

GAO

Unclassified Summary to Congressional  
Committees

April 1991

# B-2 BOMBER

## Early Radar Signature Tests



143665

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**National Security and  
International Affairs Division**

B-243577

April 15, 1991

**The Honorable Sam Nunn  
Chairman, Committee on Armed Services  
United States Senate****The Honorable Daniel K. Inouye  
Chairman, Subcommittee on Defense  
Committee on Appropriations  
United States Senate****The Honorable Les Aspin  
Chairman, Committee on Armed Services  
House of Representatives****The Honorable John P. Murtha  
Chairman, Subcommittee on Defense  
Committee on Appropriations  
House of Representatives**

Section 113 of the fiscal year 1990/1991 Authorization Act requires us to review the Department of Defense's test reports and evaluation documents for the B-2 aircraft program and provide periodic reports on our findings to the Congress. This unclassified summary discusses our evaluation of early radar signature and flight worthiness testing of the B-2, known as early Block 2 flight testing.

Our objectives were to evaluate the adequacy, rigor, and realism of the tests; the tests' compliance with the full performance matrix; and the use of appropriate threat data. To accomplish our objectives, we reviewed documents and interviewed officials at the B-2 System Program Office, Wright-Patterson Air Force Base, Ohio, and the Departments of Defense and the Air Force, Washington, D.C. We performed our review from September 1990 to March 1991 in accordance with generally accepted government auditing standards.

We are sending copies of this summary to the Ranking Minority Members of your committees; other appropriate congressional committees; the Secretaries of Defense and the Air Force; and the Director, Office of Management and Budget. We will also make copies available to others.

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This summary was prepared under the direction of Nancy R. Kingsbury, Director, Air Force Issues, who may be reached on (202) 275-4268 if you or your staff have any questions concerning this summary. Other major contributors to this summary are Robert D. Murphy, Assistant Director, Michael J. Hazard, Evaluator-in-Charge, and Matthew Lea, Evaluator, Cincinnati Regional Office.



Frank C. Conahan  
Assistant Comptroller General



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# Summary

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## Purpose

In November 1990, the Air Force started flight tests to evaluate the radar signature of the B-2 and determine if the signature met the Air Force's earlier predictions. Radar signature is one of the low observable characteristics of the B-2 that is critical to its ability to survive as it carries out its intended mission.

GAO evaluated the initial series of flight tests to measure the radar signature of the first B-2. GAO also reviewed further flight tests to evaluate the B-2's flight worthiness.

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## Background

Low observable aircraft have features that reduce an adversary's ability to detect, locate, track, and shoot at them. Important factors are radar, infrared, optical, and acoustic signatures. Radar signature is a measure of the visibility of the aircraft to radars.

The fiscal year 1990/1991 Defense Authorization Act (P.L. 101-189) required the Department of Defense to accomplish certain low observable and flight worthiness tests, known as early Block 2 tests, before more than 15 percent of fiscal year 1990 B-2 procurement funds could be expended. The tests were conducted using the first two development aircraft. The first aircraft was used for radar signature tests, and the second aircraft was used primarily for flight worthiness tests.

The act also required the Secretary of Defense to certify that the early Block 2 test results were satisfactory. In addition, the act requires GAO to review the Department of Defense's test reports and evaluation documents on the B-2 aircraft program and periodically report on various aspects of the testing, including the adequacy, rigor, and realism of the development and operational tests; the tests' compliance with the full performance matrix, which identifies minimum conditions that must be used in the tests before certain milestones are considered completed; and the use of appropriate threat data.

An initial series of flight worthiness tests, known as Block 1 tests, was previously conducted with the first aircraft between July 1989 and June 1990. GAO reported on these tests in B-2 Bomber: Initial Flight Tests (GAO/NSIAD-90-284, Sept. 4, 1990).

The Secretary of Defense certified on March 15, 1991, that the results of early Block 2 flight tests were satisfactory and that no significant technical or operational problems were identified. The certification was

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based on evaluations of test results and reports by the Defense Science Board and the Director of Operational Test and Evaluation.

The actual radar signature measurements differed in a few areas from predictions and specifications. The Defense Science Board reported, however, that no major redesign of the B-2 should be required and that the signature should closely match predictions for the conditions tested once modifications to the aircraft's surface are completed and tested. The Board stated that these test results indicated the B-2 should be survivable.

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## Results in Brief

The early Block 2 tests and those conducted under Block 1 comprise about 4 percent of the planned B-2 flight test program. The early Block 2 tests were initial development tests and were not designed to demonstrate the B-2's full capabilities or test the B-2 in a representative operational environment. In addition, the tests did not attempt to account for the effects of day-to-day operations, wear and tear on the aircraft and equipment, or maintenance over a long time frame.

The early Block 2 tests adequately met the objectives of partially measuring the first aircraft's radar signature, preliminarily assessing the signature, and further demonstrating the aircraft's flight worthiness. Testing complied with the conditions established in the full performance matrix for these early tests. Even though early test objectives were met, the flight test program has not progressed as rapidly as planned when it began in July 1989.

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## GAO's Analysis

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### Testing Met Limited Objectives

The early Block 2 flight tests were responsive to the 1991 full performance matrix requirement of taking early measurements of the radar signature. The test objectives were to provide a preliminary assessment of the radar signature for the first B-2 at selected frequencies intended to be representative of threat radars. The early Block 2 tests measured the aircraft's radar signature 360 degrees laterally around the perimeter of the aircraft. The signature around the perimeter was obtained at angles below the aircraft that are typically exposed to ground-based radars.

The full performance matrix only required the Air Force to measure from the nose to the tail on one side of the aircraft, or 180 degrees around the perimeter of the aircraft. The actual flight measurements were compared with previous Air Force radar signature projections based on scale model tests and computer predictions. Flight testing to verify directly that the B-2 meets radar signature specifications is scheduled later in the flight test program.

Flight tests for the second B-2 adequately demonstrated some basic flight characteristics beyond those accomplished in Block 1 testing. The tests also demonstrated that new flight control software corrected flight stability problems identified in Block 1 testing.

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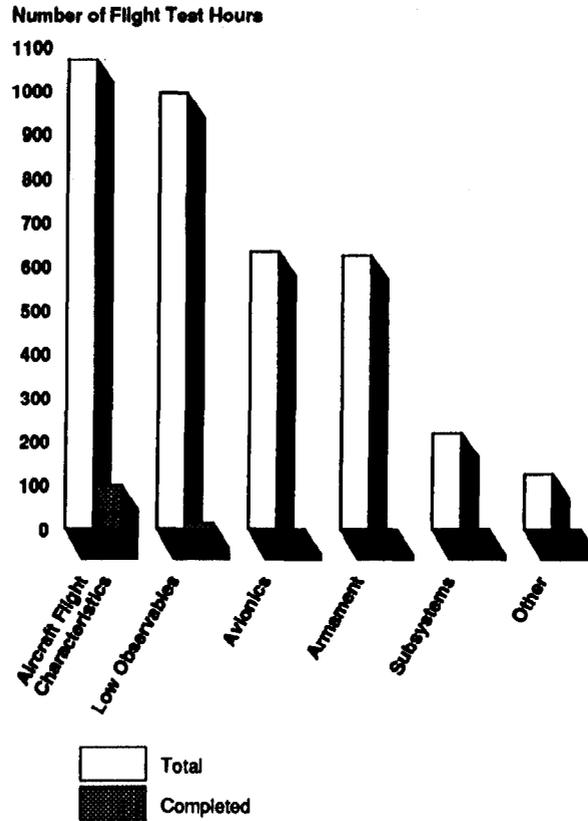
### Limited Flight Testing Has Been Completed

The early Block 2 tests were not intended to demonstrate the B-2's full capabilities. Although the tests were rigorously conducted, they were intended only to provide preliminary indications, not a complete analysis, of the B-2's radar signature and to continue analysis of the B-2's flight worthiness. Development and operational testing of the B-2's full capabilities will be accomplished as the flight test program progresses.

As shown in figure 1, the first and second B-2s have flown about 133 total hours, or 4 percent, of the 3,600-hour flight test program. Air Force plans to test low observable features of the B-2 require 992 hours to test the radar, infrared, visual, and acoustic signatures and conduct survivability assessments. The early Block 2 tests consisted of 13 hours of radar signature tests, which is 1 percent of the low observable testing planned. Flight testing of certain integrated mission avionics, subsystems, and armament has not yet started.

Block 1 and early Block 2 testing of the B-2's flight worthiness totaled about 99 hours through January 25, 1991. This represents about 9 percent of the 1,100 flight test hours planned to demonstrate flight and aircraft characteristics and validate aircraft specifications.

Figure 1: B-2 Flight Test Program



### Tests Were Not Intended to Portray an Operational Environment

Testing in a representative operational environment is planned to begin in 1992. However, a B-2 will not be tested in a representative mission environment using operational tactics and procedures until 1994. What effects operational use has on the B-2 and whether the Air Force can adequately maintain the low observable features remain to be determined.

Because the flight tests were not designed to simulate operational missions, threat data or simulations of threat systems were not used during the tests. The Air Force plans to test the B-2 against many of the threat systems that were identified by the intelligence community. The Department of Defense's capabilities to test the B-2 in an operationally representative threat environment are limited. Many of the newer and sophisticated threat systems must be simulated by computers, since representative hardware is not available. This is not unique to the B-2 flight

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test program and does not preclude an adequate survivability assessment.

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**Test Objectives Were Met,  
but Schedule Is Slipping**

The flight test program has not progressed as planned because test aircraft are being delivered to the Air Force both late and incomplete. Aircraft have been delivered late primarily because of a strike at a major subcontractor and manufacturing difficulties. These have caused the completion of the test program to slip from 1993 to 1995.

In addition, these aircraft are being delivered incomplete. Over 100,000 hours of unanticipated manufacturing work has been done on the first aircraft since it was delivered, decreasing its availability for flight testing. As a result, the Air Force has not accumulated as many flight tests and hours as planned, and early Block 2 flight testing had to start 6 months behind schedule.

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**Recommendations**

GAO is not making any recommendations in this summary. However, GAO has previously recommended that the pace of funding and production for the program be limited until the critical performance elements of the aircraft have been adequately evaluated.

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**Agency Comments**

GAO did not request written agency comments on this summary to meet the 30-day reporting requirement in the act. However, GAO provided a draft of this summary to Department of Defense officials and incorporated their comments where appropriate.

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