Human drop test

Orion test article released during airborne drop test. A drop test is a method of testing the in-flight characteristics of prototype or experimental aircraft and spacecraft by raising the test vehicle to a certain altitude and then releasing it. Test flights by powered aircraft, in particular rocket-powered aircraft, may be called drop launches due to the launch of aircraft rockets following discharge from its aircraft carrier. In the case of unauthorised aircraft, the test vehicle falls or slips after being released in a non-electric descent to a landing site. Drip tests can be used to verify the aerodynamic performance and flight dynamics of the test vehicle, to test its landing system or to evaluate the survivability of a planned or crash landing. This enables vehicle designers to validate computer flight models, wind tunnel testing or other theoretical design characteristics of the design of an aircraft or spacecraft. High-altitude dropin tests may be carried by carrying the test vehicle on board a mothership to a target height for release. [1] Low altitude drip tests may be carried out by releasing the test vehicle from a crane or portal. [2] Aircraft and lift body testing Carrier landing simulation tests The landing gear of aircraft used on aircraft carriers must be stronger than those on land-based aircraft, due to higher approach speeds and lowering speeds during carrier landings. [3] As early as the 1940s, drop-down tests were carried out by lifting a carrier-based plane such as the Grumman F6F Hellcat to a height of ten feet and then sinking, simulating the impact of a landing at nineteen meters per second (5.8 m/s). The F6F was eventually dropped from a height of twenty feet (6.1 m), indicating that it could absorb twice the strength of a carrier landing. [5] [6] Drip tests are still used in the development and testing of carrier-based aircraft; In 2010, The Lockheed Martin F-35C Lightning II was undergoing drop tests to simulate its maximum descent speed of 26.4 feet per second (8.0 m/s) during carrier landings. [7] The X-38 research vehicle is released from Balls 8, NASA's B-52 mothership, during a drop test. The pylon used to carry experimental vehicles is visible near the top of the image, between the fuselage and the inside right engine. Experimental aircraft Many experimental and prototype aircraft have been drop tested or release launched. Many powered X-planes, including the Bell X-1, Bell X-2, North American X-15, Martin Marietta X-24A and X-24B, Orbital Sciences X-34, Boeing X-40 and NASA X-43A were specifically designed for release. test articles of the non-excited NASA X-38 were also drop tested, from altitudes of up to 45,000 feet (14,000 m), to study its aerodynamic and handling qualities, autonomous flight capacity, and the expansion of its controllable parafoil. [9] Some experimental aircraft designed for launches, such as the Northrop HL-10, have done both non-powerless drop-off tests and motorized drop-shifts. Previous Past powered flights using its rocket engine, the HL-10 made 11 non-powered drop-flights to study the handling characteristics and stability of the lifting body in flight. [10] Balls 8 mothership Main article: Balls 8 (B-52) Early experimental aircraft, such as X-1 and X-2, were carried aboard modified B-29 and B-50 bombers. [11] In the 1950s, the United States Air Force provided NASA with a B-52 bomber to be used as a mothership for the X-15 experiment. Built in 1955, the B-52 was only the 10th to get off the assembly line, and was used by the Air Force for flight tests before turning over to NASA. [13] Flying with NASA tail number 008, the plane was nicknamed Balls 8 by Air Force pilots, following a tradition of referring to aircraft numbered with several zeros like Balls plus the final number. [14] Balls 8 received significant changes to carry the X-15. A special pylon, designed to carry and release the X-15, was installed under the right wing between the fuselage and the inboard engine. A snap was also cut out of one of the right wing flaps so that the plane could accommodate the X-15's vertical tail. Balls 8 was one of two such bombers modified to carry the X-15; while the second plane retired in 1969 after the end of the X-15 program, NASA continued to use Balls 8 for drop tests until it retired in 2004. During his 50-year career, Balls 8 carried many experimental vehicles including the HL-10, X-24A, X-24B, X-38, and X-43A. [13] X-24B's role in space shuttle development Main article: Martin Marietta X-24B During the design of the space shuttle orbiter in the 1970s, engineers debated whether to design the orbiter to glide to an unpowered landing or equip the orbiter with pop-out jet engines to make a motorized landing. While powered landing design required carrying engines and jet fuel, adding weight and complexity to the orbiter, engineers began favoring the driven landing option. In response, NASA conducted non-powered drop tests of the X-24B to demonstrate the ability to land a lift-body aircraft in unequipment flight. In 1975, the X-24B was dropped from a Balls 8 at an altitude of 45,000 feet (14,000 m) above the Mojave Desert, and then thrustrocket engines to increase speed and propel it to 60,000 feet (18,000 m). Once the rocket engine was cut off, they allowed fast and high-altitude X-24B conditions to simulate the path of a space shuttle during post atmospheric re-entry. The X-24B successfully made two unforceless precision landings at Edwards Air Force Base, demonstrating the possibility of a non-powerful lift body design for the space shuttle. These successes convinced those in charge of the space shuttle program to commit to an unprecedented landing design, which would save weight and increase the orbiter's payload capacity. [15] [16] Company released by Shuttle CarrierAircraft space shuttle Company main article: Procedures and landing tests 1977, a series of dropping tests by the Space Shuttle Company, conducted to test the space shuttle's flight characteristics. Because the space shuttle is designed to glide without strength during its descent and landing, a series of drop-down tests were used using a test track to show that the orbiter could be successfully controlled in unenforceable aircraft. These drop tests, known as the Approach and Landing Test program, used a modified Boeing 747, known as Shuttle Carrier Aircraft or SCA, to carry the Enterprise to a height of 15,000 to 30,000 feet (4,600 to 9,100 m). After a series of captive-flight tests in which the orbiter was not released, five free-flight tests were conducted in August to October 1977. [17] While enterprise free-flight tests involved the release of a non-powered aircraft from a powered

aircraft, these tests were not typical of drip testing because the orbiter was actually carried and released from a position above SCA. This arrangement was potentially dangerous as it placed the Enterprise in free flight directly in front of SCA's tail fin immediately after its release. As a result, the drop was carried out using a series of carefully planned maneuvers to minimize the risk of an aircraft collision. Immediately after the release, the Enterprise would climb to the right while SCA performed a shallow to the left, allowing for rapid vertical and horizontal separation between the two aircraft. [18] Dream Chaser Main Article: Dream Chaser This section needs to be updated. Update this article to reflect recent events or newly added information. (June 2019) In mid-2013, the Sierra Nevada Corporation plans to conduct drop tests of its Dream Chaser prototype commercial space plane. The unmanned first flight test will release the Dream Chaser prototype from an altitude of 12,000 feet (3,700 m), where it is planned that the vehicle will independently fly to an unpowered at the Dryden Flight Research Center. [19] [20] Crew capsule testing Drop tests of prototype crewed space capsules can be done to test the survivability of landing, primarily by testing the capsule's descent characteristics and its landing system after re-entry. These tests are usually performed unmanned before any human spaceflight testing. Apollo command module In 1963, North American Aviation built the BP-19A, an uncrewed standard Apollo command module for use in drop testing. NASA conducted a series of tests in 1964 that involved releasing the BP-19A from a C-133 Cargomaster to test the capsule's parachute system before manned tests of the Apollo spacecraft. [21] Orion capsule Orion test article after c-130 release and separation from pallet in 2011 and 2012, NASA conducted a series of short droplet tests on the survival capacity of water landings in its Orion crew cap by repeatedly dropping an Orion test vehicle into a large water basin. Tests simulated water landings at speeds ranging from 7 50 mph (11 to 80 80 by changing the height of the drop gantry above the basin. The range of landing reslocities allowed NASA to simulate a range of possible entry and landing conditions during water landings. [22] [23] [24] [25] In 2011 and 2012, NASA also conducted drop-down tests of the Orion test vehicle's parachute system and land-based landing capabilities. In each test, the orion spacecraft was released from a C-17 or C-130 cargo plane. For testing, the capsule is mounted on a pallet system and placed inside the cargo aircraft. Parachutes on the pallet are used to pull the stool and capsule out of the rear of the aircraft; The capsule then separates from the stool and begins its free fall descent. [26] On March 4, 2012, a C-17 dropped an Orion test article from a height of 7,600 feet . The capsule's parachutes successfully deployed between 15,000 to 20,000 feet (4,600 to 6,100 m), slowing the spacecraft to a landing on the ground in the Arizona desert. The capsule landed at a speed of 17 mph (27 kph), well below the constructed maximum touchdown speed. [27] The Boeing CST-100 In September 2011, Boeing conducted a series of drop-down tests, conducted in the Mojave Desert in southeastern California, to validate the design of the CST-100 capsule's parachute and airbags that dampened landing systems. The airbags are placed under the heat shield at the CST-100, which is designed to be separated from the capsule while during parachute descent at about 5,000 feet (1,500 m) altitude. The tests were conducted at ground speeds between 10 and 30 miles per hour (16 and 48 km/h) to simulate crossed wind conditions at the time of landing. Bigelow Aerospace built the mobile test rig and performed the tests. [28] In April 2012, Boeing conducted another drip test of its CST-100 prototype space capsule to test the capsule's landing system. The test vehicle was raised by helicopter to an altitude of 11,000 feet (3,400 m) and then discharged; the capsule's three main parachutes were then successfully inserted and slowed down the capsule's descent. Immediately before landing, the capsule's six airbags inflated under the capsule to absorb some of the energy effects from landing. Similar drop tests are planned to conduct additional airbag testing, as well as drogue chute and heat shield jettison tests. [29] Helicopter testing In 2009 and 2010, NASA conducted a couple of drip tests to study the survivability of helicopter crashes. Using an MD 500 helicopter donated by the U.S. Army, NASA dropped the helicopter at an angle from an altitude of 35 feet (11 m) to simulate a hard helicopter landing. Sophisticated crash test dolls with simulated internal bodies were located inside the helicopter and used to assess internal damage from such a crash. [30] [31] Due to extensive damage to the test helicopter after the second test, no third test was planned. [31] References

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