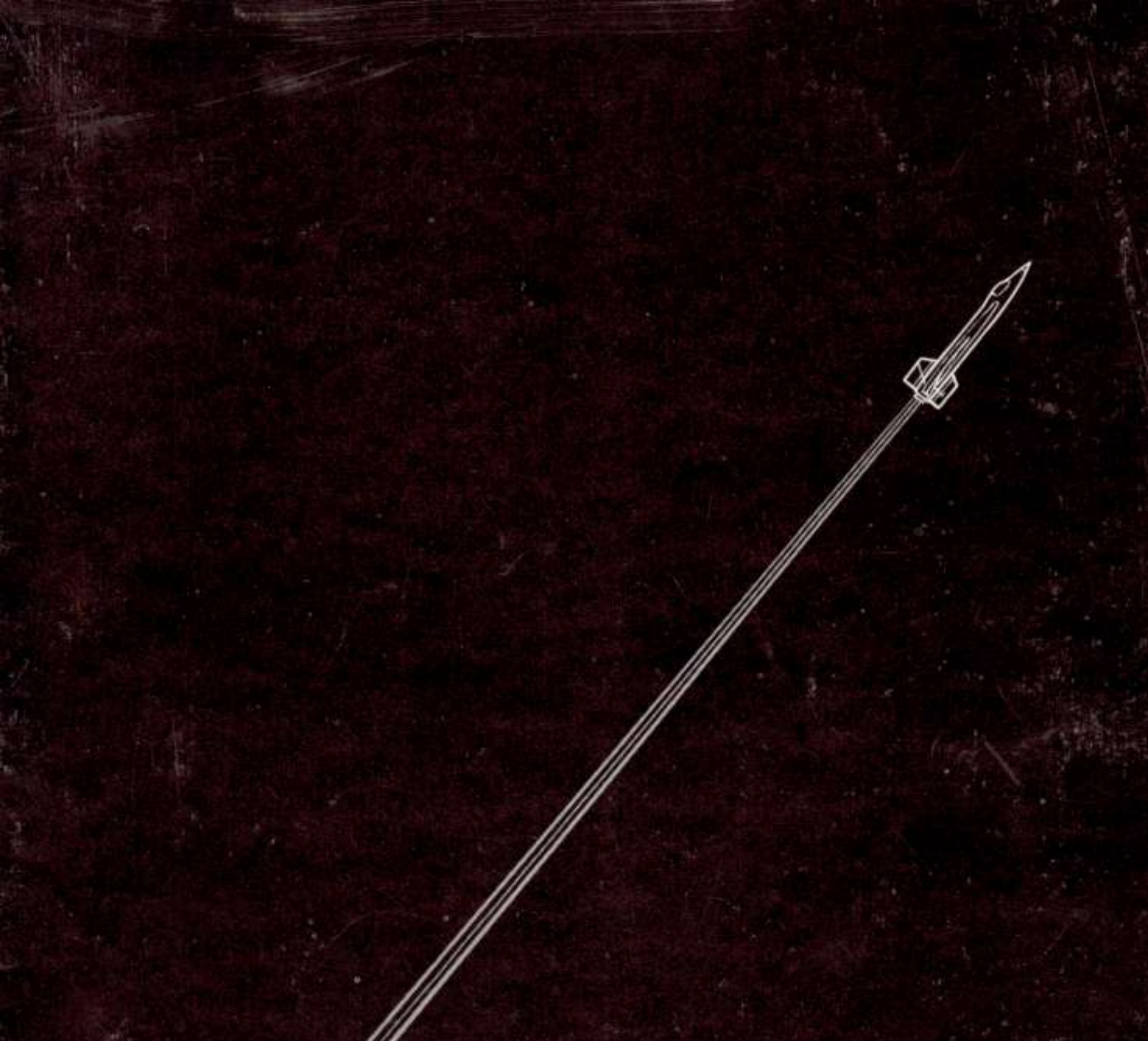

THE X-15 RESEARCH AIRPLANE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

It is one minute to zero in an X-15 countdown which began 24 hours earlier. Tucked under the right wing of a B-52 aircraft, the X-15 is about 45,000 feet over Mud Lake, Nevada. The X-15 pilot is conducting final checkout:

Engine master switch ON
Prime switch ON
Pump idle
Igniter idle
Arm ventral jettison
Final OK

The B-52 pilot moves the master arming switch to ON. The X-15 pilot starts radio countdown —

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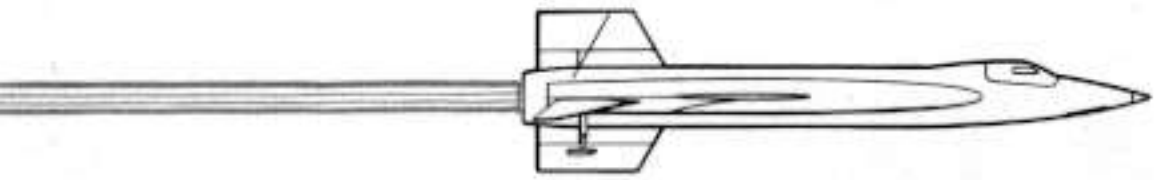

For sale by the Superintendent of Documents, U.S. Government Printing Office,
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X-15

DROP!

The three hooks which support the X-15 open. The X-15 rapidly falls away.

The X-15 pilot opens the throttle of the plane's 57,000 pound thrust rocket engine. He pulls back the stick.

In an 83-second surge of power reaching more than 400,000 hp, the X-15 accelerates from 600 to more than 4,000 mph, climbing steeply to 150,000 feet. Then, its fuel tanks empty, the X-15's momentum carries it in a ballistic arc to an altitude of approximately 250,000 feet (about 50 miles).

Here at the edge of space, the X-15 is above 99.97 percent of the earth's atmosphere. The sky above shades from deep blue to darker hues because there is no atmosphere to diffuse sunlight. The pilot sees the horizon as a curve and can make out Puget Sound in Washington, and the peninsula of Lower California.

As the X-15 travels across the top of its ballistic arc, the pilot becomes weightless, an experience sharply contrasting with the acceleration forces which pressed him against his seat during engine firing. Now, the pilot must orient the airplane for return to earth. He finds weightlessness does not materially affect his capabilities.

With no atmosphere for support, the X-15's conventional aerodynamic controls are useless. The pilot employs instead hydrogen peroxide jets located in the nose and wings. To roll to the right, he activates the left wing jets. To point the plane downward, he turns on the jets on top of the nose. Thus, the X-15 maneuvers in the near vacuum of space where no conventional airplane could fly.

Ahead is one of the most critical phases of the X-15 flight mission—entry into the earth's atmosphere. Any object entering the atmosphere from space compresses the air ahead of it, building up tremendous heat. The outer structure of the X-15 is made of Inconel X, a nickel-steel alloy that can withstand temperatures as high as 1,200° Fahrenheit. But entry heating can exceed that figure and destroy the X-15 unless it descends precisely along a predetermined path.

As the X-15 penetrates the heavy layers of air, its wings glow cherry red and its skin pops like a hot stove. Gravity forces become so great that arm movement of the center control stick is extremely difficult and the pilot keeps the plane on course with a wrist-controlled side stick.

Despite the extreme heat on the outer skin, the pilot's cabin, the instrumentation compartment, and the electrical equipment are maintained at comfortable temperatures. Cooling is accomplished by a specially-constructed system using liquid nitrogen at 300° below zero Fahrenheit.

As the atmosphere becomes heavier, the pilot again uses aerodynamic controls. Sometimes, he also employs the hydrogen peroxide jet system.

Ahead, the pilot sees his landing field, a dry lake bed at Edwards, California, about 200 miles from his starting point at Mud Lake, Nevada. He opens vanes near the tail to slow the plane. About two miles from touchdown, he jettisons the ventral fin extending under the tail (this fin contributes to stability in high-speed flight but would interfere with landing) and lowers his landing gear—two steel skids (instead of wheels) toward the rear and a conventional nose wheel.

Touchdown is made at about 220 miles per hour. The plane lands with nose up so that the skids are the first to hit the ground. The X-15 travels almost a mile across the dry lake bed before stopping.

On November 10, 1961, the X-15 was flown at 4,093 mph achieving its design speed goal. The aircraft is expected soon also to reach the design altitude of 50 miles, or higher. The X-15 already has broken world speed and altitude records for aircraft and for spacecraft under full-time control of their pilots.

Part airplane, part spacecraft, the X-15 is the only vehicle of its kind in the world. As its name implies, the X-15 research airplane is intended solely for research. It serves as a practical proving ground for theories developed by such techniques as mathematical computations and wind tunnel tests.

Up to now, X-15 flights have furnished much information needed for design of high-altitude hypersonic (speed more than five times that of sound) operational aircraft. They have demonstrated the practicability of pilot-controlled entry into the atmosphere. They have provided a great amount of data on physiological and psychological reactions of man to space flight and to piloting high-speed high-altitude aircraft. And they have assisted in space sciences programs.

The X-15 is a highly advanced research vehicle operating with great reliability and broad versatility within design objectives. The key role in every X-15 flight is played by the pilot who can not only carry out the programmed tests but also can utilize his judgment and experience in the solution of unanticipated problems. Also, data acquired by X-15 instruments are added to, interpreted, and enriched by pilot observation and judgment, faculties which no instruments can duplicate.

How do we get information from X-15 flights? What sort of information do we obtain?

During each flight, instruments installed in the airplane and inside the pilot's pressure suit transmit to ground stations a constant stream of data on aircraft operation and the pilot's physiological condition. Data on the X-15 include among others aerodynamic heating and stress on structure, powerplant behavior, electrical system operation, stability, and control. Pilot checks cover such measurements as heart action, body temperature, radiation count, respiration, pulse rate, and blood pressure. The pilot's own observations, delivered during and after each mission, supplement and clarify instrument data. Information from each flight is completely documented for later analysis.

X-15 attached to wing of B-52

X-15 research airplane drops away from B-52.

Three ground stations—at Ely and Beatty, Nevada, and Edwards, California—acquire X-15 flight data. The X-15 is always within range of at least one.

At the Edwards ground station, flight engineers closely watch aircraft performance, and a physician checks information on the pilot. If anything appears amiss, the pilot is notified and advised on action. Thus, in a sense, skilled flight engineers and a capable flight surgeon accompany the X-15 pilot on every mission.

This is one of many measures to assure the safety of the X-15 pilot. The pilot's instrument panel will also alert him to danger. Green lights tell him everything is in proper working order. If a green light winks out and a harsh orange light glares, the pilot can immediately identify the malfunction and take appropriate action. For example, one of the orange lights warns that fuel pressure at the fuel pump is too low to run the engine at full thrust; therefore, the pilot should reduce thrust.

The pilot wears a pressure suit which automatically inflates in case cockpit pressure fails. The pressure suit carries its own atmosphere and in effect becomes a pressurized cabin.

In extreme emergency, a rocket-powered ejection seat will hurl the pilot free of the airplane. Folding fins and telescopic booms on the seat prevent dangerous tumbling on catapult from the vehicle and stabilize the seat. At a safe altitude, a timer opens a parachute and releases the seat.

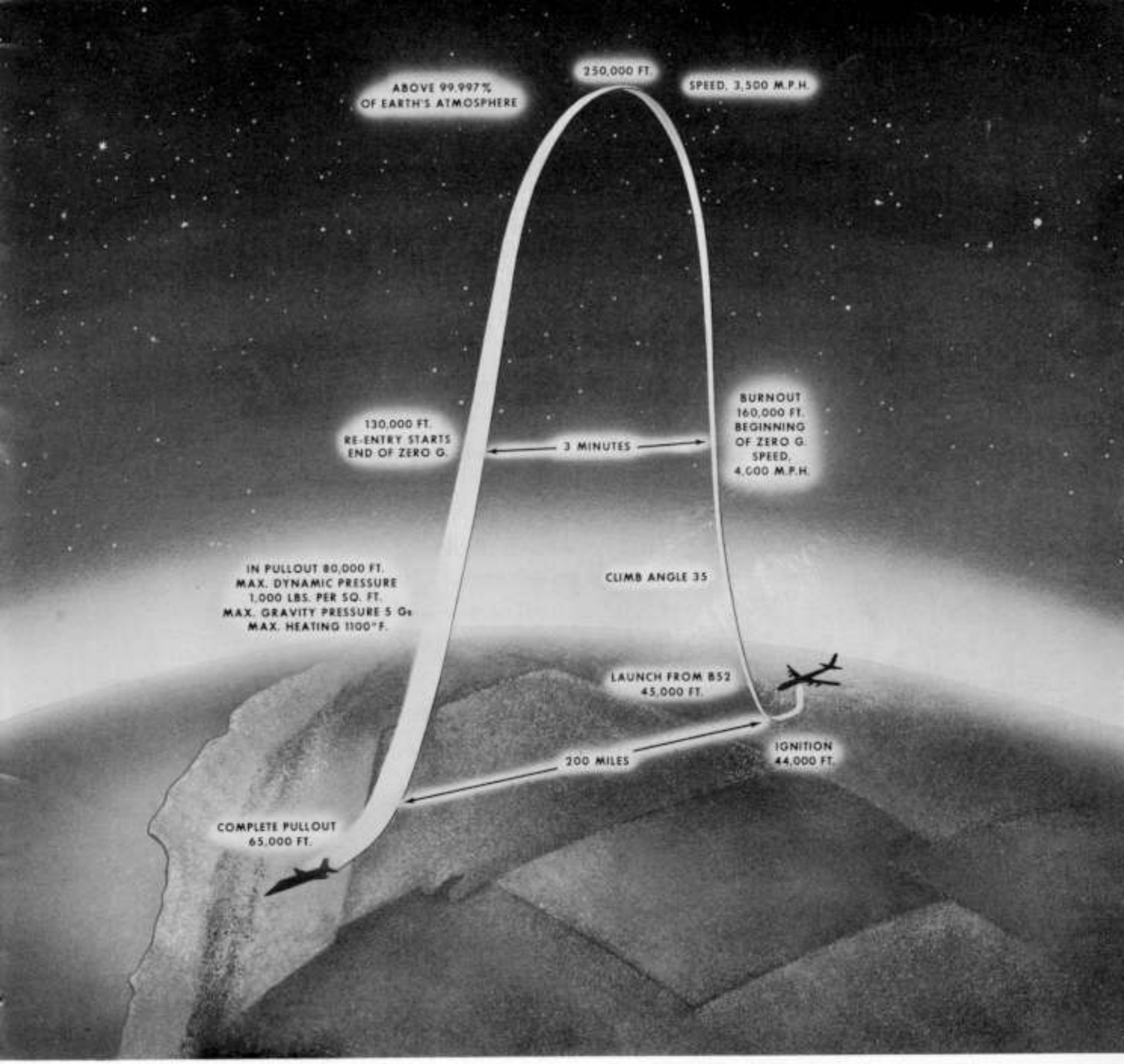
Safety factors were among considerations in locating the X-15 High Range (flight corridor), which stretches across the Mojave Desert from Wendover, Utah, to Edwards, California. The area is dotted with level dry lake beds which can be reached for emergency landings.

A careful step-by-step program has been followed in bringing the X-15 safely up to design performance. The plane was first airlifted in "captive" flights in which it did not separate from the B-52.

Then followed powerless glide flights to check control and landing; and, finally powered flights at gradually increased speeds to progressively higher altitudes.

The X-15 is a comparatively small (50-foot long, 22-foot wing span) vehicle with a big role to play in aeronautics and space. X-15 experimental flight missions are expected to continue to provide much information of significance to aeronautic and space technologies.

The aircraft is the harvest of ideas and work that extended over many years. The X-15 research airplane program began in May 1952. At this time, the National Advisory Committee for Aeronautics (NACA), which later formed the nucleus of NASA, directed its laboratories to initiate studies on manned hypersonic (speed more than five times that of sound) flight at high altitudes. In May 1954, NACA established performance requirements for a research craft to assist in such studies.



Example of X-15 flight mission. Intended to gather aeronautical, astronautical, and aeromedical data, the X-15 is designed to fly at speeds of about 4000 mph and altitudes of approximately 50 miles.

In July 1954, representatives of NACA, the Air Force, and the Navy agreed on a joint research airplane program. In December 1955, North American Aviation, Inc., was awarded a contract for building three X-15 airplanes. The chronology below briefly describes subsequent important developments.

September 1957	Contractor completes studies, begins building first X-15.
October 1958	First X-15 completed, delivered for ground tests to Edwards AFB, California.
March 1959	First "captive" flight of X-15 (plane remained attached to B-52 carrier craft during entire flight).
June 1959	First glide flight of X-15.
September 1959	First powered flight of X-15, using two interim engines, generating 16,000 pounds thrust.
February 1960	Contractor, after successfully completing flight tests, delivers first X-15 to NASA, Air Force, and Navy.
November 1960	Contractor flight-tests X-15 with final XLR-99 57,000-pound thrust engine.
February 1961	Contractor delivers to Government first X-15 powered by XLR 99.
March 1961	NASA pilot Joseph A. Walker flies X-15 to altitude of 169,600 feet, more than 32 miles. First use of space controls (hydrogen peroxide system) because X-15 was above 99.9 percent of earth's atmosphere.
May 1961	X-15 flown at 3,307 miles per hour, marking first flight at hypersonic speed under full-time control of pilot.
October 1961	X-15 reaches speed of 3,920 miles per hour in one flight and altitude of 217,000 feet (more than 41 miles) in another flight, setting new records for craft under full-time control of pilot.
November 1961	Major Robert White, USAF, flies X-15 at 4,093 miles per hour achieving design speed goal of the airplane.
? ? ?	X-15 attains design altitude goal—about 50 miles.

U.S. GOVERNMENT PRINTING OFFICE: 1961 O - 619161

X-15 landing sequence. Smoke bombs aid pilot in landing airplane.

NASA pilot Joseph A. Walker is assisted from cockpit of X-15 after flight.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