Vehicle Certification Agency

TEST PROCEDURE

CRASH PROTECTED CONTAINERS FOR DANGEROUS GOODS CARRIED BY REMOTELY PILOTED AIRCRAFT SYSTEMS

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TEST PROCEDURE –
CRASH PROTECTED CONTAINERS FOR DANGEROUS GOODS CARRIED BY RPAS

1. INTRODUCTION

This procedure describes a test method which has been developed to demonstrate the robustness of containers intended for the carriage of dangerous goods by remotely piloted aircraft systems (RPAS). Containers meeting these requirements may, at the discretion of the UK Civil Aviation Authority, be designated as crash protected containers suitable for RPAS dangerous goods operations.

2. SCOPE

This procedure is applicable to:

I. Containers which are carried externally or within the airframe of a RPAS, or
II. The RPAS airframe itself, where it is designed to protect its contents in the event of a crash

This procedure sets out tests which containers must successfully undergo in order to qualify as crash protected containers. It does not address risks inherent in setting up and performing those tests or measures necessary to ensure that testing is undertaken safely. Responsibility for safety rests solely with the parties organising and conducting the tests and neither CAA nor VCA accept liability arising from use of the methods described herein.

Note: Competent authority authorisation is required before any article is intentionally dropped from RPAS or other aircraft. It is essential that guidance be sought from CAA and the relevant authorisation is obtained before conducting the tests described in this procedure.

3. TERMS AND DEFINITIONS

For the purpose of this procedure the following terms and definitions apply:

Competent authority, CAA
The UK Civil Aviation Authority[1]

Crash protected container (CPC)
A container which is capable of falling from a predetermined height and impacting terrain without leakage of contents.

Design Type
A container of a specific design, size, shape, material(s) and thickness, manner of construction and method of closure.

Drop height
The vertical distance between the lowermost part of a container and the surface of the impact zone at the moment of release, i.e. the distance which the container will fall when dropped.

Note: Typically the drop height will be the operational height specified by the competent authority. However, where it can be demonstrated to the satisfaction of the competent authority or VCA that terminal velocity is achieved from a lesser height, the drop test may be performed from that height plus 10%.

ICAO TI's
The Technical Instructions on the Safe Transport of Dangerous Goods by Air, approved and published by decision of the Council of the International Civil Aviation Organisation.

Impact zone
A defined area, the dimensions of which are measured, recorded and when practicable, marked out on the ground prior to test. The surface shall be reasonably smooth, level and flat, and as far as possible free of loose debris. Construction shall be of concrete, compacted asphalt or other material of similar hardness laid on a suitable base/subbase such that it would generally conform to the requirements for a public highway. Surfaced roads and car parks, hardstandings, airfield runways, aprons and perimeter tracks are likely to meet the requirements; loose, unmade or grassed surfaces will not.

Operational height
The maximum height above ground level (AGL) authorised for a specified RPAS operation involving the carriage of dangerous goods.

VCA
The Vehicle Certification Agency – Dangerous Goods Office[2]

4. CONTAINER DESIGN & CONSTRUCTION

Containers may take any reasonable form and be constructed of any suitable material which might enable specimens of the design type to pass the tests described herein. A successfully tested design type shall be defined and documented by means of comprehensive drawings and material specifications, which shall form the basis of any approval offered by the competent authority.

5. NUMBER OF SPECIMENS

Normally three identical specimens of each distinct container design type shall be provided. Each specimen shall be subjected to a single drop test in accordance with the method below. Exceptionally, and with prior agreement of the competent authority or VCA, a single specimen of a container type may be provided, in which case all three drop tests shall be conducted on that specimen.

6. PREPARATION FOR TEST

The payload of containers offered for test may be any of the following:

I. Packagings conforming to the ICAO Technical Instructions (TI). In this case any approval issued to a successfully tested CPC shall be limited to carriage of the packaging type(s) it has been tested with

II. Solids, e.g. a fine, inert powder or granular material placed directly into the container without the use of lining or inner packaging. In this case any approval issued to a successfully tested CPC shall permit carriage of TI compliant package for solids, e.g. tablets, granules or powders, with a particle size no less than the material tested

III. Liquids, e.g. water or a water/antifreeze mixture, ideally containing a coloured dye to aid leak detection, poured directly into the container without any form of lining or inner packaging. In this case any approval issued to a successfully tested CPC shall permit carriage

of TI compliant package for liquids

Note: the terms liquid and solid are defined in the ICAO TI's

The gross mass of the test specimen shall dictate the maximum gross mass of any approval granted on completion of a successful test.

Packagings conforming to the TI's may in their own right be tested for qualification as a CPC in accordance with this method and if successful, packages of that design type may be carried in another container, e.g. the hold compartment of an RPAS, even if the compartment itself does not qualify as crash protected.

7. PRECONDITIONING.

Containers constructed from certain materials may be affected by adverse climatic conditions. For example, fibreboard is susceptible to moisture and unprotected containers in this material can be expected to suffer a reduction of structural integrity and impact performance as a result of exposure to a high humidity environment or rain at any point in distribution, not just in flight. Similarly, some plastics materials commonly used in packaging, e.g. polypropylene, may suffer embrittlement at lower temperatures, substantially reducing their resistance to impact. In order to account for these possibilities, the range of climatic conditions that might reasonably be encountered in a specified operation shall be identified, and containers constructed of materials likely to be affected by them shall be exposed to a corresponding atmospheric condition (preconditioning) prior to test. Reference may be made to BS EN ISO 2233 for suitable atmospheric conditions and exposure durations. The time between the end of a period of preconditioning and conduct of the test should be kept to a minimum and shall in no case exceed [one] hour.

Containers incorporating materials susceptible to adverse climatic conditions but which are fully protected from them in the distribution environment need not undergo pre-test conditioning. In that case, the scope of approval of the container shall be limited to operations where exposure to adverse climatic conditions cannot occur.

Records of the climatic conditions identified as above, and a reasoned justification for the selection or otherwise of preconditioning environment(s) shall form part of the test report.

8. TEST CONDITIONS

Tests shall be conducted in ambient climatic conditions, ideally with an air temperature between 5^{o}C and 25 ^{o}C with a windspeed no greater than 10 knots and no significant rain. Extremes of conditions shall be avoided when there is risk these may affect the test result. The impact zone surface shall be sufficiently dry such that any moisture present shall not impede the assessment of leakage from the container under test.

Note: Testing in rainy weather is undesirable in most cases because leakage is difficult to detect in a wet environment. Nevertheless, a case might be made for testing in damp conditions or even light rain if steps are taken to ensure leakage is readily detectable to the naked eye, e.g. by the addition of a coloured dye, sufficient to make liquid contents conspicuous, even in small quantities.

9. TEST METHOD

The container, prepared as for transport and if necessary preconditioned as above, shall be elevated to the predetermined drop height by any suitable means.

Note: It is anticipated that this will normally be accomplished using an aircraft (RPAS or manned) or a tethered balloon, but a ground structure such as a mast or tall building may be used if deemed suitable.

The container, in its normal transport orientation, shall be attached or supported on the means of elevation in a manner which permits it to be released on command, quickly and without application of undue forces in roll, pitch or yaw. When an aircraft is used as a drop platform, it should ideally be stationary, i.e. in the hover, but it is recognised this will not be possible in all circumstances. Where horizontal flight is unavoidable, airspeed should be kept as low as practicable and the velocity at the moment of release shall be recorded in the test report.

Note: The difference, if any, between impacts following release in horizontal flight and those resulting from release whilst in a stable hover has not been analysed. The horizontal velocity, drop height and aerodynamic properties of the container will all contribute to its trajectory. Equally the effect different impact trajectories may have on a container's performance will depend largely on its design and configuration of its contents, with some arrangements being more susceptible to a purely vertical impact than one with both vertical and horizontal components and vice versa. Consequently, whilst release from the hover and horizontal flight are both acceptable, it is recognised that the forces at impact will not necessarily be identical but given the magnitude, the difference is unlikely to be significant in most cases.

Once stabilised at the predetermined drop height, the container shall be released to fall to the surface of the designated impact zone.

Where a device is fitted to separate the container from the RPAS in the event of accident or failure in flight and deploy automatically to retard its decent, e.g. a parachute, vane or similar, no steps shall be taken to deliberately inhibit its operation providing the inherent reliability of the device is demonstrated.

The container shall strike the surface of the impact zone. Impact outside the zone, or contact with another body or surface, e.g. the side of a building, before striking impact zone shall invalidate the test; however the test is not invalidated if the container exits the impact zone or contacts another body after the initial impact.

10. ASSESSMENT

Immediately following impact, the test container shall be visually inspected for leakage and comprehensively photographed before it is handled or moved from the point that it came to rest. Once complete, the container may then be removed for more detailed assessment.

Damage or any indication of leakage shall be noted for inclusion in the test report.

Containers that have been tested with liquid contents shall be placed in a secure, dry area orientated in a manner which would allow the escape of free liquid from closures, doors or joints if they are no longer leakproof. Following a period not less than 8 hours containers shall be re-inspected for leakage. The re-inspection period may be reduced to 1 hour if positive steps are taken to equalise the internal pressure with the prevailing atmospheric pressure, for example by drilling a small hole in a side panel. Under no circumstances shall the hatch or any other closure be disturbed to effect equalisation.

11. PASS CRITERIA

A container shall pass the test if:

I. There is no major disruption of its structure and no visible hole or gap from which contents might escape, even if contents did not actually escape during the test or assessment, and

II. its test contents are solids i.e. powders, granules tablets etc or inner packages and there is no leakage from the container, or

III. its test contents are liquids and there is no leakage from the container, either immediately after test or 8 hours thereafter.

When containers have been tested in conjunction with ICAO TI compliant packages, the condition of the packages within the container does not form part of the assessment criteria. Nevertheless the condition shall be noted in the test report.

12. TEST REPORT

A test report shall be compiled containing at a minimum:

a) a title (e.g. “RPAS CPC Test Report”)
b) a unique identification such that all its components are recognisable as a portion of a complete report
c) the name and address of the organisation performing the test
d) the name and address of the organisation on whose behalf the test is performed (if different from b) above
e) a description and physical characteristics of the container tested
f) a description of the preparation of specimens, including the contents and packing arrangement.
g) identification of the method used (this method, inc. issue N^{o}. and date) and details of any addition, deviation or exclusion from it
h) the climatic conditions identified as pertinent to operation and if applicable, a reasoned justification for rejecting the use of preconditioning.
i) The temperature, relative humidity and duration of preconditioning (if any)
j) the location and date of test
k) the temperature, relative humidity, precipitation (if any) and average windspeed at the time of test
l) the method of elevation and release
m) the drop height and horizontal velocity at release (if applicable)

n) the result including a description of damage sustained and second leakage assessment >8 hours after test (if applicable)

o) a statement of pass or fail.

p) the date of issue of the report

q) name and signature of the person(s) authorising the report

r) an annex containing dimensioned drawings and a schedule of materials used in the construction of the container

The report should contain ample good quality digital photographs of the test specimens taken during preparation, test and after impact. Wherever possible a video of the whole test sequence should be made to support the application for approval.

END

[1.] The Civil Aviation Authority
www.caa.co.uk

[2.] The Vehicle Certification Agency – Dangerous Goods Office
www.vehicle-certification-agency.gov.uk/dangerous-goods/