the maximum achievable airspeeds permitted by the High Speed Protection function.

- The flight characteristics of the airplane, including the behaviour, performance and transitions of the High Speed Protection function, will also be fully evaluated during high speed upset and recovery flight testing for compliance with CS 25.253.

- Flight control system failures including stabilizer trim uncommanded motion and operation in Alternate or Direct Modes will be assessed under the Flight Controls System Safety Analysis.