

**Proposed Special Condition on 'Crashworthiness, emergency landing conditions configurations'**

**Applicable to Bombardier DHC-8 400, modified by auxiliary fuel tank system installation**

**Introductory note:**

The hereby presented Special Condition to the EASA Certification Basis 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**

On the DHC-8 Series an external Auxiliary Fuel Tank System integration outside the existing Outer Mould Line (OML) including the AFT - Auxiliary Fuel Tanks, being attached to the fuselage and below the wing inboard of the Engine Nacelle/ Main Landing Gear, with aerodynamic fairings and systems within the tank, will be installed to increase the endurance capability.

The DHC-8-400 has experienced in service emergency landings with disarranged gear configurations. In such survivable emergency landing situations, the auxiliary fuel tank must be able to resist rupture and to retain fuel when subjected to the appropriate fuel inertia loads and to minimize penetration of the external fuel tank elements by deformed or detached elements of the fuselage that may lead to subsequent release of fuel. With the proximity of the auxiliary fuel tanks to the fuselage and any concurrent degradation of the fuselage boundary, any fuel released may then constitute a direct hazard to the occupants. Moreover, the subsequent scraping action of the aircraft may lead to ignition of the released fuel.

As the installation of Auxiliary Fuel Tanks in an area outside the fuselage and below the wings is a novel and unusual design feature that has not been used on Civil Large Airplanes yet, the applicable airworthiness codes JAR/CS 25 do not provide standards or specific guidance material.

The intent of this Special Condition is to establish for the DHC-8 Series appropriate airworthiness standards, that in case of survivable emergency landing situations, the auxiliary fuel tank must be able to resist rupture and to retain fuel when subjected to the appropriate fuel inertia loads and to minimize penetration of the external fuel tank elements by deformed or detached elements of the fuselage that may lead to subsequent release of fuel, which may then constitute a direct hazard to the occupants.

## **Auxiliary fuel tank system installation – Special Condition C-101 : Crashworthiness, emergency landing conditions configurations**

### **Proposed Special Condition**

This SC requires the use of the load factors prescribed in CS 25.561(b)(3) and CS 25.963(d)(1), considering the auxiliary fuel tanks as within the fuselage contour. These higher values could provide additional protection against such rupture and penetration. Furthermore, the auxiliary fuel tanks are mounted on the fuselage exterior and in the vicinity of the high wing/fuse interface. As such, the interaction of the fuel tanks with the high wing/fuse attachment assembly would have to be assessed as part of crashworthiness scenarios being considered.

The contact scenarios for the wheels-up case, all gears fully retracted, assume a purely symmetric ground contact such that the initial load acts through the centre keel with an angle of attack appropriate to the speed range VL1 to 1.25 VL2. However, in view of the of the high wing configuration, a contact with the ground at some degree of roll is not unlikely.

Consequently, an additional wheels-up case, all gears fully retracted, in the speed range VL1 to 1.25 VL2 at maximum landing weight, 5 ft/sec vertical descent velocity and at a sufficiently large bank angle so that the lower fuselage would make the initial contact while at the same time assuming that no part of the low wing and nacelle come into contact with the ground, has to be considered. The ground reaction thus acts directly on the lower fuselage but off the centre-line keel. The case where one main landing gear is retracted does not address this situation since the remaining extended main gear absorbs the initial ground contact.

Damage to the airframe and to the auxiliary fuel systems from the subsequent sliding phases at that same angle of bank - at zero yaw and at a yaw angle of 20° - must also be assessed.

The fuel tank crashworthiness consideration would require both fuel tank integrity and the attachments of such fuel tanks to the fuselage as items of mass be addressed in an event of emergency landing.

For the structural elements of the fuel tank critical design features their appropriate maintenance tasks must be established based on CS 25.571.