Annex 9

CRITERIA FOR TESTING AND EVALUATION OF REVENUE AND CREW SEATS

1 Purpose and scope

The purpose of these criteria is to provide requirements for revenue and crew seats, seat anchorages and seat accessories and their installation to minimise the possibility of occupant injury and/or disruption of egress/ingress if the craft suffers a collision.

2 Static seat tests

2.1 The requirements of this paragraph are applicable for crew and revenue seats in craft having a design collision load of less than 3 g.

2.2 All seats to which this paragraph applies, along with their supports and deck attachments, should be designed to withstand at least the following static forces applied in the direction of the craft:

.1 Forward direction: a force of 2.25 kN,
.2 After direction: a force of 1.5 kN,
.3 Transverse direction: a force of 1.5 kN,
.4 Vertically downward: a force of 2.25 kN, and
.5 Vertically upward: a force of 1.5 kN.

If these forces are applied in the fore or aft direction of the seat, they should be applied horizontally to the seat back 350 mm above the seat bottom. If the forces are applied in the transverse seat direction, they should be applied horizontally to the seat bottom. Vertical upward forces should be evenly distributed to the corners of the seat bottom frame. Vertical downward forces should be uniformly distributed over the seat bottom.

If a seating unit consists of more than one seating position, these forces should be applied at each seating position concurrently during the tests.

2.3 When the forces are applied to a seat, consideration should be given to the direction in which the seat is to face in the craft. For example, if the seat faces sideways, the transverse craft force would be applied fore and aft on the seat and the forward craft force would be applied transversely on the seat.

2.4 Each seating unit to be tested should be attached to the support structure similar to the manner in which it will be attached to the deck structure in the craft. Although a rigid support structure can be used for these tests, a support structure, having the same strength and stiffness as the support structure in the craft, is preferred.

2.5 The forces described in paragraphs 2.2.1 to 2.2.3 should be applied to the seat through a cylindrical surface having a radius of 82 mm and a width at least equal to the width of the seat. The surface should be equipped with at least one force transducer able to measure the forces specified.

2.6 The seat should be considered acceptable if:

.1 under the influence of the forces in paragraphs 2.2.1 to 2.2.3, the permanent displacement measured at the point of application of the force is not more than 400 mm;

.2 no part of the seat, the seat mountings or the accessories become completely detached during the tests;

.3 the seat remains firmly held, even if one or more of the anchorages is partly detached, and all of the locking systems remain locked during the whole duration of the test (adjustment and locking systems need not be operational after the tests); and

.4 rigid parts of the seat with which the occupant may come into contact should present a curved surface with a radius of at least 5 mm.

2.7 The requirements of 3 may be used in lieu of the requirements of this paragraph provided that the accelerations used for the tests are at least 3 g's.

3. Dynamic seat tests

3.1 The requirements of this section are applicable for crew and revenue seats in craft having a design collision load of 3 g's or greater.

3.2 All seats for which this section applies, the seat supporting structure, the attachment to the deck structure, the lap belt if installed, and shoulder harness if installed should be designed to withstand the maximum acceleration force that can be imposed upon them during a design collision. Consideration should be given to the orientation of the seat relative to the acceleration force (i.e. whether the seat is forward, aft, or side facing).

3.3 The acceleration pulse to which the set is subjected should be representative of the collision time-history of the craft. If the collision time-history is not known, or cannot be simulated, the acceleration time-history envelope shown in the figure can be used.

3.4 In the test frame, each seat unit and its accessories (e.g. lap belts and shoulder harnesses) should be attached to the support structure similar to the manner in which it will be attached to the deck structure in the craft. The support structure can be a rigid surface, however, a support structure having the same strength and stiffness as the support structure in the craft is preferred. Other seats and/or tables with which an occupant may come in contact during a collision should be included in the test frame in an orientation and with a method of attachment typical of that in the craft.

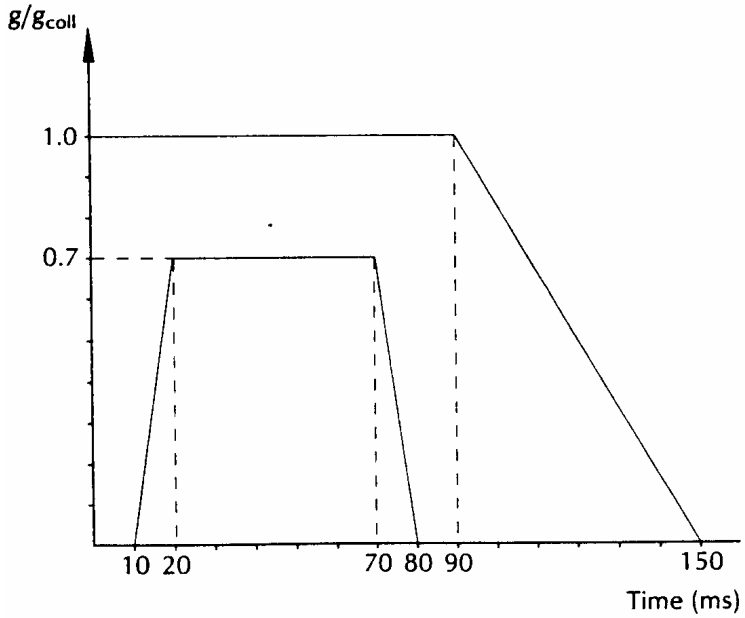

Figure - Acceleration time-history envelop

3.5 During the dynamic seat test, a fiftieth percentile anthropomorphic test dummy, corresponding to the Hybrid II to Hybrid III (preferred) human surrogate (unless a more advanced test dummy is available), should be placed in the seat in an upright seating position. If a typical seating unit is composed of more than one occupant seat, a test dummy should be placed in each occupant seat in the unit. The dummy, or dummies, should be secured in the seat unit in accordance with procedures or recognised national standards1/ and be secured using only the lap belt and shoulder harness if they are installed. Tray tables, and other such devices, should be placed in the position that would cause the greatest potential for an occupant to become injured.

3.6 The test dummy should be instrumentated and calibrated, in accordance with the requirements of a recognised national standard, so as to permit calculation of the head injury criterion, calculation of the thoracic trauma index, measurement of force in the femur, and measurement, if possible, of extension and flexion of the neck, measurement of the maximum relative pelvis acceleration, and measurement of the maximum pelvis load in the direction of the spine.

3.7 If more than one dummy is used in the tests, the dummy located in the seat having the highest potential for an occupant to be injured should be the one instrumented. The other dummy or dummies need not be instrumented.

3.8 The tests should be conducted and the instrumentation should be sampled at a rate sufficient to reliably show response of the dummy in accordance with the requirements of a recognised national standard.

3.9 The seat unit tested in accordance with the requirements of this section should be considered acceptable if:

.1 The seat unit and tables installed in the seat unit or area do not become dislodged from the supporting deck structure and do not deform in a manner that would cause the occupant to become trapped or injured.

.2 The lap belt, if installed, remains attached and on the test dummy's pelvis during the impact. The shoulder harness, if installed, remains attached and in the immediate vicinity of the test dummy's shoulder during the impact. After the impact, the release mechanisms should be operative.

.3 The following acceptability criteria are met:

.1 the head injury criterion, calculated in accordance with the formula, does not exceed 500

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

where: t_1 and t_2 are the beginning and ending times (in seconds) of the interval in which the HIC is a maximum. The term a(t) is the resultant measured acceleration in the head of the dummy in g's.

.2 The thoracic trauma index, calculated in accordance with the formula, does not exceed 30 g's except for periods totalling less than 3 ms

$$TTI = \frac{g_R + g_{LS}}{2}$$ or acceleration at he centre of gravity

where: g_R is the acceleration in g's of either the upper or lower rib; and
g_{LS} is the acceleration in g's of the lower spine.

.3 the maximum pelvis acceleration does not exceed 130 g's;

.4 the maximum pelvic load does not exceed 6.7 kN measured in the axis of the spine;

.5 neck flexion does not exceed 88 Nm if measured;

.6 neck extension does not exceed 48 Nm if measured; and

.7 the force in the femur does not exceed 10 kN except that it cannot exceed 8 kN for periods totalling more than 20 ms.

.4 Loads on the upper torso harness straps do not exceed 7.8 kN or a total of 8.9 kN if dual straps are used.