EASA
European Aviation Safety Agency

GA Road Map: Working towards

Simpler, lighter, better rules for *General Aviation*

CS-23 Certification Specifications that support innovation

Trevor Woods
EASA Certification Director

5 April 2017

EASA CS-23 Amendment 5

- This AERO marks the 25 anniversary of this airshow showing the latest and greatest aviation developments.
- This AERO also marks the publication of the revision of the certification specifications for fixed wing aeroplanes.

European Aviation Safety Agency

Certification Specifications
for
Normal-Category Aeroplanes

CS-23

Amendment 5

EASA CS-23 Amendment 5

The CS-23 (certification specifications) provide the technical requirements for certification of aeroplanes

What makes this amendment of CS-23 special?

Instead of details (limited to todays technology)
We define objectives that provide direction for new developments

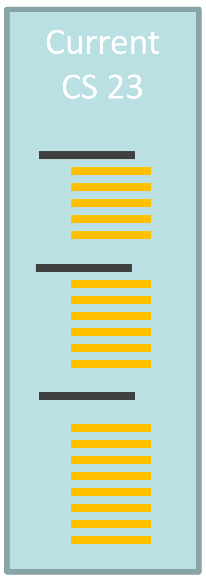
Result:

67 NEW Objective requirements

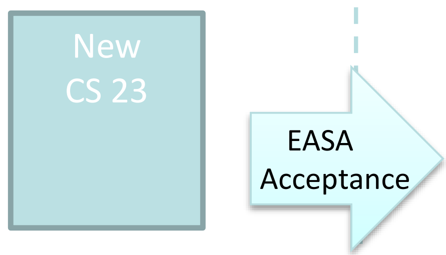
replacing

377 detailed design specific requirements

Separating Safety Requirements from Methods of Compliance

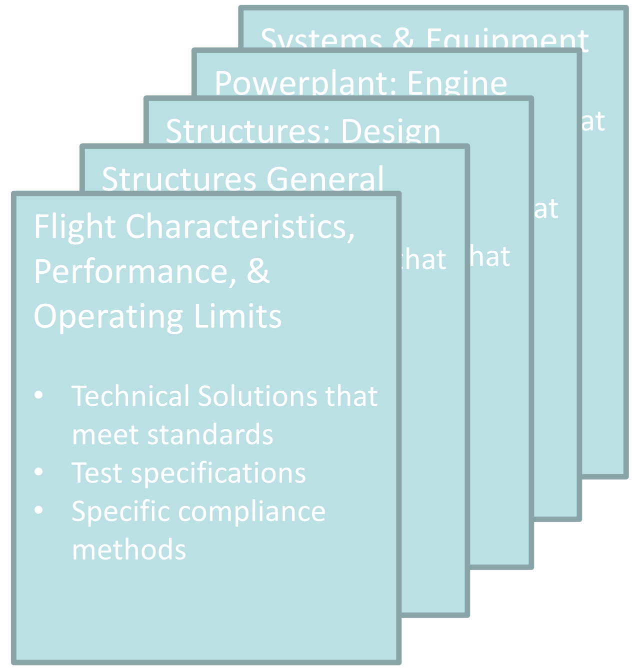


EASA



High-level requirements.
(safety driven)
NO technical solutions prescribed
No tiers or categories

AMC Consensus Standards developed with Aviation Community



<u>Detailed Design Standards</u>
- Tiered where it makes sense
- Contains detailed compliance requirements
- Current CS/Part 23 used as a starting basis

Example: Emergency landing conditions

(g) *Float bottom pressures.* The float bottom pressures must be established under CS 23.533, except that the value of K_2 in the formulae may be taken as 1·0. The angle of dead rise to be used in determining the float bottom pressures is set forth in sub-paragraph (b).

CS 23.537 Seawing loads

Seawing design loads must be based on applicable test data.

EMERGENCY LANDING CONDITIONS

CS 23.561 General

(a) The aeroplane, although it may be damaged in emergency landing conditions, must be designed as prescribed in this paragraph to protect each occupant under those conditions.

(b) The structure must be designed to give each occupant every reasonable chance of escaping serious injury when –

(1) Proper use is made of seats, safety belts and shoulder harnesses provided for in the design;

(2) The occupant experiences the static inertia loads corresponding to the following ultimate load factors:

(i) Upward, 3·0g for normal, utility, and commuter category aeroplanes, or 4·5g for aerobatic category aeroplanes;

(ii) Forward, 9·0g;

(iii) Sideward, 1·5g; and

(iv) Downward, 6·0g when certification to the emergency exit provisions of sub-paragraph 23.807(d)(4) is requested; and

(3) The items of mass within the cabin, that could injure an occupant, experience the static inertia loads corresponding to the following ultimate load factors:

(i) Upward, 3·0g;

(ii) Forward, 18·0g; and

(iii) Sideward, 4·5g.

(c) Each aeroplane with retractable landing gear must be designed to protect each occupant in a landing –

(1) With the wheels retracted;

(2) With moderate descent velocity; and

(3) Assuming, in the absence of a more rational analysis –

(i) A downward ultimate inertia force of 3g; and

(ii) A coefficient of friction of 0·5 at the ground.

(d) If it is not established that a turnover is unlikely during an emergency landing, the structure must be designed to protect the occupants in a complete turnover as follows:

(1) The likelihood of a turnover may be shown by an analysis assuming the following conditions:

(i) The most adverse combination of weight and centre of gravity position;

(ii) Longitudinal load factor of 9·0g;

(iii) Vertical load factor of 1·0g; and

(iv) For aeroplanes with tricycle landing gear, the nose wheel strut failed with the nose contacting the ground.

(2) For determining the loads to be applied to the inverted aeroplane after a turnover, an upward ultimate inertia load factor of 3·0g and a coefficient of friction with the ground of 0·5 must be used.

(e) Except as provided in CS 23.787 (c) the supporting structure must be designed to restrain, under loads up to those specified in sub-paragraph (b) (3), each item of mass that could injure an occupant if it came loose in a minor crash landing.

CS 23.562 Emergency landing dynamic conditions
(See AMC 23.562)

(a) Each seat/restraint system must be designed to protect each occupant during an emergency landing when –

(1) Proper use is made of seats, safety belts, and shoulder harnesses provided for the design; and

(2) The occupant is exposed to the loads resulting from the conditions prescribed in this paragraph.

(b) Each seat/restraint system, for crew or passenger occupancy during take off and landing, must successfully complete dynamic tests or be demonstrated by rational analysis supported by dynamic tests, in accordance with each of the following conditions. These tests must be conducted with an occupant simulated by an anthropomorphic test dummy (ATD), as specified in Appendix J or an approved equivalent with a nominal weight of 77 kg (170 lb) and seated in the normal upright position.

(1) For the first test, the change in velocity may not be less than 9.4 m (31 ft) per second. The seat/restraint system must be oriented in its nominal position with respect to the aeroplane and with the horizontal plane of the aeroplane pitched up 60°, with no yaw, relative to the impact vector. For seat/restraint systems to be installed in the first row of the aeroplane, peak deceleration must occur in not more than 0·05 seconds after impact and must reach a minimum of 19g. For all other seat/restraint systems, peak deceleration must occur in not more than 0·06 seconds after impact and must reach a minimum of 15g.

(2) For the second test, the change in velocity may not be less than 12.8 m (42 ft) per second. The seat/restraint system must be oriented in its nominal position with respect to the aeroplane and with the vertical plane of the aeroplane yawed 10°, with no pitch, relative to the impact vector in a direction that results in the greatest load on the shoulder harness. For seat/restraint systems to be installed in the first row of the aeroplane, peak deceleration must occur in not more than 0·05 seconds after impact and must reach a minimum of 26g. For all other seat/restraint systems, peak deceleration must occur in not more than 0·06 seconds after impact and must reach a minimum of 21g.

(3) To account for floor warpage, the floor rails of attachment devices used to attach the seat/restraint system to the airframe structure must be preloaded to misalign with respect to each other by at least 10° vertically (i.e. pitch out of parallel) and one of the rails or attachment devices must be preloaded to misalign by 10° in roll prior to conducting the test defined by sub-paragraph (b)(2).

(c) Compliance with the following requirements must be shown during the dynamic tests conducted in accordance with sub-paragraph (b).

(1) The seat/restraint system must restrain the ATD although seat/restraint system components may experience deformation, elongation, displacement, or crushing intended as part of the design.

(2) The attachment between the seat/ restraint system and the test fixture must remain intact, although the seat structure may have deformed.

(3) Each shoulder harness strap must remain on the ATD's shoulder during the impact.

(4) The safety belt must remain on the ATD's pelvis during the impact.

(5) The results of the dynamic tests must show that the occupant is protected from serious head injury.

(i) When contact with adjacent seats, structure or other items in the cabin can occur, protection must be provided so that head impact does not exceed a head injury criteria (HIC) of 1 000.

(ii) The value of HIC is defined as –

$$HIC = \left\{ (t_2 - t_1) \left[\frac{1}{(t_2 - t_1)} \int_{t_1}^{t_2} a(t)dt \right]^{2.5} \right\}_{MAX}$$

Where –

t_1 is the initial integration time, expressed in seconds,

t_2 is the final integration time, expressed in seconds,

$(t_2 - t_1)$ is the time duration of the major head impact, expressed in seconds, and

$a(t)$ is the resultant deceleration at the centre of gravity of the head form expressed as a multiple of g (units of gravity).

(iii) Compliance with the HIC limit must be demonstrated by measuring the head impact during dynamic testing as prescribed in sub-paragraphs (b) (1) and (b) (2), or by a separate showing of compliance with the head injury criteria using test or analysis procedures.

(6) Loads in individual shoulder harness straps may not exceed 794 kg (1 750 lb). If dual straps are used for retaining the upper torso, the total strap loads may not exceed 907 kg (2 000 lb).

(7) The compression load measured between the pelvis and the lumbar spine of the ATD may not exceed 680 kg (1 500 lb).

(d) An alternate approach that achieves an equivalent, or greater, level of occupant protection to that required by this paragraph may be used if substantiated on a rational basis.

FATIGUE EVALUATION

CS 23.571 Metallic pressurised cabin structures
(See AMC to 23.571 and 23.572)

For normal, utility, and aerobatic category aeroplanes, the strength, detail design, and fabrication of the metallic structure of the pressure cabin must be evaluated under one of the following:-

(a) A fatigue strength investigation in which the structure is shown by tests, or by analysis supported by test evidence, to be able to withstand the repeated loads of variable magnitude expected in service; or

(b) A fail safe strength investigation, in which it is shown by analysis, tests, or both that catastrophic failure of the structure is not probable after fatigue failure, or obvious partial failure, of a principal structural element, and that the remaining structures are able to withstand a static ultimate load factor of 75 percent of the limit load factor at Vc, considering the combined effects of normal operating pressures, expected external aerodynamic pressures, and flight loads. These loads must be multiplied by a factor of 1.15 unless the dynamic effects of failure under static load are otherwise considered.

(c) The damage tolerance evaluation of CS 23.573(b).

CS 23.572 Metallic wing, empennage and associated structures
(See AMC to 23.571 and 23.572)

(a) For normal, utility, and aerobatic category aeroplanes, the strength, detail design, and fabrication of those parts of the airframe structure whose failure would be catastrophic must be evaluated under one of the following unless it is shown that the structure, operating stress level, materials and expected uses are comparable, from a fatigue standpoint, to a similar design that has had extensive satisfactory service experience:

The consequence of reorganising CS-23

- 67 objective requirements become independent from the design

- That removes the design limitations and open the way to innovation

The consequence of reorganising CS-23

- The design details move to Acceptable Means of Compliance (AMC)
- Speed-up the introduction of new AMC
- Build AMC consensus standards developed in a cooperation between industry, users, EASA, FAA and other authorities

The consequence of reorganising CS-23

- Consensus standards are developed in a transparent and accessible process EASA can give credit and follow a short rulemaking process to accept the use of such standards
- The first set of consensus standards are being developed in an international cooperation via ASTM international
- AMC to CS-23 is planned to become available mid August 2017

The global picture

- Europe CS-23 (in force 15/08/2017)
- US Part 23 (in force 30/08/2017)
- EASA and FAA work on rule harmonisation
- AMC harmonisation is a joined effort, e.g. by all stakeholders in ASTM International consensus standards

CS-23
new smart flexible rules, prepared with and for a safe innovative GA industry